Contents Sisukord

Eessõna

Oli huvitav aasta – nii võiks 2007 hästi lühidalt kokku võtta. Tahame me seda või ei, teadustöö tulemusi mõõdetakse ikka eelkõige ilmunud teadusartiklite arvuga. Meil jõudis see 75 kanti, mida võib varasemate aastatega võrreldes pidada väga heaks tulemuseks.

See, mida teadustulemused tõeliselt väärt on, selgub sageli alles aastate või aastakümnete möödudes. Tänapäeva astronoomid vaevalt enam kahtlevad, et Universumi massist moodustab suurema osa nähtamatu tume aine või et galaktikate superparved paigutuvad enam-vähem korrapärasesse kärgstruktuuri. Aastat kolmkümmend tagasi polnud need asjad sugugi nii selged. Meie kosmoloogid on teinud järjekindlat tööd nende tõdede kinnistamiseks astronoomilisse maailmapilti. Veebruaris 2007 saabus vääriline tunnustus – akadeemik Jaan Einasto ning tema kaastöötajad Maret Einasto, Enn Saar ja Erik Tago said Eesti Vabariigi suurima ja prestiižikaima teaduspreemia teadusharu paradigmat ja maailmapilti mõjutava avastuse eest.

2007. aasta sügisel kerkis Observatooriumi peahoone kõrvale mast, mis võib-olla mõne inimese ilumeelt häirib – kuid teadus nõuab ohvreid. Kiire internetiühendus on tänapäeva elu vältimatu tingimus. Pärast pikki kaalumisi leidsime, et raadioühendus Füüsika Instituudiga Tartu serval on ikkagi parim lahendus. Uue liini kiirus on aga tubli 70 korda suurem kui enne.

Tartu Ülikooli Füüsika Instituudiga seob meid ka ühine ajalugu. Vahel tasub minevikule toetudes tulevikku vaadata. Selline päev oli 2. november 2007, mil tähistasime koos oma ühise eelkäija 60. sünnipäeva. Pidustuste aeg aga lähtus sellest, et 5. novembril möödus 100 aastat instituudi kauaaegse direktori, Tõraverre uue observatooriumi rajaja akadeemik Aksel Kipperi sünnist. Ühtlasi tähistasime ka akadeemik Grigori Kusmini 90. sünniaastapäeva.

Ka teadustöös ei saa unustada, et Eesti on Euroopa Liidu liige. 2007. aastal läks lahti FP7 ehk EL teadusuuringute 7. raamprogramm. Ja kohe esimeses taotlusvoorus oli meil õnne: regionaalse teaduspotentsiaali arendamiseks ja esiletoomiseks mõeldud taotlus EstSpacE – projekti juht Anu Reinart – jõudis 23 rahastatava projekti hulka 258 taotlusest. 1.1 miljonit eurot kolme aasta jooksul on märkimisväärne lisaraha, mis targalt kasutades peaks aitama välja arendada tipptasemel kosmoseuuringute keskuse.

Tippusid Eesti teadusmaastikul hakatakse varsti välja sõeluma – tippkeskuste konkurss nihkus 2008. aastasse. Peagi hakkavad liikuma kauaoodatud struktuuritoetused teadusasutuste infrastruktuuri kaasajastamiseks. Meil on plaanis mõlemal konkursil osaleda, kuigi taotluste ettevalmistamine nõuab palju aega ja energiat. Neis protsessides mitteosalemine jätaks vähe lootust, et 10–20 aasta pärast oleks Tõraveres veel tasemel teaduskeskus. Edu FP7 konkursil annab meile indu, nagu ka Eesti Vabariigi ja Euroopa Kosmoseagentuuri vahel 20. juunil 2007 sõlmitud koostööleping ja muu rahvusvaheline taust – isegi kui Eesti teadusraha jagajad vahel meie püüdlusi täielikult ei mõista, vaatame tulevikku optimistlikult.

Laurits Leedjärv
Direktor

Tõraveres
veebruar 2008

Foreword

In brief – 2007 was an interesting year. Results of research work are mostly characterized by the number of published scientific papers, do we like that or not. In 2007, this number reached 75 which can be considered a very good result in comparison with earlier years.

The real value of scientific results often will be clear only after years or decades. Nowadays astronomers hardly doubt that most of the mass in the Universe is concentrated in an invisible dark matter, or that superclusters of galaxies form more or less regular cellular structure. About thirty years ago it was not so clear. Our cosmologists have performed hard work to introduce those facts into the astronomical picture of the world. In February 2007 they received an appropriate recognition – Academician Jaan Einasto and his colleagues Maret Einasto, Enn Saar and Erik Tago were awarded the most valuable and prestigious National Science Prize for a discovery changing the paradigm of the research field.

In autumn 2007 an high mast was erected next to the main building of the Observatory. Some people maybe do not like it, but the needs of science should be in the first place. High-speed Internet connection is inevitable in the present-day life. We decided to retain the radio link to the Institute of Physics in Tartu, but at least 70 times higher speed is gained by the new device.

Tartu Observatory is also related to the Institute of Physics, University of Tartu, by a joint history. Sometimes it is useful to look into the future, relying on the past. 2 November 2007 was one of such days, when we celebrated 60th anniversary of our joint predecessor institute. This date was selected, because on 5 November one hundred years passed from the birth of Academician Aksel Kipper, a long-term director of the institute and founder of the new observatory at Tõravere. At the same time, 90th birth anniversary of Academician Grigori Kusmin was celebrated.

We cannot forget that Estonia belongs to the European Union. In 2007, the 7th Framework Programme (FP7) opened. We happened to be successful in one of the very first calls. Our application EstSpace, led by Anu Reinart, was among the 23 successful from 258 applications. This project, meant to expose and develop the potential in space research, would amount to 1.1 million euros during three years, and should contribute to establishing an high level space research centre at Tõravere.

The highest peaks on the landscape of Estonian science will be selected soon – through the contest for centres of excellence. At the same time, the European structural funds for renovating and building new research infrastructures will open soon. We plan to participate in those processes, although compiling the applications will need a lot of time and effort. But otherwise, we can hardly believe that in 10–20 years there will be high enough scientific level retained. We are motivated by success in the FP7 call as well as by the cooperation agreement between Estonia and the European Space Agency, concluded on 20 June 2007, and an international background for space research in general – if even our efforts are sometimes not entirely understood in Estonia, we look into the future optimistically.

Laurits Leedjärv
Director

Tõravere
February 2008

1 Ülevaade

1.1 Uurimisteemad ja grandid

2007. aastal jätkus Tartu Observatooriumis kolme sihtfinantseeritava teadusteema täitmine (1 kEEK = 1000 EEK = 63.9 EUR):

- Struktuuride areng Universumis kaugest minevikust tänapäevani (teema juht J. Einasto) – 2574 kEEK,
- Tähtede ehitus, keemiline koostis ja evolutsioon (teema juht T. Kipper) – 3575 kEEK,
- Eesti ning Balti regiooni keskkonna optilise kaugseire alused (teema juht A. Kuusk) – 2860 kEEK.

Lisaks rahastas Sihtasutus Eesti Teadusfond 13 granti:

1. Grant 6100: A. Kuusk – Kiirgusenergia hajumine ja neeldumine looduslikes ja kultiveeritud taimkatetes – 127.1 kEEK.
2. Grant 6104: E. Saar – Suuremastaabilise struktuuri täppiskosmoloogia – 220 kEEK.
3. Grant 6105: A.-E. Sapar – Täheatmosfääride ja tähetuule ehitus ja spektrid; füüsikalised protsessid neis – 140 kEEK.
4. Grant 6106: J. Vennik – Galaktikate evolutsioon gruppides – 137 kEEK.
5. Grant 6810: I. Kolka – Suure kiirgusvõimsusega kaugelearenenud tähed kosmoseteleskoobi Gaia objektidena – 141 kEEK.
6. Grant 6812: M. Mõttus – Hüperspektraalsete ja mitme vaatenurga alt mõõdetud kaugseireandmete kasutamisvõimalused metsa struktuuri hindamiseks – 173.2 kEEK.
7. Grant 6813: J. Pelt – Dispersioonispektrite teooria ja rakendused – 80 kEEK.
8. Grant 6814: A. Reinart – Satelliitkaugseire meetodite arendamine Eesti optiliselt mitmekomponendiliste veekogude uurimiseks – 249 kEEK.
9. Grant 6815: T. Nilson – Eesti metsade produktiivsuse monitooring satelliitkaugseire abil – 205 kEEK.
10. Grant 7115: A. Tamm – Ketasgalaktikate evolutsioon kosmoloogilistel ajaskaaladel – 57.5 kEEK.
11. Grant 7137: K. Eerme – Päikese ultraviolettkiirguse spektraalne koostis maapinnal – 100 kEEK.
12. Grant 7146: M. Gramann – Galaktikate evolutsioon ja tume energia paisuvas Universumis – 92 kEEK.
13. V. Russak oli üks põhitäitja TÜ dotsendi H. Ohvrili grandis nr. 5857 (44.8 kEEK Tartu Observatooriumile).

Need grandisummad ei sisalda asutuse üldkululõivu. Viimane (20% grantide summast) eraldati otse Observatooriumi eelarvesse.

Muud projektid ja lepingud:

- Deklareeritud põllupindade kontroll kaugseirevahenditega – Põllumajanduse Registrite ja Informatsiooni Amet: U. Peterson – 70 kEEK.
- Riikliku keskkonnaseire programmi allprogramm ”Eesti maastike muutuste uuringud ja kaugseire” – Keskkonnaministeerium: U. Peterson – 200 kEEK.
- Atmosfääri korrektsioon operatiivseks veekogude kaugseireks – Koostöö Stockholmi Ülikooliga (2007–2008): A. Reinart – 292 kEEK.
- Rannikumere muutuste uuringud ja kaugseire – Alltöövõtu leping TÜ Mereinstituudiga: A. Reinart – 60 kEEK.
- HYperspectral REmote Sensing in Europe – Specific Support Actions – EL 6. raamlepingu projekt HYRESSA: M. Mõttus (TO esindaja) – TO osa 2007. a 43.7 kEEK.
- PHYSENSE: Physically Based Remote Sensing of Forests – Põhjamaade metsauuringute komitee grant: T. Nilson – 187 kEEK.
- GREASEMH projekt ”Ground reflectance model evaluation and scaling exercise using detailed multiangular and hyperspectral reflectance data” – EUFARi (EUropean Fleet for Airborne Research) finantseeritud: M. Mõttus, A. Kuusk, A. Reinart, J. Kuusk, K. Valdmets, K. Alikas, M. Rautiainen.
- Euroopa Komisjoni Ühisuuringute Keskuse (JRC) grant: A. Kuusk – 62.6 kEEK.
- Riikliku programmi ”Humanitaar- ja loodusteaduslikud kogud” alamprogramm ”Tartu Observatooriumi teadusajaloolise arhiivi korrastamine ja digitaliseerimine” – Haridus- ja Teadusministeerium: K. Annuk – 70 kEEK.
- Eeluuring optilise kiirguse täppisradiomeetria rakendusteks Eesti ettevõtetes – Ettevõtluse Arendamise Sihtasutus: A. Reinart, U. Veismann – 102.9 kEEK.

Nende teemade ja projektide raames tehtust leidub põhjalikum ülevaade peatükkides 3–5.

1.2 Töötajad

Suuri muutusi Observatooriumi koosseisus 2007. aastal ei olnud. Aasta algul lisandusid 0.25 koormusega teadurite hulka doktorandid Lauri Juhan Liivamägi ja Elmo Tempel (kosmoloogia osakond), oktoobris Tõnis Kärdi (atmosfäärifüüsika osakond). 1. märtsil lahkus töölt staažikas insener Enn-Märt Maasik.

2007. aasta algusest töötab meil ka Soome Akadeemia järeldoktor Miina Rautiainen, kes on kaitsnud doktoritöö Helsingi Ülikoolis.

Meie oma töötajatest kaitses doktorikraadi teoreetilise astrofüüsika töörühma teadur Vladislav-Venjamin Pustõnski (12. septembril Tartu Ülikoolis). Indrek Vurm töötas suurema osa aastast Oulu Ülikoolis, kus tema doktoritöö juhendajaks on prof. Juri Poutanen. 2007. aasta augusti lõpus siirdus insener ja TÜ doktorant Tiina Liimets La Palmale (Kanaari saared), töötamaks ühe aasta Isaac Newtoni Teleskoopide grupis.

Kõigi muutuste tulemusena oli 1. jaanuaril 2008 Tartu Observatooriumis tööl 72 inimest, neist 45 vanemteaduri või teadurina ja 7 teadustööd tegeva insenerina.

1.3 Tunnustused

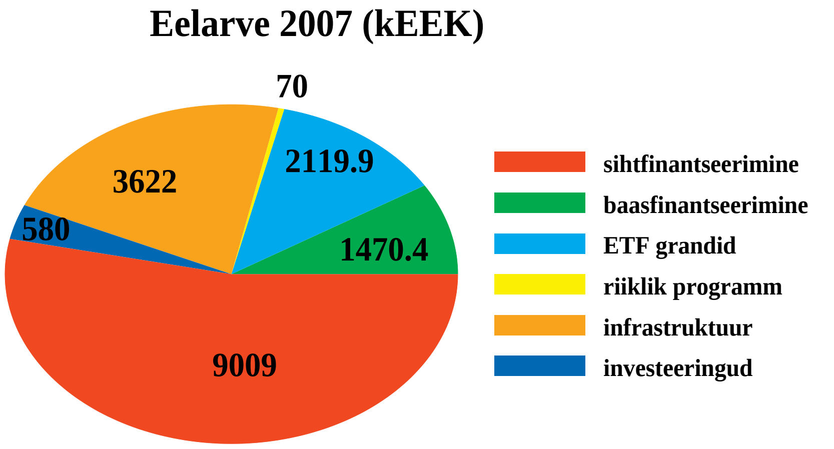
Akadeemik Jaan Einasto ja tema lähemate kolleegide teedrajavad avastused – tume aine 1970. aastatel ja Universumi suuremastaabilise struktuuri korrapära 1990. aastatel – pälvisid väärilise tunnustuse. 2007. aasta veebruaris said Jaan Einasto, Maret Einasto, Enn Saar ja Erik Tago Eesti Vabariigi tähtsaima teaduspreemia teadusharu paradigmat ja maailmapilti mõjutava avastuse eest.

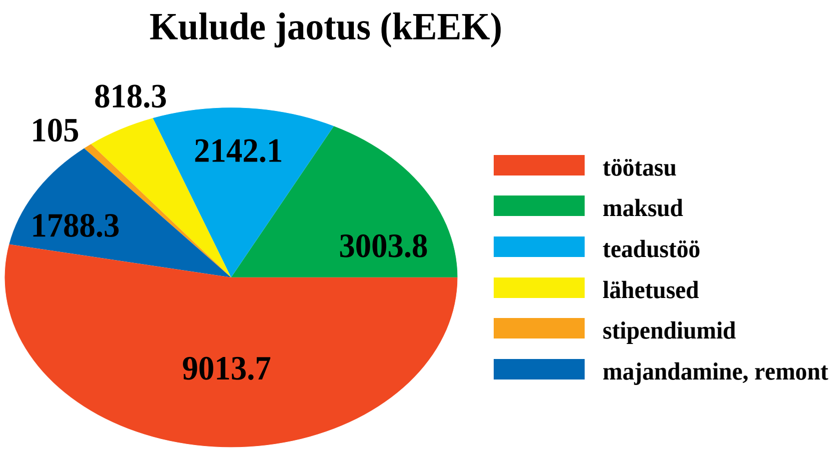
Vanemteadur Jaan Pelt nimetati 5. oktoobril 2007 Helsingi Ülikooli dotsendiks.

Eesti Rahvuskultuuri Fondi Heino Eelsalu allfondi stipendiumi sai Tartu Ülikooli magistrant Tarmo Kiik magistritöö "Vene polaaruurijate retseptsioon ingliskeelses polaarkirjanduses 19. sajandil" tegemise toetamiseks.

1.4 Eelarve

Riigieelarvest eraldati Tartu Observatooriumile 2007. aastal 16.871 miljonit krooni (16 871 kEEK). Tulud ja kulud jagunesid järgnevalt:





Lisaks laekus *ca* 1122 kEEK mitmesugustest koostööprojektidest ja lepingutest, mida on nimetatud osas 1.1.

Observatooriumi teadlaste keskmine töötasu 2007. a lõpul oli 12 847 EEK (*ca* 821 EUR).

1.5 Aparatuur ja seadmed

Tähtsaimaks uuenduseks 2007. aaastal oli Observatooriumi Interneti-ühenduse ajakohastamine. Juba ammu kitsaks jäänud raadioreleeliin Tõravere ja TÜ Füüsika Instituudi vahel asendati uuega, mille läbilaskvus on 155 Mb/s. Norra firmast Nera pärit 18 GHz sagedusel töötava seadme jaoks püstitati peahoone lähedusse 39 meetri kõrgune mast.

Hangiti ka uut teadusaparatuuri:

- Spektraalse kiiritustiheduse kalibreerimislamp FEL koos armatuuriga (Gigahertz GmbH).
- Minispektromeetri moodul MMS UV (Carl Zeiss Micro-Imaging GmbH).
- J. Kuusk arendas edasi firma Carl Zeiss minispektromeetri mooduli MMS-1 baasil ehitatud lennukispektromeetrit. Spektromeetri juhtimiseks kasutatakse sülearvuti asemel PC-moodulit – see muutis spektromeetri täiesti autonoomseks. Lisatud on indikatrissimõõtja, kiirendusandurid ja elektriline kompass. Spektromeetriga mõõdeti Järvselja katseala metsade peegeldusspektreid helikopterilt, mitme puistu alustaimestiku peegeldusspektreid ning puude tüve ja lehtede peegeldusspektreid.

Astronoomilised vaatlused jätkusid tavapärasel viisil. 1.5 m teleskoobiga tehti spektraalvaatlusi 59 ööl ning 0.6 m teleskoobiga fotomeetrilisi vaatlusi 24 ööl.

1.6 Teadusnõukogu töö

Tartu Observatooriumi teadusnõukogu on 13-liikmeline. 2007. a selle koosseis ei muutunud. Nõukogu esimees on direktor Laurits Leedjärv ja aseesimees vanemteadur Tõnu Viik. Väljastpoolt Observatooriumi kuuluvad nõukogusse Riigikogu esimees akadeemik Ene Ergma ja Tartu Ülikooli professor Rein Rõõm. Haridus- ja Teadusministeeriumi poolt määratud liige on

Tartu Ülikooli dotsent Peeter Tenjes.

Teadusnõukogu pidas 10 koosolekut, kuulati järgmisi teaduslikke ettekandeid:

Jaanuar – *T. Nugis*: Tähetuulest WR tähtedes.

Veebruar – *I. Pustylnik*: Evolutsiooni iseärasustest horisontaalharu objektidel kaksiksüsteemides.

Märts – *A. Reinart*: Sensori MERIS rakendatavusest järvede ja rannikuvete kaugseires.

Aprill – *O. Kärner*: IPCC, ISPM ja kliima.

Mai – *J. Pelt*: Modulatsioonid pikkades aegridades.

September – *L. J. Liivamägi*: Galaktikajaotuste hierarhiline struktuur.

– *K. Alikas*: Satelliitsensori MERIS rakendused siseveekogude seireks.

– *T. Kärdi*: Linnade kaugseire: spektrisegu lineaarne lahutamine Landsat Thematic Mapper satelliidipiltidelt Tartu näidetel.

Oktoober – *U. Haud*: Kiired ja vahepealsete kiirustega vesinikupilved Leiden-Argentiina-Bonni ülevaates.

November – *A. Aret*: Isotoopanomaaliate kujunemisprotsessid keemiliselt pekuliaarsetes tähtedes.

Detsember – *I. Kolka*: Suure kiirgusvõimsusega tähtede rännakud HR–diagrammil.

Muid teadusnõukogu tegemisi:

- 19. märtsi koosolekul kinnitati lõppenud ETF grantide (M. Gramann, I. Pustylnik, U. Veismann, U. Peterson) lõpparuanded.
- 27. aprillil toimus konkurss teadurite ja vanemteadurite ametikohtadele. Vanemteaduriteks astrofüüsika erialal valiti T. Kipper, T. Nugis, A. Sapar, J. Pelt, kosmoloogia erialal M. Gramann, E. Saar, U. Haud ning atmosfäärifüüsika erialal M. Mõttus ja U. Veismann. Teaduriteks astrofüüsika erialal valiti V. V. Pustynski ning kosmoloogia erialal A. Tamm.
- 24. septembril määrati Ernst Julius Öpiku nimeline stipendium (10000 EEK) Tartu Ülikooli doktorant Lauri Juhan Liivamägile. Juhan Rossi nimeline stipendium läks jagamisele – Tartu Ülikooli doktorandid Krista Alikas ja Tõnis Kärdi said kumbki 7500 krooni.
- 15. oktoobri koosolekul arutati investeeringute plaane: kiideti heaks mõte taotleda raha peahoone renoveerimiseks ja juurdeehituse rajamiseks. Samal koosolekul kinnitati ka uute sihtfinantseeritavate teadusteemade taotlused.

1.7 Suhted avalikkusega

2007. aastal toimus traditsiooniline astronoomiahuviliste üle-Eestiline kokkutulek taas kord Tõraveres. Ettekanded, millest suurema osa pidasid Observatooriumi teadlased, keskendusid kahe põhiteema ümber: 50 aastat kosmoseajastut ning astronoomide suured projektid. Kokkutuleku raames toimus ka Eesti esimene astronoomiliste fotode konkurss, mille võitis Taavi Tuvikene.

Jätkuvalt on olulisimaks avalikkusega suhtlemise viisiks ekskursioonide vastuvõtmine Tõraveres. 2007. aastal külastas Observatooriumi 280 grupi koosseisus üle 6500 inimese, kes said näha ja katsuda Eesti rahvapärast taevast Lagle Israeli seinapannool, 1.5-meetrist teleskoopi, Stellaariumi väljapanekuid, viibida virtuaalses planetaariumis jne. Giiditööd teevad mitmed astronoomid oma põhitöö kõrvalt, neid juhendab Mare Ruusalepp, kes ka ise sageli ekskursioone vastu võtab.

Observatooriumi teadlaste arvukad populaarteaduslikud kirjutised on üksikasjaliselt ära toodud lk. 80, avalikud loengud ja intervjuud lk. 108.

Ilmus Tähetorni Kalender 2008 (84. aastakäik).

Ilmus ka Mare Ruusalepa ja Kalju Annuki koostatud "Tähistaeva Kalender 2008" – värviliste taevapiltidega seinakalender.

AS EOMap trükkis Kalju Annuki koostatud tähistaeva kaardi koos Päikesesüsteemi planeetide andmetega. Poster on mõeldud eelkõige koolidele.

1.8 Tänuavaldused

Meie teadlased on saanud rahalist või muud toetust paljudelt asutustelt üle maailma. Oleme tänulikud kõigile toetajatele, nende nimed leiate ingliskeelsest osast leheküljel 22.

2 Summary

2.1 Research projects and grants

Most of the finances for basic research in Estonia are channelled through target financed projects. In 2007, research in the framework of three projects was continued (1 kEEK = 1000 EEK = 63.9 EUR):

- Evolution of structure in the Universe from deep past until the present (principal investigator J. Einasto) – 2574 kEEK,
- Structure, chemical composition and evolution of stars (principal investigator T. Kipper) – 3575 kEEK,
- Optical remote sensing of environment in Estonia and Baltic region (principal investigator A. Kuusk) – 2860 kEEK.

In addition, the Estonian Science Foundation financed 13 grant projects from our Observatory:

1. Grant 6100: A. Kuusk – Scattering and absorption of radiation energy in natural and cultivated vegetation canopies – 127.1 kEEK.
2. Grant 6104: E. Saar – Precision cosmology of the large scale structure – 220 kEEK.
3. Grant 6105: A.-E. Sapar – Structure and spectra of stellar atmospheres and stellar winds; physical processes in them – 140 kEEK.
4. Grant 6106: J. Vennik – Evolution of galaxies in groups – 137 kEEK.
5. Grant 6810: I. Kolka – Luminous highly evolved stars in the framework of GAIA – 141 kEEK.
6. Grant 6812: M. Mõttus – Applicability of hyperspectral and multiangular remotely sensed data for estimating forest structure – 173.2 kEEK.
7. Grant 6813: J. Pelt – Theory and applications of dispersion spectra – 80 kEEK.
8. Grant 6814: A. Reinart – Development of the remote sensing methods according to the specific conditions of Estonian optically multicomponental waters – 249 kEEK.
9. Grant 6815: T. Nilson – Monitoring the productivity of Estonian forests by satellite remote sensing – 205 kEEK.
10. Grant 7115: A. Tamm – Evolution of disk galaxies on cosmological time scales – 57.5 kEEK.
11. Grant 7137: K. Eerme – Spectral composition of the ground-level solar ultraviolet radiation – 100 kEEK.
12. Grant 7146: M. Gramann – Evolution of galaxies and dark energy in the expanding Universe – 92 kEEK.
13. V. Russak participated in the grant 5857 led by H. Ohvril from Tartu University (44.8 kEEK to Tartu Observatory).

Those amounts do not contain institutional overheads. The latter (20% of each grant) was transferred separately to the budget of the Observatory.

Some other projects and contracts:

- Remote sensing control of area-based subsidies – Estonian Agricultural Registers and Information Board: U. Peterson – 70 kEEK.
- Preliminary study of applications of optical radiometry in Estonian enterprises and institutions (September 2006 – February 2007) – Enterprise Estonia: A. Reinart, U. Veismann – 102.9 kEEK.
- Atmospheric correction of remote sensing data for operational lake water quality monitoring – Collaboration project with Stockholm University (2007–2008): A. Reinart – 292 kEEK.
- Changes in coastal sea and remote sensing – Contract with Estonian Marine Institute, Tartu University: A. Reinart – 60 kEEK.
- Physically-based remote sensing of forests (PHYSENSE) network – Nordic Forest Research Co-operation Committee (SNS) grant: T. Nilson – 187 kEEK.
- EU FP-6 project HYRESSA (HYperspectral Remote Sensing in Europe – Specific Support Actions): M. Mõttus, Principal Investigator from Tartu Observatory. – 43.7 kEEK in 2007.
- Ground reflectance model evaluation and scaling exercise using detailed multiangular and hyperspectral reflectance data – EUFAR-financed (EUropean Fleet for Airborne Research) GREASEMH project: M. Mõttus, A. Kuusk, A. Reinart, J. Kuusk, K. Valdmets, K. Alikas, M. Rautiainen.
- EC Joint Research Centre (JRC) grant: A. Kuusk – 62.6 kEEK.
- National programme of environmental monitoring, subprogramme "Studies on change of Estonian landscapes and remote sensing" – Ministry of Environment: U. Peterson – 200 kEEK.
- National programme for preserving collections in humanities and natural sciences, subprogramme "Digitalizing scientific archive of the historical Tartu Observatory" – Ministry of Education and Research: K. Annuk – 70 kEEK.

A scientific report about the activities within all these projects and topics will be given in Chapters 3–5.

2.2 Staff

There were no big changes in the structure and staff of the Observatory. Ph.D. students Lauri Juhan Liivamägi and Elmo Tempel were employed as part-time research associates in January, Tõnis Kärdi in October. An engineer of long service Enn-Märt Maasik left the Observatory on March 1.

From the beginning of 2007 a postdoc Miina Rautiainen, financed by the Academy of Finland, works in our Observatory.

Our colleague Vladislav-Venjamin Pustynski from the group of theoretical astrophysics defended his Ph.D. thesis at the University of Tartu on September 12. Indrek Vurm spent most of the year 2007 at the University of Oulu, being supervised by Prof. Juri Poutanen. In late August 2007, our engineer and Ph.D. student Tiina Liimets moved to La Palma (Canary Islands) to work for one year in the Isaac Newton Group of Telescopes.

As a result of all the changes, the number of people employed by the Tartu Observatory was 72 on January 1, 2008. Of them, 45 are on the position of researchers and 7 on that of research engineers.

2.3 Rewards

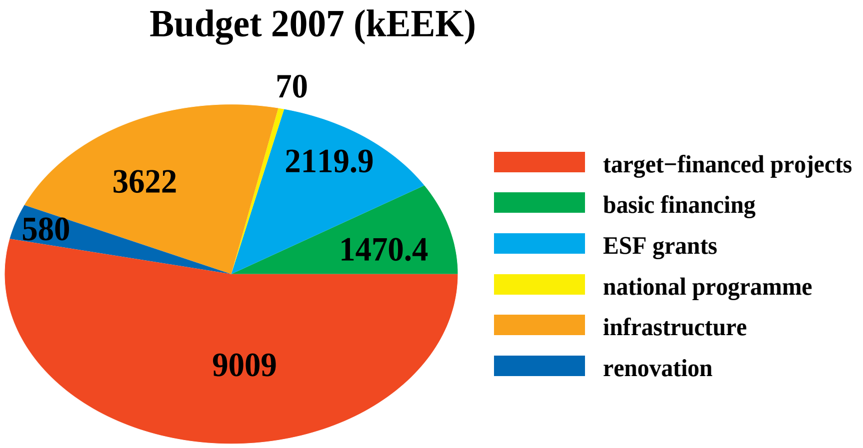
Outstanding discoveries by Academician Jaan Einasto and his colleagues – dark matter in 1970s and regularity in the large scale structure of the Universe in 1990s – gained a merited recognition in February 2007: Jaan Einasto, Maret Einasto, Enn Saar and Erik Tago were awarded the most prestigious National Science Prize for a discovery changing the paradigm of the field of research.

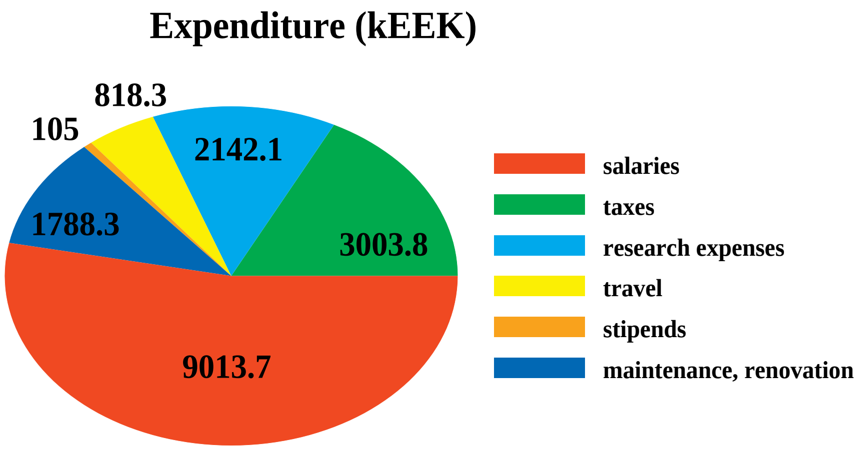
Our senior research associate Jaan Pelt was named to associate professor of the University of Helsinki on October 5, 2007.

The Heino Eelsalu fellowship foundation at the Estonian National Culture Foundation awarded the fellowship for 2007 to M.Sc. student of Tartu University Tarmo Kiik.

2.4 Budget

The total amount allocated from the state budget directly to the Observatory was 16 871 kEEK and it was divided as follows:





In addition, about 1122 kEEK from contracts with several organizations were allocated to the Observatory.

The mean monthly salary of researchers was approximately 12 847 EEK (821 EUR) by the end of 2007.

2.5 Instruments and facilities

In 2007, the Observatory significantly upgraded its connection to the Internet. The new radio link between Tõravere and the Institute of Physics in Tartu, working in the 18 GHz diapason, enables connection speed 155 Mb/s. A special 39 m high mast, accommodating the new device, was erected near the main building of the Observatory.

Some examples of new scientific equipment:

- New certificated FEL lamp with mounting (Gigahertz GmbH).
- Minispectrometer MMS UV (Carl Zeiss MicroImaging GmbH).
- J. Kuusk developed further the airborne spectrometer built using the minispectrometer module MMS-1 by Carl Zeiss. Adding indicatometer, acceleration sensors, electronic compass and controlling PC-module Puma turned the spectrometer to an universal autonomous spectro-radiometric instrument which was used for the study of reflectance properties both of forest stands and ground vegetation.

Astronomical observations were continued as usually. The 1.5 m telescope was used for spectroscopic observations during 59 nights, and the 0.6 m telescope for photometric observations during 24 nights.

2.6 Scientific Council

Tartu Observatory has a Scientific Council consisting of 13 members. There were no changes in the content of the Council during 2007. Director Laurits Leedjärv acts as a chairman of the Council, and senior research associate Tõnu Viik as a vice-chairman. There are two members from outside the Observatory, appointed by the director: Academician Ene Ergma, speaker of the Parliament of Estonia, and Prof. Rein Rõõm from Tartu University. Associate professor Peeter Tenjes has been appointed by the Ministry of Education and Research.

The Scientific Council held 10 meetings in 2007. The following scientific reports were presented:

January – *T. Nugis*: On the stellar wind of WR stars.

February – *I. Pustylnik*: Pecularities of evolution of the horizontal branch objects in binary systems.

March – *A. Reinart*: Applicability of the MERIS sensor for remote sensing of waters.

April – *O. Kärner*: IPCC, ISPM and climate.

May – *J. Pelt*: Modulations in long time series.

September – *L. J. Liivamägi*: Hierarchical structure of galaxy distributions.
– *K. Alikas*: Applications of MERIS satellite sensor for remote sensing of inland waters.

– *T. Kärdi*: Remote sensing of towns: linear decomposition of spectral mix from Landsat Thematic Mapper images in the example of Tartu.

Oktoober – *U. Haud*: High and intermediate velocity hydrogen clouds in the Leiden-Argentina-Bonn Survey.

November – *A. Aret*: Formation of isotope anomalies in chemically peculiar stars.

December – *I. Kolka*: Excursions of high luminosity stars in the HR–diagramme.

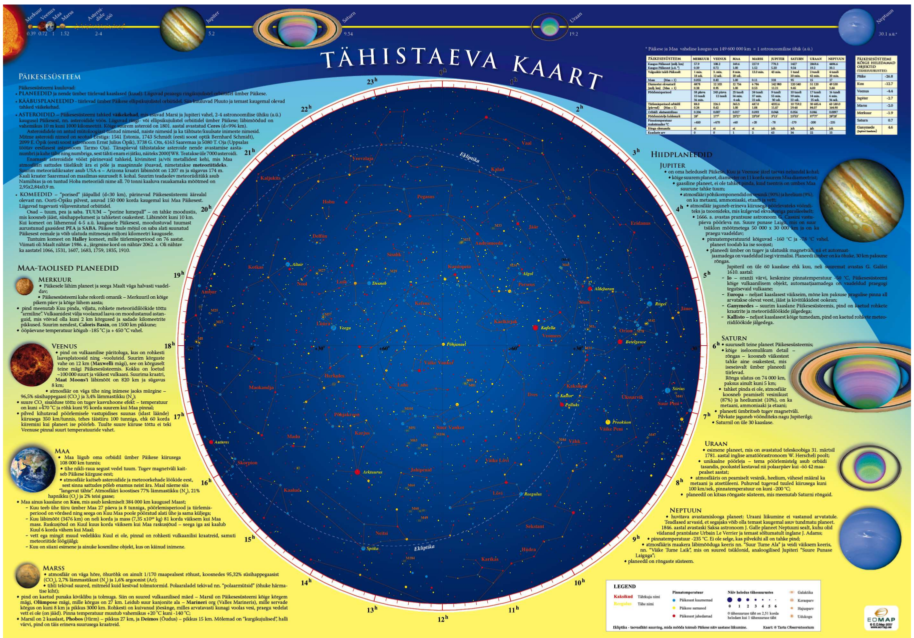
Some other activities of the Council:

- On March 19, final reports of the grants from the Estonian Science Foundation were approved (M. Gramann, I. Pustylnik, U. Veismann, U. Peterson).
- On April 27, contest to the position of senior research associates and research associates took place. T. Kipper, T. Nugis, A. Sapar and J. Pelt were elected to senior research associates in astrophysics, M. Gramann, E. Saar and U. Haud in cosmology and M. Mõttus and U. Veismann in atmospheric physics. V. V. Pustynski and A. Tamm were elected to research associates.
- On September 24, the Ernst Julius Öpik fellowship (10 000 EEK) was awarded to Ph.D. student of Tartu University Lauri Juhan Liivamägi. The Juhan Ross fellowships (7500 EEK) were awarded to the Ph.D. students of Tartu University Krista Alikas and Tõnis Kärdi.
- On October 15, plans for investments were discussed and approved. The main idea is to renovate the main building and to build a new annex, containing mostly laboratories for space research. At the same meeting, applications for continuation of the target-financed projects were discussed and approved.

2.7 Public relations

The traditional all-Estonian meeting of amateur astronomers once again took place at Tõravere in August 2007. The researchers from Observatory gave majority of the lectures which concentrated around two topics: 50 years of space age and large projects of astronomers. The first competition of astronomical photographs was also held during the meeting, Taavi Tuvikene won the first prize.

One of the main forms of our public relations are excursions to the site of the Observatory at Tõravere. In 2007, more than 6500 people in 280 groups visited the Observatory. They all could see and touch Estonian ethnographic sky on the stony mosaic by Lagle Israel, the 1.5-meter telescope, expositions in the Stellaarium, enjoy starry sky in the virtual planetarium etc. Several our astronomers guide the excursions in addition to their main job. Mare



Ruusalepp coordinates the work of guides, and often guides the excursions herself.

Numerous popular-scientific articles by our researchers are given on pages 80 of the present book, public lectures and interviews in radio and TV channels on page 108.

The 84th issue of the Calendar of the Observatory was published.

For the second time, we also published The Calendar of Starry Sky, compiled by Mare Ruusalepp and Kalju Annuk. This calendar contains nice colour photographs.

Kalju Annuk compiled a poster containing a sky map and data on the planets of the Solar system. This large format poster, printed by EOMap Ltd. is meant for schools, first of all.

2.8 Acknowledgements

Many associates were supported by various institutions throughout the world. Herewith we cordially thank:

- Astronomical Institute of the Slovak Academy of Sciences
- ASTRONET (EC FP6 project)
- Astrophysikalisches Institut Potsdam
- David Dunlap Observatory, University of Toronto
- Enterprise Estonia
- Estonian Academy of Sciences

- Estonian Meteorological and Hydrological Institute
- Estonian Ministry of Education and Research
- Estonian Ministry of Environment
- Estonian Science Foundation
- Eurisy
- Euro–Asian Astronomical Society
- European Astronomical Society
- European Commission
- European Southern Observatory
- European Space Agency
- GeoBiosphere Science Centre of Lund University
- Helsinki University
- International Astronomical Union
- Institute for Astronomy, University of Vienna
- Institute of Astronomy of Russian Academy of Sciences
- Institute of Environmental Physics, Tartu University
- Instituto Nacional de Tècnica Aeroespacial
- Isaac Newton Group of Telescopes
- National Air and Space Museum, Washington, USA
- Nordic Forest Research Co-operation Committee (SNS)
- Observatori Astronomic, Universitat de València
- OPTICON (EC FP6 project)
- Oulu University
- Pakker Avio
- Slovak Academy of Sciences
- Sternberg Astronomical Institute, Moscow
- Swedish National Space Board
- Tartu University
- University of Aveiro
- World Radiation Center

3 Evolution of structure in the Universe from deep past until the present Struktuuride areng Universumis kaugest minevikust tänapäevani

Universumi ehitust ja ajalugu saab uurida mitmeti – kas puhtalt teoreetilisi kõvera ruumi geomeetria mudeleid välja mõeldes või kasutades vaatlusandmeid. Meie kosmoloogid on läinud viimast teed – uuritakse galaktikajaotuse suuremastaabilist struktuuri ja üksikobjektide arengut. See avardab meie teadmisi Universumi praegusest olekust, kuid vaatlustest saab otsida jälgi ka ammustest protsessidest ja sellega kontrollida teoreetilisi mudeleid.

Universumi suuremastaabilise struktuuri statistilisel uurimisel pakuvad abi hiljuti avastatud barüonvõnkumised. Need on helilained ürgses aine ja kiirguse segus, millest tänaseks on jäänud väga nõrgad jäljed, mis aitavad „piiluda" Universumi väga varasesse noorusesse, inflatsioonistaadiumisse. Senised vaatlusandmed Sloani digitaalsest taevaülevaatest lubasid otsida barüonvõnkumisi kuni ca 500 Mpc kauguseni. Kuna otsitavate võnkumiste lainepikkus on 130 Mpc ringis, olid tulemused suhteliselt ebatäpsed. Uus maxBCG galaktikaparvede kataloog (kus fotomeetrilised kaugused on küll ebatäpsed) võimaldas leida barüonvõnkumiste jälgi ka suurematel kaugustel – see kinnitab taas inflatsiooniteooriat.

Galaktikad moodustavad ruumis nn. kärgstruktuuri ehk kolmemõõtmelise võrgu, kus silmale eristuvad iseloomuliku detailina filamendid (võrguniidid sõlmede vahel). Filamentide statistilises kirjeldamises, mis seni on väga raskeks osutunud, oli teatud edasiminek. Esialgu sisaldavad mudelid siiski oluliselt vähem filamente kui vaadeldud – erinevuse põhjus pole veel selge.

Kärgstruktuuri põhiosad on galaktikate superparved mõõtudega umbes 40–130 Mpc. Meie varasemates töödes olid kirjeldatud ja katalogiseeritud nn. kahe-kraadi-välja ülevaate superparved. Nüüd jätkus töö Sloani taevaülevaatega, kaasa löövad partnerid Tuorlast (Soome) ja Potsdamist. Superparvede kataloogi üks olulisi rakendusi on kogu taevast haaravate ainetiheduskaartide arvutamine kosmosemissiooni Planck tarbeks – lisaks Suurest Paugust pärit kosmilisele reliktkiirgusele peaks Planck detekteerima ka superparvede sees asuvast soojast gaasist pärit signaale.

Superparvede puhul oli eriti oluliseks teemaks nende morfoloogia (kuju) kirjeldamine. Siin tuleb mängu keerukas matemaatika: Minkowski funktsionaalid ja nende kombinatsioonid (kujuleidjad). Lihtsustatult kokku võttes – mudelsuperparved on pea kõik sarnase kujuga, vaadeldud jagunevad aga kahte klassi: hargnevad filamendid ja „ämblikud".

Superparvedest väiksemad struktuuri elemendid on galaktikaparved ja -grupid, millega meil samuti tegeldi; grupid omakorda koosnevad üksikutest galaktikatest. Viimaste hulgast oli erilise tähelepanu all meie lähim suur naaber – Andromeeda galaktika ehk M 31 – mille kohta koostati meil väga detailne mudel. Kõigepealt koostati fotomeetriline mudel. Teades tähepopulatsioonide omadusi, arvutati nende keemilise evolutsiooni mudelid ja saadi nende mass-heledussuhted. Siit saab ka vaatlustega võrreldavad värviindeksid. Üllatuseks oli M 31 äärmiselt punane välimine halo. Teise etapina arvutati dünaamilistest andmetest (pöörlemiskiirused ja kiiruste dispersioonid) massijaotuse mudel. Teades tähepopulatsioonide masse, leiti viimasest mudelist tumeaine tihedusjaotus. Saadud tulemuste põhjal kontrolliti ka teoreetilisi tumeaine tihedusprofiile – osa neist sai välistada.

Meie oma Linnuteest pakkusid jätkuvalt huvi vesinikupived, mille mass pole küll Galaktika enda omaga võrreldes suur, kuid mille liikumine jälgib hästi Galaktika gravitatsioonivälja. Tänu nutikate algoritmide kasutamisele raadiovaatluste lahutamisel Gaussi komponentideks, eristub nn. kiirete ja vahepealsete kiirustega vesinikupilvede raadiokiirgus selgesti Galaktika üldisest foonist vesiniku 21 cm spektrijoone kiirguses.

Galaktikad omakorda koosnevad tähtedest ja nendegagi tegeldi kosmoloogia teema raames – eelkõige kõige esimeste, metallivaeste tähtede tekkimise ja evolutsiooniga. Hüdrodünaamiliste mudelitega kontrolliti hüpoteesi, et esimeste supernoovade plahvatused on peamine trigermehhanism ainetihenduste (ja seega uute tähtede) tekkeks molekulaarpilvedes. Arvutused annavad siiski tekkivate tihenduste liiga väikese massi – on vaja muud mehhanismi. Kõige esimeste tähtede füüsika ja arengu üksikasjade mõistmine toob ringiga tagasi Universumi kui terviku tekke ja varase arengu juurde – kõigest, mis on eespool üsna fragmentaarselt kirjas, leidub allpool põhjalikum inglisekeelne ülevaade.

3.1 Statistics of the spatial distribution of galaxies

Statistical studies of the large-scale structure of the Universe (commonly known as LSS) were concentrated this year on two main topics – searching for the baryonic acoustic oscillations in the power spectrum of the large-scale structure, and describing the filamentary nature of the LSS.

3.1.1 Acoustic oscillations in the galaxy distribution

G. Hütsi used the direct Fourier method to calculate the redshift-space power spectrum of the maxBCG cluster catalogue – currently by far the largest existing galaxy cluster sample. The total number of clusters used in his analysis was 12 616. After accounting for the radial smearing effect caused by photometric redshift errors and also introducing a simple treatment for the nonlinear effects, he showed that the currently favoured low matter density "concordance" *LambdaCDM* cosmology provides a very good fit to the estimated power. Thanks to the large volume ($0.4\,h^{-3}\,\mathrm{Gpc}^3$), a high clustering amplitude, and a sufficiently high sampling density, the recovered power spectrum has a high enough signal-to-noise ratio to find evidence for the acoustic features. These results are encouraging in light of the several proposed large cluster surveys. G. Hütsi also showed that using only photometric redshift errors results in excess large-scale power; this curious fact has previously been noticed by several other authors.

E. Saar, together with V. Martínez from Valencia, continued their long-planned study of the extremely long-range correlations in the SDSS LRG data. The theory says that there should be only one extra peak in the correlation function, corresponding to the harmonic acoustic oscillations in the power spectrum; this peak has been discovered. However, preliminary results show additional peaks in the correlation function; it these are real, the power spectrum should have additional components, and the inflation paradigm would need modification. The problem is that it is very difficult to estimate the statistical confidence of the extra peaks. In order to do that they started simulating isotropic Gaussian fields with an exactly known oscillating correlation function, to see if the oscillations could be recovered. This cannot be done using the methods usually used in cosmology (e.g., N-body simulations), as these do not describe fully the long-range behaviour of the simulated random fields. Because of that, E. Saar and V. Martínez chose a method used in geophysics (the turning-bands method), and tried a range of tools for simulations (Matlab, R, Octave). The simulations are presently running on the University of Valencia Multivac cluster.

As for the observational data, they plan to use the recent DR6 data release of the SDSS; they have processed it, checked it, cleaned it, and have built the necessary masks that describe the sky distribution of the observed galaxies and that help to create the comparison samples. The first results of this project will arrive in the first quarter of 2008.

3.1.2 Filamentary nature of the large-scale structure

A good amount of time was spent on refinement of the manuscript on detection of filaments in the galaxy maps, sent to a statistical journal. The paper was published in the autumn.

The filament group (E. Saar, R. Stoica from Lille, and V. Martínez from Valencia) continued the filament project. R. Stoica visited Valencia for a week, when E. Saar was there, and they planned the next topics of study. The group has at the moment new results on the comparison of filaments in observed samples and in numerical simulations (mocks). They found significant differences – filaments are much more pronounced in observations than in mocks that have been especially built to mimic observations. These results will be formulated in a paper meant for the astronomical community – the languages used in astronomy and statistics differ too much. This work has started; the next goal is to extend the Bisous point process machinery for estimating physical densities in filaments.

3.1.3 Luminosity functions of galaxies and their systems

This project was started several years ago by G. Hütsi, who found the galaxy luminosity function (luminosity distribution) for the early SDSS data; his work was based on the popular Schechter representation of this distribution. A couple of years ago, J. Einasto and E. Saar derived the luminosity function for the 4th data release of the SDSS, using a non-parametric approach and describing the final result in terms of a double-power-law function. This describes much better the high-luminosity wing of the distribution. In 2007, E. Tempel carried out a thorough analysis of the luminosity function, using the latest (DR5) data and the corresponding group catalogue. He found the overall luminosity function, the function for the main galaxies of the groups, and the group luminosity function (conditional on the luminosity of the main galaxy).

The paper with these results will be finished in 2008. The results will also be compared with the subhalo simulations carried out in Tuorla Observatory by our colleagues P. Heinämäki and P. Nurmi – assuming that a subhalo corresponds to a galaxy, the observed distributions can find theoretical interpretation.

3.2 Galaxy systems

Galaxy systems range from poor groups of galaxies, containing only a few members, to the largest galaxy systems – superclusters, which are built from thousands of galaxies and tens of rich galaxy clusters. We shall describe our study of this hierarchy, starting from the largest scales.

3.2.1 Supercluster catalogues

The supercluster work continued in three directions – generating supercluster catalogues, creating projected supercluster density maps for the Planck project, and applying morphological methods to study the structure of superclusters.

The cosmology group (J. Einasto, M. Einasto, E. Tago, E. Saar, L. J. Liivamägi, E. Tempel, M. Gramann, I. Suhhonenko, and others), together with P. Heinämäki and P. Nurmi (Tuorla), and V. Müller (Potsdam) continued the study of superclusters in the 2dF Galaxy Redshift Survey (2dFGRS). The supercluster catalogues were published in Astronomy & Astrophysics and were made available on the group web site.

They also compiled catalogues of simulated superclusters, using the Millennium Simulation results (these are the largest numerical simulations available, which include simulated galaxies). These catalogues allowed them to compare properties of the observed and simulated superclusters.

3.2.2 Projected supercluster maps

Another project that is at its half-way mark is creation of spatial and sky (projected) density maps of the large-scale structure (superclusters), to be used for processing the Planck CMB satellite data. The Planck satellite will be launched in 2008, and the preparations are at the peak activity. These maps should cover almost all the sky, and they will be used to search for the SZ-effect signature from the warm intercluster gas in superclusters.

In preparation for that, compilation of all nearby superclusters was begun. For that, all available large galaxy redshift surveys (2MASS, 6dFGS, CfA) will be used. The software suite for this task is essentially complete – starting with galaxy redshift catalogues (or group catalogues) we can find the 3-D density maps (in the FITS format), and the projected density maps needed for Planck (in the Healpix format). The next step is to test the software on simulated catalogues, and to see if the SZ signal can be recovered.

This study is carried out in the Planck mission framework, together with Tuorla Observatory and the Planck working group 5.

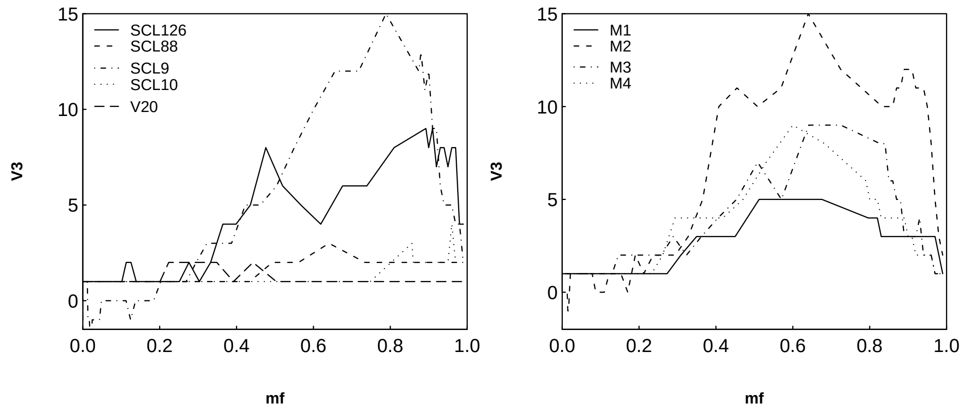


Figure 3.1: The fourth Minkowski functional V_3 (the Euler characteristic) for observed (left panel) and simulated (right panel) superclusters. As an argument we use the (excluded) mass fraction m_f – the ratio of the mass in regions with density lower than the density at a level surface, to the total mass of the supercluster. When this ratio runs from 0 to 1, the isodensity surfaces move from the outer limiting boundary into the centre of the supercluster, i.e. the fraction $m_f = 0$ corresponds to the whole supercluster, and $m_f = 1$ – to its highest density peak. Neljanda Minkowski funktsionaali (Euleri karakteristiku) V_3 väärtused vaadeldud superparvede (vasak paneel) ja numbriliste mudelite (parem paneel) jaoks. Argumendina kasutame tihedusnivoost väljapoole jääva (madalama tihedusega) osa massi suhet superparve kogumassi m_f. Kui see suhe muutub nullist üheni, liiguvad samatiheduspinnad superparve välispiirilt selle tsentrisse; kui $m_f = 0$, kirjeldame kogu superparve, kui $m_f = 1$, selle kõige tihedamat osa.

3.2.3 Morphology of superclusters of galaxies

M. Einasto and E. Saar started a morphological study of the properties of galaxies in superclusters. Together with V. Martínez (Valencia) and J.-L. Starck (Paris) they examined in detail the morphology (shapes, sizes and substructures) of the richest superclusters, both in observations and in the Millennium Simulation. In particular, they used the Minkowski functionals and shapefinders to describe the properties of superclusters. Several other members of the cosmology group (L. J. Liivamägi, J. Einasto, V. Müller (Potsdam)) have joined this study. In contrast to most earlier studies they calculated the Minkowski functionals for the whole range of threshold densities, starting with the lowest density used in the supercluster search, up to the peak density in the supercluster core. At low densities, the Minkowski functionals and shapefinders characterize the whole supercluster, at high densities – its high density core regions. In particular, the fourth Minkowski functional (the Euler characteristic) that gives us a number of isolated clumps (or holes) in a body was used to characterize the clumpiness of superclusters.

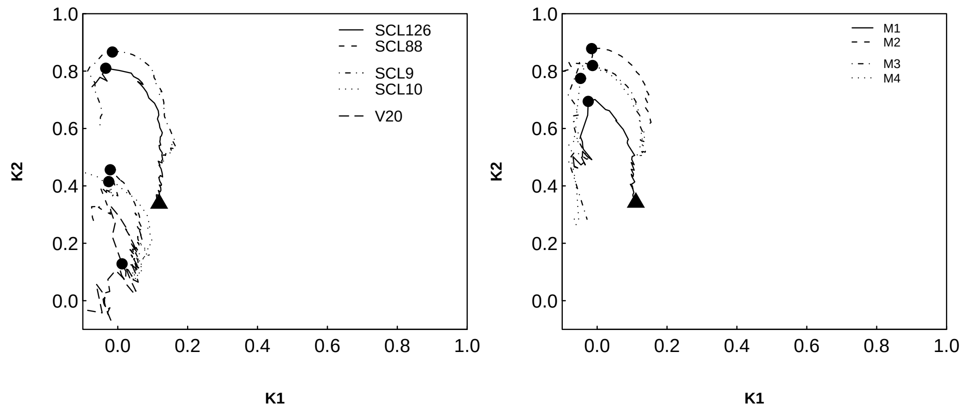


Figure 3.2: The shapefinders K_1 (planarity) versus K_2 (filamentarity) (the morphological signature) for the observed (left panel) and simulated (right panel) superclusters. Triangles show the values of K_1–K_2, where the mass fraction $m_f = 0$ (the whole supercluster), and filled circles show the values of K_1–K_2, which correspond to the mass fraction m_f, at which the Euler characteristic V_3 has a global maximum. Vaadeldud superparvede (vasak paneel) ja numbriliste mudelite (parem paneel) morfoloogiline signatuur (trajektoor kujuleidjate K_1 – planaarsus, ja K_2 – filamentaarsus, tasandil). Kolmnurkadega on näidatud kogu superparve kirjeldavad punktid ($m_f = 0$), ja pallidega punktid, mille puhul Euleri karakteristik V_3 on maksimaalne.

Fig. 3.1 shows the fourth Minkowski functional V_3 (the Euler characteristics) for the observed and simulated superclusters. We see that, typically, the value of V_3 increases with an increasing mass fraction (density level), reaches a maximum and decreases again. Such a curve is characteristic to a "multispider" – a system that consists of a large number of relatively isolated clumps or cores connected by thin filaments, in which the density of galaxies is too low to contribute to the core parts of the supercluster.

In the shapefinder's plane (Fig. 3.2) the rich superclusters have a characteristic signature that can be modelled by a simple multibranched filamentary structure.

To understand better the signatures of superclusters in the shapefinder's plane a number of simple empirical models (morphological templates) was generated; a few models are shown in Fig. 3.3, and shapefinders for all templates used are shown in Fig. 3.4. One series of these models represented a well known structure – a kitchen table, consisting of a plate and four legs; these models were generated using a smooth density field. Another series of models were calculated using point distributions to mimic galaxy catalogues. These models were also geometrically simple objects – a filament, a spider, a Cross of Lorraine (Jacob's staff, ballestina), and reindeer petroglyphs from

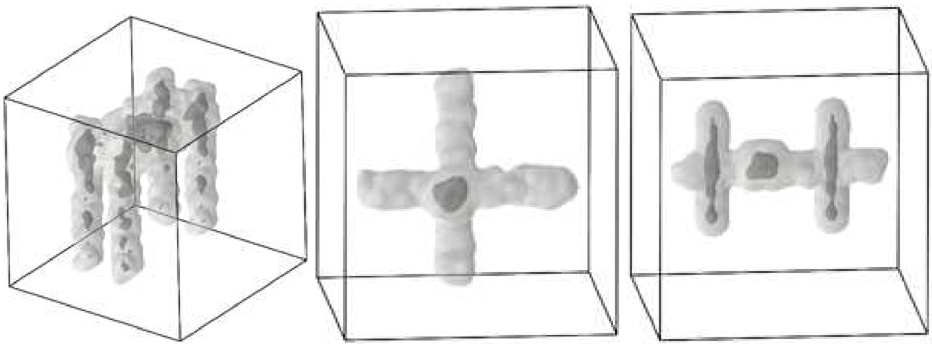


Figure 3.3: Examples of morphological templates: the table (left panel), spider (middle panel), and Karelian reindeer (right panel). Morfoloogiamudelite näidised: laud (vasakul), ämblik (keskel) ja kaljujoonise põder (paremal).

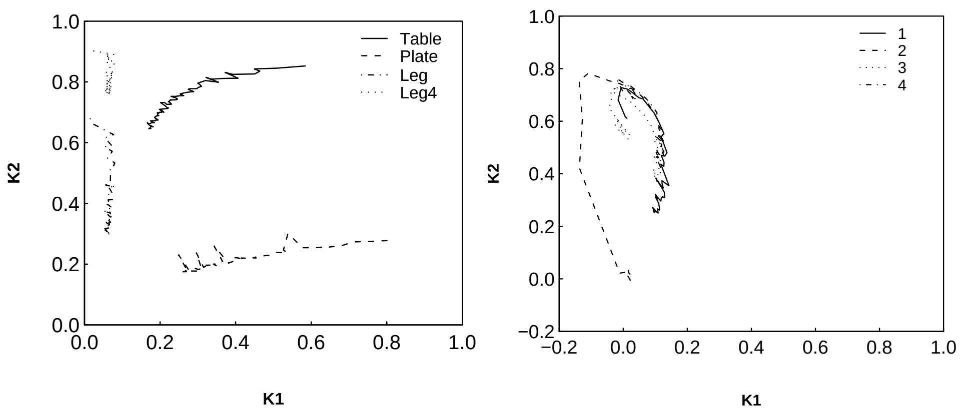


Figure 3.4: The morphological signature for morphological templates: the table and its details (left panel, smooth density fields), and for point distributions (right panel) for the following templates: 1 – filament, 2 – spider, 3 – Jacob's staff, and 4 – Karelian reindeer. Morfoloogiamudelite morfoloogilised signatuurid. Vasak paneel kirjeldab lauda ja selle osi (siledad tihedusväljad), ja parem paneel punktjaotustena esitatud mudeleid: 1 – filament, 2 – ämblik, 3 – Jacobi kepp, ja 4 – põder Karjala kaljujoonistelt.

Karelia. These models showed that there are two morphologies that resemble those of the observed superclusters. The "spider" imitates poor Virgo-type superclusters with one central cluster and surrounding filaments, while rich superclusters are best represented by the Cross of Lorraine or the Karelian reindeer that are essentially multibranching filaments.

This study also revealed an interesting difference between the observed and simulated superclusters: the scatter of the clumpiness of the bright and faint galaxies in the observed superclusters (quantified by the fourth

Minkowski functional V_3) is much larger than this scatter for simulated superclusters. This indicates that the fine structure of superclusters in real and simulated superclusters is different, i.e. the numerical models do not explain yet all the features of the observed superclusters.

The same group studied also in detail the two richest superclusters in the 2dF GRS sample volume – SCL126 and SCL9. Their morphology, cluster content, and shapes of different galaxy populations were described. Several significant differences were found. For example, the V_3 curves for the two superclusters are of different shape. For the supercluster SCL126, the richest supercluster in the 2dF GRS Northern slice (the Sloan Great Wall), the curve of the fourth Minkowski functional has two maxima at lower values of the mass fraction, and another maximum at very high densities – the shape of this supercluster resembles a rich, multibranching filament ("a wall") with a very high density core. This core region contains four Abell clusters (three of them are also X-ray clusters). The SCL9 demonstrates only a single broad maximum. Another supercluster of an exceptional V_3 curve was found in simulations – the richest simulated supercluster, M2, that contains a collection of cores assembled as a planar structure ("a Christmas cake"). There are no superclusters of such shape among the observed rich superclusters in the 2dF survey.

3.2.4 Clusters and groups of galaxies

E. Tago compiled an extensive catalogue of groups using the SDSS DR5 (data release 5, more than 675 000 galaxies with observed redshifts). He applied a Friends-of-Friends (FoF) groupfinder as modified by E. Saar, who proposed to find the scaling of the linking length with distance, shifting nearby observed groups to larger distances and reobserving these (see Fig. 3.5). Requiring the shifted groups to satisfy the FoF criterion, one can calibrate the scaling relation. Such a scaling helps to reduce selection effects in a flux limited sample.

This group catalogue was used to study the group luminosity function, to calculate the large-scale luminosity density field, to describe properties of groups in various large-scale environments, and to compile supercluster catalogues. Three papers were published and two accepted on the topic.

E. Tago started also a study of the next SDSS data release (DR6). The aim is to compile a volume-limited group catalogue (this will help to avoid selection effects), and to obtain a homogeneous sample for comparison with numerical simulations. As a follow-up project to the DR5 group catalogue, a larger flux-limited catalogue of about 66 000 groups was compiled for the DR6.

As a follow-up of the previous work, E. Tago continued updating the database of rich clusters of galaxies, in collaboration with H. Andernach

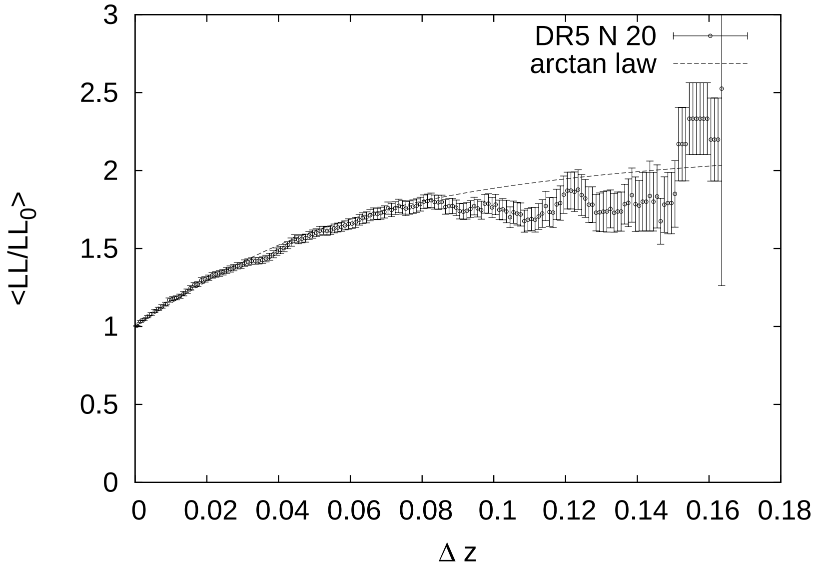


Figure 3.5: The relative change of the linking length (LL) that is required to keep a group together when it is shifted to larger distances (described by the redshift change Δz) and when its galaxies gradually drop out of the sample magnitude window. Bars show the mean linking lengths and their rms errors, the dotted line shows the arctan fit. Kui nihutame vaadeldud gruppe kaugemale (muudame nende punanihet Δz võrra), nihkuvad grupi galaktikad vähehaaval valimi heleduspiiridest välja. Et grupp koos seisaks, tuleb naabrusraadiust (LL) muuta; joonis näitabki minimaalset vajalikku suhtelist muutust. Vertikaaljooned kirjeldavad keskmist naabrusraadiust ja selle standardhälvet, ja punktiirjoon esitab parimat siledat lähendusfunktsiooni (arctan seadust).

(Mexico). The catalogue contains presently redshifts for 5401 galaxy clusters and 3125 velocity dispersions for clusters. An updated supercluster catalogue was obtained on the basis of the ACO clusters. Such a cluster-based catalogue cannot describe superclusters in detail, but it extends much deeper in space. It was used to find the spatial distribution of the clusters, and to determine one of the main cosmological parameters – the matter density parameter.

3.2.5 Local poor groups

J. Vennik studied dwarf galaxies in a sample of nearby poor groups of galaxies, located preferentially in low-density regions. Spectroscopy with the Hobby Eberly Telescope (a joint research project with U. Hopp, Munich University) of four new LSB dwarf galaxy candidates for the LGG 16 group, permitted to classify two of them as true members of the LGG 16 group and other two dIrr galaxies as belonging to a previously unknown poor association of faint galaxies, located in front of the LGG 16 group. The studied dwarfs have different star-forming properties, with two of them displaying a chain of luminous star-forming knots with a range of ages (from $5 \cdot 10^6$–$2 \cdot 10^9$ yr), and other two being 'quiescent dwarfs', but still with relatively blue integral colours, i.e. with a young (< 1 Gyr) stellar disc population. Interestingly, both the isolated and grouped faint galaxies appear to share enhanced star-formation activity.

3.3 Single galaxies

This topic includes detailed analysis and modelling of nearby galaxies. The main projects this year were detailed modelling of our neighbour, the Andromeda galaxy, and analysis of the properties of H I clouds in our Galaxy. In preparation for the Gaia project, our traditional stellar classification work was also continued.

3.3.1 Detailed visible and dark matter distribution in M 31

Constructing detailed structural models of galaxies is already a tradition at Tartu Observatory. In 2006, A. Tamm, E. Tempel and P. Tenjes returned to study the nearest giant galaxy outside our Milky Way, the Andromeda galaxy (M 31). For studies of detailed distributions of both stellar and dark matter, the Andromeda galaxy is an excellent object because of the wealth of available observational information gathered with a wide variety of instruments and techniques.

At the first stage, the photometrical model of the M 31 stellar populations was constructed on the basis of the surface brightness profiles in U, B, V, R, I and L colours. The derived model gives us the parameters of the visible galactic components, in particular, their colour indices. From independent spectral observations metallicities of the stellar content are available. All these data (component radii, luminosities, colour indices, metallicities) were used as input parameters for the chemical evolution models in order to calculate the ages and mass-to-light ratios of the visible components. In total, the output of the first stage consists of the density distribution parameters, and the ages and mass-to-light ratios of the visible components of the galaxy.

To have a sufficiently good fit of the photometrical and kinematical data with a minimum number of physically distinct components, we have to distinguish at least four main visible components of the galaxy: a bulge, a disc, a metal-poor, flattened stellar halo and a very faint outer diffuse stellar halo.

The final results of the Starburst99 chemical evolution model fitting are presented in Fig. 3.6 with solid lines. The vertical dashed lines denote the upper and lower limits of the acceptable M/L values and the corresponding

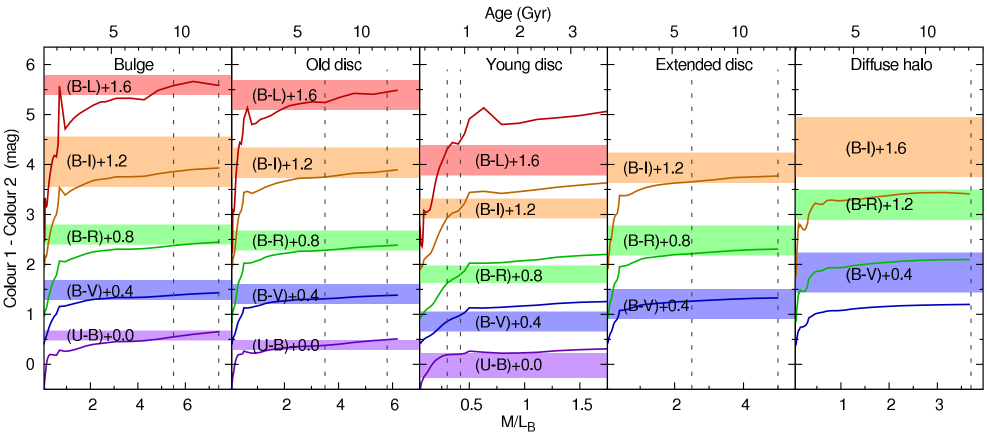


Figure 3.6: Colour indices of M 31 components as a function of their mass-to-light ratios. Filled regions – colour indices from photometrical models; solid lines – predictions of chemical evolution models of single-burst populations with fixed metallicities; dashed grey lines – permitted mass-to-light ranges. Andromeda galaktika populatsioonide värviindeksite sõltuvus nende mass-heledussuhtest. Värvilised piirkonnad näitavad fotomeetriliste mudelite ennustatud värviindekseid, pidevad jooned on kasutatud keemilise evolutsiooni mudelite ennustused, ja vertikaalsed kriipsjooned näitavad vaatlustega lubatud mass-heleduse suhte piirkondi.

ages. In general, the colours predicted by the chemical evolution model are in good concordance with the observed ones for all the components, except for the outer diffuse halo. In the halo region, the observed colours are remarkably red; even after a Hubble time of evolution, the colours of the modelled population remain significantly bluer. Using 3–5 different colour indices, we can rather well constrain the possible mass-to-light ranges.

In the second part of the study, a mass distribution model of M 31 was constructed. The stellar component parameters and their mass-to-light ratios give us the mass distribution of the visible matter. Calculating stellar rotation velocities and velocity dispersions of the visible matter from the dynamical model, we can find the amount of dark matter, which must be added in order to reach an agreement with the observed rotation and dispersion data. In the disc region of the galaxy the H I and H II observed rotational velocities are used to obtain the dark matter profiles. In the outermost region the dark matter profile was calibrated using different enclosed mass tracers (globular clusters, satellites, streams). At the final stage, the calculated dark matter density distribution was compared with commonly used dark matter density profiles and with other mass estimates.

The total mass distribution is a sum of the mass distributions caused by the visible matter components and by dark matter. Knowing the circular ve-

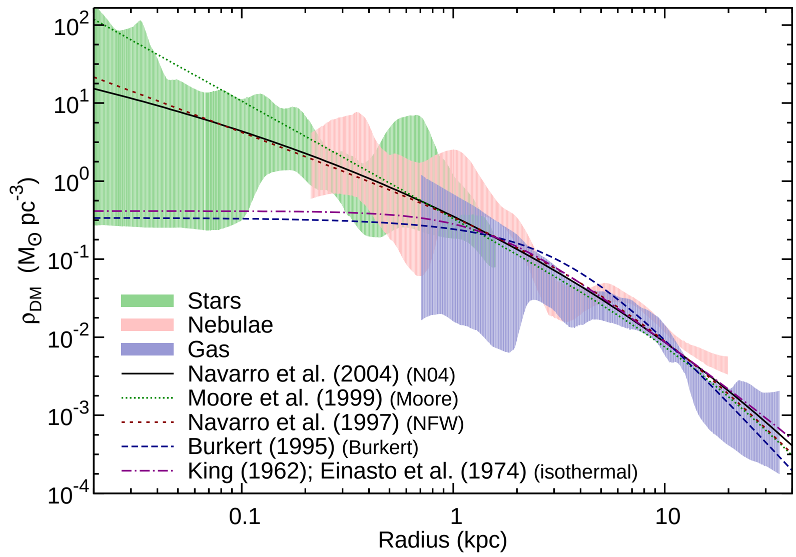


Figure 3.7: The spatial density distribution of dark matter in M 31. The filled areas show the allowed regions for the dark matter density, derived using data on stars, planetary nebulae and gas, respectively. Lines represent different analytical dark matter profiles. Tumeaine ruumtihedus Andromeda galaktikas.Värvilised piirkonnad kirjeldavad lubatud tiheduse väärtusi tähtede, planetaarudude ja gaasi andmete põhjal. Jooned näitavad erinevaid teoreetilisi tumeaine tihedusprofiile.

locities, the stellar rotation velocities and the velocity dispersions of the visible matter we can calculate the gravitational potential of the dark matter that must be added to the visible matter in order to have a good fit to the observed kinematics.

Fig. 3.7 shows the spatial density distribution of dark matter and and Fig. 3.8 – the integrated dark matter density distribution.

These Figures show that within the uncertainties, the dark matter distributions by Moore, Burkert, Navarro, Frenk & White (NFW) and Einasto 1969 (E69), and the isothermal distribution, fit the observations. However, it is also seen that in the central regions, the Moore, Burkert and isothermal profiles lie rather close to the upper and lower limits of uncertainties. The Burkert formula does not fit with the permitted region also at distances of 2.5–5 kpc. The NFW and E69 density distributions give the best fit. The Burkert law does not describe the inner mass estimates, either.

As mentioned above, the halo region of M 31 is unusually red. Abnormally red haloes at very faint flux levels around galaxies have been recently detected also by other researchers. This has initiated a new direction of studies in collaboration with N. Bergvall (Uppsala) and E. Zackrisson (Tuorla). The cause of the phenomenon remains unclear; the currently most favoured

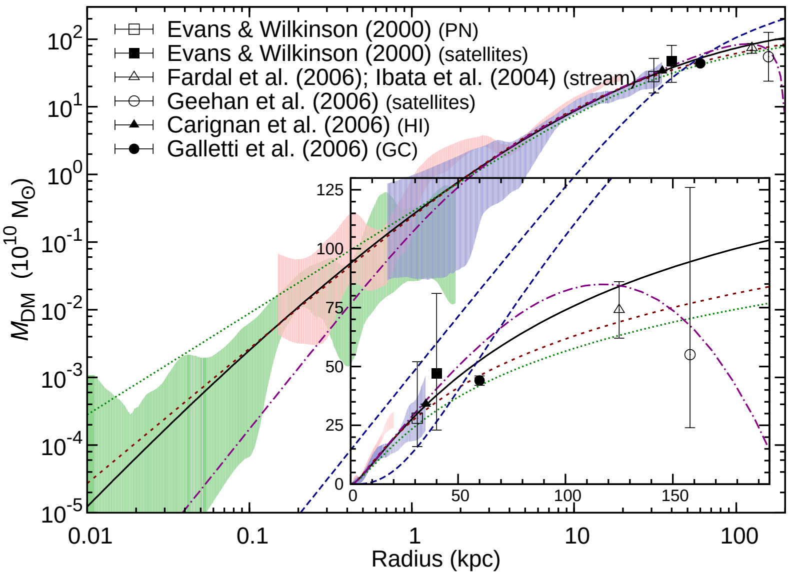


Figure 3.8: The mass-radius relation for the dark matter (designations as in the previous Figure). The points with errorbars are inner mass estimates using different objects. Tumeaine kogumassi kasv kaugusega (värvid ja jooned nagu eelmisel joonisel). Veakriipsudega massi hinnangud on saadud erinevate objektide põhjal.

explanation suggests a specific stellar population with a high excess of low-mass stars. This explanation is intriguing, because a stellar population dominated by low-mass stars has a very high mass-to-light ratio, increasing substantially the total stellar mass of a galaxy. As an example, Fig. 3.9 clearly shows colour reddening at outer regions of a galaxy, selected from the Hubble Ultra Deep Field.

3.3.2 Structure of H I in the Galaxy

U. Haud continued the analysis of the results of the Gaussian decomposition of the Leiden/Argentine/Bonn (LAB) Survey of Galactic H I. This year the main goal was the study of intermediate (IVC) and high velocity hydrogen clouds (HVC). Traditionally the IVCs and HVCs are defined as concentrations of H I gas with line-of-sight velocities, which are not consistent with the differential rotation of the Galaxy. U. Haud tried to demonstrate that these objects could be identified with density enhancements in the distribution of the parameters of the galactic H I 21-cm radio-lines. The attention was concentrated on some rather conspicuous frequency enhancements of the central velocity (V_C) versus full-width at the level of half-maximum (FWHM) distribution of the component Gaussian profiles. To separate the components,

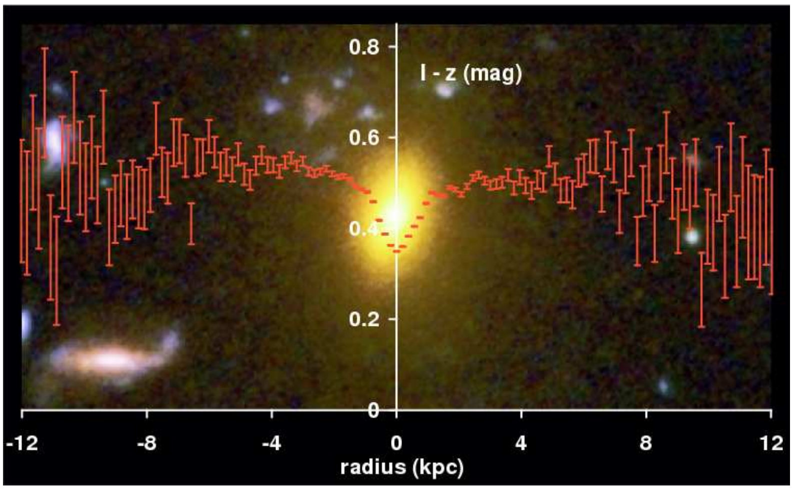


Figure 3.9: Colour image of a distant elliptical galaxy from the Hubble Ultra Deep Field, overplotted by the $(I - z)$ colour index distribution. Reddening in the outer regions is clearly seen. Hubble Ultra-sügavas Väljas leitud kauge elliptilise galaktika kujutis koos värviindeksi $(I - z)$ sõltuvusega kaugusest galaktika keskmest. On hästi näha, kuidas kaugemad piirkonnad aina punasemaks lähevad.

corresponding to these maxima, the width distribution of Gaussians was modelled by sums of lognormal distributions at equally populated velocity intervals.

The sky distribution of the Gaussians, concentrated around the parameter values of $(V_\mathrm{C}, \mathrm{FWHM}) \approx (-131^{33}_{43}, 27^{9}_{7})$, $(-49^{11}_{14}, 23^{10}_{7})$ and $(164^{71}_{49}, 26^{9}_{7})\ \mathrm{km\,s^{-1}}$, where the indices indicate the half-widths at the level of half-maximum of the distributions, well represents the sky distribution of HVCs and IVCs, as obtained on the basis of the traditional definition. Based on this identification, the division line between IVCs and HVCs may be drawn at about $V_\mathrm{C} \approx 74\ \mathrm{km\,s^{-1}}$ and IVCs could be identified down to the velocities of about $|V_\mathrm{C}| \approx 24\ \mathrm{km\,s^{-1}}$. Both structures could also be followed using Gaussians with $\mathrm{FWHM} \approx 7.3\ \mathrm{km\,s^{-1}}$. In HVCs, these cold cores have rather small angular dimensions and observed brightness temperatures. In IVCs, they are much larger and brighter.

U. Haud concluded that the IVCs and HVCs can be identified with distinctive maxima in the $(V_\mathrm{C}, \mathrm{FWHM})$ distribution of the Gaussians, representing the structure of the 21-cm radio-lines of the galactic H I. This identification relies (in somewhat lesser extent than the traditional approach) on the model of the differential rotation of the Galaxy, but use of the line-width information helps to better distinguish IVCs and HVCs from each other and from the ordinary galactic H I.

3.4 Dark ages and the first stars in the universe

The first stars in the universe are responsible for numerous feedbacks on intergalactic medium. Their ionizing radiation reionizes the universe, supernovae blast waves stimulate molecular formation, heavy metals produced by first supenovae pollute the surroundings and trigger birth of the second stellar generation. Could we find relics from this remarkable epoch that predetermines features of further galaxies and stellar populations? Extremely metal-deficient ($[\mathrm{Fe/H}] < -3$) stars in our Galaxy are believed to be one example of such relics.

Recent detection of many extremely metal-poor stars in the Milky Way motivates us to understand formation of such stars. According to theory, extremely metal-poor stars form in dense shells produced by supernova explosions of the first stars, and accrete metals from the surrounding medium during subsequent evolution. E. Vasiliev, in collaboration with E. Vorobyov (Saint Mary's University, Canada) and Yu. Shchekinov (Southern Federal University, Russia), ran numerical hydrodynamical simulations of high-energy supernova explosions (10^{53} erg) in model non-rotating and rotating dwarf protogalaxies with the mass of $10^7 M_\odot$ at high redshifts. They found that the dynamics of the shell is different in protogalaxies with and without rotation; the Rayleigh-Taylor instability in the shell develops faster in protogalaxies without rotation. The fraction of blown-away baryonic mass is larger in models with rotation than in models without it. Obviously, such differences are caused by different initial density profiles in non-rotating and rotating protogalaxies.

The clumps formed in the fragmented shell move with velocities that are at least twice as large as the escape velocity. The mass of the clumps is $\sim 0.1 - 1\ M_\odot$, close to the masses of extremely metal-poor stars, but it is lower than the Jeans mass. Hence, the clumps are expected to be pressure supported and low-mass stars are unlikely to form as a result of high-energy supernova explosions. A more feasible mechanism for low-mass, metal-poor star formation is related with the re-collapse of a supernova bubble in protogalaxies.

Another topic of E. Vasiliev's research was connected with formation of small-scale structures in interstellar medium both in early and present-day galaxies. Tiny structures are seen in 21-cm line absorption, so these must be part of the cold neutral medium of the Milky Way. Small structures are also observed in lines of heavy elements in intergalactic medium, around galaxies and in spectra of quasars. Such structures can be formed in different processes both in local and early interstellar/intergalactic medium. E. Vasiliev, in collaboration with E. Matvienko and S. Dedikov (Southern Federal University, Russia), studied formation and properties of small-scale structures produced by destruction of interstellar clouds. In their hydrodynamical simulation structures with typical size smaller than one parsec were found. They described the statistical properties of such structures.

Another process that is tightly connected with the tiny structures is mixing of heavy elements in the interstellar medium. It is well-known that the mixing process of chemical inhomogeneities is important not only during the early steps of star formation, but also in the interstellar medium of the Milky Way. In this connection E. Vasiliev, with S. Dedikov and E. Matvienko, numerically analysed destruction of interstellar clouds by shock waves, using a two-dimensional gas dynamics code. The transport of chemical inhomogeneities in cloud collisions was simulated. For the adiabatic case they found that saturation of instabilities and termination of the splitting cascade occur. They also estimated the mixing efficiency for metals in this process.

4 Structure, chemical composition and evolution of stars Tähtede ehitus, keemiline koostis ja evolutsioon

Sellise pealkirjaga teadusteema lõppes koos 2007. aastaga nagu ka teised Observatooriumi sihtfinantseeritavad teadusteemad. Teadus ise on muidugi järjepidev ning uuringud tähtede füüsika alal on meil kestnud aastaid ja toimuvad ka edaspidi.

Tähtede mitmekesisest maailmast olid meie uurijate huviorbiidis traditsiooniliselt temperatuurijada kõige jahedam (ca 2000–3000 K) ja kõige kuumem (> 30 000 K) ots, aga ka mitmed vahepealsed objektid ja kaksiktähed. R CrB tüüpi külmad tähed on tuntud kiirete ja sügavate heleduse languste poolest, mis on tingitud tolmu väljapaiskamisest tähe poolt. Prototüübi enda ja teise seda tüüpi tähe Z UMi, aga samuti külma nn. post-AGB tähe HD 161796 keemilise koostise ja füüsikaliste parameetrite täpsustamine 2007. a võimaldab paremini mõista nende hilisesse evolutsiooni faasi jõudnud tähtede käitumist. Jätkuvalt hoiti silma peal iseäralikul muutlikul tähel V838 Mon, mida nüüd juba üsna kindlalt võib pidada kaksiktäheks.

Kuumade Wolf-Rayet tähtede puhul, mida iseloomustab väga tugev aine väljavool ehk tähetuul, on jätkuvalt probleemiks tähetuule intensiivsuse sõltuvus tähe metallilisusest. Mõnedel andmetel on see sõltuvus üsna tugev, kuid meie tänavused uuringud näitavad pigem vastupidist. Igal juhul on see oluline küsimus kõige esimeste tähtede ja varase Universumi evolutsiooni kirjeldamise juures. Kuumade tähtede vaatlustest tuleks eriti esile tõsta O-spektriklassi tähte HD 191612, mis nagu muudaks oma spektriklassi ehk siis efektiivset temperatuuri. Rahvusvahelise koostöö tulemusena – meie osalesime vaatlustega – on leitud, et seda nähtust põhjustab tõenäoliselt tähega kaasapöörlevas magnetväljas asuv gaasipilv, mille joonspekter moonutab tähe enda spektrit.

Jätkus tarkvarapaketi SMART arendamine, pearõhuga kiiresti pöörlevate tähtede spektrite ja varjutusmuutlike kaksiktähtede kõrge spektraallahutusega spektrite arvutamiseks vajalike algoritmide väljatöötamisel. Juba varem meil väljatöötatud panspektraalset meetodit täheatmosfääride keemilise koostise ja elementide vertikaaljaotuse määramiseks kohandati ka efektiivse temperatuuri ja raskuskiirenduse parandite määramiseks.

Tähefüüsika teema juurde kuulub ka ainuke meie töötajate poolt

2007. a kaitstud doktoritöö: V.-V. Pustõnski „Peegeldusefekti modelleerimine kataklüsmieelsel evolutsioonietapil asuvates lähiskaksiksüsteemides". Nn. horisontaalharu ehk EHB tähti sisaldavate kaksiktähtede puhul on leitud lihtne analüütiline seos aine väljavoolu kiiruse ning süsteemi kogumassi, heleduse ja doonortähe raadiuse vahel. Nüüd õnnestus näidata, et see seos kehtib ka hoopis suuremate doonortähe masside puhul – kuni ca 20 Päikese massini. Traditsiooniliselt vaadeldi ja analüüsiti mitmeid sümbiootilisi kaksiktähti, aga koostöös Tšehhi ja Bulgaaria astronoomidega ka näiteks 2007. a augustis plahvatanud noovat V458 Vul.

Tähefüüsikute tegemistes on jätkuvalt tähtsal kohal ettevalmistused Euroopa Kosmoseagentuuri satelliidi Gaia (start planeeritud 2011) tulevaseks andmetöötluseks. Laiendasime veelgi kiirgusjoontega tähtede ringi (Be tähed, Herbigi AeBe tähed, T Tauri tüüpi tähed, sümbiootilised tähed jne.), mille spektrite vaatlused aitavad Gaia vaatlustulemusi kalibreerida. Alustati lähisinfrapunaseid spektraalvaatlusi ekliptika põhjapooluse ümbruses, mis saab üheks Gaia testalaks tema esimestel töönädalatel.

Statistilised uuringud keskendusid päikeseplekkide kõrval ka magnetiliselt aktiivsete tähtede fotomeetrilisele muutlikkusele – eesmärgiks diferentsiaalse pöörlemise ja nn. aktiivsete pikkuste poolt esilekutsutud efektide eristamine. Neid uudseid meetodeid saab kasutada ka näiteks meteoroloogiliste ja aktinomeetriliste aegridade puhul. Tegeldi ka uute statistiliste meetodite rakendamisega gravitatsiooniläätse efekti puhul.

Nö. puhta teooria vallas saadi uudseid tulemusi kiirguslevi võrrandi lahendamisel optiliselt poollõpmatus homogeenses atmosfääris erinevate kiirgusallikate puhul. Vaatluse all olid ka kiirguslikud protsessid ainet akreteerivate kompaktsete objektide (neutrontäht või must auk) läheduses. Uus arvutusprogramm võtab võimalikult täielikult arvesse kõiki olulisi füüsikalisi protsesse. Viimati lisati elektron-positron paaride tekke- ja annihilatsiooniprotsesside arvestamine, pidades silmas võimalikke rakendusi relativistlikes aine väljavooludes.

Kõigist neist ja mõnedest muudestki tähefüüsikute uuringutest annab põhjalikuma ülevaate järgnev inglisekeelne osa.

4.1 Late-type stars

The studies of post-AGB and related stars were continued by T. Kipper in collaboration with V.G. Klochkova (Special Astrophysical Observatory, Russia). The spectra of R CrB, the prototype of the group of peculiar stars with fast and deep dimmings, taken during the 2003 light minimum were studied. The spectra obtained close to the minimum light contain numerous sharp emission lines. They show complex profile of Na I D lines, including broad and sharp emissions, weak Hα emission, the remarkable emission of [O I], emission and absorption in C_2 bands, and absorption in CN bands.

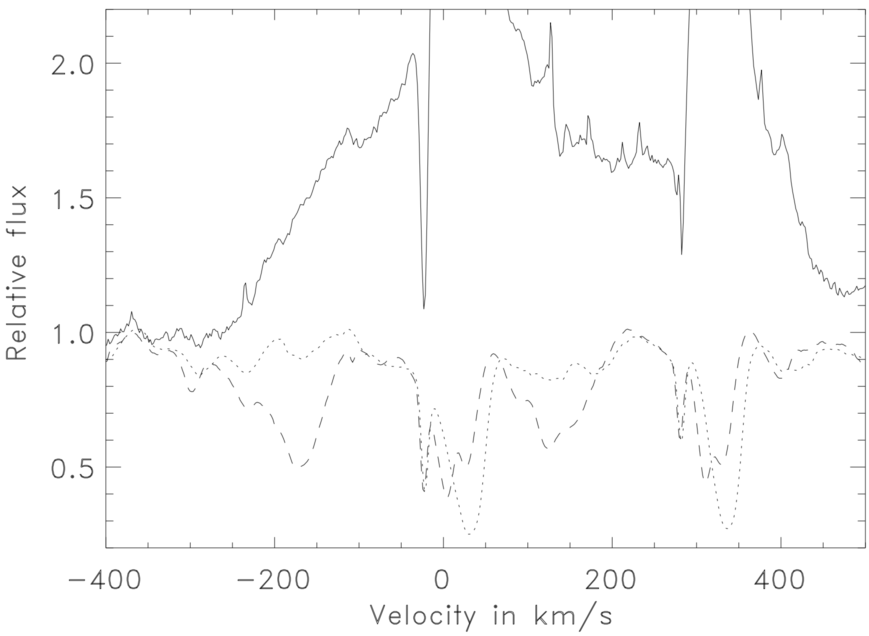


Figure 4.1: Observed spectra of R CrB near the Na I D doublet. The velocity scale is set for the D_2 line. The February 24 spectrum is shown by the solid line, the April 11 spectrum by the dashed line and the spectrum at light maximum (2004 January 12) – by the dotted line. R CrB vaadeldud spektrid Na I D dubleti juures. Kiiruste skaala vastab D_2 joonele. 24. veebruaril vaadeldud spekter on näidatud pideva joonega, 11. aprilli spekter kriipsjoonega ja spekter heleduse maksimumis (12. jaanuar 2004) punktiirjoonega.

The high resolution spectra of the R CrB type star Z UMi during the maximum light were studied. The atmospheric parameters were estimated: $T_{\text{eff}} = 5250 \pm 250\,\text{K}$ and $\log g = 0.5 \pm 0.3$. This places Z UMi among the coolest R CrB stars. We were able to confirm the hydrogen deficiency of the star. There are some red C_2 bands in its spectrum usually not visible in R type carbon stars.

The abundances of chemical elements resemble those found for the so called minority group of R CrB stars. The iron abundance is very low [Fe/H]=–1.85, but the lithium abundance is quite high [Li/Fe]=+1.9.

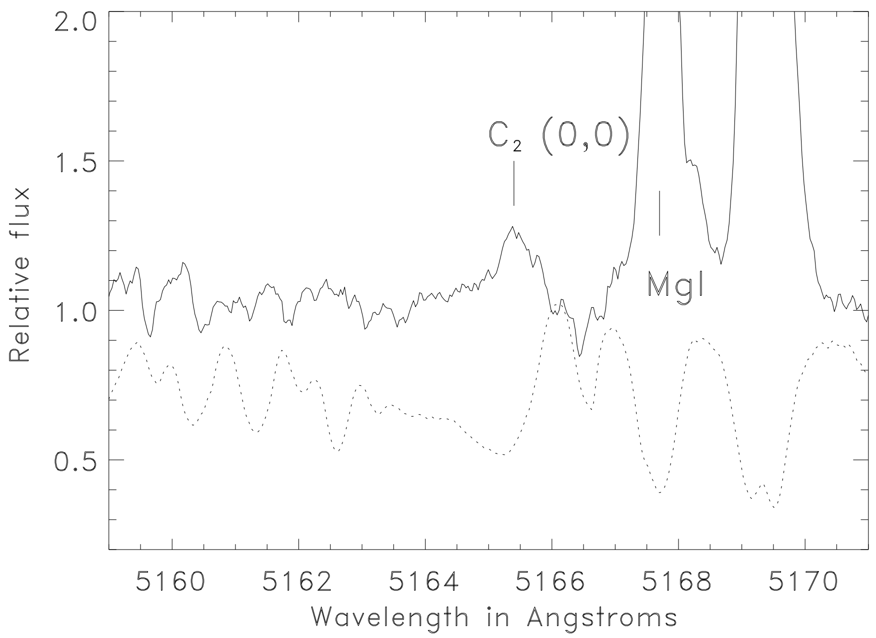


Figure 4.2: The portion of the spectrum of R CrB close to the C_2 Swan system (0,0) band head. Full line – the spectrum on February 24, dotted line – on April 11. The emission lines of Mg I and the emission blend of Fe I and Fe II are also visible. Lõik R CrB spektrist C_2 Swani süsteemi (0,0) riba pea lähedal. Pidev joon – spekter 24. veebruaril, punktiirjoon – 11. aprillil. Näha on ka Mg I ja Fe I ning Fe II blendi emissioonijooned.

The next star analysed, HD 161796 is much hotter post-AGB star: $T_{\text{eff}} = 7250 \pm 200\,\text{K}$, $\log g = 0.5 \pm 0.5$, $\xi_{\text{t}} = 4.5 \pm 0.5\,\text{km}\,\text{s}^{-1}$. The star was found to be mildly metal deficient with [Fe/H]=–0.30. The C, N, O and Na–S abundances are enhanced. The elements produced in s-process are considerably underabundant.

T. Kipper also studied a pulsating carbon star RU Cam, which has been classified as a carbon-rich W Vir type star (Pop. II cepheid). The atmospheric parameters estimated for this star are $T_{\rm eff} = 5250\,$K and $\log g = 1.0$. Our analysis does not confirm hydrogen deficiency. The iron abundance [Fe/H]=–0.37 is only slightly less than solar. Abundances of most other elements are also close to normal. We found a considerable excess of carbon and nitrogen, [C/Fe]=+1.0 and [N/Fe]=+0.6 with the carbon-to-oxygen ratio C/O$>$1. The carbon isotopic abundance ratio is ^{12}C/^{13}C=4.5. For sodium a moderate overabundance, [Na/Fe]=+0.5, was obtained.

I. Kolka and T. Liimets have started the collaboration in the field of investigations of the peculiar variable V838 Mon with U. Munari from the Astronomical Observatory of Padova and R. Corradi from the Isaac Newton Group of Telescopes on La Palma. In 2007 a cooperative paper has been published (co-authors I. Kolka, T. Liimets) on the recent eclipse (autumn 2006) in this binary system and on the changes of the emission spectrum in this period. In addition, after the eclipse (in the beginning of 2007) 22 nights of photometric observations of V838 Mon in the $UBVRI$ system have been gathered in the South African Astronomical Observatory by T. Tuvikene which indicate a few 20% brightenings in U, B, and V bands in the course of overall slow dimming of the light. The analysis of these data is in progress incorporating additionally the spectroscopic observations in the red and near-IR region made at Tartu in 2007 (I. Kolka, T. Liimets, T. Eenmäe, K. Annuk).

4.2 Hot luminous stars

T. Nugis in collaboration with K. Annuk and A. Hirv studied the mass-loss rate dependence of Wolf-Rayet (WR) stars on metallicity. The question of the dependence of mass-loss rates of hot massive stars on the initial metallicity Z of the protostellar cloud is very important for clarifying the formation and evolution scenarios of low metallicity stars (including the first generation stars). Until recently the winds of WR stars were assumed to be metallicity independent, but the new studies point to strong dependence of $\dot{M}$ on Z (recent studies in this field can be found in the proceedings of the Tartu Workshop: Lamers H., Langer N., Nugis T., Annuk K., 2006, Stellar Evolution at Low Metallicity: Mass Loss, Explosions, Cosmology. ASP Conf. Ser. 353, 430 pp.). T. Nugis, K. Annuk and A. Hirv found that the dependence of the mass-loss rates of WNE stars on the initial metallicity is still uncertain and that it is possible that this dependence is quite weak, because the flux enhancement due to clumping seems to be weaker at smaller initial metallicity.

T. Nugis continued the study of specific properties of optically thick winds of WR stars and found that in most cases the inner parts of their winds are convectively unstable and a critical point (surface) which regulates the outflow regime through the momentum conservation demand must exist in this region. The conditions at that critical point, together with the general optically thick wind equations enable to determine the theoretical mass loss rate. The results of this study are in preparation for publication.

T. Nugis in collaboration with K. Annuk, A. Hirv and with A. Niedzielski and K. Czart from Toruń University (Poland) completed the study of the near IR spectra of 37 southern and northern WR stars in the range 7900–8950 Å. All the spectra are reduced into the intensity tracings which are corrected from the contamination of telluric lines. The equivalent widths of the strongest emission lines have been measured and the new estimates for the interstellar extinction parameter $E_{\mathrm{B-V}}$ of 35 WR stars have been determined from the values of the equivalent width of the absorption feature of the diffuse interstellar band (DIB) at 8621 Å. The results of this study have been submitted for publication.

K. Annuk continued spectroscopic observations of WR stars using the 1.5-m telescope. The main aim of these observations was to study the profile variations of emission lines.

In August and September 2007 K. Annuk observed WR stars at David Dunlap Observatory (University of Toronto, Canada) using the 1.88-m telescope. The main object was the WR star WR148, a star having black hole or neutron star companion.

K. Annuk also continued spectroscopic observations of the Be star Pleione (BU Tau). At the end of 2006, Pleione reached to the new Be-shell phase. The Be-shell phase seems to appear in every 34–35 years and is consistent with the orbital period.

The spectroscopic time series on HD 191612 obtained at Tartu Observatory during 2005–2006 (K. Annuk, I. Kolka) was included in the collaborative database at the University College London to investigate this strange O-type star which periodically changes its spectral type. In a paper published in 2007 on the basis of these collected spectra the conclusion has been drawn that the line emission originating from the gas which rotates together with the star above the stellar surface and bound in the tilted magnetic field is responsible for the mimicry of changing spectral class.

In 2007 the frequency of our spectroscopic observations of the hypergiant CygOB2 No.12 was higher than previously thanks to the recently published hints that this object is a spectral-type-variable between B3Ia and B8Ia in the time scale of one year. I. Kolka started the analysis of our full 10-years spectral time series on CygOB2 No.12.

4.3 Modelling of stellar atmospheres and formation of spectra in them

Rapid progress in astrospectroscopy and in the personal computer facilities has enabled to continue detailed modelling of large set of different stellar atmospheres and physical phenomena in them. In 2007, additional packages to Fortran 90 software SMART, composed by A. Sapar, R. Poolamäe and A. Aret for computation of model atmospheres of hot stars, formation of their spectra and physical processes in the atmospheres, have been developed.

Studies carried out by A. Sapar have been directed to further elaboration of the algorithms and software for computation of spectra of rapidly rotating stars with arbitrary orientation of rotation axis and high-resolution spectra of eclipsing close binaries in the approximation where the irradiation effects and stellar disk deformation were ignored. Software for denser packing and subsequent unpacking of obtained bulky files for high-resolution stellar spectra with the limb darkening data, needed for computation of spectra of rotating and eclipsing binary stars, has been improved.

R. Poolamäe continued to elaborate the C++ code for computing stellar spectra covering somewhat wider range of spectral classes than SMART and using higher precision but therewith essentially more complicated algorithms for computing H and He line profiles broadened by the linear Stark effect. The code is also well applicable to white dwarfs, where due to high densities the average electric field strength and corresponding line broadening due to linear Stark effect generate very strong H lines, which are decisive to specify the model parameter values of these stars. The code is modified to incorporate the possibility of correcting the parameters of model atmospheres by fitting the computed and the observational spectral data.

The pan-spectral method elaborated by A. Sapar, A. Aret, L. Sapar and R. Poolamäe to determine the chemical composition and its vertical distribution throughout the whole stellar atmosphere has been adjusted also for determination of corrections to effective temperature and gravity of stars, fitting their high quality observed spectra with the model spectra. In these computations the absolute values of derivatives of residual flux with respect to each of studied parameters are to be used as the weight functions and the low quality regions must be rejected.

4.4 Diffusion of chemical elements and their isotopes in the chemically peculiar (CP) stellar atmospheres

A. Sapar, A. Aret, R. Poolamäe and L. Sapar continued to study diffusion of chemical elements and their isotopes in the quiet atmospheres of chemically peculiar (CP) stars. Further improvements of the theory of light-induced drift (LID) were elaborated and applied to computation of diffusive separation of isotopes of mercury, a typical representative of heavy metals.

Computations of the evolutionary sequences for abundances of mercury isotopes in several model atmospheres have been made using the Fortran 90 program SMART. A revised time integration method, which is more stable relative to longer evolutionary time steps and can be better fitted with the model atmosphere data, has been incorporated into SMART.

Formation of evolutionary stratification of Hg isotopes has been computed for a set of model stellar atmospheres with three effective temperatures ($T_{\rm eff}$= 9500 K, 10750 K, 12000 K) and three initial Hg abundances (ρ^0 = solar, solar + 3 dex, solar + 5 dex). Homogeneous initial abundance of Hg throughout the atmosphere and solar (terrestrial) isotope ratios have been assumed.

For heavy metals LID generally causes subsequent sinking of the lighter isotopes and rising of the heavier ones, leaving finally only the heaviest isotope in the atmosphere and its equilibrium abundance is then determined predominantly by the usual radiative acceleration (cf. Fig. 4.3). However, hyperfine splitting of spectral lines of isotopes with odd number of nucleons causes mixing of the order of isotope spectral lines and thus complicates the picture of diffusive segregation. To study the influence of hyperfine splitting of spectral lines evolutionary scenarios have also been computed for "pure mercury" case, where lines of all other elements have been ignored.

Computed early evolutionary scenarios demonstrated rapid

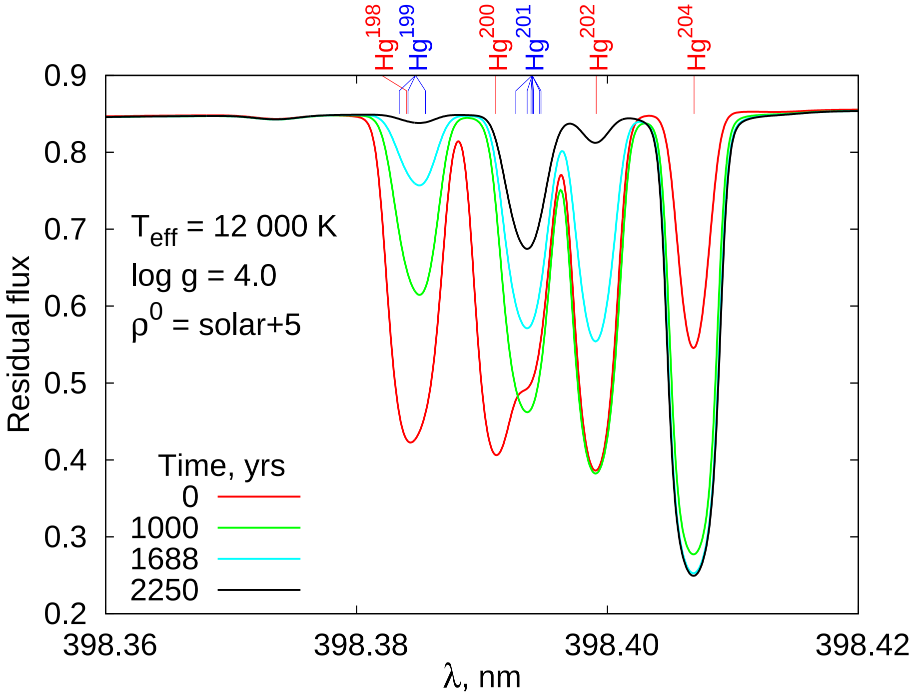


Figure 4.3: Evolutionary changes of the Hg II spectral line 3984 Å. Note consequent weakening of lines of lighter isotopes leading to presence of only the heaviest isotope line in the spectrum. Ioniseeritud elavhõbeda 3984 Å spektrijoone evolutsiooniline muutumine. Esineb kergemate isotoopide joonte järk-järguline nõrgenemine, lõpuks muutub vaadeldavaks vaid raskeima isotoobi joon.

changes in the total acceleration of isotopes due to LID. It has been found that radiative acceleration is dominant at solar abundance of Hg, the role of LID is increasing with increase of Hg abundance and it becomes dominant throughout the atmosphere at Hg abundance about solar + 5 dex. Separation of isotopes starts in the outer rarefied layers and thereafter extends into the deeper layers of the atmosphere. This process proceeds essentially slower at higher effective temperature values and higher Hg abundances.

Possible presence of stellar wind and microturbulence, both reducing or even cancelling the diffusive segregation of isotopes, has been ignored. Thus, currently obtained diffusion time-scales demonstrate only the maximal values for isotope segregation rates in absolutely quiescent stellar atmospheres. More realistic time scales can be obtained by taking into account turbulence and stellar wind. Both of the processes are included in the formulae for evolutionary scenario.

Stellar wind can be easily introduced into the codes by one additional parameter, the mass-loss rate per unit surface. However, the adequate method to include microturbulence into evolutionary computations is still lacking.

In 2004 Hubrig and Castelli analysed chemical composition of the HgMn star HD 175640 and found anomaly of calcium isotopes. The studied infrared Ca II triplet lines were redshifted by about 0.2 Å, which corresponds to the wavelength of the most heavy stable isotope ^{48}Ca. Later, similar isotopic anomalies were found in other HgMn and Ap stars. So far the light-induced drift is the only known physical process, which enables to explain the observed isotopic anomaly in CP stellar atmospheres. Positive results obtained by LID drift for mercury encouraged to start similar studies to explain the isotopic anomaly of calcium. High-precision atomic data are necessary for the study. L. Sapar has compiled initial list of calcium lines, where the hyperfine and isotopic splitting are taken into account.

4.5 Precataclysmic and eclipsing close binaries

V.-V. Pustynski and I. Pustylnik continued studies of the peculiarities of the evolutionary history of the extreme horizontal branch (EHB) objects in binary systems with hot subdwarfs. An upturn in far ultraviolet spectra of old globular clusters and galactic halo has been discovered and interpreted as the contribution from EHB objects due to their abundance and longevity of this specific evolutionary stage in binary systems. For this reason it is important to model the mass loss from progenitors of the hot subdwarfs following the filling in of the critical Roche lobe. It was found earlier by V.-V. Pustynski and I. Pustylnik that the mass loss rate from the red giant component during this stage obeys a simple analytical formula: for a wide range of initial separations between the components the mass loss rate is proportional to the luminosity of the binary and inversely proportional to its total mass multiplied by the radius of the donor star with power law index close to n=3.2. The validity of this approximation was checked now for higher masses of donors (up to 20 solar masses) when the filling in of the critical Roche lobe of the donor occurs when the star is still either on main sequence or in the Hertzsprung gap. It was shown that the same analytical relation holds also in the case of high initial masses irrespective of the fact whether angular momentum loss ensures formation of the close binary or not.

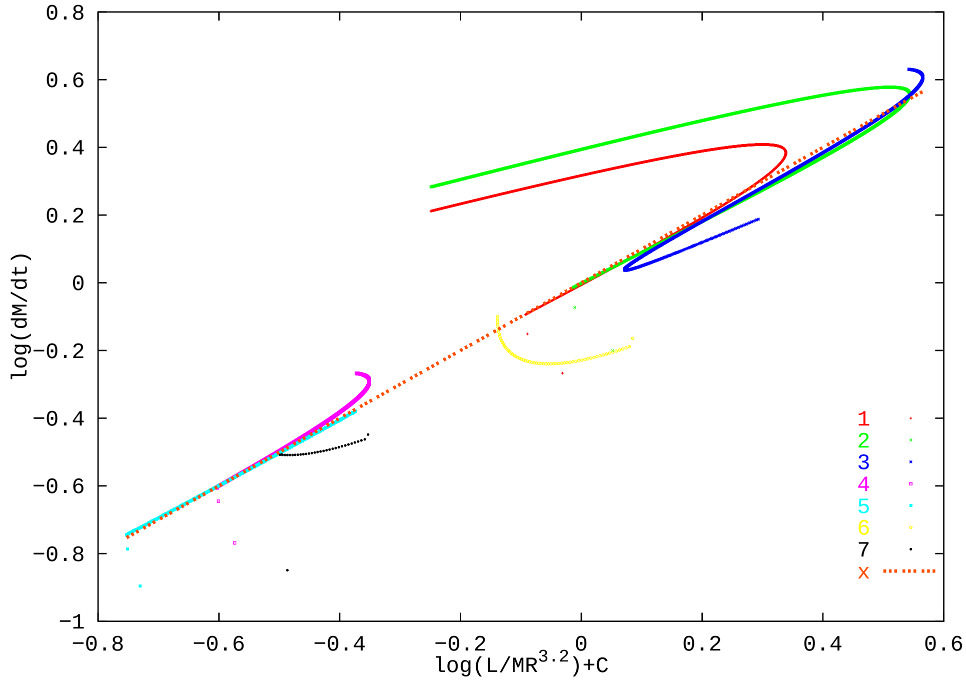


Figure 4.4: The plot of model mass loss rates for Roche lobe filling giant donors versus rates predicted by a simple approximative formula for different values of masses of donors in solar units M_1, relative Alfven radius k, mass ratios of the components q and separations d between the components (in solar radii). 1 – $M_1 = 0.7$, $k = 5$, $d = 1810^4$, $q = 0.5$; 2 – $M_1 = 0.7$, $k = 5$, $d = 1810^4$, $q = 0.1$; 3 – $M_1 = 0.5$, $k = 10$, $d = 310^3$, $q = 0.5$; 4 – $M_1 = 0.5$, $k = 10$, $d = 710^3$, $q = 0.5$; 5 – $M_1 = 0.5$, $k = 4$, $d = 710^3$, $q = 0.1$; 6 – $M_1 = 5.0$, $k = 4$, $d = 100$, $q = 0.1$; 7 – $M_1 = 5.0$, $k = 4$, $d = 200$, $q = 0.1$. x – is linear dependence (in log scale, approximative formula). Drastic deviations from linear dependence are caused by a rapid shrinkage of donor detaching from its respective critical Roche lobes.

Joonisel on mudelarvutustest saadud massikadu doonortähelt (punane hiid), mis täidab oma kriitilist Roche'i pinda ja võrdluseks massikadu, mis on arvutatud lihtsa lähendusvalemiga erinevate massi M_1 (Päikese massi ühikutes), Alfveni raadiuse k, komponentide massisuhte q ja komponentidevahelise kauguse d (Päikese raadiuse ühikutes) väärtuste korral. 1 – $M_1 = 0.7$, $k = 5$, $d = 1810^4$, $q = 0.5$; 2 – $M_1 = 0.7$, $k = 5$, $d = 1810^4$, $q = 0.1$; 3 – $M_1 = 0.5$, $k = 10$, $d = 310^3$, $q = 0.5$; 4 – $M_1 = 0.5$, $k = 10$, $d = 710^3$, $q = 0.5$; 5 – $M_1 = 0.5$, $k = 4$, $d = 710^3$, $q = 0.1$; 6 – $M_1 = 5.0$, $k = 4$, $d = 100$, $q = 0.1$; 7 – $M_1 = 5.0$, $k = 4$, $d = 200$, $q = 0.1$. x – on lineaarne sõltuvus (logaritmilises skaalas, lähendvalem). Järsud kõrvalekalded lineaarsest sõltuvusest on tingitud doonortähe kiirest kokkutõmbumisest, kui see ei täida enam oma vastavat kriitilist Roche'i pinda.

However, the range of the changes in stellar parameters of the progenitors in this case is narrower than for low mass stars. The value of numerical constant is different for different initial parameters of a binary. In the accompanying plot the approximating functional dependence is compared with numerical model results for different values of parameter of angular momentum loss (relative Alfven radius), accretion rates and masses of the accreting companion. The lower is the mass of the unevolved companion in a binary, the higher is the accuracy of the approximating analytical formula for mass loss rate.

V. Harvig (Tallinn Observatory) jointly with T. Oja (Uppsala Observatory, Sweden) studied UU Cnc, a long period ($P = 96^{\rm d}.676$) eclipsing binary with K4 III giant star as a primary component based on $UBVR$ photometry made in Tallinn between 1972 and 1994. No appreciable orbital period variations have been detected. Rough estimates of the orbital and physical parameters have been obtained. The lack of the reliable distance estimate and the radial velocity curves for both companions hampers the progress in interpretation of the numerous observed photometric peculiarities (asymmetry of the light curves, ultraviolet colour excess of unknown nature).

4.6 Symbiotic stars and related objects

M. Burmeister and L. Leedjärv compiled and analysed results of the spectroscopic observations of the peculiar symbiotic star CH Cyg from 1996 to 2007. In the context of the long-term variability of CH Cyg, this time interval can mostly be considered as a state of low activity and quiescence, except the outburst from early 1998 to mid 1999. During the most quiescent period (about 2000–2003), the hydrogen Balmer lines were practically the only emission lines in the spectrum of CH Cyg. Some similarities between the states of CH Cyg in 1996 and 2006–2007 could be detected: very low brightness ($V \sim 10^{\rm m}$) and strong nebular emission lines ([N II], [O I], [O III]) in the spectrum. On the other hand, a weak He II λ 4686 emission line appeared into the spectrum in late 2006 – this was not the case in 1996, but instead, in 1998, during the highest activity. On the long-term basis, it seems likely that the orbital period of CH Cyg is close to ~ 15 years rather than ~ 2 years as proposed by some authors sometimes.

Spectroscopic monitoring of other symbiotic stars and related objects (AG Dra, EG And, to lesser extent Z And, AX Mon, VV Cep) was continued, too. Analysis of the data on AG Dra is underway in collaboration with R. Gális and L. Hric from Slovakia.

A. Puss continued to correct model calculations of the binary star VV Cep by comparing the observed and calculated spectral line profiles.

In August 2007 the colleagues from Ondřejov Observatory (Astronomical Institute, Academy of Sciences of the Czech Republic) offered a collaboration on the new nova V458 Vul. Our team of spectroscopic investigations of V458 Vul includes now astronomers from Ondřejov, National Astronomical Observatory Rozhen (Bulgaria) and Tartu Observatory. In four nights, the light variability of V458 Vul has been monitored at Tartu Observatory with the 60 cm telescope (T. Eenmäe). Determination of physical parameters of the expanding envelope of the nova is in progress on the basis of measured intensities of characteristic emission lines (I. Kolka).

4.7 Gaia mission

The Gaia mission will use low resolution slitless spectroscopy for the classification of observed objects. This choice enhances the role of emission line objects in the calibration of Gaia instrumental performances (e.g. fixing of the wavelength scale). Previously, we have selected a sample of different emission line stars as targets for the assessment of Gaia classification abilities on these peculiar objects. In 2007 we have started to estimate their usefulness for the calibration purposes, and have included new similar objects ($\sim$10 up to now) in our observing programme. In parallel, we have started the spectroscopic observations of stars in a limited area (radius $\sim$30′) around the north ecliptic pole (NEP) to fix their physical parameters. This field near NEP will be used intensively during the verification period of Gaia mission for the assessment of the instrument and software performance, and the pre-mission knowledge of parameters on all objects in this area is obligatory for that task. I. Kolka has submitted a proposal for spectrophotometric observations at the Nordic Optical Telescope on La Palma in summer 2008 to select local secondary standards near NEP for the same purpose.

V. Malyuto continued further development of classification methods which may be applicable for treatment of some deep surveys of stellar populations in the Galaxy (Gaia, SEGUE projects). To provide the reliable samples of calibration stars necessary for classification, some selected catalogues of stars with the published values of effective temperatures have been analysed and the technique of merging the data into one homogenized catalogue has been developed.

In international cooperation, leaded by Taavi Tuvikene (Vrije Universiteit Brussel), T. Eenmäe and T. Liimets observed a faint W UMa-type contact binary system GSC 04778-00152 between 18.12.2006 and 11.11.2007, both photometrically and spectroscopically. Spectroscopic observations were good test of capabilities of the 1.5 m telescope – relatively short exposure times and required good signal-to-noise ratio placed this target at the limit of our observing possibilities. Observations gave a possibility to determine spectral classes of binary components and refine the parameters of the binary system. Results will be published in two articles, one of them is submitted to MNRAS.

T. Eenmäe observed spectra of eight preselected, apparently slowly rotating hot B-class stars with the 1.5 m telescope. Investigation of these spectra allows to estimate the influece of rotationally caused temperature gradient to the observed spectrum with higher confidence.

During international campaign of radio observations of active galactic nuclei, supporting photometric time-series observations of two objects (BL Lacertae and 8C 1803+784) were carried out during two nights.

4.8 Time and frequency analysis of astronomical phenomena

J. Pelt with colleagues from Finland and Great Britain proceeded with investigations of historical records of sunspot distributions. From earlier work the long time persistence of distribution density maxima was ruled out. Now the question is for how long the activity complexes stay on solar surface and how to quantify their statistical lifetime distributions. Preliminary computations tend to show that characteristic time of decay for distribution correlatedeness is somewhere around 10 full solar rotations. But these results need to be refined.

In addition to the sunspots, J. Pelt with Nigul Olspert (Playtech) and Heidi Korhonen (ESO, Garching) analysed long time series of magnetically active stars (typical example FK Com). The most important question under study is – how to make difference between differential rotation and changing active longitudes using only photometric data. The new statistical methods were employed which can be of interest also in the context of processing meteorological and actinometric data.

With another group of the young researchers (A. Hirv et al.) J. Pelt proceeded with investigation of gravitational lens systems. Currently they study possibility to estimate time delays for lens systems automatically. This problem is important because of planned large scale photometric experiments. They use a new method to validate designed algorithms. Traditionally the algorithm validation goes through building of Monte-Carlo type statistical experiments. Now they try methods on short previously observed data sets which gave controversial results. Automatic method can be considered useful when it recovers the correct solution which is established after the additional long time observations. Automatic algorithms must point to correct solution as early as possible. This allows to plan correctly follow-up observations.

4.9 Radiative transfer

T. Viik solved equation of radiative transfer in a semi-infinite homogeneous atmosphere with different internal sources by the method of kernel approximation – the kernel in the equation for the Sobolev resolvent function is approximated by a Gauss-Legendre sum. Then the obtained approximate equation can be solved exactly and the solution is a weighted sum of exponentials. All the necessary coefficients of the solutions may be easily found. Since the resolvent function is closely connected with the Green function of the integral radiative transfer equation, the radiation field for different internal sources can be found by simple integration. For the considered cases the formulas for the radiation field are obtained and the respective accuracy estimated. The package of codes in Fortran-77 available at the website *http://www.aai.ee/˜ viik/homogen.for*.

I. Vurm togethes with J. Poutanen (University of Oulu, Finland) studied radiative processes in the vicinity of accreting compact objects, using a numerical code developed to calculate synchrotron emission and absorption processes as well as Compton scattering over a wide energy spectrum. The observed X-ray and gamma radiation from such objects originates from the optically thick accretion disk and the hot rarefied corona above the disk, where magnetic reconnection processes can accelerate charged particles to relativistic energies. The observed spectrum is a combination of the disk blackbody radiation and a high energy component from the corona produced by inverse-Compton scattering. The latter generally follows a power-law dependence on the photon energy, depending among other things strongly on the energy distribution of charged particles in the corona, which in turn depends on the radiation field itself. Employing a simple one-zone model for radiative transfer in the corona, the developed code is able to self-consistently solve the coupled kinetic equations describing the energy distributions of the charged particles and the radiation field, taking the relevant microprocesses into account without any approximations.

Bearing in mind possible applications for studying radiative processes in relativistic outflows, the code has been improved to include electron-positron pair-production and annihilation processes, which become important at energies above mc^2.

5 Optical remote sensing of environment in Estonia and Baltic region Eesti ning Balti regiooni keskkonna optilise kaugseire alused

Kaugseire teadusteema hõlmab tegelikult üsna laia uuringute ringi, mille objektid ulatuvad Maa atmosfääri ülakihtidest Eesti metsataimestikuni või Peipsi järve pinnani. Nagu ikka, olid atmosfäärifüüsikud agarad tegema välitöid ja uuendama oma teadusaparatuuri, samuti osalema mitmesugustes lepingulistes töödes.

Päikese ultravioletne (UV) kiirgus nõuab jätkuvalt tähelepanu, on ju sellel ka teada-tuntud mõju inimese tervisele. UV kiirguse spektrite registreerimisel oleme seni pidanud läbi ajama suhteliselt odavate ühe monokromaatori baasil ehitatud kompaktsete minispektromeetritega. Mitme aasta jooksul kogutud andmete kvaliteedi kontroll näitab siiski, et välja arvatud juhul kui Päike on väga madalal (kaugemal kui 70° seniidist), võib minispektromeetri tulemusi pidada täiesti usaldusväärseteks lainepikkusteni kuni 300 nm suvel ja 310 nm talvel. Sellele vaatamata oleks vaja UV kiirguse spektrite registreerimiseks muretseda korralik skaneeriv topeltmonokromaatoriga Breweri spektromeeter, milleks loodetavasti lähemal ajal ka võimalus avaneb.

Väga aktuaalse globaalse soojenemise üks võimalikke põhjusi, kasvuhooneefekti tugevnemine on seotud muutustega atmosfääri infrapunases kiirguses. Kuigi atmosfäärikiirguse aluspinna poole suunatud osa ehk atmosfääri vastukiirgus on kiirgusbilansi üks olulisemaid komponente, on seda suhteliselt vähe uuritud; mõõdetud on vaid vähestes kohtades ja aegread on lühikesed. Tõravere meteoroloogiajaamas alates 2003. a kogutud andmete analüüs näitas, et Eestis ületab aasta jooksul maapinnale langenud vastukiirguse hulk peaaegu kolm korda summaarse kiirguse aastasummat. vastukiirguse ülekaal on suurim detsembris – kuni 30 korda, suvekuudel vaid ca 1.5 korda.

Kaugseire satelliidipiltidelt hõlmab nii maa- kui veepinda. Vee kaugseire andmete oluliseks algallikaks on Euroopa Kosmoseagentuuri satelliidi Envisat sensori MERIS andmebaas. 2007. a jätkus MERIS-e algoritmide valideerimine suurte järvede jaoks, peamiselt sogase veega Peipsi ja selge veega Vänerni järve (Rootsi) vaatluste põhjal. Varem väljatöötatud järvede optilist klassifikatsiooni rakendati ka rannikuvetele. Selle järgi kuulub näiteks Soome lahe vesi 100% selgesse veetüüpi, kuid Waddenzee (Hollandis) puhul kuulub 63%

selgesse, 13% väga sogasesse, 11% sogasesse ja 11% mõõdukasse veetüüpi. Veekogude bio-optilise mudeli edasiarendamiseks tuleks leida seosed optiliselt aktiivsete ainete kontsentratsioonide ja vee esmaste optiliste omaduste vahel. Selleks toimusid mitme teadusasutuse koostöös ulatuslikud vee optiliste omaduste mõõtmised Peipsil ja Eesti rannikuvetes ning mõõtmised lennukilt GREASEMH projekti raames.

GREASEMH kampaania 17.–20. juulini 2007, mida rahastas EL 6. raamprogrammi projekt EUFAR, oli ulatuslik hüperspektraalsete mõõtmiste seeria Hispaania Aero- ja Kosmosetehnika Instituudi lennukilt CASA 212-200. Eriti palju tulemusi said sellest kampaaniast taimkatte kaugseirajad. Skaneeriva spektromeetri AHS 80 kanalit katsid spektripiirkonna 450 nm (sinine valgus) kuni 13 μm (soojuslik infrapunakiirgus). Lennukimõõtmistele lisaks tehti tugimõõtmisi maapinnal Järvselja katsealal. Mõõdeti maapinna ja taimkatte infrapunakiirgust meie uue termokaameraga ThermaCam SC-3000. Õhus oli ka helikopter, mis mõõtis meil konstrueeritud spektromeetriga UAVSpec peegeldustegurit otse metsa kohal.

Jätkusid ka teoreetilisemat laadi uuringud kiirguslevist taimkattes, kus uudse aspektina alustati näiteks mitme vaatlusnurga alt mõõdetud hüperspektraalsete taimkatte peegeldusspektrite ja struktuuriparameetrite seoste uurimist. Tehti Järvselja katseala Landsat TM ja Spot satelliidipiltide aegrea uus kalibratsioon. Koguti ja süstematiseeriti eksperimentaalseid lähteandmeid, mis on vajalikud energiavõsa ja looduslike koosluste kiirgusmudelite sisendparameetritena, arendati footoni taaspõrketõenäosuse kasutusvõimalusi taimkatte peegeldusomaduste modelleerimisel jne.

Riikliku keskkonnaseire programmi raames hinnati Peipsi ja Võrtsjärve rannaroostike dünaamikat Landsat TM piltide kahekümneaastasest aegreast ning tuvastati roostike oluline laienemine selle aja jooksul. Detailsemalt kirjeldab eespool mainitud uuringuid jällegi järgnev inglisekeelne osa.

5.1 Solar UV radiation and atmospheric ozone

The actuality of recording ground-level solar UV radiation spectra in addition to the broadband and narrowband filter instrument measurements has increased in recent decade. It is related to the deepened research of the health effects of UV radiation as well as of its environmental effects in the atmosphere, in plants and microorganisms. In most cases the Brewer spectrometers or other expensive double-monochromator scanning instruments are used for spectral measurements of the UV radiation. The advancement of technology has also made available compact and cheap single-monochromator array spectrometers. A complementary metal-oxide semiconductor (CMOS) array minispectrometer AvaSpec-256 produced by Avantes Inc. company is used at Tartu Observatory since 2004 for regular recording of the UV spectra in the wavelength range 300–400 nm with a period of 15 minutes. The weighted spectral irradiance values retrieved from spectra were compared with those obtained by the filter instruments and also with the results of calculations using the LibRadtran package. The results of testing confirm the reliability of the recorded spectra in a wide range of solar zenith angles (SZA) except those above 70–75 degrees.

The daily doses of erythemal, 306 nm spectral, UV-A and UV-B irradiances were integrated interpolating over all the recorded spectra satisfying the quality requirements. The covariance of the UV-B irradiance over the wavelength region 290–315 nm as well as the spectral irradiance at 306 nm with the narrowband spectral irradiance measured by the Kipp & Zonen CUVB1 instrument at 306 nm has also been investigated. The diurnal cycles of the ratio UV-A/UV-B irradiances in sunshine and overcast conditions have been studied (K. Eerme, U. Veismann, I. Ansko, S. Lätt). The UV-A irradiance is defined as an integrated value over the wavelength region 315–400 nm and the UV-B irradiance as the value integrated over 290–315 nm. In Fig. 5.1 the ratios of irradiances UV-A/UV-B together with the model calculated ratios versus SZA in the summer sunshine conditions are presented for two different atmospheric total ozone amounts.

The UV irradiance is closely correlated to the pyranometer measured global irradiance. The weather pattern of the Northern Hemisphere (NH) extratropics experiences interannual and intraseasonal variability on different timescales. Both the internal variation of the atmospheric system as well as the external (natural or anthropogenic) forcings influence the variability. According to the idea of nonlinear

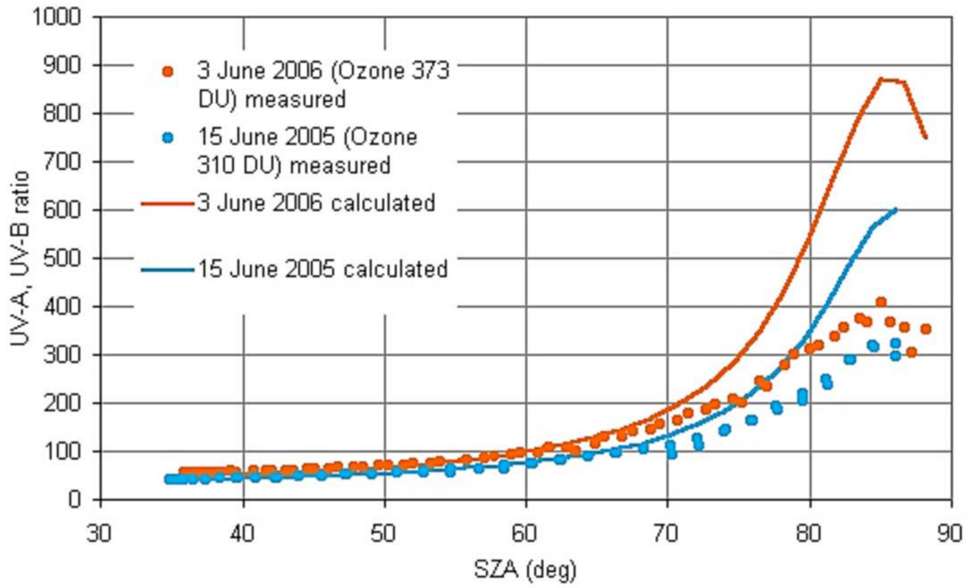


Figure 5.1: Dependence of the measured and calculated ratio $UV\text{-}A/UV\text{-}B$ on the solar zenith angle for two different total ozone amounts. Mõõdetud ja arvutatud $UV\text{-}A/UV\text{-}B$ suhte sõltuvus päikese seniitnurgast osooni koguhulga kahe erineva väärtuse korral.

dynamical perspective on climate change the response to the relatively weak forcing would be seen mainly in a change of the frequencies of the climate regimes, while the spatial structure of the regimes would be insensitive to the forcings. Significant increases of both the NH atmospheric mean and eddy kinetic energy in boreal winter and summer since about 1970 influences the frequency of certain atmospheric circulation regimes which underwent considerable change. The daily sums of global irradiance recorded at the typical Estonian rural site and presented as the ratios to the assumed clear-day values G/G_{clear} were analysed for their amplitude and frequency variations during 1955–2006. The daily average total cloud and low cloud amounts closely related to the G/G_{clear} are analysed simultaneously. The averaged over ten-days pictures of seasonal and interannual variation of the G/G_{clear} and cloud amount have been constructed to display their major features in interannual and intraseasonal timescales. As a next step a wavelet analysis of these time series has been performed (K. Eerme, I. Ansko, U. Veismann, S. Lätt). Wavelet analysis is an alternative to classical Fourier methods for data analysis and synthesis. Wavelet analy-

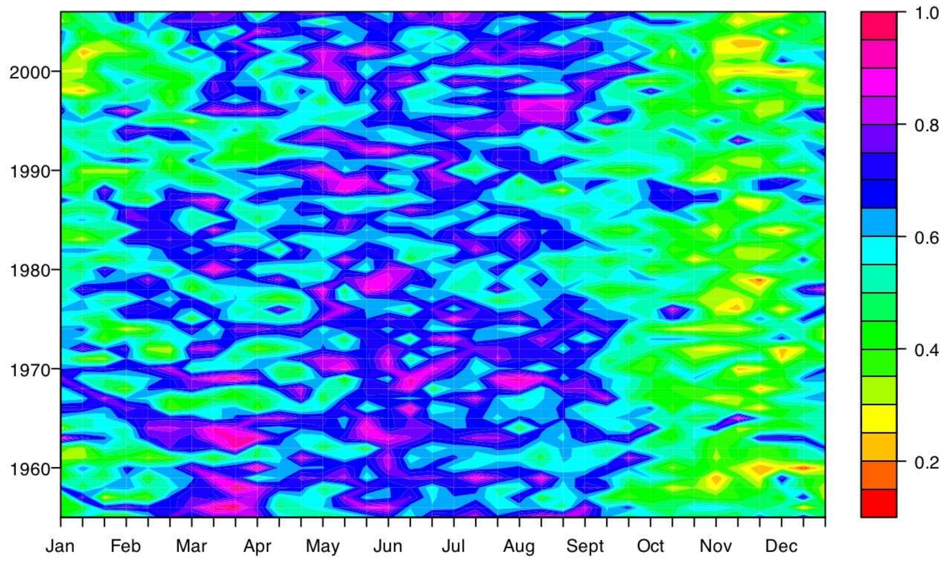


Figure 5.2: Annual and interannual variations of the relative (to the assumed clear day) daily sum of global irradiance in 1955–2006. Summaarse kiirguse suhtelise päevasumma (selge päeva suhtes) aastane ja aastast aastasse muutumine 1955–2006.

sis is able by decomposing a time series into the time-frequency space to determine both the dominant modes of variability and how these modes vary in time. The peaks of wavelet power appear in interannual as well as in intraseasonal scales. The calculations of wavelet spectral power of global radiation were also performed on seasonal level. Often the peaks of wavelet power in variations of both irradiance and cloud amount and also in their cross-wavelet spectra coincide. Despite of the seemingly chaotic short period variations there often appear the period between 3 days and one month and also the periods close to a seasonal length about three months. Interannual variations with periods close to one, two and three years are also evident. There appear time intervals about decadal length when the interannual variations are clearly different from those in other intervals.

5.2 Earth atmosphere and climate

O. Kärner participated in voluntary activities of international groups in comparing the IPCC (International Panel on Climate Change) predictions on global warming with the actual variability in the Earth atmosphere.

The mesurements with the sun-sky scanning spectral radiometer Cimel 318A were continued. The results of these mesurements are required for the atmospheric correction of the sattellite measurements and also to consider spectral transparency of the atmosphere and the content of water vapour and aerosol in the radiation climate investigation.

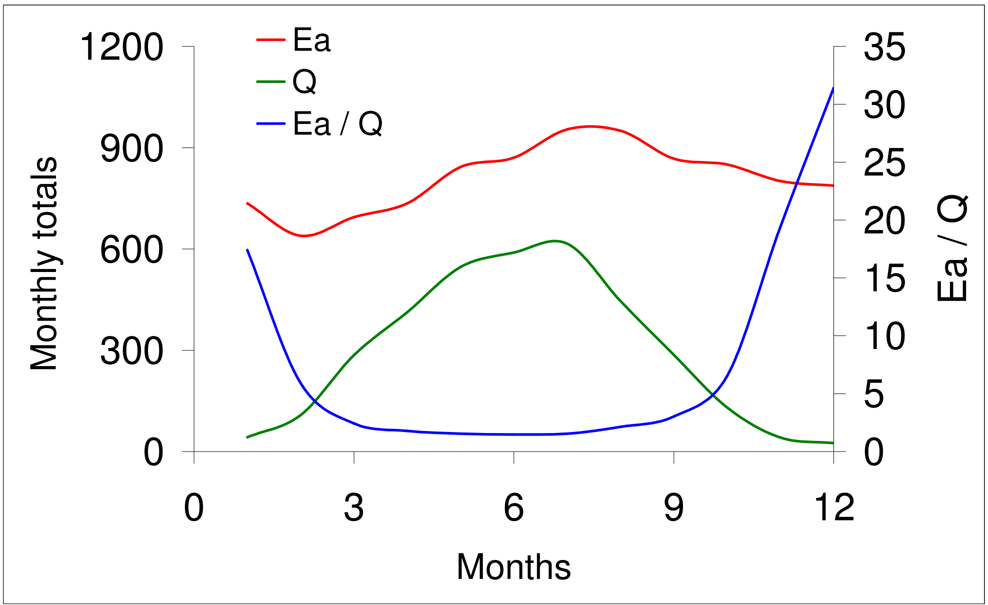


Figure 5.3: Mean monthly totals of atmospheric counterradiation E_a and global radiation Q (MJm^{-2}) and their ratio E_a/Q at Tõravere in 2003–2006. Atmosfääri vastukiirguse E_a ja summaarse kiirguse Q (MJm^{-2}) kuusummad ning nende suhe E_a/Q Tõraveres aastail 2003–2006.

Global climate warming has been a key research area of atmospheric physicists during a number of decades. One of the possible factors causing the temperature rise, the enhancement of greenhouse effect, is connected to changes in downward atmospheric radiation (counterradiation). Although the counterradiation is a very essential component of the radiation balance of the ground, it has been studied rather poorly, the measurements have been made at a small number of geographical locations and the time series are short. An analysis of counterradiation by V. Russak, based on the measurements at the Tartu-Tõravere Meteorological Station since 2003, has shown that annual totals of downward atmospheric radiation exceed the totals of global radiation about three times. Since the ratio of atmospheric to global radiation depends mainly on solar elevation, duration of light time (the counterradiation is measured throughout twenty-four hours while solar radiation in daytime only) and cloudiness, the predominance of atmospheric radiation is the greatest in winter (in December about 30, in summer months 1.5 times) (Fig. 5.3). The influence of cloudiness on atmospheric infrared radiation is most essential in winter. Then the counterradiation in the overcast days exceeds the values in cloudless days about two times. In summer, the influence of some other factors (e.g. higher content of water vapour in the atmosphere) on counterradiation becomes more essential and the effect of clouds is relatively small.

5.3 Remote sensing of water bodies

K. Alikas in cooperation with the Institute of Environmental Physics, University of Tartu (H. Teral, H. Ohvril) continued validation of MERIS products over large lakes Peipsi (Estonia/Russia) and Vänern (Sweden). MERIS aerosol product over water contains AOT (aerosol optical thickness) values at 550 and 865 nm. We have extracted pixel values from the MERIS images of both lakes in one point and compared them with AOT values measured in AERONET stations (closest station to the lake).

The best correlation ($R^2 = 0.52$) and slope value close to 1, is found for Vänern dataset at 550 nm, while lower correlation and overestimation about 40% is observed at 865 nm. In turbid Peipsi, however, the correlation was lower for both bands ($R^2 = 0.34$ and 0.31, accordingly at 550 and 865 nm), and overestimation up to 84%. More likely this is related to large particles in atmosphere – clouds, not detected by MERIS cloud mask. Over lakes water pixels are often flagged as ″invalid aero-alpha″, ″aero-opt-thickness″. Flags ″Uncertain aerosol type″ and ″aerosol model is out of aerosol model database″ are raised over turbid areas of Peipsi.

Optical classification scheme developed for lakes (A. Reinart) was applied to coastal waters (K. Valdmets). By these results water of the Gulf of Finland belongs entirely into type ″clear″. Water in Wadden Sea (The Netherlands) belonged 63% type ″clear″, 13% ″very turbid″ and 11% into both ″moderate″ and ″turbid″. Bio-optical model developed for turbid waters was also applied for validation of classification algorithm. It gave consistent results with original model, despite of

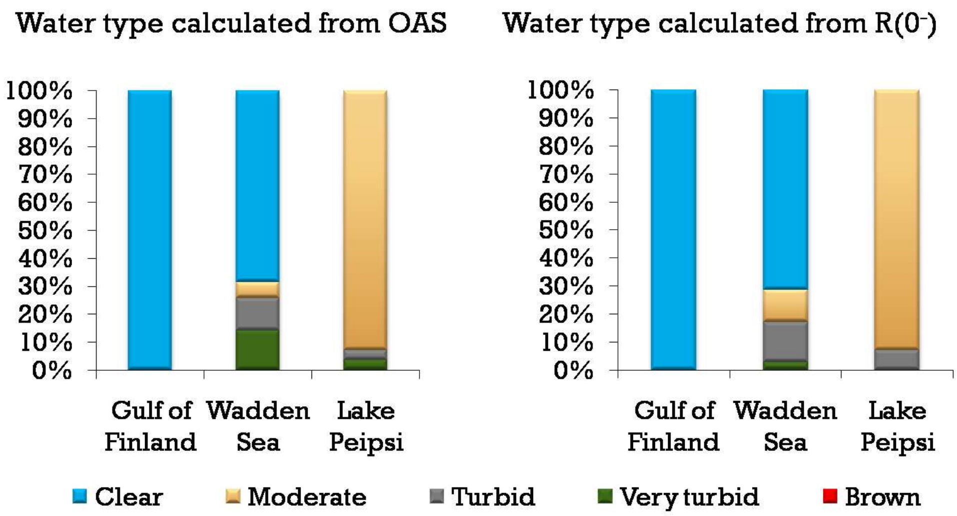


Figure 5.4: Comparison of optical water type in various water bodies calculated by optically active substances and from remote sensing reflectance spectra. Erinevate veekogude optiliselt aktiivsete ainete kontsentratsioonide ja mõõdetud peegeldustegurite alusel arvutatud optiliste veetüüpide võrdlus.

the shortcomings in estimation suspended matter and dissolved organic matter (Figure 5.4). Most critical is separation between "turbid" and "very turbid" types. Unfortunately, there is presently not enough data about "brown" type for validation. Further development of the model needs detailed measured data about inherent optical properties of the water. This work was started in 2007, when extensive field campaign was carried out in collaboration of Võrtsjärv Limnological Centre, Marine Institute of the University of Tartu, Estonian Maritime Board and Luode Consulting Oy (Finland). Collected data will be used as ground-truth in conjunction with EUFAR (M. Mõttus, J. Kuusk) airborne measurements over Lake Peipsi and coastal waters near Hiiumaa (Figure 5.5).

5.4 Remote sensing of vegetation

In 2007, we started to work on relating multiangular hyperspectral canopy reflectance data to forest canopy parameters (M. Rautiainen et al.). The foundation for these studies was laid during the previous years by creating and applying sensor calibration and atmospheric correction to a CHRIS/Proba image obtained over Järvselja test site on

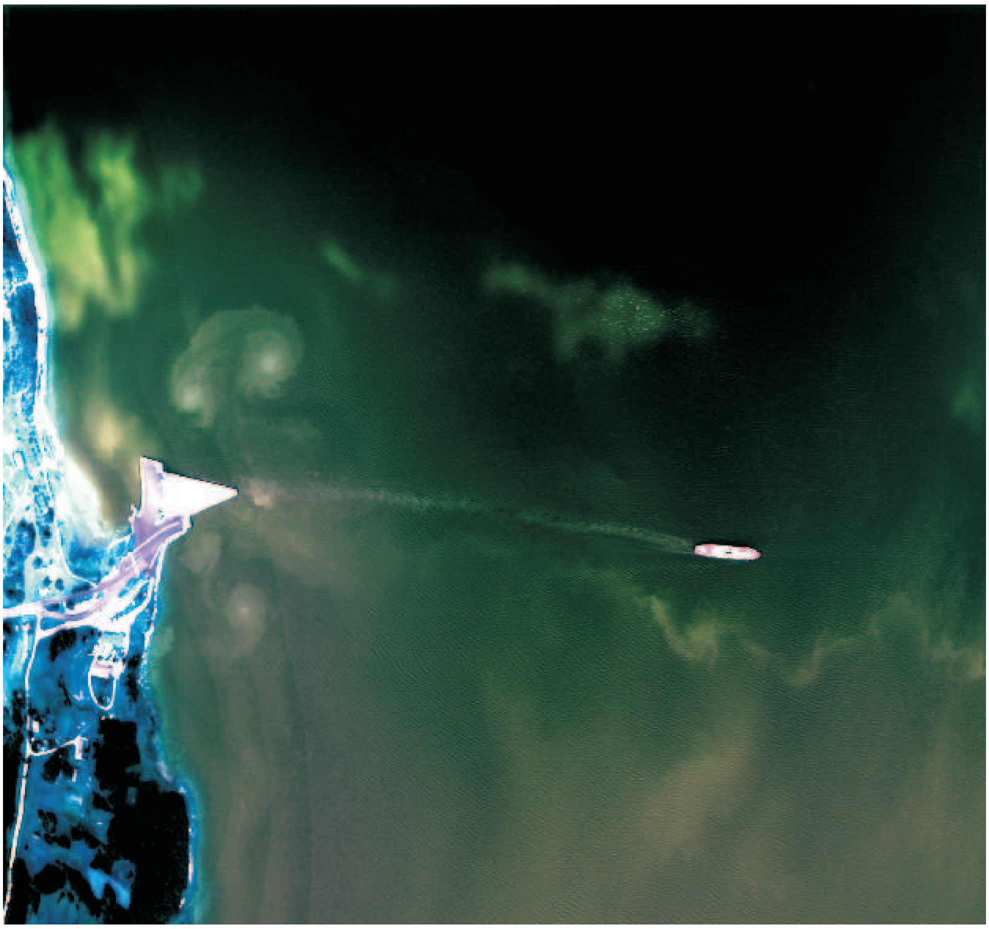


Figure 5.5: Example of image acquired by air-borne remote sensing during EUFAR project flight campaign: coastal waters of Hiiumaa, 20.07.2007, upper side of image is covered with clouds shadow, clearly visible is the track of a ferry. Näide GREASEMH projekti käigus lennukilt mõõdetud heledusteguri jaotusest: rannikuveed Hiiumaal, 20.07.2007, pildi ülemist osa katab pilve vari, allpool on hästi näha sadamast lahkuva praami jälg ja tekkinud keerised vees.

July 10, 2005 (A. Kuusk et al.). Additionally, stand reflectance coefficients were calculated for separate stands from image data. These coefficients were then merged with the ground truth database for the test area. Using three images taken at different view angles, differences in the above-canopy reflectance spectra were related to differences in species composition. The results were directly compared with model results generated using the FRT hybrid forest reflectance model to determine the reflectance components having the largest contribution to these differences (M. Rautiainen). The study indicated that hyperspectral and multiangular remote sensing provides an opportunity to study canopy structure from a distance. However, the limited number of viewing geometries available and their specific configuration (only a nadir-looking image and two images in backward viewing directions) was a considerable limitation for the study.

T. Nilson and T. Lükk carried out a new calibration of the time series of Landsat TM and SPOT images over the Järvselja site. The atmospheric correction for the images was made by the 6S atmospheric radiative transfer code using the dark target method and a selection of dark spruce forests from the scene and assuming that the midsummer reflectance factor of spruce forests in the red band was 0.019. The latter figure was obtained from the analysis of helicopter-borne spectral measurements over the Järvselja test site carried out by A. Kuusk, J. Kuusk and M. Lang in 2006 and from the spaceborne CHRIS image of summer 2005. Compared with the previous calibration the spruce forests appeared to be considerably darker, and the resulting atmospheric contribution in the images increased. The effect of recalibration appeared to be larger in the visible bands where the atmospheric influence is larger if compared with the middle infrared bands. The increased role of atmospheric contribution naturally changed the absolute reflectance values, but also the shape of seasonal reflectance curves derived on the basis of the time series of images. In the new calibrated time series the seasonal reflectance course of reflectance for the selected forest types appeared to be less pronounced than it was with the previous calibration. Especially this effect was noted for the sparse Pinus bog, which was one of the key forest types used in smoothing of the time series. This way the shapes of simulated and image-derived seasonal reflectance courses became closer. Recalibrated time series will now be used to relate the seasonal reflectance courses of different forest types to their productivity, and thus to test the use of remote sensing methods in estimating the primary productivity of Estonian forests.

More multiangular and hyperspectral data with higher spectral, spatial and angular resolution were acquired for the Järvselja test site during the GREASEMH flight campaign on 17–20 July 2007. The GREASEMH campaign, financed by the EU FP6 network EUFAR, had several objectives: multiangular measurement of forest reflectance, hyperspectral mapping of different vegetation types from forests to wetlands, and high-resolution hyperspectral remote sensing of water bo-

Figure 5.6: GREASEMH project close to its culmination: INTA data acquisition team and members of TO vegetation remote sensing workgroup at Tartu Airport on 19 July 2007. The CASA 212–200 EC-DUQ ”Paternina” aircraft in the background. GREASEMH mõõtmisprojekti tipphetki: INTA andmekogumismeeskond ja TO taimkatte kaugseirajad Tartu Lennuväljal. Taustaks CASA 212-200 EC-DUQ ”Paternina”.

dies. Hyperspectral multiangular data were collected using AHS (Airborne Hyperspectral Scanner, Argon ST, USA) mounted on a CASA 212 aircraft (operated by INTA, Spain). Measurements were performed at an altitude of 1000 m, below most of the atmosphere. AHS has a large field of view of the sensor, 90 degrees, resulting in a large swath width and highly off-nadir view angles allowing. With highly overlapping flight lines set at right angle to the direction of sunrays, the configuration of the sensor allows to measure angular reflectance characteristics in the principal plane, i.e. the plane where reflectance variations are the greatest. The 80 spectral bands of AHS cover the visible and infrared parts of the spectrum, from 450 nm (blue light) to 13 μm (thermal infrared). To support the airborne data acquisition, ground truth measurements were carried out in Järvselja. Besides the canopy transmittance and reflectance measurements described above, canopy and ground thermal images were recorded with a thermal camera (ThermaCam SC-3000, FLIR Systems). Also, the UAVSpec-2 was flown on a helicopter directly above the forest.

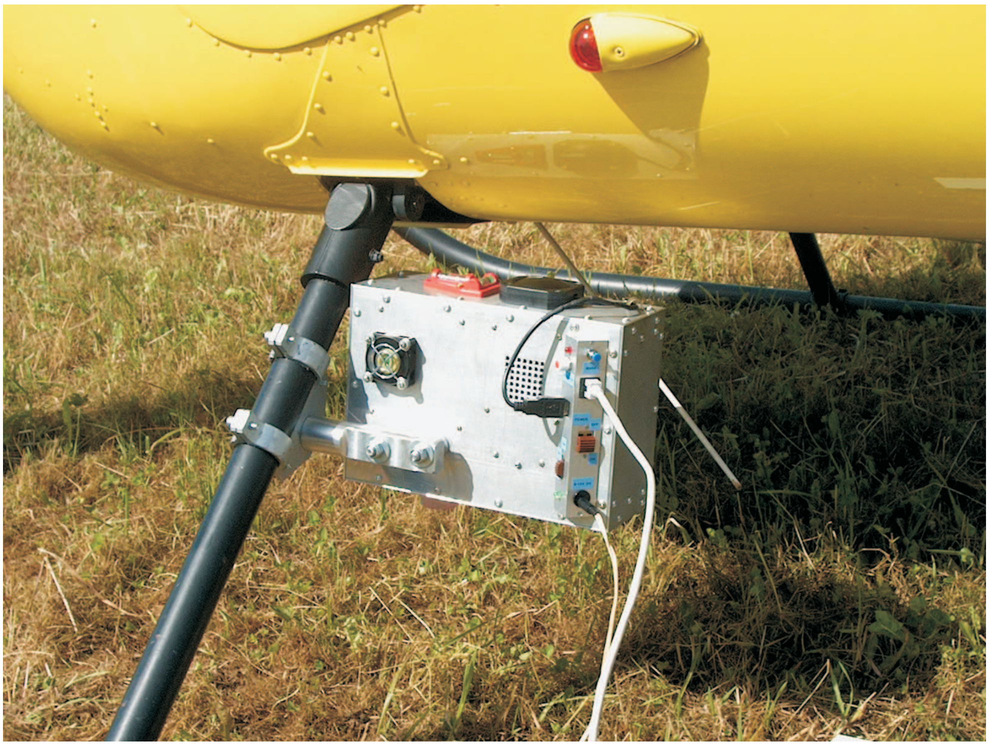


Figure 5.7: Spectrometer UAVSpec-2. Lennukispektromeeter UAVSpec-2.

J. Kuusk modified the airborne spectrometer built at Tartu Observatory adding indicatometer, acceleration sensors, electronic compass and GPS-receiver. The spectrometer is controlled by embedded PC-module Puma, and thus is fully autonomous. Metrological characteristics of the Zeiss minispectrometer module MMS-1 were investigated and algorithms for the correction of stray light and spectral aliasing were developed.

Reflectance spectra of several forest stands at Järvselja test site were measured on board a helicopter using the modified by J. Kuusk spectrometer UAVSpec-2 (J. Kuusk, A. Kuusk, M. Lang). Three 100x100 m stands – a 124 years old pine stand, a 59 years old spruce stand, and a 49 years old birch stand – are selected as test stands for the intercomparison of forest radiative transfer models RAMI. Exact position and brest-height diameter of every tree was measured. Tree height, crown length and radius of model trees were measured and allometric relationships were built for the calculation of these parameters for every tree in the stands. Leaf area index was measured with the plant canopy analyser LAI-2000 (M. Rautiainen), and gap fractions were estimated from fish-eye photos (M. Lang). Reflectance spectra of ground vegetation, tree stems, branches and leaves (needles) were measured as well. A comprehensive database for the testing of forest radiative transfer models was created.

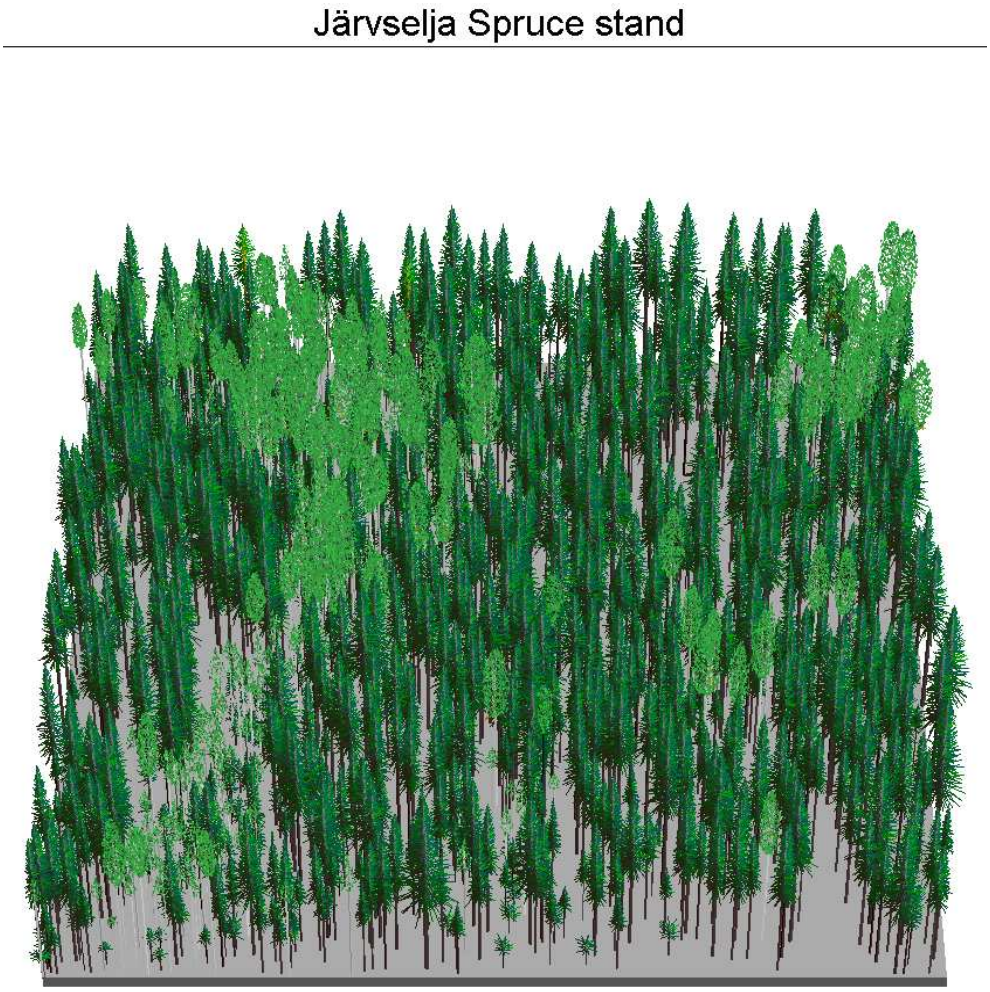


Figure 5.8: The spruce stand at Järvselja. Järvselja kuusik, kvartal 162, eraldis 4.

M. Sulev continued measurements and analysis of data needed as the input parameters for the energy forest radiation transfer models and also for validation of the models. In 2007 the laboratory measurements of the spectral characteristics of the grey alder leaves were carried out taking into account errors caused by the apparatus. The estimation of the apparatus errors enabled to correct the results of the earlier measurements and as the result we have reliable data of the spectral properties of leaves for most Estonian deciduos trees in the spectral region 400–1100 nm.

The critical anlysis of the spectral and integral outdoor measurements in the grey alder plantation allowed to create the database of the spectral reflection coefficients of the forest and underlaying surface, and for the spectral diffuse radiation inside the forest. The measurements of the global and photosynthetically active radiation under forest and outside allow to estimate penetration of direct radiation and the absorption of global radiation and PAR, and variability of radiation inside a forest.

To be applicable for remote sensing of vegetation of large regions, robust yet simple physically-based parameterizations have to be developed. The canopy spectral invariants theory, or p-theory, is a new research line in modelling of scattering in vegetation. The theory states that the amount of radiation scattered by a vegetation canopy should depend only on the wavelength and a spectrally invariant canopy structural parameter p. The canopy structural parameter p is called photon recollision probability, the probability that a photon scattered from a leaf in the canopy will interact within the canopy again. The concept of photon recollision probability is very powerful modelling tool and enables a completely new approach to assessment of canopy scattering, e.g. an alternative and compressed way to account for the effects of 3D structure on canopy absorptive and reflective properties in forest reflectance models. Following this research line, we worked on the improving the applicability of the photon recollision probability theory in modelling canopy reflectance. As a first step in predicting the angular reflectance characteristics, M. Mõttus developed the first parameterization to separate incident fluxes into reflected and transmitted fractions. In the process, he related photon recollision probability to the hypothetical "critical" leaf albedo at which the number of photons exiting the canopy exceeds the number of incident photons. As the value of the critical albedo is larger than unity it has no direct physical meaning, but it serves as a useful tool for numerical estimation of the photon recollision probability in Monte Carlo models and for estimating the fraction of radiation reflected upwards by a canopy. Next, M. Rautiainen used the new reflectance-transmittance division to improve the PARAS model, a simple forest reflectance model based on the concept of photon recollision probability, and applied the model to CHRIS/Proba data from Järvselja. Towards the end of the year, M. Rautiainen and co-workers tested methods for estimating photon recollision probability from empirical data (canopy gap fraction measurements and hyperspectral, multiangular reflectance data) for Järvselja, and presented the results in the fall meeting of the American Geophysical Union. As a part of their canopy spectral invariants research, M. Mõttus and M. Rautiainen visited professors Y. Knyazikhin and R. Myneni at Boston University in December to discuss future perspectives and practical applications of the theory.

Within the framework of the national environmental monitoring programme U. Peterson estimated the dynamics of coastal reeds at the shore areas of the two great Estonian lakes. The reed dynamics was estimated with a time series of medium resolution Landsat Thematic Mapper satellite images. The reed areas at both Lake Peipsi and Lake Võrtsjärv showed a significant expansion tendency within the last twenty years since 1986.

6 Publications Publikatsioonid

6.1 Papers in scientific journals and books Artiklid teadusajakirjades ja -kogumikes

6.1.1 Astronomy Astronoomia

Burmeister M., *Leedjärv L.*: Evidence for Bipolar Jets from the Optical Spectra of the Prototypical Symbiotic Star Z Andromedae. *Astron. Astrophys. 461*, L5–L8, 2007.

Einasto J., Einasto M., Tago E., Saar E., Hütsi G., Jõeveer M., Liivamägi L.J., Suhhonenko I., Jaaniste J., Heinämäki P., Müller V., Knebe A., Tucker D.: Superclusters of Galaxies from the 2dF Redshift Survey. I. The Catalogue. *Astron. Astrophys. 462*, 811–825, 2007.

Einasto J., Einasto M., Saar E., Tago E., Liivamägi L.J., Jõeveer M., Suhhonenko I., Hütsi G., Jaaniste J., Heinämäki P., Müller V., Knebe A., Tucker D.: Superclusters of Galaxies from the 2dF Redshift Survey. II. Comparison with Simulations. *Astron. Astrophys. 462*, 397–410, 2007.

Einasto M., Einasto J., Tago E., Saar E., Liivamägi L.J., Jõeveer M., Hütsi G., Heinämäki P., Müller V., Tucker D.: Superclusters of Galaxies from the 2dF Redshift Survey. III. The Properties of Galaxies in Superclusters. *Astron. Astrophys. 464*, 815–826, 2007.

Einasto M., Saar E., Liivamägi L.J., Einasto J., Tago, E., Martínez V.J., Starck J.-L., Müller V., Heinämäki P., Nurmi P., *Gramann M.*, *Hütsi G.*: The Richest Superclusters. I. Morphology. *Astron. Astrophys. 476*, 697–711, 2007.

Haud U., Kalberla P.M.W.: Gaussian Decomposition of H I Surveys. III. Local H I. *Astron. Astrophys. 466*, 555–564, 2007.

Hirv A., Eenmäe T., Liivamägi L.J., Pelt J.: Estimation of Time Delays from Two Blended Light Curves of Gravitational Lenses. *Baltic Astronomy 16*, 241–250, 2007.

Hirv A., Eenmäe T., Liimets T., Liivamägi L.J., Pelt J.: Estimation of Time Delays from Unresolved Photometry. *Astron. Astrophys. 464*, 471–478, 2007.

Howarth I.D., Walborn N.R., Lennon D.J., Puls J., Naze Y., *Annuk K.*, Antokhin I., Bohlender D., Bond H., Donati J.-F., Georgiev L., Gies D., Harmer D., Herrero A., *Kolka I.*, McDavid D., Morel T., Negueruela I., Rauw G., Reig P.: Towards an Understanding of the Of?p Star HD 191612: Optical Spectroscopy. *Mon. Not. Royal Astr. Soc. 381*, 433–446, 2007.

Kalberla P.M.W., Dedes L., Kerp J., *Haud U.*: Dark Matter in the Milky Way. II. The H I Gas Distribution as a Tracer of the Gravitational Potential. *Astron. Astrophys. 469*, 511–527, 2007.

Kalv P., Oja T., *Harvig V.*: Observations of UU Cancri. *The Journal of Astronomical Data 13*, 1–18, 2007.

Kipper T., Klochkova V.G.: Optical Spectroscopy of RU Cam, a Pulsating Carbon Star. *Baltic Astronomy 16*, 383 – 396, 2007.

Kipper T.: Optical Spectrometry of the Post-AGB Star HD 161796. *Baltic Astronomy 16*, 191–198, 2007.

Kipper T., Klochkova V.G.: A Cool R Coronae Borealis Star Z UMi. *Baltic Astronomy 15*, 531–537, 2006.

Kipper T., Klochkova V.G.: The Optical Spectrum of R CrB at the 2003 Light Minimum. *Baltic Astronomy 15*, 521–530, 2006.

Leedjärv L., Burmeister M.: CH Cygni on the Background of Heterogeneity of Symbiotic Stars. *Baltic Astronomy 16*, 31–34, 2007.

Munari U., Corradi R.L.M., Henden A., Navasardyan H., Valentini M., Greimel R., Leisy P., Augusteijn T., Djupvik A.A., Glowienka L., Somero A., de La Rosa I.G., Vazdekis A., *Kolka I., Liimets T.*: Eclipse of the B3V Companion and Flaring of Emission Lines in V838 Monocerotis. *Astron. Astrophys. 474*, 585–590, 2007.

Nugis T., Annuk K., Hirv A.: Mass Loss Parameters of WNE Stars: Dependence on Metallicity. *Baltic Astronomy 16*, 227–239, 2007.

Pustylnik I., Kalv P., Harvig V.: RX Cas Revisited. *Astronomical and Astrophysical Transactions 26*, 37–41, 2007.

Pustylnik I., Kalv P., Harvig V., Aas T.: BM Cas – a Long-Period Eclipsing Young Supergiant Binary System in Common Envelope Stage. *Astronomical and Astrophysical Transactions 26*, 339–350, 2007.

Saar E., Martínez V. J., Starck J.-L., Donoho D. L.: Multiscale Morphology of the Galaxy Distribution. *Mon. Not. Royal Astr. Soc. 374*, 1030–1044, 2007.

Shchekinov Yu. A., *Vasiliev E.*: Particle Decay in the Early Universe: Predictions for 21 cm. *Mon. Not. Royal Astr. Soc. 379*, 1003–1010, 2007.

Stoica R. S., Martínez V. J., *Saar E.*: A Three-dimensional Object Point Process for Detection of Cosmic Filaments. *Journal Roy. Stat. Soc.: Ser. C (Applied Statistics) 56*, 459–477, 2007.

Tuominen I., *Pelt J.*, Brooke J.M., Korpi M.J.: Does the Sun Have a Face? *Astron. Nach. 328*, 1020–1022, 2007.

Viik T., Rõõm R.: Radiation Field in a Semi-infinite Atmosphere with Internal Sources. *Journal of Quant. Spectr. Rad. Transfer 109*, 363–377, 2007.

6.1.2 Atmospheric physics Atmosfäärifüüsika

Alikas K., Reinart A.: Validation of the MERIS Products on Large European Lakes – Peipsi, Vänern and Vättern. *Hydrobiologia*, DOI: 10.1007/s10750-007-9212-0, 2007.

Eerme K., Vaht M., *Veismann U.*: Päikese ultraviolettkiirgus Eestis: mõõtmised, sõltuvused ja mõjud. *Eesti Arst 5*, 322–328, 2007.

Eerme K., Kallis A., Veismann U., Ansko I., Lätt S.: Integraalse päikesekiirguse sesoonne aastast-aastasse muutlikkus Tartu-Tõravere Meteoroloogiajaamas aastatel 1955–2006. *Publ. Inst. Geographici Universitatis Tartuensis 102,* 53–70, 2007.

Eklundh L., Jönsson P., *Kuusk A.*: Investigating Modelled and Observed Terra/MODIS 500-m Reflectance Data for Viewing and Illumination Effects. *Advances in Space Research 39*, 119–124, 2007.

Huang D., Knyazikhin Y., Dickinson R., *Rautiainen M.*, Stenberg P., Disney M., Lewis P., Cescatti A., Tian Y., Verhoef W., Martonchik J., Myneni R.: Canopy Spectral Invariants for Remote Sensing and Model Applications. *Remote Sensing of Environment 106*, 106–122, 2007.

Kaasalainen S., *Rautiainen M.*: Backscattering Measurements from Individual Scots Pine Needles. *Applied Optics 46*, 4916–4922, 2007.

Kannel M., Ohvril H., Teral H., *Russak V., Kallis A.*: A Simple Parameterization of Columnar Aerosol Optical Thickness. *Proc. Estonian Acad. Sci. Biol. Ecol. 56*, 57–68, 2007.

Kuusk A., Paas M.: Radiometric Correction of Hemispherical Images. *ISPRS Journal of Photogrammetry & Remote Sensing 61*, 405–413, 2007.

Korhonen L., Korhonen K.T., Stenberg P., Maltamo M., *Rautiainen M.*: Local Models for Forest Canopy Cover with Beta Regression. *Silva Fennica 41*, 671–685, 2007.

Kärner O.: Tartu õhutemperatuuri pikaajalise muutlikkuse seaduspärasusest. *Publ. Inst. Geographici Universitatis Tartuensis 102*, 71–82, 2007.

Kärner O.: On a Possibility of Estimating the Feedback Sign of the Earth Climate System. *Proc. Estonian Acad. Sci. Engineering 13*, 260–268, 2007.

Kärner O.: Temporal Variability in Local Air Temperature Series Shows Negative Feedback. *Energy and Environment 18*, 1057–1070, 2007.

Lang M., Kurvits V.: Restoration of Tree Crown Shape for Canopy Cover Estimation. *Forestry Studies 46*, 23–34, 2007.

Lang M., Nilson T., Kuusk A., Kiviste A., Hordo M.: The Performance of Foliage Mass and Crown Radius Models in Forming the Input of a Forest Reflectance Model: A Test on Forest Growth Sample Plots and Landsat 7 ETM+ Images. *Remote Sensing of Environment 110*, 445–457, 2007.

McKitrick R., D'Aleo J., Khandekar M., Kininmonth W., Essex C., Karlen W., *Kärner O.*, Clark I., Murthy T., O'Brien J.-J.: Independent Summary for Policymakers IPCC Fourth Assessment Report (ISPM), *The Fraser Institute, Vancouver, Canada,* 1–64, 2007.

Mõttus M., Stenberg P.: A Simple Parameterization of Canopy Reflectance Using Photon Recollision Probability. *Remote Sensing of Environment*, DOI:10.1016/j.rse.2007.08.002, 2007.

Mõttus M., Stenberg P., *Rautiainen M.*: Photon Recollision Probability in Heterogeneous Forest Canopies: Compatibility with a Hybrid GO Model. *Journal of Geophysical Research – Atmospheres 112(D03104)*, DOI:10.1029/2006JD007445, 2007.

Mõttus M.: Photon Recollision Probability in Discrete Crown Canopies. *Remote Sensing of Environment 110*, 176–185, 2007.

Nilson T., Lükk T., Suviste S., Kadarik H., Eenmäe A.: Calibration of Time Series of Satellite Images to Study the Seasonal Course of Forest Reflectance. *Proc. Estonian Acad. Sci. Biol. Ecol. 56*, 5–18, 2007.

Nõges P., Kangur K., Nõges T., Simola H., *Reinart A.*, Viljanen M.: Highlights of Large Lake Research and Management in Europe. *Hydrobiologia*, DOI:10.1007/s10750-007-9233-8, 2007.

Post P., *Kärner O.*: Simple Statistical Structure for Some Dynamical Airflow Characteristics. *Environmetrics*, DOI:10.1002.env/855, 2007.

Rautiainen M., Suomalainen J., *Mõttus M.*, Stenberg P., Voipio P., Peltoniemi J., Manninen T.: Coupling Forest Canopy and Understory Reflectance in the Arctic Latitudes of Finland. *Remote Sensing of Environment 110*, 332–343, 2007.

Reinart A., Reinhold M.: Mapping Surface Temperature in Large Lakes With MODIS Data. *Remote Sensing of Environment*, DOI:10.1016/j.rse.2007.05.015, 2007.

Reinart A., Valdmets K.: Variability in Optical Type of Water in Lake Peipsi. *Proc. Estonian Acad. Sci. Biol. Ecol. 56*, 33–46, 2007.

Russak V., Kallis A., Jõeveer A., Ohvril H., Teral H.: Changes in Spectral Aerosol Optical Thickness in Estonia (1951–2004). *Proc. Estonian Acad. Sci. Biol. Ecol. 56*, 69–76, 2007.

Widlowski J.-L., Taberner M., Pinty B., Bruniquel-Pinel V., Disney M., Fernandes R., Gastellu-Etchegorry J.-P., Gobron N., *Kuusk A.*, Lavergne T., Leblanc S., Lewis P.E., Martin E., *Mõttus M.*, North P.R.J., Qin W., Robustelli M., Rochdi N., Ruiloba R., Soler C., Thompson R., Verhoef W., Verstraete M.M., Xie D.: Third Radiation Transfer Model Intercomparison (RAMI) Exercise: Documenting Progress in Canopy Reflectance Models. *Journal of Geophysical Research 112(D09111)*, DOI:10.1029/2006JD007821, 2007.

6.2 Conference papers Artiklid konverentsikogumikes

6.2.1 Astronomy Astronoomia

Annuk K.: Astronomical Archive at Tartu Observatory. In: *Astronomical Data Analysis Software and Systems XVI. Tucson, Arizona, USA, October 15–18, 2006*, eds. D. Shaw, F. Hill and D. Bell, *ASP Conf. Series 376*, 201–204, 2007.

Gális R., *Leedjärv L.*, Šuhada R.: Long-term Photometric Behaviour of Symbiotic System AG Dra. In: *Binary Stars as Critical Tools and Tests in Contemporary Astrophysics. Proceedings IAU Symposium 240, August 22–25, 2006*, eds. W.I. Hartkopf, E.F. Guinan and P. Harmanec, Cambridge University Press, 121, 2007.

Kipper T., Škoda P.: Chemical Composition of V838 Mon. In: *The Nature of V838 Mon and its Light Echo. La Palma, Spain, May 16–19, 2006,* eds. R.L.M. Corradi and U. Munari, *ASP Conf. Series 363*, 231–234, 2007.

Kolka I., Kipper T.: Spectral Variability and Binary Nature of V838 Mon. In: *The Nature of V838 Mon and its Light Echo. La Palma, Spain, May 16–19, 2006*, eds. R.L.M. Corradi and U. Munari, *ASP Conf. Series 363*, 235–240, 2007.

Liimets T., Kolka I., Kipper T.: Photometry of V838 Mon and its Light Echo. In: *The Nature of V838 Mon and its Light Echo. La Palma, Spain, May 16–19, 2006*, eds. R.L.M. Corradi and U. Munari, *ASP Conf. Series 363*, 174–180, 2007.

Nurmi P., Heinämäki P., Holopainen J., Pihajoki P., *Saar E., Einasto M., Einasto J.*: Mass, Spatial Distributions of Subhaloes in ΛCDM

Cosmological Simulations. In: *Galaxy Evolution Across the Hubble Time. Proceedings IAU Symposium 235, Prague, August 14–17, 2006*, eds. F. Combes, J. Palous, Cambridge University Press, 127, 2007.

Pustynski V.-V., Pustylnik I.: What Can we Learn About the Evolutionary History of Progenitors of EHBs and Related Binary Systems from their Observed Properties? In: *15th European Workshop on White Dwarfs*, eds. R. Nappiwotzki and M.R. Burleigh, *ASP Conf. Series 372*, 23–26, 2007.

Pustylnik I.: Reflections on George Gamow's Unique Scientific Legacy and Personality. In.: *Proceedings of the International Conference Dedicated to Centennial Birthday Anniversary of G. Gamow "Astrophysics and Cosmology after Gamow – Theory and Observations"*, Cambridge University Press, 7–12, 2006.

Saar E.: Universumi suuremastaabiline struktuur. In: *Eesti Füüsika Seltsi Aastaraamat 2006: Eesti Füüsikapäevad 2006, Tartu, 21.–22.03 2006*. Toim. A. Aret, P. Kuusk, H. Kaasik. Eesti Füüsika Selts, 37–62, 2007.

Sapar A., Aret A., Sapar L., Poolamäe R.: The Separation of Isotopes of Chemical Elements in the Atmospheres of CP Stars due to Light-induced Drift. In: *Spectroscopic Methods in Modern Astrophysics*, eds. L. Machonkina, M. Sachkov. Moscow, 220–235, 2007 (in Russian).

Sapar A., Poolamäe R., Sapar L., Aret A.: Computation of Model Atmospheres and Spectra of Hot Stars by Programme SMART: Results and Problems. In: *Spectroscopic Methods in Modern Astrophysics*, eds. L. Machonkina, M. Sachkov, Moscow, 236–254, 2007 (in Russian).

Vasiliev E., Shchekinov Yu. A.: Critical Metallicity for Post-Pop III Stars. In: *EAS Publications Series 24*, 295–296, 2007.

Vasiliev E., Shchekinov Yu. A.: Additional Sources of Ionization in Early Universe and 21 cm Line. In: *Highlights of Astronomy 14, IAU 26th General Assembly, Prague, 2006*, 267, 2007.

Vennik J., Hopp U.: Stellar Ages and Star-forming Properties of Galaxies in a Dense Group around IC 65. In: *Proceedings of IAU Symposium No. 241: Stellar Populations as Building Blocks of Galaxies. La Palma, Spain, December 10–16, 2006*, eds. A. Vazdekis and R.F. Peletier, Cambridge University Press, 525–526, 2007.

6.2.2 Atmospheric physics Atmosfäärifüüsika

Eerme K., Veismann U., Ansko I., Lätt S.: Determination of UV-A/UV-B Ratios from the Automatically Recorded Global Solar Ultraviolet Spectra. In: *Proceedings of the UV Conference "One Century of UV Radiation Research". Davos, Switzerland, September 18–20, 2007*, 57, 2007.

Kuusk A., Kuusk J., Lang M., Lükk T., Nilson T.: Hyperspectral Reflectance of Sub-Boreal Forests Measured by CHRIS/PROBA and Airborne Spectrometer. In: *Proceedings of Envisat Symposium 2007, Montreux, Switzerland, April 23–27, 2007, ESA SP-636*, 6 pp., 2007.

Koepke P., Schmalwieser A.W., De Backer H., Bais A., Curylo A., *Eerme K.*, Feister U., Johnson B., Junk J., Kazantzidis A., Krzyscin J., Lindfors A., Olseth J. A., den Outer P., Pribullova A., Slaper H., Steiger H., Verdebout J., Vuillemier L., Weihs P.: Comparison of Algorithms and Input Data for Modelling Solar Ultraviolet Radiation in the Past. In: *Geophysical Research Abstracts 9, 08259, Egu2007-A-08259*, 2007.

Manninen T., Stenberg P., *Rautiainen M.*, Voipio P.: Leaf Area Index Estimation of Boreal and Sub-Arctic Forest Using ENVISAT/ASAR Data of Various Swaths. In: *Proceedings of Envisat Symposium 2007, Montreux, Switzerland, April 23–27, 2007, ESA SP-636*, 6 pp., 2007.

Peterson U., Budenkova J., Kiviste A., Liira J.: Forest Clearcut Areas in the Eastern Baltic Region Estimated with a Time Series of Satellite Images. In: *Proceedings of the IV International Conference "Aerospace Methods and GIS-technologies in Forestry and Forest Management". Moscow, Russia, April 17–19, 2007*, 117–118, 2007.

Peterson U., Liira J., Mander Ü.: Magnitude and Distance of Edge Influence at Anthropogenically Created Forest Edges on Very High Resolution IKONOS Satellite Images. In: *Abstracts of a Scientific Workshop: Forestsat2007, Forests and Remote Sensing. Methods and Operational Tools. Montpellier, France, November 5–7, 2007*, 80, 2007.

Reinart A., Reinhold M., Kärbla V.: MODIS-Derived Water Temperatures over Large European Lakes. In: *32nd Proceedings of the International Symposium on Remote Sensing of Environment "Sustainable Development Through Global Earth Observations", San Jose, Costa Rica, June 25–29, 2007*, CD-ROM.

Reinart A., Ohvril H., *Alikas K.*, Ibrus P., Teral H., *Valdmets K.*, Okulov O.: MERIS Products over Large European Lakes – Comparison with Measured Data About Aerosol and Water Quality. In: *Proceedings of Envisat Symposium 2007, Montreux, Switzerland, April 23–27, 2007, ESA SP-636*, 6 pp., 2007.

Reusen I., Holzwarth S., Nieke J., Kooistra L., Malthus T., Chabrillat S., Kaufmann H., Gomez-Sanchez J.-A., Homolova L., Itten K., Malenovsky Z., Meuleman K., de Miguel E., *Mõttus M.*, Mueller A., Pellikka P., Schaepman M.: Towards an Improved Access to Hyperspectral Data Across Europe (HYRESSA). In: *Proceedings 5th EARSeL Workshop on Imaging Spectroscopy. Bruges, Belgium, April 23–25, 2007*, 6 pp., 2007.

Russak V., Ohvril H., Teral H.: Multi-Annual Changes in Columnar Aerosol Optical Thickness in Estonia. In: *CD-ROM: EGU General Assembly, Vienna, April 2007. Geophysical Research Abstracts 9*, CD-ROM, ISSN: 1029–7006, 2007.

Suviste S., Nilson T., Lükk T., Eenmäe A.: Seasonal Reflectance Course of Some Forest Types in Estonia from Multi-Year LANDSAT TM and SPOT Images and Via Simulation. In: *Proceedings of Multi Temp 2007. Leuven, Belgium, July 18–20, 2007,* eds. G.J.M. De Lannoy, R. Hoeben, N.E.C. Verhoest, W.W. Verstraeten, S. Bruneel and P. Coppin, CD-ROM by Katholike Universitet Leuven, 5 pp., 2007.

6.3 Popular Articles Aimeartiklid

6.3.1 Astronomy Astronoomia

Eenmäe T.: Globe at Night 2007. *Vaatleja 2*, 2007.

Eenmäe T.: Astronoomiahuviliste XII kokkutulek: fotomeetriliste vaatluste kokkuvõte. *Vaatleja 4*, 2007.

Eenmäe T.: Astrofotode konkurss 2007. *Vaatleja 4*, 2007.

Einasto J., Einasto M., Saar E., Tago E.: Tumeda aine lugu. *Eesti Vabariigi Teaduspreemiad*. Toimet. R. Villems. Eesti Teaduste Akadeemia, Tallinn, 6–21, 2007.

Einasto M.: GOODS'i projekt kolm aastat hiljem. *Tähetorni Kalender 2008*, 50–57, 2007.

Kaplinski J., *Einasto J.*: Tulevik nõuab suunamuutust. *Eesti Päevaleht*, 23.02.2007.

Leedjärv L.: Aksel Kipper ja Tõravere. *Horisont 6*, 38–39, 2007.

Pelt J.: Tume aine – vaade tagasi. *Horisont 2*, 50–51, 2007.

Pelt J.: Katsume harjuda. *Lehed ja tähed IV*. Koost. I. Rohtmets, MTÜ Loodusajakiri, Tallinn, 64–71, 2007.

Puss A.: Meie sõber Kuu. *Tähetorni Kalender 2008*, 45–49, 2007.

Pustylnik I.: Dramatic Episodes of Life and Scientific Heritage of Latvian Astronomer Stanislavs Vasilevskis (1907–1988) I. *Zvaigznota Debess 197*, 33–41, 2007 (In Latvian).

Pustylnik I.: Dramatic Episodes of Life and Scientific Heritage of Latvian Astronomer Stanislavs Vasilevskis (1907–1988) II. *Zvaigznota Debess 198*, 47–51, 2007 (In Latvian).
Pustylnik I.: Ernst Öpik Ameerika mandril. Intervjuu Fred Singeriga. *Horisont 4*, 18–22, 2007.
Pustylnik I.: Noore astronoomi Erich Schoenbergi (1882–1965) teekond Tartu Observatooriumis. *Tähetorni Kalender 2008*, 71–76, 2007.
Pustylnik I., Karetnikov V.G.: Eclipsing Variable Stars and V.P. Tsesevich. *Odessa Observatory Calendar 2007*, 160–166, 2007 (In Russian).
Pustylnik I.: On an Early History of Old Tartu Observatory. *Proceedings of the Conference "Study of the near-Earth Objects and Small Bodies of the Solar System" 2006*, 340–343, 2007.
Pustylnik I.: A.J. Kipper, Centennial Birthday Anniversary. *Odessa Observatory Calendar 2007*, 229–230, 2007 (in Russian).
Pustylnik I.: NATO Advanced Research Workshop in Tallinn: "Impact of Global Crises on Human Awareness and Behaviour in Risk Conditions". *Euroscience News 37*, 6–7, 2007.
Tago E.: Astronoomia sündmusi 2007. *Tähetorni Kalender 2008*, 58–63, 2007.
Tago E.: Sündmusi astronoomias 2006. *Vaatleja 1*, 2007.
Tago E.: Tume aine on tundmatu, aga juba kaardistatud. *Vaatleja 1*, 2007.
Tago E.: Päikesel pole vististi "nägu", kuid on "pealagi". *Vaatleja 1*, 2007.
Tago E.: Fermi paradoksi lahendus läheneb: Maa-sarnane eksoplaneet leitud !!! *Vaatleja 2*, 2007.
Tago E.: Päike näitab uurimisjaamade "rünnakule" oma sõjakat "nägu". *Vaatleja 2*, 2007.
Tago E.: Soome harrastusastronoomid avastasid supernoova. *Vaatleja 2*, 2007.
Tago E.: Musta augu peitusmäng. *Vaatleja 2*, 2007.
Tago E.: Kõige kalgim kiirgus kosmoses. *Horisont 1*, 40–45, 2007.
Tago E.: Andromeeda udukogu: Eesti astronoomide lemmik. *Horisont 5*, 34–37, 2007.
Tuvikene T.: 100 vaatlusööd lõunataeva all. *Tähetorni Kalender 2008*, 64–70, 2007.
Viik T.: Kaugete tähtede planeedid. *Horisont 4*, 40–43, 2007.
Viik T.: F.W. Bessel ja geodeesia. *Geodeet 35*, 74–78, 2007.

6.3.2 Atmospheric physics Atmosfäärifüüsika

Eerme K.: Soe El Niño, külm La Niña. *Horisont 3*, 23–25, 2007.
Eerme K.: Mussoonkliima kapriisid. *Horisont 5*, 26–29, 2007.
Eerme K.: Kliimamuutused. *Kalender 2008*, Olion, Tallinn, 90–93, 2007.
Kallis A.: Ridi, radi, ralla - soojakraanid valla! *Maaleht*, 04.01.2007.
Kallis A.: Säärast sooja jõulukuud pole siinmail veel olnud! *Postimees*, 10.01.2007.
Kallis A.: Ilmataat suhtus meisse soojalt. *Maaleht*, 11.01.2007.
Kallis A.: Enne jääaega võib veel paljugi juhtuda. *Järva Teataja*, 13.01.2007.
Kallis A.: Näärikuu laul: "Tuule-eit – see tõstab tiibu..." *Postimees*, 20.02.2007.
Kallis A.: Kes on ilma kihva keeranud? *Maaleht*, 22.02.2007.
Kallis A.: Küünlakuus pakast ja päikest. *Maaleht*, 08.03.2007.
Kallis A.: Tänavu jäi küünlakuul talve selgroog murdmata. *Postimees*, 13.03.2007.
Kallis A.: Kas kliimaga on nüüd jokk? *Maaleht*, 22.03.2007.
Kallis A.: Esimese Eesti sünoptiku sünnist möödus laupäeval 150 aastat. *Postimees*, 02.04.2007.
Kallis A.: Märts tegi aprilli. *Maaleht*, 05.04.2007.
Kallis A.: Märtsis unustas ilmataat kalendrisse vaadata. *Postimees*, 13.04.2007.
Kallis A.: Külmalaine sissetooja. *Maaleht*, 25.04.2007.
Kallis A.: Aprill oli nagu aprill ikka... *Maaleht*, 03.05.2007.
Kallis A.: Kas me siis sellist aprilli tahtsimegi? *Postimees*, 19.05.2007.
Kallis A.: Kes keerutab vannis vett? *Maaleht*, 24.05.2007.
Kallis A.: Mai läks kuumaks kätte. *Maaleht*, 07.06.2007.
Kallis A.: Maikuu tegi lõpuspurdi troopilises kuumuses. *Postimees*, 20.06.2007.
Kallis A.: Kuhu juunivihmad jäävad? *Maaleht*, 21.06.2007.
Kallis A.: Jaan käitus päris korralikult. *Maaleht*, 05.07.2007.
Kallis A.: Taevataat kinkis juunikuuks maheda ilma. *Postimees*, 18.07.2007.
Kallis A.: Päikese käest vihmavarju alla. *Maaleht*, 19.07.2007.
Kallis A.: Juuli oli püsimatu. *Maaleht*, 02.08.2007.
Kallis A.: Juuli lõppeski nutuselt ehk lõpp halb – kõik halb. *Postimees*, 07.08.2007.
Kallis A.: Las kallab! *Maaleht*, 23.08.2007.
Kallis A.: Lõikuskuu lõppes sügiseselt. *Maaleht*, 06.09.2007.
Kallis A.: Šovinistlikud oraaklid. *Maaleht*, 13.09.2007.

Kallis A.: Sügiskuu lõppes lausa suviselt. *Maaleht*, 04.10.2007.

Kallis A.: Eestis liigub kuradeid! *Maaleht*, 18.10.2007.

Kallis A.: Igal aastal tuleb oma mihklikuu. *Postimees*, 19.10.2007.

Kallis A.: Vesisevõitu viinakuu. *Maaleht*, 08.11.2007.

Kallis A.: Ilma teevad nii ilmamehed kui -tüdrukud. *Maaleht*, 22.11.2007.

Kallis A.: Viinakuus sai Eestimaal harva selget päeva näha. *Postimees*, 27.11.2007.

Kallis A.: Tükati talvine talvekuu. *Maaleht*, 06.12.2007.

Kallis A.: Novembri ja detsembri ilm äpardus. *Postimees*, 22.12.2007.

Kallis A.: Minevalgi aastal ilm tembutas. *Maaleht*, 28.12.2007.

Kallis A.: Ilm. Ülevaade ilmaoludest september 2006 – september 2007. *Aastaraamat Kes?Mis?Kus? 2008*. Tänapäev, 415–428, 2007.

Kallis A.: Heino, ilm ja inimesed. *Heino Tooming. Bibliograafia. Meenutused. Eesti Geograafia Seltsi Publikatsioonid 9*, 158–160, 2007.

Kallis A.: Kas kliimakatastroofiga ähvardajad ajavad käojaani? *Kägu. Eesti Bioloogia ja Geograafia Õpetajate Liidu Toimetised 15*, 11–18, 2007.

Nilson T.: Maksimaalse produktsiooni printsiibi sünnist. *Heino Tooming. Bibliograafia. Meenutused. Eesti Geograafia Seltsi Publikatsioonid 9*, 183–184, 2007.

Rautiainen M.: Miltä kasvit näyttävät avaruudesta katsottuna? *LUOVA Nuorten tiedelehti*, *LUMA-keskus, University of Helsinki*, 2 pp., 2007 (in Finnish).

Veismann U.: Päike, osoonikiht ja inimene. *EV Keskkonnaministeerium. Tartu Observatoorium*, Tallinn, 2007, 52 lk.

Veismann U.: Kas Gagarin oli esimene? *Horisont 5*, 50, 2007.

Veismann U., Eerme K., Leedjärv L., Noorma M.: Milleks ja kuidas Eestile kosmos? *Akadeemia 12*, 2583–2613, 2007.

6.4 Grant Reports Grandiaruanded

Gramann M.: Dynamical Evolution of Superclusters, Clusters and Galaxies in the Universe. *Grant of the Estonian Science Foundation No 5347, Final Report.* 11 pp, 2007.

Peterson U.: Rates and Patterns of Forest Cover Change from Mid-1980s till 2005 in the Eastern Baltic Region, Evaluated with Multitemporal Landsat Imagery. *Grant of the Estonian Science Foundation No 6845, Final Report.* 14 pp, 2007.

Pustylnik I.: Physical Processes and Evolutionary Trends in Close Binary Systems During the Early Stages of White Dwarfes Formation. *Grant of the Estonian Science Foundation No 5760, Final Report.* 10 pp, 2007.

Veismann U.: The Influence of Atmospheric Optical Parameters on the Ground-Level Solar UV Radiation. *Grant of the Estonian Science Foundation No 5348, Final Report.* 12 pp, 2007.

6.5 Preprints Preprindid

Einasto M., Saar E., Liivamägi L.J., Einasto J., Tago E., Martínez V.J., Starck J.-L., Müller V., Heinämäki P., Nurmi P.: The Richest Superclusters I. Morphology [astro-ph/0706.1122].

Einasto M., Saar E., Einasto J., Tago E., Liivamägi L. J., Martínez V. J., Starck J.-L., Müller V., Heinämäki P., Nurmi P., *Gramann M., Hütsi G.*: The Richest Superclusters. II. Galaxy Populations [astro-ph/0706.1126].

Hütsi G.: Power Spectrum of the maxBCG Cluster Sample: New Evidence for the Acoustic Features [astro-ph/0705.1843].

Sapar A., Aret A., Sapar L., Poolamäe R.: A Pan-Spectral Method of Abundance Determination [astro-ph/0712.3222].

Sapar A., Aret A., Poolamäe R., Sapar L.: Segregation of Isotopes of Heavy Metals Due to Light-Induced Drift: Results and Problems [astro-ph/0712.3462].

Sapar A., Aret A., Sapar L., Poolamäe R.: Formulae for Study of LID Induced Diffusion in CP Star Model Atmospheres [astro-ph/0712.3456].

Tamm A., Tempel E., Tenjes P.: Visible and Dark Matter in M 31. I. Properties of Stellar Components [astro-ph/0707.4375].

Tago E., Einasto J., Saar E., Tempel E., Einasto M., Vennik J., Müller V.: Groups of Galaxies in the SDSS Data Release 5. A Group-finder and a Catalogue [astro-ph/0706.1593].

Tempel E., Tamm A., Tenjes P.: Visible and Dark Matter in M 31. II. A Dynamical Model and Dark Matter Density Distribution [astro-ph/0707.4374].

Vennik J., Hopp U.: Photometric Study of the IC 65 Group of Galaxies [astro-ph/0710.1786].

7 Meetings Konverentsid ja seminarid

7.1 Astronomy Astronoomia

ASTRONET Symposium "A Science Vision for European Astronomy in the Next 20 Years" (Poitiers, France, 23.01.–25.01.2007) – L. Leedjärv, I. Pustylnik, A. Tamm.
Pustylnik I.: Hot Subdwarf Stars in Binary Systems (oral presentation).

Astronomical Seminar (University of Helsinki, Finland, 07.02.2007) – J. Einasto.
Einasto J.: Formation of the Supercluster-Void Network (oral presentation).

International Year of Astronomy Meeting at ESO (ESO, Garching, Germany, 02.03.–05.03.2007) – K. Annuk.

Astronomical Seminar (University of Helsinki, Finland, 11.04.2007) – J. Pelt.
Pelt J.: Time Delay Estimation from Astronomical Data (oral presentation).

ASTRONET Board Meeting (Paris, France, 12.04.–13.04.2007) – L. Leedjärv.

Conference "First stars" (Copenhagen, Denmark, 16.04.–20.04.2007) – E. Vasiliev.
Vasiliev E.: Critical Metallicity for Post-Pop III Stars (poster).

Conference "Astrophysics in the LOFAR Era" (Emmen, Netherlands, 23.04.–27.04.2007) – E. Vasiliev.
Vasiliev E.: The 21 cm Power Spectrum from the Universe with Decaying Particles (poster).

Crafoord Jubilee Symposium (Lund, Sweden, 23.04.–26.04.2007) – J. Einasto.

Board of Directors Meeting, "Astronomy and Astrophysics" (Vienna, Austria, 05.05.2007) – L. Leedjärv.

Astronomical Seminar "S. Vasilevskis Centennial Birthday Anniversary" (Latvian University, Riga, 23.05.2007) – I. Pustylnik.
Pustylnik I.: Dramatic Episodes from Life and Scientific Career of Latvian Astronomer Stanislavs Vasilevskis (1907–1988).

Workshop "RS Ophiuchi (2006)" (Keele, United Kingdom, 12.06.–14.06.2007) – M. Burmeister, L. Leedjärv.
Burmeister M.: First Detection of Jets in the Spectrum of Z Andromedae (oral presentation).

Conference "Asymmetrical Planetary Nebulae IV" (La Palma, Spain, 18.06.–22.06.2007) – T. Liimets.

Workshop "Sub-Parsec Structures in ISM" (Moscow, Russia, 03.07.–04.07.2007) – E. Vasiliev.

Matvienko E.E., Dedikov S. Yu., *Vasiliev E.*: Small-Scale Structures Produced by Destruction of Interstellar Clouds (oral presentation).

Dedikov S. Yu., *Vasiliev E.*, Matvienko E.E.: Transport of Chemical Inhomogeneities on Scales in Cloud Collisions (oral presentation).

Extragalactic Workshop "Galaxy Interactions and Mergers" (Nottingham, United Kingdom, 04.07.–05.07.2007) – A. Tamm.

Tamm A.: Galactic Halos as Tracers of Mergers (oral presentation).

Conference "Galaxy Growth in a Dark Universe" (Heidelberg, Germany, 16.07.–20.07.2007) – E. Tempel.

Tempel E.: Dark Matter Distribution and a Self-Consistent Model of the Andromeda Galaxy (poster).

VIII Oxford Archaeoastronomy Conference and SEAC 15th Annual Meeting "Astronomy and Cosmology in Folk Traditions and Cultural Heritage" (Klaipeda, Lithuania, 21.07.–28.07.2007) – I. Pustylnik.

Pustylnik I.: The Enigma of the Lost Seventh Sister in the Pleiades and Occam's Principle (oral presentation).

Conference "Dynamics of Galaxies" (Pulkovo, Russia, 06.08.–10.08.2007) – J. Einasto.

Einasto J.: Grigori Kusmin and Astronomy in Estonia.

Conference "Modern Problems of Astronomy", dedicated to Professor V.P. Tsesevich Centennial Birthday Anniversary (Odessa, Ukraine, 11.08.–17.08.2007) – I. Pustylnik, V. Malyuto.

Pustylnik I.: Extreme Horisontal Branch Stars: Implications of Observational Data and Evolutionary History (oral presentation).

Pustylnik I.: On Quasi-Periodic Intrinsic Light Variability in a Close Spectroscopic Binary CX Dra (oral presentation).

Malyuto V.: Homogenization of Stellar Catalogues through Data Intercomparison (poster).

JENAM 2007, Joint European and Armenian National Astronomical Meeting (Jerevan, Armenia, 20.08.–25.08.2007) – I. Pustylnik.

Pustylnik I.: Extreme Horisontal Branch Stars: Observational Evidence on Binary Nature and Evolutionary History (oral presentation).

CP#AP Workshop (Vienna, Austria, 10.09.–14.09.2007) – A. Aret, A. Sapar, L. Sapar.

Sapar A., Aret A., Sapar L., Poolamäe R.: Formulae for Study of LID Induced Diffusion in CP Star Model Atmospheres (poster).

Sapar A., Aret A., Poolamäe R., Sapar L.: Segregation of Isotopes of Heavy Metals Due to Light-induced Drift: Results and Problems (oral presentation).

Summer School Novicosmo 2007: Fiat Lux – Formation and Evolution of Cosmic Structures (Novigradā Cittanova, Croatia, 10.09.–21.09.2007) – E. Tempel, L. J. Liivamägi.

Tempel E.: Visible and Dark Matter Distribution of the Andromeda Galaxy (oral presentation).

Conference "Hydrogen-Deficient Stars" (Tübingen, Germany, 17.09.–21.09.2007) – T. Kipper.

Kipper T.: Optical Spectrum of Z UMi during its Maximum Light (poster).

VAK 2007, All-Russian National Astronomical Conference "XXI Century Cosmic Frontiers" (Kazan, Russia, 17.09.–22.09.2007) – V.-V. Pustynski.

Pustynski V.-V.: On the Evolutionary History of Progenitors of Extreme Horisontal Branch Stars and Related Binary Systems Based on the Analysis of their Observed Properties (poster).

Annual Meeting of Astronomische Gesellschaft, Colloquium on History of Astronomy (Würzburg, Germany, 24.09.2007) – I. Pustylnik.

Pustylnik I.: Erich Schoenberg (1882–1965) – Early Scientific Career in Tartu (Dorpat) (1907 to 1918) (oral presentation).

Annual Meeting of Astronomische Gesellschaft (Würzburg, Germany, 24.09.2007) – V. Malyuto.

Kovtyukh V.V., Soubiran C., Beliks I., Yasinskaya M.P., Chehomadskih F.A., *Malyuto V.*: Colour Exesses of 74 Supergiants and 30 Classical Cepheids (oral presentation).

High Energy Phenomena in Relativistic Outflows (Dublin, Ireland, 24.09.–28.09.2007) – I. Vurm.

Uppsala University Astrophysics Seminar (Uppsala University, Sweden, 27.09.2007) – A. Tamm.

Tamm A.: Colourful Darkness of Andromeda (oral presentation).

Formation and Evolution of Galaxy Disks (Rome, Italy, 01.10.–05.10.2007) – J. Vennik.

Vennik J., Hopp U.: Photometric Study of the Disk Galaxies in a Poor Group of Galaxies LGG 16 (poster).

Tuorla and Tartu Observatories Autumn Meeting in Cosmology and Large Scale Structure (Tuorla, Finland, 03.10.–05.10.2007) – J. Einasto, E. Saar, I. Suhhonenko, E. Tago, A. Tamm, E. Tempel, L. J. Liivamägi.

Einasto J.: Dark Matter and the Structure of the Universe (oral presentation).

Saar E.: Morphology of Cosmological Fields (oral presentation).

Tamm A.: Dark Matter Halos of High Redshift Galaxies (oral presentation).

Tago E.: How to Find a Group of Galaxies (oral presentation).

Tempel E.: Dark Matter Distribution and a Self-Consistent Model of the Andromeda Galaxy (oral presentation).

Communicating Astronomy with the Public 2007 (CAP 2007) (Athens, Greece, 06.10.–13.10.2007) – K. Annuk.

Annuk K., *Ruusalepp M.*: Popularization of Astronomy in Estonia (poster).

Workshop "First Stars in the Universe" (Moscow, Russia, 04.12.–05.12.2007) – E. Vasiliev.

Vasiliev E., Vorobyov E.I., Shchekinov Yu.A.: First Supernovae in Dwarf Protogalaxies (oral presentation).

7.2 Atmospheric physics Atmosfäärifüüsika

10th International Symposium on Physical Measurements and Signatures in Remote Sensing (Davos, Switzerland, 12.03.–14.03.2007) – M. Mõttus.

Mõttus M.: Approximating Photon Recollision Probability in Vegetation Canopies (oral presentation).

Rautiainen M.: Forest Reflectance Modeling in the Arctic Region: Results from a Case Study in Finland (poster).

VALERI Network Meeting (Davos, Switzerland, 15.03.2007) – M. Rautiainen.

Rautiainen M.: VALERI Activities at the Järvselja Test Site (oral presentation).

HYRESSA 2nd Progress Meeting (Davos, Switzerland, 15.03.2007) – M. Mõttus.

Baltic Sea Science Congress (Germany, Rostock, 19.03.–23.03.2007) – K. Alikas, A. Reinart, K. Valdmets.

Valdmets K., Hommersom A., *Reinart A.*, Paavel B., *Alikas K.*: Optical Properties of the Gulf of Finland as Compared with Other Waterbodies (oral presentation).

Alikas K.: MERIS Full Resolution Products Over Gulf of Finland (oral presentation).

GEO Water Quality Workshop (Geneva, Switzerland, 26.03.–29.03.2007) – A. Reinart.

The Eighth COST 726 Member Countries Meeting (Budapest, Hungary, 29.03.–30.03.2007) – K. Eerme.

Finnish-Estonian Remote Sensing Seminar (Helsinki, Finland, 11.04.2007) – T. Nilson, M. Lang, M. Mõttus, M. Rautiainen, J. Kuusk, A. Kuusk.

Kuusk A.: Hyperspectral Reflectance of Sub-Boreal Forests Measured by CHRIS/PROBA and Airborne Spectrometer (oral presentation).

Lang M.: Estimation of Crown Closure, Canopy Cover and Tree Grouping Index (oral presentation).

Mõttus M.: Spectral Invariants and Beyond (oral presentation).

Kuusk J.: Overview of the Airborne Spectrometer UAVSpec (oral presentation).

Non-Governmental International Panel on Climate Change to Critique IPCC-AR4 (Vienna, Austria, 14.04.–15.04.2007) – O. Kärner.

European Geosciences Union General Assembly 2007 (Vienna, Austria, 15.04.–20.04.2007) – V. Russak.

Russak V., Ohvril H., Teral H.: Multi-Annual Changes in Columnar Aerosol Optical Thickness in Estonia (poster).

IV International Conference "Aerospace Methods and GIS-Technologies in Forestry and Forest Management" (Moscow, Russia, 17.04.–19.04.2007) – U. Peterson.

Peterson U., Budenkova J., Kiviste A., Liira J.: Forest Clearcut Areas in the Eastern Baltic Region Estimated with a Time Series of Satellite Images (oral presentation).

ESA ENVISAT Symposium (Montreux, Switzerland, 23.04.–27.04.2007) – A. Kuusk, A. Reinart.

Reinart A., Alikas K., Valdmets K., Ansko I.: Comparison of the MERIS Products Over Large European Lakes and Measured Data (oral presentation).

Kuusk A., Kuusk J., Lang M., Lükk T., Nilson T.: Hyperspectral Reflectance of Sub-Boreal Forests Measured by CHRIS/PROBA and Airborne Spectrometer (poster).

Mapping of Forest Leaf Area Index (LAI) by Remote Sensing, 1st Marie Curie – iLEAPS Training Course (Hyytiälä, Finland, 07.05.–12.05.2007) – T. Nilson.

MASI (Modelling & Simulations Workshop) of the Academy of Finland and Finnish Funding Agency for Technology and Innovations (Tampere, Finland, 15.05.–16.05.2007) – M. Rautiainen, M. Mõttus.

Nordic Ozone Group (NOG) Meeting 2007 (Fredrikstad, Norway, 24.05.–25.05.2007) – K. Eerme.

Eerme K.: Interannual Variations of Broadband Global and UV Doses in Estonia on Seasonal Level (oral presentation).

International Symposium on Remote Sensing of Environment "Sustainable Development Through Global Earth Observations" (San Jose, Costa Rica, 25.06.–29.06.2007) – A. Reinart.

Reinart A., Reinhold M., Kärbla V.: MODIS-Derived Water Temperatures Over Large European Lakes (oral presentation).

Fourth International Workshop on the Analysis of Multi-Temporal Remote Sensing Images (Leuven, Belgium, 18.07.–20.07.2007) – S. Suviste.

Suviste S., Nilson T., Lükk T., Eenmäe A.: Seasonal Reflectance Course of Some Forest Types in Estonia from Multi-Year LANDSAT TM and SPOT Images and via Simulation (poster).

Workshop "Econometric Time Series Analysis Applied to Climate Research" (Frascati, Italy, 05.08.–07.08.2007) – O. Kärner.

HYRESSA Protocol Meeting (Madrid, Spain, 12.09.–13.09.2007) – M. Mõttus.

The Ninth COST Member Countries Meeting (Davos, Switzerland, 17.09.2007) – K. Eerme.

Eerme K.: Variations of Daily Sums of Global Radiation and Cloud Amount at Tartu Observatory Site in 1955–2006 (oral presentation).

Conference "One Century of UV Radiation Research" (Davos, Switzerland, 18.09.–20.09.2007) – K. Eerme.

Veismann U., Lätt S., Ansko I., Eerme K.: Study of the UV-A/UV-B Ratios from the Automatically Recorded Solar Ultraviolet Irradiance Spectra (poster).

Physical Methods in Remote Sensing. Course for Graduated Students – (Viikki, Helsinki, Finland, 09.10.–11.10.2007) – A. Kuusk, T. Nilson, T. Lükk.

Nilson T.: Physical Basis and Concepts Used in Remote Sensing (oral presentation).

Nilson T.: Solar Radiation and its Transfer through the Atmosphere (oral presentation).

Nilson T.: Soil Reflectance Models (oral presentation).

Nilson T.: Simulation Examples (oral presentation).

Nilson T.: Instruments and Methodologies (oral presentation).

Kuusk A.: Atmospheric Radiative Transfer Packages (oral presentation).

Kuusk A.: Radiative Transfer in Vegetation (oral presentation).

Kuusk A.: Leaf Optical Models (oral presentation).

Nilson T., Kuusk A.: Spectral Characteristics of Forests, Understorey and Soil (oral presentation).

Kuusk A.: Overview of Canopy Reflectance Models (oral presentation).

Kuusk A.: Radiative Transfer in a Forest (oral presentation).

Kuusk A.: Field Measurements (oral presentation).

Conference "Areas and Mechanisms for Collaboration Between Turkish and European Actors in Space Activities" (Istanbul, Turkey, 22.10.–23.10.2007) – S. Lätt.

Nordkalotten Satellite Evaluation Network Meeting (Tromsø, Norway, 01.11.–03.11.2007) – M. Rautiainen, M. Mõttus.

ForestSat 2007 Scientific Workshop (Montpellier, France, 05.11.–07.11.2007) – M. Lang, U. Peterson.

Lang M., Kuusk A., Nilson T., Mõttus M., Kuusk J., Rautiainen M., Lükk T.: Järvselja Testsite for the RAMI (RAdiation Model Intercomparison) Phase 4 (oral presentation).

HYRESSA Future Plan Meeting (Edinburgh, United Kingdom, 08.11.–09.11.2007) – M. Mõttus.

American Geophysical Union Fall Meeting (San Francisco, USA, 10.12.–14.12.2007) – M. Rautiainen, M. Mõttus.

Rautiainen M.: Multiangular and Hyperspectral Forest Reflectance Modeling in the Hemiboreal Zone: A Case Study With CHRIS PROBA Data (poster).

Mõttus M.: Partioning Incident Radition Fluxes Based on Photon Recollision Probability in Vegetation Canopies (poster).

7.3 Meetings at Tartu Observatory Tartu Observatooriumis korraldatud konverentsid

Joint Seminar on Cosmology and Astroparticle Physics

26.–27. veebruaril 2007 korraldas kosmoloogia osakond Tõraveres ühisseminari. Korraldustoimkonda juhtis A. Tamm. Umbes 35 osalejat Helsingi Ülikoolist, Turu Ülikooli Tuorla Observatooriumist, Keemilise ja Bioloogilise Füüsika Instituudist (Tallinn) ja Tartu Observatooriumist kuulasid 20 ettekannet. Meie teadlaste ettekanded on näidatud ingliskeelses tekstis allpool.

On February 26–27, 2007 the department of cosmology arranged a joint seminar, with A. Tamm leading the organization team. About 35 participants from the University of Helsinki, Tuorla Observatory of the University of Turku, National Institute of Chemical and Biological Physics (Tallinn) and Tartu Observatory listened to and discussed 20 reports. The following reports were presented by the researchers from Tartu Observatory:

Einasto J.: Supercluster-Void Network.
Einasto M.: The Richest Superclusters.
Gramann M.: Evolution of Galaxies.
Hütsi G.: Cosmic Sounds: Measuring the Universe with Baryonic Acoustic Oscillations.
Nugis T.: Mass Loss from Stars and Galaxies: Impact on Evolution.
Tamm A.: Dark Matter at Galaxy Scale.
Vassiljev E.: The Redshifted 21 cm Background and Particle Decay.

The Finnish Graduate School in Astronomy and Space Physics Summer School 2007: Time Series Analysis

3.–7. septembrini 2007 korraldas J. Pelt Elva lähedal Waide motellis Soomes tegutseva astronoomia ja kosmosefüüsika doktorikooli suvekooli astronoomiliste aegridade analüüsist. 14 osavõtjale esinesid loengutega J. Pelt ja A. Hirv ning H. Korhonen (Potsdami Astrofüüsika Instituut & ESO) ja T. Arentoft (Aarhusi Ülikool).

J. Pelt organized the Finnish Graduate School in Astronomy and Space Physics Summer School 2007 in Waide motel, Elva, Estonia from September 3 to 7, 2007. 14 participants listened to the lectures by J. Pelt and A. Hirv (Tartu Observatory), H. Korhonen (Potsdam Astrophysical Institute & ESO) and T. Arentoft (University of Aarhus).

Joonis 7.1: Participants of the Summer School. Suvekoolist osavõtjad.

Hirv A.: Time Delays from Blended Data.
Pelt J.: Graphical Display of Time Dependent Phenomena.
Pelt J.: Gravitational Lensing.
Pelt J.: Numerical and Statistical Methods in Time Series Analysis.
Pelt J.: Time Series Models with Time Dependent Parameters.
Pelt J.: Estimation of Time Delays.
Pelt J.: Significance Estimation, Bootstrap etc.

PHYSENSE Workshop on Physically-based Remote Sensing of Forests

2007. aastal loodud Põhjamaade koostöövõrgustik metsade füüsikaliseks kaugseireks PHYSENSE (direktor T. Nilson, sekretär M. Rautiainen) pidas 25. septembril 2007 Tartus oma esimese tööseminari. Osales 24 inimest Eestist, Soomest ja Rootsist.

PHYSENSE, the Nordic Network on Physically Based Remote Sensing of Forests, with T. Nilson as director and M. Rautiainen as secretary, held its first seminar on September 25, 2007 in Tartu. 24 researchers from Estonia, Finland and Sweden participated.

Nilson T.: The Use of Reflectance Models in Forest Remote Sensing.

Kuusk J.: Airborne Measurements of Forest Reflectance at Järvselja, Estonia.

Mõttus M.: Photon Recollision Probability and Canopy Reflectance.

Lang M.: Järvselja Test Site for Radiation Transfer Model Intercomparison.

Rautiainen M.: Multiangular Reflectance Properties of a Hemiboreal Forest: Analysis Using CHRIS PROBA Data.

Füüsika, Matemaatika ja Mehaanika Instituut 60, Grigori Kusmin 90, Aksel Kipper 100.

2. novembril 2007 tähistas Tartu Observatoorium koos Tartu Ülikooli Füüsika Instituudiga oma ühise eelkäija, Füüsika, Matemaatika ja Mehaanika Instituudi 60. aastapäeva, ühendades selle instituudi nägu oluliselt kujundanud akadeemikute Aksel Kipperi ja Grigori Kusmini sünniaastapäevadega

On November 2, 2007 Tartu Observatory together with the Institute of Physics, University of Tartu celebrated 60th anniversary of their common predecessor, the Institute of Physics, Mathematics and Mechanics. At the same time, the Academicians Aksel Kipper and Grigori Kusmin who played a great role in shaping the Institute, were remembered.

FMMI

F I

Lugupeetud ....

Olete oodatud 2. novembril 2007 osalema pidulikul päeval teemal

"Füüsika, Matemaatika ja Mehaanika Instituut 60, Grigori Kusmin 90, Aksel Kipper 100"

TÜ Füüsika Instituut
Tartu Observatoorium

Päevakorras:

11.00 Tõraveres:

- Avasõna – *Laurits Leedjärv*
- Akadeemik Aksel Kipper 100 – *akadeemik Arved Ervin Sapar*
- Akadeemik Grigori Kusmin 90 – *akadeemik Jaan Einasto*

12.50 Ringkäik TÜ Füüsika Instituudis (Riia 142), kohv

15.00 Tartu Ülikooli aulas

- Avasõna – *Ergo Nõmmiste*
- Instituudi algus ja ajalugu – *Henn Käämbre*
- Tartu Ülikooli Füüsika Instituudi olevik ja tulevik – *Ergo Nõmmiste*
- Tartu Observatoorium täna ja homme – *Laurits Leedjärv*

18.00 Vastuvõtt TÜ Ajaloo Muuseumis (soovijatel võimalus tervitusteks)

7.4 Miscellaneous Muud koosolekud ja ettevõtmised

European High-Level Space Policy Group Meeting (Brussels, Belgium, 31.01.2007) – L. Leedjärv.

ISPM Presentation Meeting (Atrium Restaurant, London, United Kingdom, 05.02.2007.) – O. Kärner.

EURISY Workshop "What Action at European Level for the European Community of Actors Involved in Education and Space? Current Activities, Needs and Prospects" (Paris, France, 07.03.2007) – L. Leedjärv.

European High-Level Space Policy Group Meeting (Paris, France, 09.03.2007) – L. Leedjärv.

2nd Programme Committee – FP7 – for Space (Brussels, Belgium, 23.03.2007) – T. Viik.

EL teadus- ja arendustegevuse 7. raamprogrammi avakonverents (Tartu, 28.03.2007) – L. Leedjärv, T. Viik.

Global Monitoring for Environment and Security Advisory Council Meeting (Brussels, Belgium, 28.03.2007) – A. Reinart.

European High-Level Space Policy Group Meeting (Brussels, Belgium, 24.04.2007) – L. Leedjärv.

World Meteorological Organization Congress (Geneva, Switzerland, 14.05.–16.05.2007) – A. Kallis.

BSRN Meeting in WMO (Geneva, Switzerland, 15.05.2007) – A. Kallis.

EURISY Conference "Future Challenges for Local and Regional Authorities: How can Space Technology Help?" (Barcelona, Spain, 29.05.–30.05.2007) – L. Leedjärv.

FP7 Environment Expert Panel (Brussels, Belgium, 30.05.–01.06.2007) – A. Reinart.

HIRLAM-A Council Meeting 3 (Cork, Ireland, 24.06.–26.06.2007) – T. Viik.

6th European Space Policy Workshop "A First European Space Policy: The Challenges to Come" (Leuven, Belgium, 26.06.2007) – L. Leedjärv.

3rd Programme Committee – FP7 – for Space (Brussels, Belgium, 27.06.2007) – T. Viik.

Fieldwork on Lake Peipsi and Baltic Sea (16.07.–26.07.2007) – A. Reinart, K. Valdmets, K. Alikas.

FP7 Environment Expert Panel (Brussels, Belgium, 08.07.–12.07.2007) – A. Reinart.

FP7 Environment Expert Panel (Brussels, Belgium, 16.07.–19.07.2007) – A. Reinart.

Advanced Training Course on Land Remote Sensing (Lisbon, Portugal, 02.09.–07.09.2007) – K. Alikas.

Global Monitoring for Environment and Security Advisory Council Meeting (Brussels, Belgium, 13.09.2007) – A. Reinart.

EURISY Workshop "Efficient Management of Coastal Regions and Cities: Implementation and Use of Space Application-Based Services" (Tallinn, Estonia, 17.09.–18.09.2007) – K. Alikas, L. Leedjärv, S. Lätt, A. Reinart, K. Valdmets, T. Viik.

European High-Level Space Policy Group Expert Meeting (Brussels, Belgium, 19.09.2007) – L. Leedjärv.

XII International Astronomy Olympiad (Simeiz, Crimea, Ukraine, 28.09.–08.10.2007) – T. Eenmäe.

FP7 Capacity Projects Negotiation Meeting (Brussels, Belgium, 16.10.2007) – L. Leedjärv, A. Reinart.

4th Programme Committee – FP7 – for Space (Darmstadt, Germany, 17.10.2007) – T. Viik.

The Annual Finnish Forest Science Day (Suomen Metsätieteen päivä) (Helsinki, Finland, 23.10.2007) – M. Mõttus, M. Rautiainen.

International Space Exploration Conference (Berlin, Germany, 08.11.–09.11.2007) – L. Leedjärv.

Konverents "Vesi meis ja meie ümber" (Tartu, Eesti Maaülikool, 22.11.2007) – K. Eerme, A. Kallis.

Kallis A.: Taevane vesi (oral presentation).

Scientific Session of the 10th Anniversary of Euroscience (Strasbourg, France, 10.11.–11.11.2007) – I. Pustylnik.

European High-Level Space Policy Group Meeting (Paris, France, 28.11.2007) – L. Leedjärv.

10th Meeting of the EUMETSAT Advisory Committee of Cooperating States (Darmstadt, Germany, 05.12.2007) – T. Viik.

Global Monitoring for Environment and Security Advisory Council Meeting (Lisbon, Portugal, 06.12.2007) – A. Reinart.

Euroscience Eesti Workshop-Seminar "Kuidas alustada teadlase teed?" (Tartu, Estonia, 07.12.2007) – L. Leedjärv, I. Pustylnik, U. Veismann.

Leedjärv L., Veismann U.: Mida ootab Eesti kosmosest? (oral presentation).

Pustylnik I.: ESOF 2008, Euroscience ja noorte teadlaste väljavaated (oral presentation).

Seminar "Teeme tutvust kliimamuutustega" (Tartu, AHHAA - Domus Dorpatensis, 13.12.2007) – K. Eerme, A. Kallis.

Kallis A.: Mis juhtub meie kliimaga? (oral presentation).

Editing of five papers on astrophysics submitted for publication in "Central European Journal of Physics" – I. Pustylnik.

Editing of the Proceedings of NATO Advanced Research Workshop "Recent Global Catastrophes and their Impact on Human Awareness and Behaviour" (Strasbourg, 26.02.–03.03.2007) – I. Pustylnik.

Editing of three papers on radiative transfer submitted for publication in "Journal of Quantitative Spectroscopy and Radiative Transfer" – T. Viik.

Member of the LOC Workshop "First Stars in the Universe" (Moscow, Russia, 04.12.–05.12.2007) – E. Vasiliev.

Member of the LOC Workshop "Sub-parsec Structures in ISM" (Moscow, Russia, 03.07.–04.07.2007) – E. Vasiliev.

8 Visits and guests Visiidid ja külalised

8.1 Astronomy Astronoomia

I. Vurm – University of Oulu, Oulu (Finland); 07.01.–28.04.2007.
J. Einasto – University of Helsinki, Helsinki (Finland); 06.02.–08.02.2007.
I. Pustylnik – Euroscience, Strasbourg, (France); 26.02.–03.03.2007.
J. Einasto – Potsdam Astrophysical Institute (Germany); 07.03.–21.04.2007.
I. Pustylnik, V.-V. Pustynski – Sternberg Astronomical Institute, Moscow (Russia); 17.04.–20.04.2007.
I. Vurm – University of Oulu, Oulu (Finland); 03.05.–31.08.2007.
L.J. Liivamägi – Potsdam Astrophysical Institute (Germany); 10.08.–28.08.2007.
K. Annuk – David Dunlap Observatory, University of Toronto, Toronto (Canada); 16.08.–08.09.2007.
T. Liimets – Isaac Newton Group of Telescopes, La Palma (Spain); 01.09.–08.12.2007.
I. Vurm – University of Oulu, Oulu (Finland); 01.09.–31.12.2007.
I. Pustylnik – Stellar Department of Masaryk University, Stellar Department of Astronomical Institute, Academy of Sciences of Czech Republic (Brno); 08.10.–01.11.2007.
E. Saar – Observatori Astronòmic, Universitat de València, València (Spain); 15.10.–14.12.2007.
T. Eenmäe – Vrije Universiteit Brussel (Belgium); 18.10.–24.10.2007.
M. Gramann – Tuorla Observatory, Turku (Finland); 29.10.–11.11.2007.

8.2 Atmospheric physics Atmosfäärifüüsika

A. Reinart – Stockholm University (Sweden); 17.01.–19.01.2007.
K. Valdmets – Vrije Universiteit Amsterdam (The Netherlands); 10.02.–07.04.2007.
U. Veismann – Physikalisch-Technische Bundesanstalt, Berlin (Germany); 20.02.–28.02.2007.
A. Reinart – Stockholm University (Sweden); 06.03.–10.03.2007.
M. Mõttus, M. Rautiainen – University of Helsinki, Department of Forest Resource Management (Finland); 19.03.–13.04.2007; 22.10.–23.11.2007.
J. Kuusk – Finnish Geodetic Institute, Masala (Finland); 05.09.–07.09.2007.

J. Kuusk – Instituto Nacional de Técnica Aeroespacial, Department of Remote Sensing, Torrejón de Ardoz (Spain); 21.10.–28.10.2007.

A. Reinart – University of Oslo (Norway); 18.11.–26.11.2007.

M. Mõttus, M. Rautiainen – Boston University, Department of Geography (USA); 28.11.–08.12.2007.

8.3 Guests of the observatory Observatooriumi külalised

Aleksandr Rosenbush – Main Astronomical Observatory, Kiev (Ukraine); 17.01.2007.

Pekka Heinämäki – Tuorla Observatory, University of Turku (Finland); 18.01.–20.01.2007; 23.08.–24.08.2007.

Pauline Stenberg – Helsinki University (Finland); 19.02.–21.02.2007.

Pekka Heinämäki, Pasi Nurmi, Aimo Sillanpää, Rami Rekola – Tuorla Observatory, University of Turku (Finland); 14.05.–16.05.2007.

Johannes Andersen, Birgitta Nordström – Niels Bohr Institute, University of Copenhagen / Nordic Optical Telescope (Denmark); 31.05.–01.06.2007.

Moises Bosch, Gonzalo Garzón, Iñigo Ortiz, Fernando Montero, Francisco-Javier Paniagua, Jose-Antonio Gomez-Sánchez, Cayetano Doñamayor, Oscar Gutierrez-de-la-Camara – Instituto Nacional de Técnica Aeroespacial (Spain); 17.07.–20.07.2007.

Jean-Luc Widlowski – Joint Research Centre, European Commission, Ispra (Italy); 30.07.–31.07.2007.

Jüri Toomre – Joint Institute for Laboratory Astrophysics, and Department of Astrophysical and Planetary Sciences, University of Colorado, Boulder (USA); 20.08.2007.

Atsumu Ohmura – ETH Institute for Atmospheric and Climate Science, Zürich (Switzerland); 16.09.–19.09.2007.

Lauri Korhonen – Faculty of Forest Sciences, University of Joensuu, Joensuu (Finland); 26.09.2007.

Ladislav Hric, Maria Bartolomejovā – Astronomical Institute of the Slovak Academy of Sciences, Tatranská Lomnica (Slovakia); 12.11.–21.11.2007.

Abdelaziz Kallel - Centre d'Etude des Environnements Terrestre et Planétaires (CETP), Paris (France); 26.11.–27.11.2007

Jan Pisek – University of Toronto, Toronto (Canada); 12.12.–14.12.2007.

Giancarlo Granero – GMES Bureau, European Commission, Brussels (Belgium); 13.12.2007.

9 Seminars at the Observatory Observatooriumis toimunud seminarid

9.1 Astronomy Astronoomia

10.01.2007 – Jaan Pelt: Hüpoteeside lugemine ja Hough'i teisendus.
17.01.2007 – Alexander Rosenbush (Kiiev): Basic Features of the Novae by Types in the Modified Scales of the Light Curve.
24.01.2007 – Tõnu Viik: Johannes Kepler. I.
31.01.2007 – Izold Pustylnik: Slovakkia astronoomiast ja Pluuto degradeerimisest.
07.02.2007 – Antti Tamm: Uuest süvaülevaatest COSMOS – vaatlused ja esimesed tulemused.
14.02.2007 – Tõnu Viik: Johannes Kepler. II.
21.02.2007 – Laurits Leedjärv, Izold Pustylnik, Antti Tamm: ASTRONET'ist ja Euroopa astronoomia tulevikust.
28.02.2007 – Jaan Einasto: Vestlus teemal "Tume aine ja Universumi ehitus".
07.03.2007 – Tõnu Viik: Johannes Kepler. III.
14.03.2007 – Jaan Pelt: Johannes II seiklused jääkarude maal ja mõjal.
21.03.2007 – Kalju Annuk: Projektid E–ELT ja IYA 2009.
28.03.2007 – Urmas Haud: LAB ülevaate töötlusest.
04.04.2007 – Vladislav Venjamin Pustynski: Peegeldusefekti modelleerimine kataklüsmieelsel evolutsioonietapil olevates kaksiktähtedes.
11.04.2007 – Valeri Maljuto: Homogenization of Stellar Catalogues through Data Intercomparison.
18.04.2007 – Mari Burmeister: Sümbiootilise tähe Z And gaasijugadest.
16.05.2007 – Tõnu Viik: Natuke James Hopwood Jeansi elust ja tööst.
23.05.2007 – Tõnu Kipper: II populatsiooni tsefeiidid.
30.05.2007 – Evgenii Vasiliev: From First Stars to LOFAR.
01.06.2007 – Johannes Andersen ja Birgitta Nordström (Kopenhaagen): NOT ja ASTRONET.
06.06.2007 – Tiina Liimets: Pekuliaarse muutliku tähe V838 Monocerotis ja tema võrdlustähtede fotomeetria.
13.06.2007 – Izold Pustylnik: Läti astronoom Stanislavs Vasilevskis (1907–1988) – E.J. Öpiku saatusekaaslane.
20.08.2007 – Jüri Toomre (USA): Unfolding the Sources of Solar Magnetism.

29.08.2007 – Elmo Tempel: Galaktikate kasv tumedas Universumis.
26.09.2007 – Anti Hirv: Ajanihete leidmine blendeeritud heleduskõveratest.
03.10.2007 – Anna Aret, Arved Sapar, Raivo Poolamäe, Lili Sapar: Hg isotoopide difusiooniline segregatsioon CP tähtedes.
– Lili Sapar: Uuest vene kosmoseteleskoobist WSO.
10.10.2007 – Arved Sapar, Lili Sapar, Anna Aret: CP#AP Workshop Viinis (10.–14. sept. 2007).
17.10.2007 – Tõnu Kipper: Vesinikuvaeste tähtede konverents Tübingenis.
24.10.2007 – Kalju Annuk: CAP 2007 ehk astronoomia populariseerimisest (konverentsist Ateenas).
31.10.2007 – Alar Puss: Tähtkujudest ja sodiaagimärkidest.
07.11.2007 – Antti Tamm, Jaan Pelt: Eestlased Teravmägedel.
14.11.2007 – Ladislav Hric, Marina Bartolomejova (Slovaki TA Astronoomia Instituut): 1. Symbiotic Star YY Her – Envelope or Disk?
2. Recurrent Nova RS Oph – One Year After the Outburst.
3. The Ancient Egyptian Calendar and Mathematics.
21.11.2007 – Mari Burmeister: Keele'i konverents ehk RS Ophiuchi 2006. aastal.
28.11.2007 – Izold Pustylnik: Kokkuvõte JENAM–2007-st Jerevanis.
12.12.2007 – Izold Pustylnik: Prof. Tsesevitš'i saja aasta juubelile pühendatud rahvusvahelisest konverentsist Odessas.
19.12.2007 – Tiina Liimets: Tiina Poiste-Kivi Observatooriumis.

9.2 Atmospheric physics Atmosfäärifüüsika

12.01.2007 – Tiit Nilson: Peakomponentide meetod Järvselja satelliidipiltide analüüsil.
26.01.2007 – Kalju Eerme: Integraalse päikesekiirguse sesoonne muutlikkus Tõraveres 1955–2006.
09.02.2007 – Viivi Russak: Atmosfääri vastukiirgus Tõraveres 2003–2006.
16.02.2007 – Miina Rautiainen: Optical Remote Sensing of Forest Canopies: Some Research Activities at the University of Helsinki.
02.03.2007 – Matti Mõttus: Footoni taaspõrke tõenäosus taimkattes.
09.03.2007 – Mart Noorma (TÜ EFTI kursuse Kvaliteedijuhtimine II projektigrupp): Kvaliteedijuhtimine laboris.
11.05.2007 – Gert Tomingas (Tartu Ülikool): Termokaamerate kalibreerimisest Eestis.
18.05.2007 – Silver Lätt: UV spektrite argipäev.

24.05.2007 – Erko Jakobson (Tartu Ülikool): Meteoroloogilistest mõõtmistest Arktika triivjääl.
14.09.2007 – Andres Kuusk: Difuusse peegeldumise ja läbilaske mõõtmine integreeriva keraga.
21.09.2007 – Matti Mõttus: HYRESSA: mis ja milleks?
28.09.2007 – Kalju Eerme (kaasautorid: Ilmar Ansko, Silver Lätt, Uno Veismann): Tõravere integraalse kiirguse päevasummade ja pilvisuse muutlikkuse lainikanalüüs.
26.10.2007 – Andres Kuusk: Peegeldusindikatriss.
27.11.2007 – Abdelaziz Kallel: Canopy Bidirectional Reflectance Calculation Based on Adding Method and SAIL Formalism and Estimation of the fCover by Model Inversion.
07.12.2007 – Joel Kuusk: Minispektromeetri Carl Zeiss MMS1 aparaatfunktsiooni uurimine ja mõõtmisandmete korrektsioon.
14.12.2007 – Jan Pisek (Toronto): Mind the Angles: Towards Global LAI/fAPAR Estimates Using Multi-Sensor, Multi-Angle Data Fusion Approach.

10 Membership in scientific organizations
Teadusorganisatsioonide liikmed

Academia Europaea – J. Einasto
Akademische Gesellschaft für Deutschbaltische Kultur – T. Viik
American Astronomical Society – J. Einasto
American Geophysical Union – M. Mõttus, M. Rautiainen, A. Reinart, S. Lätt (student member), K. Valdmets (student member)
American Society of Photobiology – U. Veismann
ASTRONET Board – L. Leedjärv
Board of Directors "Astronomy and Astrophysics" – L. Leedjärv
Board of Member Countries Representatives of COST 726 Action – K. Eerme
Board of the Tartu Astronomy Club – E. Tago
British Interplanetary Society – U. Veismann
Eco-Ethics International Union – A. Kallis
Editorial Board "Agricultural and Forest Meteorology" – A. Kuusk
Editorial Board "Astronomical and Astrophysical Transactions" – I. Pustylnik
Editorial Board "Baltic Astronomy" – T. Kipper
Editorial Board "Central European Journal of Physics" – I. Pustylnik
Editorial Board "Journal of Quantitative Spectroscopy and Radiative Transfer" – T. Viik
Editorial Board "Silva Fennica" – T. Nilson
Eesti Astronoomia Selts – K. Annuk, T. Eenmäe, J. Einasto, V. Harvig, T. Kipper, I. Kolka, L. Leedjärv, T. Nugis, J. Pelt, A. Puss, I. Pustylnik, V.-V. Pustynski, M. Ruusalepp, L. Sapar, E. Tago, U. Veismann, T. Viik
Eesti Füüsika Selts – A. Aret, K. Eerme, J. Einasto, T. Kipper, L. Leedjärv, S. Lätt (juhatuse liige), A. Reinart (juhatuse liige), E. Saar, M. Sulev, P. Tenjes, T. Viik
Eesti Geograafia Selts – A. Kallis
Eesti Geofüüsika Komitee / Estonian Geophysical Committee – K. Eerme
Eesti Rahvuslik Astronoomia Komitee / Estonian National Committee on Astronomy – J. Einasto, L. Leedjärv (Chair), E. Saar, T. Viik
Eesti Kirjanduse Selts – U. Veismann
Eesti Kosmosepoliitika Töögrupp / Estonian Space Policy Working Group – L. Leedjärv (Vice-Chair), T. Viik
Eesti Kvaliteediühing – U. Veismann
Eesti Looduseuurijate Selts – K. Eerme, A. Kallis, V. Russak, A. Sapar, M. Sulev, U. Veismann, T. Viik

Eesti Teadlaste Liit – J. Einasto, T. Viik
Eesti Teaduste Akadeemia / Estonian Academy of Sciences – J. Einasto, A. Sapar
Eesti Teadusfondi Nõukogu – T. Viik
EUFAR (EUropean Fleet for Airborne Research): Expert in the Imaging Remote Sensing Workgroup – M. Mõttus
EUFAR (EUropean Fleet for Airborne Research): Education and Training – S. Lätt
EURISY Programmatic Steering Committee – L. Leedjärv
European Association of Remote Sensing Laboratories (EARSeL) – department of atmospheric physics
European Astronomical Society – K. Annuk, J. Einasto, M. Gramann, V. Harvig, T. Kipper, I. Kolka, L. Leedjärv, V. Malyuto, T. Nugis, I. Pustylnik, V.-V. Pustynski, E. Saar, A. Sapar, L. Sapar, E. Tago, P. Tenjes, U. Veismann, J. Vennik, T. Viik
European High Level Space Policy Group – L. Leedjärv
Euroscience – I. Pustylnik, U. Veismann
Euro–Asian Astronomical Society – A. Aret, J. Einasto, V. Malyuto, I. Pustylnik, V.-V. Pustynski, A. Sapar
Field Editor "Agronomie. Agriculture and Environment" – A. Kuusk
Finnish Society of Forest Sciences – M. Mõttus, M. Rautiainen
The GAIA Data Processing and Analysis Consortium (DPAC), Coordination Unit CU8: Astrophysical Parameters – I. Kolka, V. Malyuto
German Astronomical Society – J. Einasto
GMES (Global Monitoring for Environment and Security) Advisory Council – A. Reinart
Institute of Electrical and Electronical Engineers (IEEE) – S. Lätt (student member)
The International Society for Optical Engineering (SPIE) – U. Veismann, S. Lätt (student member)
International Astronomical Union – K. Annuk, J. Einasto, M. Einasto, M. Gramann, U. Haud, T. Kipper, I. Kolka, L. Leedjärv, V. Malyuto, T. Nugis, J. Pelt, I. Pustylnik, E. Saar, A. Sapar, L. Sapar, I. Suhhonenko, E. Tago, P. Tenjes, U. Veismann, J. Vennik, T. Viik
Marie Curie Fellowship Association – A. Reinart
MTÜ Euroscience Eesti – I. Pustylnik, V.-V. Pustynski
Nordic Network on Physically-based Remote Sensing of Forests – T. Nilson (director), M. Rautiainen (secretary), M. Lang (member of steering committee), M. Mõttus (member of steering committee)
Optical Society of America – T. Viik, S. Lätt (student member)
Royal Astronomical Society – J. Einasto (associated member)

Society for European Astronomy in Culture – I. Pustylnik
Societas Biologica Fennica Vanamo – M. Rautiainen
Ultraviolettkiirguse, osooni ja aerosoolide uurimise koordineerimise Eesti Nõukogu – K. Eerme, A. Kallis, U. Veismann
Õpetatud Eesti Selts – U. Peterson
Working Group 4 of COST 726 Action – S. Lätt
WMO World Climate Research Programme, Baseline Surface Radiation Network (BSRN), PAR (Photosynthetically Active Radiation) Working Group – A. Kallis
7. raamprogrammi kosmose programmikomitee ekspert – T. Viik
7. raamprogrammi keskkonna programmikomitee ekspert – A. Reinart

11 Teaching and Popularizing Õppetöö ja populariseerimine

11.1 Lecture courses and seminars Loengukursused ja seminarid

11.1.1 Astronomy Astronoomia

Astronomy Course for the Nõo High School, held at the Observatory *Astronoomia kursus Nõo Reaalgümnaasiumi 12. klassidele, läbi viidud observatooriumis* – K. Annuk, L. Leedjärv, M. Ruusalepp, E. Saar, T. Viik.

Astronomy *Astronoomia* – P. Tenjes, Tartu University.

Atomic and Subatomic Physics I *Mikromaailma füüsika I* – P. Tenjes, Tartu University.

General Astronomy *Üldine astronoomia* – E. Tempel, L. J. Liivamägi, Tartu University.

General Course of Physics *Füüsika üldkursus* – V.-V. Pustynski, Tallinn University of Technology.

The Physics of the Universe *Universumi füüsika* – T. Viik, Tartu University.

Mathematical Physics I *Matemaatiline füüsika I* – P. Tenjes, Tartu University.

Quantum Physics *Kvantfüüsika* – P. Tenjes, Tartu University.

Short lecture course "Modelling Stellar Evolution of Single Stars and Binaries with Swift Stellar Evolutionary Code" for Master Degree and PhD students — I. Pustylnik, Stellar Department of Masaryk University, Brno, Czech Republic.

11.1.2 Atmospheric physics Atmosfäärifüüsika

Introduction to Geophysics *Sissejuhatus geofüüsikasse* – K. Eerme, Tartu University.

Meteorological Technology and Observational Networks *Meteotehnoloogia ja vaatlusvõrgud* – A. Kallis, Tartu University.

Physical Geography *Füüsiline geograafia* – A. Kallis, Estonian Maritime Academy.

General Meteorology and Climatology *Üldine meteoroloogia ja klimatoloogia* – A. Kallis, Tallinn University of Technology.

Computer-Aided Measurements *Arvutijuhitavad mõõtmised* – U. Veismann, I. Ansko (together with A. Mirme, S. Mirme, A. Luts), Tartu University.

Image Processing in Remote Sensing *Pilditöötlus kaugseires* – U. Veismann (together with A. Luts), Tartu University.

Military and Defence Technologies *Militaar- ja sisekaitsetehnoloogiad* – M. Noorma, S. Lätt, Tartu University.

Seminar on Space and Military Technology *Kosmose- ja militaartehnoloogia seminar* – M. Noorma, U. Veismann, S. Lätt, Tartu University.

Master Seminar in Applied Physics *Magistriseminar rakendusfüüsikas* – S. Lätt (together with M. Noorma, K. Tarkpea, J. Vedru), Tartu University.

Practical Work in Robotics *Robootika praktikum* – J. Kuusk (praktikumi juhendaja), Tartu University.

Realtime Systems *Reaalajasüsteemid* – S. Lätt (together with A. Reinart), Tartu University.

Remote Sensing I Course – M. Rautiainen, visiting lecturer, University of Helsinki.

Remote Sensing II Course – M. Rautiainen, visiting lecturer, University of Helsinki.

Environmental GIS Course – M. Rautiainen, visiting lecturer, University of Helsinki.

Applied GIS Analysis Course – M. Rautiainen, visiting lecturer, University of Helsinki.

Environmental Remote Sensing *Keskkonna kaugseire* – T. Nilson, Tartu University.

Fundamentals of Remote Sensing *Kaugseire alused* – U. Peterson, Tartu University.

Geographic Information Systems *Geograafilised Informatsioonisüsteemid* – U. Peterson, Estonian University of Life Sciences.

Environmental Monitoring *Keskkonnaseire* – U. Peterson, Estonian University of Life Sciences.

11.2 Popular lectures Populaarteaduslikud loengud ja esinemised

7 intervjuud BNS-ile, raadiole ja televisioonile – T. Viik.

42 intervjuud BNSile, raadiole ja televisioonile – A. Kallis.

Tumeainest ja selle kaardistamisest (intervjuu Vikerraadio saates "Labor", 14.01.2007) – M. Gramann.

Kas majandus- ja tavalisel kliimal on midagi ühist? (Pühajärve, Eesti Panga majandusanalüütikute seminar, 06.02.2007) – A. Kallis.

Universum, nagu me teda tunneme (loeng Pärnu Koidula Gümnaasiumis, 09.02.2007) – L. Leedjärv.

Uudiseid Tõraverest (Raadio 4, 15.02.2007) – L. Leedjärv.

Tume aine läbi gravitatsioonilise optika (Tartu Tähetorni Astronoomiaring, 20.02.2007) – J. Pelt.

Intervjuu Eesti Raadiole Eesti Vabariigi teaduspreemia puhul (24.02.2007) – J. Einasto.

Viisid, kuidas loodus teid tappa püüab. (Tartu Tähetorni Astronoomiaring, 06.03.2007) – A. Kallis.

Kvantitatiivsed meetodid kaugseires (GLOBE õpetajate aastaseminar "Loodusteaduslik haridus ja jätkusuutlik areng Eestis", Tartu, 09.03.–10.03.2007) – T. Nilson.

Valgusreostus ja tähevaatlused ("Loodusteaduslik haridus ja jätkusuutlik areng Eestis", Tartu, 09.03.2007) – T. Eenmäe.

Ilmast ja kliimast (Lions Klubi, Elva, 13.03.2007) – A. Kallis.

Rahvusvaheline astronoomia aasta 2009 (Eesti Astronoomia Seltsi aastakoosolek, Tõravere, 17.03.2007) – K. Annuk.

Kliimakatastroofid (Üliõpilaste Looduskaitse Ring, Tartu, 24.03.2007) – A. Kallis.

Universum, nagu me teda tunneme (loeng Kohila Gümnaasiumis, 03.04.2007) – L. Leedjärv.

Universum kõverpeeglis (Tartu Tähetorni Astronoomiaring, 03.04.2007) – E.Tago.

Aktuaalset ilmateaduses ja kuidas on Tartus ilma mõõdetud (Tartu, Akadeemiline Muinsuskaitse Selts, 09.04.2007) – A. Kallis.

Tumedad ained kirjanduses ja päriselt (Algupärase lastekirjanduse päev, 11.04.2007) – M. Müürsepp, A. Tamm.

Mis on loodusõnnetused? (Tartu Ülikooli eakate klubi, 11.04.2007) – A. Kallis.

Päikesesüsteemi hämarates tagatubades (Eesti Geodeetide Ühingu kevadkonverents, Pärnu, 13.04.–14.04.2007) – T. Viik.

Kliimast (Euroülikool, Tartu, 19.04.2007) – A. Kallis.

Päikesesüsteemi hämarates tagatubades (Eesti Looduskaitse Seltsi Tartu osakonna aastakoosolek, (Tartu, 19.04.2007) – T. Viik.

Dark Matter and the Supercluster-void Network (Lundi Eesti Akadeemilise Seltsi 60. aastapäeva konverents, Lund, 22.04.2007) – J. Einasto.

Planeet Gliese 581C ja teised eksoplaneedid (Ärataja, Raadio Kuku, 26.04.2007) – L. Leedjärv.

Ilmavaatlused (Ekskursioonijuhtide seminar, Vellavere, 03.05.2007) – A. Kallis.

Johannes Kepleri elu ja töö (Akadeemiline Baltisaksa Kultuuri Selts, Tartu, 15.05.2007) – T. Viik.

Kliimamuutustega seotud probleemid (Pühajärve, Keskkonnaministeeriumi seminar, 24.05.2007) – A. Kallis.

Päikesesüsteemi hämarates tagatubades (Eesti Psühholoogiaüliõpilaste Ühenduse kevadkool, Liuranna, Pärnumaa, 09.06.2007) – T. Viik.

Päikesesüsteemi hämarates tagatubades (Eesti Ornitoloogiaühingu suvepäevad, Mõedaku, Lääne-Virumaa, 16.06.2007) – T. Viik.

Päikesesüsteemi hämarates tagatubades (Eesti Füüsika Seltsi täppisteaduste kool, Arbavere, Lääne-Virumaa, 17.06.2007) – T. Viik.

Mis on lahti kliimaga? (Nõo, Füüsikaõpetajate täienduskoolitus, 26.06.2007) – A. Kallis.

Eestlased kosmoses: sputnikuvaatlustest mehitatud lendudeni (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 11.08.2007) – K. Eerme.

Kipper, Kusmin ja astronoomia Eestis (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 11.08.2007) – J. Einasto.

Eesti tee Euroopa kaudu kosmosesse (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 11.08.2007) – L. Leedjärv.

Astronoomiaharidus Tartu Ülikoolist (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 11.08.2007) – P. Tenjes.

Väga suured teleskoobid (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 12.08.2007) – K. Annuk.

GAIA: Kui kaugel on tähed? (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 12.08.2007) – I. Kolka.

WMAP ja PLANCK: Mineviku jäljed taustkiirguses (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 12.08.2007) – E. Saar.

GOODS: GAIA-st PLANCK-ini (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 12.08.2007) – M. Einasto.

Uudiseid astronoomiast (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere, 13.08.2007) – E. Tago.

Tähtede heleduste mõõtmised käepäraste vahenditega (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere 13.08.2007) – T. Eenmäe.

Vaatluste kokkuvõte ja fotomeetriliste andmete töötluse tutvustus (Astronoomiahuviliste XII üle-Eestiline kokkutulek, Tõravere 13.08.2007) – T. Eenmäe.

Innovatsioonist ja teadusest (Presidendi Akadeemiline Nõukoda, Paslepa, 13.08.2007) – J. Einasto.

Ultraviolettkiirgus: aastane tsükkel ja muutlikkus Eestis (Reumatoloogia päevaprobleeme VIII, Pühajärve, 17.08.2007) – K. Eerme.

50 aastat kosmoseajastut (Kuuspakk, Vikerraadio, 19.08.2007) – L. Leedjärv.

Eesti kui kosmoseriik (teadus.ee suvekool, Käsmu, 24.08.2007) – U. Veismann.

Eksoplaneetidest (Loovprojekt "Kaevu taga kostab kosmos", Tõravere, 01.09.2007) – T. Viik.

Teleskoobid eile, täna, homme (Loovprojekt "Kaevu taga kostab kosmos", Tõravere, 15.09.2007) – K. Annuk.

Maa kui kosmiline märklaud (TÜ Ajaloomuuseumi populaarteaduslik teeõhtu, Tartu, 25.09.2007) – T. Viik.

Intervjuu Kuku Raadiole (30.09.2007) – J. Einasto.

Muutused Maa kliimas (Tartu Lennukolledži õppepäev, Pühajärve, 04.10.2007) – A. Kallis.

Mälestusi Rohuneemest (Viimsi Kultuuriloo Selts, Viimsi, Pringi küla, 06.10.2007) – T. Viik.

Eesti kliimast (Keskkonnahariduse Keskus, Keskkonna info kättesaadavuse parandamise projekti raames, Tartu, 10.10.2007) – A. Kallis.

Eesti keskkonna ülevaade – kliima (Üliõpilaste Looduskaitse Ring, Tartu, 11.10.2007) – A. Kallis.

Galaktikate mudelid (III Geoloogia sügiskool: "Mudelid ja modelleerimine", Pikajärve, 13.10.2007) – E. Tempel.

Atmosfääri roll kliimasüsteemis üldse ja Eesti puhul (Eesti Füüsika Seltsi Täppisteaduste Sügiskool 2007, Kääriku, 20.10.2007) – K. Eerme.

Maailma sünd ja areng (AHHAA seminar, Tartu, 22.10.2007) – J. Einasto.

F.G.W. Struve Maa kuju täpsustajana (Konverents "Avanduselt UNESCO Maailmakultuuri pärandisse", Simuna, 23.10.2007) – T. Viik.

Koidutäht Veenus ja muud huvitavat taevas (Huvitaja, Vikerraadio, 29.10.2007) – L. Leedjärv.

Uus väljakutse astronoomiale – galaktikate punased halod (Tartu Tähetorni Astronoomiaring, 30.10.2007) – A. Tamm.

F.W. Bessel ja geodeesia (Tartu Tähetorni Astronoomiaring, 06.11.2007) – T. Viik.

Kakskümmend aastat Eesti lageraiealasid satelliidipiltidel (Teabepäev "Geograafia paneb paika", Eesti Rahvusraamatukogu, Tallinn, 14.11.2007) – U. Peterson.

Maailma areng (Tallinna Tehnikaülikooli seminar EDU, Tallinn, 16.11.2007) – J. Einasto.

Eesti kosmos eile ja homme (Tartu Tähetorni astronoomiaring, 22.11.2007) – U. Veismann.

Ilmast ja kliimast (Laekvere, 25.11.2007) – A. Kallis.

Kliima on läbi aegade olnud muutuv (Teaduse ja Kultuuri Sihtasutuse Domus Dorpatensis populaarteaduslik seminar "Ahhaa. Teeme tutvust kliimamuutustega", Tartu, 13.12.2007) – K. Eerme.

Helioseismoloogia – kuidas me saame näha Päikese sisse? (Tartu Tähetorni Astronoomiaring, 18.12.2007) – J. Pelt.

Petlemma täht (Jõuluprogramm, Raadio Kuku, 24.12.2007) – L. Leedjärv.

Rubriik "Ain Kallis ilmast" – veebisaidis *www.ilm.ee*.

11.3 Theses defended, supervised and refereed by the staff of the Observatory Observatooriumi töötajate poolt kaitstud, juhendatud ja oponeeritud väitekirjad

11.3.1 Ph.D. theses Doktoritööd

V. V. Pustynski: Modelling the Reflection Effect in Precataclysmic Binary Systems Peegeldusefekti modelleerimine kataklüsmieelsel evolutsiooni etapil asuvates lähiskaksiksüsteemides, Ph.D. Thesis, Tartu University.
Defence Kaitsmine: 12.09.2007.
Supervisor Juhendaja: I. Pustylnik (Tartu Observatory).
Opponents Oponendid: A. Cherepashchuk (Sternberg Astronomical Institute, Moscow, Russia), L. Leedjärv (Tartu Observatory).

11.3.2 M.Sc. theses Magistritööd

K. Alikas: Satelliitsensori MERIS rakendused Eesti veekogude kaugseireks Use of MERIS Sensor for Remote Sensing of Estonian Waters (M.Sc.), Tartu University.
Supervisor Juhendaja: A. Reinart (Tartu Observatory).
Opponent Oponent: T. Nilson (Tartu Observatory).

T. Kärdi: Linnade kaugseire: spektrisegu lineaarne lahutamine Landsat Thematic Mapper satelliidipiltidelt Tartu linna näitel Urban Remote Sensing: Linear Spectral Unmixing of Landsat Thematic Mapper Satellite Images Acquired over Tartu (Estonia) (M.Sc.), Tartu University.
Supervisor Juhendaja: U. Peterson (Tartu Observatory).
Opponent Oponent: T. Nilson (Tartu Observatory).

T. Liimets: Pekuliaarse muutliku tähe V838 Monocerotis ja tema võrdlustähtede fotomeetria Photometry of the Peculiar Variable V838 Monocerotis and its Comparison Stars (M.Sc.), Tartu University.

Supervisor Juhendaja: I. Kolka (Tartu Observatory).
Opponent Oponent: A. Tamm (Tartu Observatory).

K. Valdmets – Peipsi järve bio-optiline mudel Bio-optical Model of Lake Peipsi (M.Sc.), Tartu University.
Supervisor Juhendaja: A. Reinart (Tartu Observatory).
Opponent Oponent: T. Nilson (Tartu Observatory).

11.3.3 Supervising of theses Juhendamine

K. Eerme – *R. Kivi*: Observations of Ozone, Polar Stratospheric Clouds and Water Vapour Profiles in the Arctic (Ph.D.), Tartu University.

T. Nilson – *S. Suviste*: Mõnede Eesti metsatüüpide heleduskordajate sesoonne käik mudelarvutustest ja satelliidipiltidelt The Seasonal Reflectance Course of Some Forest Types of Estonia from Simulation and Satellite images (M.Sc.), Tartu University.
Opponent Oponent: U. Peterson (Tartu Observatory).

A. Kuusk, T. Nilson – *H. Kiivet*: Temperatuuri ruumiline muutlikkus puistu ja üksikpuu lehestikus Spatial Temperature Variability of Foliage in Tree Plantation and Individual Tree (B.Sc.), Tartu University.

11.3.4 Refereeing of theses Oponeerimine

K. Eerme – *M. Prüssel*: Õhusaaste Vilsandi EMEP jaamas aastatel 2001–2003 Air Pollution at Vilsandi EMEP Station in 2001–2003 (B.Sc.), Tartu University.

V. Russak – *M. Kannel*: Atmosfääriaerosooli spektraalse optilise paksuse modelleerimine Modeling of Spectral Aerosol Optical Depth (M.Sc.), Tartu University.

T. Viik – *K. Suik*: Tycho Brahe – vaatlusandmete tõlgendamise probleem Tycho Brahe – Problem of Interpretation of Observational Data (B.Sc.), Tartu University.

12 Staff Koosseis (01.01.2008)

Director / Direktor	Laurits Leedjärv (Ph.D.)
Vice director (management) / Haldusdirektor	Enno Ruusalepp

Department of Astrophysics Astrofüüsika osakond

Group of stellar physics Tähefüüsika töörühm

Senior research associate / Vanemteadur	Tõnu Kipper (D.Sc.) (Head of Department / Osakonna juhataja)
Senior research associate / Vanemteadur	Tiit Nugis (Ph.D.)
Senior research associate / Vanemteadur	Indrek Kolka (Ph.D.)
Research associate / Teadur	Kalju Annuk (Ph.D.)
Research associate / Teadur	Alar Puss (M.Sc.)
Research associate / Erakorr. teadur	Mari Burmeister (M.Sc.)
Research associate / Erakorr. teadur	Anti Hirv (M.Sc.)
Research associate / Erakorr. teadur (0.50)	Tõnis Eenmäe (M.Sc.)
Engineer / Insener (0.10)	Tiina Liimets (B.Sc.)

Group of theoretical astrophysics Teoreetilise astrofüüsika töörühm

Senior research associate / Vanemteadur	Arved Sapar (D.Sc., Prof., EAS[1])
Senior research associate / Vanemteadur	Jaan Pelt (Ph.D.)
Senior research associate / Vanemteadur	Izold Pustylnik (D.Sc.)
Senior research associate / Vanemteadur	Tõnu Viik (D.Sc.)
Research associate / Teadur	Anna Aret (M.Sc.)
Research associate / Teadur	Raivo Poolamäe (M.Sc.)
Research associate / Teadur	Lili Sapar (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Voldemar Harvig (Ph.D.)
Research associate / Erakorr. teadur (0.50)	Vladislav-Venjamin Pustynski (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Indrek Vurm (M.Sc.)

[1]Member of the Estonia Academy of Sciences Eesti Teaduste Akadeemia akadeemik

Group of telescopes Teleskoopide töörühm

Leading electronic engineer / Juhtinsener-elektroonik	Riho Koppel
Maintenance engineer / Hooldusinsener	Toivo Kuusk

Department of Cosmology Kosmoloogia osakond

Group of physics of galaxies Galaktikate füüsika töörühm

Senior research associate / Vanemteadur	Jaan Vennik (Ph.D.)
Senior research associate / Vanemteadur	Urmas Haud (D.Sc.)
Research associate / Teadur	Antti Tamm (Ph.D.)
Research associate / Teadur (0.25)	Peeter Tenjes (D.Sc.)
Research associate / Erakorr. teadur	Valeri Malyuto (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Elmo Tempel (M.Sc.)

Group of cosmology Kosmoloogia töörühm

Senior research associate / Vanemteadur	Enn Saar (D.Sc.) (Head of Department / Osakonna juhataja)
Senior research associate / Vanemteadur	Jaan Einasto (D.Sc., Prof., EAS[1])
Senior research associate / Vanemteadur	Mirt Gramann (Ph.D.)
Senior research associate / Vanemteadur	Maret Einasto (D.Sc.)
Senior research associate / Vanemteadur	Erik Tago (Ph.D.)
Research associate / Teadur	Ivan Suhhonenko (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Gert Hütsi (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Lauri J. Liivamägi (M.Sc.)
Post doctoral associate / Järeldoktor	Evgenii Vasiliev (Ph.D.)

Group of data communication Andmeside töörühm

Leading engineer / Andmeside juhtinsener	Margus Sisask

Department of Atmospheric Physics Atmosfäärifüüsika osakond

Group of remote sensing of vegetation Taimkatte seire töörühm

Senior research associate / Vanemteadur	Andres Kuusk (D.Sc.) (Head of Department / Osakonna juhataja)
Senior research associate / Vanemteadur	Matti Mõttus (Ph.D.)
Senior research associate / Vanemteadur	Tiit Nilson (D.Sc., Prof.)
Senior research associate / Vanemteadur	Anu Reinart (Ph.D.)
Research associate / Teadur (0.50)	Mait Lang (Ph.D.)
Research associate / Teadur	Urmas Peterson (Ph.D.)
Research associate / Teadur	Madis Sulev (Ph.D.)
Engineer / Insener (0.25)	Krista Alikas (M.Sc.)
Engineer / Insener (0.30)	Joel Kuusk (M.Sc.)
Engineer / Insener (0.20)	Tõnis Kärdi (M.Sc.)
Engineer / Insener (0.50)	Tõnu Lükk (B.Sc.)
Engineer / Insener	Matti Pehk (Ph.D.)
Engineer / Insener (0.25)	Kristi Valdmets (M.Sc.)
Technician / Tehnik	Tõnu Prans
Post doctoral associate / Järeldoktor	Miina Rautiainen (Ph.D.)

Group of remote sensing of atmosphere Atmosfääri seire töörühm

Senior research associate / Vanemteadur	Kalju Eerme (Ph.D.)
Senior research associate / Vanemteadur	Uno Veismann (Ph.D.)
Research associate / Erakorr. teadur	Viivi Russak (D.Sc.)
Research associate / Erakorr. teadur	Olavi Kärner (Ph.D.)
Research associate / Erakorr. teadur (0.25)	Ain Kallis (Ph.D.)
Electronic engineer / Insener-elektroonik (0.30)	Ilmar Ansko (M.Sc.)
Software engineer / Tarkvarainsener (0.30)	Silver Lätt (M.Sc.)

Management Haldusosakond

Group of information Info töörühm

Head / Juhataja	Mare Ruusalepp (Ph.D.)
Librarian / Raamatukoguhoidja (0.80)	Maire Rahi
Chief of staff / Kantselei juhataja	Mare Senka

Book-keeping Raamatupidamine

Head book-keeper / Pearaamatupidaja	Liidia Meier
Senior book-keeper / Vanemraamatupidaja	Külli Kärner
Book-keeper / Raamatupidaja (0.60)	Helju Eller

Maintenance Haldus

Chief engineer / Peainsener (0.50)	Rein Kalberg
Housekeeper / Majahoidja	Leida Kivirand
Electrician / Elektrik-haljastustehnik	Ülo Kivirand
Repair technician / Remonditööline	Henn Leitu
Cleaner / Koristaja (0.50)	Mare Linnamägi
Cleaner / Koristaja	Helvi Vennik

13 Contact data Kontaktandmed

13.1 General addresses Üldaadressid

Tartu Observatory
61602 Tõravere, Tartumaa, Estonia
Tel.: (372) 7410 265
Telefax: (372) 7410 205
E-mail: aai@aai.ee

Computer address: jupiter.aai.ee, 193.40.1.1
Home page: http://www.aai.ee

13.2 Telephones and E-mail Telefonid ja arvutipost

Tel. number Ph. number	Nimi Name	E-post E-mail
(372) 7410 443	Annuk Kalju	annuk@aai.ee
(372) 7410 278	Alikas Krista	alikas@ut.ee
(372) 7410 230	Ansko Ilmar	jazov@aai.ee
(372) 7410 465	Aret Anna	aret@aai.ee
(372) 7410 443	Burmeister Mari	mari@aai.ee
(372) 7410 258	Eenmäe Tõnis	tonis_ee@aai.ee
(372) 7410 258	Eerme Kalju	kalju@aai.ee
(372) 7410 110	Einasto Jaan	einasto@aai.ee
(372) 7410 450	Einasto Maret	maret@aai.ee
(372) 7410 409	Eller Helju	helju@aai.ee
(372) 6551 827	Gramann Mirt	mirt@aai.ee
(372) 6701 690	Harvig Voldemar	harvig@staff.ttu.ee
(372) 7410 305	Haud Urmas	urmas@aai.ee
(372) 7410 443	Hirv Anti	anti@aai.ee
	Hütsi Gert	gert@aai.ee
(372) 7410 136	Kallis Ain	kallis@aai.ee
(372) 7410 443	Kipper Tõnu	tk@aai.ee
(372) 7410 443	Kolka Indrek	indrek@aai.ee
(372) 7410 492	Koppel Riho	riho@aai.ee
(372) 7410 152	Kuusk Andres	andres@aai.ee
(372) 7410 152	Kuusk Joel	joel@aai.ee
(372) 7410 492	Kuusk Toivo	toivo@aai.ee
(372) 7410 409	Kärner Külli	kylli@aai.ee

(372) 7410 258	Kärner Olavi	olavi@aai.ee
(372) 7410 265	Leedjärv Laurits	leed@aai.ee
(372) 7410 258	Liimets Tiina	sinope@aai.ee
(372) 7410 450	Liivamägi Lauri Juhan	juhan@aai.ee
(372) 7410 258	Lätt Silver	silver@aai.ee
	Malyuto Valeri	valeri@aai.ee
(372) 7410 145	Meier Liidia	meier@aai.ee
(372) 7410 278	Mõttus Matti	mottus@aai.ee
(372) 7410 152	Nilson Tiit	nilson@aai.ee
(372) 7410 443	Nugis Tiit	nugis@aai.ee
(372) 7410 230	Pehk Matti	matti@aai.ee
(372) 7410 465	Pelt Jaan	pelt@aai.ee
(372) 7410 152	Peterson Urmas	urpe@aai.ee
(372) 7410 465	Poolamäe Raivo	praivo@aai.ee
(372) 7410 278	Prans Tõnu	
(372) 7410 443	Puss Alar	alar@aai.ee
(372) 7410 465	Pustylnik Izold	izold@aai.ee
(372) 7410 465	Pustynski Vladislav V.	vladislav@aai.ee
(327) 7410 409	Rahi Maire	maire@aai.ee
(372) 7410 278	Reinart Anu	reinart@aai.ee
(372) 7410 258	Russak Viivi	russak@aai.ee
(372) 7410 167	Ruusalepp Enno	enno@aai.ee
(372) 7410 261	Ruusalepp Mare	mare@aai.ee
	Saar Enn	saar@aai.ee
(372) 7410 465	Sapar Arved	sapar@aai.ee
(372) 7410 465	Sapar Lili	lilli@aai.ee
(372) 7410 409	Senka Mare	senka@aai.ee
(372) 7410 445	Sisask Margus	ms@aai.ee
	Suhhonenko Ivan	ivan@aai.ee
(372) 7410 278	Sulev Madis	sulev@aai.ee
(372) 7410 450	Tamm Antti	atamm@aai.ee
(372) 7410 450	Tago Erik	erik@aai.ee
	Tempel Elmo	elmo@aai.ee
(372) 7410 305	Tenjes Peeter	tenjes@aai.ee
(372) 7410 278	Valdmets Kristi	valdmets@aai.ee
(372) 7410 258	Vasiliev Evgenii	evgenii@aai.ee
(372) 7410 230	Veismann Uno	uno@aai.ee
(372) 7410 305	Vennik Jaan	vennik@aai.ee
(372) 7410 154	Viik Tõnu	viik@aai.ee
	Vurm Indrek	vurm@aai.ee