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# RADIO INTERFEROMETERS LARGER THAN EARTH: LESSONS LEARNED AND FORWARD LOOK OF SPACE VLBI

**Abstract**

Extension of radio interferometric baselines into space is inevitable if a diffraction-limited angular resolution defined by the Earth diameter at a given observing wavelength limits a pursuit of specific scientific goals. This was understood in early1960s, at the very dawn of the era of Earth-based Very long Baseline Interferometry (VLBI). Since then, the first ad hoc demonstration Space VLBI experiment with the Tracking and Data Relay Satellite (TDRS, Levy et al. 1986) and two dedicated missions, the VLBI Space Observatory Programme (VSOP, Hirabayashi et al. 1998) and RadioAstron (Kardashev et al. 2013), enabled studies of celestial radio sources with an unprecedentedly sharp angular resolution reaching 0.1 nanoradian.

Space VLBI is a conglomerate of diverse technologies and arguably one of the most sophisticated techniques of space-based astronomy. It involves deployment of large space-borne electro-mechanical structures, state of the art analogue and digital instrumentation, precise attitude control and orbit determination, high capacity data downlink, simultaneous and highly coordinated operations of space-borne and Earth-based facilities, advanced processing of large (tens of terabytes) volumes of data. The presentation will offer a 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. One of the Space VLBI missions, the RadioAstron, also ventured into the domain of fundamental physics by sing its onboard Hydrogen maser local oscillators for experimental verification of the Einstein Equivalence Principle (Litvionov et al. 2018). 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. This comparison, together with the review of technological achievements of the three SLBI missions and experiments create a solid fundament for projecting the development of space-based radio interferometry into the next decades.

References

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