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Metsähovi Radio Observatory
Annual Report 2008

M. Tornikoski, A. Mujunen, B. Holmberg, S. Hurtta (editors)

Metsähovi Radio Observatory
Helsinki University of Technology TKK

Director:
Dr. Merja Tornikoski
Tel. +358-9-4283 2048
Email: Merja.Tornikoski@tkk.fi

Secretary:
Mrs. Birgit Holmberg
Tel. +358-9-4283 2054
Email: Birgit.Holmberg@tkk.fi

Metsähovi Radio Observatory
Helsinki University of Technology TKK
P.O. Box 3000
FIN-02015 HUT
Finland

Metsähovin radiotutkimusasema
Teknillinen korkeakoulu
Metsähovintie 114
02540 KYLMÄLÄ

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1 Introduction

Metsähovi Radio Observatory, a research institute at 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 2008 twenty-four scientists, engineers, research assistants and support personnel worked at the institute. In 2008 the total expenditure of Metsähovi Radio Observatory was 1 020 390 euros including salaries and the rent of the office and laboratory space at the Metsähovi premises. This was funded by TKK, the Academy of Finland, the European Union, and other outside sources. We have also obtained considerable additional funding in the form of radio astronomical equipment to be delivered to Metsähovi in 2009-2010, a project funded by a debt conversion agreement between Finland and Russia.

In the beginning of 2008 there were some major organizational changes in TKK. Metsähovi was merged with the new faculty of Electronics, Communications and Automation but still maintained its status as a separate research institute. Another major reformation takes place in 2009, when Aalto University is created through a merger between TKK, the Helsinki School of Economics and the University of Art and Design. We sincerely hope that after these recent and on-going changes – with considerable administrative load related to the processes – there will again be more time to concentrate on science!

Merja Tornikoski
Director of TKK Metsähovi Radio Observatory

2 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.

2.1 Radio Astronomical Instrumentation

Research Group at Metsähovi: <u>Tornikoski</u>, Peltonen, Mujunen, Kallunki, Kirves, Oinaskallio, Ritakari, Rönnberg

2.1.1 3 and 2 mm SIS Receivers

Project team: <u>Kirves</u>, Peltonen, Mujunen, Oinaskallio, Kallunki, Rönnberg, Kotiranta

The 3 mm SIS receiver was used twice during the year 2008. Metsähovi participated in GMVA sessions in May and in October. In the May session the noise temperatures for the two channels were 80 K and 170 K in the laboratory. Up on the telescope the measurement presented similar performance. In the October session the other channel was found to be inoperative during a performance check at the laboratory. The mixer was replaced, which required a temperature cycling of the dewar. Following that the other channel was found to be dead. It was decided to run the session with one channel only, rather than replacing the mixer once more. After the session it was noticed that the quasioptics were stuck at the middle position, so the measurement results could be questionable.

The 3 mm receiver has been functioning unreliably for many years. After the session all 3 mm parts were disassembled from the 3 mm/2 mm receiver complex and some of them were sent to IAP for reuse in the new HEMT based receiver. The dewar was then rebuilt with only 2 mm components to be used exclusively at that wavelength in the future. A functional test was conducted with the one-channel 2 mm receiver and the measured noise temperature was 120 K.

2.1.2 Continuum Receivers

The venerable K and Q band continuum receivers operated smoothly during the whole year. The frequency response and the noise temperature of the receivers were measured as a standard maintenance procedure. The noise temperature was found to be 270 K and 290 K for the K-band and Q-band receivers, respectively. The calibration noise equivalent temperature is around 2 K.

The loose contact on the K band receiver LO requires maintenance from time to time.

2.1.3 VLBI Receivers

The Geodetic VLBI receiver at 2/8 GHz and the astronomic VLBI receiver at 22 GHz were operated several times during the year. With the Geo-VLBI RX an enhancement on the phase locking chain was done by replacing a T-junction with a decent power divider. Front-end components of the 22 GHz VLBI RX were reinvestigated to find the upper limit of the usable observation frequency. The outcome was that at least the RF amplifiers and band pass filters would require a replacement to be able to serve at the proposed new observing frequency of 23.8 GHz.

2.1.4 Receivers under Construction

Mikko Kotiranta was involved in the design of the new HEMT based W-band receiver front end. During the spring 2008 the design of several passive WR-10 waveguide components was finished. The components, intended to be used in the front end of the new 3 mm VLBI receiver, are a corrugated conical feed horn, a septum polariser, a power divider, a directional coupler and a band-pass filter. A commercial electromagnetic field simulation software, Ansoft HFSS, was used to simulate and optimise the structures. Initially, an operating band of 81 - 99 GHz, meaning a 20 percent relative bandwidth, was planned, but it became later evident that the septum polariser could provide only a relative bandwidth of about 13 percent. Prototypes of the components, except the corrugated feed horn, were manufactured and measured by DA-Design Ltd. A detailed description of the component design may be found from the Master's thesis of Mikko Kotiranta: A cooled 90 GHz VLBI-receiver front end (2008).

CAD drafts of the construction were received in October. The drafts were reviewed and accepted for the start of manufacturing. At the meeting in October, Pekka Sjöman from DA-Design presented engineering models of the front end module components. Visit to IAP, Nizhny Novgorod at the end of March 2009 was agreed. A schematic diagram for the following project, the pseudocorrelation receiver, was obtained in May and preliminary CAD drafts were obtained in November.

2.1.5 Opacity of the Atmosphere

A program for determining the opacity of the atmosphere at zenith was developed. It measures the system noise temperature at different antenna elevations and fits a line to the data by using the method of least squares. The opacity is then given by the slope of the line. In normal operation, the 22 GHz and 37 GHz continuum receivers utilise Dicke-switching between two feed horns to cancel the contribution of the atmosphere from the measurements. In order to determine the opacity, Dicke-switching must be disabled, and the old analog back end, which is currently used to provide the program with data, has to be set manually to the total power mode. This makes the measurement process slighty awkward.

2.1.6 Study of Antenna Properties

A program for calculating different properties of the antenna, such as the effective aperture, aperture efficiency, beam efficiency and directivity, was written. A calibration source measurement is required as well as knowledge about the amount of calibration noise injected to the receiver (determined with hot and cold loads). An initial version of a program for measuring the half power beam width of the antenna was also developed.

2.1.7 IT Infrastructure

Project Team: Mujunen, Lindfors, Aatrokoski

Antenna Control

Preliminary work for a new, Linux-based antenna control computer was started by writing Linux drivers for the add-on ISA cards used in controlling the antenna.

Data Acquisition

As a part of modernizing the system used to make observations, a daemon program to read the A/D data from the new digital backend was developed. The daemon reads the A/D samples from the Datel PCI-416M data acquisition card using the previously written Linux driver, and dispatches them to an arbitrary number of programs that can be added and removed on the fly.

Weather Stations

The existing weather monitoring system was modified to add support for controlling and reading data from the new Vaisala WXT520 weather monitoring stations.

Telephones

The old phone exchange was aging and spare parts were not available anymore. As the mobile phones offered as the upgrade were not acceptable, it was decided to replace the old phones with internet (VoIP) phones. A server was purchased and configured to run Asterisk to route all phone traffic between Metsähovi and Saunalahti, the VoIP provider chosen. Thirty Linksys SPA941 VoIP phones were purchased to replace the old phones.

Mobile Internet

A Huawei 3G modem and an unlimited data plan was purchased to enable employees to work remotely from summer cottages and other locations without any other internet connectivity. As a supporting feature an embedded Linux computer that can share the modem's internet connection via WLAN was built and installed into Metsähovi's car.

Network

The whole Metsähovi computer network was upgraded to use private 10.x.x.x IP addresses, and a new managing system for DNS and DHCP configuration was written. The old addresses were from the TKK 130.233.x.x address space but not allocated and used privately behind a NAT, thus masking access to any hosts at TKK having those addresses. The masking had not been a problem, but using the same address space can cause confusion about being in the same network as the rest of the addresses, as well as being a potential problem in case of NAT malfunctions.

Data Storage

The NFS servers housing home directories (nova) and the collected data (data) were upgraded to new machines with larger, mirrored (RAID10 and RAID1) disks. The backup server in the clock cellar also needed new disks to be able to back up the constantly growing amount of data. To speed up the backups the connection to the clock cellar was upgraded from 100 Mbps to 1 Gbps by changing the media converters at boths ends of the fibre optic cable.

Virtualization

Two identical servers with four processor cores and 8 GB of memory were purchased to be used as hosts for virtual machines. The virtualization technology chosen at this point was KVM. The replacement for apps2 (named orbit) was installed for test use, and the windows terminal server (winapps) was also migrated from Vmware to KVM on these servers. A virtual server was also setup for running Matlab, and it is the intention that all proprietary software will be installed into their own virtual machines to avoid problems related to upgrading the hardware (and possibly the OS). To resolve some stability issues, other virtualization technologies will be considered in 2009 as an alternative to KVM.

2.1.8 Hydrogen Masers

Project Team: <u>Oinaskallio</u>, Kallunki, Mujunen

The H-Maser 69 worked throughout 2008 without any failures. In January 2008 PPS (pulse per second)-board of H-Maser 69 was replaced by a new one by KVARZ. The rest of the year the H-Maser (70) worked without any failures. In Figure 1 the time differences between the two H masers and several GPS clocks is illustrated. The Synthesizer value of the H-maser 69 was adjusted nine times and the H-maser 70 value was adjusted three times during the year 2008.

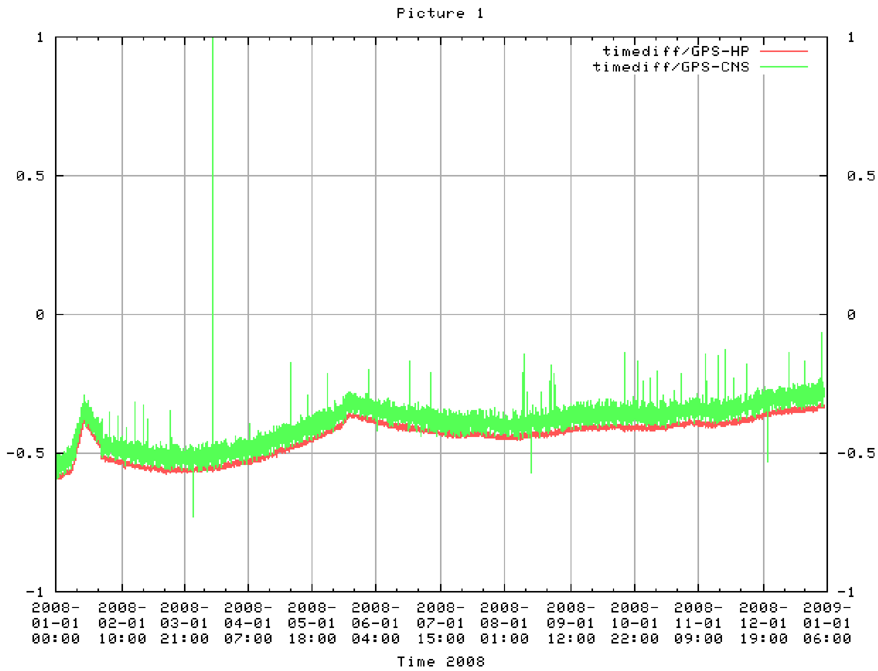

Figure 1: Time differences of H maser and GPS clocks, in microseconds.

The H-maser's power supply's old (Fiskars) battery chargers were replaced with new ones (Mascot) in May 2008.

2.1.9 New Hardware

Project Team: <u>Mujunen</u>, Kallunki, Oinaskallio, Rönnberg

Antenna Motors

Both elevation and azimuth motors were replaced after previous ones broke in November/December 2008. Simultaneously the first gear wheel between the motor axis and the gearbox was renewed.

Renewing the Antenna Cables

Coaxial, ethernet and electric cables from the control room/distribution centre to the antenna platform were renewed in April/May 2008. The cables were destroyed after the antenna had rotated approximately 10 rounds over it axis. The reason for this was that the incremental sensor control board lost its original position. Limit switches did not work (they were stuck), which in a normal situation should stop the antenna. The antenna accident happened on 24.3.2008.

GPS Antennas in Radiotelescope

Global positions system antennae were installed at the edge of main telescope mirror. They were used during the Geodetic VLBI sessions. The Finnish Geodetic Institute (FGI) wanted GPS antennae for tracking the accurate position and the movement of the radio telescope. In Figure 2 the GPS antenna assembly at the edge of the main telescope mirror is illustrated.

Figure 2: GPS antenna assembly at the edge of the main telescope mirror.

Sunant

The pointing of the Sunant antenna was further developed. The azimuth motor was replaced in December 2008 after the previous one failed. The rest of the year the antenna worked without any failures.

Background Measurement

In Figure 3 a background sweep (2009-07-25) using the 37 GHz receiver is presented. The measurment was done using the 37 GHz continuum receiver. The Receiver was settled to Sun measurement mode (analog-back-end with gain 40 and time constant 1 s). The measurement was made so that the elevation angle was increased up to certain intervals and then scanning the whole azimuth range (-180°... +180°).

Weather Stations

The old weather stations (GroWeather) were replaced with new Vaisala WXT520 weather stations. The weather stations are located in the same places as the previous ones and follow also the same transfer protocol. Weather station power supplies were renewed. One of the old GroWeather stations was installed in the radome wall.

Receiver Crane

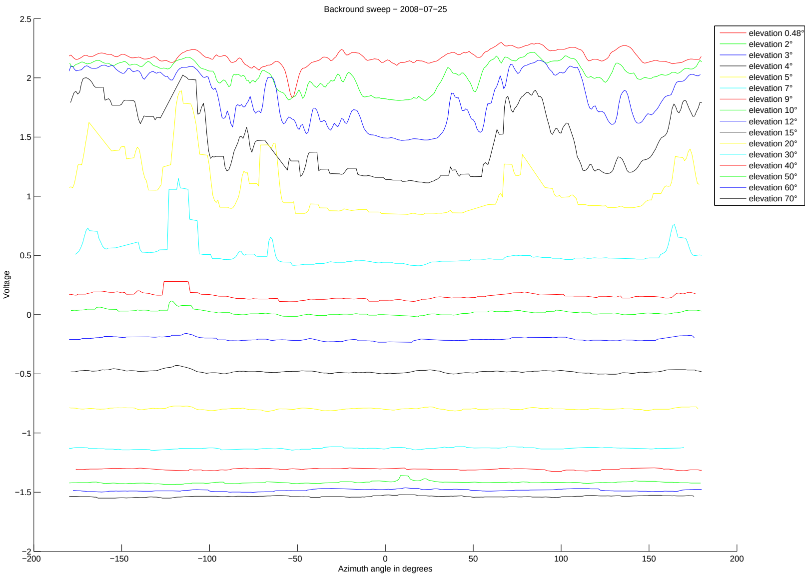

Figure 3: Background measurement using the 37 GHz receiver.

The receiver crane was finally lifted up to the antenna (lifting in process in Figure 4) in January 2008. In February 2008 the crane was taken in use when the last electrical and mechanical components were installed and the control software was updated. The crane has been working since then without any problems. In Figures 5 and 6 the receiver crane is shown in action.

Figure 4: Lifting the receiver crane to the antenna.

2.2 VLBI Instrumentation

Project team: Ritakari, Kirves

The 1.3cm K-band LCP+RCP receiver continues to be available. The 0.7cm receiver is still in our receiver laboratory waiting for replacement of the LNAs. The tests indicate that the room

Figure 5: Lifting the 22 GHz-VLBI receiver to the antenna.

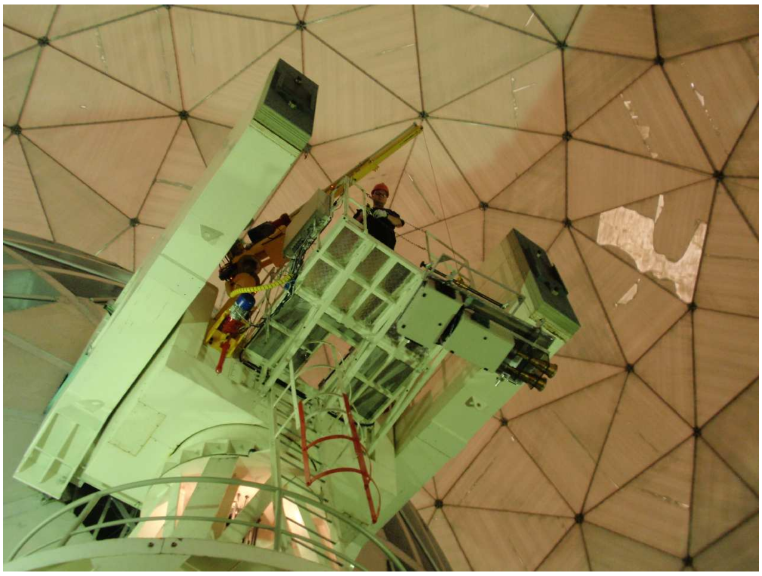

Figure 6: Lowering the 37 GHz continuum receiver to the radome platform.

temperature part of the receiver works correctly according to the block diagram and theoretically calculated signal levels and frequencies were measured.

Currently there is an effort to put the receiver into operation during the summer of 2009. The problematic custom-made MMIC chips are to be replaced with commercially available ones. According to data sheets the performance of these devices is fairly good. However the operation at cryogenic temperatures is still a question.

The 13/3.6cm standard S/X (not wideband X with the third IF3) geo-RCP-only receiver is available. It is owned by the Finnish Geodetic Institute (FGI) and for astronomy requires arrangements, thus prospective PIs need to contact Metsähovi directly. The 2/8 GHz Geo-VLBI receiver has proven to be reliable.

2.2.1 eVLBI and EU FP6 EXPReS

Project team: Ritakari, Wagner, Molera, Mujunen

Metsähovi is a partner in the FP6 project EXPReS.

Selective real-time channel dropping for 896 Mbit/s was demonstrated with Metsähovi Tsunami in late 2006 to early 2007. An update to Tsunami in 2008 sustains rates over 7 Gbps. During 2008 some stations have begun off-line Tsunami transfers for astronomic VLBI data in the EVN, too, in addition to previous daily geodetic transfers.

An FPGA-based test Digital Backend has been designed on an iBOB board at Metsähovi. The system sends digitized analog IF's via 10 Gigabit CX4 lines. A polyphase filter bank has been implemented as well but the performance is limited by the lack of internal memory of the board and the FPGA chip. The system has been evaluated without PFB in maser and spacecraft observations and in 10G network tests during 2008.

Real-time 4 to 8 Gbps radio signal streaming was demonstrated between Metsähovi and Onsala in 2008.

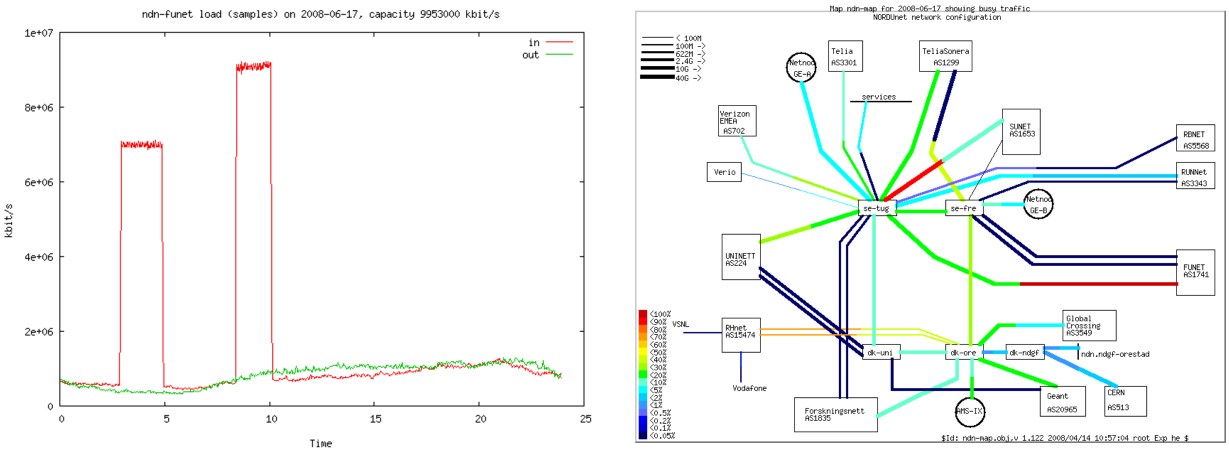

Figure 7: Internet 6-8 Gbps traffic between NorduNET and Funet on one Onsala/Metsähovi 10G test day (left). NorduNET load map during the 8 Gbps test (right). Images © by NorduNet 2008.

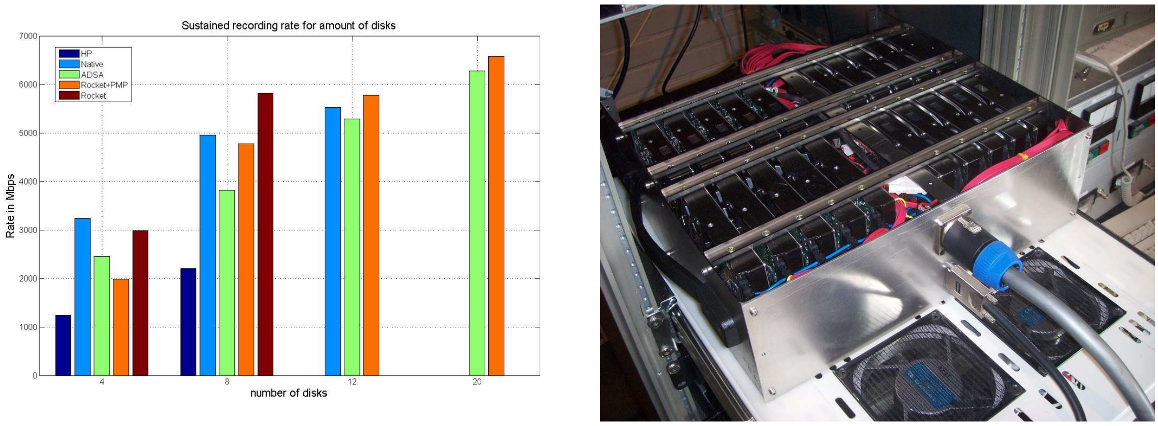

Figure 8: Early 2008 test of RAID controllers and port multipliers show COTS hardware allows over 4-6 Gbps rates to Mark5C-like 10G NAS (left). Shippable 4G-EXPReS SATA diskpack prototype on a rack-tray (right).

A shippable data storage system 4G-EXPReS capable of over 4 Gbps was developed in 2008 for

VLBI use. It allows Mark5C-compliant network recordings at over 4 Gbps to 20 disks (30TB). We plan to further evaluate and do demonstrations of 4 Gbps during 2009, hopefully reaching 8-10 Gbps sustained.

At the end of 2008 some assistance was provided to Italian DBBC FiLa 10G development.

2.3 VLBI Space Science Applications and Spacecraft tracking

Project team: Mujunen, Wagner, Molera

Campaigns on spacecraft observations with the Metsähovi radio telescope coordinated by the JIVE institute started in 2008 as a part of development and test activity in preparation for future involvement of EVN, Metsähovi and JIVE in planned ESA/NASA/JAXA Deep Space missions. The ESA Venus Express spacecraft was observed with the Metsähovi radio telescope at X-band on June 11 2008 using multi-bit data sampling and capture instrumentation and high performance processing software, developed at Metsähovi. (J. Wagner et al, Presentation at RadioNet FP6 Workshop, Yebes, Spain, Nov, 2008). Data analysis tools were developed at JIVE. Figure 9 shows a summary plot of results of this test run.

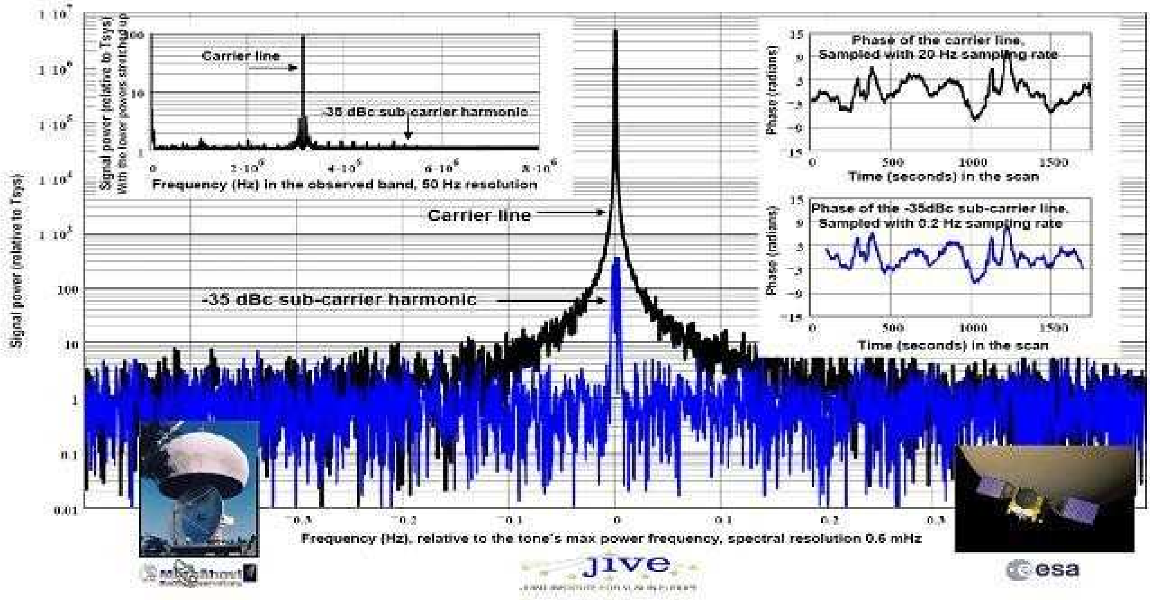

Figure 9: Summary plot for VEX observations with the Metsähovi telescope. The top left corner insert shows a preview spectrum with 50 Hz resolution over 8 MHz video band, with more than 40 dB dynamic range. The top right inserts show the detected phases of the carrier line and sub-carrier harmonic at the -35 dBc level. The central part of the plot shows the final spectra of the carrier line and one of sub-carriers with 0.6 milli Hz resolution and SNR of 5 million.

Successful detection and phase extraction of the -35 dB subcarrier, when VEX was 1.5 AU away from Earth, allows us to estimate that VEX-class transmitters can be detected by Metsähovi-class telescopes from a distance of more than 50 AU. This is a very encouraging step in preparation for EVN participation in Deep Space Gravity Theory Test missions (Pioneer-anomaly), like The Odyssey mission, proposed for the ESA Cosmic Vision program (B. Cristophe, Experimental Astronomy, in press). The NASA/ESA Ulysses spacecraft was observed simultaneous by Medicina and Metsähovi telescopes on S-band on Nov 28 2008. For these observations we used a 8-bit data capture unit based on iBob hardware and FPGA firmware developed at Metsähovi. Two hours of captured data were electronically transferred from Medicina to Metsähovi for high performance processing; while intermediate data were sent from MRO to JIVE for post-processing and analysis. At the time of observations Ulysses was 4.5 AU away from Earth, and its signal power level was more than 1000 times less than that from Venus Express. Preliminary results of this test achieved with the Medicina antenna are shown in Figure 10.

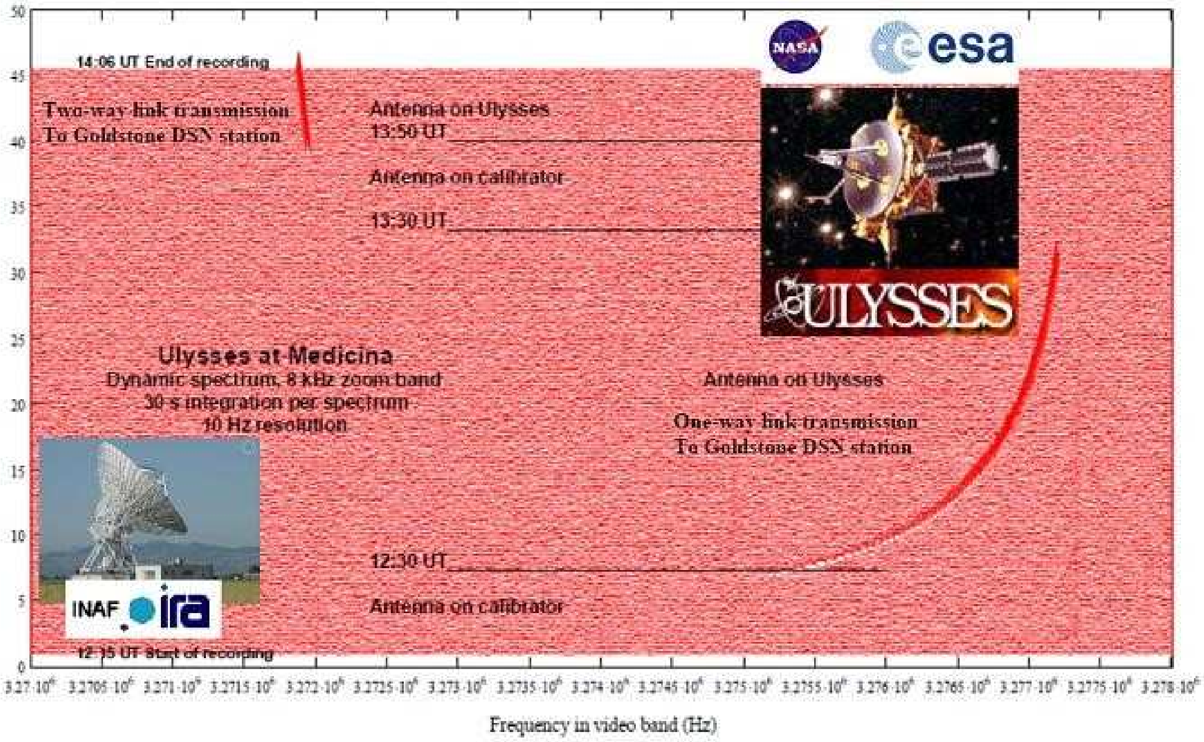

Figure 10: Medicina and Metsähovi data processed at Metsähovi and analyzed at JIVE. Spectral resolution is 10 Hz over the 8 MHz video band. Received signal power was 4 dB Tsys in 1 Hz. JIVE, Metsähovi and Medicina scientists are thankful to ESA/NASA VEX and Ulysses teams for interest in this work.

2.4 VLBI Observational Activities

Project team: Mujunen, Molera, 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 (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.

2.4.1 VLBI Sessions in 2008

In 2008 Metsähovi took part in nine geodetic off-line and real-time eVLBI sessions. The Global mm-VLBI Array (GMVA) observed also two sessions, in May and October in 2008. Five regular EVN sessions were conducted using the only available receiver (K-band frequency) at the station.

2.4.2 e-VLBI Sessions in 2008

Metsähovi has had 10G since 2006. All Germany or Japan correlated geodetic sessions were performed regularly either in real-time or using Tsunami e-VLBI. The fuseMk5A file system software has enabled astro/geo VLBI stations without PC-EVN to perform fast off-line e-VLBI.

Short JIVE e-VLBI checks up to 512 Mbps using Mark5A were performed successfully in 2007 and 2008. Lacking correlator capacity, EVN and GMVA sessions were however sent with traditional courier.

2.4.3 Rapid dUT1 Development Activities

Real-time 128 and 256 Mbps observation sessions with Tsukuba, Kashima and Onsala EVN stations were performed achieving near real-time dUT1 estimates. There was a live demo held in the JGN2 Symposium 2008. In a Japanese-Scandinavian joint dUT1activity we developed, evaluated and successfully demonstrated ultra-rapid dUT1 turnaround times and novel un-manned 24 hour near real-time dUT1 pipeline processing.

2.5 AMS-02

Project Team: Ritakari, Molera

The construction of the detector is progressing well at CERN in a specially-built clean room at the CERN Prévessin site. The data acquisition tests with the detector have been initially performed with ad-hoc software made by the detector groups, but the common HRDL/UDP-based data acquisition developed by Metsähovi will be tested later, probably in 2010. The current launch estimate for AMS-02 to be shipped to the ISS is in the 2010/2011 timeframe.

2.6 Extragalactic Radio Sources

2.6.1 BL Lacertae Objects

Project Team: Tornikoski, Nieppola, Hovatta, Kotiranta, Lähteenmäki, Torniainen, Valtaoja (Turku)

The work on the intrinsic blazar sequence was submitted in March. Blazar sequence refers to the much debated anticorrelation between the luminosity and the frequency of the synchrotron radiation energy peak of blazars. Blazars are a class of AGN formed by BL Lacertae objects (BLOs) and flat-spectrum radio quasars.

The blazar sequence has been proved and disproved with samples of varying size and composition over the years. However, the work has always been done with observed properties rather than intrinsic, i.e., source frame properties. To get to the root of the problem, the Metsähovi team used the Doppler factors calculated in another study (see Section 2.6.2) to derive the de-boosted luminosities and synchrotron peak frequencies for a sample of 135 blazars. This revealed that the alleged blazar sequence is not viable when using the source frame values. In fact, due to the very strong correlation between the Doppler factor and the synchrotron peak frequency, the anticorrelation turns positive when only BLOs are considered. This study was published in September 2008 in *Astronomy and Astrophysics.*

The manuscript on BL Lacertae variability was finished in 2008. The extensive work tackles radio variability of BLOs using several frequencies. The sample includes 24 of the radio-brightest BLOs and the data was acquired from both Metsähovi and the University of Michigan Radio Observatory in the U.S. Variability was studied from two angles: theoretical time scales (structure function, discrete correlation function and periodogram) and observed variability as quantified straight from the flux curves. The paper concludes that BLO variability is diverse, ranging from almost none at all to flares with a flux change of 10 Jy. The flares seem to adhere to the generalized shock model, though data are too sparse for truly conclusive modelling. The work was submitted to *Astronomical Journal* in October 2008.

2.6.2 Long-term Variability

Project Team: Tornikoski, Hovatta, Lähteenmäki, Torniainen, Nieppola, Valtaoja (Turku), Lainela (Turku)

In 2008 the work on long-term variability of active galactic nuclei continued and two articles were published in Astronomy & Astrophysics. Our study of long-term variability timescales using the wavelet analysis method showed that the variability behaviour of AGN is complex and timescales in these sources change over a long time. An example of a wavelet plot is shown in Figure 11. The y-axis is the frequency in units 1/year and the x-axis is time in years. Power of a timescale is shown in colour. The plot shows that in this source, the timescale of 3.4 years is only present in the latter half of the flux curve starting around 1995. Our previous study, using global methods (Hovatta et al. 2007) revealed the same timescale for the source but did not indicate that it is visible only in half of the flux curve. Based on these analyses we consider it appropriate to use wavelets when quasi-periodicities in AGN are studied.

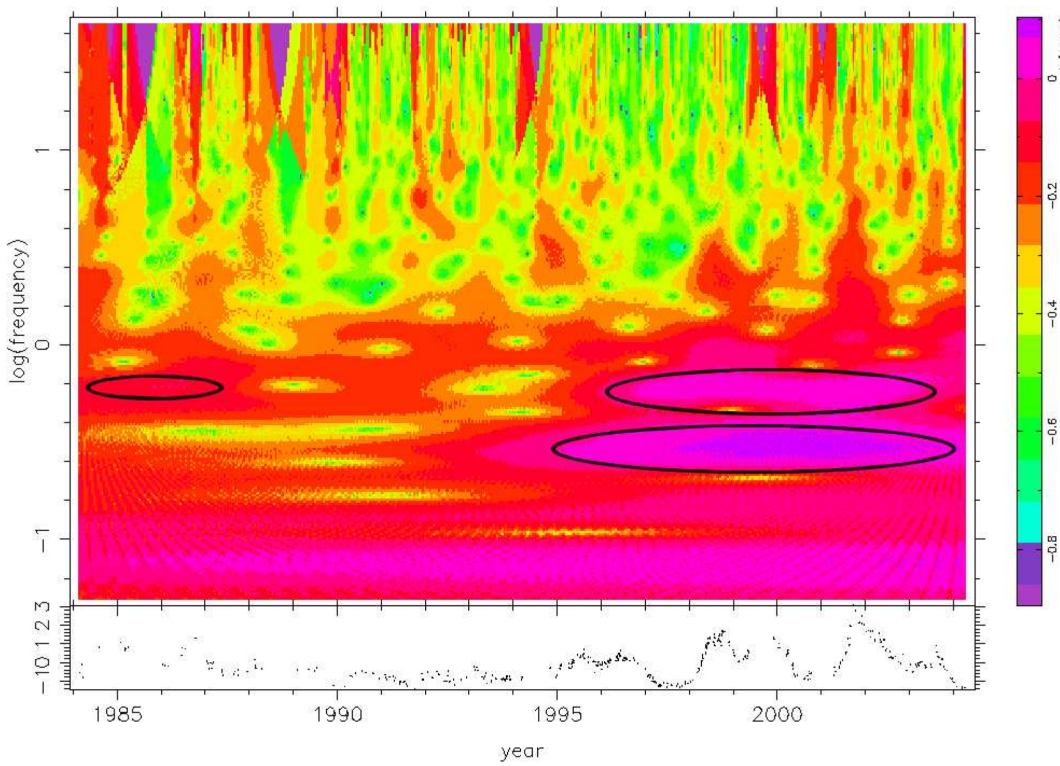

Figure 11: Wavelet transform of the source 1156+295 at 22 GHz (Hovatta et al. 2008).

Our results on flare characteristics of 55 sources were also published in 2008. In our analyses we used 8 different frequency bands between 4.8 and 230 GHz and extracted flare properties, such as duration and peak flux density, for 159 flares. Using these data we were able to study how well the flares correspond to the shock model. The observations seem to adhere well to the shock model, but there is still large scatter in the data. Especially the time delays between the different frequency bands are difficult to study due to the incomplete sampling of the higher frequencies. The average duration of the flares is 2.5 years at 22 and 37 GHz which shows that long-term monitoring is essential in understanding the typical behaviour of these sources.

We also used the long-term data obtained at Metsähovi at 22 and 37 GHz to calculate various jet parameters. By decomposing the flux curves into exponential flares (as shown in Figure 12), we were able to determine the Doppler boosting factors for 87 sources. In addition, we obtained apparent speeds of the jets from the Monitoring Of Jets in Active galactic nuclei with the VLBA Experiments (MOJAVE) project. Using these values and the Doppler boosting factors, we were able to calculate the Lorentz factors and viewing angles for 67 sources. We found that Flat Spectrum Radio Quasars (FSRQs) are more Doppler boosted and have faster jets than BL Lacertae Objects (BLOs). Additionally, almost all the sources in our sample are seen at a small viewing angle of less than 20 degrees. The article on these results was accepted for publication in Astronomy & Astrophysics in the end of 2008.

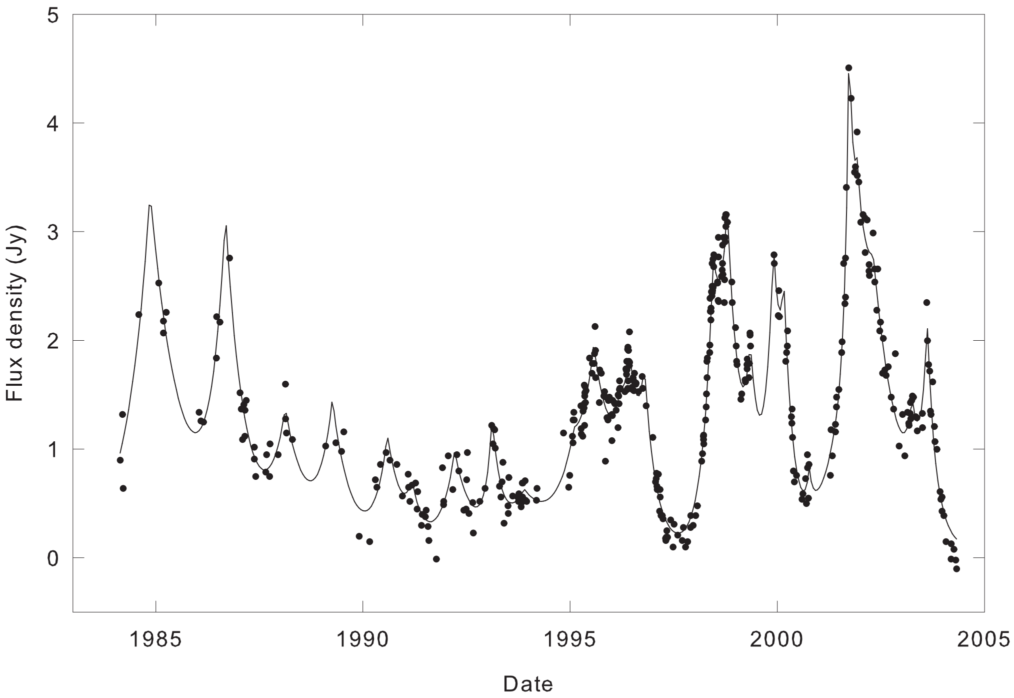

Figure 12: Flux curve of the source 1156+295 (points) decomposed into exponential flares (solid line) at 22 GHz (Hovatta et al. 2008c).

2.6.3 Inverted-spectrum sources and candidates

Project team: Tornikoski, Torniainen, Lähteenmäki, Hovatta, Turunen

In recent years our team has collected extensive data sets of gigahertz-peaked spectrum (GPS) sources and candidates – radio sources that have continuum spectra peaking at high radio frequencies. As we have shown earlier (e.g., Torniainen et al. A&A 435, 2005; Torniainen et al. A&A 469, 2007), a vast majority of them are highly variable flat-spectrum sources that show convex spectra only during active states. And contrary to earlier assumptions, even the ones whose spectra remain somewhat convex during the various states of activity can be highly variable especially in the high-frequency domain.

Except for the spectral shape there seemed to be no clear and simple “GPS source type properties” in the sources that we have classified as genuine GPS sources. There are both quasars and galaxies, compact symmetric objects (CSOs) and core-jet morphologies, variable and non-variable sources.

Intrigued by this variety of objects still classified as GPS sources, and seeking for understanding of their physics, we wanted to study their properties by using an advanced analysis method. We used a self-organized map (SOM), which is an unsupervised neural network that uses no *a priori* assumption of the cluster memberships. Using a large collection of parameters, the algorithm places the objects on a multidimensional map so that the Euclidian distance of the parameter vectors of similar objects is minimized. One of the advantages of this method is its ability to analyse incomplete data matrices, i.e. the method can be effectively used even when some data are missing for some sources.

We used a sample of 206 GPS and high frequency peaker (HFP) sources for this detailed study of the underlying populations of various source types. For completeness, the sample included basically all sources that have been identified as GPS sources or candidates in the literature. The parameters that we used for the analysis were collected from our own observations as well as from the literature, including: redshift, size, radio power, optical and radio polarization information, optical magnitudes at various wavebands, optical colours, hydrogen column density, power law slope in X-rays, radio variability indices,and various parameters describing the shape of the radio spectrum. For tracing the locations of different types of sources on the maps we also used auxiliary classification information from our previous papers (for the spectral classification of GPS sources and candidates) and from the literature (e.g., for optical identification and VLBI morphology).

We tested several clustering methods and clustering parameters. There were no substantial differences between the various approaches, even though for some single sources the cluster memberships change when changing the clustering method or the parameter space. For the "big picture" the outcome of the various runs remained consistent: when combining the cluster map and the auxiliary identification information, the map could be divided roughly into four quarters. Two quarters are populated with quasar-type sources,one of them with consistently GPS-type spectra and the other with other types of spectra. In one half of the map there are mainly galaxy-type sources; again one side is dominated by consistently GPS-type spectra, while the other side has other types of spectra (flat, steep, convex with variability, or those with too few data points for accurate determinationof their spectra). As they are not numerical quantities, neither the optical identification, VLBI morphology or our spectral classification were used by the algorithm, and therefore the formation of groups of sources similar in these properties is likely to reflect some genuine similarities between the sources.

Our results confirm the contamination of GPS samples by small, beamed blazar-type sources. More than one quarter of the map is populated by variable flat-spectrum sources and variable sources that have inverted spectra only during outbursts. These sources should be excluded from GPS samples when new "master lists" for GPS sources are being constructed.

Sources with confirmed GPS-type spectra form various separate clusters, and it seems likely that there are diverse subpopulations of GPS sources in addition to the quasar vs. galaxy dualism. Our analyses produce a cluster of very young (confirmed by kinematic age estimates) galaxy CSOs with rather low radio powers and – somewhat unexpectedly – low intrinsic turnover frequencies.There is another cluster consisting of young CSO and compact double (CD) quasars and galaxies with high peak frequencies and high radio powers, and thus considerably different from the aforementioned cluster. We have also identified a cluster that may represent free-free absorbed sources, as well as another one of quasars and galaxies with mostly core-jet morphologies and consistent GPS-type spectra.

The results of this study have been published in Torniainen et al. A&A 482, 2008, and a thorough review to GPS sources and our team's contribution to the field is published in the PhD thesis of Ilona Torniainen, 2008 and in Tornikoski et al. Astronomische Nachrichten 330, 2008.

2.6.4 Planck Satellite Science

Project Team: Lähteenmäki, Tornikoski, Aatrokoski, Torniainen, Valtaoja (Turku)

The Planck satellite will map the sky at nine high radio frequencies from 30 GHz to 857 GHz, and measure the cosmic microwave background (CMB) radiation. At the same time all foreground radio sources in the sky, including extragalactic radio sources, will be observed, too. Planck will produce unique all sky catalogs of sources at several high radio frequencies. They will, finally, fill the gap in the present radio survey data. The launch of the satellite is scheduled for May 2009.

A dedicated Planck Extragalactic Point Sources Working Group (WG6) meeting took place in Bologna, Italy, in November. A. Lähteenmäki and M. Tornikoski participated. The main issues discussed were the supporting observations, both with satellites and with ground based instruments, to be conducted during the mission. Another critical topic were the Memorandums of Understanding (MoUs) to be signed by external collaborators –in our case the multifrequency campaign collaborators. Each external participant must sign a MoU to be able to join the observing campaigns based on QDS alerts or other Planck data. The work on defining the content of the MoUs is ongoing.

The Planck LFI and HFI Joint Core Team meetings were held in Paris, France, in May, and in Bologna, Italy, in November. A. Lähteenmäki participated. In addition, the non-CMB Core Team CTA-09 stayed in touch with telecons twice a month.

The preparatory work for Planck continued. Observations, analysis, and publication of our Planck-related AGN data were carried out in Metsähovi in cooperation with our collaborators worldwide. The Finnish Planck science group, led by A. Lähteenmäki, met several times during the year.

Quick Detection System (QDS)

QDS is a software package designed to detect interesting point sources (for example, active galactic nuclei, AGNs) in the time-ordered datastream of the Planck satellite within one or two weeks from the time of the observation. AGNs are rapidly variable, in the timescale of a few days to a few weeks, and any significant event must be investigated without delay. QDS makes this possible by alerting observatories for followup observations when it detects something interesting in the Planck data.

The software was completed in 2006. In 2008 only some minor features, enhancements and bugfixes were added. Notable changes were minor updates to the interface to the Planck Low Frequency Instrument's Data Processing Center (LFI DPC) database, which kept slightly changing during its development process, and changing the noise level estimation algorithm to a better one.

2.7 Galactic Sources

2.7.1 X-ray Binaries

Project Team: Hannikainen, Savolainen, Koljonen (CfA)

Dr. Diana Hannikainen transferred from Helsinki University to Metsähovi on January 1, 2008, and continued her ongoing research on X-ray binaries, primarily analyzing data from INTEGRAL, an ESA satellite dedicated to X-ray and gamma-ray observations. Dr. Hannikainen had initiated a monitoring program with INTEGRAL during its first year of operations of GRS 1915+105, an X-ray binary composed of a 14-solar mass black hole and an evolved companion. This program has continued uninterrupted since then, and two papers highlighting observations from 2004-2005 in conjunction with NASA's RXTE satellite were published with collaborator Dr. Jérôme Rodriguez from CEA-Saclay. GRS 1915+105 is notorious for exhibiting various modes of variability that all reflect differing accretion processes. For this series of observations the team also had radio data obtained with the Ryle Telescope in Cambridge, UK. As a result of these studies, the hypothesis that the corona (thought to be responsible for the hard X-ray emission observed from X-ray binaries) is ejected from the system was corroborated, and thus constitutes the matter accelerated that we observe as relativistic radio jets.

During the AO1 observation of GRS 1915+105, Dr. Hannikainen and collaborators discovered a new source in the field of view, designated IGR J19140+0951. They continued to study various aspects of this source using INTEGRAL and RXTE data, and the latest study, published in Monthly Notices of the Royal Astronomical Society, led to tighter constraints on the orbital inclination and a determination of the mass-loss rate. Interestingly, a soft excess in the X-rays was detected for the first time for this source which was explained as the reprocessing of the X-ray emission originating from the neutron star by the surrounding ionized gas.

With then-PhD student Linnea Hjalmarsdotter (based at Stockholm University during 2008) Dr. Hannikainen continued to be involved in the deciphering of Cygnus X-3. Cygnus X-3 is the brightest radio-emitting X-ray binary in our Galaxy, and is also a strong X-ray source. It exhibits relativistic jets, the companion is thought to be a Wolf-Rayet star, but the nature of the compact object is uncertain. However, L. Hjalmarsdotter's work, published in MNRAS, suggests a black hole of ¿20 solar masses; if this turns out to be the case, then this would make Cygnus X-3 the most massive stellar black hole in the Galaxy to date. For this work, INTEGRAL data, as well as CGRO/BATSE and RXTE data, were used. In addition, significant inroads were made into understanding the complex absorption that hampers better understanding of Cygnus X-3.

Various other projects with collaborators from ESAC/ISOC included multiwavelength observations and data analysis and subsequent interpretation of XTE J1818-245 during its discovery outburst; with collaborators from the University of Helsinki the analysis of Chandra data of Cygnus X-3 revealing complex line structures; the interpretation of Nordic Optical Telescope data of UW CrB (Tuorla Observatory); and maintaining collaboration with the University of Southampton by participating in a study on blue hook stars, a rare class of horizontal branch stars that have so far been found in only very few Galactic globular clusters. These were all submitted during 2008 to Astronomy & Astrophysics and Monthly Notices of the Royal Astronomical Society.

Throughout her first year at Metsähovi, Dr. Hannikainen remained in contact with her PhD student Karri Koljonen who was at the time a pre-doctoral fellow at Harvard-CfA and returned to Finland in the fall of 2008. Although Mr. Koljonen did not immediately start work at Metsähovi due to family reasons, Dr. Hannikainen worked with him throughout the fall, and he eventually started at Metsähovi in January 2009. During the fall period, they worked on multiwavelength observations of Cygnus X-3, some of this work was presented at the 7th INTEGRAL workshop.

2.7.2 The Spreading Layer of GX 9+9

Project team: Savolainen, Hannikainen, Vilhu (Helsinki), Paizis (Milan), Nevalainen (Helsinki), Hakala (Turku)

Joining Metsähovi in January 2008 as a graduate student of Dr. Diana Hannikainen, Petri Savolainen worked most of the year on expanding his Master's thesis (University of Helsinki, December 2007) into a refereed publication. The work concerned the persistently bright neutron star Low-Mass X-ray Binary (LMXB) GX 9+9, making use of archived X-ray spectral data from NASA's Rossi X-ray Timing Explorer (RXTE) and ESA's INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL) satellites to study the accretion of matter from the companion star onto the neutron star. X-ray spectra of the source from 2003-2007 were modelled according to the recent Spreading Layer theory, a scenario in which plasma flows away from the accretion disc plane as it approaches the neutron star surface and settles on it, forming a luminous band that accounts for the harder spectral component - the softer one being the accretion disc blackbody.

The main results included the observed temperature of the Spreading Layer, which stayed close to the expected value of 2.5 keV, except for a previously detected rise at low luminosities, which was confirmed with greater statistical significance. Interestingly, though, there was indication that our source, GX 9+9, is roughly twice as distant as previously assumed, 10 kpc instead of 5 kpc, placing it closer to the Galactic Centre.

Initial results were presented as a poster (Modelling the RXTE and INTEGRAL Spectra of GX 9+9) at The X-ray Universe 2008 conference in Granada, May 27-30. 2008, and the final ones published in the Monthly Notices of the Royal Astronomical Society, Vol. 393 (Exploring the spreading layer of GX 9+9 using RXTE and INTEGRAL).

2.8 Multifrequency Observing Campaigns

Project Team: Lähteenmäki, Tornikoski, Torniainen, Hovatta, Nieppola, Kotiranta, Turunen, Kainulainen

We took part in several multifrequency campaigns in 2008, 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. Metsähovi radio data are in high demand, and the number of campaigns and requests have steadily increased during the last few years. This is also reflected in the steady inflow of publications using Metsähovi data.

Examples of recent campaigns are the WEBT adn GASP collaborations on several sources in connection to satellite observations at high energies, such as Fermi and AGILE. 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, for example, MAGIC observations.

2.9 Solar Research

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

In 2008 we continued to use the 37 GHz frequency band (of the bigger radio telescope) for observing Solar maps during the summer months. The number of observation days was around 20. Additionally, the 86 GHz SIS-receiver was tested for Solar observations in May 2008.

The small radio telescope (diameter 1,8 m) was used for continuous monitoring of the whole Solar disk at a frequency of 11.7 GHz.

We continue to investigate solar oscillation in the quiet Sun regions, polar regions with enhancement brightness temperature and single sunspots using observed data from both the bigger and the small radio telescope. For the considered regions we have found solar quasi-periodic oscillations in intervals of 3, 5, 10 and 30-40 minutes. Also longer scales of the variations were found.

2.10 Recreational Events & Keeping Fit

In 2008 we continued to encourage our staff members to take care of their physical well-being.

Our PhD student and a trained aerobics instructor Ilona Torniainen continued organising short "coffee-break stretching sessions" for the staff ca. twice a week until her maternity leave.

On October 20th we had our annual recreational day. This year the event was a visit to the Nuuksio national park. We first hiked in the woods for a couple of hours in beautiful crispy weather, and afterwards we enjoyed the sauna and a delicious dinner created by Metsähovi's astonishing gourmet chefs.

The traditional Metsähovi Christmas party was held on December the 22nd, with porridge and ham and Christmas sauna.

Figure 13: The lake is like a mirror.

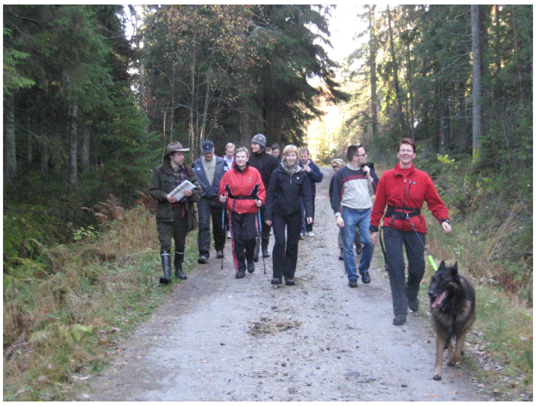

Figure 14: Follow the leader!

Figure 15: The merry troopers descend through the forest.

Figure 16: Camouflage!

Figure 17: Has this walking technique been officially approved?

Figure 18: Us, lost? Never!.

Figure 19: Let's synchronize our watches .. umm, GPS devices .. umm, thingamyjigs ... whatever, get us back to food!.

Figure 20: And the fish gets nailed.

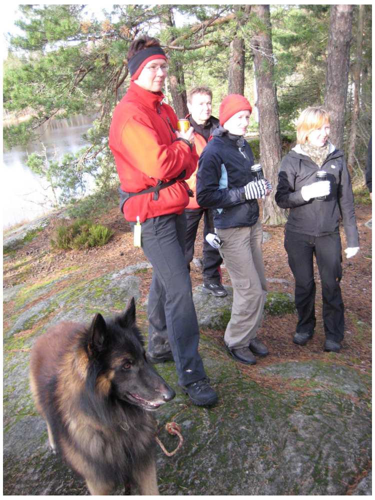

Figure 21: One of us doesn't need woolly gloves and hats and scarves!

Figure 22: Please, fireplace, radiate!!

Figure 23: The happy chef and his yummy tortilla.

Figure 24: Metsähovi barbecue party on the 11th of June. This is the traditional Metsähovi "Pre-Midsummer" barbequelunch.

Figure 25: Helsinki University of Technology staff party in Dipoli on the 4th of December.

3 Publications

3.1 International Journals

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27 Hannikainen, D.C., Rodriguez, J.: Microquasars: A brief overview and a snapshot of GRS 1915+105. Chinese Journal of Astronomy & Astrophysics Supplement, Vol. 8, pp.341-348, 2008

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34 Hovatta, T., Valtaoja, E., Tornikoski, M., Lähteenmäki, A.: Doppler boosting factors, Lorentz factors and viewing angels for quasars, BL Lacertae objects and radio galaxies. Astronomy and Astrophysics, accepted, 2008.

3.2 International Conferences

1 Hovatta, T.; Tornikoski, M.; Lehto, H. J.; Nieppola, E.; Valtaoja, E.; Lainela, M.; Torniainen, I.; Lähteenmäki, A.; Aller, M. F.; Aller, H. D.: Long term radio variability of AGN. "Workshop on Blazar Variability across the Electromagnetic Spectrum", 2008 April 22-25, Palaiseau, France, 2008.

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3 Valtaoja, E., Lainela, M., Lindfors, E., Saloranta, P.-M., Wiik, K., Hovatta, T., Lähteenmäki, A., Nieppola, E., Torniainen, I., Tornikoski, M.: Total intensity radio variations in blazars. Workshop on Blazar Variability across the Electromagnetic Spectrum, 2008 April 22-25, Palaiseau, France, 2008.

4 Savolainen, T., Wiik, K., Valtaoja, E., Tornikoski, M.: Magnetic Field Structure in the Parsec Scale Jet of 3C273 from Multifrequency VLBA Observations. Extragalactic Jets: Theory and Observation from Radio to Gamma Ray, Girdwood, Alaska, USA May 21-24.2007, eds. T. A. Rector and D. S. De Young, ASP conference series, p. 451, 2008.

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7 Hannikainen, D.C., Rodriguez, J.: GRS 1915+105: A Snapshot with INTEGRAL. A POPULATION EXPLOSION: The Nature and Evolution of X-ray Binaries in Diverse Environments, St Petersburg Beach, 28.10-2.11.2007, AIP Conference Proceedings, Vol. 1010, pp. 85-87, Eds.: R.M. Bandyopadhyay, S. Wachter, D. Gelino, C.R. Gelino, 2008.

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Environments, St Petersburg Beach, 28.10-2.11.2007, AIP Conference Proceedings, Vol. 1010, pp. 91-93, Eds.: R.M. Bandyopadhyay, S. Wachter, D. Gelino, C.R. Gelino, 2008.

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14 Tornikoski, M.; Torniainen, I.; Lähteenmäki,A.; Hovatta, T.; Nieppola, E.; Turunen, M.; Lainela, M.; Valtaoja, E.; Aller, M.F.; Aller, H.D,; Mingaliev, M.; Trushkin, S.: Long term behaviour of GPS sources and candidates. Proceedings of the 4th CSS/GPS workshop, Riccione, Italy, 26-29 May 2008, submitted, 2008.

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21 Lähteenmäki, A.; Tornikoski, M.; Valtaoja, E.; Aatrokoski, J.: Planck Satellite Revisited. The X Finnish-Russian Radio Astronomy Symposium, September 1-5, 2008, Orilampi, Finland, eds.: T. Hovatta, M. Tornikoski, A. Lähteenmäki, Metsähovi Reports HUT-KURP-35, 2008.

22 Tornikoski, M.; Torniainen, I.; Lähteenmäki, A.; Hovatta, T.; Nieppola, E.; Turunen, M.; Lainela, M.; Valtaoja, E.; Aller, M.F.; Aller, H.D.: Studies of inverted-spectrum radio sources and candidates. The X Finnish-Russian Radio Astronomy Symposium, September 1-5, 2008, Orilampi, Finland, eds.: T. Hovatta, M. Tornikoski, A. Lähteenmäki, Metsähovi Reports HUT-KURP-35, 2008.

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24 Volvach, A.E.; Larionov, M.G.; Kardashev, N.S.; Lähteenmäki, A.; Tornikoski, M.; Hovatta, T.; Nieppola, E.; Torniainen, I.; Aller, M.F.; Aller, H.D: Variability of radio flux of 0716+714. VIII Gamows Odessa Astronomical Summer School-Conference: Astronomy and Beyond: Astrophysics, Radioastronomy, Cosmology and Astrobiology, 18-23 August, 2008, Odessa, Ukraine, p. 19, 2008.

25 Cadolle Bel, M.; Rodriguez, J.; Hannikainen, D.; Shaw, S.; Malzac, J.; Tagger, M.; Varnire, P.; Lehnert, B.: Broad-band parallel studies of Cygnus X-1 and GRS 1915+105. VII Microquasar Workshop: Microquasars and Beyond, September 1-5, 2008, Foca, Izmir, Turkey, submitted, 2008.

26 Savolainen, P.; Hannikainen, D.C.; Vilhu, O.; Paizis, A.; Nevalainen, J.; Hakala, P.: Using INTEGRAL AND RXTE to explore the Spreading Layer of GX 9+9. 7th INTEGRAL Workshop, Copenhagen, Denmark, September 8-11, 2008, Proceedings of Science, 2009.

27 Prat, L.; Rodriguez, J., Hannikainen, D.C.: Peering through the stellar wind of IGR J19140+0951 using RXTE and integral observations. Proceedings of the Annual Meeting of the French Society of Astronomy and Astrophysics. Eds.: C. Charbonnel, F. Combes and R Samadi, pp. 273-276, 2008.

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29 McCollough, M.L., Koljonen, K.I.I., Hannikainen, D.C.: Probing the Nature of Cygnus X-3's Major Radio Flares with INTEGRAL. Proceedings of the 7th INTEGRAL Workshop. 8 - 11 September 2008 Copenhagen, Denmark. Online at:
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http://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=67, p. 79

31 Savolainen, P., Hannikainen, D.C., Vilhu, O., Paizis, A., Nevalainen, J., Hakala, P.: Using INTEGRAL and RXTE to explore the Spreading Layer of GX 9+9. Proceedings of the 7th INTEGRAL Workshop. 8 - 11 September 2008 Copenhagen, Denmark. Online at http://pos.sissa.it/cgi-bin/reader-/conf.cgi?confid=67, p. 35

32 Wagner, J., Molera, G., Uunila, M.: High bandwidth data acquisition and network streaming in VLBI. INGRID 2008 - Instrumenting the Grid Workshop. 9 – 11.4.2008, Lacco Ameno, the Island of Ischia, Italy, submitted 2008.

3.3 National Conferences

1 Ritakari, J.; Wagner, J.; Molera, G.: Recent achievements at Metsähovi Radio Observatory. XXXI Finnish URSI Convention on Radio Science, Electromagnetics 2008, Espoo 28 October 2008, Proceedings of the URSI XXXI Convention on Radio Science, submitted, 2008.

2 Molera, G.; Wagner, J.; Ritakari, J.: High capacity recorders for radio astronomy digital backends. XXXI Finnish URSI Convention on Radio Science, Electromagnetics 2008, Espoo 28 October 2008, Proceedings of the URSI XXXI Convention on Radio Science, submitted, 2008.

3 Kallunki, J.:Recent activities in solar radio astronomy at Metsähovi Radio Observatory. XXXI Finnish URSI Convention on Radio Science, Electromagnetics 2008, Espoo 28 October 2008, Proceedings of the URSI XXXI Convention on Radio Science, submitted, 2008.

3.4 Laboratory Reports

1 Tornikoski, M., Mujunen, A., Hurtta, S. (editors): Metsähovi Radio Observatory Annual Report 2007. Metsähovi Reports HUT-KURP-34, 27 p., 2008.

4 Visits to Foreign Institutes

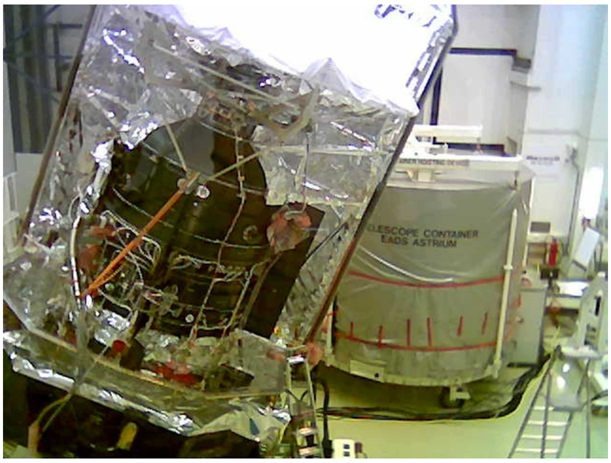

Figure 26: Herschel satellite in the ESTEC cleanroom during M. Tornikoski's visit to the European Space Agency ESTEC facilities in Holland in May 2008.

Figure 27: Herschel project scientist Dr. Göran Pilbratt explains the details of the Herschel mission and technology.

European Space Agency ESTEC, Noordwijk, Netherlands, 13.-14.5.2008 and 14.-15.10.2008, M. Tornikoski

European Southern Observatory Headquarters, Garching, Germany, 14.-15.4.2008, M. Tornikoski

Chalmers University of Technology, Sweden, 30.6.2008, M. Tornikoski

Harvard-Center for Astrophysics, Boston, MA, USA, 5-14.4.2008, D. Hannikainen

Czech Technical University and Charles University, Prague, Czech Republic, 21-25.4.2008, D. Hannikainen

Nordic Optical Telescope, La Palma, Spain, 25.9-1.10.2008, D. Hannikainen

Stockholm University, Stockholm, Sweden, 29-31.10.2008, D. Hannikainen

ESO Headquarters, Garching, Germany, 17-20.11.2008, D. Hannikainen

University of Sydney, Sydney, Australia, 14.12.2008-9.1.2009, D. Hannikainen

Observatorio Astronomico Nacional, Centro Astronomico de Yebes, Yebes, Spain, 2–4.1.2008, G. Molera

5 Visiting Scientists

Figure 28: Professor Messerschmitt giving a guest lecture

On September 29th Professor David G. Messerschmitt from Department of Electrical Engineering and Computer Sciences, University of California at Berkeley & SETI Institute of Mountain View, California gave a guest lecture "Broadband Interstellar Beacons".

Dr. Vyacheslav Vdovin, Institute of Applied Physics Russian Academy of Sciences, Russia, 5 – 8.5.2008, 6 – 11.10.2008

Alexander Shtanyuk, Institute of Applied Physics Russian Academy of Sciences, Russia, 5 – 14.5.2008, 6 – 15.10.2008

Oleg Bolshakov, Institute of Applied Physics Russian Academy of Sciences, Russia, 5 – 14.5.2008, 6 – 15.10.2008

Jonathan Hargreaves, Jodrell Bank, United Kingdom, 2.5.2008

Prof. Bruce Partridge, Haverford college, USA, 22 – 24.5.2008

6 Theses

Thesis for the degree of Doctor of Technology: Torniainen, Ilona: Multifrequency studies of gigahertz-peaked spectrum sources and candidates.

Figure 29: Ilona Torniainen's thesis defence on "Multifrequency studies of gigahertz-peaked spectrum sources and candidates" ready to start.

Figure 30: The opponent, Prof. Bruce Partridge from Haverford College, USA.

Figure 31: The candidate elaborates on the issue of unification models. On the right: the custos of the defence, Prof. Martti Hallikainen.

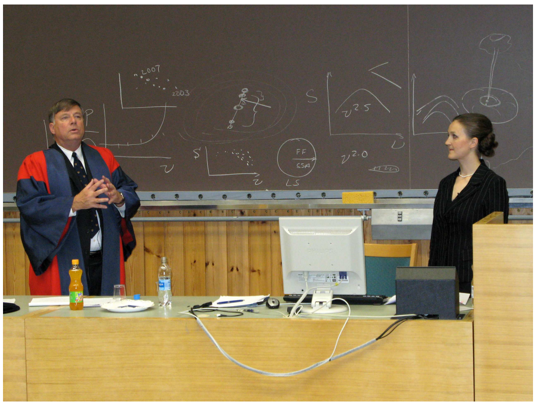

Figure 32: Opponent's closing remarks.

Figure 33: Congratulations, Dr. Torniainen

7 Teaching

S-92.3145 Radio Astronomy, M. Tornikoski, A. Lähteenmäki, T. Hovatta, D. Hannikainen

8 Other Activities

Planck satellite's LFI Consortium, Scientific Associate, M. Tornikoski

Associate member of the Very Energetic Radiation Imaging Telescope Array System (VERITAS) collaboration. M. Tornikoski, A. Lähteenmäki

Referee for Proceedings of the Fourth Workshop on Compact Steep Spectrum and GHz-Peaked Spectrum Radio Sources, M. Tornikoski

Reviewer for Viksu the Academy of Finland Annual Science Competition for Senior Secondary Students 2008, A. Lähteenmäki

URSA Tähtipäivät, Metsähovi tour, 18.5.2008, A. Lähteenmäki

Planck satellite Co-Investigator, Planck Scientist, A. Lähteenmäki

Academy of Finland Research Fellow 1.8.2005 – 31.7.2010, A. Lähteenmäki

"Planck –unlocking the secrets of the Universe Outstanding Junior Research Group of Helsinki University of Technology for the academic years 2006 — 2007 and 2007 — 2008, A. Lähteenmäki

Co-Chair, Local Organizing Committee, 10th International Workshop on Radiation Imaging Detectors, Helsinki, Finland, June 29 - July 3, 2008. D. Hannikainen

Panel member, PhD examination, Stockholm University. D. Hannikainen

8.1 Participation in Boards and Committees

Finnish National Committee of COSPAR (Committee of Space Research), M. Tornikoski

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

European Southern Observatory, Finland's representative to the Users Committee, M. Tornikoski

Global Millimetre VLBI Array, referee of observing proposals, M. Tornikoski

European Space Agency, member of the Astronomy Working Group, M. Tornikoski

Onsala Space Observatory Time Allocation Committee, M. Tornikoski

Finland's representative in the European Space Agency, M. Tornikoski

Planck Satellites LFI Consortium, Scientific Associate, M. Tornikoski

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

EXPReS Consortium Board, chairman, A. Mujunen

Finnish Astronomical Society, vice chairman, Elina Nieppola

Steering group member of the Ministry of Education graduate school of astronomy and space physics, A. Lähteenmäki

Member of the Planck/TEKES 70 GHz instrument steering group, A. Lähteenmäki

Associate member of the Very Energetic Radiation Imaging Telecope Array System (VERITAS) collaboration, M. Tornikoski, A. Lähteenmäki

Member of the EXPReS eVLBI Science Advisory Group, A. Lähteenmäki

Member of the Graduate School Board of the Faculty of Electronics, Communications and Automation, A. Lähteenmäki

Scientific Committee, International Workshop on Radiation Imaging Detectors. D. Hannikainen

ESO Observing Proposals Committee, panel referee (co-chair). D. Hannikainen

Scientific Organizing Committee, The X-Ray Universe, Granada, Spain, May 27-30, 2008. D. Hannikainen

Helsinki University Observatory, board member (substitute), D. Hannikainen

Finnish Astronomical society, board member, T. Hovatta

8.2 International Meetings and Talks

The Metsähovi team organized the tenth Finnish-Russian radio astronomy symposium on September 1-5 in Orilampi, in the surroundings of the Repovesi national park. The Finnish-Russian symposia are a form of collaboration between the Metsähovi and Tuorla teams and our Russian colleagues. There were 24 participants in the tenth symposium, approximately half of them from Finland and half from Russia. The topics of the talks covered extragalactic and galactic radio sources, the Sun, and radio astronomical instrumentation.

Figure 34: Professor Alexander Stepanov from the Pulkovo Observatory gave a talk about particle acceleration in the Sun and stars.

Figure 35: Talvikki Hovatta from Metsähovi Radio Observatory gave a talk about long-term variability behaviour of Active Galactic Nuclei

Figure 36: The attentive audience.

Figure 37: In the evenings we had an informal get-together at the "Kota".

Figure 38: Esko Valtaoja and Alexander Stepanov had lively discussions during the ferry cruise on Lake Repovesi.

Figure 39: Conference participants getting ready for a bus ride to Helsinki at the end of the conference.

EU-FP6-EXPReS Consortium Board, Utrecht, Holland, 29–31.1.2008, A. Mujunen.

Planck point source workshop/meeting, Pasadena, USA, 3–8.2.2008, J. Aatrokoski

AGN and related fundamental physics in high energy gamma astronomy workshop, Jerisjärvi, Finland, 31.3–5.4.2008, M. Tornikoski, A. Lähteenmäki

Harvard-Smithsonian Center for Astrophysics, Boston, MA, USA, 5-14.4, D. Hannikainen.

INGRID 2008-Instrumenting the Grid workshop, Lacco Ameno, the Island of Ischia, Italy, 9–11.4.2008, talk: High bandwithd data acquisiton and network streaming in VLBI, J.Wagner, G. Molera, M. Uunila

ESO Users Committee meeting at ESO Headquarters, Garching, Germany, 14–15.4.2008, M.Tornikoski

46th CRAF-meeting, Thessaloniki, Greece, 17–18.4.2008, J. Ritakari

iWorid Preparation, Charles University, Prague, Czech Republic, 21-25.4, D. Hannikainen

Workshop on Blazar Variability across the Electromagnetic Spectrum, Palaiseau, France, 22–25.4.2008, T. Hovatta, E. Nieppola

EVN Consortium Board of Directors, Bordeaux, France, 23–26.4.2008, A. Mujunen

Planck Joint Core Team meeting, Paris, France, 6–9.5.2008, A. Lähteenmäki

The 131st ESA Astronomy Working Groups meeting at ESTEC, Noordwijk, Holland, 13–14.5.2008, M. Tornikoski

The Fourth Workshop on Compact Steep Spectrum and GHz-Peaked Spectrum Radio Sources, Riccione, Italy, 25–30.5.2008 M.Tornikoski

The X-ray Universe 2008, Granada, Spain, May 27–30.5. 2008, D. Hannikainen, P. Savolainen

7th International eVLBI Workshop, Shanghai, China, 16–17.6.2008, talks: Metshovi Four-GBps Data Recorder for VLBI and eVLBI, J. Ritakari, J. Wagner, G. Molera; iBOB data aquisition and network streaming, J. Wagner, J. Ritakari, G. Molera; Evaluation of new multi-bits sampling systems, G. Molera, J. Wagner, J. Ritakari

XXXVIII Young European Radio Astronomers conference, Onsala, Sweden, 23–26.6.2008, M. Kotiranta

10th International Workshop on Radiation Imaging Detectors, Helsinki, Finland, June 29 - July 3. D. Hannikainen, P. Savolainen

Onsala Space Observatory, Time Allocation committee, Chalmers, Gothenburg, Sweden, 30.6.2008, M. Tornikoski

2nd MCCT-SKADS meeting at Siguenza, Spain, 24.8–6.9.2008, G. Molera

12th European Solar Physics Meeting, Freiburg, Germany, 7–12.9.2008, J. Kallunki

7th INTEGRAL Workshop, Copenhagen, Denmark, 8–11.9.2008, D. Hannikainen, P. Savolainen

The 9th European VLBI Network Symposium, Bologna, Italy, 23–26.9.2008, J. Wagner, J. Ritakari, G. Molera

The 133rd ESA Astronomy Working Group meeting at ESTEC, Noordwijk, Holland, 14–15.10.2008, M. Tornikoski

Bonn MFIfR consultation, Bonn, Germany, 15–20.10.2008, J. Wagner

EVN Consortium Board of Directors, Arecibo, Puerto Rico, 1–6.11.2008, A. Mujunen

Planck Joint Core Team meeting and Extragalactic Working Group WG6 meeting, Bologna, Italy, 4–7.11.2008, A. Lähteenmäki, M. Tornikoski (WG6 meeting only)

47th CRAF-meeting, Brussels, Belgium, 13–14.11.2008, J. Ritakari

8th Radionet meeting, Yebes, Spain, 24–25.11.2008, talk: High capacity recorders at 4Gbps for VLBI, G. Molera, J. Wagner, J. Ritakari

ISSI team "Decrypting and Modeling the High-Energy Emission of Blazars" meeting, Bern, Switzerland, 9–13.12.2008, T. Hovatta, A. Lähteenmäki, E. Lindfors

8.3 National Meetings and Talks

Kirkkonummen Komeetta, 26.2. D. Hannikainen

The Tenth Finnish-Russian Radio Astronomy Symposium, Orilampi, Finland, 1–5.9.2008, A. Lähteenmäki, T. Hovatta, P. Kirves, J. Kallunki, D. Hannikainen

A national meeting of the Finnish ESO scientists and students 23-24.10.2008, P. Savolainen, T. Hovatta, Piikkiö, Finland

XXXI Finnish URSI Convention on Radio Science, 28.10.2008, A. Lähteenmäki Talk in plenary session "Planck -looking back to the dawn of time

MIKES, aika- ja taajuusseminaari, 30.10.2008, J. Wagner

8.4 Participation in winter and summer schools

The Finnish Graduate School in Astronomy and Space Physics Summer School, Orilampi, Finland, 1–6.6.2008, M. Uunila, T. Hovatta

The sixth IRAM Millimeter Interferometry School, Grenoble, France, 6–10.10.2008, P. Savolainen

8.5 Public Relations

YLE Ykkösaamu, radio interview 16.5.2008, A. Lähteenmäki

Otaniemi Technology Day in Dipoli. Lecture to the public about water in the universe, 16.1.2008, M. Tornikoski. The contents of this lecture were also summarised in the net publication Verkkouutiset.

TV interview about water in the universe, YLE Prisma Studio, 16.1.2008 (replay on 17.1.), M. Tornikoski

Tiede 1/2008 about water in the Universe, M. Tornikoski

9 Personnel in 2008

Permanent Positions funded by the Helsinki University of Technology

Tornikoski, Merja, Dr.Tech.	Director of the institute Docent of Radio Astronomy and Space Technology	Merja.Tornikoski@hut.fi
Hurtta, Solveig, Ms.	Department Secretary, part-time	Solveig.Hurtta@hut.fi
Mujunen, Ari, M.Sc. (Tech)	Laboratory engineer	Ari.Mujunen@hut.fi
Oinaskallio, Erkki, Mr.	Technician	Erkki.Oinaskallio@hut.fi
Peltonen, Juhani, Dr.Tech.	Laboratory engineer, part-time until 31.3.2008	
Rönnberg, Henry, Mr.	Mechanician	

Scientific and Technical Staff Funded by Research Contracts

Aatrokoski, Juha, M.Sc.(Tech)	System administrator	jha@kurp.hut.fi
Hannikainen, Diana, Ph.D.	Researcher	diana@kurp.hut.fi
Hovatta, Talvikki, M.Sc. (Tech)	Researcher	tho@kurp.hut.fi
Kainulainen, Jouni, M.Sc.	Civilian serviceman until 24.12.2008	
Kallunki, Juha, M.Sc. (Tech)	Operations engineer	kallunki@kurp.hut.fi
Kirves, Petri, M.Sc. (Tech)	Operations engineer	pkirves@kurp.hut.fi
Kotiranta, Mikko, M.Sc. (Tech)	Researcher, until 31.10.2008	
Lindfors, Elina, M.Sc.	Researcher 1.10-31.12.2008	
Lindfors, Timo, student	Research assistant, part time 1.1-31.5.2008 and 1.9-31.12.2008, full time 1.6-31.8.2008	lindi@kurp.hut.fi
Lähteenmäki, Anne, D.Sc.(Tech.)	Academy Research Fellow	alien@kurp.hut.fi
Molera Calves, Guifre, M.Sc. (Tech)	Researcher	gofrito@kurp.hut.fi
Nieppola, Elina, M.Sc.	Researcher	eni@kurp.hut.fi
Ritakari, Jouko, M.Sc. (Tech)	Researcher	jr@kurp.hut.fi
Savolainen, Petri, M.Sc.	Researcher	psa@kurp.hut.fi
Torniainen, Ilona, M.Sc. (Tech)	Researcher	ilo@kurp.hut.fi
Turunen, Miika, student	Research assistant part-time 1.1-31.5.2008 and 1.9-31.12.2008, full time 1.6.2008-31.8.2008	maturun@kurp.hut.fi
Uunila, Minttu, M.Sc.	Researcher	minttu@kurp.hut.fi
Wagner, Jan, M.Sc. (Tech)	Researcher	jwagner@kurp.hut.fi

Metsähovi Advisory Committee

Korpela, Seppo, Dir.
Koskinen, Hannu, Prof.
Nygren, Tuomo, Prof.
Somervuo, Pekka, Dr.Tech.
Valtaoja, Esko, Prof.
Tiuri, Martti, Prof.emer., M.P. (Chair)
Tornikoski, Merja, Director (Secretary)