

REPORT ON THE RADIONET3 NETWORKING ACTIVITY

TITLE: DISSECTING THE UNIVERSE – WORKSHOP ON RESULTS FROM HIGH-RESOLUTION VLBI

DATE: *MONDAY NOVEMBER 30-
WEDNESDAY DECEMBER 02,
2015* **TIME:** *MON 13:00-
WED 18:00*

LOCATION: *BONN, GERMANY*

MEETING WEBPAGE <https://events.mpifr-bonn.mpg.de/indico/event/4/>

HOST INSTITUTE: *MAX-PLANCK-INSTITUT FÜR RADIOASTRONOMIE*

PARTICIPANTS NO: *70*

MAIN LEADER: *MAX-PLANCK-INSTITUT FÜR RADIOASTRONOMIE*

REPORT:

1. Agenda and/or programme of the meeting

The detailed agenda including speakers and institutes is included here. A version of this can be obtained at <https://events.mpifr-bonn.mpg.de/indico/event/4/timetable/#20151130.detailed>.

Monday 30 November 2015

Session I - RadioAstron : Chair: J. Anton Zensus - 0.02 (13:00-14:40)

time	title	presenter
13:00	Welcome Address and Introductory Remarks (00h10')	Prof. ZENSUS, Anton (MPI für Radioastronomie)
13:10	RadioAstron Mission Overview (00h20')	Dr. KOVALEV, Yuri (Astro Space Center of Lebedev Physical Institute)
13:30	Current status of Millimetron space observatory (00h20')	Dr. PILIPENKO, Sergey (P.N. Lebedev Physical Institute RAS)
13:50	The farthest view with overterrestrial baselines (00h20')	Prof. GURVITS, Leonid (JIVE)
14:10	Pulsar Studies with RadioAstron (00h30')	Mr. RUDNITSKIY, Alexey (ASC LPI)

Session II - mm-VLBI: the GMVA, nearby objects: Chair: Eduardo Ros - 0.02 (15:10-17:15)

time	title	presenter
15:10	The Global Millimetre VLBI array: technique and science (00h25')	Dr. KRICHBAUM, Thomas P. (MPI für Radioastronomie)
15:35	GMVA Observations of M87 and Status Report of the GLT Project (00h20')	Dr. ASADA, Keiichi (ASIAA)
15:55	Magnetohydrodynamic Model of the M87 Jet Based on VLBI Observations (00h20')	Dr. NAKAMURA, Masanori (ASIAA)
16:15	Millimeter VLBI Observations of the Twin-Jet-System in NGC1052 (00h20')	Ms. BACZKO, Anne-Kathrin (MPI für Radioastronomie)
16:35	mm-VLBI Observations of the Active Galaxy 3C 111 in Outburst (00h20')	Mr. SCHULZ, Robert (Univ. Erlangen-Nürnberg; Univ. Würzburg)
16:55	First 3mm-VLBI imaging of the two-sided jet in Cygnus A: zooming into the launching region (00h20')	Dr. BOCCARDI, Biagina (MPI für Radioastronomie)

Tuesday 01 December 2015

Session III - mm-VLBI: AGN at 3mm: Chair: Marcello Giroletti - 0.02 (09:00-10:35)

time	title	presenter
09:00	Millimeter-wave VLBI of Blazar Jets (00h35')	Prof. MARSCHER, Alan (Boston University)
09:35	What has VLBI at the highest resolutions taught us about the VLBI "core"? (00h20')	Dr. HODGSON, Jeffrey (MPI für Radioastronomie)
09:55	Microarcsecond Structure of the Parsec Scale Jet of the Quasar 3C454.3 (00h20')	Dr. JORSTAD, Svetlana (IAR, Boston University, Boston, USA)
10:15	86 GHz VLBI survey of Ultra compact radio emission in Active Galactic Nuclei (00h20')	Ms. NAIR, Dhanya G (MPI für Radioastronomie)

Session IV - RadioAstron: AGN at high brightness temperatures: Chair: Talvikki Hovatta - 0.02 (11:05-12:45)

time	title	presenter
11:05	Extreme physics at extreme baselines (00h20')	Dr. LOBANOV, Andrei P. (MPI für Radioastronomie)
11:25	RadioAstron survey of AGN cores at extreme angular resolutions (00h30')	Dr. KOVALEV, Yuri (Astro Space Center of Lebedev Physical Institute)
11:55	Multiband RadioAstron imaging of 0836+710 (00h20')	Ms. VEGA GARCÍA, Laura (MPI für Radioastronomie)
12:15	High-resolution observations of 0836+710 and jet physics. (00h30')	Dr. PERUCHO, Manel (Univ. València)

Session V - mm-VLBI: SgrA* at 3mm and 1mm, EHT: Chair: Heino Falcke - 0.02 (14:00-15:30)

time	title	presenter
14:00	New Developments with the Event Horizon Telescope (00h20')	Dr. FISH, Vincent (MIT Haystack Observatory)
14:20	Anatomy of the horizon-scale structure of Sagittarius A* with a resolution of ~ 3 Schwarzschild radii (00h20')	Dr. LU, Rusen (MPI für Radioastronomie)
14:40	Closure phase measurements of SgrA* at 3mm (00h20')	Dr. MUELLER, Cornelia (Radboud University)
15:00	Detection and Implications of Horizon-Scale Polarization in Sgr A* (00h25')	Dr. JOHNSON, Michael (Harvard-Smithsonian Center for Astrophysics)
15:25	JIVE role in BlackHoleCam (00h03')	Dr. VAN BEMMEL, Ilse (JIVE)

Session VI - RadioAstron: AGN and beyond: Chair: Alexander Pushkarev - 0.02 (16:00-18:10)

time	title	presenter
16:00	Probing the innermost regions of AGN jets and their magnetic fields with RadioAstron (00h30')	Dr. GÓMEZ, Jose L. (Instituto de Astrofísica de Andalucía - CSIC)
16:30	Dissecting TeV blazars: Space VLBI study of the BL Lac source Markarian 501 (00h20')	Dr. GIROLETTI, Marcello (INAF Osservatorio di Radioastronomia)
16:50	The Nuclear Structure in Nearby AGN at 3-500 Schwarzschild Radii Resolution (00h30')	Dr. SAVOLAINEN, Tuomas (Aalto Univ. & MPI für Radioastronomie)
17:20	Radio and gamma-ray properties of the nearby radio galaxy 3C 84 (00h20')	Dr. ORIENTI, Monica (INAF-ORA Bologna)
17:40	Gravitational redshift experiment with RadioAstron: current status, perspectives, and VLBI applications (00h30')	Prof. RUDENKO, Valentin (Lomonosov MSU SAI) Dr. LITVINOV, Dmitry (Sternberg Astron. Inst., Lomonosov Univ.)

Refreshments and Discussion - Entrance Hall (18:10-20:55)

Reception and Discussion

time	title	presenter
20:25	Discussion in small groups and preparation of final, plenary discussion (00h30')	Prof. ROS, Eduardo (MPI für Radioastronomie & Univ. València) Dr. LOBANOV, Andrei P. (MPI für Radioastronomie) Dr. KOVALEV, Yuri (Astro Space Center of Lebedev Physical Institute) Dr. HOVATTA, Talvikki (Aalto Univ.) Dr. GIROLETTI, Marcello (INAF Osservatorio di Radioastronomia) Prof. ZENSUS, J. Anton

Wednesday 02 December 2015

Session VII - mm-VLBI: continuum, gamma-connection, spectral lines: Chair: Ilse van Bemmel - 0.02 (09:00-10:20)

time	title	presenter
09:00	Oblique shocks in polarised sources revealed by GMVA observations (00h15')	Prof. ROS, Eduardo (MPI für Radioastronomie & Univ. de València)
09:15	Comprehensive study of a gamma-ray to radio connection in 3C273 (00h20')	Mr. LISAKOV, Mikhail (ASC LPI)
09:35	VLBI Studies of Star Forming Regions using Molecular Masers (00h20')	Dr. GODDI, Ciriaco (Radboud University, Nijmegen, The Netherlands)
09:55	The Kinematics of M81 and M82 Galaxies (00h20')	Mr. KIMANI, Naftali (MPIfR)
10:15	Jets from Water-Disk-Megamaser Galaxies (00h03')	Ms. KAMALI, Fateme (MPI für Radioastronomie)

Session VIII - RadioAstron: Galactic and extragalactic masers, pulsars, & technique: Chair: Yuri Kovalev - 0.02 (10:55-12:46)

time	title	presenter
10:55	Studies of masers in star forming regions of our Galaxy and megamasers in external galaxies within RadioAstron space-VLBI project (00h30')	Dr. SOBOLEV, Andrej M. (Ural Federal University)
11:25	The most compact H ₂ O maser spots and their locations in W3 IRS5 (00h20')	Dr. IMAI, Hiroshi (Kagoshima University)
11:45	Water megamasers at high resolution (00h20')	Prof. BAAN, Willem (ASTRON)
12:05	Development of Processing Centers from Radioastron to Millimetron Projects (00h20')	Dr. SHATSKAYA, Marina (ASC LPI)
12:25	Primary data processing in Space-VLBI missions. ASC Correlator. (00h03')	Dr. RUDNITSKIY, Alexey (ASC LPI)
12:28	Accurate shifts measurements for AGN multifrequency VLBI maps (00h03')	Mr. LISAKOV, Mikhail (ASC LPI) Dr. PASHCHENKO, Ilya (ASC LPI)
12:31	Quasar 0529+483 on Space-Earth baselines: brightness temperature and scattering substructure from RadioAstron observations (00h03')	Dr. PILIPENKO, Sergey (ASC LPI)
12:34	Assessing uncertainties of VLBI results (00h03')	Dr. PASHCHENKO, Ilya (ASC LPI)
12:37	RadioAstron AGN survey: statistics of sources detections (00h03')	Mr. VOYTSIK, Petr (ASC LPI)
12:40	ASL Software Package: VLBI data reduction and imaging. (00h03')	Mr. ZUGA, Victor (ASC LPI)
12:43	A physical model for the radio and GeV emission from the microquasar LS I +61°303 (00h03')	Mr. JARON, Frederic (MPI für Radioastronomie)

Session IX - mm-VLBI and the KVN: Chair: Krisztina Gabanyi - 0.02 (14:00-15:20)

time	title	presenter
14:00	PKS 1502+106: A high-redshift Fermi blazar at extreme angular resolution. Structural dynamics with VLBI imaging up to 86 GHz (00h20')	Dr. KARAMANAVIS, Vassilis (MPI für Radioastronomie)
14:20	Global 3-mm VLBI observations with Korean VLBI Network toward bright AGN jets (00h20')	Dr. KOYAMA, Shoko (MPI für Radioastronomie)
14:40	The Plasma Physics of Active Galactic Nuclei (PAGaN) project with KVN and KaVA (00h20')	Mr. KIM, Jae-Young (MPI für Radioastronomie)
15:00	Dynamics in acceleration and collimation regions of relativistic jets in black hole accretion disk system (00h20')	Dr. MIZUNO, Yosuke (ITP, Goethe University Frankfurt)

Session X - VLBI science and technique, outlook: Chair: Andrei Lobanov - 0.02 (15:50-17:50)

time	title	presenter
15:50	The Discovery and Implications of Refractive Substructure for VLBI at the Highest Angular Resolutions (00h20')	Dr. JOHNSON, Michael (Harvard-Smithsonian Center for Astrophysics)
16:10	Silhouettes of parsec-scale AGN jets (00h20')	Dr. PUSHKAREV, Alexander (Crimean Astrophysical Observatory)
16:30	Exploring the magnetic field configuration close to central engines (00h20')	Dr. RANI, Bindu (MPI für Radioastronomie)
16:50	The connection between the mm VLBI jet and the gamma-ray emission in the blazar CTA102 and the radio galaxy 3C120 (00h20')	Ms. CASADIO, Carolina (IAA-CSIC)
17:10	New insight into AGN-jets: they are alive! (00h20')	Dr. BRITZEN, Silke (MPI für Radioastronomie)

2. Scientific Summary

Scientific rationale: Recent developments have pushed the limits of resolution in astrophysics to new frontiers. Very-long-baseline interferometry (VLBI) at millimetre wavelengths or using antennas in space yields resolutions down to tens of microarcseconds (that is, fractions of nanoradians). These observations probe compact objects such as the innermost regions of active galactic nuclei. Space VLBI is living a new era at present with the results from the RadioAstron mission, enhancing radio interferometry in terms of resolution at least one order of magnitude with respect to ground-based VLBI. Millimetre VLBI also brings radio interferometry to a new range of resolution and with much enhanced sensitivity due to improvements in data bit rate. With more antennas capable of VLBI at 3-mm wavelength, and successful observations being carried out at 1-mm, a new window is open to universe at unprecedented resolution. The workshop reviewed recent results on high resolution radio astronomy, including opportunities provided by new antennas becoming available. It also discussed on the applications of high-resolution imaging techniques and the synergies in the study of compact objects by space and mm-VLBI together.

Nine posters with VLBI-related scientific highlights were presented, and a 3-minute talk was allocated for each one of the posters.

The conference was broadcasted by streaming by the computer division of the MPIfR through the streaming server. Several participants who cancelled their attendance and additional interested people watched the workshop fully or partially.

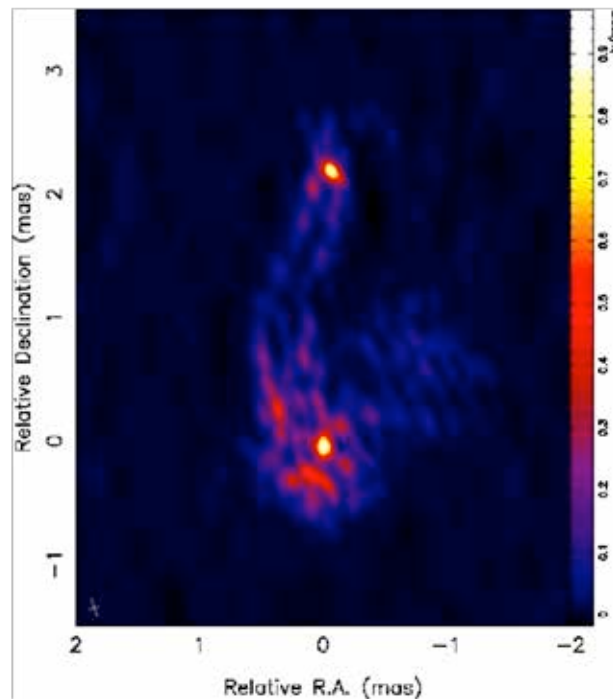


Figure 1 - 22 GHz RadioAstron image of the blazar 3C 84, produced with a restoring beam of 0.075×0.35 mas. 1 mas corresponds to 0.35 pc.

Conference Highlights: The conference can be divided in two big areas, one devoted to space VLBI and one devoted to millimetre VLBI. Invited talks were delivered by several individuals.

Concerning RadioAstron (space VLBI) topics, invited reviews were given from all Key Science Programs, by Yuri Kovalev (AGN Survey), Alexey Rudnitsky (Pulsars), José Luis Gómez (Polarisation), Savolainen (Nearby Sources), Manel Perucho (strong AGN), Valentin Rudenko (Gravitational Redshift), and Sobolev (Masers). Also Monica Orienti was invited to deliver a talk on RadioAstron observations of 3C 84. Yuri Kovalev delivered a second presentation to introduce the RadioAstron mission.

One of the highlights of the conference were the images of 3C 84 obtained with RadioAstron, as presented by Tuomas Savolainen. Figure 1 shows a super-uniform weighting with the core being the bright feature at the top part of the plot, and a hot spot at the south inside the moving feature C3. The most striking feature is the east-west extension of the core region and the edge-brightened jet south from the core, which match with mm-VLBI images as observed by Hodgson et al. Other interesting results on space-VLBI were shown by Leonid Gurvits (concerning space VLBI observations with the VSOP mission in the late 1990s and early 2000s), Laura Vega García (0836+710), Andrei Lobanov (observations of brightness temperatures), and others.

Invited presentations on mm-VLBI were delivered by Thomas Krichbaum (the Global mm-VLBI Array), Alan Marscher (millimetre-wave VLBI of blazar jets), Vincent Fish (New Developments with the Event Horizon Telescope), and Michael Johnson (Polarisation of SgrA* at 1mm). One of the highlights of the conference in the area of mm-VLBI is shown in Figure 2, corresponding to the presentation by Ms. Anne-Kathrin Baczko (from her Master Thesis work). The mm-VLBI image at the bottom of the figure shows the innermost regions of the twin jet in NGC 1052, where regions between 100 and 400 Schwarzschild radii are resolved. The magnetic field is estimated to be between 360 and 6900 Gauss at the event horizon, from extrapolations of the measured values at the image. Results at 7mm (e.g., blazar monitoring results by Jorstad et al.), 3mm (GMVA observations by Boccardi, Karamanavis, Koyama, Nair, and Ros, among others; and VLBA observations by Müller), and 1mm (Fish, Lu).

Additionally, interesting, more general VLBI results were shown by Michael Johnson (in a second presentation at the meeting), Carolina Casadio, Alexander Pushkarev, Silke Britzen, or Naftali Kimani.

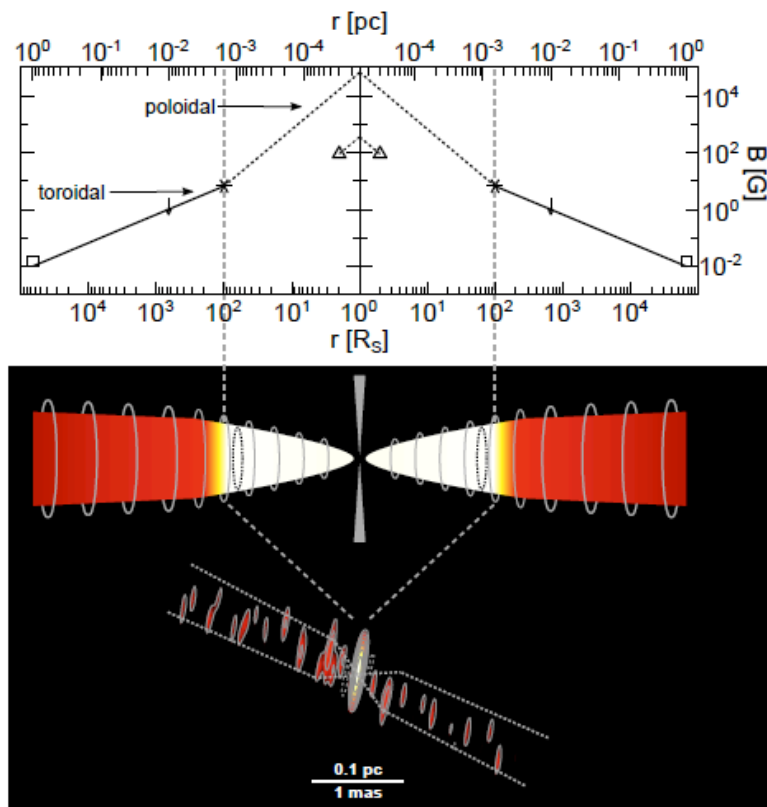


Figure 2 - Sketch of the jet-launching region (mm-VLBI image at the bottom panel) and the magnetic fields (top panel) in the galaxy NGC 1052.

The conference picture is provided in Figure 3.



Figure 3 - Conference picture taken at the 2nd day of the meeting at the main entrance of the Max-Planck-Institut für Radioastronomie

The **Scientific Organising Committee** was composed by E. Ros (MPIfR Germany; Chair), M. Giroletti (IRA-INAF, Italy), T. Hovatta (Aalto Univ., Finland), Y.Y. Kovalev (ASC Lebedev, Russia), A.P. Lobanov (MPIfR, Germany), and J.A. Zensus (MPIfR, Germany).

3. Attendance list (incl. participant names, affiliation and country) signed by the participants and confirmed by the organizer

The attendance list is following. Postdoctoral (early stage, non-permanent) researchers are marked with ■, graduate students with *. A signed version is attached.

Name	Institution	Country
Ms. AGHABABAEI, Atefeh*	MPI für Radioastronomie	Germany
Dr. AGUDO, Iván	Instituto de Astrofísica de Andalucía-CSIC	Spain
Dr. ALAKOZ, Alexey■	ASC LPI	Russia
Dr. ALEF, Walter	MPI für Radioastronomie	Germany
Dr. ANGELAKIS, Emmanouil	MPI für Radioastronomie	Germany
Mr. ANGIIONI, Roberto*	MPI für Radioastronomie	Germany
Dr. ASADA, Keiichi	ASIAA	Taiwan
Prof. BAAN, Willem	ASTRON	Netherlands
Dr. BACH, Uwe	MPI für Radioastronomie	Germany
Ms. BACZKO, Anne-Kathrin*	MPI für Radioastronomie	Germany
Dr. BERNHART, Simone	IGG Uni Bonn	Germany
Dr. BOCCARDI, Biagina■	MPI für Radioastronomie	Germany
Dr. BRITZEN, Silke	MPI für Radioastronomie	Germany
Dr. BRUNI, Gabriele■	MPI für Radioastronomie	Germany
Ms. CASADIO, Carolina*	Instituto de Astrofísica de Andalucía-CSIC	Spain
Prof. FALCKE, Heino	Radboud University Nijmegen	Netherlands
Dr. FISH, Vincent	Haystack/MIT	United States
Ms. G NAIR, Dhanya*	MPI für Radioastronomie	Germany
Dr. GABANYI, Krisztina	Satellite Geodetic Observatory, FOMI	Hungary
Dr. GIROLETTI, Marcello	IRA-INAF	Italy
Dr. GODDI, Ciriaco	Radboud University Nijmegen	Netherlands
Prof. GURVITS, Leonid	JIVE	Netherlands
Dr. GÓMEZ, Jose L.	Instituto de Astrofísica de Andalucía-CSIC	Spain
Dr. HADA, Kazuhiro	NAOJ	Japan
Dr. HODGSON, Jeffrey■	MPI für Radioastronomie	Germany
Dr. HOVATTA, Talvikki■	Aalto Univ.	Finland
Dr. IMAI, Hiroshi	Kagoshima University	Japan
Mr. JARON, Frédéric*	MPI für Radioastronomie	Germany
Dr. JOHNSON, Michael D.■	Harvard-CfA	United States
Dr. JORSTAD, Svetlana	Boston University	United States
Ms. KAMALI, Fateme*	MPI für Radioastronomie	Germany
Dr. KARAMANAVIS, Vassilis■	MPI für Radioastronomie	Germany
Mr. KIMANI, Naftali*	MPI für Radioastronomie	Germany
Mr. KIM, Jae-Young*	MPI für Radioastronomie	Germany
Dr. KOVALEV, Yuri Y.	ASC LPI	Russia
Dr. KOYAMA, Shoko■	MPI für Radioastronomie	Germany
Dr. KRICHBAUM, Thomas P.	MPI für Radioastronomie	Germany
Mr. LISAKOV, Mikhail	ASC LPI	Russia
Dr. LITVINOV, Dmitry	Sternberg Astronomical Institute	Russia
Dr. LOBANOV, Andrei	MPI für Radioastronomie	Germany
Dr. LU, Rusen■	MPI für Radioastronomie	Germany

Prof. MARSCHER, Alan	Boston University	United States
Dr. MAUERSBERGER, Rainer	MPI für Radioastronomie	Germany
Dr. MAX-MOERBECK, Walter [■]	MPI für Radioastronomie	Germany
Dr. MERTENS, Florent [■]	MPI für Radioastronomie	Germany
Dr. MIZUNO, Yosuke	Univ. Frankfurt	Germany
Dr. MÜHLE, Stefanie	German ARC - Alfa - Univ. Bonn	Germany
Dr. MÜLLER, Cornelia [■]	Radboud University	Netherlands
Dr. NAKAMURA, Masanori	ASIAA	Taiwan
Dr. ORIENTI, Monica	IRA-INAF	Italy
Ms. PASETTO, Alice [*]	MPI für Radioastronomie	Germany
Dr. PASHCHENKO, Ilya	ASC LPI	Russia
Dr. PERUCHO, Manel	Univ. València	Spain
Dr. PILIPENKO, Sergey	ASC LPI	Russia
Dr. PORCAS, Richard	MPI für Radioastronomie	Germany
Dr. PUSHKAREV, Alexander B.	ASC LPI / CrAO	Russia
Dr. RANI, Bindu [■]	MPI für Radioastronomie	Germany
Prof. ROS, Eduardo	MPI für Radioastronomie	Germany
Dr. ROY, Alan	MPI für Radioastronomie	Germany
Dr. RUDENKO, Valentin	Sternberg Astronomical Institute	Russia
Dr. RUDNITSKY, Alexey [■]	ASC LPI	Russia
Dr. SAVOLAINEN, Tuomas	Aalto University Metsähovi Radio Observatory	Finland
Mr. SCHULZ, Robert [*]	Univ. Erlangen-Nürnberg; Univ. Würzburg	Germany
Mr. SELIVERTSTOV, Sergey [*]	ASC LPI	Russia
Dr. SHATSKAYA, Marina	ASC LPI	Russia
Dr. SOBOLEV, Andrej	Ural Federal University	Russia
Dr. VAN BEMMEL, Ilse	JIVE	Netherlands
Ms. VEGA GARCÍA, Laura [*]	MPI für Radioastronomie	Germany
Mr. VOYTSIK, Petr [*]	ASC LPI	Russia
Prof. ZENSUS, J. Anton	MPI für Radioastronomie	Germany
Dr. ZUGA, Victor	ASC LPI	Russia

On gender distribution and junior researchers: 12 graduate or undergraduate students (a 17.1% of the attendants) and 14 postdocs (a 20.0%) attended to the meeting. Out of the participants, 18 were female (a 25.7%) of the total. Out of the 10 sessions, 3 were moderated by female scientists (a 30%). The scientific organising committee had 1 female scientist from a total of 6 persons (a 16.7%). From the 26 junior researchers (doctoral candidates and postdocs), 12 of them were female (a 46.1% of them).

The distribution of the institutions of the attendants by country is as follows: a 41.3% of the registered participants was German, a 18.7% was Russian, 8.0% of the participants were affiliated to an institute in the Netherlands, 6.7% from Spain, 5.3% from the USA, and other nations such as Japan, Italy, or Taiwan had a 2.7% of participants each.

4. Financial Report / RadioNet3 contribution

The expenses are distributed as follows:

Concept	Amount (Netto)
<i>Accommodation Invited Speakers</i>	
Gómez, José Luis (Spain) – Hotel Mozart 29.11-03.12	284,00 €
Marscher, Alan & Jorstad, Svetlana (USA) – Hotel Kurfürstenhof 29.11-02.12	305,00 €
Kovalev, Yuri (Russia) – Guest Room MPIfR 29.11-05.12	150,00 €
Orienti, Monica (Italy) – Hotel Altes Treppchen 29.11-03.12	132,00 €
Perucho, Manel (Spain) – Hotel Mozart 28.11-03.12	355,00 €
Rudenko, Valentin (Russia) – Hotel Mozart 29.11-03.12	284,00 €
Rudnitskiy, Alexey (Russia) – Guest Room MPIfR 29.11-03.12	100,00 €
<i>Coffee Breaks & Refreshments</i>	
Coffee Breaks 1x 30.11, 2x 01.12, 2x 02.12 & Refreshments Evening 01.12	2098,00 €
TOTAL	3708,00 €

RadioNet allocated a total of 3000,00 € for the meeting. The rest of the costs are covered by the budget of the MPIfR, as well as infrastructure, badges, blocks, etc. No conference fee was requested from the participants. The participants who received funding are listed in the table above.

5. Conference Proceedings and Web page

No conference proceedings are published. The presentations are available at the conference web page, as well as the recorded videos from the meeting. The MPIfR computer division reported 30 logins for watching the streaming, 7 directly from the MPIfR and 23 external.

The abstracts of the presentations and posters are sent to NASA's Astrophysics Data System to be indexed at the data base. All delivered presentations made available by the authors. have been made available at the conference webpage as PDF files.

The report must be delivered to the chair of the Networking Activity **within 30 days after the end of the event** and then transmitted to the *RadioNet3* Project Manager:

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