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ARISE - A Proposed Future Space VLBI Mission

J. S. Ulvestad
National Radio Astronomy Observatory, Socorro, NM, U.S.A.

R. P. Linfield
Jet Propulsion Laboratory, Caltech, Pasadena, CA, U.S.A.

Abstract. We are developing a future space VLBI mission, ARISE, that would involve placing a VLBA-equivalent radio telescope in a highly elliptical Earth orbit. The telescope would operate at VLBI frequencies of 5, 22, 43, and 86 GHz, as well as being capable of single-dish operation at 60 GHz. Fringe-detection thresholds will be less than 10 mJy except at 86 GHz. Key scientific goals include dual-polarization imaging of blazars on the same physical scale as their γ-ray emission, astrophysical and astrometric studies of extragalactic water megamasers, and single-dish observations of O_2.

The 1990s have brought substantial technical developments in VLBI. These include the completion of the Very Long Baseline Array (VLBA), the formation of the Coordinated Millimeter VLBI Array (CMVA), and the launch of the HALCA satellite by the VLBI Space Observatory Programme (VSOP). ARISE (Advanced Radio Interferometry between Space and Earth) is a proposed space VLBI mission that would synthesize the improvements represented by these instruments. It would include a telescope with observing parameters similar to those of a VLBA radio telescope, would observe at frequencies in the millimeter regime, and would be a dedicated space VLBI mission building on the anticipated successes of VSOP. ARISE is one of the primary "Observatory Class Missions" listed in the recently completed Structure and Evolution of the Universe Roadmap for NASA in the years 2000–2020.

Some of the major scientific goals of ARISE have been discussed in a number of other papers in recent years (e. g., Ulvestad, Linfield, & Smith 1995; Gurvits, Ulvestad, & Linfield 1996; Ulvestad, Gurvits, & Linfield 1997), and are summarized briefly here:

- Image radio jets in full polarization at resolutions of light weeks (10–20 microarcsec), similar to the size indicated by γ-ray variability
- Image radio jets over a wide range of redshifts, to perform a variety of tests of cosmology and source evolution
- Image H_2O megamasers in external galaxies, to determine the physics and motions of molecular material within 0.1 parsecs of the central black holes, and to make geometric distance determinations
- Image gravitationally-lensed sources, to estimate Hubble's constant and to model the distribution of matter (both dark and luminous) in the lensing objects
- Make single-dish measurements of O_2 in molecular clouds to model the temperature distribution and chemistry within star-forming regions

The ARISE mission would be built around a 25-m-class deployable radio telescope operating at a frequency as high as 86 GHz. The current leading

Table 1. Basic parameters of the ARISE mission.

	VSOP	**ARISE**
Mission Characteristics		
Launch Date	12 Feb 1997	2008
Lifetime	3 yr	5 yr
Perigee Altitude	600 km	5000 km
Apogee Altitude	21,500 km	~40,000 km
Observing Parameters		
Antenna Diameter	8 meters	25 meters
Antenna Type	Mesh	Inflatable
Data Rate	128 Mbit/s	1–8 Gbit/s
Polarization	Left Circular	Dual
Observing Bands, GHz	1.6, 4.9, 22	4.9, 22, 43, 60, 86
System Temperatures, K	100–200	8–40

candidate for the main reflector is an inflatable structure, such as those currently being studied and tested for a variety of users (e. g., Veal & Freeland 1995; Freeland, Bilyeu, & Veal 1995). An ARISE "pre-project" has recently been formed at the Jet Propulsion Laboratory, and preliminary mission design studies are under way. Table 1 shows the basic characteristics of ARISE, comparing them to the design goals of VSOP (Hirabayashi, these Proceedings, p. 11).

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References

Freeland, R. E., Bilyeu, G. D., & Veal, G. R. 1995. in *46th International Astronautical Congress*, Paper IAF-95-1.5.0.1.

Gurvits, L. I., Ulvestad, J. S., & Linfield, R. P. 1996. in *Large Antennas in Radio Astronomy*, ed. C. G. M. van't Klooster (Noordwijk: ESTEC), 81–88.

Ulvestad, J. S., Gurvits, L. I., & Linfield, R. P. 1997. in *High Sensitivity Radio Astonomy*, eds. N. Jackson, & R. Davis (Cambridge: Cambridge University Press), 252–255.

Ulvestad, J. S., Linfield, R. P., & Smith, J. G. 1995. in *33rd AIAA Aerospace Sciences Meeting and Exhibit*, Paper AIAA 95-0824

Veal, G., & Freeland, R. 1995. in *AIAA Space Programs and Technologies Conference*, Paper AIAA 95-3739