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Metsähovi Radio Observatory
Annual Report 2001

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Contents

List of Figures

1 Introduction

The Metsähovi Radio Observatory, a separate research institute at the Helsinki University of Technology since May 1988, operates a 14 m diameter radio telescope at Metsähovi, Kylmälä, about 35 km west from the university campus. The institute also has premises in the Electrical Engineering Faculty building, Otakaari 5, Espoo. The main users of the station are the Helsinki University of Technology, the University of Helsinki, and the University of Turku. In the same area, near Metsähovi Radio Observatory, there are also the buildings of the Metsähovi Observatory (University of Helsinki; optical astronomy) and the Metsähovi Space Geodetic Station (Geodetic Institute; geodesy).

The Metsähovi Radio Observatory has been operational since 1974. The upgrading of the telescope was done during 1992−1994. The radome was replaced with a new one and new surface panels were installed. The surface accuracy of the present telescope is 0.1 mm (rms). The old analog servo system of the telescope was replaced by a new digital servo system in 1998−1999. Planning of new observing programmes was started in 1999.

The Metsähovi Radio Observatory is active in the following £elds:

- Research in radio astronomy,
- Development of instruments needed in radio astronomy,
- Development of methods for radio astronomical measurements,
- Space research, and
- Education.

The activities at Metsähovi are concentrated on millimeter waves and microwaves. The used frequencies are 10 $\cdots$ 150 GHz, and the corresponding wavelengths 30 $\cdots$ 2 mm. The research in technology includes development of microwave receivers, development of receiving methods, development of data processing and development of antenna technology. The objects of radio astronomical research are: solar millimeter and microwave radiation, variable quasars, active galaxies, molecular line radiation, and very long baseline interferometry (VLBI). Metsähovi participates in the education at the Helsinki University of Technology by organizing courses and exercises for students, and graduate students can study for a licentiate's or doctor's degree at Metsähovi.

Around 20 scientists, engineers, or research assistants, and support personnel from the Helsinki University of Technology work at the institute. In addition about 10 students did radio astronomical observations under the guidance of Metsähovi staff. Five of the employees are paid by the Helsinki University of Technology, and the others are employed by research projects £nanced mainly by the Academy of Finland. The other users of the Metsähovi telescope are the radio astronomy group at the University of Helsinki, and the radio astronomy group at the University of Turku.

In 2001 the total expenditure of the Metsähovi Radio Observatory was about 5,9 million FIM, including salaries. This was £nanced by:

Helsinki University of Technology 49 %
Academy of Finland 26 %
Tekes 12 %
Others 14 %

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: Urpo, Peltonen, Mujunen, Oinaskallio, Koistinen, Ritakari, Rönnberg, Sjöman

2.1.1 Planck 70 GHz Receiver

Project Team: Sjöman, Peltonen, Rönnberg

Metsähovi has kept the co-operation going with Ylinen Electronics Ltd in the Planck 70 GHz receiver development project. The recent development has been in the measurement £eld where EBB-type (Elegant Bread Board) receiver preliminary testing has been done collaborating with Ylinen in the Planck project. The receiver design has been done by Nicholas Hughes at Ylinen but also in the design phase some problems were solved by Metsähovi personnel. The £nal EBB ampli£ers chains and receiver can be seen in Figure 1 a,b and c.

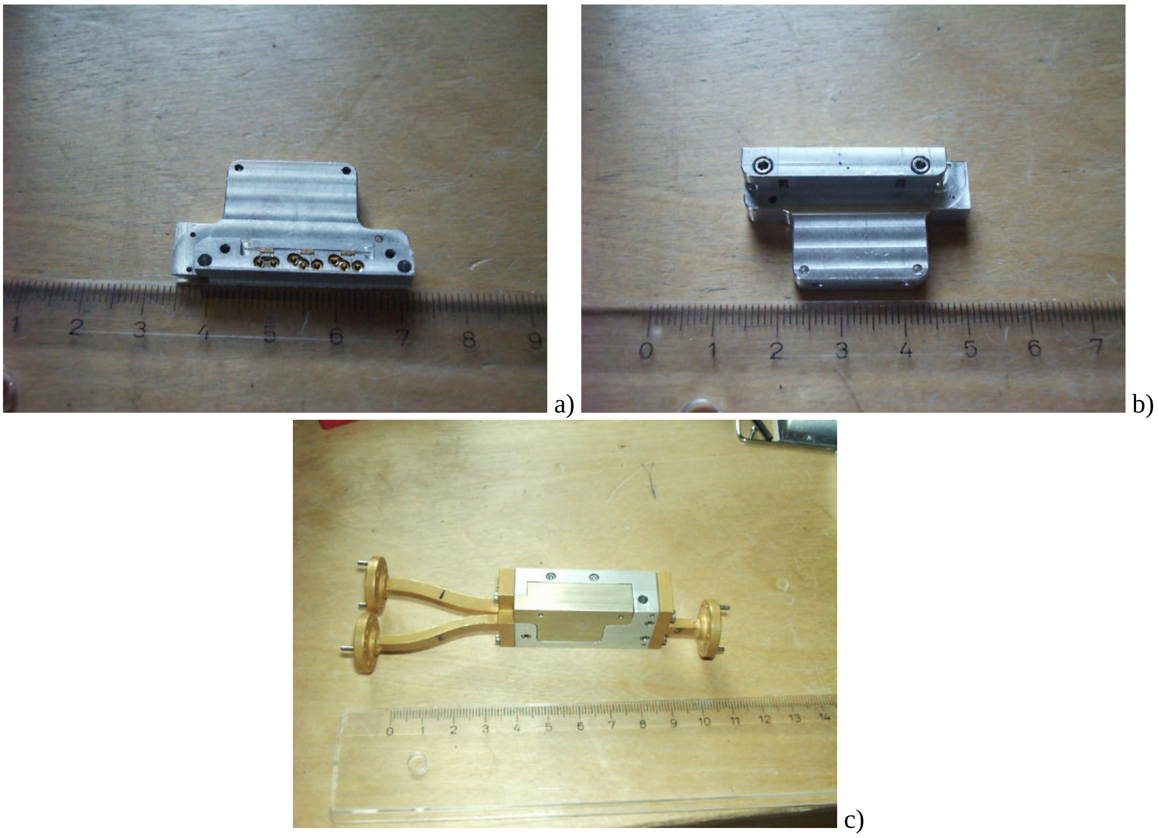
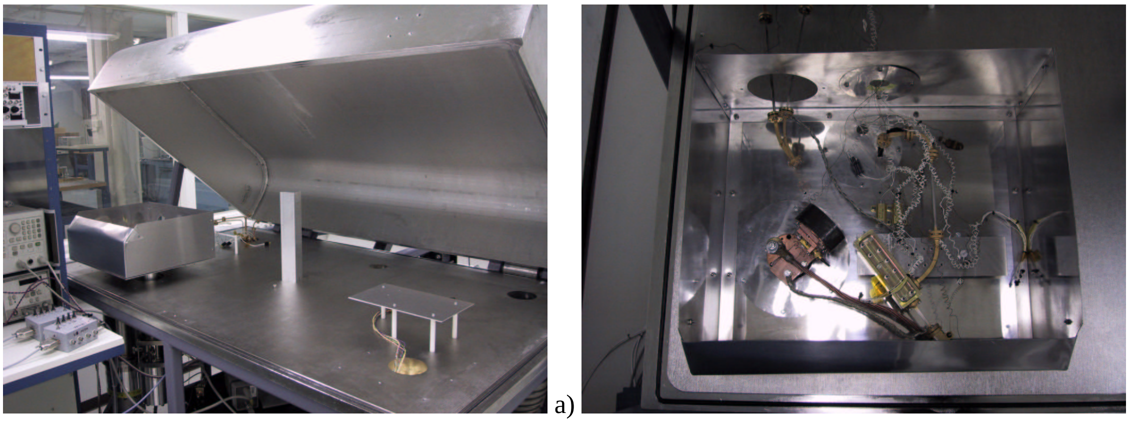


Figure 1: a) An EBB ampli£er chain with lid off. b) The EBB ampli£er chain with lid on and from other direction. c) Final integrated EBB receiver with test waveguide jigs.

The main Metsähovi work has been in the EBB test system design and building. The equipments of the system are supplied by Ylinen Electronics. The system contains 20K and 4K closed cycle coolers, 60-90 GHz VNA, automated noise temperature measurement set-up and all the needed power and monitoring interfaces. Also the

EBB tests itself have been mainly done by Metsähovi people. In Figure 2 a and b is shown vacuum chamber for the cryogenic measurements.



a) b)

Figure 2: a) The vacuum chamber for the cryogenic EBB measurements. b) A 70 K radiation shield where EBB is mounted when measured. The EBB is not mounted inside the shield.

2.1.2 Maintenance and Upgrades of Receivers

Project team: Peltonen, Urpo, Oinaskallio

Two failures in operational receivers occurred during the year 2001: LO source fault of the 22 GHz room temperature continuum receiver and the right hand polarization channel front end (HEMT LNA) of the 43 GHz VLBI receiver.

The temperature control of the detector in the 22 GHz continuum receiver was improved in order to achieve better output stability. Unfortunately during this work probably a mechanical shock caused a failure in the LO source. The Gunn diode lost the contact to the bias post resulting zero output power. The oscillator mount was disassembled and pressure between the bias post and diode was increased by a stiffter spring in the bias structure. After this repair the Gunn oscillator has been operating reliable at the same frequency and power level as before.

A completely new concept for this room temperature receiver has been considered. Replacing this free running Gunn oscillator with a phase locked YIG-source this receiver could be used both for continuum observations as before and also for spectral line observations at 22.232 GHz. The YIG-oscillator (MLPM-1083) with an output of + 13 dBm and center frequency of 11 GHz will be used. Experiments showed that with coarse tuning voltages of +0.74 and -1.83 V the desired output frequencies of 11.1 GHz and 10.74 GHz were generated. This spectrally pure oscillator is followed by a FET power ampli£er and a frequency doubler designed by Ylinen Electronics. The power ampli£er module also includes a harmonic mixer which can be used with a harmonic number as high as 20, thus the required synthesizer frequency is around 500 MHz. The doubler operates with 10

The 43 GHz VLBI-receiver can be used at the moment only for the left hand polarization. The LNA in the right hand polarization channel shows lowered gain and increased noise temperatures even at room temperature. In the £ve stage HEMT ampli£er the fourth stage seems to be the reason for degraded performance. The gate voltage of this stage is much too high indicating that the bonding has lost the contact to the gate pad or the chip has been destroyed. The LNA has been delivered to Ylinen Electronics for an attempt to repair the failure.

2.1.3 Computing Infrastructure

Project Team: Mujunen

Metsähovi computing facilities are based on networked Linux computers. A core set of Linux servers offer general-purpose and observational data storage. Another set of dedicated Linux control computers manage the telescope, data acquisition, and auxiliary services such as GPS receivers and weather stations. Finally, a larger set of Linux workstations running the X Window System provide access to Metsähovi personnel.

The observatory site is connected to the Internet using a 2 Mbit/s dedicated leased line to university computing center.

Both the "`/home`" and "`/data`" NFS servers were upgraded with AMD Athlon 1GHz-class processors, 512MB of memory, and Linux RAID0 75GB IDE disk subsystems with an equal amount of non-RAIDed IDE backup storage.

IDL version 5.4 was installed on "`kurp.hut.fi`" (2 ¤oating licenses) and on two Linux computers dedicated to solar research. Version 5.4 drops support for GIF graphic output. Matlab 6.0 with shared license support from university computing center was also installed on "`kurp.hut.fi`".

For electronics development, PADS PowerLogic and PowerPCB 3.0 were used, together with Xilinx Foundation v2.1i VHDL tools for FPGA development.

2.1.4 Data Monitoring

Project Team: Könönen, Mujunen

Data origin

There are several different types of data which are observed and collected non-stop at Metsähovi Radio Observatory. Most often the purpose of the data is to aid astronomical observations and the maintenance and upgrading of instruments. Data sources vary; for example, there are two weather stations in Metsähovi, a spectrum analyzer to measure radio interference, the EFOS-9 hydrogen maser which is the frequency reference of the observatory and an ADAM/NuDAM control/monitor network which is used amongst other things to observe the state of astronomical receivers and to collect data from the 2-m solar radiometer.

Original data format

The monitoring data is saved to daily text £les to a linux pc "data.kurp.hut.£". The £le format is a set rows, each row including a time label, the name of a data parameter and its' prevailing value, all separated by tabulators.

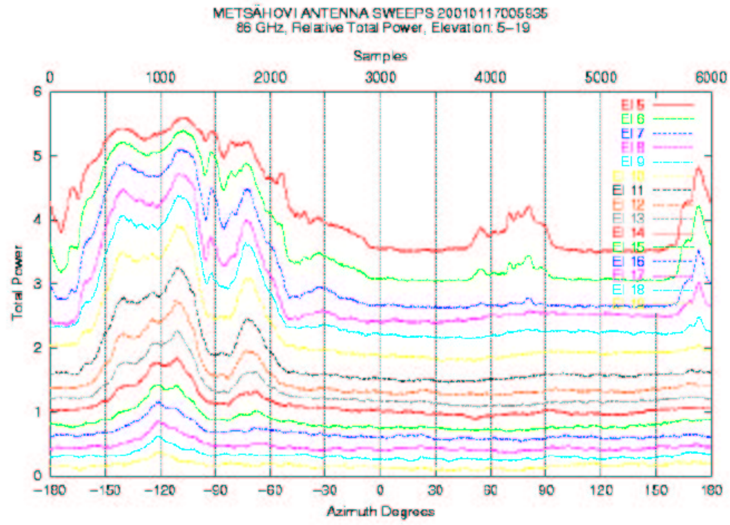
Monitoring programs

As long sets of plain numerical values are not very illustrative there is a demand to view the data graphically by plotting monitored data values versus a selected time period, or simply to catch the latest data values. For that reason two CGI programs were developed during the last two years. These programs have been written in Perl programming language and they are available at the site "http://kurp.hut.£/local/" which initially limits the access to the computers on-site at Metsähovi. Available monitoring programs and their present development status are listed below.

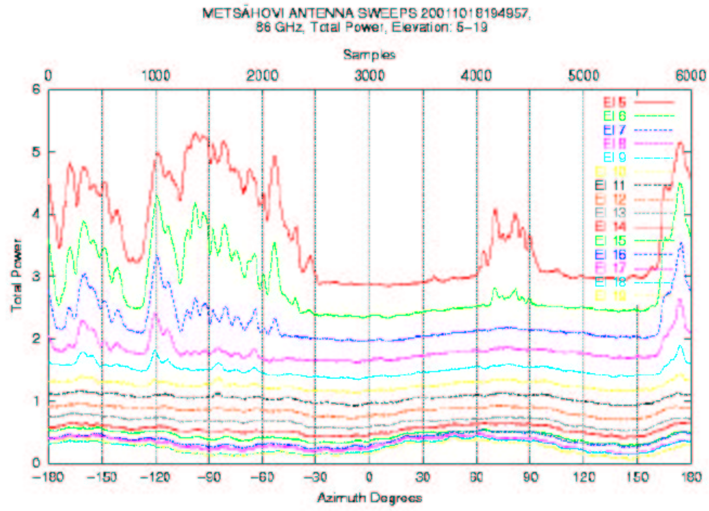
Figure 3 a and b illustrate the observed total power at 86 GHz while making azimuthal sweeps in the elevation range 5-19 degrees on clear nights in January and October, respectively. Between these two observations the surrounding forest was partly cut. The observational results are not calibrated but only plotted to a same scale. By comparing £gures, it seems that the noise level near to horizon has dropped from January. Figure 3 c presents the difference of uncalibrated observational results at each elevation. The plot is only suggestive but one can claim that the level of the background radiation in East has dropped remarkably.

Monitoring programs - MB

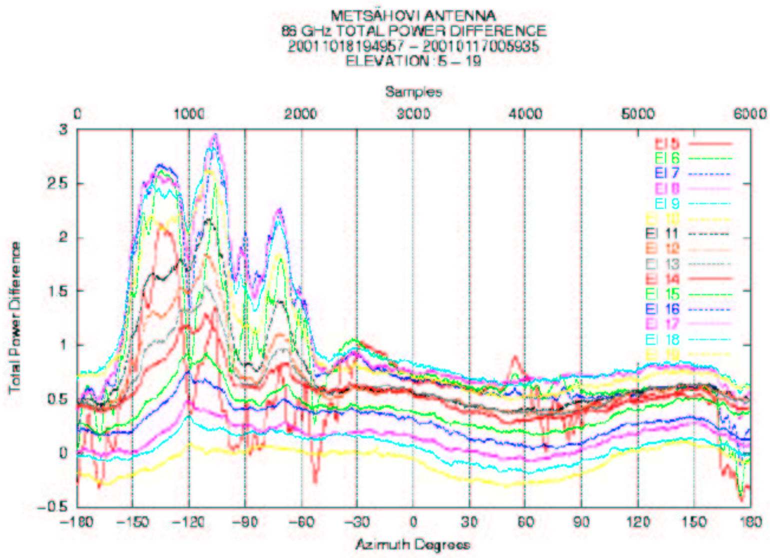
The "Multi-Browsing" program, "MB", is a very consumed CGI-program that allows ¤exible plotting of monitored data. MB is based on Perl programming language and it utilizes a perl module "CGI.pm" for creating the web interface, and a freely distributable plotting program "gnuplot" for imaging. The program can be found at the address "http://data.kurp.hut.£/cgi-bin/mb.cgi".



a)



b)



c)

Figure 3: Monitoring the background noise at low elevations before and after cutting the forest which surrounds Metsähovi.

By using MB, a user can freely choose data parameters, a time period and plot settings. One can make new selections, load one's own prede£ned selections, or use default plot settings for selected data parameters.

The resulting plots can be eyed on the screen and the plotting data is available in several formats (plots in Postscript and GIF formats, both gnuplot command £les to generate these plots and plain numerical values of parameters in corresponding text £les).

Several data parameters can be graphed in a single picture, the time axis can be either vertical or horizontal axis and both orthogonal data axes can be used in a de£ned way. The plot texts can include iso-8859-1 characters.

MB makes a new data type available automatically as the new directory including a text £le with "mb_txt" extension is added to the "data". The "mb_txt" £le holds general information of log £le data in that directory.

In use following features were found to be potential new facilities: plotting on a sub-second scale, averaging and otherwise mathematically manipulating data before plotting, and plotting broad-band RI or astronomical data in 3D. Also, it is worthwhile to consider adding the use of latex formulations in text titles, since it is a fairly straighforward task.

Monitoring programs - Parameter replacement, "latest" script

The latest monitored parameter values can be inserted into a regular html text £le by using proper "coding" and viewing these text £les using a CGI program "latest.cgi". The manual page for the program can be found from the address "http://data.kurp.hut.£/cgi-bin/latest.cgi?element_replacement.html". The manual includes a listing of all available data parameters, a description of coding syntax, and instructions how to view the html page using the "latest.cgi" script.

A selection of html pages presenting parameter info were written to aid observers. An observer can select a from a side frame link to a page with suitable set of weather and antenna temperature values. These are presented on the background picture of the observatory. The automatically updating pages are available at the address "http://data.kurp.hut.£/latest/kurp_pic.html".

2.1.5 Solar Monitoring Telescope

Project Team: Puhakka, Mujunen, Sjöman

Sun antenna is a separate small size receiver system designed to observe the total ¤ux of the solar microwave radiation with a pass band of about 1 GHz around center frequency of 11.7 GHz. Rather simpli£ed construction consists of standard commercial microwave front end, self designed IF-electronics and data acquisition by 16-bit A/D-converter. The size of the mainbeam in radiation pattern of the antenna is approximately 1.1°, which is enough to observe the total ¤ux of the Sun's hemisphere.

Receiver has got two channels, linear and logarithmic from which the linear is the only calibrated one at the moment. Thus, the receiver offers now a dynamical range up to approximately 5000 K in antenna temperature, corresponding up to 400 Solar Flux Unit radio burst in the Sun when the system noise and silent Sun background level is substracted.

Control system of the antenna is using quite largerly the same computer and electronics architecture as the main telescope of Metsähovi observatory, altough some new design for example with SSI encoder interfaces was implemented. The out-door part of the receiver consists of diameter of 1.8 m commercial satellite dish and small accessory compartment. Main electronics for servo system and data acquisition with two computers are £tted into one rack inside the control room.

This instrument has been observing the Sun continuously since August 2000 excluding some calibration measurements, maintenance and twilight/night time. Some examples of observed events are included in chapter 2.6.3.

Figure 4: Sun antenna.

Figure 5: Control rack of the Sun antenna.

2.1.6 The Development of New Observational Programs for Metsähovi

Project Team: <u>Könönen</u>, Mujunen

<u>Philosophy</u>

The renewal of the antenna control system reached the state where it is natural to rewrite observational programs for taking the pro£t of the new digitalized backend system, TCP network and the distributed Linux PC system.

So far the observational program renewal process has followed the path of writing separate programs for separate types of observations (e.g., solar continuum, quasar continuum). This time it was decided that the approach would be to write rather an “observational program language” that would allow: - simple syntax for writing “observational procedures” - communicative control of observational sub-systems (antenna control, data-acquiring, etc.) - necessary tools for monitoring observational results and for executing speci£c operations (e.g., determination of the quiet Sun level) - reliable execution of observational procedures

The ¤exibility of this approach lies in two basis. Firstly, in the multifunctionality of the observational program language, since command procedures can be generated for various systems that can be controlled externally, e.g., 14-m antenna, 2-m solar radiometer. Secondly, in the “re-programmability” of the observational procedures, since observers may choose to use pre-written observational procedures and libraries, but also can edit observational procedures and write completely new ones.

The very basic assumption is that most of the observers want to make “standard observations” using “prede£ned” observational procedures. Only a few observers will need to create completely new observational schemes or update and improve existing ones. These observers should be offered good instructions of both the observational language syntax and of the means of extending observational program language with additional modules.

Since VLBI observations are done by using the international Field System program and the maintenance of the spectral line observational program has been the responsibility of the University of Helsinki, the main focus is to develop the observational procedures for solar and quasar continuum observations and for controlling the newly constructed 2-m solar radiometer.

Means

It was decided that the basis of the observational program language would be Perl programming language that is distributed under the GNU General Public License for several platforms, including Linux. Perl has excellent text processing and TCP communication capabilities, and allows “glueing” the functions of various other programs (C, graphical, etc) into it.

The observational program language project runs under a title “Meas” which is an abbreviation for “Metsähovi Astronomical Syntax”. The name originates from the name of the Linux PC “meacon” which will host “meas”. The name “meas” may be replaced by a more appropriate one in the future.

Meas interprets text lines as executable commands. Depending on the syntax of the line the command will be classi£ed as a TCP command, condition sentence, timing command, procedure execution, substitution, operation or a sentence for Perl evaluation.

The TCP commands are directed to a named computer using a de£ned port number. The reply can be tested for a certain string and possible comma-separated return values are distinguished for possible use in later commands. This way separate observational Linux PCs (daqqer - data acquiring computer, antcon - antenna controlling computer, data - data saving computer, etc.) and Adam/NuDAM controlled instruments are available for meas users.

Several observational tasks will require special procedures to be constructed. These include graphical presentation of observational results (solar maps, solar hot spot and quasar continuum monitoring), de£ning quiet sun level and locating solar hot spots, pointing procedures, transcripting observational data £les into a suitable £ts format £les, possibility to create coordinate/source libraries, and the automatization of calibrational procedures, etc..

Status

The new backend system was completed in autumn but for the delay caused by various other projects the programming work only got properly started in November. By the end of the year the “meas interpreter” for most basic meas commands was functionable and experimental solar maps were produced.

As observational perl scripts were experimented, a test script was written to measure 87 GHz radiation levels near to the horizon. The main motivation for the experiment was that most of the forest surrounding antenna site was going to be cut in the summer. We were interested of possible changes in the background radiation levels at low elevations.

The following two pictures present the observed total power at 86 GHz near to the horizon on clear nights in January and in October, respectively. In both images the elevation span is 5-19 degrees and the step is one degree.

The third image presents a suggestive (no calibration was done, neither opacity effects were considered) difference between the observed values at each elevation. This picture indicates the quantity of the “tree effect” to observations prior to the cut.

As there still is un-cut forest very near to radome (especially in East), the landscape is not ¤at (rocky hills especially in East) and there are two geodetic measuring towers close to the observatory (in East), it is clear that there are also other obvious reasons than opacity to avoid astronomical observations at low elevations.

There has been no discussion if these “systematic low altitude effects” should be mapped at each observational frequency in order to use results, for example, to enhance the accuracy of calibrational and pointing schemes.

2.2 Extragalactic Radio Sources

Research Group at Metsähovi: Urpo, Lähteenmäki, Teräsranta, Tornikoski

2.2.1 Monitoring of Quasars

Project Team: Teräsranta, Koivisto, Kujala, Saarinen, Wiren.

The monitoring of quasars with the Metsähovi antenna continued for the 21st year. Despite long service breaks about 2500 observations were made during the year 2001. Over 50% of the observations were done in automatic mode. The rest was done by H. Teräsranta, Seppo Wiren, Pertti Koivula, Pasi Kujala and Ville Saarinen. All the observer’s salaries were paid by the Metsähovi observatory. The extended list of sources, over 200 ¤at spectrum sources was observed through the year to learn more of the duty cycle of the sources. The aim is to select the sources which retain a ¤at spectrum up to 37 GHz and also show Blazar type behaviour (violent variability). The new sample is to give support to next gamma-ray observatories AGILE (to be launched 2003) and GLAST (to be launched 2005), as well as to the PLANCK surveyer (to be launched around the year 2007). AGILE and GLAST are more sensitive than EGRET (the former gamma-ray observatory) and have a much wider £eld of view. With months long integrations they are expected to detect a multible number of sources compared to EGRET.

In Figure 6 is shown the weekly mean ¤ux density of the quasar 2145+067 from 1986 to the end of 2001 at 22 GHz as observed at Metsähovi. From the detections of the former gamma-ray observatory, EGRET, it was found that the gamma-ray bursts come when the millimeter ¤ux is in the start of an outburst or in a high state. Another common feature was a ¤at spectrum up to millimeter wavebands. Also a new VLBI component has been seen ejected soon after the gamma-ray events. At the higher frequencies, 90 GHz and higher, the duty cycle in the blazar ¤ares is such that the £rst outburst is seen to decay before the next outburst is rising. This behaviour is also seen in most cases at 37 GHz and in some cases at 22 GHz. At lower frequencies it is usually not possible to separate the individual ¤ares. Well sampled ¤uxcurves help to connect events seen at different wavebands and thus give a possibility to verify which emission model is responciple for the gamma-ray events in Blazars. Metsähovi is the only place where monitoring of a large number of Blazars is done above 15 GHz, which outlines the importance of this project.

Co-operation with several research groups continued also during this year.

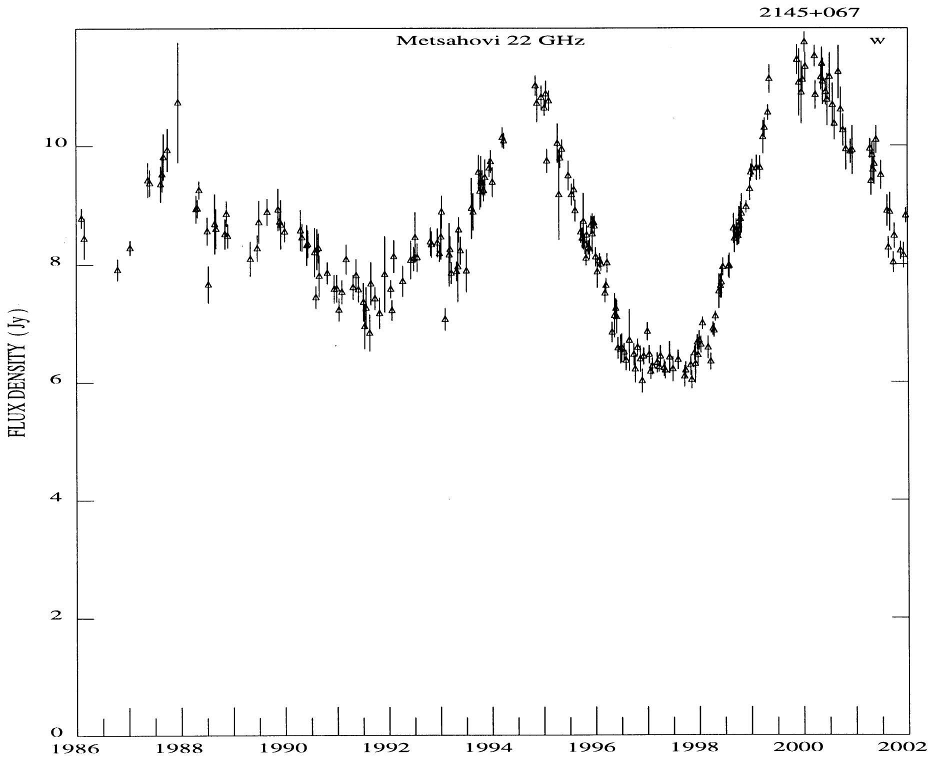


Figure 6: The weekly mean ¤ux density of the quasar 2145+067 at 22 GHz since 1986.

2.2.2 AGN Science

Project team Tornikoski, Lähteenmäki, Jussila, Parviainen, Valtaoja (Turku), Lainela (Turku)

Inverted-spectrum sources and candidates

In 2001 we continued our study of inverted-spectrum radio sources. Our study of new southern inverted-spectrum sources and the variability of southern "bona £de" GPS sources was published in the Astronomical Journal in the beginning of 2001. We wanted to continue to study these sources and submitted an observing proposal for the SEST telescope, and we were granted observing time in August. Unfortunately the weather was very bad (high wind speeds, high humidity, heavy snowfall) and only obtained very few new data points. We also extended our study of the inverted-spectrum sources to the Nothern hemisphere and started to observe a sample of GPS sources and candidates with the Metsähovi radio telescope. The project continues to 2002 and the results will be published in 2002 as part of Ilona Jussila's Master's Thesis.

High-peaked BL Lacertae Objects

In 2001 we started an observing project related to the study of BL Lacertae Objects (BLOs) conducted the previous summer (P. Johansson's Bachelor's Thesis in 2001). Our main interest lies in the Intermediate BLOs (IBL) and High-Peaked BLOs (HBL).

The two main BLO subclasses, the radio-selected BLOs and the X-ray-selected BLOs ($\approx$ HBLs), are a product of different discovery techniques. Currently it is not known whether these two classes of objects are two extremes of the BLOs, the observed properties of which are de£ned by the jet orientation, or whether they have intrinsically different properties. The newly discovered class of IBLs seems to consist of sources intermediate to the radio-selected and X-ray selected samples. It is still unclear whether the detection of the IBLs was due to a selection effect when producing the sample, or whether the sample represents the actual distribution of BLOs, showing a continuous distribution of properties from the HBLs to the LBLs. If we study a full sample of BLOs, we can get a full understanding of the spectral energy distribution of the BLOs, all the way from the radio-selected to X-ray selected BLOs, and we can see if there is a continuity from subsample to subsample and if this £ts within the framework of the uni£cation models.

We started to observe a large sample of IBLs and HBLs in the millimeter-domain with the SEST (in August, under extremely unoptimal weather conditions) and at 37 GHz with the Metsähovi telescope. We will continue the observations in 2002.

Identi£cations for Southern EGRET sources

In 2001 we analysed our data for the Southern EGRET sources and candidates. We were able to con£rm the identi£cation of several sources classi£ed as "possible identi£cations with an AGN" in the Third EGRET Catalog, and suggested a handful of new AGN counterpart identi£cations for previously unidienti£ed EGRET sources. The results were presented at the Gamma 2001 Symposium in Baltimore, and M. Tornikoski was also requested to give a presentation about our project at the press conference. We are in the progress of completing the paper about the southern EGRET identi£cations and it will be submitted in early 2002.

Radio to gamma-ray connection in AGNs

We also continued to study the relationship of high frequency radio emission and EGRET gamma-ray emission between different kinds of AGNs. We found an interesting connection between the modeled synchrotron peak frequency and the radio properties. The gamma-ray and radio emission behavior of AGNs may actually depend on the source type (LPQ, HPQ, BLO, ...) and the shape of the SED (i.e. the location of the synhrotron peak). The paper will be submitted in early 2002.

2.3 Planck Science

Project Team: Lähteenmäki, Tornikoski, Urpo, Parviainen, Jussila, Sjöman, Valtaoja (Turku)

The Planck satellite is a mission designed to measure the cosmic microwave background (CMB) radiation of the entire sky. In addition, it will observe all other foreground radio sources in the sky, including extragalactic radio sources (e.g., quasars and BL Lac objects). The satellite launch is scheduled for 2007 but scienti£c preparations are already under way. Lots of prelaunch information on extragalactic radio sources is required for good-quality CMB maps for cosmological studies, and for successful exploitation of the foreground data. Our Planck AGN research team consists of Metsähovi Radio Observatory and Tuorla Observatory (University of Turku).

Baseline core programme The First General Planck Meeting on the scienti£c programme of Planck was held at ESTEC in the Netherlands in early 2001. The purpose of the meeting was to review the preliminary core science abstracts submitted in autumn 2000. The actual Baseline core programme proposals were prepared in spring 2001 (deadline 28.5.2001). "The Astrophysics of quasars and BL Lac objects" proposal was written and submitted by A. Lähteenmäki. The proposal was accepted by the Planck Science Team as a part of the Baseline core programme in July. A signi£cant contribution aiding the preparation of three other LFI Extragalactic point source proposals and one HFI-related proposal was also given by the Metsähovi/Tuorla team (Phenomenology of radio sources, Statistical properties of radio sources, Extreme GPS and other strongly inverted-spectrum radio sources, and Follow-up of unusual real-time and ECSC objects with Herschel).

Working groups The structure of the Working Groups responsible for all work done for the project was modi£ed after the LFI Consortium Meeting in Eibsee, Germany, in October. A. Lähteenmäki was appointed as the coordinator of the Quick time alarm Working Group and our team has members in several other groups as well. Activities within the Extragalactic point source Working groups have been of£cially kicked off in December 2001 and are expected to speed up to full swing during the year 2002.

Quick time alarm system The Metsähovi/Tuorla team is responsible for the development of the quick time alarm system. The purpose of this system is to detect unusually bright objects in the sky and trigger as simultaneous as possible follow-up observations from ground-based observatories and other satellites at various frequencies. For this purpose we recruited M. Parviainen to design the system and write software for it, in cooperation with one of the Data Processing Centres (DPC), located in Trieste, Italy.

To £nd out about the latest developments in data and image processing techniques, A. Lähteenmäki and M. Parviainen took part in the Planck Workshop on Image Processing in Pisa, Italy, in July. The Quick time alarm Working Group started preliminary discussions already after the ESTEC meeting, and it has been agreed that Mr. Parviainen will start working on the project full time after graduation in early 2002.

Ancillary observations & Modeling Two new observing projects were launched in 2001 by our team. First, to observe a sample of intermediate BL Lac objects, and secondly, to observe a sample of GPS candidate sources. The observations are being carried out with three high frequency radio telescopes: Metsähovi, SEST and IRAM. Observations of faint ¤at-spectrum sources will begin in the near future. We have recently extablished cooperation with other observatories as well, e.g., the RATAN-600 telescope. We continue our theoretical work & modeling of active galactic nuclei for the Planck project, in cooperation with Osservatorio Astronomico in Padova, Italy.

Academy of Finland and National Technology Agency research programme for space research (ANTARES) The Metsähovi Planck research team was granted funding for years 2001 - 2004 from the Academy of Finland and National Technology Agency research programme for space research (ANTARES) in collaboration with teams from Millilab, University of Helsinki, and University of Turku. Together these teams form the Finnish Planck Surveyor Consortium. The funding has enabled us to increase the number of people working on the project (observations, theoretical work, and software development) and therefore also increase our of£cial involvement in the Planck satellite project in the year 2001.

Homepage Our team's Planck homepage was launched in autumn 2001 at http://kurp.hut.£/quasar/ planck/.

2.4 Observations with Other Facilities

SEST: 24.-28.8. Projects: "Millimeter domain observations of intermediate and high-energy peaked BL Lac objects" and "High-peaked GPS sources and candidates". P.I. M. Tornikoski, Observers: M. Tornikoski, I. Jussila

VLBA: 12.5., 14.5. Project: "New high peaked GPS sources" (K. Wiik, M. Tornikoski, E. Valtaoja, T. Savolainen)

VLBA: 11.-12.9. Project: "PKS 0521-365" (S. Tingay, P. G. Edwards, J.E. Reynolds, M. Tornikoski)

HALCA: 7.-8.9., Project "Two-epoch 5 GHZ observations of PKS0506-612 and PKS0522-610", P.I. P. G. Edwards, Co-I M. Tornikoski.

HALCA: 11.-12.9., Project "Dual-frequency VSOP observations of PKS0521-365", P.I. S. J. Tingay, Co-I M. Tornikoski.

"III ZW 2, a superluminal jet in a spiral galaxy", P.I. H. Falcke, CO-I H. Teräsranta. Monthly observations with the VLA during the year 2001.

Observations of 4C 38.41 with VLA and VLBA, P.I. T.P. Krichbaum, CO-I H. Teräsranta.

2.5 VLBI Research

Research Group at Metsähovi: Urpo, Könönen, Liljeström, Mujunen, Ritakari

2.5.1 VLBI Observational Activities

Project Team: Urpo, Könönen, Mujunen, Ritakari

Field System Updates

In September Ari Mujunen spent two weeks in Goddard Space Flight Center in order to develop a new standard kernel, so-called “FS Linux 4” to accommodate more modern available PC hardware. The new kernel is based on Linux kernel 2.2.19.

The newest FS release, 9.5.1, was installed at Metsähovi in October, just before a CMVA session. The FS 9.5.x versions include support for recording with two head stacks. This has been a wanted feature since doubling the number of head stacks doubles the maximal data rate (to 512 Mbits/sec) which increases the sensitivity of observations.

Geo-VLBI Project

The plans to start geodetic VLBI observations at Metsähovi are slowly advancing as the neighbouring Finnish Geodetic Observatory’s project budget is clearing. In order to have a full set of 14 BBCs at Metsähovi, Geodetic Observatory ordered six new BBCs from Signatron in 2000. Signatron’s £rst estimate for the delivery was six months, so the order is badly delayed. By the end of the summer Geodetic Observatory ordered from Yebes, Spain, a S/X receiver and instructions for building a bigger secondary mirror for SX observations. Basically Metsähovi should be able to start geodetic VLBI observations within two years.

ICN - Infrastructure Cooperation Network in Radio Astronomy

Metsähovi participates as a principal member in the programme “Infrastructure Cooperation Network in Radio Astronomy - Radionet” (contract no: HPRI-CT-1999-40003). The programme activities include development of sustained reliable operations in EVN and development of ALMA and SKA radio arrays. Jouko Ritakari and Ari Mujunen represent Metsähovi in the programme.

New Masers and New Maser Room

Metsähovi will get two new Russian Kvartz H masers by the £rst half of the year 2002 as a part of Russia’s plan to pay off some of it’s debt to Finland by supplying scienti£c equipments and know-how.

The regularly inoperative ventilation system of the old maser room caused EFOS-9 Maser instabilities. Also, the old room was too small for several apparatus.

Therefore a decision was made to build a completely new isolated, ventilated maser cellar just outside the observatory building. The major construction work for the cellar was £nished in the end of the December.

During the construction work the EFOS-9 Maser stayed in a temporary location, in a separate room, at the Observatory. The stability of the maser did not suffer signi£cantly from the move.

New Station Coordinates

Dr. D. Graham from Bonn calculated more accurate station coordinates for Metsähovi on the basis of 43 GHz and 150 GHz VLBI observations. The new ITRF2000 coordinates of Metsähovi (2892583.770, 1311715.590, 5512630.070) were updated to several different databases (Bonn correlator, JIVE correlator, NRAO correlator, NRAO Sched, Geodetical Stations).

Next Generation VLBI Project

Jouko Ritakari and Ari Mujunen from Metsähovi Radio Observatory have actively developed Next Generation (NG) VLBI concepts and techniques. This work is more profoundly described in a separate chapter. Regarding to the NG-VLBI project Jouko Ritakari and Ari Mujunen participated Schiphol MK5 meeting in August and Steve Parsley and Sergei Pogrebenko from JIVE visited Metsähovi in 5.-6.11.2001.

Several documents on the project can be found at the web address “http://kurp-www.hut.£”.

Receivers

The 43 GHz receiver's broken RCP HEMT ampli£er was replaced in October. After that the receiver was installed on the receiver bed that was neatly covered with perspex and taken to Metsähovi's stand on Finnish Space 2001 Expo. The public found the opened receiver very interesting. The receiver still has to be tested at 20 K.

The 86 GHz receiver needed to be repaired just before the October CMVA experiment due to a sudden collapse of the cold reference lense's isolation sheet. The collapsed mylar piece was replaced but it did not last. The working solution was to completely remove the isolation sheet and tighten up the glass lens instead.

Metsähovi has ordered a new 80-150 GHz SIS receiver from Nizhny Novgorod. Russia will pay off some of it's debt to Finland by supplying scienti£c equipments and know-how. The receiver and two new masers will be a small part of the £nancial agreement.

Second Head Installation

The aim of EVN was to establish 2-head 512 Mbit/sec recording as a standard EVN mode in 2001. By the end of the year (after the £rst try and a corrected Sched bug) the recording quality at most stations using 2-heads was found good and £rst images of 2-head correlated data were produced.

CMVA also tested 2-head recording in October using the data from Effelsberg, Pico Veleta, Haystack and Onsala. (More about the session at the web address "http://www.mpifr-bonn.mpg.de/EVN/ 512CMVA.html".) Metsähovi participated to this session but with one head only.

Since there were no high frequency EVN sessions with two heads and since extremely small VLBI group of Metsähovi was heavily occupied with various other projects, it was decided in agreement with EVN and CMVA people that the installation and testing of the second head stack at Metsähovi would be until year 2002.

EVN and CMVA Sessions in 2001

In January Metsähovi participated in JIVE recording test. The test results showed that especially the recording quality of upper tracks was poor. Part of the reason was most likely thin/thick tape switching. To improve recording quality the writing head was pre-contoured with an abrasive tape at high (40humidity using the vacuum of 28 inches of water and the recording with thick tapes was done hereafter using always this high pressure.

Metsähovi missed one day EVN 22 GHz session in the beginning of March. The reasons were both the lack of thin tapes for the session (having not received supplements in time) and an overlapping 150 GHz VLBI experiment.

The joint 2 mm VLBI experiment was organized with Pico Veleta (Spain) and SEST (Chile). Metsähovi borrowed an old He-cooled 150 GHz SIS receiver and a 150 GHz noise generator from PV for that purpose. During the setup of the receiver two engineer visits from Spain were required. Also the main organiser of the experiment, Albert Greve from IRAM-France, visited Metsähovi in March before the £rst session. Due to the weaker ¤ux of the sources at higher frequencies station de£ned on-off pointing procedures were added to FS. Also the antenna's maximum elevation was limited to 35 degrees due to elevation restictions of the 150 GHz receiver. There were two two day sessions; one in March (ME-PV) and another one in April (MH-PV-SEST). During the sessions the weather conditions were variable; moderate 0 C-deg at MH, wet at SEST and good at PV. The data were correlated at Bonn. The observations focused on the strongest sources, i.e. 3C279 and 3C273, which were detected on the baseline MH-PV. Weaker sources were undetectable. The baselines MH-SEST and PV-SEST did not cause fringes. More about the experiment at the web address "http://iram.fr/ARN/aug01/aug01.html". The experiment will be repeated in spring 2002.

In October Metsähovi participated a £ve day 3 mm CMVA-session. During the session the weather was mostly rainy and there were receiver and BBC problems. The receiver needed to be repaired just before the experiment due to a collaption of the cold reference lense's isolation sheet. By then the session had already started and during the £rst 10 hrs of the experiment pure noise was recorded. A WVR experiment was combined to the session. For that reason we were supposed to monitor IF distributor values during the last part of the session. As the receiver would have needed more attenuation after it had £nally completely cooled these values were over¤own. Also the "manual Tsys calculation" (which is obligatory as the 86 Ghz receiver does not have a calibration diode) suffered from this effect.

There was some trouble with BBCs. Changing their locations and adding an extra plate to direct the ventilation helped little but yet two out of eight BBCs stayed unlocked and two other complained about 1PPS. The BBCs have functioned during tests so an improved ventilation could help. The new fans will be installed in 2002.

2.5.2 VLBI Science

Project Team: Wiik (Turku)

A paper describing 22 GHz VLBI observations and data analysis of 15 bright Active Galactic Nuclei (AGN) was published. Submilliarcsecond resolution images of sources were included. Observations cover three epochs during years 1992-1996. This study covers all the sources from the complete 2 Jy catalog of Valtaoja et al. that were not observed at 22 GHz before the £rst epoch. The second part of the paper will be published later. It will focus on the analysis of images.

2.6 Solar Research

Research Group at Metsähovi: Urpo, Koistinen, Puhakka

2.6.1 Solar Observing Campaigns

Project Team: Urpo

Solar observations continued at Metsähovi in 2001. Receivers working at 37 GHz and 87 GHz were used. Number of observing days was 45. More than 100 solar radiation maps were measured and active regions were tracked for about 200 hours in order to detect energy burst and releases at radio waves. Only few events were detected. Analysis of measured data continued in international cooperation.

2.6.2 Solar Data Analysis

Project Team: Urpo, Puhakka

Metsähovi solar data analysis continued in international cooperation with Russia. solar bursts measured with the Metsähovi main telescope were analysed using Wigner-Ville method. Simultaneous bursts measured with the main telescope and 1.8 m “space weather telescope” were compared. Metsähovi solar maps were analysed using improved IDL-programs.

2.6.3 Space Weather Observation at 11.7 GHz

Project Team: Urpo, Puhakka, Oinaskallio

Sun antenna is dedicated for continuous solar observations while the main telescope could be used for that purpose only few weeks annually. Operation of the instrument started in August 2000. Radioevents starting from few Solar Flux Units up to approximately 400 SFU can be recorded. Logarithmic channel will increase the dynamical range from that essentially. All together over 200 events during 2001 were observed and few of them simultaneously with 37 GHz receiver of the main telescope. Read more about the Sun antenna in chapter 2.1.5.

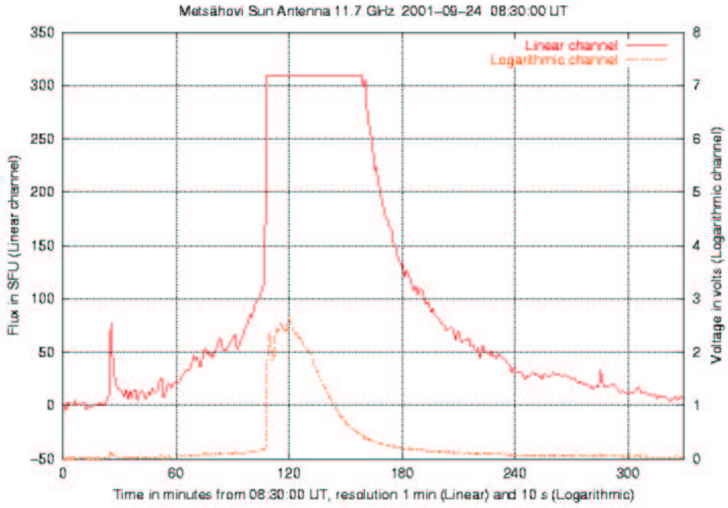


Figure 7: The most powerful event observed by the Sun antenna until the end of 2001 was this one from the active region number 9632. The linear channel was saturated almost for one hour while the logarithmic ampli£er still offers a possibility to investigate the £ne structure of the highest ¤uxes. According to NOAA solar events database over 20000 SFU:s were observed around 10 GHz region. Pre-burst quiet Sun level is substracted from the graph.

2.7 Radio Spectroscopy

Research Group: Liljeström, Urpo

2.7.1 Water Masers

Project Team: Liljeström, Gwinn (Univ. of California)

The Metsähovi radio telescope has been used for long-term water maser observations at 22 GHz. Water maser observations commonly show dramatic variations in ¤ux density as a function of time. Such short-lived (typically some 2 months), dramatic increases in ¤ux density are termed “outbursts”. Combining the Metsähovi 22 GHz database of some 150 maser outbursts of W49 N (Liljeström 2000) with simultaneous VLBI data of Gwinn (University of California Santa Barbara), notably obtained with the same velocity resolution, Liljeström and Gwinn (2000) were able to £x the free parameters in the shock model of Hollenbach and McKee (1979, 1989) and the maser model of Elitzur, Hollenbach and McKee (1989). This enabled a straightforward determination of some 20 physical parameters of W49 N. We checked the validity of these models with independent measurements and found a very good agreement between predictions and observations.

The analyses of water masers were continued in 2001 concentrating on the problem how to extract magnetic properties of dense masing regions. The data clearly showed that the observed velocity ¤uctuation of a line peak during maser outbursts is nonthermal and correlates with Alfvenic pressure (as long as the wave pressure is nonshocking). The fact that Alfvenic wave ¤uctuations are oriented perpendicular to the £eld lines enabled us to estimate the inclination angle of the mean £eld to the line of sight from the observed shifts in Doppler velocity of outburst features. The postshock £eld strengths were determined from space/shock velocities of the maser features (measured by VLBI).

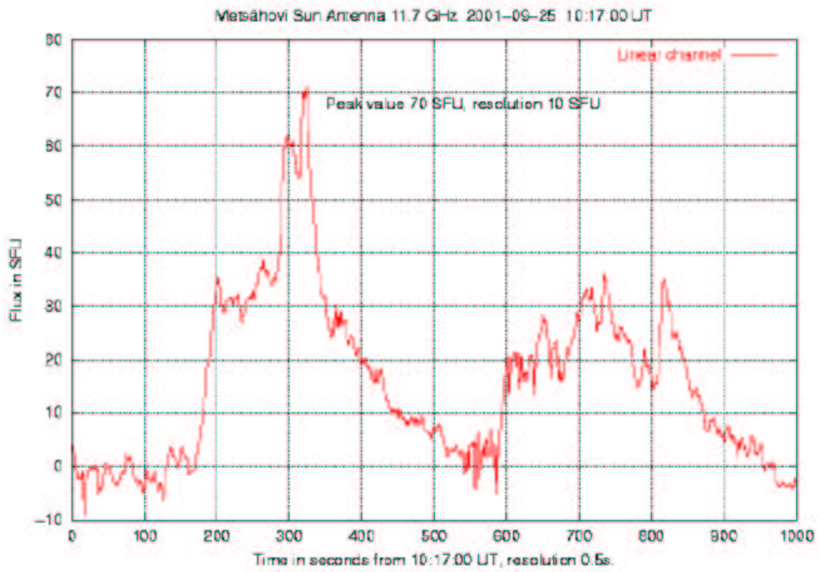


Figure 8: This event from the active region number 9628 was observed simultaneously with the Sun antenna and the main telescope. Pre-burst quiet Sun level is substracted from the graph.

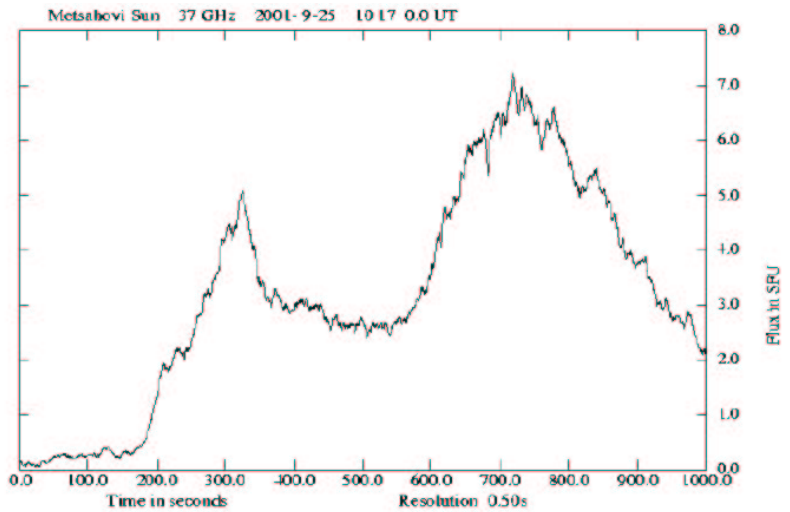


Figure 9: Graph from the main telescope data shows inverse amplitudes between two peaks when compared to the data of the Sun antenna in picture 8. Pre-burst quiet level is substracted from the graph.

2.7.2 Spectroscopic Space Research with the Submillimetre Wave Satellite Odin

Project Team: Liljeström

ODIN is a Swedish satellite project with international participation from Canada, Finland and France. The most important spectral lines to be observed in a variety of astrophysical environments are the H_2O line at 557 GHz and the O_2 line at 119 GHz and 487 GHz. The satellite was successfully launched in February 2001.

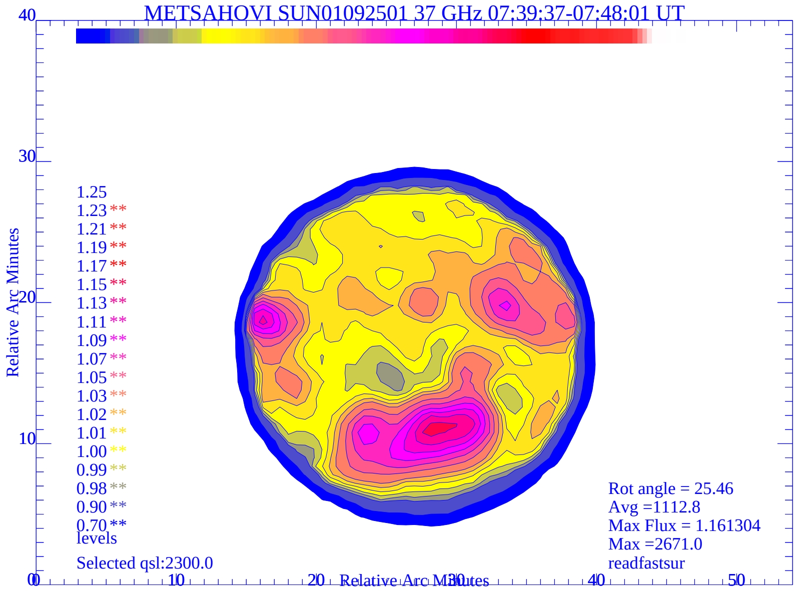


Figure 10: Solar map measured in 37 GHz with the main telescope. Active region number 9628 is easily recognized from the bottom part of the Sun's disk (Location S16W03).

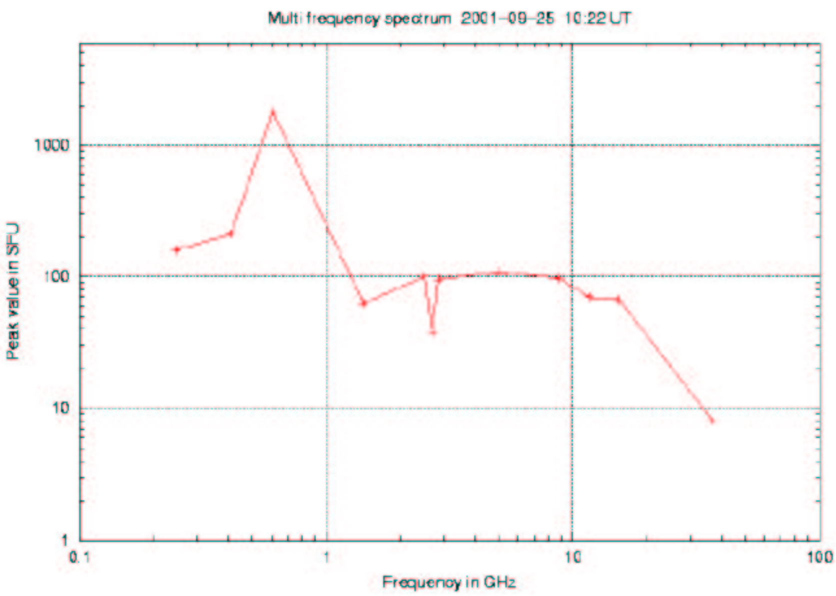


Figure 11: Multi frequency spectrum composed with the data from NOAA database, Metsähovi observations (11.7 GHz and 37 GHz) and observations of Crimean Astrophysical Observatory (2.5 GHz and 2.85 GHz).

The scienti£c work of the ODIN astronomy group has been split into 17 project teams, of which Liljeström and J. Black are the leaders of two scienti£c teams: (1) Photon Dominated Regions and (2) High-Latitude Clouds. Besides these two PI-investigator responsibilities, Liljeström has a co-investigator status in the following ODIN teams: (1) Galactic Centre, (2) Giant Molecular Clouds, (3) Star Forming Regions, (4) Shocks and Out¤ows, and (5) Absorption Lines.

The thermal water line at 557 GHz is easily detected in photon dominated regions. Figure 12 shows the Odin water spectrum toward S140.

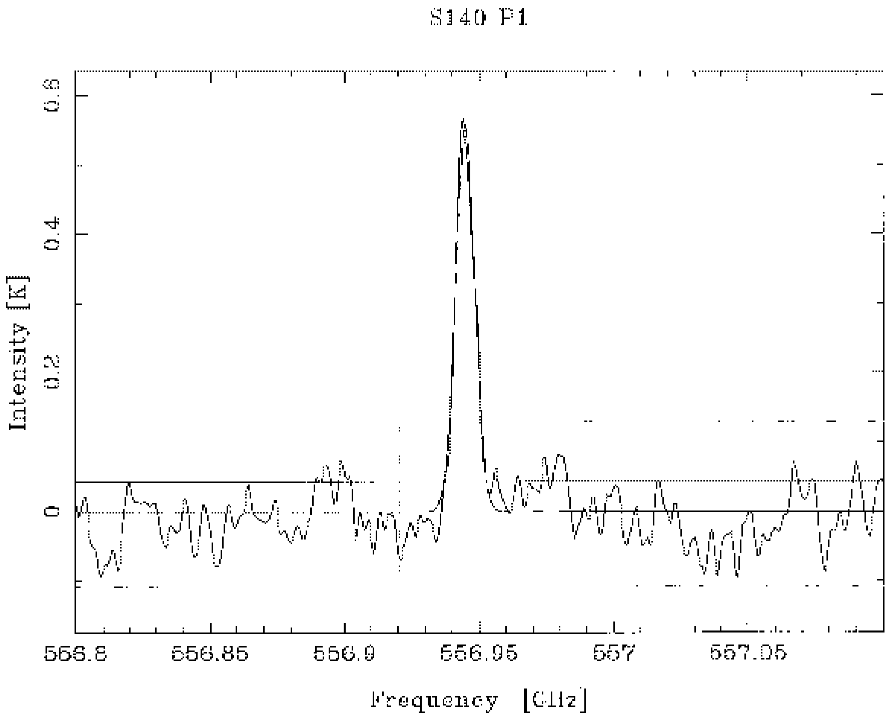


Figure 12: The thermal water line at 557 GHz toward S140 as measured with the ODIN satellite.

2.8 Space 2001-exhibition

The (amateur) astronomical association Ursa arranged a large exhibition about space research in Kaapelitehdas, 2.-4.11. Most Finnish institutes and companies with space research activities had their stand in the exhibition, and in addition to them there was an ESA stand and several model satellites/launchers in the exhibition, and also two ESA astronauts were present.

Metsähovi Radio Observatory had a stand featuring our research activities, and most of the Metsähovi scientists took turns educating the public about radio astronomy and the Metsähovi research projects. The Metsähovi stand featured: the small Finnish ¤ag that had been onboard the Space Shuttle Discovery during the mission STS-91 in June 1998, the high-frequency end of the 43 GHZ VLBI receiver, a PowerPoint presentation about Metsähovi research topics, an internet terminal with an access to the Metsähovi web pages, a VLBI tape and explanationary poster about the VLBI technology, and several posters about the various £elds of research in which the Metsähovi scientists participate.

The exhibition was a great success, with ca. 25000 visitors over the three days' time. There was a lot of traf£c at the Metsähovi stand because the radio astronomical receiver, the VLBI tape and the "¤ag that had been in the space" attracted a lot of interest.

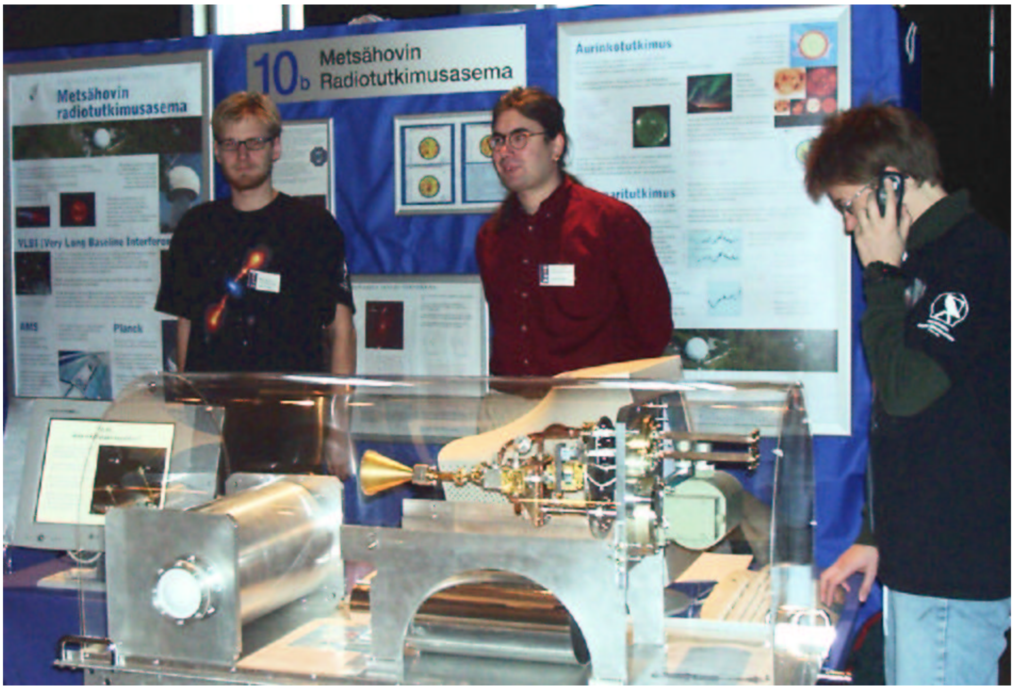


Figure 13: Metsähovi stand at the Space 2001 exhibition.

3 Publications

3.1 International Journals

1 Hartman, R. C., Böttcher, M., Aldering, G., Aller, H., Aller, M., Backman, D. E., Balonek, T. J., Bertsch, D. L., Bloom, S. D., Bock, H., boltwood, P., Collmar, W., De Francesco, G., Ferrara, E. C., Freudling, W., Gear, W. K., Ghisellini, G., Hall, P. B., Heidt, J., Hughes, P., Hunter, S. D., Jogee, S., Johnson, W. N., Kanbach, G., Katajainen, S., Kidger, M., Kii, T., Kraus, A., Kubo, H., Kurtanidze, O., Lanteri, L., Lawson, A., Lin, Y. C., Lisenfeld, U., Madejski, G., Makino, F., Maraschi, L., Marscheri, A. P., McFarland, J. C., McHardy, I., Miller, H. R., Mukherjee, R., Nikolashvili, M., Nilsson, K., Nucciarelli, G., Ostorero, L., Pian, E., Pursimo, T., Raiteri, C. M., Reich, W., Rekola, R., Richter, G. M., Robson, E. I., Sadun, A., Savolainen, T., Sillanpää, A., Smale, A., Sobrito, G., Sreekumar, P., Stevens, J. A., Takalo, L. O., Teräsranta, H., Thompson, D. J., Tornikoski, M., Tosti, G., Ungerechts, H., Urry, C. M., Valtaoja, E., Villata, M., Wagner, S. J., Wehrle, A. E., Wilson, J. W.: "Multi-Epoch Multiwavelength Spectra and Models for Blazar 3C 279", Astrophysical Journal 553. 683, 2001.

2 Zaitsev, V.V., Kislyakov, A.G., Stepanov, A.V., Urpo, S., Shkelev, E.I.: Low frequency pulsations of coronal magnetic loops. *Radiophysics and Quantum Electronics*, Vol. 44, pp. 36-52, 2001.

3 Zaitsev, V.V., Kislyakov, A.G., Urpo, S., Shkelev, E.I.: Experimental evidences of storage and dissipation of electric current energy in coronal loops (in russian). *Radiophysics and Quantum Electronics*, Vol. 44, pp. 756-769, 2001.

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906-914, 2001.

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3.2 International Conferences

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3.3 Laboratory Reports

1 Urpo, S., Mujunen, A. (editors): Metsähovi Radio Observatory Annual Report 2000. *Metsähovi Reports HUT-KURP-22*, 37 p., 2001.

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3.4 Other Publications

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4 Visits to Foreign Institutes

Visit to the VIRAC radio telescope in Latvia, in conjuction with the 2001 Nordic-Baltic Summer School in Radio Astronomy, 26.7.2001, M. Tornikoski

Observations at the SEST telescope 24.-28.8.2001, M. Tornikoski, I. Jussila.

Visit to NASA Goddard Space Flight Center (GSFC), Baltimore, Maryland, USA; development on FS Linux 4 operating system distribution, 12.8.–23.8.2001, A. Mujunen.

University of Oxford, Astrophysics, United Kingdom, several visits, A. Lähteenmäki

5 Visiting Scientists

Dr. Göran Olofsson, Stockholm Observatory, Ruotsi
Dr. Albert Greve, Institut de Radio Astronomie Millimetrique, Ranska
Dave John, Instituto de Radio Astronomia, Spain
Dr. Igor Zinchenko, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. Vyacheslav Vdovin, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. Igor Lapkin, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. Alexander Shtanyuk, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. A.G. Kislyakov, Central Astronomic Observatory, Russia
Dr. V.V. Zaitsev, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. Polina Yavorovskaya, Russian Academy of Science, Institute of Applied Physics, Russia
Dr. Vladimir Bogod, Special Astrophysical Observatory, Russia

6 Thesis

Thesis for the degree of Doctor of Philosophy:

Tarja Liljeström: Radio spectroscopic studies on cosmic water masers.

7 Teaching

The Post-graduate seminar on Space Technology II, Spring 2001: "Radio Astronomy: New Challenges for the New Millennium", weekly lectures / M. Tornikoski, A. Lähteenmäki

The 2001 Nordic-Baltic Summer School in Radio Astronomy, Ventspils, Latvia, 25.-29.7., Two lectures: "Introduction to Active Galactic Nuclei" and "Radio Observations of Active Galactic Nuclei" / M. Tornikoski

Lecture to the astronomy speciality group of the Anttila Junior High School: radio astronomical research, recent developments in astronomy, and the work of an astronomer, 20.11., M. Tornikoski

Supervisor for Ilona Jussila's Master's Thesis / M. Tornikoski

General Metsähovi tours and short talks about radio astronomical research to visiting groups: M. Tornikoski, P. Könönen, S. Urpo, P. Könönen, H. Teräsranta, J. Peltonen.

8 Other Activities

Referee for Solar Physics, S. Urpo

Member of a working group for nomination of a professorship to space technology, Helsinki University of Technology, S. Urpo

8.1 Participation in Boards and Committees

Board member of the Finnish Astronomical Society, 2000-2001, M. Tornikoski.

Member of the Scienti£c Organizing Committee of the 2001 Nordic-Baltic Summer School in Radio Astronomy / M. Tornikoski

Member of the steering committee of the ANTARES Space Research Program, M. Tornikoski

URSI Comission J (Radio astronomy) delegate / M. Tornikoski

AAS, American Astronomical Society, member S. Urpo.

AMS, Tekes Guiding Group, member S. Urpo.

Planck, Tekes Steering Group, member, S. Urpo.

COSPAR, Committee on Space Research, Finnish National Committee, member, S. Urpo.

COSPAR, Commission E2, Solar Physics, member S. Urpo.

EAS, European Astronomical Society, founding member S. Urpo.

ESA, European Space Agency, SPC Science Programme Committee delegate S. Urpo.

EVN, European VLBI Network Board of Directors, member S. Urpo.

Hvar Observatory Bulletin, Board of Editors S. Urpo.

IAG, associate member S. Urpo.

IAU, Finnish National Committee, member S.Urpo.

RISC, Radioastron International Science Committee, member S. Urpo.

Tuorla Observatory, vice member of the Board S. Urpo.

URSI, Finnish National Committee, vice member S. Urpo.

Working Group for Finnish-Russian Cooperation in Space Field, member S. Urpo.

8.2 International Meetings and Talks

IAU Symposium 206, Cosmic masers: from protostars to black holes, 5-11.3.2001, Angra dos Reis, Rio de Janeiro, Brasil, invited talk: Time variations of water masers, T. Liljeström.

IAU Symposium 206, Cosmic masers: from protostars to black holes, 5-11.3.2001, Angra dos Reis, Rio de Janeiro, Brasil, poster: First detection of vibrationally excited water masers toward embedded young stellar objects, T. Liljeström.

IAU Symposium 206, Cosmic masers: from protostars to black holes, 5-11.3.2001, Angra dos Reis, Rio de Janeiro, Brasil, poster: New detections of submillimeter water masers at 321 GHz toward late-type stars, T. Liljeström.

Maxi workshop on AGN variability, 10-11.3.2001, Nikki, Japan, talk: Ground support for the γ-ray observatories by monitoring the 200 strongest ¤at-spectrum AGN at 22 and 37 GHz, H. Teräsranta.

Blazar astrophysics with BebboSax and other observatories, 10-11.12.2001, Frascati, Italy, H. Teräsranta

Gamma-ray astrophysics 2001 Symposium, Baltimore Maryland 4-6.4.2001, Poster “Possible New Identi£cations for Southern EGRET Sources” + Presentation at the press conference / M. Tornikoski

Planck LFI Consortium meeting 17.-19.10.2001, Eibseee, Germany M. Tornikoski, A. Lähteenmäki, M. Parviainen.

The Scienti£c Programme of Planck, First General Meeting, 30.1 – 2.2.2001, ESTEC Noordwijk, The Netherlands, A. Lähteenmäki, M. Tornikoski, S. Urpo

Gamma 2001, Gamma-Ray Astrophysics 2001, 4 – 6.4.2001, Baltimore, Maryland, USA. Poster: The effect of the SED shape on the gamma-ray vs. radio emission dependence in AGNs, A. Lähteenmäki Poster: Possible new identi£cations for southern EGRET sources, M. Tornikoski, A. Lähteenmäki

Planck Workshop on Image Processing, 4 – 6.7.2001, Pisa, Italy, A. Lähteenmäki, M. Parviainen

ESA/SPC Meeting 26-27.2.2001, Paris, France, S. Urpo

EVN Directors Meeting, 3-6.5.2001, Torun, Poland, S. Urpo

EVN Directors Meeting, 22-23.11.2001, Manchester, UK, S. Urpo

Odin workshop, 14-15.12.2001, Onsala, Sweden, T. Liljeström.

8.3 National Meetings and Talks

Tutkas/Parlament of Finland, talk: Finland in mapping of the most remote objects of the Universe, 4.4.2002, S. Urpo

The scienti£c society of Natural Philosophy, House of Sciences, Helsinki, invited talk: Cosmic Water, 26.4.2001, T. Liljeström.

Space 2000 Seminar, 22.5.2001, Innopoli, Espoo, s. Urpo

Space strategy meeting organized by the Finnish Space Committee, 19.10.2001, Spektri, Espoo, S. Urpo

Antares fall seminar, Helsinki, 1.11.2001, S. Urpo, talk “Planck satellite and the foreground separation”, M. Tornikoski

8.4 Participation in summer schools

2001 Nordic-Baltic Summer School in Radio Astronomy: Radio Universe, Ventspils, Latvia, 15-28.7.2001, Ilona Jussila

Iram Summer School 2001, Observing Techniques and Applications, Sierra Nevada, Spain, 14-21.9.2001, Ilona Jussila

Astrometry and Geodesy Summer School in Bologna, 17-28.9.2001, Prisse Könönen

8.5 Public Relations

Space 2001 exhibition, 2.-4.11., Kaapelitehdas. Preparation for the exhibition and/or short presentations about the Metsähovi research activities at the Metsähovi Radio Observatory’s stand: all the Metsähovi staff.

Press conference of the Finnish Planck Surveyor Consortium, 3.4.2001, S. Urpo, Talk on the extragalactic and galactic radio sources science, A. Lähteenmäki

Several newspaper articles following the press conference.

Radio interview about solar radio ¤ares and auroral lights, 3.4.2001, S. Urpo

9 Personnel in 2001

Permanent Positions funded by the Helsinki University of Technology

Urpo, Seppo, Prof., Dr.Tech.	Director of the institute, Docent	Seppo.Urpo@hut.£
Hurtta, Solveig, Ms.	Secretary	Solveig.Hurtta@hut.£
Oinaskallio, Erkki, Mr.	Technician	Erkki.Oinaskallio@hut.£
Peltonen, Juhani, Dr.Tech.	Laboratory engineer, part time	jussi@kurp.hut.£

Scienti£c and Technical Staff Funded by Research Contracts

Jussila, Ilona, student	Research aid, full time 1.6-31.8. part time 1.1-31.5., 1.9-31.12.	ilo@kurp.hut.£
Kahanpää, Henrik, student	Research aid, 21.5-31.8.	
Koistinen, Olli, Lic.Tech.	Researcher, part time	Olli.Koistinen@hut.£
Kujala, Pasi, student,	Research aid, 1.6-15.7.	
Könönen, Prisse, student	Research aid	prisse@kurp.hut.£
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Lähteenmäki, Anne, Dr.Tech.	Researcher	alien@kurp.hut.£
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Parviainen, Mikko, student,	Research aid, full time 28.5-31.8. part time 1.9-31.12.	pare@kurp.hut.£
Puhakka, Pekka, student	Research aid, 25.6-31.12.	pvspuhak@kurp.hut.£
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Rönnberg, Henry, Mr.	Mechanic	
Saarinen, Ville, student	Research aid, full time 1.6-31.8. part time 1.4-31.5.	vss@kurp.hut.£
Sjöman, Pekka, Dipl.Eng	Laboratory engineer,	psj@kurp.hut.£
Teräsranta, Harri, Dr.Tech.	Researcher	hte@kurp.hut.£
Tornikoski, Merja, Dr.Tech.	Senior Fellow, Academy of Finland, Docent of space technology and radio astronomy	Merja.Tornikoski@hut.£
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Metsähovi Advisory Committee

Juuti, Pauli, M.Sc. (Eng)
Pellinen, Risto, Prof.
Somervuo, Pekka, Dr.Tech.
Tanskanen, Pekka, Prof.
Tiuri, Martti, Prof.emer., M.P. (Chair)
Valtonen, Mauri, Prof.
Urpo, Seppo, Prof. (Secretary)

METSÄHOVI PUBLICATIONS ON RADIO SCIENCE

HUT-MET-27 Silja Pohjolainen (ed.): CESRA Workshop on Coronal Explosive Events. 1998.

HUT-MET-28 Anne Lähteenmäki, Esko Valtaoja: Total ¤ux density variations in extragalactic radio sources. III. Doppler boosting factors, Lorentz factors and viewing angles for active galactic nuclei. 1999.

HUT-MET-29 V.V. Zaitsev, S. Urpo, A.V. Stepanov: Dynamics of energy release in single ¤are loop. 1999.

HUT-MET-30 V.V. Zaitsev, S. Urpo, A.V. Stepanov: Radiation signatures of solar energy release at mm-wavelengths: Advanced circuit model. 1999.

HUT-MET-31 Anne Lähteenmäki: Total ¤ux density variations extragalactic radio sources: observations and analysis. 1999.

HUT-MET-32 V.V. Zaitsev, A.G. Kislyakov, S. Urpo, A.V. Stepanov, E.I. Shkelev: The Wigner-Ville Analysis of Solar Microwave Emission, 2000.

METSÄHOVI REPORTS

HUT-KURP-13 Silja Pohjolainen (ed.): Metsähovi Radio Observatory Annual Report 1997. 1998.

HUT-KURP-14 Ari Mujunen, Mika Perttula, Jan Engelberg: Using CVS at Metsähovi. 1998.

HUT-KURP-15 S. Urpo, A. Mujunen (eds.): Metsähovi Radio Observatory, Annual Report 1998. 1999.

HUT-KURP-16 J. Engelberg, A. Mujunen, E. Oinaskallio: Radio Spectrum Monitoring System – spektrd. 2000.

HUT-KURP-17 Esa Vilenius, Prisse Könönen: Calibration of the “GroWeather” weather stations at Metsähovi. 2000.

HUT-KURP-18 Prisse Könönen: “Weather@Metsähovi” – weather monitoring system at Metsähovi. 2000.

HUT-KURP-19 S. Urpo, A. Mujunen (eds.): Metsähovi Radio Observatory, Annual Report 1999. 2000.

HUT-KURP-20 J. Engelberg, A. Mujunen: EFOS Monitoring System – efosd. 2000.

HUT-KURP-21 P. Könönen: “Efos9@Metsähovi” – Efos 9 Hydrogen Maser Monitoring System at Metsähovi. 2000.

HUT-KURP-22 S. Urpo, A. Mujunen (eds.): Metsähovi Radio Observatory, Annual Report 2000. 2001.

HUT-KURP-23 S. Urpo, A. Mujunen (eds.): Metsähovi Radio Observatory, Annual Report 2001. 2002.

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