The DSN in Global VLBI Collaboration

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Robert A. Preston (3), James Lovell(4), Cristina Garcia-Miro(5)
& Shinji Horiuchi(6)

VLBI is one of the most successful and extensive international scientific collaborations.

the cake gets bigger
with more collaborators

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(6) CSIRO Astronomy and Space Science, Canberra Deep Space Communication
Complex, Australia

The Deep Space Network in 1967

The beginning of VLBI for the DSN; June 1967, 3C273 at S-Band in Australia....

Nine Million Wavelength Baseline Interferometer Measurements of 3C 273B

OBSERVATIONS on the angular dimensions of the variable

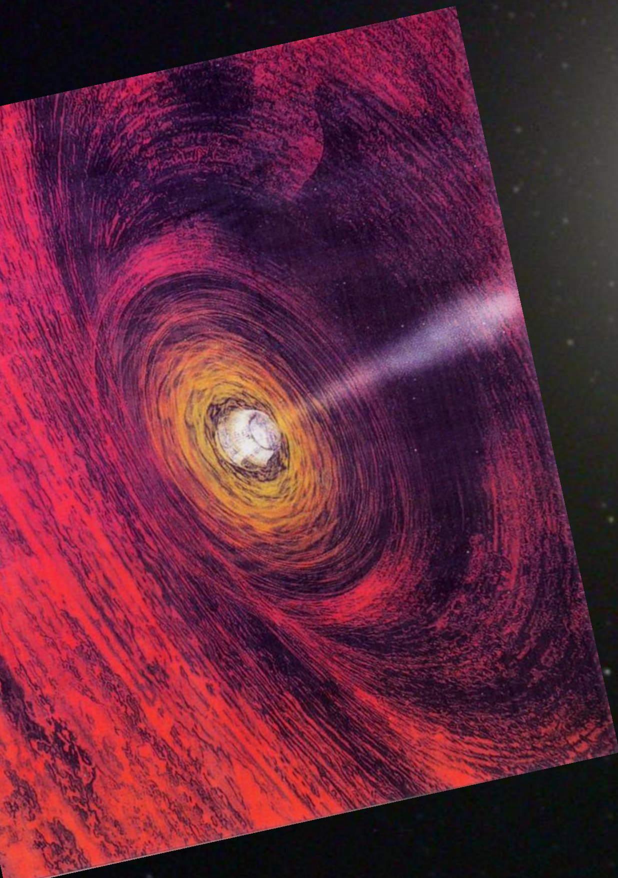
NASA's Island Lagoon
85 ft DSN station, DSS41

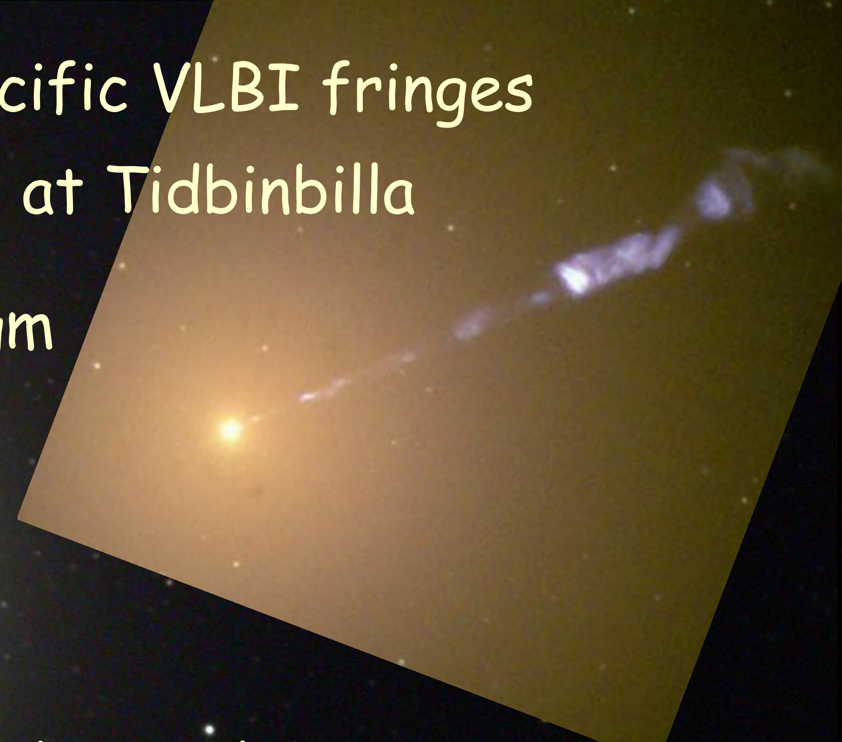
NASA's Tidbinbilla
85 ft DSN station, DSS 42

1969; first successful trans-Pacific VLBI fringes

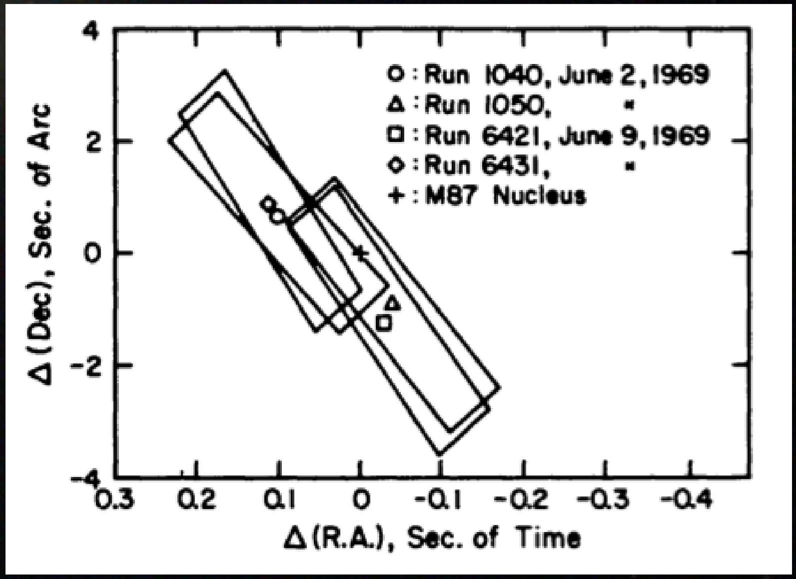
DSS 14 at Goldstone to DSS42 at Tidbinbilla

Virgo-A today's AGN paradigm





Cohen et al, 1969 ApJ., 158, L83



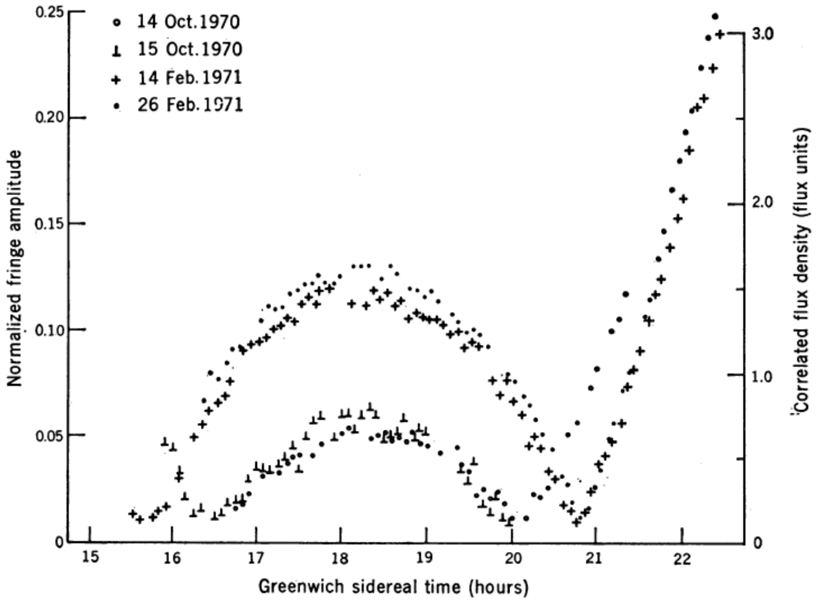


Fig. 1. Fringe-amplitude data from observations of 3C 279 with the Goldstone-Haystack interferometer. Each point is based on 110 seconds of integration.

Alan Whitney et al., 1971
Science, 173, 225

Superluminal expansion in 3C279

Goldstone to Haystack

The quasar patrol

Quasars Revisited: Rapid Time Variations Observed Via Very-Long-Baseline Interferometry

Abstract. *Recent Goldstone-Haystack radio interferometric observations of the quasars 3C 279 and 3C 273 reveal rapid variations in their fine structure. Most notably, the data for 3C 279, interpreted in terms of a symmetric double-source model and the accepted red-shift distance, indicate differential proper motion corresponding to an apparent speed about ten times that of light. A number of*

However....

all used DSS14.....

1094

Variations of Small Quasar Components at 2,300 MHz

NATURE VOL. 224 DECEMBER 13 1969

1976 From Tidbinbilla

The first global radio telescope

R. Batchelor, D. L. Jauncey, K. J. Johnston, V. A. Efanov, L. R. Kogan, V. I. Kostenko, L. I. Matveenko, I. G. Moiseev, S. H. Knowles, A. Kh. Papatsenko, R. Preston, J. H. Spencer, A. N. Timofeev, N. Fourikis, and R. T. Schilizzi

U. S. Naval Research Laboratory,
Institute for Space Research, USSR Academy of Sciences,
Commonwealth Scientific and Industrial Research Organization, Australia,
Crimean Astrophysical Observatory, USSR Academy of Sciences,
and Owens Valley Radio Observatory, California Institute of Technology

(Submitted July 26, 1976)

Pis'ma Astron. Zh. **2**, 467–473 (October 1976)

On April 28 and May 6, 1976, radio telescopes on three continents were linked together to perform observations of H_2O maser sources with an angular resolution of less than 0".0001. The first results of these observations for the radio sources W49N and W51 are presented. W51 is found to be a compact

Approaching a billion wavelengths!

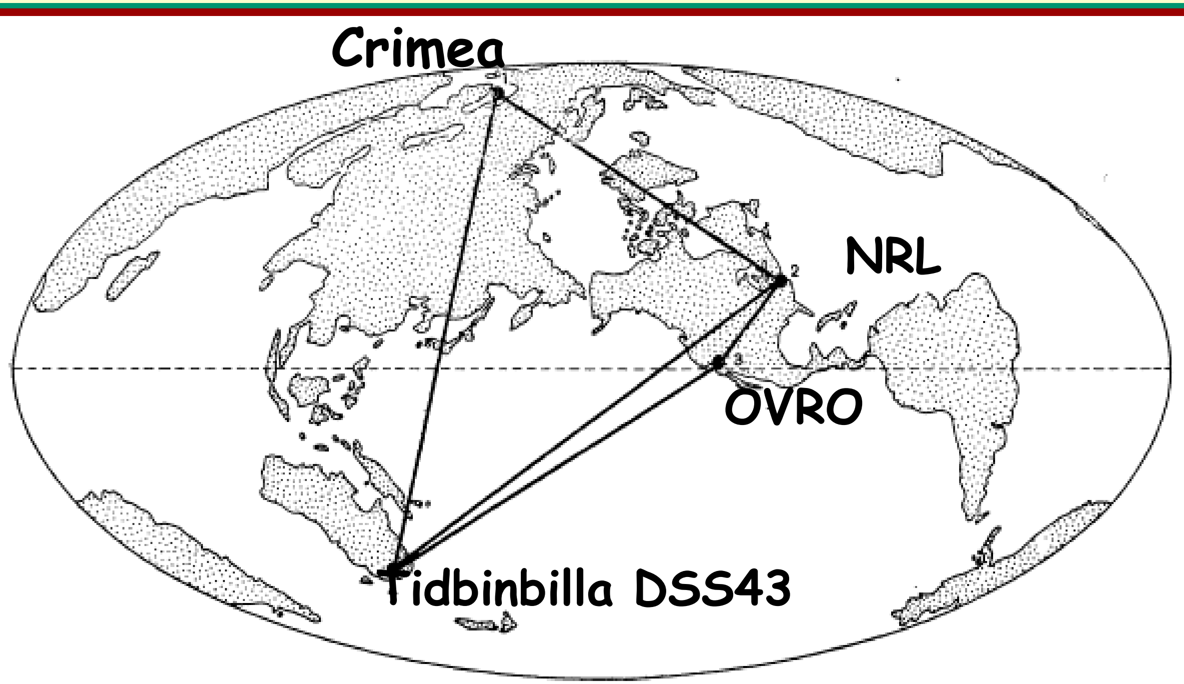


Fig. 1. Baselines of the global radio interferometer formed by antennas of: 1) 22 m at Simeiz, Crimea; 2) 26 m at Maryland Point; 3) 40 m at Big Pine, California; 4) 64 m at Tidbinbilla, Australia.

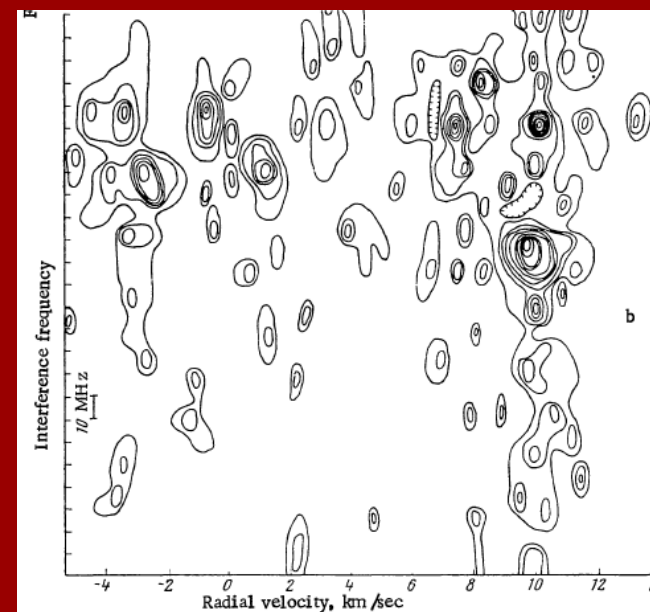
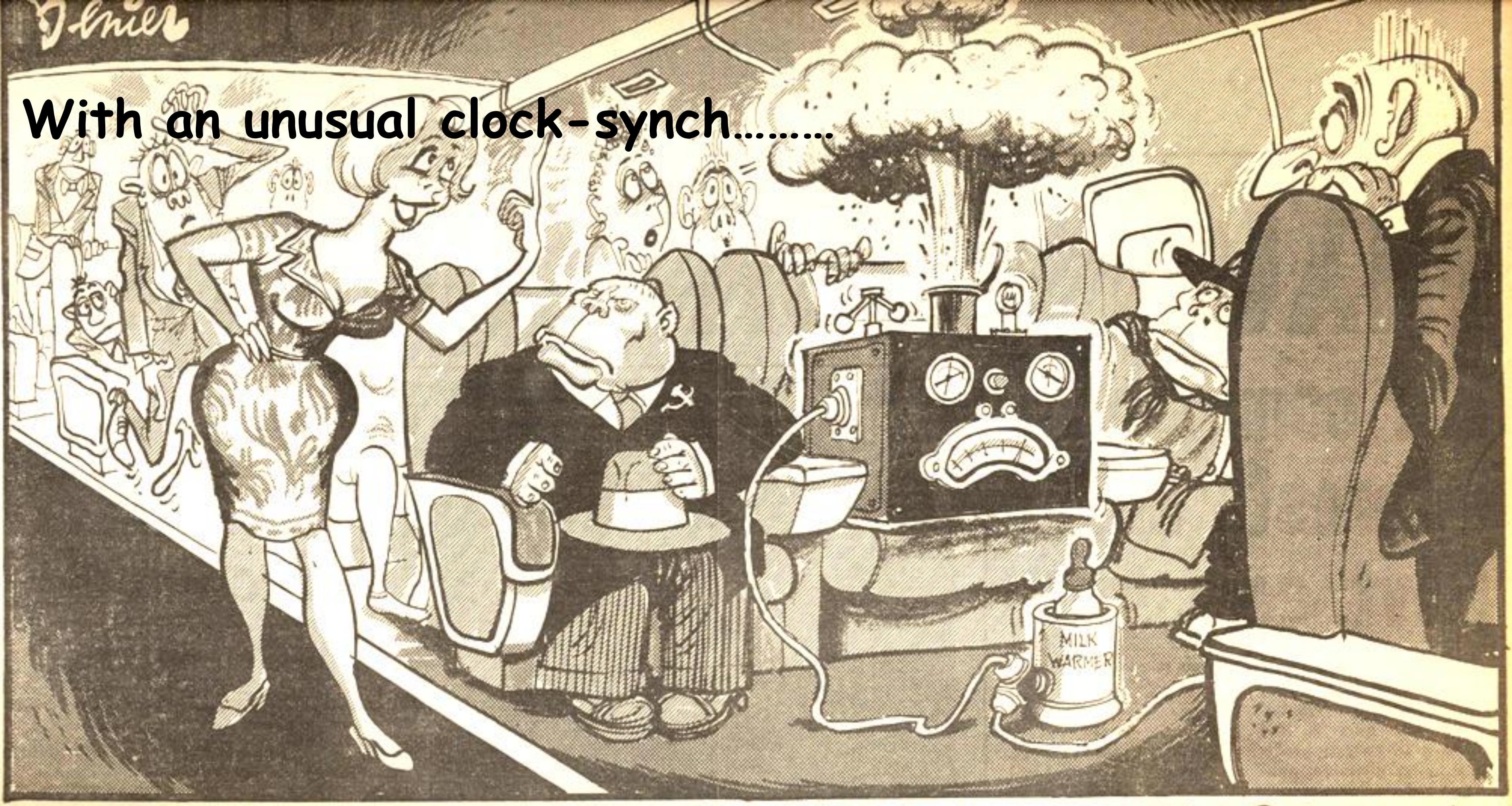


Fig. 3. Amplitude distribution of interference fringes for the source W49N

W49N Fringes Tid-OVRO

With an unusual clock-synch………



" DON'T LOOK NOW, IVAN — BUT I THINK YOUR ATOMIC CLOCK NEEDS BURPING... "

QF2 CREW HAS A HIGH TIME FEEDING VOLTS TO AN ATOMIC BABY

S.A.A. SETS A RECORD

THE world's distance flight record for commercial aircraft was shattered by South African Airlines on March 23 with the delivery flight of it's first Boeing 747SP.

SHEVE 1982

THE ASTRONOMICAL JOURNAL VOLUME 98, NUMBER 1 JULY 1989

THE SOUTHERN HEMISPHERE VLBI EXPERIMENT

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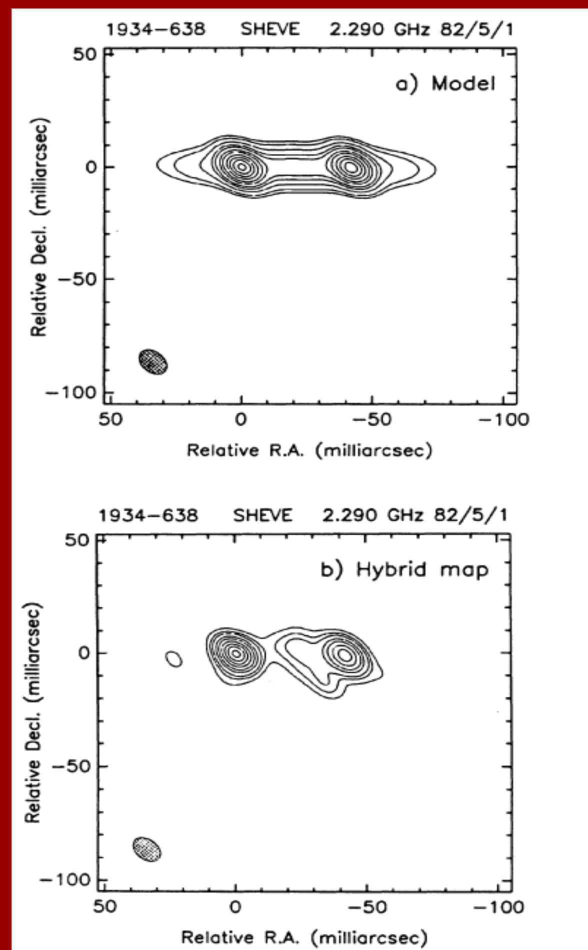
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109

DAVID L. JAUNCEY
Division of Radiophysics, CSIRO, Epping, NSW 2121, Australia

and a cast of thousands....



Antenna name & abbreviation
TIDBINBILLA (DS43)
PARKES (PRKS)
FLEURS (FLRS)
HOBART[b] (HBRT)
ALICE SPRINGS (ALSP)
HARTEBEESTHOEK (HART)

SHEVE'82 played a major role in achieving the Australia Telescope

Determination of Venus Winds by Ground-Based Radio Tracking of the VEGA Balloons

R. A. Preston, C. E. Hildebrand, G. H. Purcell, Jr., J. Ellis, C. T. Stelzried, S. G. Finley, R. Z. Sagdeev, V. M. Linkin, V. V. Kerzhanovich, V. I. Altunin, L. R. Kogan, V. I. Kostenko, L. I. Matveenko, S. V. Pogrebenko, I. A. Strukov, E. L. Akim, Yu. N. Alexandrov, N. A. Armand, R. N. Bakitko, A. S. Vyshlov, A. F. Bogomolov, Yu. N. Gorchankov, A. S. Selivanov, N. M. Ivanov, V. F. Tichonov, J. E. Blamont, L. Boloh, G. Laurans, A. Boischot, F. Biraud, A. Ortega-Molina, C. Rosolen, G. Petit

A global array of 20 radio observatories was used to measure the three-dimensional position and velocity of the two meteorological balloons that were injected into the equatorial region of the Venus atmosphere near Venus midnight by the VEGA spacecraft on 11 and 15 June 1985. Initial analysis of only radial velocities indicates that each balloon was blown westward about 11,500 kilometers (8,000 kilometers on the night side) by zonal winds with a mean speed of about 70 meters per second. Excursions of the data from a model of constant zonal velocity were generally less than 3 meters per second; however, a much larger variation was evident near the end of the flight of the second balloon. Consistent systematic trends in the residuals for both balloons indicate the possibility of a solar-fixed atmospheric feature. Rapid variations in balloon velocity were often detected within a single transmission (330 seconds); however, they may represent not only atmospheric motions but also self-induced aerodynamic motions of the balloon.

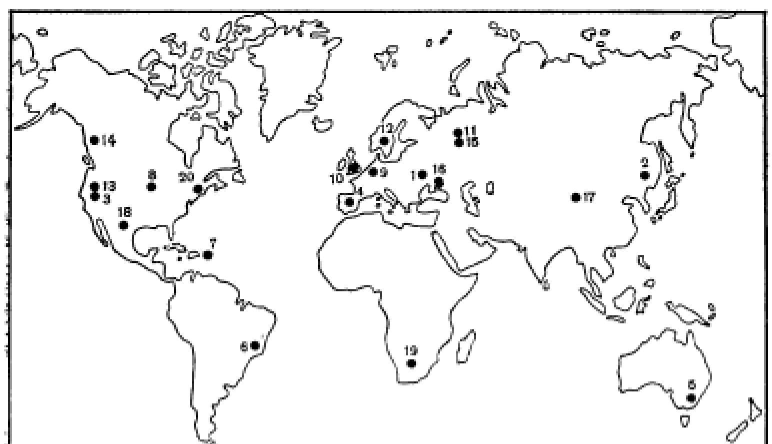


FIG. 1. The global Vega balloon tracking network, with stations numbered as in Table I.

The DSN 70 m antennas provided data to smaller antennas for them to integrate long enough for detection.

Preston et al., 1985 undertook an all-sky 2.29 GHz VLBI survey of 1398 sources using the DSN 64 m antennas at Goldstone, Tidbinbilla and Madrid, plus the 26 m ex-DSN antenna at Hartebeesthoek in South Africa.

THE ASTRONOMICAL JOURNAL VOLUME 90, NUMBER 9 SEPTEMBER 1985

A VLBI SURVEY AT 2.29 GHZ

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DAVID L. JAUNCEY
CSIRO Division of Radiophysics, Sydney, Australia

GEORGE D. NICOLSON
CSIR, Johannesburg, South Africa

Received 13 February 1985

ABSTRACT

VLBI observations at 2.29 GHz with fringe spacings of about 3 milliarcsec have been performed on 1398 radio sources spread over the entire sky. 917 sources were detected, including 93% of the identified BL Lacertae objects, 86% of the quasars, and 36% of the galaxies. The resulting catalog of compact radio sources is useful for various astrophysical studies and in the formation of VLBI celestial reference frames.

Overall 917, 66%, were detected on baselines of order 10^6 wavelengths. These observations were an essential component in preparation for the establishment of the current VLBI celestial and terrestrial reference frames.

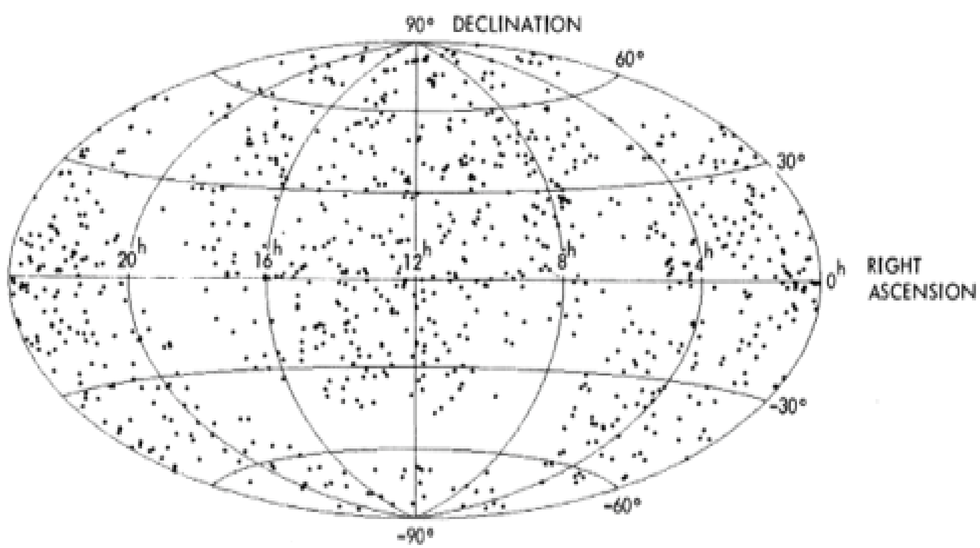
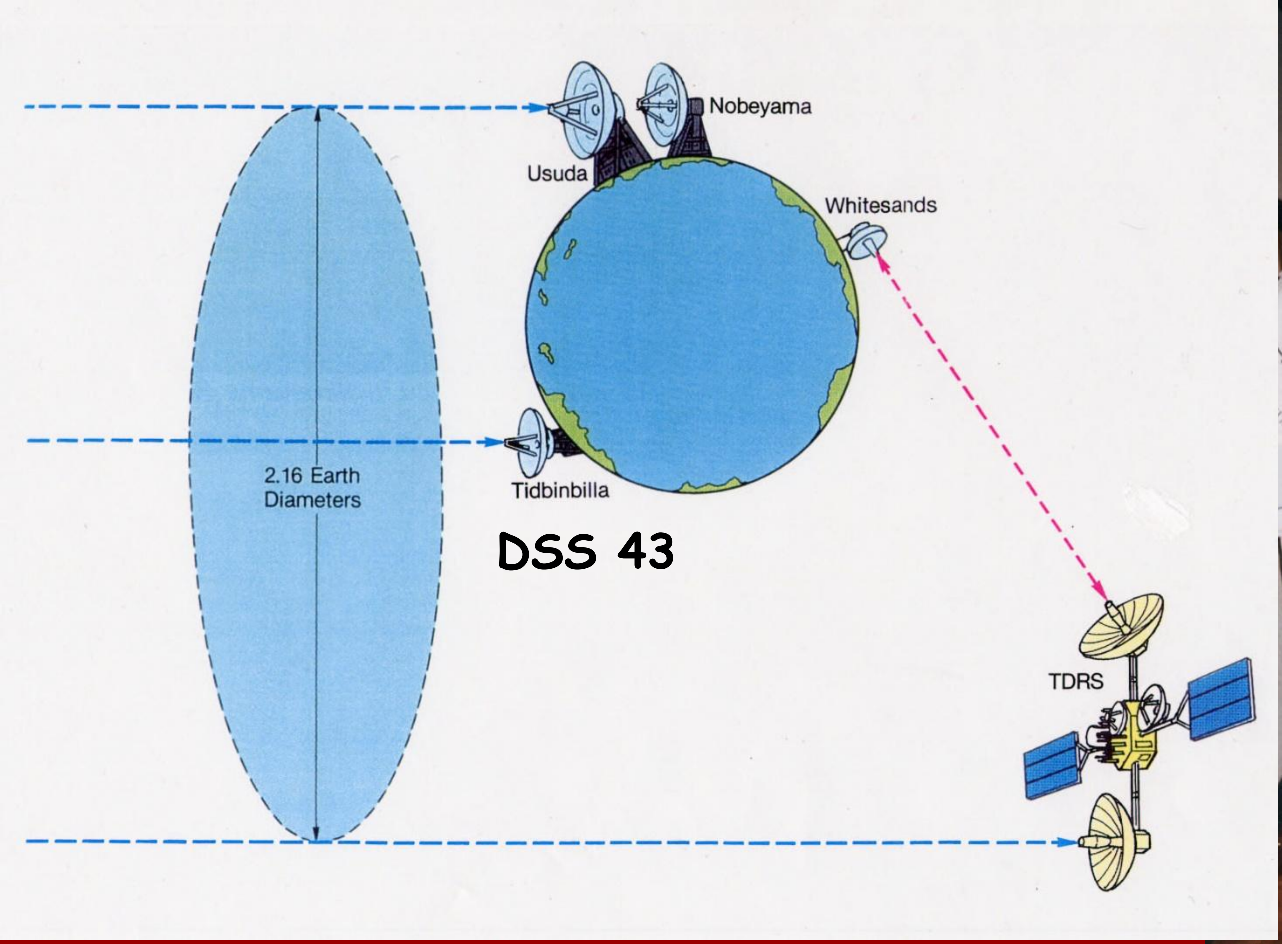


FIG. 1. Sky distribution of sources detected with VLBI.

TDRSS: First Space-VLBI

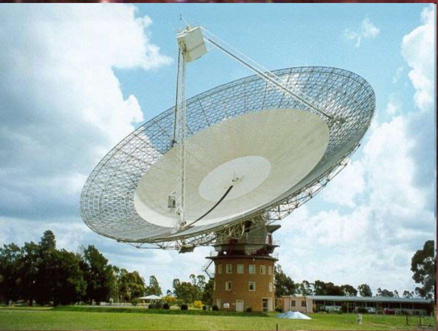
Demonstration Experiment

Brightness Temperatures > 10^{12} K



Observing Frequencies 2.3 GHz, 15 GHz

Gerry Levy (JPL/NASA)



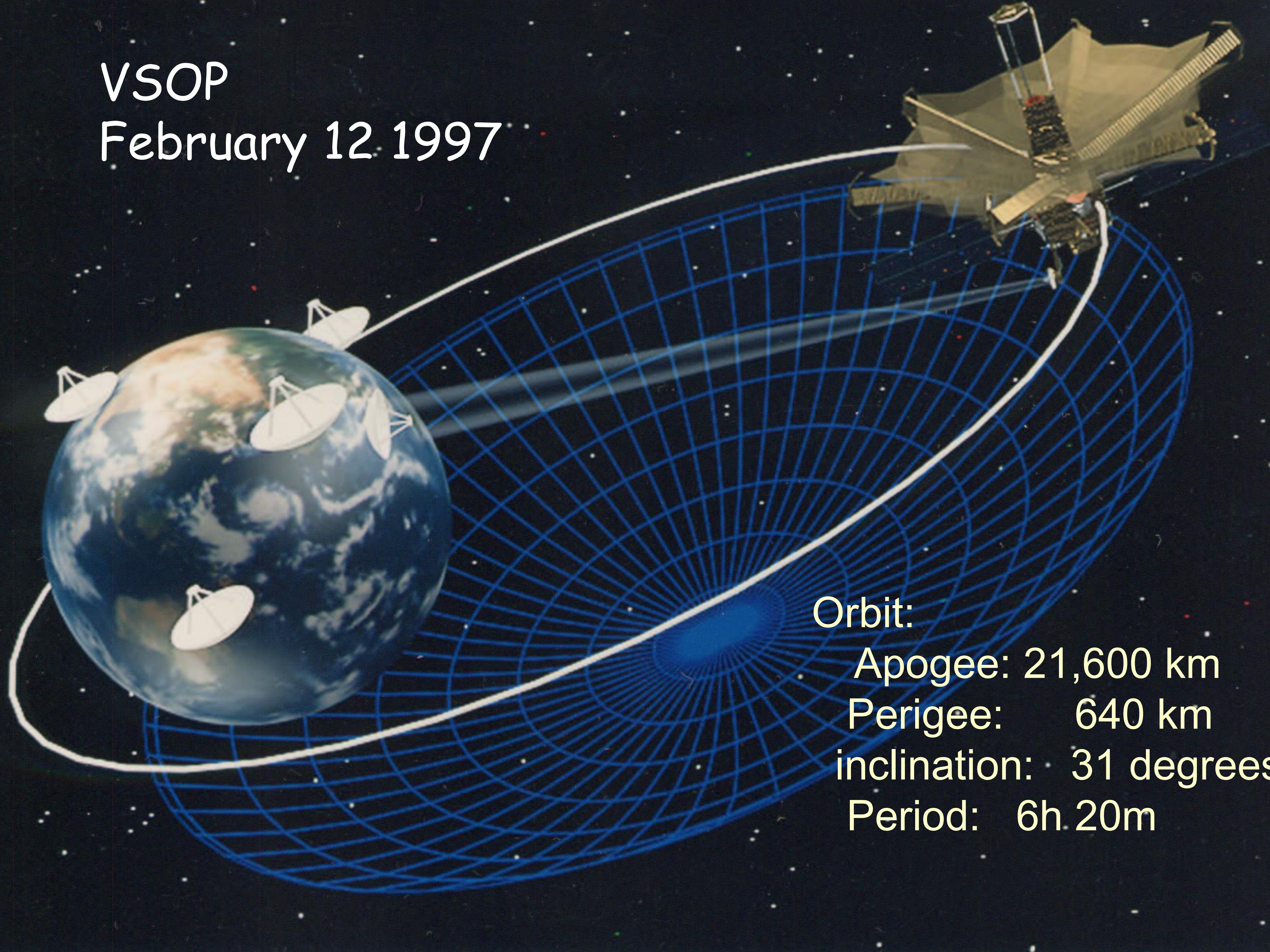
Supernova 1987A: radiosphere resolved with VLBI five days after the neutrino burst

D. L. Jauncey[*], A. Kemball[†], N. Bartel[‡], A. R. Whitney[§], A. E. E. Rogers[§], I. I. Shapiro[‡], R. A. Preston[||], T. A. Clark[¶], B. R. Harvey[*], D. L. Jones[*], G. D. Nicolson[†], A. Nothnagel[†], R. B. Phillips[§], J. E. Reynolds[**] & J. C. Webber[§]

1. [*]CSIRO, Division of Radiophysics, PO Box 76, Epping, New South Wales 2121, Australia
2. [†]Hartebeesthoek Radio Astronomy Observatory, PO Box 3718, Johannesburg 2000, South Africa
3. [‡]Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138, USA
4. [§]Haystack Observatory, NEROC, Westford, Massachusetts 01886, USA
5. [||]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California 91109, USA
6. [¶]NASA, Goddard Space Flight Center, Code 974, Greenbelt, MD 20771, USA
7. [**]Mount Stromlo and Siding Springs Observatory, Private Bag, PO Woden, ACT 2606, Australia

February 23 1987

Sn 1987A in the LMC


VSOP
February 12 1997
Orbit:
Apogee: 21,600 km
Perigee: 640 km
inclination: 31 degrees
Period: 6h 20m

TANAMI monitoring of Centaurus A: The complex dynamics in the inner parsec of an extragalactic jet★,★★

C. Müller[1,2], M. Kadler[2], R. Ojha[3,4,5], M. Perucho[6], C. Großberger[1,2], E. Ros[7,6,8], J. Wilms[1], J. Blanchard[9], M. Böck[7], B. Carpenter[5], M. Dutka[5], P. G. Edwards[10], H. Hase[11], S. Horiuchi[12], A. Kreikenbohm[1,2], J. E. J. Lovell[13], A. Markowitz[14,1,15], C. Phillips[10], C. Plötz[11], T. Pursimo[16], J. Quick[17], R. Rothschild[14], R. Schulz[1,2], T. Steinbring[2], J. Stevens[10], J. Trüstedt[2], and A.K. Tzioumis[10]

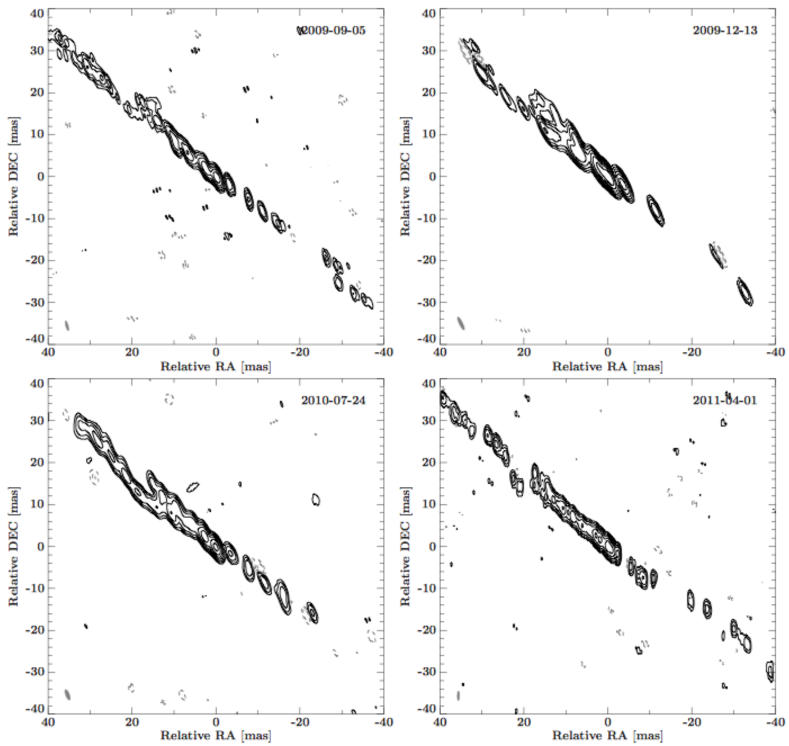
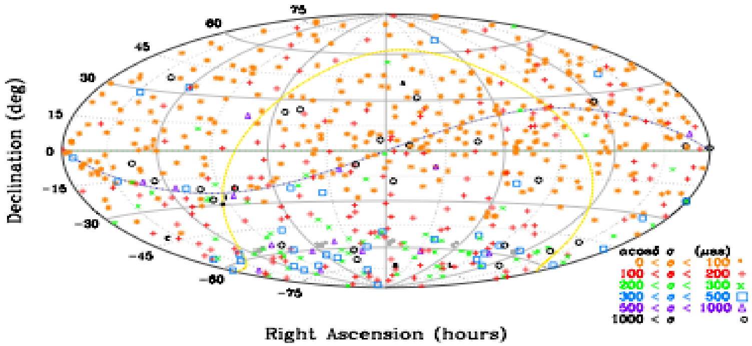


Fig. 2. Same as Fig. 1 for the 4th to 7th TANAMI observations. From *top left to bottom right*: 2009 September, 2009 December, 2010 July, and 2011 April.

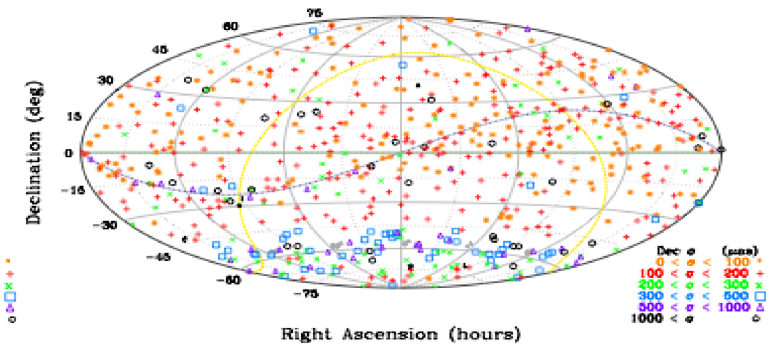
Muller et al., A&A, **569**, A115 (2014)

A CELESTIAL REFERENCE FRAME AT X/KA-BAND (8.4/32 GHZ) FOR DEEP SPACE NAVIGATION

C. S. Jacobs[1], J.E. Clark[2], C. García-Miró[3], S. Horiuchi[4], A. Romero-Wolf[5], L. Snedeker[6], and I. Sotuela[7]



3a. RA* (arc) precision: Median σ is 96 μas. Note lower precision for Dec < -45° because less than 5% of data is from the all-southern baseline.



3b. Dec precision: Median σ is 126 μas. Note lower precision for Dec < -45° because less than 5% of data is from the all-southern baseline.

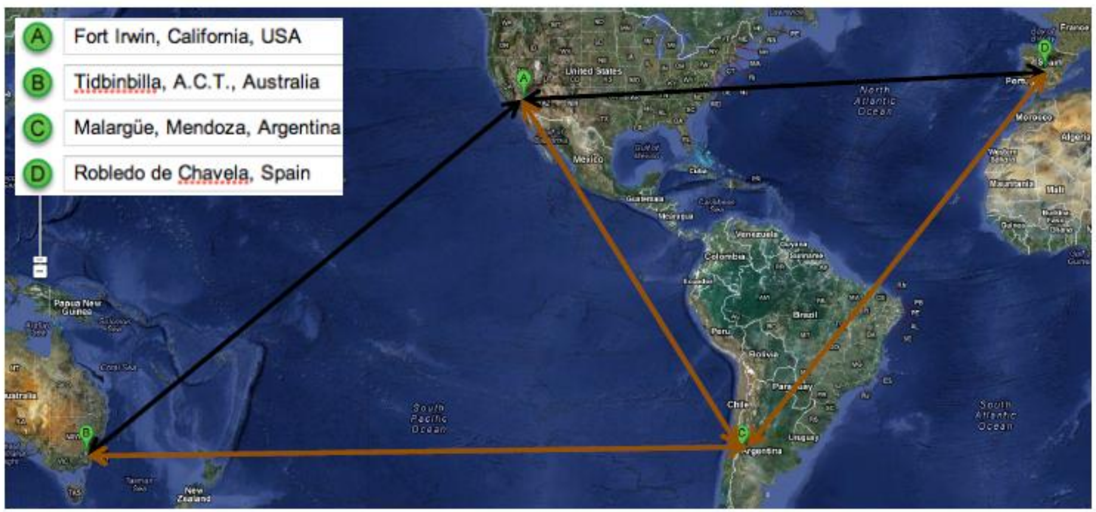


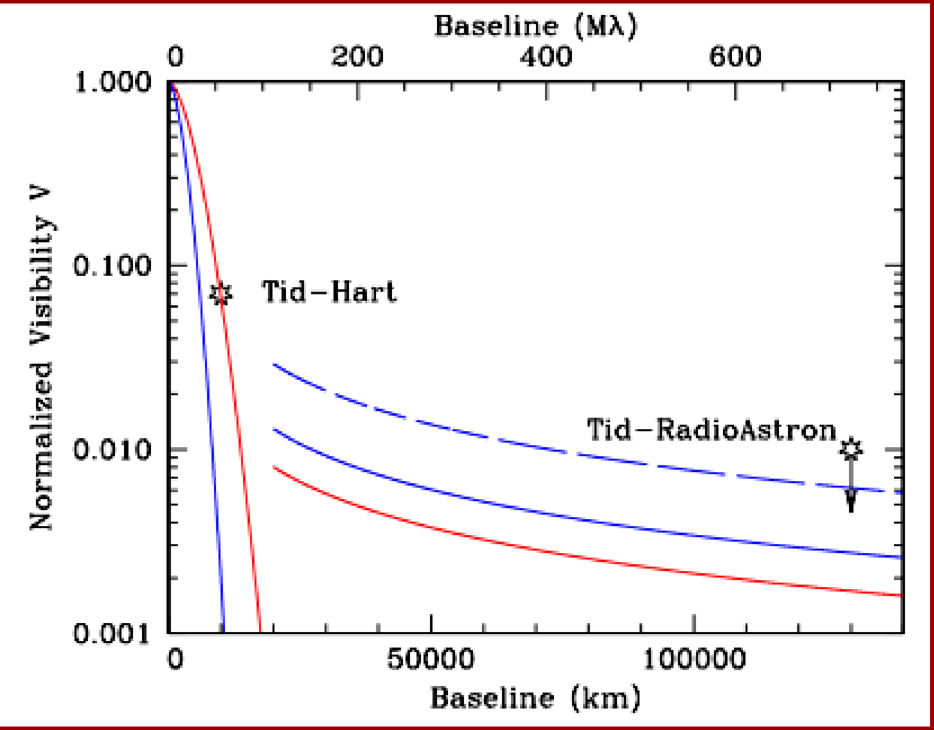
Figure 2. X/Ka Network Geometry: The addition of ESA's Deep Space Antenna (DSA) 03 at Malargue, Argentina adds three new baselines (brown lines: CB, CA, CD) to the already existing pair of NASA Deep Space Network baselines (black lines: AB, AD). The Australia-Argentina baseline (BC) will allow for the first time X/Ka observations of the south polar cap ($\delta < -45°$).

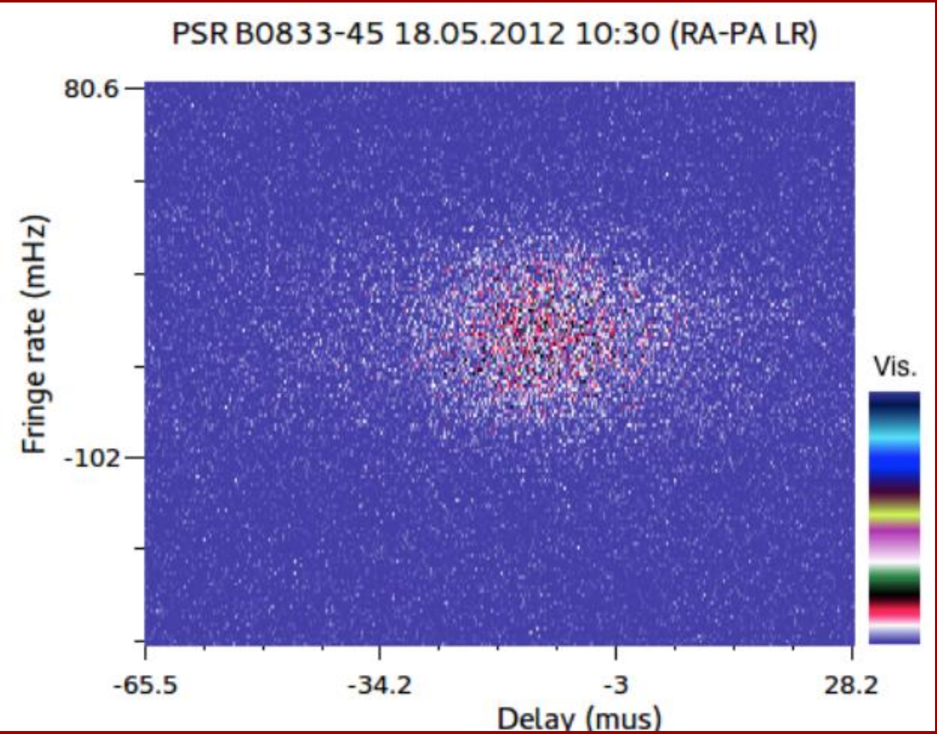
DSS 24 Goldstone
DSS 34 Tidbinbilla
DSS 55 Robledo
ESA Malargue

With the addition of the ESA Deep Space antenna (DSA 03) at Malargue Argentina, the array now covers the south polar cap with 200 μas precision.

Refractive substructure in VELA scattering disc

Goodman and Narayan (1989) had predicted the existance of persistent substructure within scattering discs. The 18 cm Tidbinbilla- RadioAstron early science observations of the Vela Pulsar verified this prediction.





The AB Doradus system revisited: the dynamical mass of AB Dor A/C

R. Azulay[1,2], J. C. Guirado[1,3], J. M. Marcaide[1], I. Martí-Vidal[4], E. Ros[2,1,3], E. Tognelli[5,6], D. L. Jauncey[7,8], J. -F. Lestrade[9], and J. E. Reynolds[7]

[1] Departament d'Astronomia i Astrofísica, Universitat de València, C. Dr. Moliner 50, E-46100 Burjassot, València, Spain
e-mail: Rebecca.Azulay@uv.es

[2] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

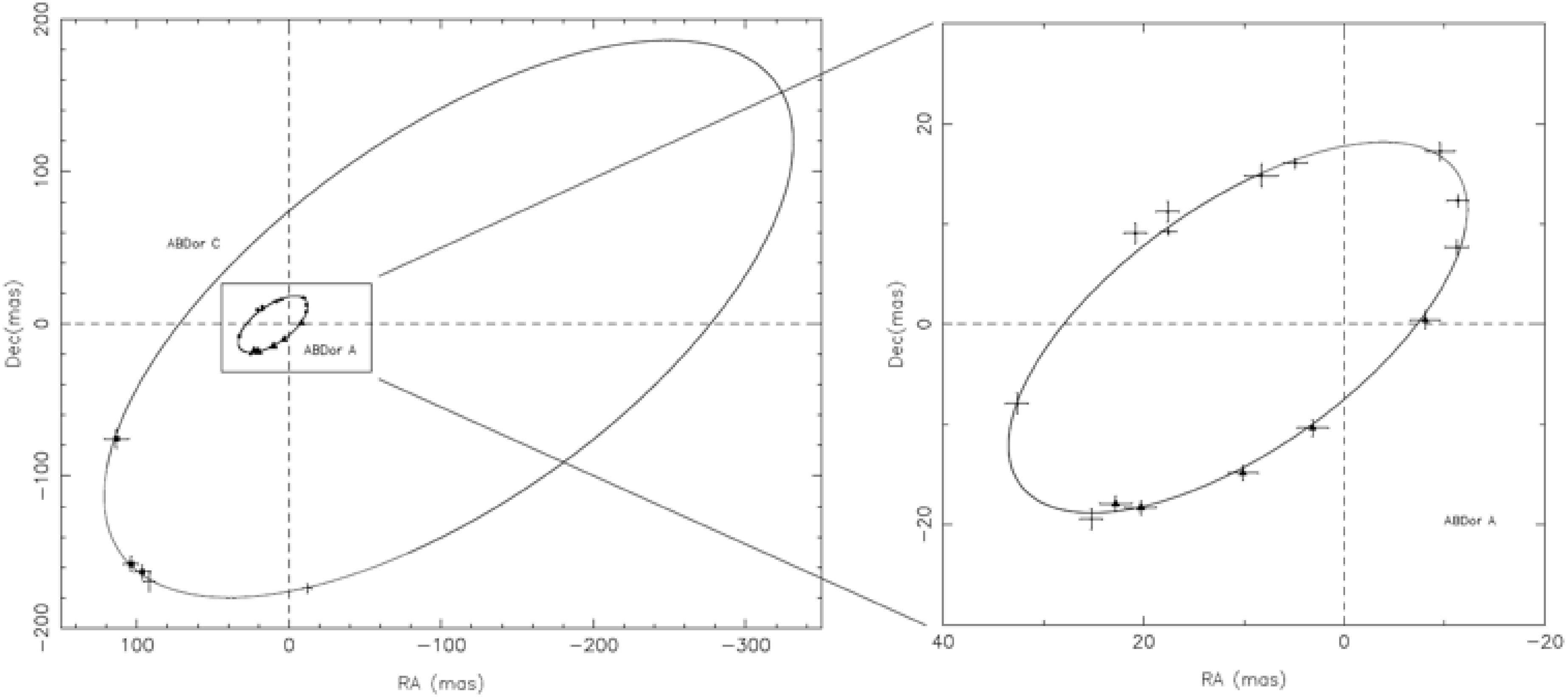


Fig. 2. Absolute orbits of the components AB Dor A and AB Dor C using the orbital elements in Table 4 (with a_A and a_C, respectively). The positions of the component A (triangles, *Hipparcos* data; circles, VLBI data) and C (squares) are marked. The center of mass of the system is placed at the origin.


The CHARM of VLBI
“VLBI ties the world. It connects radio astronomers by coherence and covers the world by a network of friendship”