Metsähovi Radio Observatory

Annual Report 2011

M. Tornikoski, B. Holmberg,
M. Uunila

Aalto University

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Preface

Metsähovi Radio Observatory, a research institute at Aalto University (formerly: Helsinki University of Technology, TKK), operates a 14 m diameter radio telescope at Metsähovi, the village of Kylmälä in Kirkkonummi, about 35 km west from the Otaniemi university campus.

Metsähovi is active in the following fields: radio astronomical research, multifrequency astronomy and space research, development of instruments and methods for radio astronomy, and (radio) astronomical education. Geodetic VLBI observations are also done in Metsähovi in collaboration with the Finnish Geodetic Institute.

In 2011 twenty-two scientists, engineers, research assistants and support personnel worked at the institute. In 2011 the total expenditure of Metsähovi Radio Observatory was 1 338 889 euros including salaries and the rent of the office and laboratory space at the Metsähovi premises. This was funded by Aalto University, Academy of Finland, European Union, and other outside sources.

Merja Tornikoski

Director of the Aalto University Metsähovi Radio Observatory

Kylmälä, April 15, 2013,

M. Tornikoski, B. Holmberg, M. Uunila (editors)

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1. Research activities

In this chapter the main research activities at Metsähovi are introduced. Some of the project teams include also scientists working at other institutes. The contact person at Metsähovi is underlined in each project team list.

1.1 Radio astronomical instrumentation

Research Group at Metsähovi: Tornikoski, Mujunen, Kallunki, Kirves, Oinaskallio, Ritakari, Rönnberg

1.1.1 3 mm

Project team: Kirves, Mujunen, Oinaskallio, Kallunki, Rönnberg

After October 2011 GMVA session the receiver was dismantled for modifications and improvements. Which gave an excellent opportunity to separate the front part for radiation pattern check. The feedhorn was measured at a near field scanner facility at Otaniemi in February. From the measured patterns it was evident that the quasioptics really distorts the radiation pattern severely. One solution could be to move feedhorn 80-100 mm forward.

Another main problem with the receiver is its high dependency on the outside environment temperature. Therefore some detector types and the IF modules of the receiver were characterized. The outcome was that it is necessary to have a temperature stabilisation for the IF part.

Addendum 4 to the Contract was agreed by the Finnish party in the middle of February 2011. The contents of this addendum was to set realistic dates and conditions in the view of finalising the project. The addendum was nevertheless not signed by the Russian party.

Several pointing calibration runs were performed both in the Spring and in the Autumn 2011, but satisfactory results were not achieved. Investigations continue with the stability and radiation pattern issues.

For testing purposes a phase locked 9 GHz programmable signal source was built from readily available modules. The cost of this was only some hundreds of euros. It was ready in two weeks time and the performance is quite good.

1.1.2 RFI

Callisto spectrometer was carried to Nuuksio backwoods area in order to have a reference level of RFI.

To be able to catch RFI also in Callisto frequencies a new RFI detection system was designed. The system consists of a large LPD 30-1000 antenna, which had been already acquired many years ago, a rotator Yaesu and a SDR from Ettus Research. With this setup we hope to improve the scanning speed and flexibility of the interference detection system. Because of the open source, modular and intrinsically remote operated environment desired applications for interference detection can be designed.

Antenna was erected during November 2011 to the northwest end of the new building. Final installation point of the SDR must be quite near the antenna, otherwise the cable attenuation will become too high. Commissioning testing must be done at the control room using a 100 m coaxial cable, because gigabit connections are not available nearer at the moment.

1.1.3 Maintenance of receivers

The VLBA rack is reaching its end of life. During the years several BBC units have failed and spare parts are not anymore available. Two of the BBCs with failing VCO were restorated back into operation by installing an ADF4350 synthesizer board in place of the original LO unit. This modification is supposed to hold up the old analog system until its replacement with the new digital BBC system in the year 2012.

22 GHz VLBI receiver appears to have some trouble with the signal level while not yet fully cooled down. The operation restores to normal when it reaches the nominal operating temperature around 20 Kelvin. The reason is being investigated.

1.1.4 Miscellaneous

Petri Kirves presented a poster about temperature effects at RadioNet 5th Engineering Workshop in Cagliari, Italy in May 2011. Measuring infrastructure was updated in autumn with a new signal generator, lock-in amplifier, waveguide amplifiers, waveguide detectors, wide band directional couplers etc. Simulator software programs were evaluated and a joint purchase with a couple of related research organisations was explored. Actual purchase decisions were left for the future.

1.1.5 IT infrastructure

Project Team: Mujunen, Lindfors, Aatrokoski

The backbone switches were configured to use VLANs in order to make network administration more flexible and also more secure by isolating test computers from the rest of the network.

The Otaniemi office NFS server was upgraded to new hardware, and the network was changed to a private 10.x.x.x network in order to be able to use our own DHCP server to support an arbitrary number of laptops (the university's WLAN is available, but the connectivity is very bad at Metsähovi's office).

Previously all traffic going to the Otaniemi IP range was routed via our VPN link so it would appear to originate from that same range. As most services had moved to single sign-on authentication that works regardless of origin, this default was removed and only some exceptions are routed via the VPN link.

After 25 years of service, the last year of which it was mostly sitting idle, our venerable MicroVAX II measurement computer was finally unplugged (by the dean that happened to be on a visit at an opportune moment) and retired. See Figure 1.1.

The antenna control computer of the small Sun antenna was upgraded to new hardware and Linux control software. The Metsähovi-made PWM generator ISA board which in 2010 was diagnosed as the cause of low temperature computer freezes was also replaced with the new, Arduino-based PWM generator. After about a month of testing on the Sun antenna the new PWM generator was also installed on the main antenna control computer.

With a plan to modernize some specialized hardware, e.g. the ISA cards of the antenna control computers, we came to the conclusion that ether-

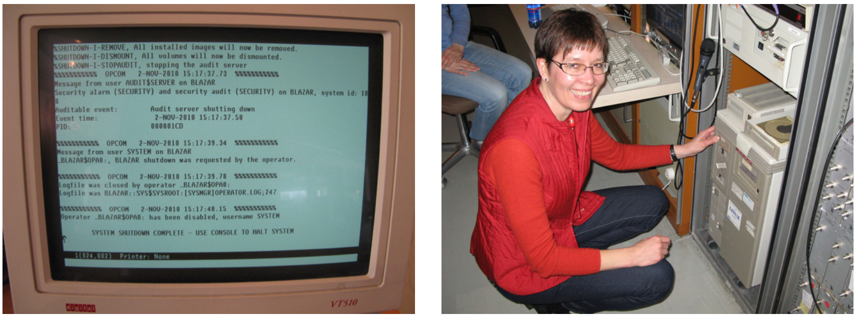

Figure 1.1. ELEC's dean Prof. Tuija Pulkkinen unplugged our venerable MicroVAX II measurement computer.

net is the most future-proof way to connect home-made devices to a computer. And there is a very suitable platform to implement such devices: the Arduino Mega 2560 prototyping board with the Ethernet Shield add-on board. We purchased over thirty of both and using them as a base designed and built three add-on boards:

- A PWM generator board to replace the computer-freezing ISA card. This utilizes the PWM generation capabilities of the Arduino, and basically just has backwards-compatible connectors, RS-422 transmitters and a power connector. As noted earlier, these were also deployed during 2011. See figure 1.2.

- An A/D conversion board with the AD7609 8-channel A/D chip for simultaneous synchronous sampling at 10 kHz. Several of these will replace the current PCI-416 4-channel A/D PCI card used for measurement data acquisition. See figure 1.3.

- A multiplexer board for the A/D board, that feeds the eight A/D inputs through four 8-to-2 MUXes, enabling (non-simultaneous) sampling of 32 channels. A replacement for the ACL-8113 32-channel ISA A/D cards. See figure 1.3

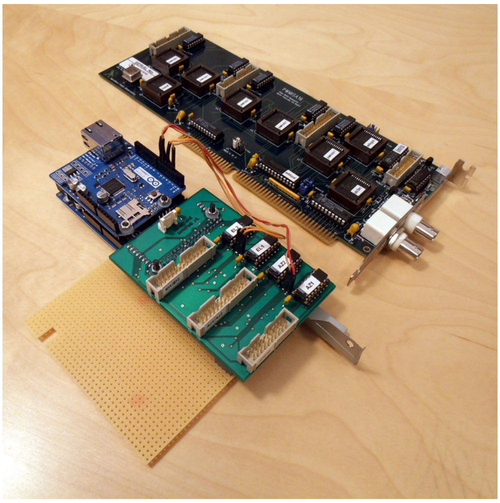

Figure 1.2. The old PWMISA card and its Arduino-based replacement.

The Linux version of the e-Callisto control software was finished and deployed in the beginning of the year. Later another e-Callisto module was acquired and set up to measure a higher frequency band.

The windows application server winapps was upgraded from Windows Server 2003 to (Windows 7 -based) Windows Server 2008 R2.

Two new virtualization servers with 6-core processors and 16 GB memory each were purchased and all the virtual hosts were moved to them. The old virtualization servers are used mostly for testing and other miscellaneous virtual hosts.

The desktop computers were finally migrated to use the modern UTF-8 character encoding. As could be expected, this did not go without causing some minor issues.

Our VoIP provider Saunalahti terminated our VoIP services with relatively short notice. We started looking for a new provider and managed to get an extension from Saunalahti's parent company Elisa while it implemented the new VoIP system as a part of Aalto University's general telephone contract.

The destructive Christmas storms caused a several day blackout in Metsähovi, which caused several issues and broke some equipment including the power supply of the GPS receiver used to provide NTP time to the network.

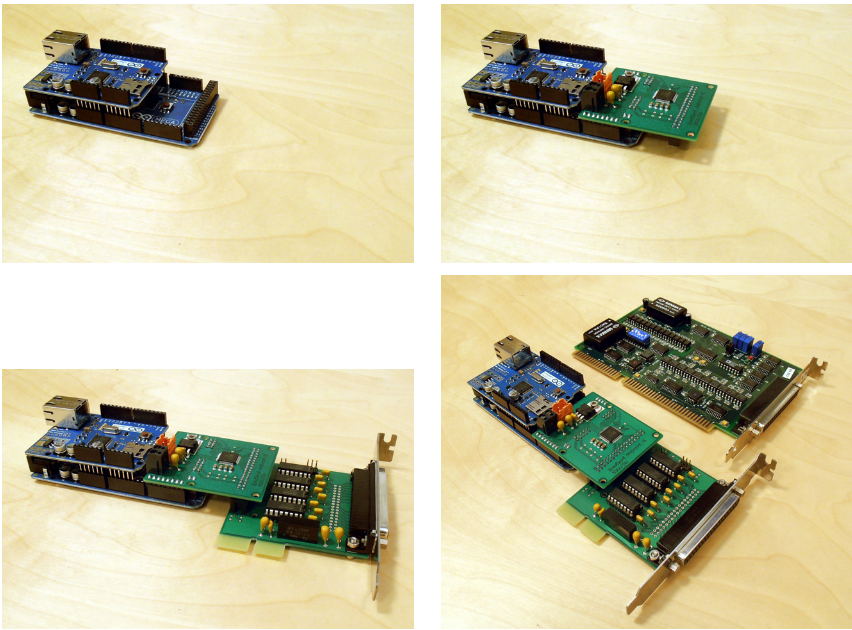

Figure 1.3. (1) An Arduino with an Ethernet Shield installed. (2) The A/D conversion board installed (MUX version, normal version has the signal connector on top). (3) The A/D MUX board installed. (4) The ACL-8113 ISA card and its replacement.

1.1.6 Hydrogen maser

Project Team: Oinaskallio, Kallunki, Mujunen

Both Hydrogen masers 69 and 70 continued to work throughout 2011 without any failures. Only the synthesizer value of H-maser 69 was adjusted three times and H-maser 70 value was adjusted once during the year 2011. In Figure 1.4 the time differences between the H masers (69) and GPS (HP-GPS) and between the H masers (69) and H masers (70) clocks is illustrated.

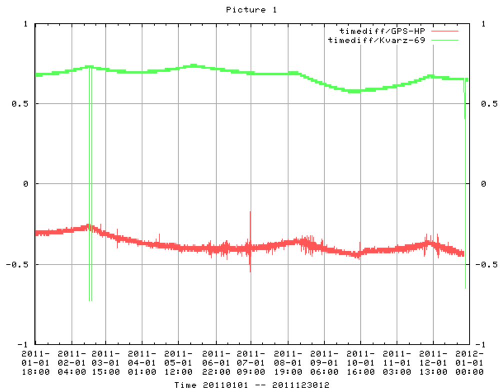

Figure 1.4. Time difference of H maser (69) and GPS clocks in red, and H maser (69) and H maser (70) in green, in microseconds.

1.1.7 New hardware

Project Team: Mujunen, Kallunki, Oinaskallio, Rönnberg

Sunant and Callisto

The elevation motor (gear ratio 246:1) was replaced in 4/2011. Also various new motors were tested for Sunant use.

The original Callisto log-periodic antenna (installed at 9/2010) was replaced with two new log-antennae in the fall of 2011. The antennae have better sensitivity and signal-noise ratio than the original one. Thus the Callisto observing band was increased to cover 50-1450 MHz. Second Callisto radiospectrometer was purchased from ETH Zurich, the down-converting module and other necessary technical equipment were built for this purpose. In Figure 1.5 the new Callisto antenna setup is presented.

Figure 1.5. Sunant (dish) and Callisto antennae (two log-antennae)

GSM monitoring

In the summer of 2011, the GSM-phone detection antenna (+ cabling and pre-amplifier) was installed in monitoring GSM-traffic (900 MHz) in Metsähovi. The signal detection is realized with Aaronia portable spectrum analyzer. An alert about the exceptional GSM traffic will be sent to technical personnel.

Additionally, the old RFI-antenna was repaired.

Servo motor testing

One pair of AC-servo motors (delivered by Omron) were purchased in the fall of 2011. Some preliminary tests were carried out with the motors. The motors are meant to replace the current DC-motors in main radiotelescope and perhaps also in Sunant radiotelescope.

Other technical upgrades

The air condition machine was replaced in the computer room at 3/2011 and at 9/2011 in the clock cellar.

Exceptional long power outages (around 40 hours) occurred at 26.12-28.12.2011. Back-up batteries in the cellar room took the power feeding around 30 hours, before the diesel generator was started.

A separate closet for geodetic GPS-receivers (battery + battery chargers) was built in the fall of 2011.

During the 2011 all the receivers, which are in the active use were moved to the new receiver beds.

1.2 VLBI instrumentation

Project team: Ritakari, Kirves, Uunila, Rastorgueva

The 86 GHz receiver was not in use in 2011.

The 43 GHz receiver has been out of order for the last years and it is still waiting to be repaired. The 22 GHz receiver is working fine. There have been some problems with the S-band of the geodetic S/X receiver since 2007. We changed the semi-rigid coaxial cables of the receiver which were broken.

Status of our VLBI hardware: only 9 BBCs were being used in the experiments in 2010. Three of the broken ones were fixed in 2011. One DBBC unit for geodetic purposes was ordered in 2011 and it should be ready for use in mid-2012. For the time being we will use an iBOB 1xVSI => 10G workaround design.

1.2.1 Metsähovi data processing site

In 2011 we have continued the processing of VLBI data using programs developed by Jan Wagner.

We have also an opportunity to use two Finnish supercomputer clusters, one has 2100 cores and the other has 2880 cores. There are some differences in Unix versions and connectivity. The computers rank at roughly number 100 in the world top-500 supercomputer list.

This is rare opportunity to test the scalability of VLBI software correlators. So far the scalability tests have been done with maximum of 12 computers with four processor cores each, so moving to really powerful system is unknown territory. Scalability of high-speed data streams is also an interesting topic.

We have also been encouraged to apply for the computing grand challenge program in Finland and/or request resources in the world's top-5 supercomputer in Juelich, Germany. Because of lack of personnel resources, we did not do these yet in 2011.

1.2.2 eVLBI and EC FP7 NEXPReS

Project team: Ritakari, Molera, Mujunen, Uunila, Turtiainen

Metsähovi takes part in a 3-year EC FP7 project ”NEXPReS” (Novel EXplorations Pushing Robust e-VLBI Services, FP7 Grant Agreement RI-261525) as the work package leader for its WP8, “High-Bandwidth, High-Capacity Networked Storage”. The aim is to determine the best practical combination of technologies which will serve the needs of evolving, multi-Gbps, data acquisition and processing. This includes determining what kind of storage should be used, location(s), packaging, connectivity, and how this storage should be allocated/deallocated and accessed.

In 2011 NEXPReS WP8 Metsähovi have concentrated on developing the basic technologies to allow continuous, high-speed bidirectional buffering. A fully-COTS 4U platform was developed at relatively low cost and still offering generous disk space (36 disks, 72 TB or 20 hours of continuous 8Gbps recording) and excellent expansion potential (7 low-profile PCIe x8 expansion slots) see Figure 1.6 .

Figure 1.6. The fully-COTS 4U 36 disk chassis platform (Supermicro SC847A-R1400B).

On the software side we were able to identify and eliminate most of the bottlenecks that limited the performance of our disk recording system in the previous EXPReS project to 6Gbps with a 20-disk raid0 arrangement. We could confirm that the performance was limited by a single kernel thread flushing all data from block buffer cache to the single raid0 file system. We had tried to rectify this already in EXPReS by experimenting with “O_DIRECT” write option, which should bypass the buffer cache and the synchronizing kernel thread. However instead of an improvement, performance decreased. Further testing revealed that it is imperative to use O_DIRECT together with relatively large blocks in a single “write()” call (2–64MB or more). This allows the Linux kernel to effectively distribute the elementary hardware requests to multiple disks without causing too frequent completion waits which are otherwise inherent in the O_DIRECT mechanism.

As it is relatively straightforward to divide our data in successive large blocks we will get very limited benefit from using few large RAID arrays. If we instead give each disk spindle its own process and/or thread performing O_DIRECT “write()” calls with large enough block size, we will get maximum parallelism and utilization of available multiple CPU cores concurrently. In our tests with the low-cost preliminary hardware platform we already obtained more than 17Gbps using only 22 disks concurrently. This process only required 20% of the available capacity of six CPU cores.

Supporting simultaneous reading and writing presents two fundamental difficulties in today’s disk systems. The first one is the limited bandwidth available throughout the system. Reading and writing simultaneously requires double the data streaming bandwidth in the internal data path, compared to the bandwidth needed for reading or writing alone.

The second problem is caused by hard disk drive seek time: it takes a long time to move the magnetic head back and forth between two read and write areas of the disk. This problem can be alleviated with proper interleaving of reads and write. To minimize the effects of hard disk 8–12ms seek times, one must stream in either read or write direction for much longer than this seek time (or full disk rotation time, approximately 8.3+1.1ms). For instance, read streaming for about 120ms gives the data from 10 rotations, then the seek required to switch to write streaming wastes only the time of one rotation. This will result in approximately 90% efficiency for the total read+write bandwidth. It is important to note that simultaneous read and write will at least halve the available total bandwidth in a given system.

1.3 VLBI space science applications and spacecraft tracking

Project team: Molera-Calvés

Tracking of planetary spacecraft have continued during the year 2011 with the radio telescope of Metsähovi at X-band. Six sessions targeting the ESA’s Venus Express (VEX) spacecraft were scheduled. The most outstanding experiment (em081c) was conducted on 28th of March 2012. Twelve radio telescopes participated in the experiment: Metsähovi, Medicina, Noto, Matera, Wettzell, Yebes, Pushchino, Onsala, Hartebeesthoek, Badary, Zelenchukskaya and Saint Croix.

During the em081c session, the EVN radio telescopes observed alternatively the phase-reference source and the spacecraft signal with a 4-minute nodding cycle. The addition of telescopes in Russia, South Africa and North America allowed us to cover a large uv-plane, with maximum baselines of 8500 km in East-West direction and 7800 km North-South direction.

The reconstructed projection of the spacecraft within the Venus orbit observed on 2011.03.28 is shown in Figure 1.7

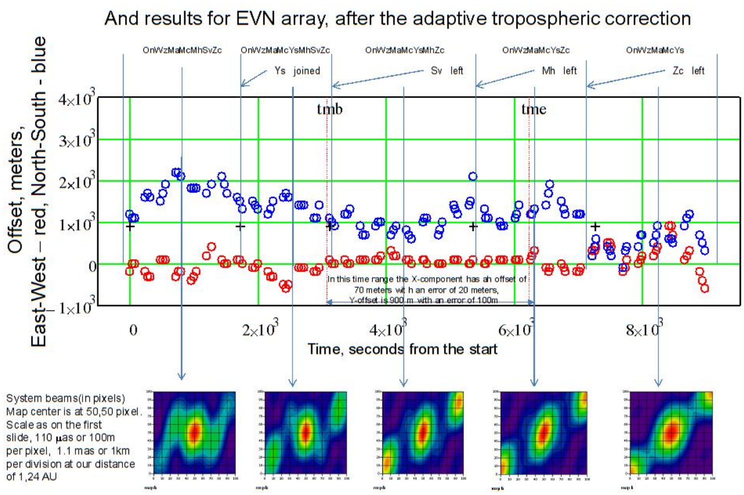

Figure 1.7. Spacecraft position reconstructed from the 2011.03.28 observations. The y-axis indicates the offset in meters for E-W (in red) and N-S directions (in blue). The system beams belong to the spacecraft position at several intervals of time.

1.3.1 Interplanetary plasma scintillations

Project team: <u>Molera-Calvés</u>

Planetary spacecraft as targets of radio astronomy offer new possibilities to study a broad variety of physical processes: planetary atmospheres, geodynamical diagnostics of the interior of planets, fundamentals of spacecraft motion or characterisation of the solar wind.

The phase analysis of the Venus Express spacecraft signal demonstrated a high level of fluctuations. The variations on the phase are caused by the Earth's ionosphere, temperature noise of the system and primarily by the interplanetary plasma. Motivated by these fluctuations, we started a campaign measuring the propagation of the spacecraft signal through the interplanetary plasma.

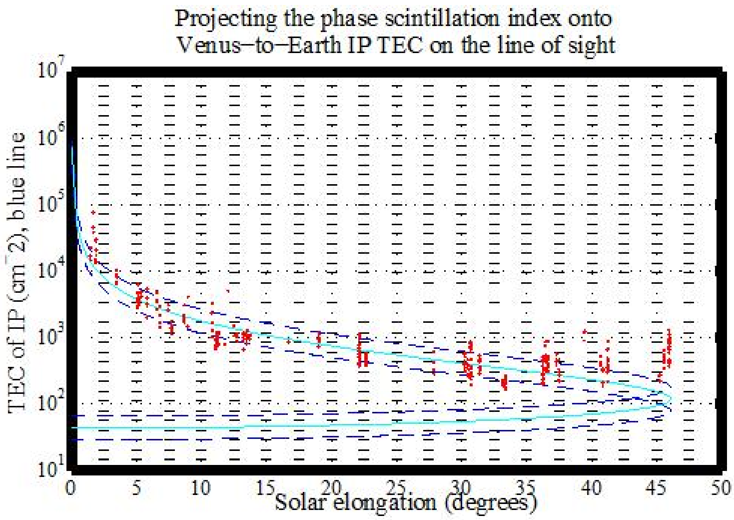

Figure 1.8. Superimposition of the scintillation index and the simulated TEC (cyan) along the line of sight Venus-Earth. The values of the scintillation index have been normalised to match with the TEC.

The sessions initiated at the end of 2009 and have continued until end of 2011. We have observed more than 80 sessions with 14 different radio telescopes. The sessions targeted to cover a full cycle of Venus around the Sun. Venus was at the major conjunction on January 2010 and again on August 2011.

The observations allowed us to relate the phase scintillation index with respect to the angle Sun-Observer-Target and to estimate index of scintillations regarding the Total Electron Content (TEC) in the path of view as seen in Figure 1.8 (Molera Calvés et al., presentation at the IPPW-9, Virginia, June, 2011).

1.4 VLBI observational activities

Project team: Uunila, Rastorgueva, Molera, Mujunen, Ritakari, Wagner

Metsähovi performs both astronomical and geodetic VLBI observations in conjunction with three global networks of VLBI: the European VLBI Network (EVN), the International VLBI Service for geodesy and astrometry (IVS: in collaboration with FGI), and the Global Millimeter VLBI Array (GMVA). Furthermore, Metsähovi has actively taken part in spacecraft VLBI tracking observations organized by Joint Institute for VLBI in Europe (JIVE) in cooperation with the European Space Agency (ESA) as well as real-time dUT1 experiments with Japan and Sweden.

1.4.1 VLBI sessions in 2011

In 2011 Metsähovi took part in eight geodetic VLBI sessions (in four EUROPE sessions and in four T2 sessions). The Global mm-VLBI Array (GMVA) observed two sessions, in May and October of 2011. Three EVN sessions were conducted at the station. In June 2011 one 22 GHz EVN ToO experiment was observed.

1.5 Geodetic VLBI data analysis

Project team: Uunila, Kareinen

Geodetic VLBI data is analyzed with the Vienna VLBI Software (VieVS) developed at the Institute of Geodesy and Geophysics, Vienna University of Technology. In 2011 the analysis was concentrated on the IVS intensive sessions (INT1, INT2 and INT3), and 24-hours sessions (R1 and R4).

1.5.1 Automated analysis of IVS intensive sessions

Project team: Uunila, Haas (SWE), Kareinen, Lindfors

Analysis of the intensives with VieVS was automated, to be able to get data as soon as possible. For results and plots, see http://www.metsahovi.fi/vlbi/vievs/

1.5.2 Influence source positions on UT1

Project team: Uunila, Nothnagel (DE), Leek (DE)

Influence of source constellations on the quality of UT1 was derived from IVS INT1 sessions. The Kokee-Wettzell baseline midpoint was chosen as a reference point for the analysis, and a Matlab code to classify sessions with quality codes was written.

1.5.3 Comparison of UT1 and polar motion from IVS sessions derived from VieVS and Solve analysis

Project team: Uunila, Baver (US), Gipson (US), Nilsson (AT)

The results of using Vienna VLBI Software (VieVS) and Calc/Solve were compared to estimate UT1 and Polar Motion using IVS sessions from 2011. The results from both 24 hour sessions and intensives were compared.

1.5.4 Determination of Tsukuba VLBI station post-Tohoku earthquake coordinates

Project team: Kareinen, Uunila

Tsukuba VLBI station was affected by the Tohoku earthquake on March 11, 2011. The new coordinates for the station were determined from 38 VLBI XA/XE sessions dating from 2011-01-03 to 2011-09-15 with VieVS. After the initial VieVS analysis, a visualization tool was written in Matlab to analyze the possible change in the coordinates and to detect possible low quality measurements missed by initial processing. The visualization tool has a functionality to transform the ECEF coordinates and errors acquired with VieVS to the local tangent plane of Tsukuba for better comparison possibilities. The visualization tool was written in a way that it could be added in the next version of VieVS as a general time series tool.

1.6 AMS-02

Project Team: Ritakari, Molera, Uunila

Metsähovi Radio Observatory has been involved in the development of AMS-02 (Alpha Magnetic Spectrometer). AMS-02 started operating in space onboard the Shuttle Endeavour in 2011. Spectrometre was installed in one of the ISS (International Space Station) arms and will operate for the following 2 to 3 years.

AMS-02 has been developed for the last 13 years in many research institutes of Europe and China. It is the continuation of the AMS project launched in 1998 which resulted as a total success. Metsähovi Radio Observatory's role in the project is to provide help to the mission in the Ground System Equipment and acquisition of data in the Johnson Space Center (Houston). Data acquired from a HRDL link must be acquired and stored in a server, which needs to allow the access from the researcher for checking, revising and downloading to their respective working-sites.

AMS-02 is a state-of-the-art particle physics detector designed to operate as an external module on the ISS. It will use the unique space environment to study the universe and its origin by searching for antimatter, dark matter while performing precision measurements of cosmic rays composition and flux.

1.7 Extragalactic radio sources

1.7.1 Active Galactic Nuclei

Project team: Tornikoski, Lähteenmäki, Nieppola, Kareinen, León-Tavares, Tammi, Rastorgueva, Oksman, Järvelä, Lavonen, Savolainen, Valtaoja (Turku)

In 2011 the main focus of our AGN science continued to be on Planck-related studies (described in the following section) and in radio-to-gamma-ray connections.

We extensively analysed Metsähovi radio data and Fermi satellite's gamma-ray data from various angles, and published several papers on the topic of radio-to-gamma-ray connection in blazars.

Our most important results are summarized in the following:

- Although the Fermi mission has increased our knowledge of gamma-ray AGN, many questions remain open, such as the site of gamma-ray production, the emission mechanism, and the factors that govern the strength of the emission. Using data from a high radio band, 37 GHz, uncontaminated by other radiation components besides the jet emission, we studied these questions with averaged flux densities over the the first year of Fermi operations.

  We looked for possible correlations between the 100 MeV - 100 GeV band used by the Fermi satellite and 37 GHz radio band observed at the Aalto University Metsähovi Radio Telescope, as well as for differences between the gamma-ray emission of various AGN subsamples. We used data averaged over the 1FGL period. Our sample includes 249 northern AGN, including a complete sample of 68 northern AGN with a measured average flux density exceeding 1 Jy.

  We found significant correlation between the flux densities and luminosities in gamma and radio bands. The Fermi luminosity is inversely correlated with the peak frequency of the synchrotron component of the AGN spectral energy distributions. We also calculated the gamma dominances, defined as the ratio between the gamma and radio flux densities, and found an indication that high-energy blazars are more gamma-dominated than low-energy blazars. After studying the distributions of gamma and radio luminosities, it is clear that BL Lacertae objects are different from quasars, with significantly lower luminosities. It is unclear whether this is an intrinsic difference, an effect of variable relativistic boosting across the synchrotron peak frequency range, or the result of Fermi being more sensitive to hard spectrum sources like BL Lacertae objects. Our results suggest that the gamma radiation is produced co-spatially with the 37 GHz emission, i.e., in the jet.

- We compared the gamma-ray photon flux variability of northern blazars in the Fermi/LAT First Source Catalog with 37 GHz radio flux density curves from the Metsähovi quasar monitoring program. We found that the relationship between simultaneous millimeter (mm) flux density and gamma-ray photon flux is different for different types of blazars. The flux relation between the two bands is positively correlated for quasars and does no exist for BLLacs. Furthermore, we find that the levels of gamma-ray emission in high states depend on the phase of the high frequency radio flare, with the brightest gamma-ray events coinciding with the initial stages of a mm flare. The mean observed delay from the beginning of a mm flare to the peak of the gamma-ray emission is about 70 days, which places the average location of the gamma-ray production at or downstream of the radio core. We have also started to investigate alternative scenarios for the production of gamma-rays at distances of parsecs along the length of the jet.

- We investigated the relationship between black hole mass (MBH) and Doppler boosted emission for BL Lacertae type objects (BL Lacs) detected in the Sloan Digital Sky Survey and Faint Images of the Radio Sky at Twenty-Centimeters (FIRST) surveys. The synthesis of stellar population and two-dimensional decomposition methods allows us to disentangle the components of the host galaxy from that of the nuclear black hole in their optical spectra and images, respectively. We derived estimates of black hole masses via stellar velocity dispersion and bulge luminosity. We found that masses delivered by both methods are consistent within errors. There is no difference between the black hole mass ranges for high-synchrotron peaked BL Lacs (HBL) and low-synchrotron peaked BL Lacs (LBL). A correlation between the black hole mass and radio, optical and X-ray luminosity has been found at a high significance level. The optical continuum emission correlates with the jet luminosity as well. Besides, X-ray and radio emission are correlated when HBLs and LBLs are considered separately. We (i) show that the black hole mass does not decide the spectral energy distribution shapes of BL Lacs, (ii) confirm that X-ray and optical emission is associated to the relativistic jet and (iii) present evidence of a relation between MBH and Doppler boosted emission, which among BL Lacs may be understood as a close relation between faster jets and more massive black holes.

1.7.2 Planck satellite science

Project Team: Lähteenmäki, Tornikoski, Aatrokoski, León-Tavares, Nieppola, Tammi, Valtaoja (Turku)

The Planck satellite has mapped the sky at nine high radio frequencies from 30 GHz to 857 GHz, and measured the cosmic microwave background (CMB) radiation. At the same time all foreground radio sources in the sky, including extragalactic radio sources, have been observed, too. Planck has therefore produced unique all sky catalogs of sources at several high radio frequencies. These catalogs will, finally, fill the gap in the present radio survey data. Planck was launched on May 14, 2009, and in Autumn 2011 the nominal (2) and extended (2) all-sky surveys ended. HFI is expected to observe until the end of 2011 and after that the LFI alone continues to observe the sky until at least the end of 2012, using a slightly different scanning strategy than before.

The first Planck dataset, the Early Release Compact Source Catalog (ERCSC) was published in January, together with a set of Planck Early Results papers. The ERCSC has a cumulative reliability of >=90%, and it contains lists of extragalactic and Galactic sources at 9 Planck frequecies. The measurements were taken between August 13, 2009 and June 6, 2010. We participated in several early papers, and led one called "Planck early results. 15. Spectral energy distributions and radio continuum spectra of northern extragalactic radio sources."

Soon after this the planning of Planck intermediate papers began. We submitted two drafts. The idea was to start working on the multifrequency data as soon as the Planck data from all four all-sky surveys became available later in the year but due to several reasons this work has been delayed until 2012. Due to internal Planck Consortia schedules these papers are now expected to be submitted in early 2013.

Multifrequency campaigns with our collaborators continued in 2011. A reminder e-mail was sent every week to everyone who participates in the campaign. In autumn the observing campaigns were halted, at the end of the nominal and extended all-sky surveys of Planck. However, the Metsähovi telescope continued to monitor the most interesting sources.

In 2011 A. Lähteenmäki and J. Leon-Tavares participated in several Planck related meetings and telecons where Planck data reduction, analysis, results, and publications were discussed.

The Planck satellite project has been a very long one, and finally the time, money, and perseverance put into the project by the Metsähovi team is paying off. There will now be a constant flow of data (and publications), and the team will continue working on them at least for the next couple of years.

1.7.3 Numerical modelling

Project Team: Tammi, Hovatta, Lähteenmäki, Valtaoja (Turku)

We continued developing the numerical methods for modelling non-thermal emission from flaring AGN jets. We concentrated on focusing on determining the relevant physical building blocks of the model. A significant part of the year was spent on planning the actual implementation of the new version of the code. The bottom-up approach was discussed in two workshops and conferences, and it was determined that more time and resources were needed to fully realise the planned project. Funding was applied for – and obtained (Aalto Starting Grant for 2012—2013), enabling Tammi to start looking for students.

The collaboration with the German modelling group continued, with Tammi visiting Würzburg for a week in November. The visit concentrated on the high-energy emission modelling, and as a result, we applied the Würzburg code to various gamma-ray blazars, leading to our participation in one article published in 2012, and one that is still in progress and needs more modelling.

1.8 Galactic sources

1.8.1 The multiwavelength nature of the enigmatic microquasar Cygnus X-3

Project team: Koljonen, Hannikainen (Melbourne, FL), McCollough (Cambridge, MA), Droulans (Toulouse), Pooley (Cambridge), Trushkin (Nizhnij Arkhyz), Tavani (Rome)

Continuing the work on the search for quasi-periodic oscillations (QPO) from the microquasar Cygnus X-3, Karri Koljonen published a paper in MNRAS mid-way through the year. This paper consisted of a Monte Carlo -based timing analysis which was used to analyze the whole archive (at the time of publication) of the X-ray observatory RXTE including all X-ray spectral states to search for low-frequency QPOs (< 0.1 Hz). This extensive search resulted in two detections above the 99.9% confidence level, reinforcing the short-lived and sporadic nature of these events in Cygnus X-3. In addition, both of these detections are associated to a certain extent with major radio flaring events.

In May 2011 Karri Koljonen visited the Harvard-Smithsonian Center for Astrophysics (CfA) in Boston, MA, US, as a guest of Dr. Michael McCollough to wrap up previous work and initiate new projects concerning the research on Cygnus X-3. The visit included an oral presentation held at the High Energy Astrophysics Division lunch talk at the CfA and a poster presented at the 218th AAS Meeting. Results from Cygnus X-3 research were also presented at the Black Hole Astrophysics: Tales of Power and Destruction -workshop held in Winchester, UK.

Being part of the Finnish graduate school for astronomy and space physics, Karri Koljonen attended the annual summer school that was held this year in Weesenstein castle, Germany, where the subject was high energy astrophysics.

Karri Koljonen continued to be a co-investigator in monitoring proposals of Cygnus X-3 with the infrared observatory PAIRITEL as well as the X-ray observatory Swift and a new monitoring proposal with the gamma-ray observatories Fermi and VERITAS. Also, a collaboration with the gamma-ray observatory AGILE group continued.

1.8.2 2010-2011 observing campaigns on Cygnus X-3

Project Team: Savolainen, McCollough (SAO), Hannikainen (Florida Institute of Technology)

Petri Savolainen has worked at Metsähovi since January 2008 as a postgraduate student of Dr. Diana Hannikainen, who has recently transfered to the Florida Institute of Technology. He spent 2011 as a Predoctoral Fellow at the Harvard-Smithsonian Center for Astrophysics (CfA), funded from a NASA grant through the Smithsonian Astrophysical Observatory (SAO). While there, he worked with Dr. Michael McCollough of SAO on the enigmatic microquasar Cygnus X-3.

A weekly observing campaign of the microquasar Cygnus X-3 by NASA's Swift satellite started in April 2010 was enhanced with a series of Target of Opportunity observations by Swift and NASA's Rossi X-ray Timing Explorer satellite (RXTE), when the source descended to a quenched state in February 2011 and emerged a month later with a major radio flare. We have modeled ~90 sets of X-ray spectra taken over a period of one year, during which Cygnus X-3 went through all its previously known spectral states. Our dataset features the most extensive coverage of the 0.5–3 keV energy range from Cygnus X-3 ever observed, enabling us to detect and characterize a soft (~50 eV) blackbody- or Bremsstrahlung-like component, which is modulated in phase and correlated with the main continuum. This soft component has a temperature consistent with that of the photoionized Radiative Recombination Continua seen in high-resolution observations by NASA's Chandra satellite, and associated with the stellar wind from the Wolf-Rayet -type companion star. The continuum between 1–60 keV (with the addition of Iron features between 6–9 keV) can be described by a disk blackbody Comptonized by a thermal electron plasma of ~20 keV temperature, optically thick during quiescence and minor flaring, thin in the quenched state and stronger flares, with a non-thermal accelerated population providing the occasional hard power law tail; reflection, while by no means excluded, is not necessary for our model. The consistent fit residuals between 1–5 keV can be eliminated by the addition of unresolved line components, whose consistent presence and characteristics are constrained by Chandra data. The X-ray modeling results will be presented in a paper currently under preparation, in context with near-simultaneous radio fluxes from AMI-LA (Arcminute Microkelvin Imager Large Array). Further multiwavelength analysis by collaborators using radio data from the RATAN-600 telescope, infrared data from PAIRITEL (Peters Automated IR Imaging Telescope), and gamma-ray data from the Fermi satellite, will be published in another paper. Some initial results were presented in the poster ”Using Chandra HETG and Swift XRT Spectra to Understand Cygnus X-3” at the 218th American Astronomical Society Meeting in Boston, Massachusetts, which took place on 22.–26.5.2011.

1.8.3 Analysis of Chandra grating spectra of Cygnus X-3

Project Team: Savolainen, McCollough (SAO), Hannikainen (Florida Institute of Technology)

The observations of Cygnus X-3 by the Chandra satellite's grating instruments in 1999, 2000 and 2006 resulted in a set of X-ray spectra with the best available wavelength resolution, capturing the source in all the major spectral states it exhibits. We have reprocessed and analyzed the data, further improving the resolution to accurately model the evolution of ~30 of the strongest photoionized features through different spectral states and orbital phases. These features are present in each observation integrated over at least a complete orbital cycle, but some, most notably the 6.4 keV neutral Iron line, undergo significant orbital modulation. Emission lines are seen to be relatively stronger in specral states with lower soft X-ray continuum emission. Line broadening and centroid-shifting consistently show stellar wind velocities of ~1000 km/s, variation from the average potentially giving us information on the concentration of emission from different lines in different parts of the system. From the 2006 observations, during which Cygnus X-3 was in the hypersoft/quenched state, we can start to resolve the triplet structure (Resonance, Intercombination, and Forbidden lines) of the 6.7 keV Helium-like Iron emission line using the third-order spectra; the best-fit line ratios are consistent with an origin in a high-density, low temperature photoionized plasma with a high ionization parameter. The plasma temperatures derived from the Radiative Recombination Continua are in the range 10–70 eV, or 9–60 million K. The phase-resolved part of the analysis, as well as photoionizational modeling of the features with the XSTAR code, are still ongoing. Initial results were presented in the poster ”Using Chandra HETG and Swift XRT Spectra to Understand Cygnus X-3” at the 218th American Astronomical Society Meeting in Boston, Massachusetts, which took place on 22.–26.5.2011, and in the poster ”A Chandra HETG analysis of the X-ray line features of Cygnus X-3” at the 2011 Meeting for the High

Energy Astrophysics Division in Newport, Rhode Island, which took place on 7.–10.9.2011.

1.9 Multifrequency observing campaigns

Project Team: Lähteenmäki, Tornikoski, Nieppola, León-Tavares, Oksman, Rastorgueva, Tammi, Lavonen, Järvelä, Kareinen

We took part in several multifrequency campaigns in 2011, and did individual observing requests, too. Typically we support the campaign with daily observations, and continue regular monitoring also before and after the core campaign. Examples of such campaigns are the WEBT and GASP collaborations on several sources in connection to satellite observations at high energies, particularly Fermi and also Swift. We are also regularly observing selected sources for VERITAS Blazar Science Working Group multiwavelength campaigns and support VERITAS Target of Opportunity campaigns. We also support MAGIC observations. The largest observing campaign of the year was the support campaign for the Planck satellite.

1.10 Solar research

Project Team: Kallunki, Tornikoski, Lavonen, Riehokainen (University of Turku, Tuorla Observatory)

During Summer 2011, the main emphasis was to study the long-periodic solar oscillations in the radio brightenings (sunspots) using the 13.7-meter radiotelescope. Totally, around 20 feasible observation days were achieved and continous solar tracks of up to 12 hours in length were observed. Additionally, almost every day of the year, at least one solar radio map was observed.

In 2011 a new technique was adopted for making tracking observations of the Sun with the 13.7-meter telescope. The new technique is based on making a series of small partial solar maps of an area of interest on the solar surface. To gain a reference point on the atmospheric conditions, small partial maps are also measured from the sky, typically about 0.3-1 degrees apart from the solar disk. The data from the partial maps is processed into a time series for visualization and saving. The new technique differs from the one used earlier where the tracking was done by continuously pointing the telescope's beam at the point of interest on the Sun's disk. The partial map method addresses the old tracking system's problem of an inaccurate telescope pointing, albeit it loses to the old system in temporal resolution; where the old system reached a sampling rate of 20 samples per second, the new technique can only record about one partial map every one to four minutes. An example tracking observation made in 2011-08-03 is depicted in Figure1.9

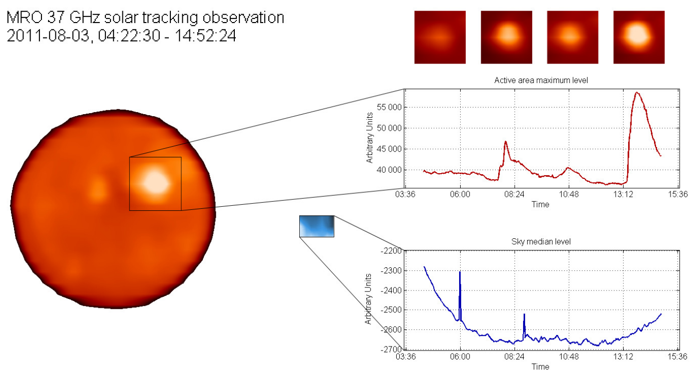

Figure 1.9. The new partial map-tracking method used with Metsähovi's 13.7-meter telescope.

During 2011, the development of the Matlab-based solar observation tool 'Sunmap' continued. The program's user interface received continual upgrades and compatibility with the Linux based observation system was maintained as the system was gradually upgraded. Also, the method for acquiring the radius and center of the solar disk was switched to a more accurate and reliable circle fitting system.

The small radiotelescope (diameter 1,8 m) was used for continuous monitoring of the whole Solar disk at a frequency of 11,7 GHz.

The scientific focus was with the solar oscillation both in the active regions (sunspot) of the Sun and quiet Sun areas. In addition to our own data, mainly Nobeyama and SOHO/MDI data were used for these investigations. Also, the radio pulsating structures of solar flares were studied at various radio wavelengths along with some optical data. Solar cyclicity studies were started using Metsähovi's exceptionally long solar radio map set.

1.10.1 Callisto - solar radio spectrometer

Due the rising solar activity during 2011, over 100 solar radio burst were detected with Callisto measurement system. The whole e-Callisto network's observation archive can be found from: http://soleil.i4ds.ch/solarradio/callistoQuicklooks/

1.11 Recreational events & keeping fit

1.11.1 Recreational day at Bengtskär Lighthouse and Rosala Viking Centre

The annual Metsähovi recreational day was held on June 15th, 2011.

Figure 1.10. First row: Arriving to Rosala and lunch at the Viking Centre. Second row, left: Metsähovi's Director getting ready for ELEC Management Team meeting. Second row, right and third row, left: Heading towards Bengtskär Lighthouse. Third row, right: First some guidance, and then up to look at the view from the lighthouse.

2. Publications

2.1 International journals

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(23 co-authors): Flare activity of the blazar 3C454.3 from gamma to radio wavelength range in 2004-2010, Kinematics and Physics of Celestial Bodies, Vol. 17, No. 2, pp. 68, 2011.

63. Kislyakova, K.G.; Zaitsev, V.V.; Urpo, S.; Riehokainen, A.: Long-Period Oscillations of the Solar Microwave Emission, Astronomy Reports, Vol. 55, No. 3, pp. 275-283, 2011.

2.2 International conferences

1. Rügamer, S.; Angelakis, E.; Bastieri, D.; Dorner, D.; Kovalev, Y.; Lähteenmäki, A.; Lindfors, E.; Longo, F.; Reinthal, R.; Stamerra, A.; Ungerechts, H.: MAGIC and Multi-Wavelength Observations of three HBLs in 2008, 2011 Fermi Symposium, Rome, Italy, 9-12 May, eConf C110509, 2011.

2. Fromm, C.M.; Perucho, M.; Savolainen, T.; Ros, E.; Lobanov, A.P.; Zensus, J.A.; Lähteenmäki, A.: Evidence for Shock-Shock Interaction in the Jet of CTA 102. Proceedings of the International Astronomical Union, IAU Symposium, Vol. 275: Jets at all Scales, Buenos Aires, September 13-17 2010. pp. 194-195, 2011.

3. Pacciani, L.; Donnarumma, I.; Piconcelli, E.; Antonelli, A.; Fiore, F.; Hannikainen, Diana; Lähteenmäki, Anne; Mathur, S.; Miller, H.R.; Panessa, F.: A preliminary cencus of soft excess occurrence from a small sample of R1-NLSy1, NARROW-LINE SEYFERT 1 GALAXIES AND THEIR PLACE IN THE UNIVERSE, Milano, Italy, April 4-6 2011, Proceedings of Science, Vol. NLS1, 2011.

4. Marscher, A.P.; Jorstad, S.G.; Joshi, M. ; Larionov, V.M. ; Agudo, I. ; Lähteenmäki, Anne; Kurtanidze, O.; Gurwell, M.; Wehrle, A.E.: Observations and Modeling of Multi-waveband Variations of Blazars during Gamma-ray Outbursts, Proceedings of the 2011 Fermi Symposium, Rome, Italy, May 9-12, SLAC econf C110509, 2011.

5. Agudo, I.; Jorstad, S.G.; Marscher, A.P.; Larionov, V.M.; Gómez, J.L.; Lähteenmäki, Anne; Gurwell, M.; Smith, P.S.; Wiesemeyer, H.; Thum,

C.; Heidt, J.: Gamma-ray flaring emission in the blazar OJ287 located in the >14pc from the black hole, Proceedings of the 2011 Fermi Symposium, Rome, Italy, May 9-12, SLAC econf C110509, 2011.

6. Rügamer, S.; Angelakis, E.; Bastieri, D.; Dorner, D.; Kovalev, Y.; Lähteenmäki, Anne; Lindfors, E.; Longo, F.; Reinthal, R.; Stamerra, A.; Ungerechts, H.: MAGIC and Multi-wavelength Observations of Mrk 180 and 1ES 2344+514 in 2008, 32nd International Cosmic Ray Conference, Beijing, China, August 11-18, 2011.

7. Agudo, Ivan; Jorstad, Svetlana G.; Marscher, Alan P.; Larionov, Valeri M.; Gómez, Jose L.; Lähteenmäki, Anne; Gurwell, Mark; Smith, Paul S.; Wiesemeyer, Helmut; Thum, Clemens; Heidt, Jochen: Gamma-ray emission region located in the parsec scale jet of OJ287, Beamed and unbeamed gamma-rays from Galaxies, Muonio, Finland, 11-15.4.2011.

8. Tammi, Joni: Flare like Outbursts from Loading of the Jets?, Proceedings Steady Jets & Transient Jets-workshop, MPIfR, Bonn, Germany, 7-8 April 2010, Memorie della Società Astronomica Italiana, Vol. 82, p. 129, 2011.

9. Savolainen, Petri; Paizis, A.; Farinelli, R.; Hannikainen, D.C.; Kuulkers, E.; Vilhu, O.: Disentangling the Z and Atoll sources: results from a NS LMXB survey with INTEGRAL, AIP Conference Proceedings, Vol. 1379, pp. 217-218, 2011.

10. Koljonen, K.I.I.; Hannikainen, D.C.; McCollough, M.L.; Pooley, G.G.; Trushkin, S.A.; Tavani, M.; Droulans, R.: The disk/jet connection in the enigmatic microquasar Cygnus X-3. Jets at all Scales, , September 13-17, 2010, Buenos Aires, Argentina, Proceedings IAU Symposium. No. 275, pp. 285-289, 2011.

11. Reinthal, R.; Lindfors, E.; Longo, F.; Lähteenmäki, Anne; Rügamer, S.; Stamerra, A.: Multi-wavelength Observations of HBL object 1ES 1011+496 in Spring 2008, 32nd International Cosmic Ray Conference, Beijing, China, August 11-18, 2011.

12. Haas, R.; Hobiger, T.; Sekido, M.; Koyama, Y.; Kondo, T.; Takiguchi,

H.; Kurihara, S.; Kokado, K.; Tanimoto, D.; Nozawa, K.; Wagner, Jan; Ritakari, Jouko; Mujunen, Ari; Uunila, Minttu: Near real-time monitoring of UT1 with geodetic VLBI, Proceedings of the 20th Meeting of the European VLBI Group for Geodesy and Astronomy, Ed. By W. Alef, S. Bernhart, A. Nothnagel, pp. 64-66, March 29-30, Bonn, 2011.

13. Tornatore, V.; Haas, R.; Duev, D.; Pogrebenko, S.; Casey, S.; Molera Calvés, Guifré; Keimpema, A.: Single baseline GLONASS observations with VLBI: data processing and first results, Proceedings of the 20th Meeting of the European VLBI Group for Geodesy and Astronomy, Ed. By W. Alef, S. Bernhart, A. Nothnagel, pp. 162-165, March 29-30, Bonn, 2011.

14. Raiteri, C.M.; Villata, M.; Aller, M.F.; Gurwell, M.F.; Kurtanidze, O.M.; Lähteenmäki, Anne; Larionov, V.M.; Romano, P.; Vercellone, S.; on behalf of the GASP-WEBT Collaboration: Multifrequency observations of the blazar 3C 454.3 activity in 2008-2010, Time Domain Astrophysics with SWIFT, 24-26.10.2011, Clemson, USA, submitted 2011.

15. Joshi, M.; Marscher, A.; Jorstad, S.; Böttcher, M.; Agudo, I.; Larionov, V.; Aller, M.; Gurwell, M.; Lähteenmäki, Anne: Multiwavelength Spectral Studies of Fermi-LAT Blazars, 2011 Fermi Symposium, Roma, May 9-12, 2011.

16. León-Tavares, Jonathan; Tornikoski, Merja; Lähteenmäki, Anne: The connection between the gamma-ray emission and millimeter flares in Fermi/LAT blazars, 2011 Fermi Symposium, Roma, May 9-12, 2011, econf C110509.

17. Kallunki, J.; Riehokainen, A.: Investigations of the quasi-periodic solar oscillations at the sunspots/active regions based on SOHO/MDI magnetograms, 13th European Solar Physics meeting, Rhodos, Greece, 12-16.9 2011, pp. 89.

18. Kallunki, J.; Pohjolainen, S.: Radio pulsating structures associated with coronal loop contraction, 13th European Solar Physics meeting, Rhodes, Greece, 12-16.9.2011, pp. 137.

19. Koljonen, K.; McCollough, M.; Hannikainen, D.; Pooley, G.; Trushkin, S.; Tavani, M.; Droulans, R.: The Anatomy of Major Radio/X-ray Flares in the Enigmatic Microquasars Cygnus X-3, Bulletin of the American Astronomical Society, Vol. 43, 2011.

20. Joshi, M.; Marscher, A.; Jorstad, S.; Agudo, I.; Larionov, V.; Aller, M.; Gurwell, M.; Lähteenmäki, Anne: Multiwavelength Spectral Studies of Fermi-LAT Blazars, Bulletin of the American Astronomical Society, Vol. 43, 2011.

21. Jorstad, S.G.; Marscher, A.P.; Smith, P.S.; Larionov, V.M.; Agudo, I.; Lähteenmäki, Anne: A Gamma-Ray Outburst in the Quasar 4C+21.35 on Milliarcsecond Scale, Bulletin of the American Astronomical Society, Vol. 43, 2011.

22. Savolainen, P.; McCollough, M.L.; Hannikainen, D.C.: Using Chandra HETG and Swift XRT Spectra to Understand Cygnus X-3, American Astronomical Society, AAS Meeting #218, #228.04; Bulletin of the American Astronomical Society, Vol. 43, 2011.

23. Savolainen, P.; McCollough, M.L.; Hannikainen, D.C.: A Chandra HETG analysis of the X-ray line features of Cygnus X-3, American Astronomical Society, HEAD meeting, #12, #13.16, 2011.

24. McCollough, M.L.; Savolainen, P.; Koljonen, K.; Hannikainen, D.: Cygnus X-3 Collaboration: The 2011 Cygnus X-3 Multi-Wavelength Campaign, American Astronomical Society, HEAD meeting, #12, #8.16, 2011.

2.3 Laboratory reports

1. Tornikoski, M., Mujunen, A., Holmberg, B., (editors): Aalto University Metsähovi Radio Observatory Annual Report 2011.

3. Visits to foreign institutes

- University of Berkeley, USA, 1.10.2010-30.09.2011, G. Molera
- Smithsonian Astrophysical Observatory/Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA, 3.1. - 27.12.2011, (SAO Predoctoral Fellowship), P. Savolainen
- Chalmers University of Technology, Gothenburg, Sweden, 5.1. 2011, M. Tornikoski
- INAF Institute of radio astronomy, Bologna, Italy, 11. - 14.4.2011, M. Tornikoski
- Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts, USA, 2. - 29.5.2011, K. Koljonen
- Onsala Space Observatory, Onsala, Sweden, 20. - 24.6.2011, M. Uunila
- Max Planck Institut für Radio Astronomie, Bonn, Germany, 1.10.2011-31.1.2012, M. Uunila
- Joint Institute for VLBI in Europe (JIVE), Dwingeloo, Netherlands, 1. - 4.11.2011, G. Molera
- Jodrell Bank Radio Observatory, UK, 3.11.2011, M. Tornikoski
- University of Manchester, UK, 2 & 4.11.2011, M. Tornikoski
- University of Würzburg, Germany; Dr. Felix Spanier & Dr. Matthias

Weidinger, 20. - 25.11.2011, J. Tammi

4. Teaching

1. S-92.3146, Radio Astronomy, M. Tornikoski, A. Lähteenmäki

5. Other activities

- Scientific Associate in the Planck satellite's LFI consortium, M. Tornikoski
- Referee for the Publications of the Astronomical Society of Japan, M. Tornikoski
- Referee of observing proposals for the Global Millimetre VLBI Array, M. Tornikoski
- Evaluator for a research funding application to the Latvian Science Council, M. Tornikoski
- Planck satellite Co-Investigator, Planck Scientist, A. Lähteenmäki
- Pre-examiner of Elizaveta Rastorgueva's doctoral thesis at University of Turku, A. Lähteenmäki

5.1 Participation in boards and committees

- Steering group member of the Ministry of Education graduate school of astronomy and space physics, A. Lähteenmäki
- Associate member of the Very Energetic Radiation Imaging Telescope Array System (VERITAS) collaboration, M. Tornikoski, A. Lähteenmäki
- Member of the XMM-Newton A0-11 Observing Time Allocation Committee, A. Lähteenmäki

- Member of IVS Task Force on UT1 Intensives, M. Uunila

- Finnish Astronomical Society, treasurer, K. Koljonen

- Management Committee member and gender coordinator of the COST-funded research network Black holes in a violent universe, M. Tornikoski

- Finland's delegate to the Scientific Comission J (Radio Astronomy) of the International Union of Radio Science (URSI), M. Tornikoski

- Member of the Finnish National committee of COSPAR (Committee on Space Research), M. Tornikoski

- Member of the Onsala Space Observatory Time Allocation Committee (OSO + APEX time allocation), M. Tornikoski

- ESF Committee for Radio Astronomy Frequencies, CRAF, Finland's representant, J. Ritakari

- NEXPReS Consortium Board, chairman, A. Mujunen

- Member of the Scientific Organizing Committee of the Planck conference 2012 "Astrophysics from the radio to the submillimetre - Planck and other experiments in temperature and polarization", to be held in Bologna, Italy, 13. - 17.2.2012, A. Lähteenmäki

- Deputy member of the steering group for Finnish Centre for Astronomy with ESO (FINCA), A. Lähteenmäki

5.2 International meetings and talks

1. Onsala Space Observatory OSO/APEX-Time Allocation Committee meeting, Göteborg, Sweden, 5.1.2011, M. Tornikoski

2. Planck 2011 - conference, The millimeter and submillimter sky in the Planck mission era, Paris, France, 10. - 14.1.2011, Invited talk on Planck early paper: Planck observations of extragalactic radio sources, A. Läh-

teenmäki

3. EVN Technical and Operations Group meeting, Dwingeloo, Netherlands, 27. - 29.1.2011, M. Uunila

4. NEXPReS WP8-meeting at Joint Institute for VLBI in Europe (JIVE), Dwingeloo, Netherlands, 17. - 19.2.2011, A. Mujunen

5. Planck CORE-team meeting, Bologna, Italy, 8. - 11.3.2011, J. León-Tavares

6. 20th European VLBI for Geodesy and Astrometry meeting and 12th Analysis Workshop, Bonn, Germany, 28.3 - 1.4.2011, M. Uunila

7. COST action MP0905-Black holes in a violent universe WG and MC-meetings, Bologna, Italy, 11. - 14.4.2011, M. Tornikoski

8. Planck Intermediate Paper-workshop, Paris, France, 12. - 15.4.2011, A. Lähteenmäki

9. Planck Joint Core team - meeting and WG6 meeting, Paris, France, 2. - 6.5.2011, A. Lähteenmäki, J. León-Tavares

10. The 2011 Fermi Symposium, Rome, Italy, 8. - 13.5.2011, J. León-Tavares

11. IVS TOW-meeting, Haystack Observatory, Westford, USA, 6. - 15.5.2011, M. Uunila, G. Molera

12. RadioNet 5th Engineering Forum workshop, Cagliari, Italy, 11. - 14.5.2011, P. Kirves

13. HEAD Lunch talk at Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA, 16.5.2011, K. Koljonen

14. Onsala Space Observatory OSO/APEX-Time Allocation Committee meeting, Göteborg, Sweden, 18.5.2011, M. Tornikoski

15. 218th American Astronomical Society Meeting, Boston, Massachusetts, USA, 22. - 26.5.2011, P. Savolainen, K. Koljonen

16. ICT VLBI2SKA Workshop, Aveiro, Portugal, 23. - 26.5.2011, A. Mujunen

17. Summer School in Statistics for Astronomers VII, Pennsylvania, USA, 4. - 13.6.2011, J. León-Tavares

18. The 8th Annual International Planetary Probe Workshop (IPPW-8), Portsmouth, VA, USA, 6. - 10.6.2011, G. Molera

19. The 41st Young European Radio Astronomers Conference, Jodrell Bank Observatory, Great Britain, 17. - 21.7.2011, E. Rastorgueva

20. Black hole astrophysics workshop: Tales of Power and Destruction, Winchester, Great Britain, 17. - 22.7.2011, K. Koljonen

21. XXVI International Conference of Physics Students, Budapest, Hungary, 11. - 18.8.2011, P. Savolainen

22. Summer School High Energy Astrophysics, Weesenstein, Germany, 21. - 27.8.2011, K. Koljonen

23. Central Kiloparsec in Galactic Nuclei Workshop, Cologne, Germany, 28.8 - 2.9.2011, J. León-Tavares

24. Planck LFI Core Team-meeting, Bologna, Italy, 4. - 8.9.2011, J. León-Tavares

25. 1st Annual Review Meeting of the EC-FP7 project NEXPReS, Brussels, Belgium, 7. - 8.9.2011, A. Mujunen

26. 2011 Meeting for the High Energy Astrophysics Division, Newport, Rhode Island, USA, 7. - 10.9.2011, P. Savolainen

27. 13th European Solar Physics meeting, Rhodes, Greece, 11. - 16.9.2011, J. Kallunki

28. The Extreme and Variable High Energy Sky-conference, Sardinia, Italy, 18. - 24.9.2011, J. Tammi

29. COST network's Black holes in a violent universe WG and MC-meeting, Manchester, Great Britain, 1. - 4.11.2011, M. Tornikoski

30. Fermi and Jansky: Our evolving Understanding of AGN-meeting, St. Michaels, MD, USA, 8. - 13.11.2011, J. León-Tavares

31. The XMM-Newton A0-11 TAC-meeting, ESAC Madrid, Spain, 9. - 12.11.2011, A. Lähteenmäki

32. The Planck Joint Core Team-meeting, Bologna, Italy, 13. - 17.11.2011, J. León-Tavares

33. Harvard-Smithsonian Center for Astrophysics, Graduate Student Seminar, Cambridge, Massachusetts, USA, 16.11.2011, P. Savolainen

34. Onsala Space Observatory OSO/APEX-Time Allocation meeting, Onsala, Sweden, 7.12.2011, M. Tornikoski

35. Harvard-Smithsonian Center for Astrophysics, HEAD Lunch Talk, Cambridge, Massachusetts, USA, 7.12.2011, P. Savolainen

5.3 National meetings and talks

- Beamed and unbeamed gamma-rays from galaxies- conference, Muonio, 10. - 15.4.2011, J. Tammi

- The XIII meeting of Finnish space researchers: FinCOSPAR 2011, Kasnäs, Kemiö, 31.8 - 2.9.2011, J. Tammi

- Colloqium of the Department of Physics, University of Jyväskylä, 13.5.2011, talk: Planck Early results, A. Lähteenmäki

5.4 Public relations

- General Metsähovi excursions and short talks about radio astronomical research to many visiting groups. M. Tornikoski, A. Lähteenmäki

- Pollux, the astronomy and model rocketry club at Aalto University, excursion to Metsähovi, 27.1.2011, J. Tammi

- Sjökulla lågstadieskola, 3.11.2011, J. Tammi

- Kaikuja avaruudesta - radioteleskoopit kuuntelevat aikojen alkua, talk at Avaruusviikko 2011 (World Space Week 2011) event at the Finnish Science Centre Heureka, 8.10.2011, A. Lähteenmäki

6. Personnel in 2011

Permanent positions funded by Aalto University

Tornikoski, Merja, Prof.	Director of the institute Docent of Radio Astronomy and Space Technology	merja.tornikoski@aalto.fi
Aatrokoski, Juha, M.Sc. (Tech)	System administrator	juha.aatrokoski@aalto.fi
Holmberg, Birgit, Mrs.	Department Secretary	birgit.holmberg@aalto.fi
Kallunki, Juha, Lic.Sc. (Tech)	Operations Engineer	juha.kallunki@aalto.fi
Kirves, Petri, M.Sc. (Tech)	Operations Engineer	petri.kirves@aalto.fi
Mujunen, Ari, M.Sc. (Tech)	Laboratory Engineer	ari.mujunen@aalto.fi
Oinaskallio, Erkki, Mr.	Technician	erkki.oinaskallio@aalto.fi
Rönnberg, Henry, Mr.	Mechanician	henry.ronnberg@aalto.fi

Scientific and technical staff funded by research contracts

Järvelä, Emilia, student	Research assistant part-time 1.1 - 13.05., 1.9 - 31.12.2011 fulltime 14.5 - 31.8.2011	emilia.jarvela@aalto.fi
Kareinen, Niko, student	Research assistant fulltime 23.5 - 31.12.2011	niko.kareinen@aalto.fi
Koljonen, Karri, M.Sc.	Researcher	karri.koljonen@aalto.fi
Lavonen, Niko, student	Research assistant part-time 1.1-15.5, 1.9-31.12.2011 fulltime 16.5-31.8.2011	niko.lavonen@aalto.fi
León-Tavares, Jonathan, Ph.D.	Post-doc Researcher	j.leontavares@aalto.fi
Lindfors, Timo, student	Research assistant part-time 1.1-31.12.2011	timo.lindfors@aalto.fi
Lähteenmäki, Anne, D.Sc. (Tech)	Researcher	anne.lahteenmaki@aalto.fi
Molera Calvés, Guifré, M.Sc. (Tech)	Researcher part-time 1.1 - 30.9.2011 fulltime 1.10 - 31.12.2011	guifre.molera@aalto.fi
Nieppola, Elina, D.Sc. (Tech)	Visiting post-doc researcher	eni@kurp.hut.fi
Oksman, Miika, student	Research assistant part-time 1.1 - 15.5, 1.9 - 31.12.2011 fulltime 16.5 - 31.8.2011	miika.oksman@aalto.fi
Rastorgueva, Elizaveta, Ph.D.	Doctoral Student from 1.5.2011 until 31.10.2011, Post-doc researcher from 1.11.2011	elizaveta.rastorgueva@aalto.fi
Ritakari, Jouko, M.Sc. (Tech)	Researcher	ritakari@cc.hut.fi
Tammi, Joni, Ph.D.	Post-doc researcher	joni.tammi@aalto.fi
Turtiainen, Esa, Lic.Sc. (Tech)	Researcher, 1.1. - 31.5.2011	
Uunila, Minttu, M.Sc.	Doctoral Student part-time 1.1-31.12.2011	minttu.uunila@aalto.fi

Metsähovi advisory board

Jokela, Petteri, Dir.	Valtaoja, Esko, Prof.
Korpela, Seppo, Dir.	Tiuri, Martti, Prof.emer. (Chair)
Koskinen, Hannu, Prof.	Nygren, Tuomo, Prof.

HUT-MET-33 P. Sjöman, N.J. Hughes: Planck Technology 70 GHz Demonstrator Test Report. 2001.

HUT-MET-34 T. Liljeström, C.R. Gwinn: Water Masers Probing Magnetic Pressure and Alfvénic Turbulence in W49N. 2001.

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