VSOP-2 science targets

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The next space VLBI mission VSOP-2 will enable imaging with the highest angular resolutions ever achieved. The resolutions of 240, 87, and 44 μarcsec at 8, 22, and 43 GHz allow us to unveil details of astrophysical phenomena such as accretion disks of AGNs, jet formation and acceleration mechanisms, and magnetospheres in the vicinity of young stellar objects. Cooled receivers, wide bandwidths, and a phase referencing capability will lead to improved sensitivities over VSOP, enabling detections of correlated flux densities of 6, 8, 11 mJy or brightness temperatures of 7×10^7, 1.3×10^8, and 2.1×10^8 K at each of the three frequencies, respectively.

The primary aim of the VSOP-2 is to image accretion disks around supermassive black holes in Active Galactic Nuclei (AGNs). Accretion disks are considered to generate all of the AGN power in ~ 10 – 100 Schwartzschild radius (r_s). The disk size of nearby AGNs corresponds to tens of μarcsec, comparable to resolutions of the VSOP-2. The best target object is the radio galaxy M 87, which hosts a massive black hole of 3.2×10^9 $M_\odot$, where VSOP-2 angular resolution at 43 GHz corresponds to 10 r_s. There are at least three objects in which the VSOP-2 beam is sharper than 20 r_s, and at least 13 objects within 20 Mpc for which the resolution is better than 200 r_s.

Relativistic jets emanating from AGNs are formed, collimated, and accelerated in the vicinity of accretion disks. VSOP-2 will image fine structures in the jet formation region to clarify the acceleration mechanism. The polarization imaging capabilities of VSOP-2 are essential to illustrate the structure of the magnetic field which is related to the physics of jets.

VSOP-2 will also allow studies of star formation. The angular resolution corresponds to 1.2 solar radii in star forming regions at 150 pc. Thus we'll be able to examine the magnetosphere of young stellar objects, where non-thermal high-energy phenomena like X-ray flares have been observed. VSOP-2 will illustrate magnetic field structures, which play important roles in combining an accretion disk and the central star, and the ejection of outflows.

In this presentation we introduce a sneak preview of the extremely high-resolution universe which will be brought by VSOP-2.