



MAX-PLANCK-GESELLSCHAFT



Max-Planck-Institut
für Radioastronomie

Effelsberg, VLBA, HSA

Anton Zensus

Max-Planck-Institut für Radioastronomie

- VLBA Key Science
- Effelsberg & VLBA
- Brinkmanship

with C. Fromm, T. Savolainen, F. Schinzel, R. Porcas, T. Krichbaum

28 January 2011 - NRAO Charlottesville - *Future of the VLBA Workshop*

- VLBA Key Science
- Effelsberg 100m Telescope & VLBA
- Brinkmanship

Some Key Science Projects for a 5-year mission with the VLBA

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Active Galactic Nuclei

- The Core Business -

- Formation of AGN and central black holes
- Accretion disks
- Formation and launching of jets and flows
- Emission processes leading to emission from radio to gamma
- Interaction of jets with broadline-emitting clouds

Key Research Programs for the VLBA

- MOJAVE & F-GAMMA
- Mm/sub-mm VLBI of AGN & Sgr A*
- Archetypes of AGN

Imaging Capability
Frequency Agility
Polarization Purity

Full-time Dedication
Dynamic Scheduling
Development & User Focus

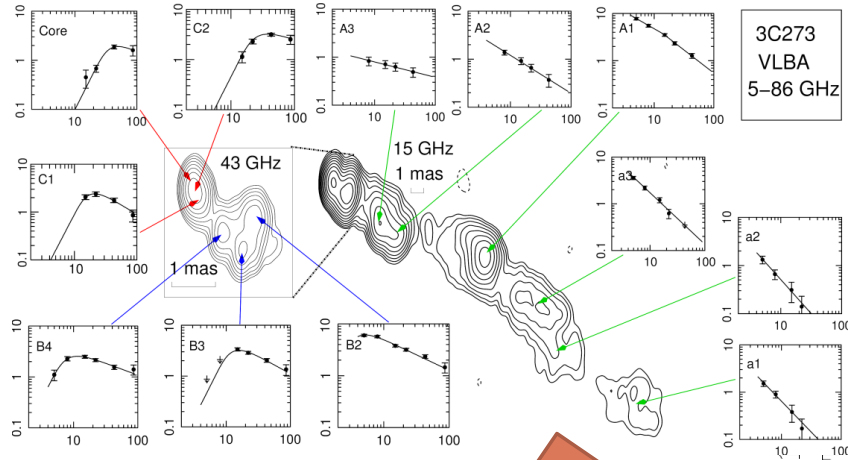
MOJAVE monitoring: ~300 sources at 2cm.
BU 7mm monitoring: ~30 sources at 7mm.

Do we need additional, targeted VLBA/HSA
studies of pc-scale jets?

Yes, we do.

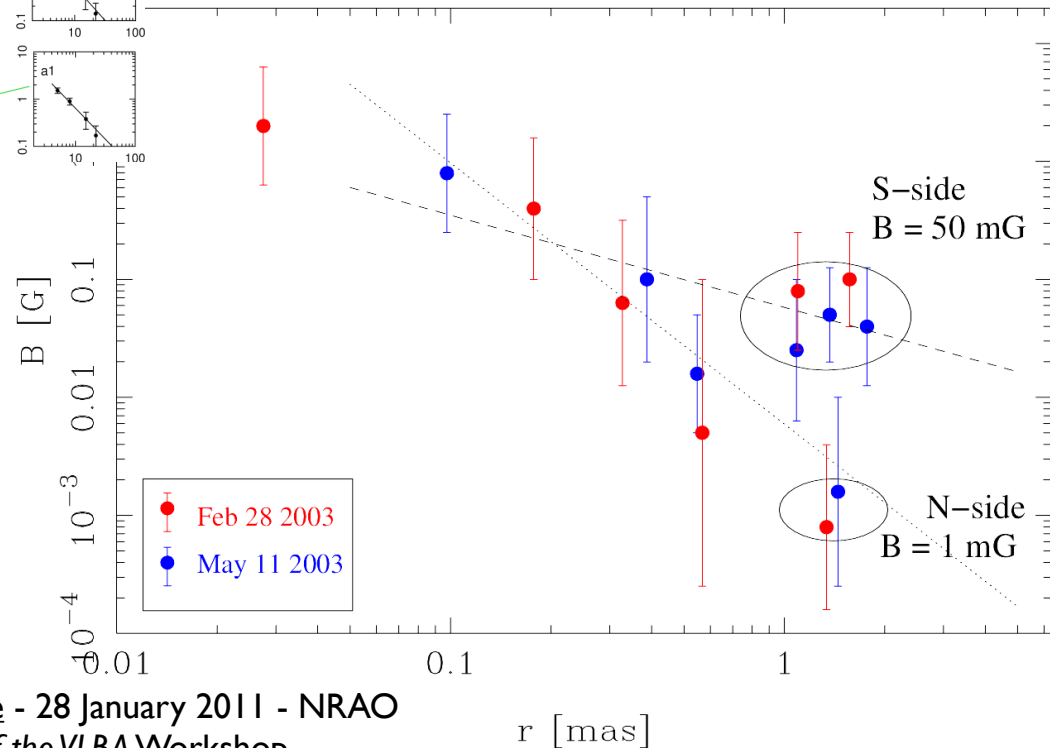
- **Need: Multi-frequency polarization measurements** [$I(\nu), Q(\nu), U(\nu), V(\nu)$]
 - Probe the physical conditions in and around the jet (magnetic field strength and configuration, particle population)
 - Comparison with simulated jets
- **Need: Coordinated VLBA+SED monitoring**
 - Mapping the energy dissipation region, locating the gamma-ray source
- **Need: High time resolution studies** (e.g. M87, 3C273, 3C345)
 - Correlating events from high energy observations

The B-field Distribution in 3C273



Multifrequency VLBA obs. of 3C273 in 2003 provided B-field measurements in the first 2 mas of the jet.

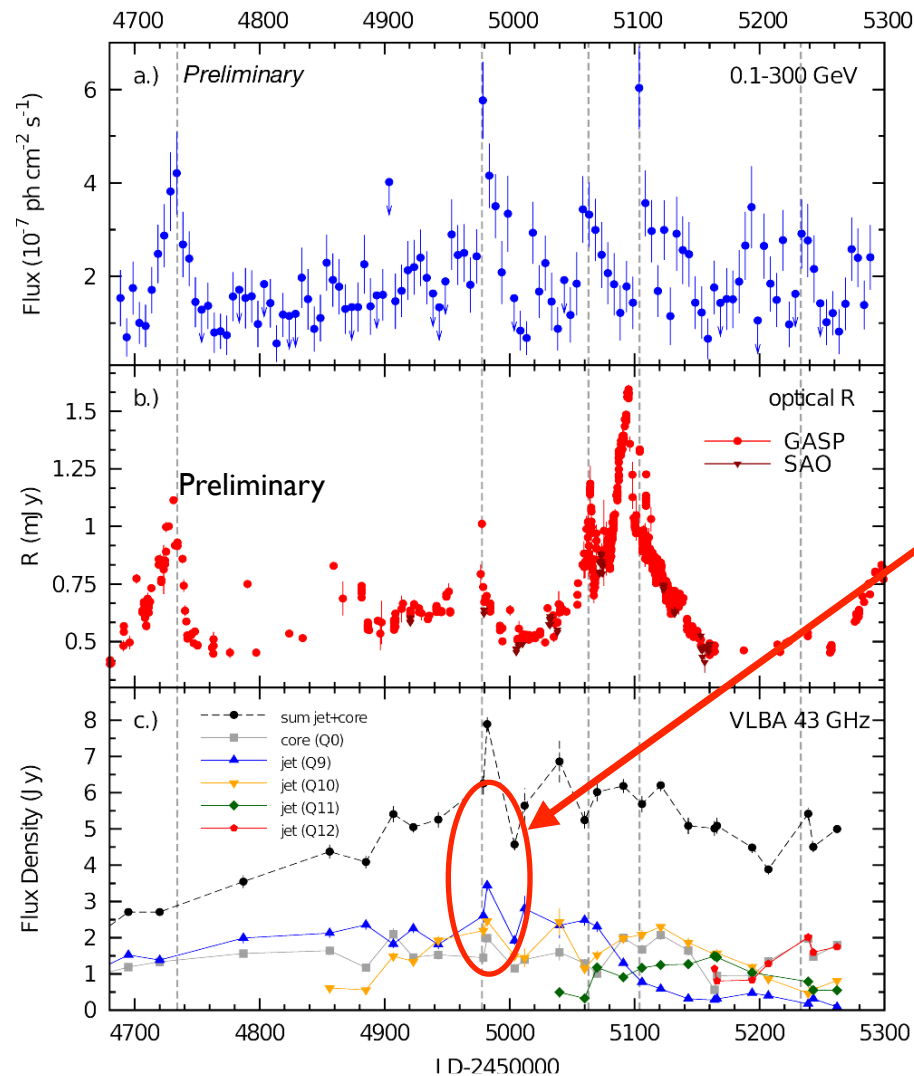
- $B \sim 1$ G in the mm-core
- Significant B-field gradient across the jet in direction perpendicular to the flow – theory and/or simulations need to explain it.



Savolainen et al. 2008

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Critical time resolution in 3C345



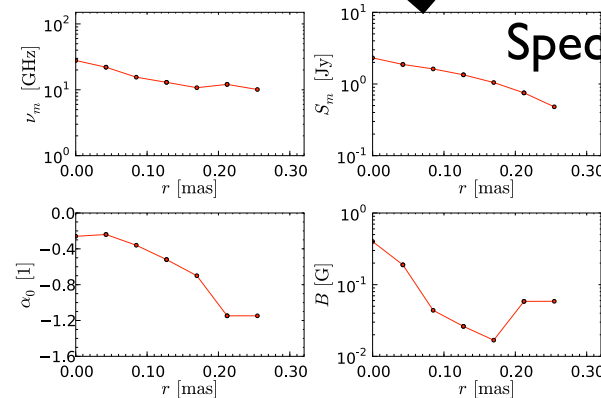
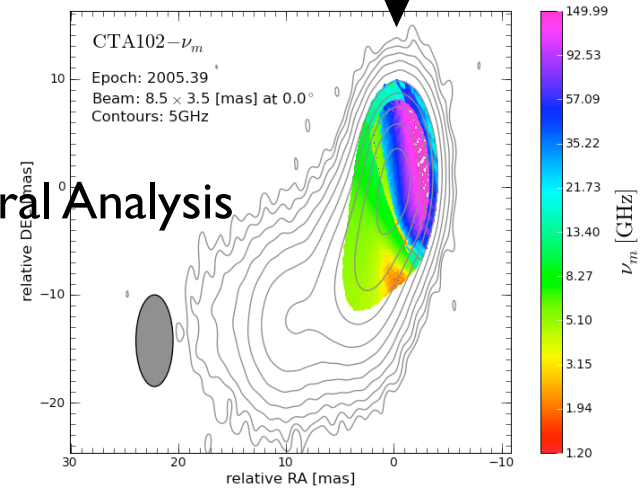
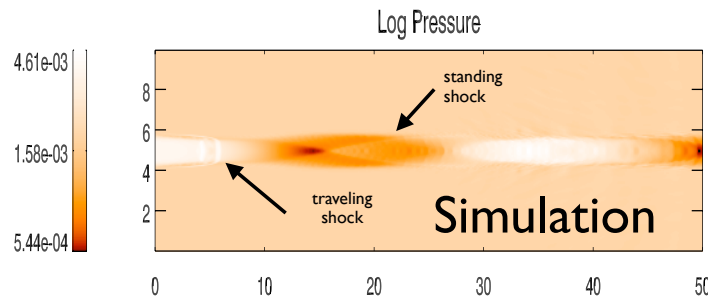
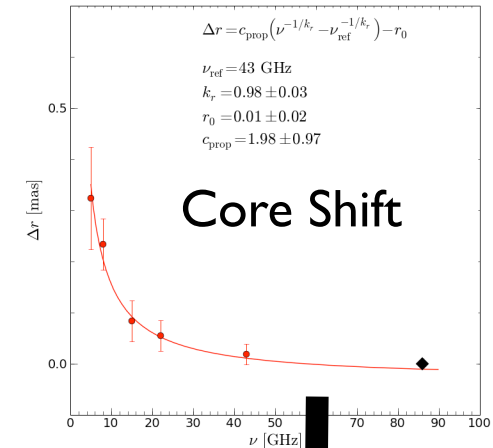
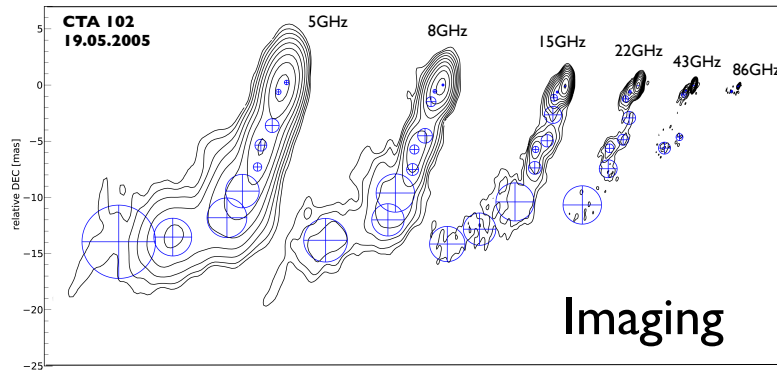
Multiwavelength observations of 3C345 in 2009-2010

- Gamma-ray and 43 GHz VLBA flux density trends correlate
- VLBA core region at 7mm shows a rapid flare: ~ 1.5 Jy increase in only 4 days
- The rapid VLBA flare is coincident with a gamma-ray flare – but this is not always the case \rightarrow complicated emission region!
- High time resolution needed also in the VLBA observations in order not to miss rapid variability.

Schinzel et al. (in prep.)

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Multi-Frequency Study of CTA 102



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Fromm et al. (in prep.)

Quasar Movie Project

- Targets: 3C273 & 3C279
- Polarimetric VLBA observations at 15, 24, 43 and 86 GHz every 20 days and additional 5 and 8 GHz measurements every 60 days (Approved in Fermi G13; PI T.Savolainen)
- SED monitoring: gamma-rays (Fermi), X-rays/UV (Swift), optical (several telescopes; incl. polarization), near-IR (OAGH, REM), far-IR (Herschel), mm (SMA, IRAM 30m), radio (Effelsberg)
- Produces movies of the structural, spectral and polarization evolution of the jets at sub-parsec linear resolution and 20-day temporal resolution + SED evolution → mapping of the energy dissipation region
- Additionally: evolution of the rotation measure; comparing to GRMHD simulations

Savolainen et al.

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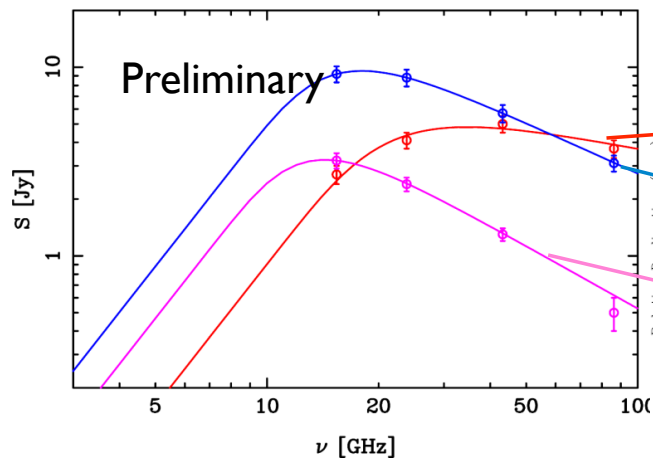
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Quasar Movie Project

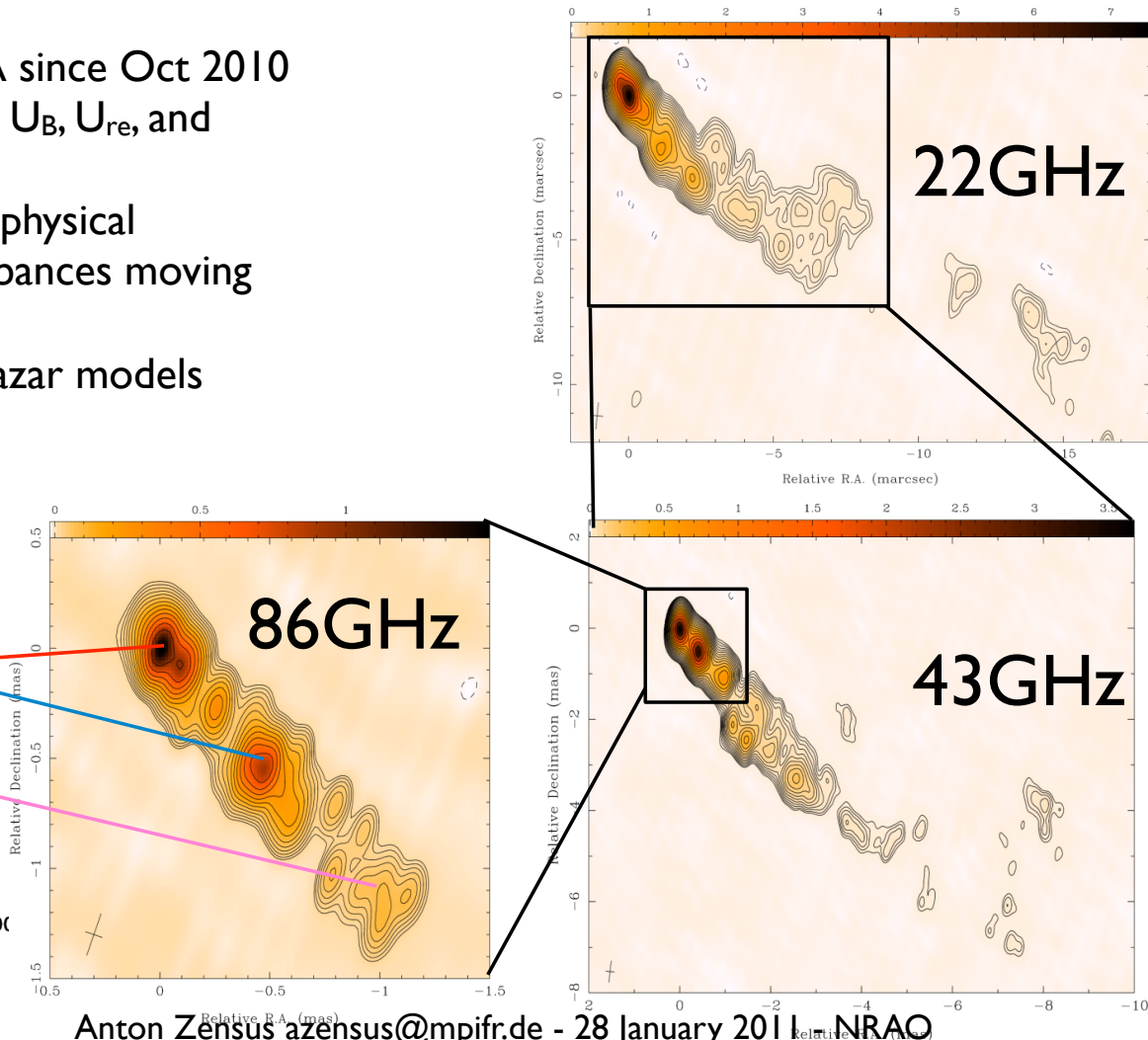


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- Project running at VLBA since Oct 2010
- Provides constraints on U_B , U_{re} , and B-field configuration
- Shows the evolution of physical conditions in the disturbances moving along the jet
- add SEDs \rightarrow tests of blazar models



3C 273 on Oct 27 2010



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Quasar Movie Project

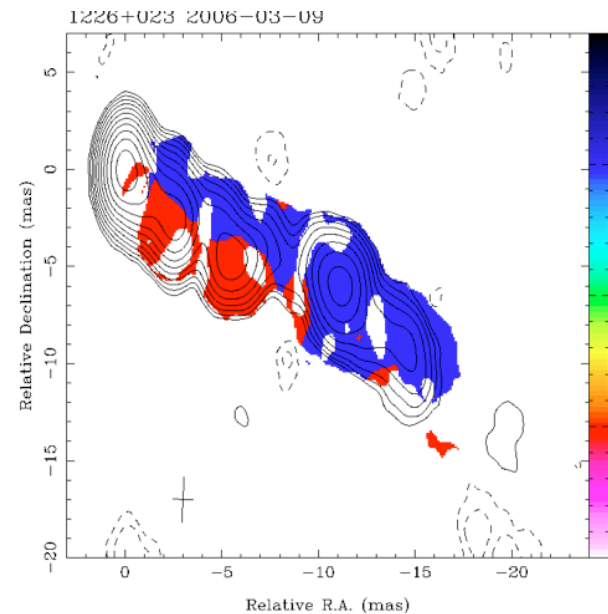


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- GRMHD jet simulations now provide predictions of the pc-scale rotation measure distribution (Broderick & McKinney 2010)
- The quasar movie project will probe the RM distribution at different size scales as well as constrain its time evolution
- Other comparisons with simulations may be possible in the near future

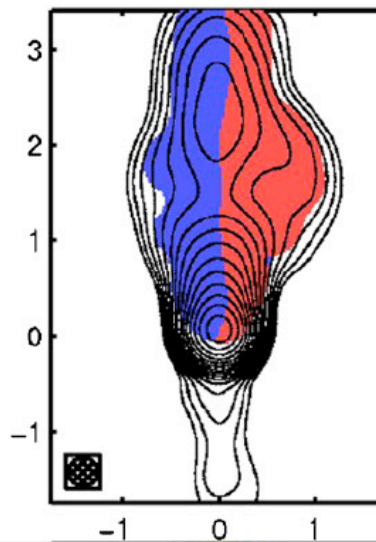
Comparison to simulations

3C 273 sign map



From MOJAVE; Hovatta et al. in prep

sign map from
GRMHD simulations



Broderick & McKinney 2010



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Effelsberg + VLBA ... towards HSA

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Formal Global observations since 1979

Optimized Compatibility: common frequency bands, VLBA Terminal, 4, 8 BBCs, Recent RDBE, scheduling coordination



Memorandum of Agreement
between the
National Radio Astronomy Observatory
and the
Max Planck Institute for Radioastronomy
regarding
Joint Availability of Facilities for VLBI Observing

Recognizing that combinations of NRAO and MPIfR telescopes offer advantages in sensitivity and resolution required by certain Very Long Baseline Interferometry (VLBI) observing programs, it is agreed that:

- 1) There will be up to 20 days/year allocated to such observations, provided that a sufficient number of approved proposals exists.
- 2) These observations can involve the Effelsberg 100 m Telescope, the Very Large Array (VLA), the Very Long Baseline Array (VLBA), and the Green Bank Telescope (GBT), with the understanding that proposals requesting Effelsberg, the VLA and the GBT will compete with all proposals for these telescopes and not just the VLBI proposals.
- 3) The observations be made in blocks adjacent to those of other regular observations (e.g. EVN-VLBA), with the observing periods and frequencies to be agreed at least 6 months in advance.
- 4) The access to the observing time should be open to all, on the basis of observing proposals. These proposals should be reviewed both by NRAO and by the Effelsberg program committee. The deadlines for submission of proposals should be the same as for the VLBA, VLA, EVN, and GBT.
- 5) The selection of proposals to be observed in given blocks be made by consultation between the NRAO and MPIfR schedulers.
- 6) This agreement may be terminated by either party at any time with one year's notice.

Paul Vanden Bout
Director, NRAO

Date 12-Nov-92

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28 January 2011 -
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- Future of the VLBA
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Richard Wielebinski
Director, MPIfR

Date 12.11.1992.

USER INFORMATION

Visitors coming to the NRAO-New Mexico may find it useful to fill out the reservation form on the next page prior to contacting the AOC reservationist. Some of the questions may require a bit of research, and having a copy of the form should save you time while making your reservations. The information requested is used to plan a productive and pleasant visit for you.

A copy of this form is in the public area of the VLAIIS. To get to this area, telnet to zia, then type <vlais> in lower case. The menu will have a listing called Visitors, where the form is located. Alternatively, you can request this form via e-mail from Eileen Latasa.

T. ROMERO

LATE BREAKING NEWS

VLBA - EFFELSBURG 100 M TIME AVAILABLE

VLBI observers wishing to propose programs involving the VLBA and Effelsburg 100 m telescope, but not the other telescopes that normally make up the European VLBI Network, may do so by simply submitting their proposals both to the NRAO and to the Max-Planck-Institut für Radioastronomie (MPIfR). Approximately twenty days of additional 100 m observing time per year has been reserved for such programs under the terms of an agreement between

NRAO and the MPIfR. Inclusion of additional NRAO telescopes or telescopes outside of Europe is not precluded by this agreement; proposals including such telescopes should be submitted to those observatories as well as to the NRAO and MPIfR.

P. A. VANDEN BOUT

NRAO Newsletter 54, 1 January 1993

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Date: Mon, 17 May 2004 11:54:20 -0600 (MDT)
From: gtaylor <gtaylor@ao.nrao.edu>
To: vlbi@nrao.edu
Subject: Amendment to High Sensitivity Array Call for Proposals
Status: R

We are pleased to announce the inclusion of the 100-m Effelsberg telescope with the High Sensitivity Array (HSA) for VLBI. Proposals requesting at least three of the five instruments including the VLBA will be accepted beginning with the June 1, 2004 deadline. Further details about individual telescope capabilities are available from the HSA web page at

<http://www.nrao.edu/HSA/>.

For completeness, a copy of the original announcement of the HSA is appended to this note.

Since June 2004: Formal Cooperation in HSA

Proposals for a high sensitivity VLBI array consisting of the VLBA, Green Bank Telescope (GBT), phased VLA (Y27), and Arecibo (AR) are now being accepted with priority. A total of up to 100 hours in each trimester (~25 hours/month) may be scheduled for highly rated projects that can justify the increase in sensitivity over the VLBA by more than an order of magnitude. This capability opens up promising new avenues for scientific discovery.

The High Sensitivity Array (HSA) is available at frequencies of 0.33, 0.61, 1.4, 5, 8.4, 15, 22, and 43 GHz starting with the June 1, 2004 proposal deadline. Proposals should be sent to NRAO only. To request HSA time, the observer should indicate in item 11 of the proposal coversheet on the line starting "VLBA" that the antennas requested are "HSA = VLBA+GBT+Y27+AR" (or any subset of three of these that includes the VLBA). See the web pages at <http://www.nrao.edu/HSA> for more details.

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- Greg Taylor

Brinkmanship, Partnerships, Community

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brinkmanship (also **brinksmanship**)

the art or practice of pursuing a dangerous policy to the limits of safety before stopping, typically in politics.



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Partnerships related to VLBA



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- VLBA C Band
- VLBA W and K Band
- Facilitation of the GMVA 3mm array
- DivX development

- Caltech: 15 GHz receiver for 40-m program
- Haystack: VLBI developments & mm VLBI

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The open skies paradigm
governed our earlier contributions.

The mission/contributor concept
may be an option that is easier to realize,
perhaps with a lesser community building impact.

Fermi meets Jansky: AGN at Radio and gamma-rays

MPIfR, Bonn, June 21-23, 2010



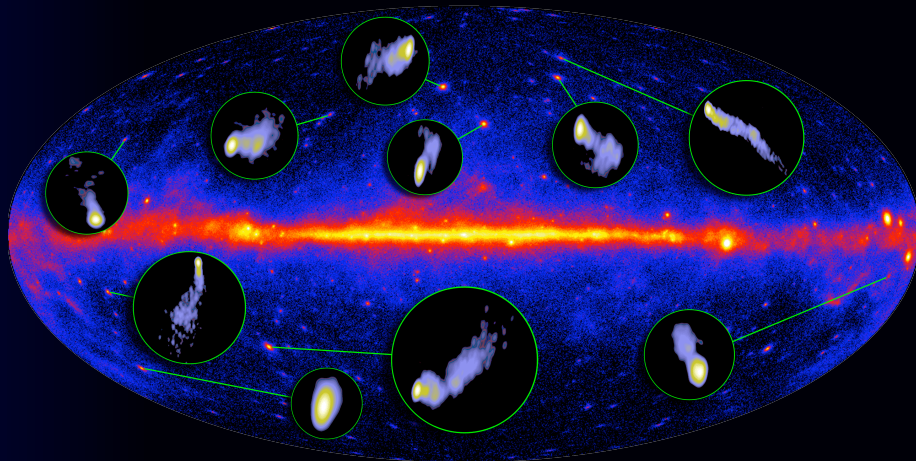
...21 of the 55 papers presented VLBA results.

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Fermi meets Jansky

AGN at Radio and Gamma Rays

Proceedings of a Workshop held at the
Max-Planck-Institut für Radioastronomie
Bonn, Germany, 21st-23rd June 2010



Tuomas Savolainen
Eduardo Ros
Richard W. Porcas
J. Anton Zensus
Editors



[http://www.mpifr-bonn.mpg.de/
div/vlbi/agn2010/](http://www.mpifr-bonn.mpg.de/div/vlbi/agn2010/)

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Today, Ford reported 6.6 billion dollars profit

Chinas external trade surplus is 316 billion dollars

Cost of operating a VLBA station compares to cost of
outfitting an old SatCom antenna