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Metsähovi Radio Observatory
Annual Report 2005

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1 Introduction

The Metsähovi Radio Observatory, a separate research institute at the Helsinki University of Technology TKK since May 1988, operates a 14 m diameter radio telescope at Metsähovi, Kylmälä in Kirkkonummi, about 35 km west from the Otaniemi university campus.

Metsähovi is active in the following fields: radio astronomical research and space research, development of instruments and methods for radio astronomy, and (radio) astronomical education. In 2004 also geodetic VLBI observations were started in Metsähovi in collaboration with the Finnish Geodetic Institute.

In year 2005 15 scientists, engineers, research assistants and support personnel worked at the institute. Six of the employees were funded by the Helsinki University of Technology, and the others were funded by research projects financed mainly by the Academy of Finland. In 2005 the total expenditure of the Metsähovi Radio Observatory was 631 000 euros, including salaries and the rent of the office and laboratory space at the Metsähovi premises. This was financed by Helsinki University of Technology (68%), Academy of Finland (19.5%), European Union (7.5%) and other outside sources (5%). Unfortunately the funding situation has not improved during the recent years, forcing us to cut back expenditure on many items, including both scientific research as well as maintenance and technical development issues.

Metsähovi was part of a consortium that applied for the Academy of Finland's Center of Excellence program. (The consortium was led by professor Valtaoja from the Tuorla Observatory.) In the first phase we were successful, and during the second phase we submitted a very extensive research plan and were interviewed by international expert evaluators. Unfortunately our consortium was finally not selected as one of the Centers of Excellence. However, the evaluator comments were good and we are confident that we carry out world-class research, and we will continue to aim to the top also in the future.

In November 2005 we received sad news: the former director of Metsähovi, professor emeritus Seppo Urpo died on November 16th. To a very large extent, the Metsähovi Radio Observatory as it is today, was the result of the hard work and innovative mind that Seppo put into it throughout the years. The whole staff of Metsähovi was saddened by the passing away of Seppo, as were many of his colleagues and friends abroad.

May 17th, 2006 in Metsähovi
Merja Tornikoski
Acting director of the Metsähovi Radio Observatory

In memoriam

Seppo Urpo 19.8.1941 - 16.11.2005

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: Tornikoski, Peltonen, Mujunen, Oinaskallio, Ritakari, Rönnberg

2.1.1 3 and 2 mm SIS Receivers

Project team: Peltonen, Mujunen, Oinaskallio, Rönnberg

The new mm-wave SIS receiver designed and constructed at Institute of Applied Physics (hereafter called IAP), Russian Academy of Sciences, Nizhny Novgorod, Russia was used twice for 3 mm VLBI sessions in 2005. The first session was on 11. to 18. April and the second on 13. to 19. October. The frequencies and other technical details are descripted in the annual report of 2004 pp. 2. During the April session the receiver operated in a dual channel mode with high sensitivity (noise temperature about 50 K). Unfortunately during the October session the left polarization channel showed higher noise temperature and finally died completely. Also due to the mechanical stickiness of the quasioptics resulted a failure to the calibration of the receiver. The reason for the mechanical fault was found later and has been now corrected. The reason for the second mixer failure however remained unexplained.

Due to the fact that the SIS receiver is a very complex system to be used on the telescope the IAP personnel (Dr. V. Vdovin) suggested that the receiver should be upgraded. This would include new developed SIS structures, upgraded cryostat, quasioptical systems and control system. In order to realize this modernization of the whole cryoelectronic receiver complex a new contract was negotiated with IAP personnel as Supplier and Machinoimport as Seller. However the contract can be finally signed when the Intergovernmental Agreement between the Governments of the Russian Federation and the Finland Republic (as the partial compensation of the ex-USSR debt to Finland) has been signed. According to the preliminary information, this is expected to happen in the end of March 2006.

2.1.2 Receiver Maintenance and Upgrades

Project team: Peltonen, Mujunen, Oinaskallio, Rönnberg

During the year 2005 both 22 GHz and 37 GHz Dicke-switched receivers operated without failures. The temperatures inside the receiver and the local oscillator power can be monitored via ADAM/NuDAM module network. The detected LO power is dependent of the ambient temperature, however the reason for this might be that the detector itself is more sensitive for temperature changes than the Gunn oscillator. For the best sensitivity the temperature inside the receiver box is set to a low value (about 17 C). The 22 GHz VLBI receiver and the 2/8 GHz Geo-VLBI receiver (designed and constructed by Tecnologías de Telecomunicaciones y de la Información, Santander, Spain) have been used also successfully for appropriate observations. The phase calibrator unit can be used for both of these two receivers by changing it mechanically to the receiver to be used and connecting two output cables to the corresponding input ports.

Both Dicke-switched continuum receivers have been operated already over 12 years with some upgrades during this time period. In conjunction with the earlier mentioned new agreement with IAP also a new next-generation cryoelectronic receiver complex to replace these old receivers was planned. The PLANCK project has introduced a new concept for broadband continuum radiometers. Dr. Kaj

Wiik (Tuorla Observatory, Turku) gave on October 2005 a presentation for IAP and Metsähovi personnel of the benefits of this new scheme. This pseudocorrelation receiver has no Dicke-switch in front of the receiver which is very problematic at these low millimetre wave frequencies. The signal is also directly detected, thus local oscillator is not needed. However some other problems must be solved: the front end needs a wideband magic-tee, direct detection at RF and a wideband phase switch (phase shift of 180 degrees) is needed. Also for broadband operation cryogenic MMIC techniques should be adapted. Discussions with IAP personnel will continue next year about the possibilities to solve these problems with some help from Mr. Pekka Sjöman, SF-Design Oy, Forssa.

2.1.3 IT Infrastructure

Project Team: Mujunen, Lindfors

Several of the oldest Pentium 100 MHz class Linux workstations were replaced with new 3GHz/1GB Dell PCs. The venerable HP LaserJet 4 laser printer acquired in 1994 was superseded by a new multifunction Ricoh Aficio 3035 copier/printer/scanner, and the old Xerox color printer and fax machines were replaced with Dell 5100cn and 1600n units. All of the new PC and printer hardware feature long-term maintenance contracts (3–5 years).

The backup system of both Metsähovi observatory site and Otaniemi university campus site has been completely revamped. A "quintet" of computers take part in the "backup subnet", designed to give protection against hardware failures and even Metsähovi site disasters. The local Metsähovi "`/home`" and "`/data`" NFS servers are being rsynced to a third local backup computer, "`telescreen`". A fourth dedicated backup computer located off-site at Otaniemi campus, "`tachyon`" fetches daily a copy from both Metsähovi "`/home`" and "`/data`" NFS servers and stores it in a new date-stamped subdirectory. The actual files are shared with Linux hard links between the daily subdirectories, so this method effectively retains several months of daily file revision history while not consuming much more space than a simple single backup copy.

An additional local Metsähovi NFS server "`remus`" for network booting of diskless Linux workstations was established. Further, this server takes backup copies of Linux system installations in other Metsähovi computers. The backups are stored in the same directory structure which is used for network booting, and this allows a quick substitution of a failed Linux system disk by simply rebooting the computer with the backed-up system image on "`remus`". Additionally, the backup server "`telescreen`" takes a daily-stamped hard link copy-based backup of the "`remus`" contents—the Linux system files are not considered so unique as to warrant off-site backup with "`tachyon`".

All the local autonomously-running Linux observation and data acquisition software have been supplemented with Debian packaging subdirectories which enables the generation and distribution of the usual Debian `.deb` binary packages instead of special installation and `scp` scripts. The "debianized" packages include the following (only the "`spektr`" RFI monitoring system has not yet been converted):

antcon2 is the main antenna control and tracking software being used in both the 14m main antenna as well as in the 1.8m solar monitoring antenna.

arranger is the generic archiver script of daily data and log files. It ensures that files are safely transferred from observing computers to the "`/data`" NFS server.

clodi controls the multi-channel 1pps time difference counter "Clodi" and stores the 1pps time difference measurements in daily log files.

dammer is the bus master of the shared RS-485 ADAM/NuDAM instrumentation bus which is available in most parts of the Metsähovi control room and telescope. Separate variants are generated for the main bus, the H maser cellar bus, and the solar monitoring antenna bus segment.

daq takes care of the four-channel 16-bit Datel A/D converter used in main telescope data taking (continuum and solar observations).

datalogd is a generic collector of miscellaneous observation data which thus gets logged in a time-stamped fashion in the common "`/data`" pool.

hmaser2, hmaser2ftp take care of integrating, filtering, and auto-FTP transferring the Clodi 1pps H maser vs. GPS clock data to the EVN FTP server where the VLBI correlators expect to find this data to model the performance of our H maser clocks.

mb is the "master browser" Perl CGI script system which enables quick on-demand plotting of any data values stored in the common "`/data`" pool in various combination plots via a Web interface. Gnuplot is used to generate both the on-line `.png` plot files and `.ps/.eps` printable plots.

sundaq is the continuously-running data acquisition program of the 1.8m solar antenna.

weather controls the two GroWeather weather stations and stores the weather observations into daily log files.

The first attempts to create a sustainable shared Windows environment, accessible from the regular Linux desktops were started in 2005. A Windows Server 2003 trial environment was set up with Terminal Server, facilitating multiple Windows sessions using the `rdesktop` Remote Desktop Protocol (RDP) client. The trial was successful in the extent that a real Windows Server 2003 and the required TSCALs were ordered. Windows server is run in a VMware virtual machine and this allows backing up, snapshotting, and migrating the installation from one Linux server to another without affecting the hardware profile as seen by the Windows server product.

2.1.4 Hydrogen Masers

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

The performance of both Kvarz CH1-75 H maser frequency standards ("Kvarz69", "Kvarz70") continued to be very good. In Figure 1 the time differences between the two H masers and several GPS clocks is being illustrated.

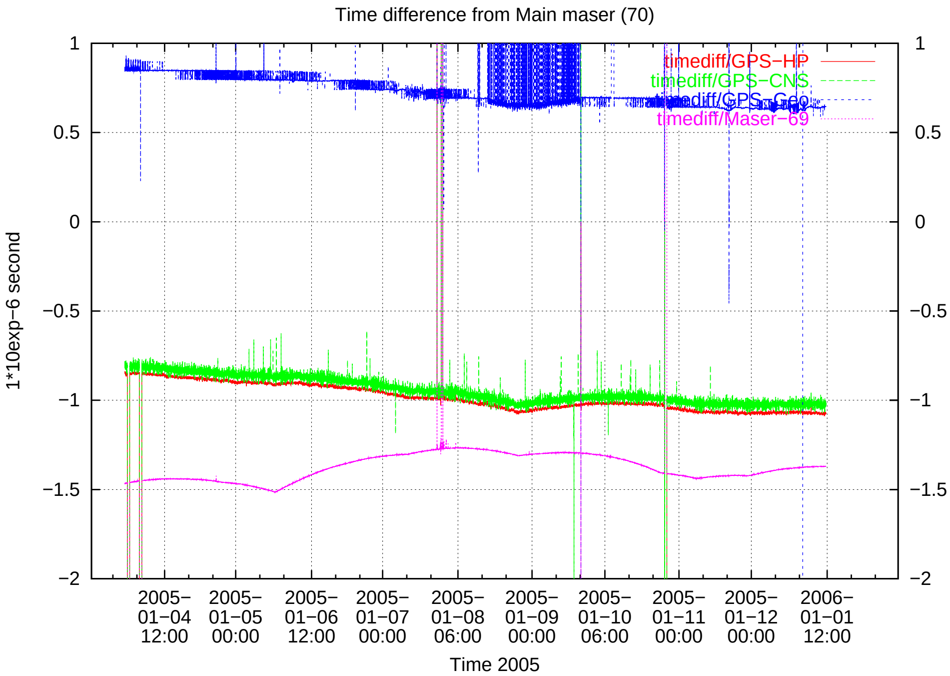


Figure 1: Time differences of H maser and GPS clocks, in microseconds.

The measurements in Figure 1 were taken with the “Clodi” 10-channel clock difference counter and its associated Linux software. “Clodi” is able to measure and store the difference between one “master” channel (typically the station H maser 1pps) and ten other 1pps channels simultaneously and all channels for every second. Although the measurement resolution of each channel is a relatively low 10 ns, integrating the frequent measurements occurring every second delivers an accurate picture of the long-term drift trends of the associated clocks.

The automated software to extract station H maser vs. HP58503A Timing GPS Receiver clock difference to model H maser long-term drift for the VLBI correlators was revamped to properly use all of “Clodi” data, integrate it and reformat it to the EVN GPS offset file specifications, and then automatically transfer it using FTP to the EVN shared server `vlbeer.ira.inaf.it`.

2.1.5 New Hardware

Project Team: Mujunen, Oinaskallio, Rönnberg

In addition to the completion of the “Clodi” clock difference counter described in section 2.1.4, the construction of a new receiver lift winch has progressed significantly in 2005. The mechanical construction nears completion in a specially-built test pedestal in the radome ring basement. The electrical control system is based on a Crouzet Millennium II programmable logic controller (PLC) converting the operations of a handset push-button control device into control sequences of several Mitsubishi frequency converter AC drives. These enable smooth and precise movements of every axis. A network of Omron induction proximity sensors prevents out-of-bounds movements of the winch. The final developments still required include a finer bearing re-smoothing process for the main stanchion, the provision for rotating the winch using a motor (manual rotation was envisaged initially), and the integration of control electronics into a weather-protecting warmed enclosure to provide above-zero-Celsius environmental conditions to the AC drives.

2.1.6 Automatization of Quasar Observations

Project Team: Tornikoski, Hovatta, Kotiranta, Lähteenmäki, Mujunen, Oinaskallio

In 2004 we took a large step towards the automatization of quasar observations by designing and implementing new software and hardware. In 2005 we continued this effort. The main additions and improvements that were done in 2005 include:

- A more effective / userfriendly updating of the web-paged source list `http://kurp.hut.fi/cgi-bin/gixlist.pl` that also includes entries for the most recent observations.
- The noise diode calibration can now also be done in a remote mode via dammer.
- The heater can be scheduled to automatically operate over a longer period of time in alternating on/off cycles (`autoheat.pl`).
- There is a new web-based user log `http://kurp.hut.fi/cgi-bin/gixlog.cgi`. This log can be used for logging and communicating information to the other Metsähovi users, for example about the telescope usage, observing information, receivers, antenna, weather etc. The automatic mode of the heater operation (`autoheat.pl`) also logs each heating cycle into this log.
- All the observers have been instructed to run their observations through a vnc session. This makes the change from live observations to a remote session very smooth, and also recovers from data transfer breaks without problems.
- The data reduction software read_contobs_data.pl was updated.
- The autolist production tool mkautofile.pl was updated.

- We have negotiated access to the "Helsinki Testbed" weather radar data with the Finnish Meteorological Institute. This helps us greatly in planning ahead our observations under non-optimal weather conditions.

2.2 VLBI Instrumentation

Project team: Ritakari, Mujunen

1.3cm K-band LCP+RCP receiver continues to be available, as does 0.7cm. (0.7cm is still in receiver laboratory pending some wiring. If 0.7cm proposals demand for it, it can be made available.)

13/3.6cm standard S/X (not wideband X with the third IF3) geo-RCP-only receiver is available. It is owned by Finnish Geodetic Institute (FGI) and using it for astronomy requires arrangements, thus prospective PIs need to contact Metsähovi directly.

The single-headstack VLBA recorder (the upper tracks of which had been failing for years, no reason/explanation ever found for this) has been detached from the rack and put into storage, so no tape recordings at Mh anymore.

The Mark5A unit on loan from JIVE had to be returned in February, but the Finnish Geodetic Institute (FGI) purchased a replacement unit which arrived in March 2005. It is being used in all VLBI experiments. It has developed a strange behaviour, some disk packs work only in slot B. If they are inserted in slot A some of the disks are not recognised and the Mark5 program locks so that the disk pack cannot be powered down—only a complete reboot helps. The test programs provided with the Mark5 do not help, since they lock too. The unit was finally sent to Conduant Corporation in December for warranty repairs.

All the 14 BBCs can achieve lock at their geodetic standard frequencies but BBC09–14 have all sorts of other troubles. For astronomy it is best to favor 8 BBC modes.

A repair kit has been designed for the gigabit counter in the VLBA BBC. It has not been tested yet, but it only replaces the GaAs counter with the same device in a different package.

In year 2005 Metsähovi continued to develop and improve the VSI-standard data acquisition system. A considerable improvement was made when the first nForce4-based motherboards arrived in June.

The possibility to speed up the data acquisition to 4 Gbit/s was studied, but the project was postponed since suitable microcircuits were not yet available. We also made a brief study of the technologies used by the SETI institute in the Allen Telescope Array. This technology uses common and inexpensive components designed for cellular phone base stations and gives essentially the same (or better) functionality as the old BBCs. The geodetic "VLBI 2010" plan seems to be based on this technology. For details see `www.seti.org` and `http://astron.berkeley.edu/ral/ata/memos/`.

2.2.1 eVLBI

Jouko Ritakari programmed a realtime version of the Tsunami file transfer protocol in December 2004. In January 2005 the program was successfully tested, streaming 512 Mbit/s over Internet proved to be possible. The protocol is capable of transferring realtime data error-free between two microcomputers. An interesting detail in the new protocol was the low CPU usage, both the sending and receiving computer had enough power to make backup copies on hard disks "on the fly".

In March 2005 Timo Lindfors programmed a VSI-standard filename parsing for the Tsunami protocol and later a version for distributed data transfer and correlation was developed.

Metsähovi has ordered a dark fiber connection to the Funet hub, bypassing the TKK network. Delivery time is approximately 2-3 months, that is, January 2006. Since the connection is dark fiber, we can install 10 Gbps Ethernet equipment that is increasingly competitive in price.

Metsähovi took part in an EU FP6 Integrated Infrastructure Initiative project proposal "EXPReS", "A Production Astronomy e-VLBI Infrastructure", coordinated by Joint Institute for VLBI in Europe (JIVE). The main participation area of Metsähovi in this proposal would be the Join Research Activity "FABRIC", "Future Arrays of Broadband Radio-telescope on Internet Computing" where Metsähovi would develop further high-speed COTS-based data acquisition technology it has pioneered since 2002.

2.3 VLBI Observational Activities

Metsähovi performs both astronomical and geodetic VLBI observations in conjuction 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).

2.3.1 VLBI Sessions in 2005

Project Team: Mujunen

In 2005 Metsähovi took part in four geodetic VLBI experiments in collaboration with the Finnish Geodetic Institute (FGI). Two regular EVN VLBI sessions were conducted in February and in October. The Global mm-VLBI Array (GMVA) observed also two sessions, in April and in October.

2.3.2 Huygens Probe

Project Team: Mujunen, Ritakari

Metsähovi participated in measuring the trajectory of the Huygens probe when it dropped through Titan's atmosphere. Ther experiment was one of the biggest VLBI experiments ever, seventeen observing stations in total, and the accuracy of the results was remarkable. An accuracy of 1000 meters was achieved at the distance of a thousand million kilometers.

The equipment that was used in Australia to measure the trajectory of the probe had been developed in Metsähovi, and Ari Mujunen developed the conversion software to change the results to a format suitable for the JIVE correlator.

2.4 AMS-02

Project Team: Ritakari

Metsähovi participated in the AMS-02 project by performing UDP transfer tests for the AMS-02 high speed data link. The 50 Mbit/s high speed data link comes from the International Space Station to the NASA Marshall Space Flight Center and will be repackaged into Ethernet frames using UDP.

2.5 Micromechanics

Project Team: Rönnberg

A novel waveguide impedance matcher based on tunable microstructures designed by Helsinki University of Technology TKK Radio Laboratory was successfully manufactured in the micromechanics shop of Metsähovi.

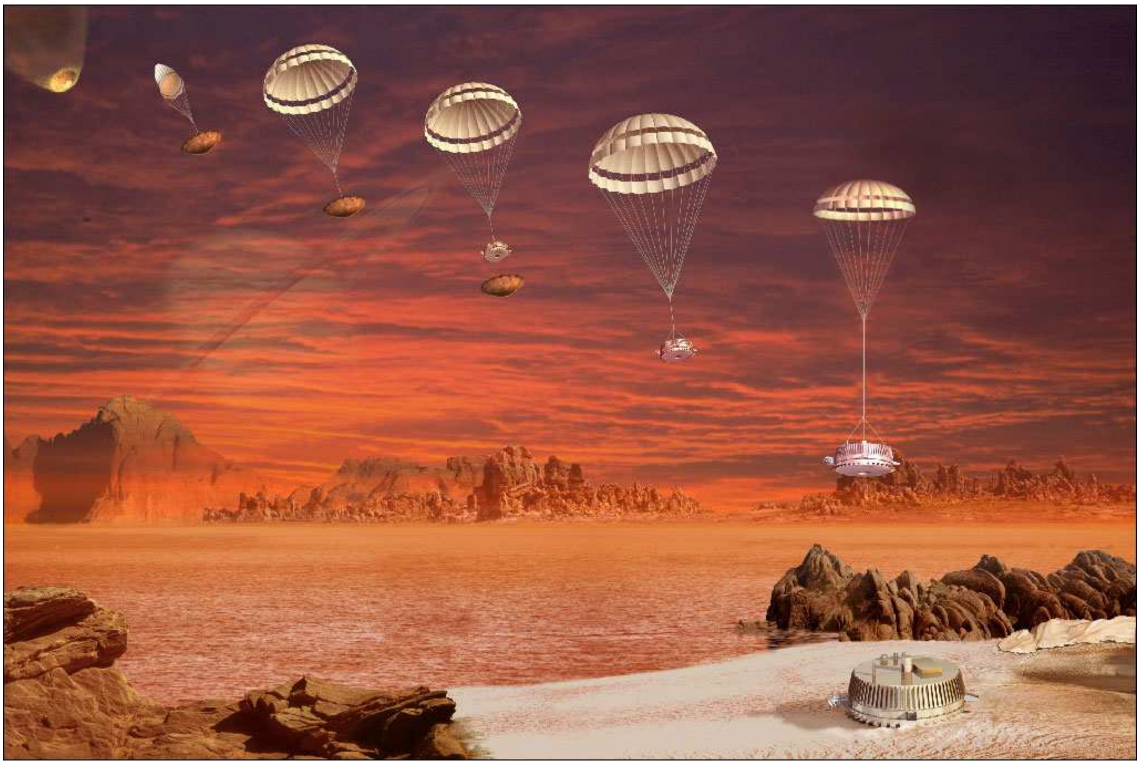


Figure 2: Huygens descent and landing (Credits: ESA - C. Carreau)

2.6 Extragalactic Radio Sources

2.6.1 BL Lacertae Objects

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

The research of a large sample of BL Lacertae objects (BLOs), which started in 2001, continued in Metsähovi. BLOs constitute an enigmatic group of active galactic nuclei with near-featureless spectra and rapid variability. One of their most intriguing aspects is the continuum formed by the peak frequencies of their synchrotron energy spectra. While the shape of the spectral energy distribution (SED) stays approximately the same from object to object, its place is shifted on the frequency axis as we move from low-energy BLOs (LBLs) to high-energy BLOs (HBLs). The population in between is often termed as intermediate BLOs (IBLs).

In her Master's thesis, Elina Nieppola studied the demography of the Metsähovi BLO source sample and determined a classification for most BLOs based directly on the SED of each individual object. Her thesis was completed in February 2005. The study was refined into a refereed paper, which achieved useful results. The major advantage of the BLO research in Metsähovi is the considerable size of the source sample. In many previous studies the results are based on samples of tens of objects at best, while our sample contains 398 sources, for 308 of which we were able to determine the SED. Our study confirmed that the BLO population is indeed continuous, instead of two discrete subgroups as suspected in the early years of BLO study. Also, it concluded that there is no dependency between the peak frequency of the synchrotron component and the object luminosity at that frequency. This speaks against the prevailing theoretical model which states that there is a negative correlation between the peak frequency and the bolometric luminosity of the source. The existing negative correlation at the radio frequencies is, however, a natural consequence of the difference in the location of the synchrotron component in the frequency axis.

In the view of our results, HBLs seem to be more intense synchrotron sources than predicted, being approximately as luminous as LBLs, but emitting in wavelengths a few magnitudes shorter. Such a contradiction with earlier studies provides an interesting foundation for future work. The two main factors that influence the relativistic jet, where the synchrotron radiation is thought to originate, are the accretion rate of the central engine and the spin of the black hole. Thus, to shed light on the differences in the intrinsic properties of LBLs and HBLs, the ideal attributes to be examined would include jet speeds and Doppler factors. This work will be resumed in 2006.

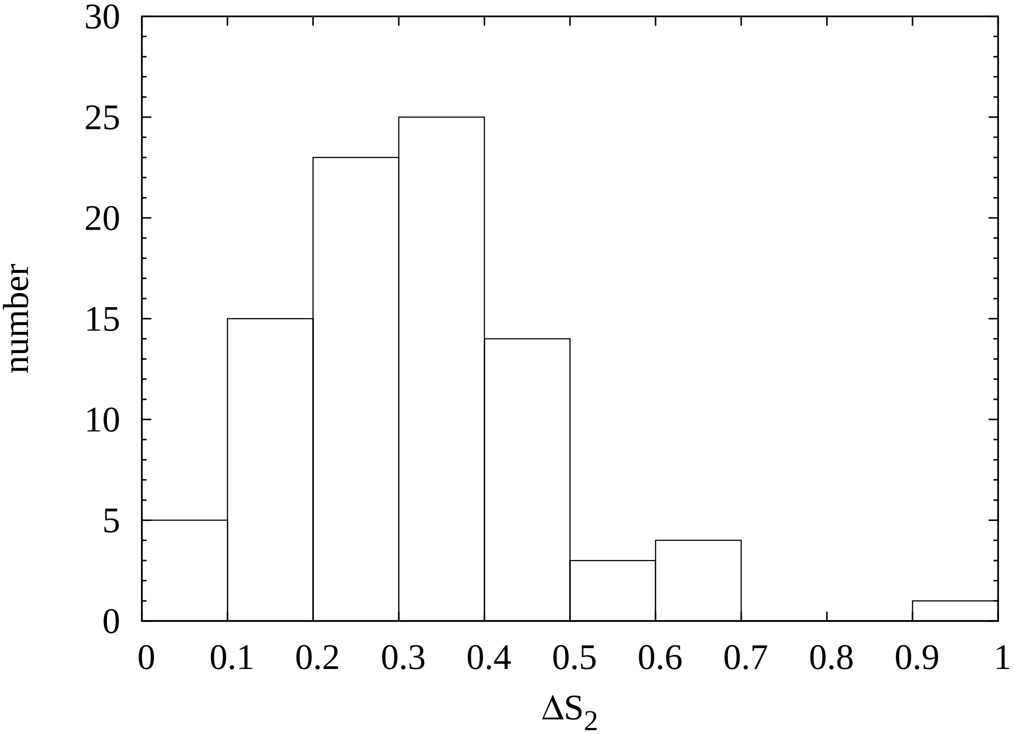


Figure 3: The distribution of the variability indices of the Metsähovi BL Lac sample.

In 2005 we also prepared the release of the BLO data obtained in Metsähovi during the first 3.5 years of our observing project. The database contains over 3000 measurements. All BLOs on the source list have been observed, and over 1/3 have a S/N $>$ 4 detection at 37 GHz. One of the most interesting findings of this observing project so far was that we got several detections of HBLs, which were thought to be nearly radio-quiet. This is useful information, in particular in cleaning the foreground sources off the CMB maps measured by the Planck satellite. In the paper accompanying the data release, some basic descriptive parameters we calculated for the sample, such as variability indices and spectral indices. Almost all sources exhibit some degree of variability. However, the quantification of variability is made difficult by its dependency on the number of measured datapoints. Similarly, the spectral indices suffer from the lack of simultaneous broad band observations. On average, the BLO spectra are very flat. The median broad band indices are α_{5-37} =0.07 and α_{37-90} =-0.02. This paper will be submitted in early 2006.

In connection with the AGN variability studies (section 2.6.2), we started preparing a manuscript on the long-term variability characteristics and flaring behaviour of a limited sample of BLOs. This paper will include calculations of the flaring timescales. A large majority of the objects included in this study are LBLs. Due to their typical radio-faintness, the detections of HBLs are few and far between. Thus the variability behaviour of HBLs is unresolved. Some of them have one clear detection amongst a number of non-detections. It is tempting to think that those serendipitous detections are the peaks of flares similar to those of LBLs, but we cannot know for certain. In 2006, we hope to study low radio frequency BLO variability using the RATAN-600 radio telescope of the Special Astrophysical Observatory in Russia.

2.6.2 Variability studies

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

We have been frequently monitoring a large sample of Active Galactic Nuclei frequently for over 25 years in Metsähovi. This has provided us with a large database which forms an excellent basis for long term variability studies.

In her Master's thesis Talvikki Hovatta gathered a sample of 193 sources that had been monitored in Metsähovi at frequencies 22, 37 and 87 GHz and also with the Swedish-ESO Submillimeter Telescope (SEST) during years 1986-2003 at frequencies 90 and 230 GHz. Higher frequency data were also collected from literature.

From this large sample, all sources which had at least one well monitored flare in at least two frequencies, were chosen for further analysis. There were alltogether 55 such sources, and 159 flares in them. We also asked for lower frequency data from the University of Michigan Radio Observatory. The aim was to study the differencies of individual flares at different frequencies. Hovatta calculated amplitudes and durations of all flares and compared the frequencies. She found out that on average flares last about three years and the duration shortens with increasing frequency. She also attempted to calculate time delays between different frequencies, which turned out to be complicated because of the complex shape of the flares. In figure 4 the different shape of a flare at frequencies 37 and 90 GHz can be seen. The study of the flares will continue in 2006.

In Hovatta's Master's thesis also the longterm timescales of AGN were studied with several statistical methods. She calculated the Structure Function, Discrete Correlation Funcion (DCF) and Lomb-Scargle periodogram for all sources that had been monitored for over ten years in at least two frequencies and had a flux level of more than 2 Janskys. There were 61 such sources. In literature these methods have been mostly used to study periodicities in the light curves of different sources but she wanted to use these methods to study the characteristic timescales of AGN. She also compared the results of the structure function analysis with old analysis, made when the monitoring had lasted ten years (Lainela & Valtaoja 1993). We found out that for some sources even ten years of monitoring is not enough for revealing all timescales.

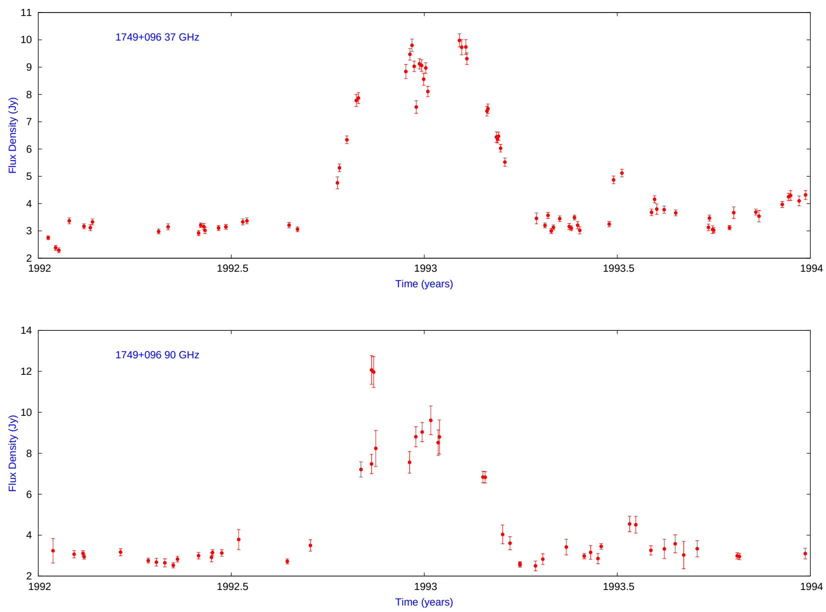


Figure 4: 1749+096 single flare at 37 and 90 GHz.

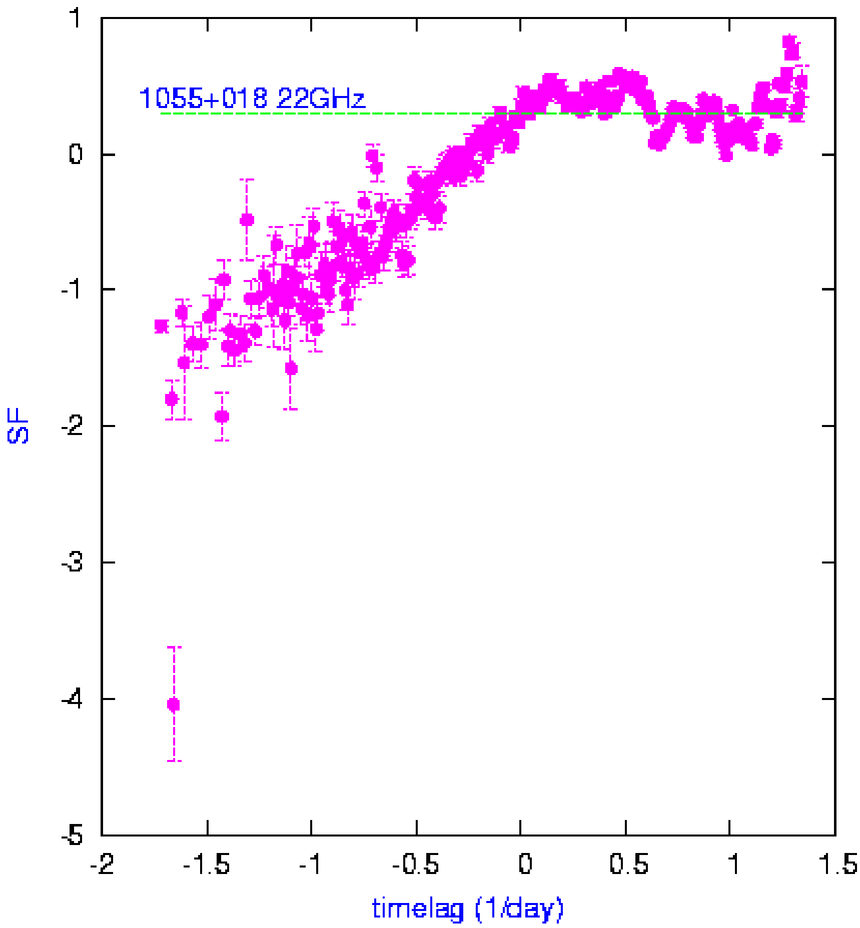


Figure 5: Structure function of source 1055+018 at 22 GHz

The DCF and periodogram analysis gave somewhat similar results with timescales shortening with increasing frequency. In the DCF autocorrelations the timescales ranged from 11 to 4 years and in the periodogram analysis from 9 to 6 years when frequency increased from 8 to 90 GHz, respectively. We also noticed that the Lomb-Scargle periodogram method produces spurious timescales and the results need to be studied carefully with other methods to confirm the time scales. This study will also continue in 2006, and there are at least two articles in preparation.

2.6.3 Inverted-Spectrum Sources

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

We continued the monitoring of our sample of gigahertz-peaked spectrum (GPS) sources and high frequency peakers (HFPs). The number of sources in the sample was increased as described below. Due to this increase the monitorig was not as intense as earlier. Most of the sources were observed at least a couple of times during 2005.

In March 2005, our paper on the variability of GPS and HFP sources was published (Torniainen et al. 2005). We proved that many previously identified GPS and HFP sources were classified with insufficient data and that they are actually variable flat-spectrum sources with inverted spectra during flares. First we intended to continue by analyzing all possible parameters of the 'bona fide' sources in the sample of Torniainen et al. (2005) with traditional statistical methods, such as the principal component analysis, cluster analysis, and discriminant analysis. Our goal was to identify what kinds of classes the sources would be divided into by the analyses, and to study what this classification would tell us about the nature of different kinds of AGNs. However, these methods require all variables for all sources, which was impossible to accomplish. Also the sample was not very large so we decided to extend it from 44 (mostly quasar type) sources to 208 sources (both quasars and galaxies) from all the major bright GPS and HFP source samples. The toilsome compilation of all possible data was started in autumn and is continuing in 2006. The problem with the analysis was solved by choosing to use Self Organizing neural Maps (SOM), which provide an effective method of clustering objects with sparse variable space.

Our collaboration with Margo and Hugh Aller from UMRAO continued in this project and we received flux density data from them for the new sources in the sample. We also broadened our collaboration with Marat Mingaliev and his group from the RATAN-600 telescope. They provided us with data on some GPS sources, found to be low in variability. These sources were included in our source sample.

2.6.4 Compact Steep Spectrum Sources

Project Team: Tröller, Tornikoski, Valtaoja (Turku)

Compact steep spectrum sources are high luminosity radio sources with steep spectra. Their (radio) size is much smaller than normal radio galaxies. They may be young sources or alternatively old and frustrated objects. In either case they provide important constraints on the environmental factors influencing the origin and evolution of powerful radio sources.

A sample of CSS sources obtained with the Nordical Optical Telescope (NOT) in R- and V-bands has been studied to distinguish between the two evolution scenarios.

A detailed photometric analysis was applied using a two-dimensional surface brightness model. The model consists of two components: a core representing the nuclear component and a host galaxy. The core was described by a scaled point-spread-function (PSF) whereas the model of the host galaxy was assumed to have constant elliptical surface brightness contours.

It was found that in optical the nuclear component is nearly always weaker that the host galaxy (except for two cases). The hosts of CSS sources are large and bright ellipticals, with an absolute brightness in the R-band of $< M_R >=$ -24.4mag and $< M_V >=$ -24.9mag in the V-band. The mean half-light radius is $r_{eff} = 11kpc$.

The shapes of the hosts would seem to confirm the youth scenario in which these sources are evolving radio galaxies. The results will be published in 2006.

2.6.5 Planck Satellite Science

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

The Planck satellite will map the sky at several radio frequencies 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 as well. The satellite launch is scheduled for February 2008.

Our Metsähovi Radio Observatory and Tuorla Observatory Planck collaboration team has enthusiastically participated in the core acitivities of the Planck Extragalactic Point Sources Working Group (WG 6). In 2005 the main tasks for our team have been the refinement of the Planck Quick Detection System software, and observations and analysis of AGN source samples in Metsähovi and with our collaborators worldwide (see previous subsections). J. Aatrokoski replaced M. Parviainen as the QDS software developer. A closer account on the QDS status will be given in section 2.6.6. Preliminary work for the Herschel proposals was already done in autumn, but the actual deadline was postponed until 2006.

During early 2005, A. Lähteenmäki was nominated the Finnish science Co-Investigator and also a Planck Scientist by the LFI Consortium. Following this, a Finnish Planck science group was set up by her, to provide a connection point to all the Finnish scientific teams as well as the 70 GHz instrument team, and to find ways of improving cooperation and PR. The group met twice in 2005.

The annual Planck LFI and HFI Consortia meeting was held in Garching in January. A. Lähteenmäki and M. Parviainen participated. WG 6 also met and discussed the latest developments. WG6 had a separate meeting in Padova in October, to address the most urgents tasks and plans, such as the ongoing observing and data analysis programmes, the pre-launch catalog, and Planck science topics (i.e. how to use Planck data). It was also agreed that the next WG 6 meeting will be arranged in Finland by our Metsähovi and Tuorla Planck team. Our representatives in the Padova meeting were A. Lähteenmäki, M. Tornikoski, J. Aatrokoski, and E. Valtaoja. The Working Group also held a few teleconferences for WG coordinators (A. Lähteenmäki).

The homepage of the Metsähovi and Tuorla Planck collaboration can be found at
http://kurp.hut.fi/quasar/planck/index-en.htm.

2.6.6 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.

In the course of 2005 the software was implented to its current, near-final state. The finishing touches, some additional features as well as the user and developer documentation will be finished in 2006.

The following is an overview of the current features of the software as well as a more detailed look at the data processing steps (Figure 6).

General Features

- Very configurable. Most configuration variables can have frequency- and detector-specific values as well as a default value.
- Support for arbitrary number of detectors and frequencies.
- Not strictly Planck-specific: the main restriction is that the data must be in similar rings as in Planck.
- Can also be run in interactive mode where the results can be examined and source histories can be plotted as graphs.
- User manual (not yet complete).

Processing Pipeline

Planck data is organized in rings in the sky. The first step in the processing pipeline is the *normalization* of the data rings. The normalization (Figure 7) performs the following operations:

- The 60 very noisy sampling rings from the same sky circle are averaged together to produce a noise-reduced ring.
- The rings are adjusted to have a well-defined and consistent starting point and direction.
- Sample units are converted from antenna temperature to flux density.

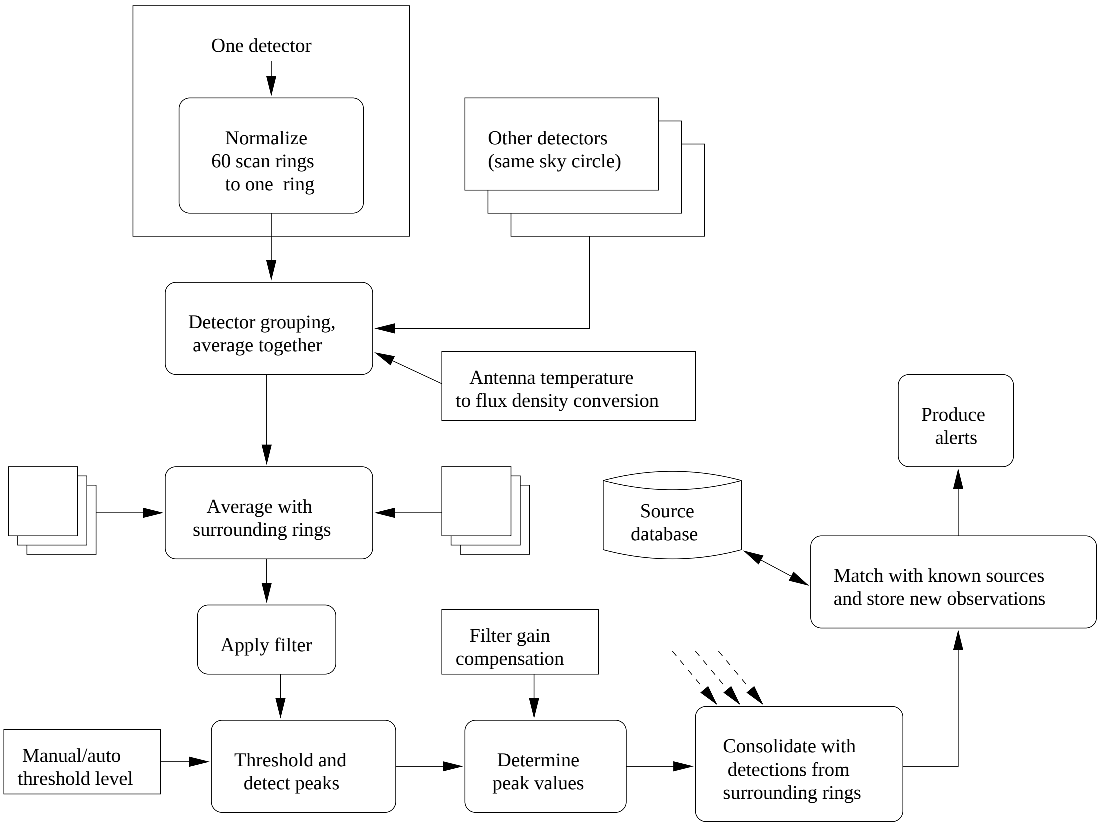


Figure 6: A detailed chart of the QDS processing pipeline. This procedure is repeated for every ring and every detector.

Future work will implement caching of the normalized rings to reduce processing time on rings already processed once.

The normalized rings can be easily averaged with rings from other detectors in the same sky circle (detector grouping) and also with surrounding rings to further reduce noise.

The next step is filtering and thresholding, which are the steps that actually detect the point sources. Filtering uses a Mexican Hat Wavelet filter (Figure 8) with the width parameter configurable for each detector either as a multiple of the beam FWHM or directly in arc minutes. Future plans for filtering include:

- Support for matched filters.
- Optimal Mexican Hat width determination from the background power spectrum.

After filtering the noise level σ of the data is determined and the data is thresholded to detect point sources. The threshold is usually configured as a multiple of the noise level. Future plans for thresholding involve possibly using several thresholds for each ring, primarily depending on the galactic coordinates.

As a point source is usually visible in several rings, the detection results for each ring must be consolidated with the results from all the other rings being processed to remove duplicates and determine the correct values for coordinates and brightness. Finally those detections that are deemed interesting will produce an alert for the operator.

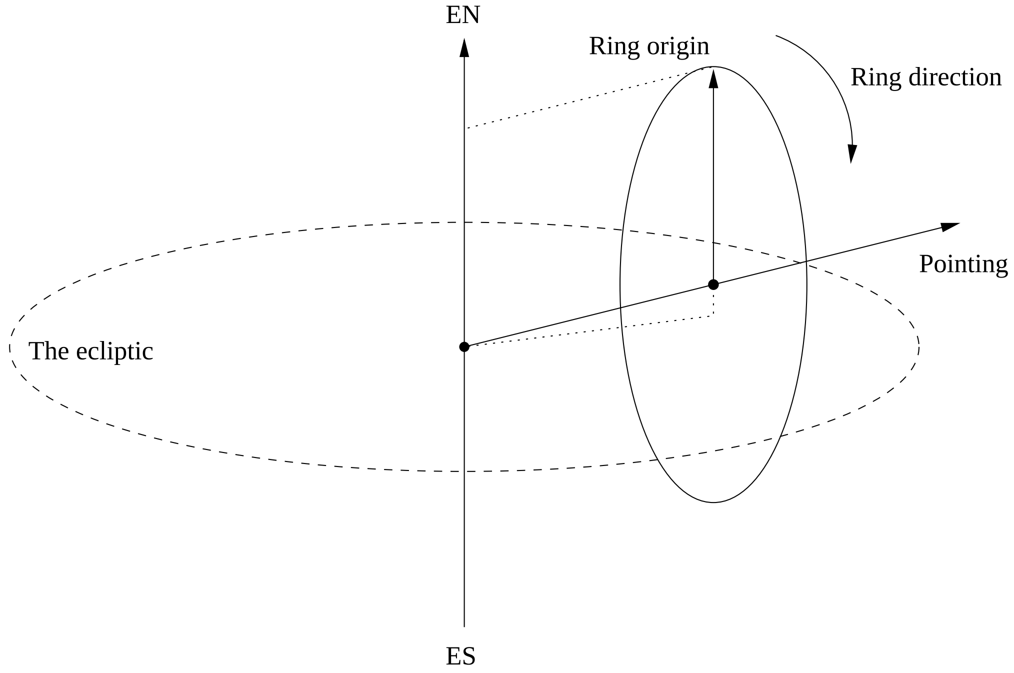


Figure 7: QDS ring normalization principles. A normalized ring starts at the ecliptic north and goes around the satellite pointing vector in the clockwise direction.

Alert Criteria

After found, a detection must satisfy one of the following criteria to be deemed interesting and produce an alert:

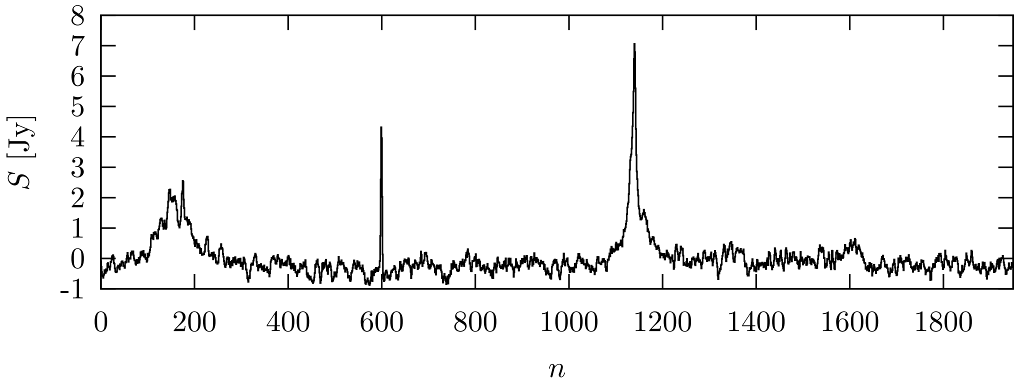
- The source is previously unknown. Most of these will probably be spurious. They will be added to the source database so they will not appear as unknown sources again.
- The source is brighter than ever by a certain factor i.e. the current flux is large enough compared to the historical maximum flux of the source at that frequency.
- The source is brighter than the previous, recent enough observation at that frequency. This criterion is triggered when there is a steep rise in the flux of the source.
- The source has an inverted spectrum. Generally this means that the spectral index between two frequencies is larger than a given threshold.

2.6.7 Multifrequency Observing Campaigns

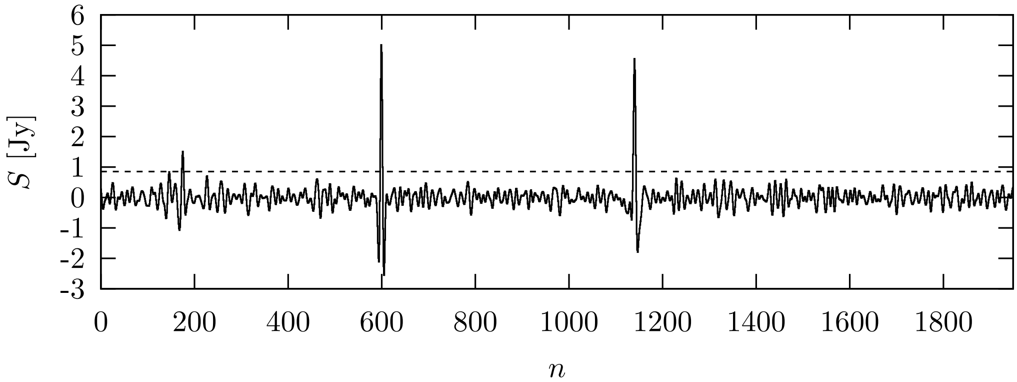
Project Team Tornikoski, Lähteenmäki, Torniainen, Tröller, Parviainen, Hovatta, Kotiranta, Nieppola

We took part in several multifrequency campaigns in 2005, and did individual observing requests as usual. Typically we support the campaign with daily observations, and continue regular monitoring also before and after the actual core campaign.

0716+714 & 0836+710 Monitoring of 0716+714 and 0836+710 was continued regularly. In addition there was a Suzaku campaign of 0836+710 in November, and an optical campaign of 0716+714 in February.



(a) Noise-reduced ring before filtering. There is a 5 Jy point source at $n = 600$, everything else is background. The signal has been adjusted so that its mean is zero.



(b) The ring after filtering. A detection threshold of 4σ is marked with dashes. Note the spurios detections at $n \approx 150$ and $n \approx 1150$.

Figure 8: Simulated Planck ring data before and after filtering with a Mexican Hat Wavelet filter in QDS.

0235+164 The second part of the WEBT/ENIGMA campaign of 0235+164 continued until April 2005. There was also an XMM pointing in January, as well as frequent VLBA observations.

3C 454.3 Extensive multifrequency campaigns were arranged in 2005 to monitor the optical and radio outbursts of 3C 454.3.

J0746.3+2548 J0746.3+2548 is a new high-z blazar that was targeted by Suzaku in November.

In November 2005 Metsähovi also participated in a multifrequency campaign on J0746.2+2548. This newly found high-z blazar was first detected by BAT gamma-ray detector on Swift satellite. During this campaign, the source was observed on Nov 4th - 6th by the hard-X-ray detector onboard Suzaku X-ray astronomy satellite and other instruments across the world. In Metsähovi, the weather ruined the possibility to make simultaneous observations, but we managed to get detections a few days before and after the campaign. A paper on the campaign written by Dr. Rita Sambruna from NASA's DSFC is to be published in Astrophysical Journal in 2006.

4C 38.41 4C 38.41 has been the target of intensive VLBA and GMVA observations since its major mm flare in 2002. In 2005 we continued to observe it, particularly during the VLBA sessions.

OJ 287 There will be extensive multifrequency campaigns of OJ 287 in 2006 and 2007, trying to catch the predicted outburst(s). We will be taking part in the campaigns and have started monitoring this source frequently, along with the optical observatories. In 2005 we also supported the two XMM campaigns, in April and in November.

BL Lac The WEBT campaign on BL Lac continued until early 2005.

Whipple cooperation We are observing a handful of sources for the Whipple gamma-ray telescope AGN monitoring programme: 1ES2344+514, 1ES1959+650, MARK 421, H1426+428 and MARK 501.

Others & requests We are watching 3C 279 and other requested AGNs for MAGIC (Elina Lindfors, Tuorla Observatory), in case they start brightening at 37 GHz. We have also monitored ARP299 for Dave Clements (Imperial College). It consists of two galaxies and might be a buried AGN. It had an IR-flare early 2005. B2201+315 was monitored for David Jauncey (Australia Telescope National Facility).

2.6.8 RATAN-600 Collaboration

Project Team: Tornikoski, Lähteenmäki, Valtaoja (Turku)

We have continued our collaboration with the Russian RATAN–600 team for multifrequency, multi-epoch observations of inverted-spectrum sources and BL Lacertae Objects (a list of ca. 80 sources). The observations at RATAN–600 are made between the frequency bands 1 and 22 GHz, and we complement them with 37 GHz data from Metsähovi (semi-simultaneous data and also some longer term flux history).

In this project we want to determine the true shape of the continuum spectrum of these sources in different variability stages, and we also want to study their general variability behaviour. We are preparing a paper based on the results from the first years of this project, but we plan to expand our sample and continue our fruitful collaboration.

2.7 Solar Research

Project Team: Tornikoski, Riehokainen (Turku)

In 2005 the main emphasis was on using the 37 GHz frequency band and on observing Solar maps (especially declination maps in order to study the polar region activity) during the summer months. Solar radio flares observed during earlier observing epochs (during higher activity) were studied in detail in order to model interacting coronal magnetic loops with our Russian collaborators.

Additionally, the small (1.8-metre) "SunAnt" telescope was used for continuous monitoring of the whole Solar disk at 11.7 GHz.

Due to an azimuth motor failure the SunAnt antenna was not operating from September until mid-November of 2005. Several outbursts (up to the saturation of the linear amplifier channel) can be seen in Figure 9.

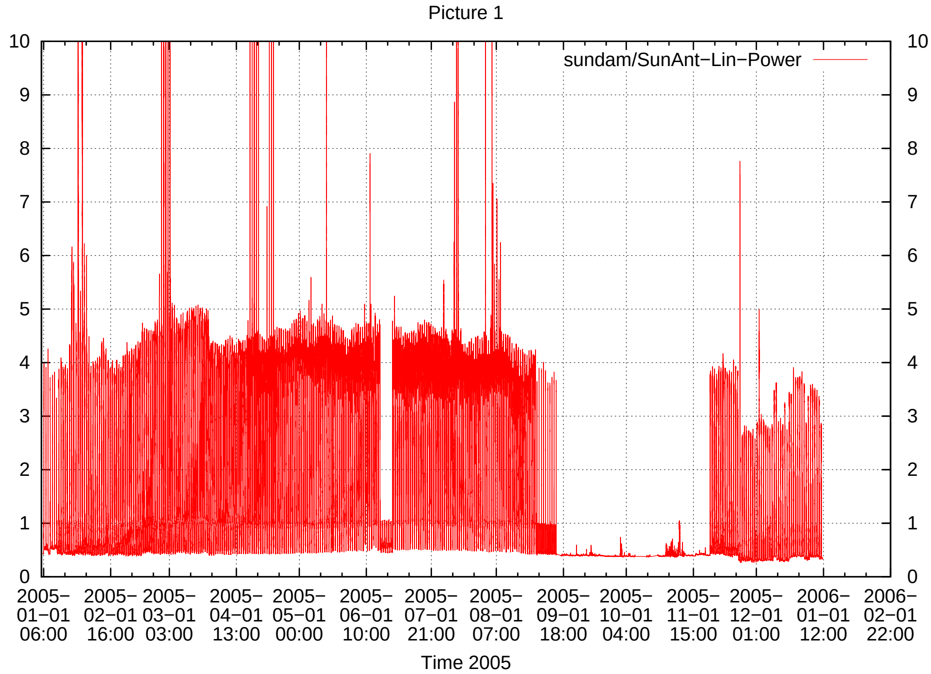


Figure 9: SunAnt total power output across year 2005.

2.8 Recreational events & keeping fit

On May 23rd Metsähovi staff had a recreational afternoon canoeing on the Siuntio River, and afterwards swimming in the Siuntio Spa (well, some of us decided to swim already earlier in the day...)

The athletic Metsähovi staff members also enthusiastically took up running. We decided to challenge the Tuorla team to participate in a half marathon running event Helsinki City Run, and the Metsähovi ladies also participated in the "Women's 10k" event.

Figure 10: Metsähovi staff canoeing on the Siuntio river.

Figure 11: At the finishing line of the half marathon.

Figure 12: The Metsähovi HCR team.

Figure 13: 3 of the 4 women runners in our Women's 10k team (one is behind the camera) with the cheerleader-dog Apollo.

3 Publications

3.1 International Journals

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8 Tröller, M.: Host galaxies of CSS radio sources. Proceedings of the 5th ENIGMA meeting held in Neubrandenburg, Germany, 13-17.6.2005. http://www.lsw.uni-heidelberg.de/projects/enigma/Efiles/proceedingsEM5.pdf, 2005.

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10 Hovatta, T.: Multifrequency radio behaviour of Active Galactic Nuclei, XXXV Young European Radio Astronomer's Conference (YERAC) held in Cagliari, Italy, 12-16 October 2005, http://lucipher.ca.astro.it/

3.3 National Conferences

1 Tröller, M., Tornikoski, M., Valtaoja, E.: Host galaxies of compact steep spectrum radio sources. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

2 Lähteenmäki, A., Tornikoski, M., Valtaoja, E.: Planck satellite: Extragalactic point source science. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

3 Ritakari, J., Mujunen, A.: eVLBI: 1Gbit/s data acquisition and transfer. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

4 Mujunen, A., Ritakari, J.: Tracking the Huygens Probe Trajectory using VLBI. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

5 Hovatta, T., Tornikoski, M., Trushkin, S.A.: Multifrequency Metsähovi and RATAN-600 observations of Active Galactic Nuclei. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

6 Torniainen, I., Tornikoski, M., Aller, M., Aller, H.: Long-term variability of inverted-spectrum sources. 10. Suomen avaruustutkijoiden kokous (FinCOSPAR), Helsinki-Tukholma-Helsinki, 11-13.5.2005, Ilmatieteen laitos raportti 2005:3, eds. T. Siili, E. Huttunen, H. Koskinen ja P. Toivanen, 2005.

3.4 Laboratory Reports

1 Urpo, S., Tornikoski, M., Mujunen, A., Oinaskallio, E., Lindfors, T.: Major solar radio flares measured at Metsähovi in 2004. Metsähovi Publications on Radio Science HUT-MET-51, 37 p., 2005.

2 Tornikoski, M., Mujunen, A. (editors): Metsähovi Radio Observatory Annual Report 2004. Metsähovi Reports HUT-KURP-31, 30 p., 2005.

3 Lähteenmäki, A., Tornikoski, M. (toimittajat): (Ali)millimetriradioastronomian käytännön näkökohtia. Metsähovi Publications on Radio Science HUT-MET-52, 2005.

4 Torniainen, I.: Kalibrointi mm- ja alimm-alueella (Ali)millimetriradioastronomian käytännön näkökohtia, S-92.605 Avaruustekniikan lisensiaattikurssi, A. Lähteenmäki, M. Tornikoski (eds) Metsähovi Publications on Radio Science, HUT-MET-52, 2005.

5 Torniainen, I.: Sunyaev-Zel'dovich-ilmiö (Ali)millimetriradioastronomian käytännön näkökohtia, S-92.605 Avaruustekniikan lisensiaattikurssi, A. Lähteenmäki, M. Tornikoski (eds) Metsähovi Publications on Radio Science, HUT-MET-52, 2005.

6 Hovatta, T.: Atacama Large Millimeter Array ALMA, S-92.605 Avaruustekniikan lisensiaattikurssi, A. Lähteenmäki, M. Tornikoski (eds) Metsähovi Publications on Radio Science, HUT-MET-52, 2005.

7 Hovatta, T.: Datankäsittely alimm-alueella, S-92.605 Avaruustekniikan lisensiaattikurssi, A. Lähteenmäki, M. Tornikoski (eds) Metsähovi Publications on Radio Science, HUT-MET-52, 2005.

4 Visits to Foreign Institutes

Landessternwarte Heidelberg, Germany, 10.3.-8.4.2005 and 21-25.10.2005, M. Tröller.

Observations at the Calar Alto Observatory, Spain, 26.10-2.11.2005, M. Tröller.

Blackrock Castle Observatory, Cork, Ireland, November 24, 2005. M. Tornikoski, A. Lähteenmäki.

European Southern Observatory headquarters, Munich, Germany, 11.-12.4.2005, M. Tornikoski.

Joint Institute for VLBI in Europe (JIVE), Dwingeloo, the Netherlands, 20-27.1.2005, A. Mujunen (ESA/Huygens-VLBI processing).

5 Visiting Scientists

Dr. Sergei Trushkin, Special Astrophysical Observatory RAS
Prof. Yuri Parijskij, Special Astrophysical Observatory RAS
Dr. Marat Mingaliev, Special Astrophysical Observatory RAS Dr. Vyacheslav Vdovin, Russian Academy of Sciences
Dr. Alexander Shtanyuk, Russian Academy of Sciences
Mr. Andrey Perminov Russian Academy of Sciences
Dr. Alexander Shtanyuk, Russian Academy of Sciences
Mr. Igor Kuznetsov, Russian Academy of Sciences

6 Thesis

Talvikki Hovatta M.Sc. (Tech) thesis: Multifrequency long term radio behaviour of Active Galactic Nuclei. Helsinki University of Techonology, Department of Electrical and Communications Engineering, supervised by Merja Tornikoski.

Master's thesis at Turku University: Elina Nieppola M.Sc. thesis: Properties of the BL Lac population, supervised by Merja Tornikoski.

7 Teaching

Post-graduate course "Practical aspects of (sub)millimetre-wavelength radio astronomy", spring 2005, M. Tornikoski, A. Lähteenmäki

Assistant teacher at the "Solar and Cosmic Plasmas" summer school of the Academy of Finland graduate school for astronomy and space physics (13-17.6.2005, Kiljava), A. Lähteenmäki

Radioastronomy demonstration for HUT Space Technology students, 9.3.2005, I. Torniainen

8 Other Activities

Referee for an observing proposal for the James Clerk Maxwell Telescope, M. Tornikoski

Referee for Monthly Notices of the Royal Astronomical Society, M. Tornikoski

Referee for Global Millimetre-VLBI Array (GMVA) observing proposals, M. Tornikoski

Evaluator for the Doctoral Thesis of Natalia Babkovskaia, University of Oulu, M. Tornikoski

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

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

8.1 Participation in Boards and Committees

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

Local coordinator for the EC research training network ENIGMA ("European Network for the Investigation of Galactic Nuclei through Multifrequency Analysis"), M. Tornikoski

Member of the Finnish Astronomical Advisory Group for the ESO project "Development of distributed data analysis system for extensive astronomical data", a.k.a Sampo, M. Tornikoski

Member of the TEKES streering group for the Sampo project for ESO, M. Tornikoski

Finland's representative to the ESO Users Committee, M. Tornikoski

Steering group member of the Academy of Finland graduate school of astronomy and space physics, A. Lähteenmäki

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

Member of the scientific organizing committee of "Solar and Cosmic Plasmas" summer school of the Academy of Finland graduate school for astronomy and space physics (13-17.6.2005, Kiljava), A. Lähteenmäki

Finnish Astronomical Society, Secretary, I. Torniainen

Member of the ESF:n Committee for Radio Astronomy Frequencies, Jouko Ritakari

8.2 International Meetings and Talks

Tornikoski M: Millimetre variability of AGNs, talk at the Russian-Finnish Symposium in Turku, Finland, January 19.-21., 2005.

Torniainen, I., Tornikoski, M., Aller, M.F. and Aller, H.D.: Long term variability of inverted-spectrum sources, Talk at Russian-Finnish Symposium, 19th January, 2005, Tuorla Observatory.

Nieppola, E.: Properties of the BL Lac population based on the Metsähovi BL Lac sample, talk at the Russian-Finnish Symposium, in Piikkiö, Finland, Jan 19-21 2005.

Hovatta, T.: Multifrequency Radio Variability of AGN, talk at the Russian-Finnish Symposium, 19th January 2005, Tuorla Observatory, Piikkiö, 2005.

Planck LFI/HFI Consortia Meeting in Garching, Germany, 26-28.1.2005, A. Lähteenmäki (Talk: Status of the Metsähovi/Tuorla Planck project and update on cooperation with RATAN-600), M. Parviainen (Talk: Status of the QDS software).

Mujunen, A.: EVN-NREN eVLBI meeting, Schiphol, Amsterdam, 28.1.2005.

Ritakari, J.: EVN-NREN eVLBI meeting, Schiphol, Amsterdam, 28.1.2005.

Tornikoski, M., Tröller, M.: ENIGMA mid-term review meeting, held March 9, 2005, at the Max Planck Institute in Bonn, Germany, M. Tornikoski, M. Tröller.

Tornikoski, M.: ESO Users Committee meeting held April 11-12, 2005, at the ESO Headquarters in Garching, Germany.

Ritakari, J.: The 40th CRAF meeting, Bologna, Italy, 11-12.4.2005.

Mujunen, A.: EVN dBBC meeting, Bologna, Italy, 1-4.5.2005.

Tornikoski, M., Tröller, M.: The fifth ENIGMA network meeting, held June 13-17, 2005 in Hotel

Bornmuehle, Neubrandenburg, Germany.

Mujunen, A.: EVN Technical Operations Working Group meeting, Onsala, Sweden, 1-2.7.2005.

Ritakari, J.: EVN-NREN meeting, Schiphol, Amsterdam, 12.10.2005.

Lähteenmäki, A., Tornikoski, M., Aatrokoski, J.: Planck Working Group 6 (Extragalactic foregrounds) meeting held October 17-19, 2005 in Padova, Italy.

Hovatta, T.: Multifrequency radio behaviour of Active Galactic Nuclei, XXXV Young European Radio Astronomer's Conference (YERAC), 12-16.10.2005, Cagliari, Italy, http://lucipher.ca.astro.it/ matteo/yerac05/abstracts/hovatta.html.

Planck Extragalactic Working Group meeting in Padova, Italy, 17-18.10.2005, A. Lähteenmäki, M. Tornikoski, J. Aatrokoski (Talk: Report on QDS software), E. Valtaoja (Turku)

Tornikoski M, Lähteenmäki A, Valtaoja E, Nieppola N, Hovatta T, Trushkin S: Radio Observations of a Complete Sample of BL Lacertae Objects... and Some Words about the Long Term Behaviour of AGNs, talk at the Planck Working Group 6 Workshop in Padova, Italy, October 17-18, 2005.

Ritakari, J.: The 41th CRAF meeting, Aveiro, Portugal, 15-19.11.2005.

Tornikoski, M., Lähteenmäki, A., Tröller, M.: The sixth ENIGMA network meeting, held November 22-25, 2005 in Kinsale, Ireland.

Mujunen, A.: EVN Consortium Board of Directors, Bonn, Germany, 28.11-1.12.2005.

8.3 National Meetings and Talks

X Finnish COSPAR meeting (FinCOSPAR) 11-13.5.2005,
Talk: A. Lähteenmäki: Planck satellite, Extragalactic point source science,
M., Tornikoski: Host galaxies of compact steep spectrum radio sources,
J. Ritakari: eVLBI: 1Gbit/s data acquisition and transfer,
A. Mujunen: Tracking the Huygens Probe Trajectory using VLBI,
T. Hovatta: Multifrequency Metsähovi and RATAN-600 observations of Active Galactic Nuclei,
I. Torniainen: Long-term variability of inverted-spectrum sources.

8.4 Participation in winter and summer schools

Summer school of Finnish Graduate School in Astronomy and Space Physics, Kiljavanranta, Nurmijärvi, 13-17 June, 2005, I. Torniainen, T. Hovatta, E. Nieppola

Summer School on Dark Energy and Dark Matter in the Universe, Alpbach, Austria, 18-29.7.2005, M. Tröller.

IRAM mm Observing Summer School, Pradollano, Sierra Nevada, Spain, Sep 30 - Oct 7 2005, T. Hovatta, E. Nieppola.

8.5 Public Relations

TKK Nyt verkkolehti: Huygens-Titan-project.

Newspaper Helsingin Sanomat Verkkolehti, January 13th, about Metsähovi's participation in the Huygens tracking project, interview with J. Ritakari & A. Mujunen.

Magazine Tähdet + Avaruus 4/2005 Huygens, about Metsähovi's participation in the Huygens tracking project, interview with J. Ritakari & A. Mujunen.

Magazine Kotiliesi, February 1st 2005, M. Tornikoski was interviewed about the work of a radio astronomer.

TV program “Huomenta Suomi” on MTV3, November 16th 2005, M. Tornikoski was interviewed about the ALMA telescope array and the Metsähovi research.

Tähtipäivät 10.4.2005, meeting of the Finnish amateur astronomy association URSA, invited talk “Radioastronomit kuuntelevat kosmisia kuiskauksia”, A. Lähteenmäki

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

9 Personnel in 2005

Permanent Positions funded by the Helsinki University of Technology

Tornikoski, Merja, Dr.Tech.	Acting 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	jussi@kurp.hut.fi
Rönnberg, Henry, Mr.	Mechanician	

Scientific and Technical Staff Funded by Research Contracts

Aatrokoski, Juha, student	Research assistant from 1.8.2005	jha@kurp.hut.fi
Hovatta, Talvikki, M.Sc. (Tech)	Research assistant, part-time 1.1-22.5.2005 full time 23.5-30.11.2005, full time researcher from 1.12.2005.	tho@kurp.hut.fi
Kotiranta, Mikko, student	Research assistant, part-time 1.1-31.5.2005 full time 1.6-31.8.2005	
Lindfors, Timo, student	Research assistant, part time 1.1-31.5.2005 and 26.9-31.12.2005, full time 1.6-31.8.2005	lindi@kurp.hut.fi
Lähteenmäki, Anne, D.Sc.(Tech.)	Researcher Academy Research Fellow from 1.8.2005	alien@kurp.hut.fi
Nieppola, Elina, M.Sc.	Researcher from 1.8.2005	eni@kurp.hut.fi
Parviainen, Mikko, M.Sc.(Tech.)	Researcher until 31.3.2005	pare@kurp.hut.fi
Ritakari, Jouko, M.Sc. (Tech)	Researcher	jr@kurp.hut.fi
Torniainen, Ilona, M.Sc. (Tech)	Researcher	ilo@kurp.hut.fi
Tröller, Mirko, M.Sc.	Researcher	mtr@kurp.hut.fi

Metsähovi Advisory Committee

Korpela, Seppo, Dir.
Pellinen, Risto, Prof.
Somervuo, Pekka, Dr.Tech.
Tanskanen, Pekka, Prof.
Tiuri, Martti, Prof.emer., M.P. (Chair)
Tornikoski, Merja, Director (Secretary)