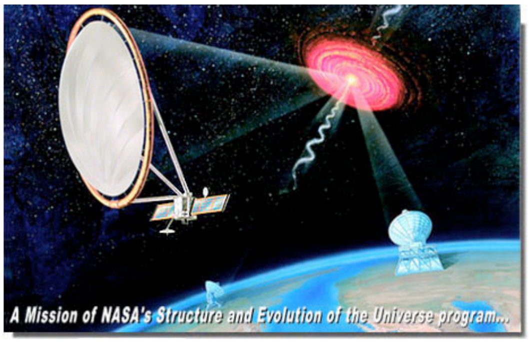
Advanced Radio Interferometry Between Space and Earth (ARISE)

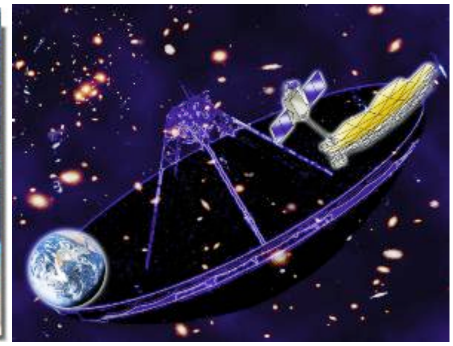
Moderate Initiative #10, Space Initiative #9

Replaced by potential U.S. participation in Japanese VSOP-2 Mission



Decadal Survey Projection

AANM Panel Reports, pg 207



VSOP-2

http://www.vsop.isas.jaxa.jp/vsop2e

Project: Advanced Radio Interferometry Between Space and Earth

Description: 4-Band Radio Interferometer Observing range = 7.5 GHz – 100 GHz

Resolution goal = ~10 μarcsec

Size = ~ 25m

Status: Replaced by U.S. involvement in VSOP-2

First Light: NA

US Cost: $350 million (FY2000 dollars)

Project: VLBI Space Observatory Programme -2 (VSOP-2)

Description: Radio interferomer at 8, 22, 43 GHz. JAXA's ASTRO-G spacecraft observes in conjunction with ground radio telescope arrays such as VLBA.

Resolution goal = 38 μarcsec

Size = 10m, cooled receivers

Status: ASTRO-G is an approved JAXA mission and is now in Phase-B

First Light: 2013

US Cost: $35 million (FY08 dollars) to support U.S. science team, tracking station, VLBA, and precision orbit determination. A Mission of Opportunity proposal for this US participation was submitted to NASA in 2008; it received the highest possible rating ("Category 1") but was not selected.

AANM Summary Blurb (Taken from AANM Panel Reports, pg 207)

ARISE, a proposed NASA mission, will place a sensitive ~25-m radio antenna into space that can operate at wavelengths as short as 3 mm in an elliptical orbit reaching as high as 50,000 km and giving baselines as long as ~5 Earth diameters. Together with Earth-based radio telescopes, ARISE will allow radio imaging with a sixfold improvement in angular resolution compared with the VLBA. In combination with the large ground-based telescopes such as the VLBA, GBT, and LMT, the 25-m space antenna, equipped with state-of-the-art receivers, will be more than an order of magnitude more sensitive than the 8-m Japanese HALCA antenna.

VSOP-2 achieves the major science objectives of ARISE at a factor of 10 reduction in US cost. US scientists and facilities are critical to VSOP-2 mission scientific success.

Summary of ARISE/VSOP-2 Developments in 2000-2008

In NASA roadmaps, ARISE was placed in a long queue behind Constellation-X and LISA, both of which were highly ranked in the AANM survey. Since it is unlikely that both will be launched before 2020, it was no longer productive to pursue a US-led mission. Instead, an approach was sought to achieve a significant fraction of the ARISE science goals at lower cost, in a mission that had potential for an earlier launch. Such an approach was found via collaboration in the Japanese-led VSOP-2 mission, now approved by the Japanese Space Agency and in Phase B of development. VSOP-2 is centered on the ASTRO-G spacecraft, scheduled for launch in 2013. VSOP-2 follows on the successful mission of VSOP (Halca) , which was launched by Japan in 1997 and carried out space-ground VLBI imaging for five years.

US participation in VSOP-2 would greatly enhance the science return of the mission, enabling achievement of many of the ARISE science goals, for only 10% of the proposed cost of ARISE. The necessary US participation includes funding of an additional tracking station for time transfer and a wideband data link (data rate of 1 Gigabit/s cannot be stored onboard), as well as funding of precision orbit determination, a US science team, and the operation of the VLBA in support of VSOP-2. The most important science that would be enabled has become more timely since 2000. The two primary science goals called out in the NASA Mission of Opportunity proposal were the following:

Understand how super-massive black holes generate ultra-relativistic jets and powerful gamma-ray emission. This goal would be achieved by making repeated images of relativistic gamma-ray blazars at resolution three times better than available from the ground, correlating changes in the source morphologies with gamma-ray light curves measured by GLAST, and using the combined data to model the jet generation and gamma-ray emission.

Constrain the nature of dark energy by making the most accurate measurement of Hubble's constant. This goal would be achieved by making high-resolution imaging and astrometric observations of H_2O megamaser sources in active galactic nuclei, combining the source images with accelerations measured by monitoring of the source spectra, and thus deriving geometric distance measurements to the galaxies. Combining the geometric distances with measurements of recession velocity provides a direct measure of Hubble's constant, breaking a degeneracy in the determination of the key dark-energy parameter. As a by-product, direct measurements of the masses of black holes also will be made for the target galaxies.