



## VLBI with the SKA: from concept to reality

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The Square Kilometre Array (SKA) will revolutionise our view of the radio universe. The SKA precursors are already providing surprising results thanks to their sensitivity, image fidelity, and new observing capabilities (a variety of examples can be found in [1, 2, 3, 4]). But full realisation of many of the SKA science cases will need high angular resolution images of the sky at m and cm wavelengths that will be achieved when including the SKA telescopes in the Very Long Baseline Interferometry (VLBI) networks. Examples of the science cases that this will enable include high precision astrometry for different types of objects, such as pulsars, masers and AGN; deep surveys of AGN; jet physics and strong gravitational lensing studies; and a variety of transient phenomena such as Fast Radio Bursts, Tidal Disruption Events and Gravitational Wave Events. Thus, many of the science programs of the different SKA Science Working Groups will be able to take advantage of the SKA-VLBI capability.

The SKA1-MID and SKA1-LOW telescopes have been designed to be compatible with the established VLBI networks, by including the phased-up cores and/or selected individual elements, MID antennas or LOW stations, in the VLBI observations. From user-selected core sizes, the SKA will provide multiple tied-array beams pointing to different directions in the sky, within the VLBI antennas field of view. Additionally, the SKA brings exquisite control of radio frequency interference, enhanced calibration products to aid the VLBI calibration and simultaneity with other SKA observing modes, such as continuum and spectral line imaging at lower angular resolutions, transient buffer and transient search, pulsar timing, etc.

The SKA will also contribute to the expansion of the VLBI networks towards the southern hemisphere and to improve its coverage, as well as to stimulate the expansion of the observing frequencies to lower values, down to 50 MHz. But spatial distribution of the VLBI arrays in the globe is far from perfect and the very sensitive SKA elements will dominate certain spatial scales in the sky images and will produce very non-gaussian point spread functions, or dirty beams. Other technical issues are related to the radically different size of the SKA beams compared to the primary beams of the VLBI antennas that will also have to be dealt with, considering multiple phase centres in correlation. Other issues are related to the correction of direction dependent effects when coherently phasing up the SKA beams that point in different directions and the effect this may have in the astrometric precision.

Recognising the importance that simulations may have in understanding the true capabilities of SKA-VLBI, a simulation task force has been recently established, to advise the science cases of the different SKA science working groups and to guide VLBI array expansions and their technical enhancements.

## References

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