Science Priorities of the RadioAstron Space VLBI Mission

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Glen Langston[2],
and the International Space VLBI Collaboration

1-ASC, P. Lebedev Phys. Inst., Moscow. 2- NRAO

10m Diameter Space Radio Telescope

Designed by Astro Space Center, Moscow.

International Collaboration

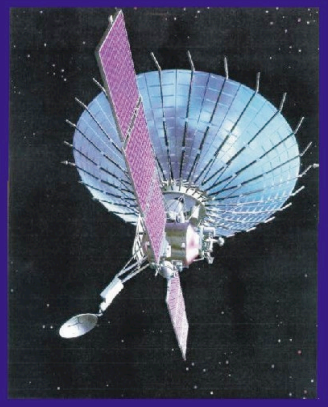
Dual Circular polarization with high sensitivity cooled front end.

High downlink data rate, 128 MBps.

Launch delayed more than 1 decade.

Scheduled for 2008.

RADIOASTRON



PARAMETERS

Band (GHz)	0,327	1,665	4,830	18-25
Band width (MHz)	4	32	32	32
Fringe size (μas) [base line 350 000 km]	540	106	37	7,1-10
Min. cor. flux (mJy) [RMS, with upgrated VLA, 300s integration time]	10	1,3	1,4	3,2

Orbit: period 9.5 days. Semi-major axis 189 000 km, inclination 51.6 deg

Kardashev, Langston
AAS 2007

http://www.asc.rssi.ru/radioastron/description/intro_eng.htm

Construction Progress

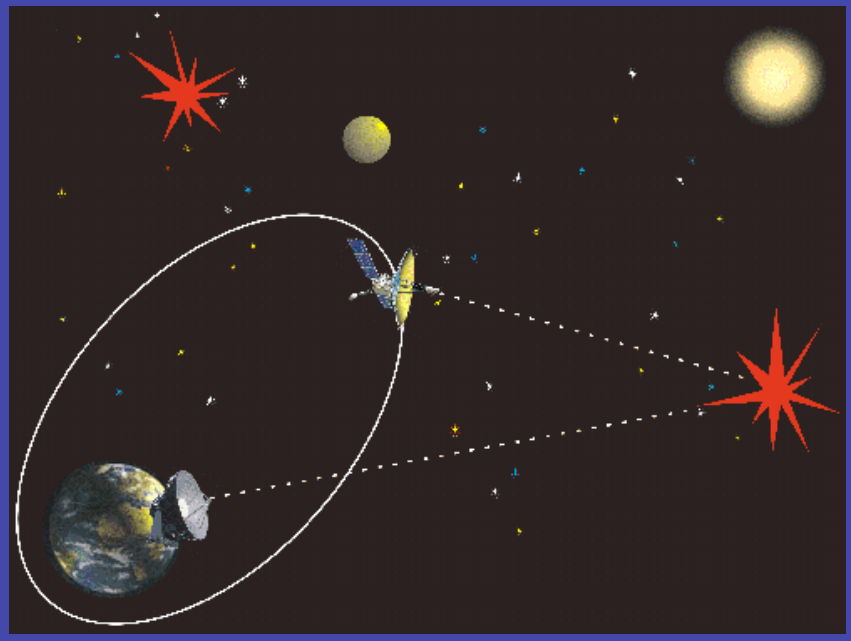
Launch Configuration

General view of the RadioAstron in Lavochkin Association, May 2004

Deployed Configuration with solar panels and downlink antenna

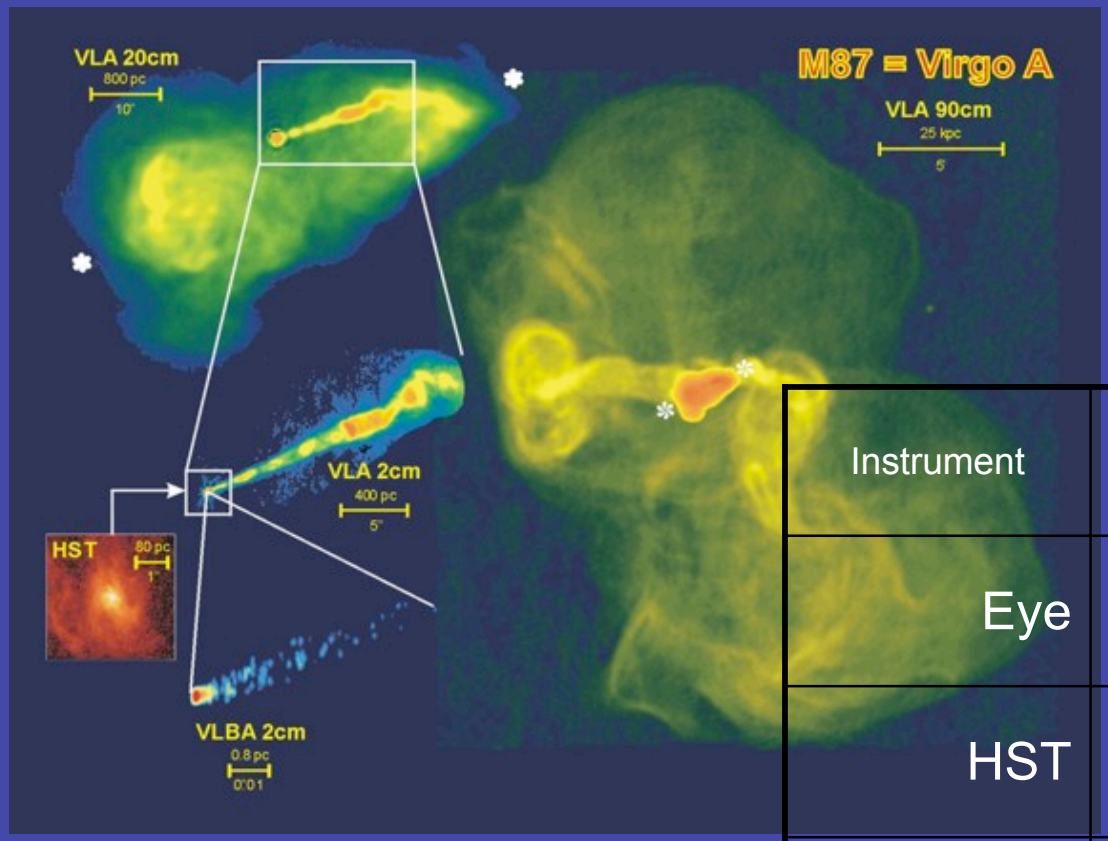
VLBI Observations

First Light: Radio astronomical tests of SRT Engineering Model in Pushchino in 2004



Future Space VLBI observations in simultaneous with ground radio telescopes.
Orbit reaches nearly to the Moon.

Unprecedented Angular Resolution



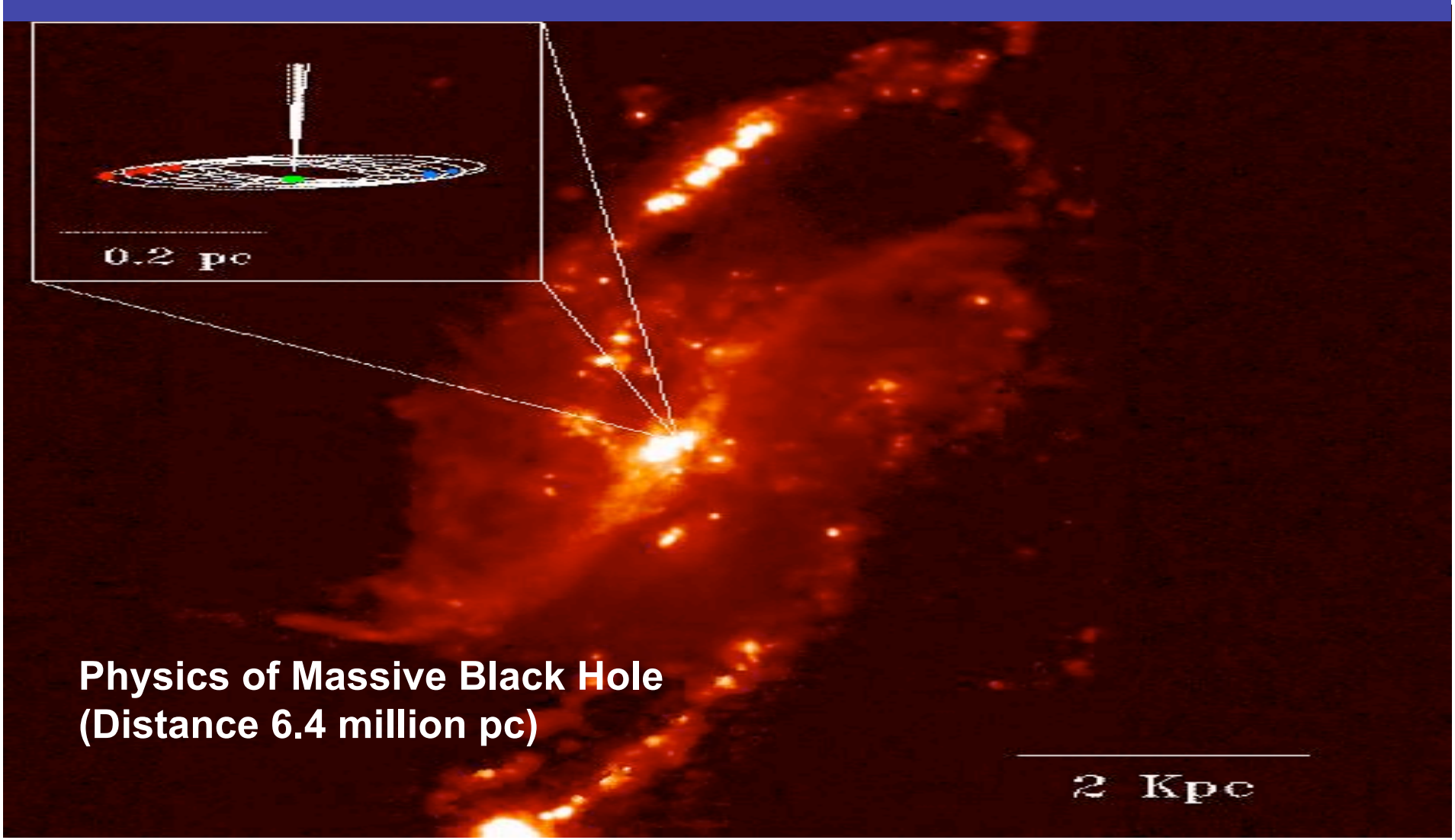
Instrument	Angular Resolution	Improvement Factor
Eye	60”	1
HST	0.1”	600
Radio Astron	0.00001”	6,000,000

Kardashev, Langston:
AAS 2007

Scientific Objectives

- **Active galactic nuclei (super massive black holes, event horizon, particle acceleration, brightness temperature limits, Faraday rotation, magnetic field, cosmic rays, super luminal motion, new physics),**
- **Cosmology, red shift dependencies, dark matter, dark energy**
- **Regions of star and planet formation (masers and Megamasers),**
- **Black holes of stellar masses and neutron stars,**
- **Interstellar and interplanetary medium,**
- **Fundamental astrometry and high accuracy coordinate system,**
- **High precision measurements of the Earth gravity field.**

Megamaser in Galaxy NGC4258



Unique Application

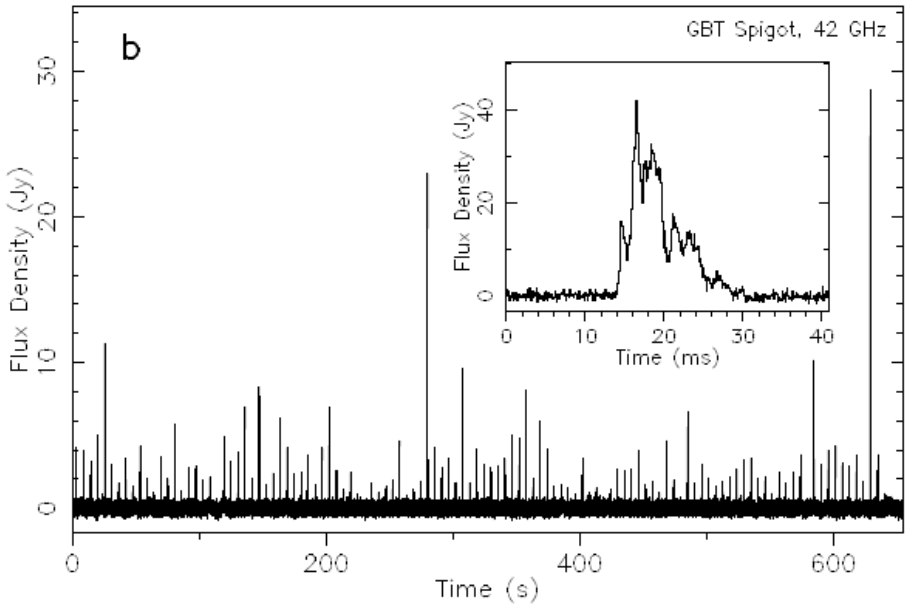
NATURE, VOL 442, 892–895, 24 AUGUST 2006

XTE J1810-197, distance 3.3 kpc

Transient pulsed radio emission from a magnetar

Fernando Camilo [1], Scott M. Ransom [2], Jules P. Halpern [1], John Reynolds [3], David J. Helfand [1], Neil Zimmerman [1] & John Sarkissian [3]

Applications:
- Micro-lensing
- Physics of compact objects
- Structure of the Milky Way
- Studies of the interstellar medium



http://arxiv.org/pdf/astro-ph/0605429

Future Prospects

SPACEDAILY
YOUR PORTAL TO SPACE

RUSSIAN SPACE

Russia Set To Implement Ambitious Space Program

by Yury Zaitsev
Moscow, Russia (RIA Novosti) Dec 20, 2006

Although the Russian government approved a new federal space program this year for the period between now and 2015, there have been no breakthroughs in the last 12 months. True, the national space program, which is supported by President Vladimir Putin and the government, has started receiving additional resources. ...

Four Spektr-class astrophysical orbital observatories will lift off under the 2006-2015 federal space program. The first such observatory, the Spektr-Radioastron, was supposed to go into orbit this year, but the launch has been rescheduled for late 2008. These delays can be explained by the fully-fledged crisis that plagued the Russian space program throughout the 1990s, whose consequences have not yet been completely overcome. ...

There is now every reason to believe that the Spektr - Radioastron observatory will lift off in 2008 and operate in conjunction with a global ground instrument network. Known as radio interferometers, these combined systems have an impressive resolving power comparable to that of a radio telescope whose antenna diameter is equal to the distance between the system's ground and space instruments. ...

Kardashev, Langston:
AAS 2007

http://www.spacedaily.com/reports/Russia_Set_To_Implement_Ambitious_Space_Program_999.html

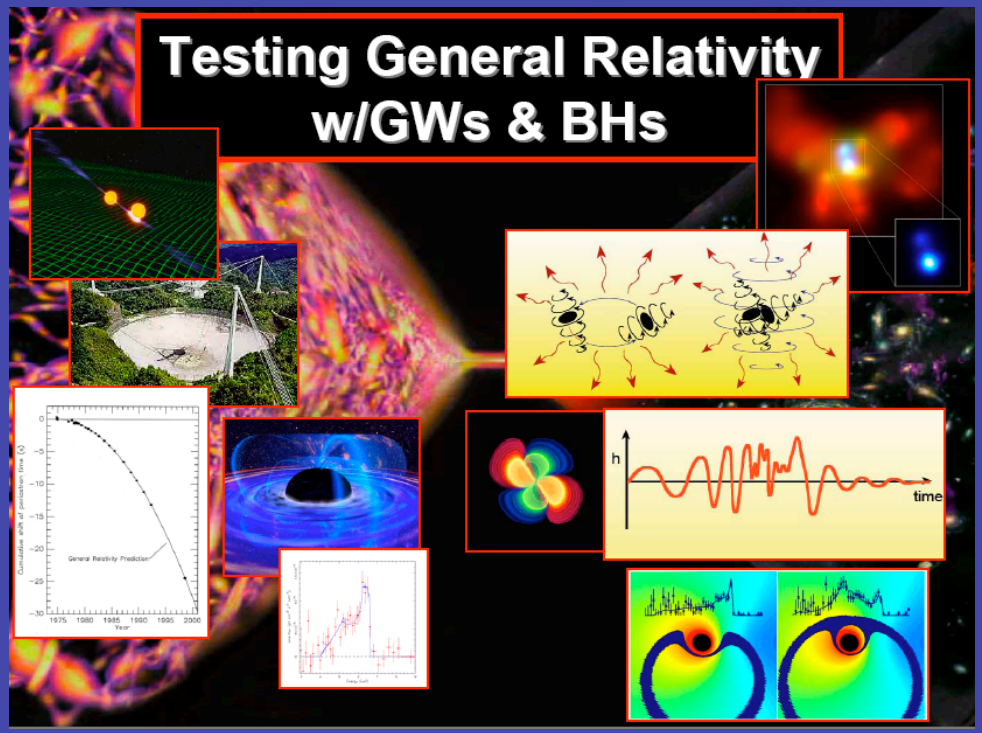
Opportunities

Radio Astron shares “Beyond Einstein” Science Goals.

Radio Astron shares some “Return to the Moon” technology development goals.

Radio Astron mission is revived by Russian Funding

Radio Astron VLBI collaborations will have unique, powerful, capabilities.

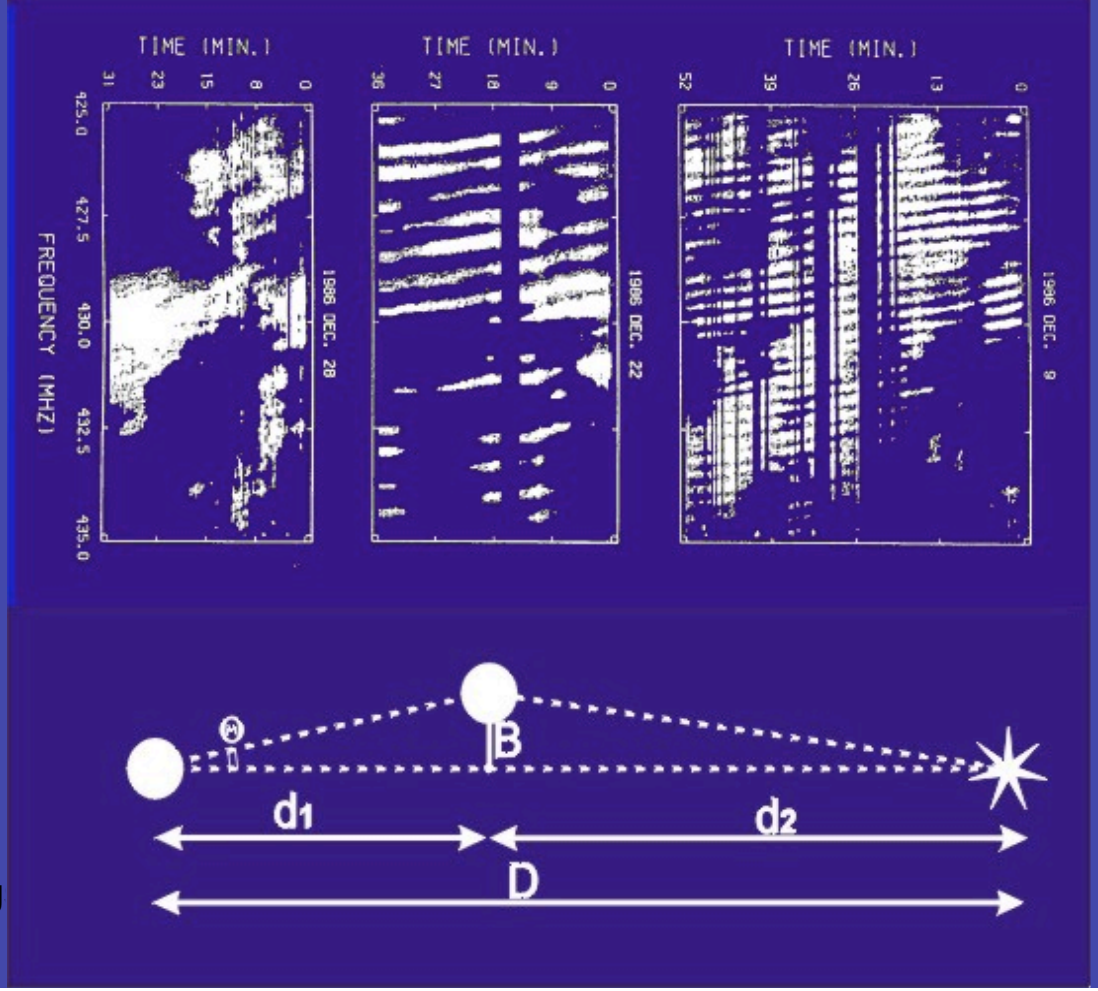


Graphic from Turner, M. 2006
http://www7.nationalacademies.org/ssb/SSB_Decadal06_MTurner.pdf

Interstellar interferometer

(A.Wolszchan & J.M. Cardes, Ap.J., 320, L35, 1987)

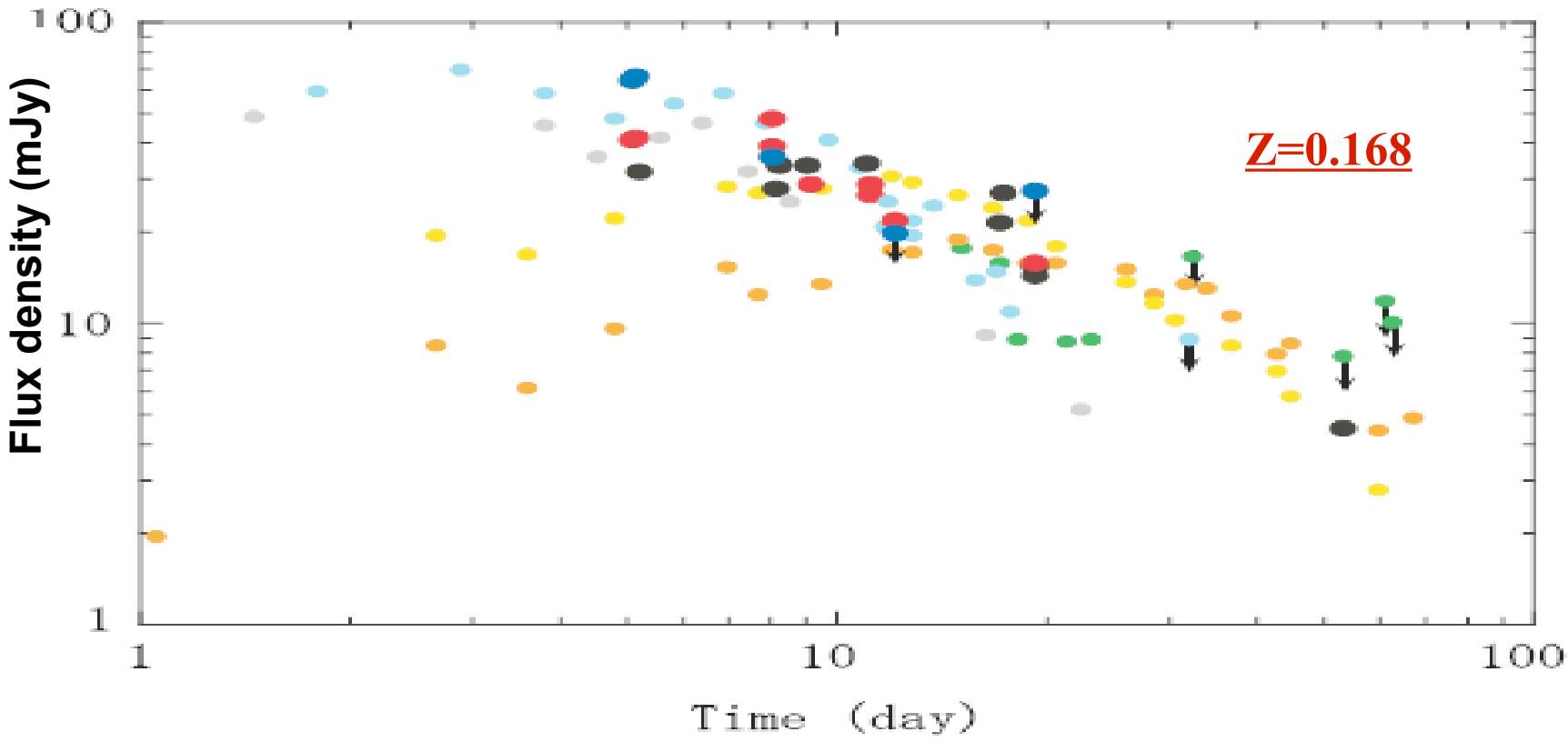
PSR 1237+25 (P=1,4c, D= 560 nc)



Radio Observations of the Afterglow of GRB 030329

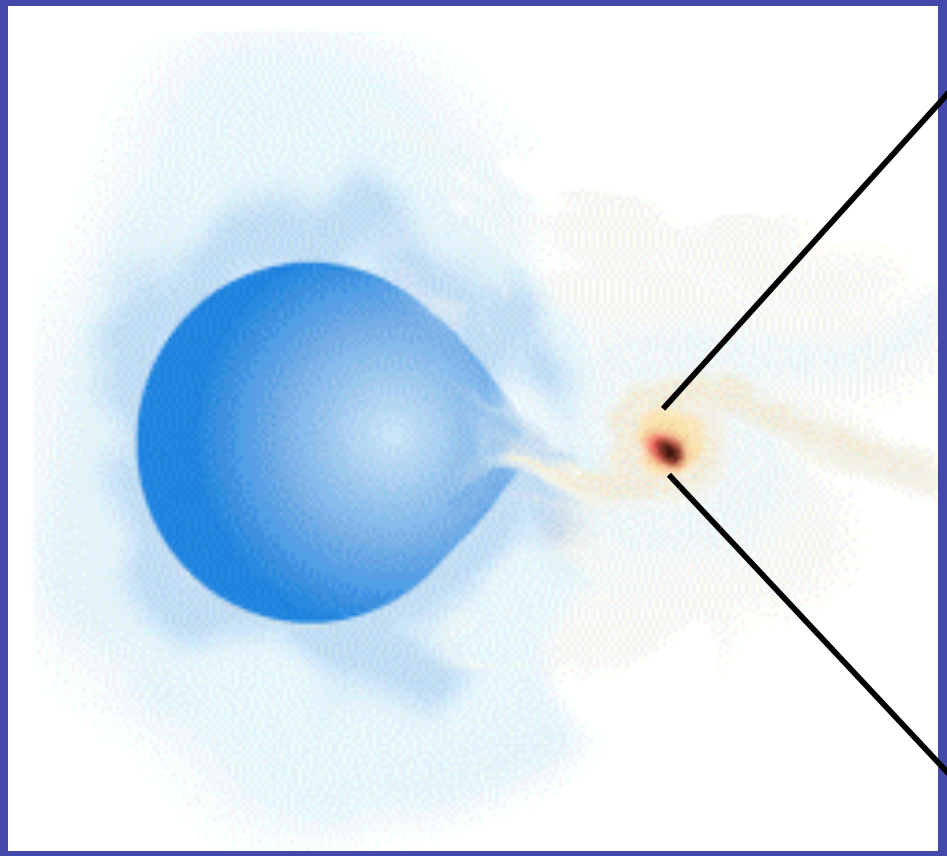
(astro-ph/0401258)

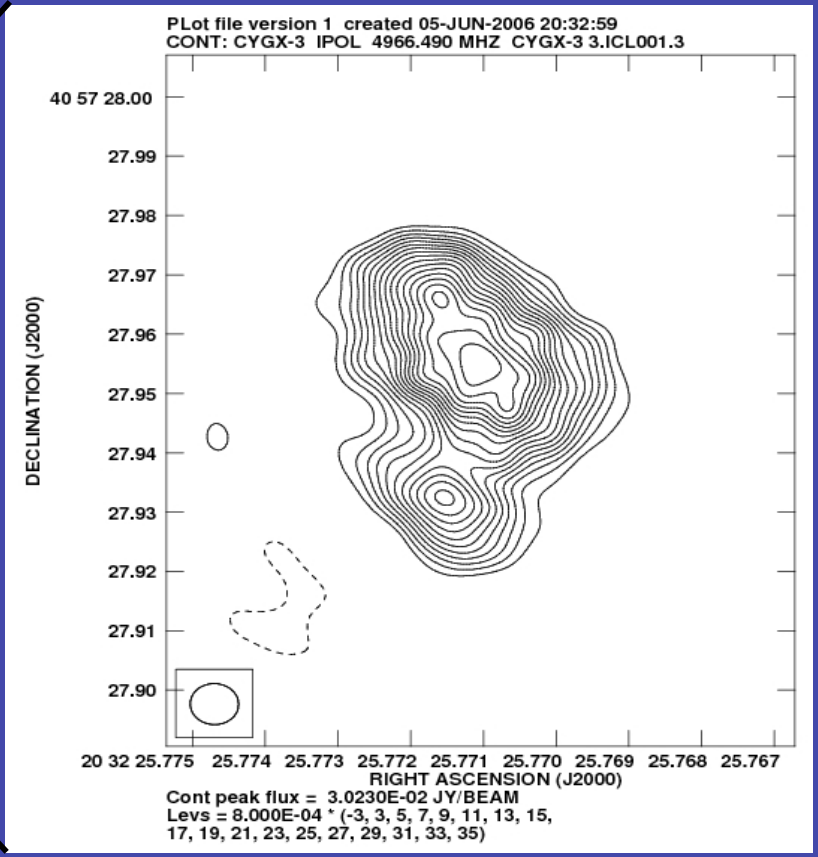
Nario KUNO[1,2], Naoko SATO[1,3], Hiroyuki NAKANISHI[4], Aya YAMAUCHI[1,5],
Naomasa NAKAI[1], Nobuyuki KAWAI[6,7]



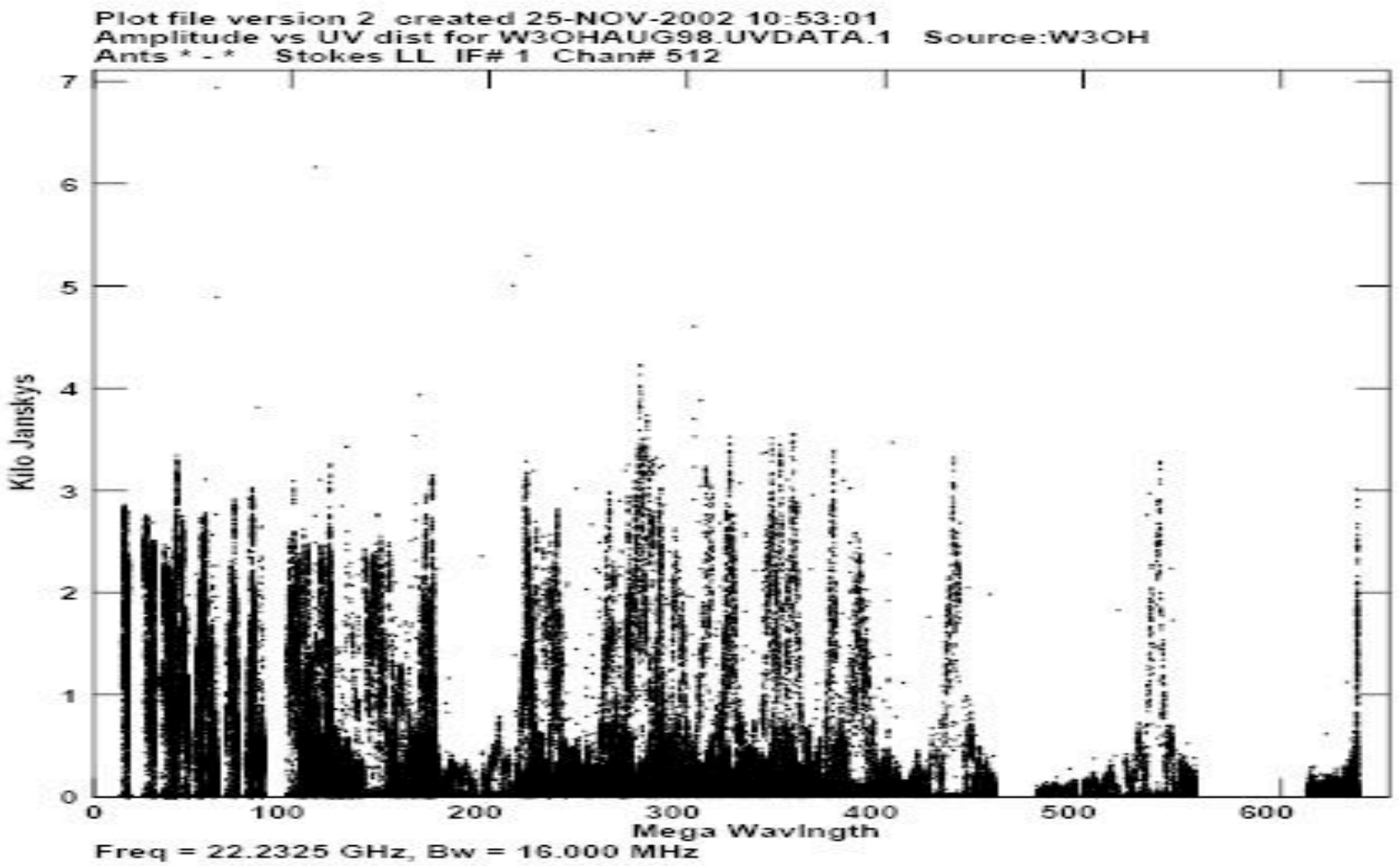
Light curves of the radio afterglow. Blue: 90 GHz by this work. Red: 43 GHz by this work. Black: 23.5 GHz by this work. Grey: 230 GHz by Sheth et al. (2003). Light blue: 100 GHz by Sheth et al. (2003). Green: 93 GHz by Kohno et al. (2003). Yellow: 15.0 GHz by Berger et al. (2003). Orange: 8.46 GHz by Berger et al. (2003). The upper limits are 3 σ.

- First e-VLBI Target of Opportunity Observations (May 2006, Cygnus X-3), *Tudose et al. (in prep).*





W3(OH) (VLBA, V. Slysh et al.)



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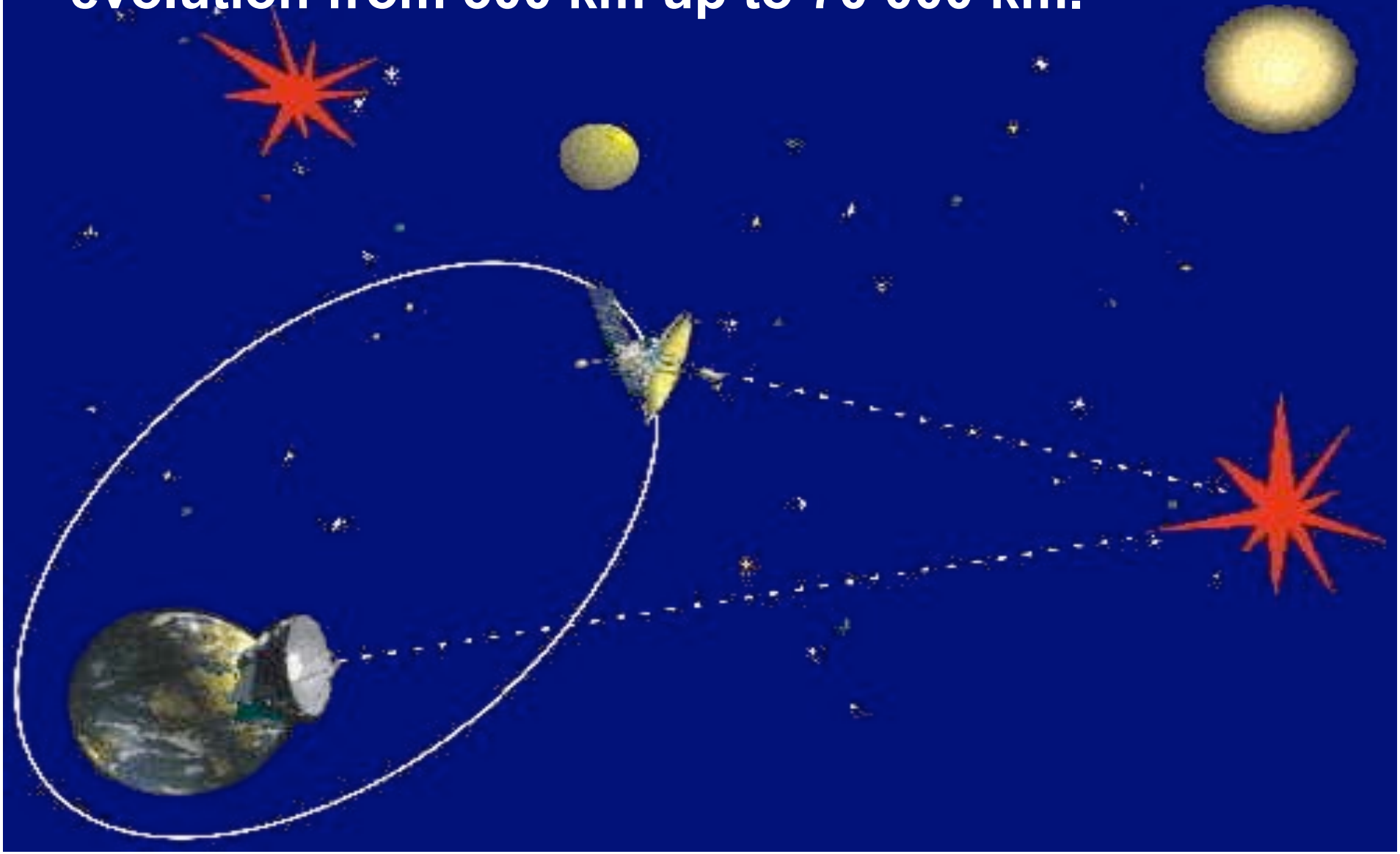
Any pictures from

The Astronomical Journal, Volume 130, Issue 6, pp. 2473-2505, 2005.
Sub-Milliarcsecond Imaging of Quasars and Active Galactic Nuclei.
IV. Fine-Scale Structure
Y.Y. Kovalev at al.

1063-7729, Astronomy Reports, 2006, Vol. 50, No. 8, pp. 601–611. c
Pleiades Publishing, Inc., 2006.
Original Russian Text c N.S. Kardashev, I.D. Novikov, A.A. Shatskii, 2006,
published in Astronomicheskiĭ Zhurnal, 2006, Vol. 83, No. 8, pp. 675–686.
Magnetic Tunnels (Wormholes) in Astrophysics
N. S. Kardashev, I. D. Novikov, and A. A. Shatskii

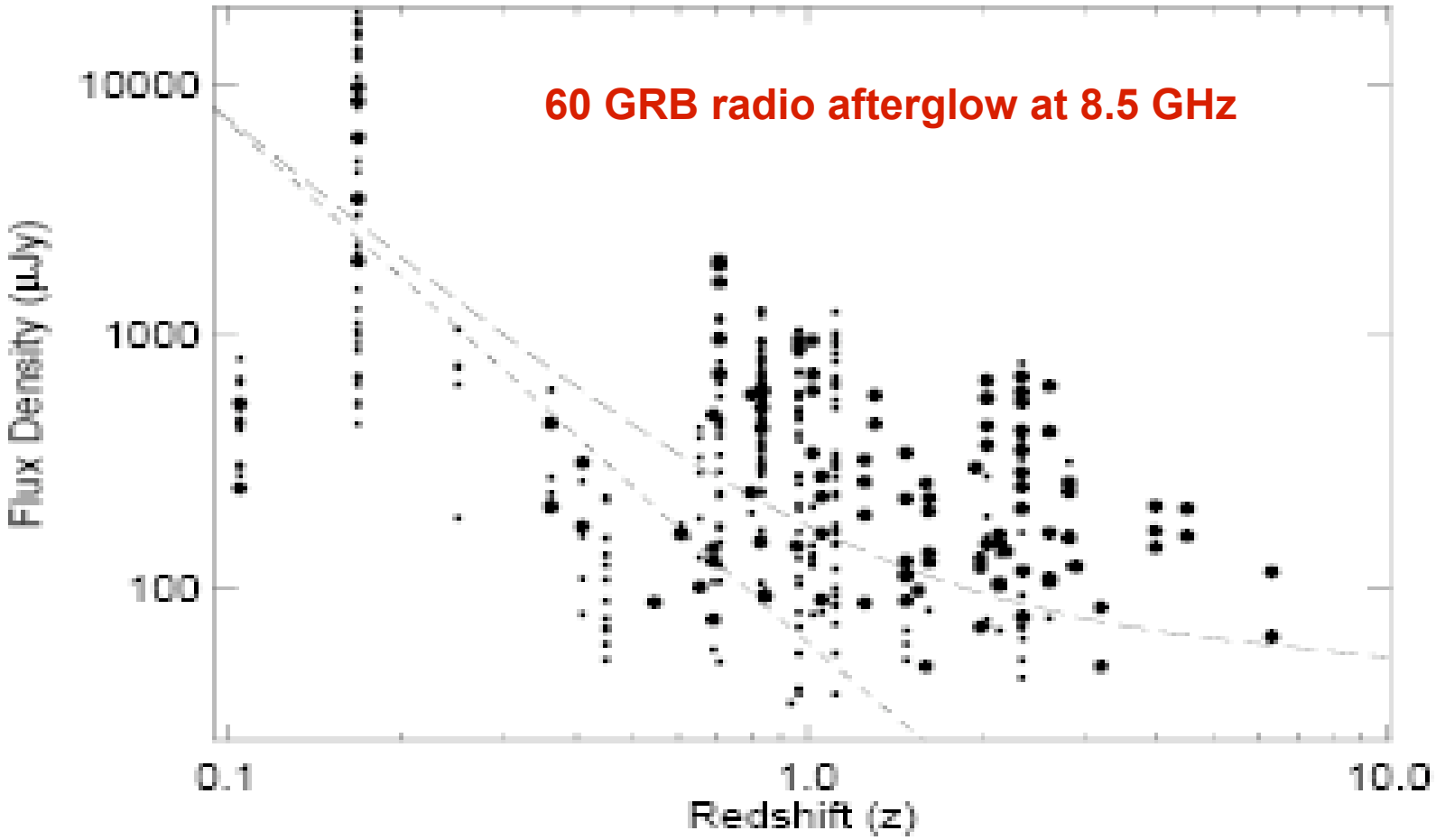
Orbit: period 9.5 days (7 - 10 days), semi-major axis 189 000 km, inclination 51.6 deg, perigee arise due to evolution from 300 km up to 70 000 km.



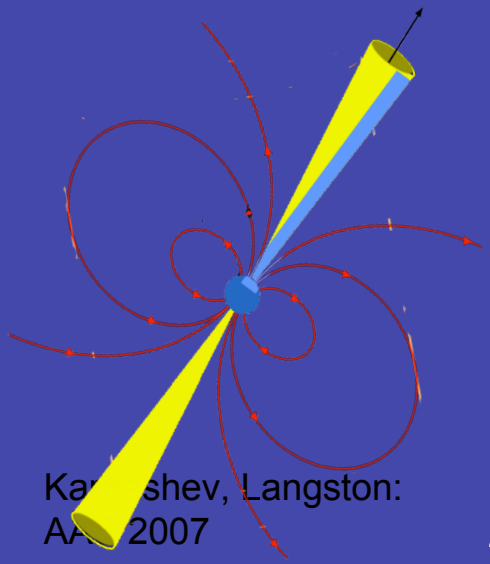
THE ASTROPHYSICAL JOURNAL, 646: L99–L102, 2006 August 1

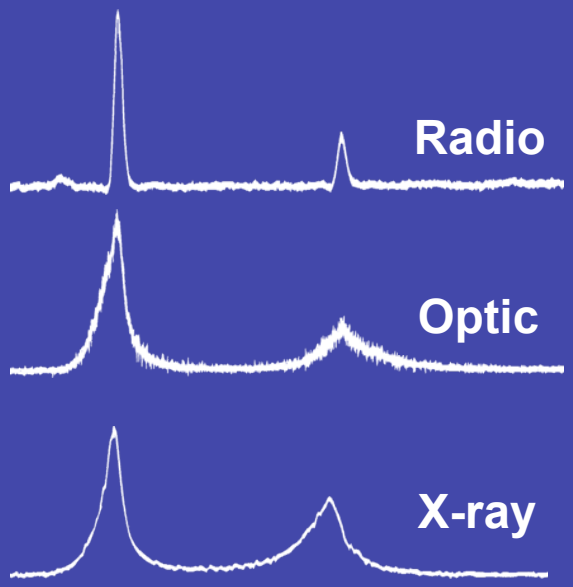
AN ENERGETIC AFTERGLOW FROM A DISTANT STELLAR EXPLOSION

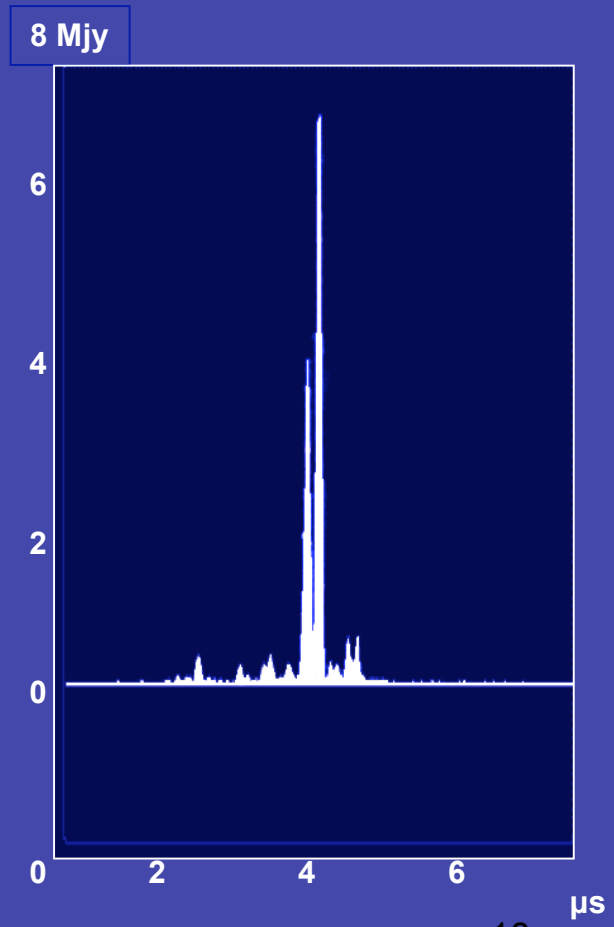
D. A. FRAIL,[1] P. B. CAMERON,[2] M. KASLIWAL,[2] E. NAKAR,[3] P. A. PRICE,[4] E. BERGER,[5,6,7] A. GAL-YAM,[2,7] S. R. KULKARNI,[2]



Giant pulse from the Crab pulsar with the observed flux density about 7MJy at 2.2 GHz leading to the estimate of brightness temperature Tb>10^40 K (64-m radio telescope in Kalyazin)







Ka[illegible]shev, Langston: AA[illegible] 2007

Rotation period of neutron star is 33 mc