

The first half-century of Space VLBI

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Extension of radio interferometric baselines into space is a necessity if a diffraction-limited angular resolution defined by the Earth diameter at a given wavelength limits a pursuit of specific astrophysical goals. This was understood at the very beginning of the VLBI era in the middle of the 1960s. Since then, the first ad hoc demonstration Space VLBI experiment with the Tracking and Data Relay Satellite (TDRS, [1]) and two dedicated missions, the VLBI Space Observatory Programme (VSOP, [2]) and RadioAstron [3] (Fig. 1), enabled studies of celestial radio sources with an unprecedentedly sharp angular resolution.



Figure 1. Artist impressions of three spaceborne VLBI radio telescopes. *Left:* a Tracking and Data Relay Satellite (TDRS, NASA, USA). *Middle:* Highly Advanced Laboratory for Communication and Astronomy (HALCA), the orbital component of the VLBI Space Observatory Programme (VSOP, JAXA/ISAS, Japan). *Right:* Spektr-R, the orbital component of the RadioAstron mission (Roscosmos and Astro Space Center of LPI, RAS, Russia).

Space VLBI is an amalgam of various advanced technologies and arguably one of the most sophisticated techniques of spaceborne astronomy. It involves deployment of large precise spaceborne electro-mechanical structures, state of the art onboard analogue and digital electronics, precise attitude control and orbit determination, high capacity data downlink, simultaneous and highly coordinated operations of spaceborne and Earth-based facilities, advanced processing of large volumes of data. The presentation will offer a brief review of the technological challenges and means of their resolution in the three SVLBI missions.

The first generation of SVLBI missions provided cutting-edge results in several topics of modern radio astronomy. These include discoveries of ultra-compact galactic hydroxyl and water vapor masers, radio emission in active galactic nuclei with the brightness exceeding conventional theoretical limits, and detection of pulsar emission at meter wavelengths shedding a new light on the properties of the interstellar medium. The presentation will review these discoveries and compare them with the pre-mission expectations that served as a justification of mission developments. The presentation will be concluded with a summary of lessons learned over the first half-century of Space VLBI.

References

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