Contribution ID : **61** Type : **not specified**

The KVN-Mopra VLBI Network: System Performance, Early Results, and Recent Updates

Content

Global VLBI observations with baseline lengths of ˜10,000km allow detailed imaging at sub-milliarcsecond resolution at the expense of reduced observation cadence. Given the typical variability of blazars, investigation of flaring AGNs benefits from high cadence and long-term monitoring of targets of interest. Observations with a VLBI array consisting of a smaller number of antennas allow the high-cadence observations necessary to probe the high angular resolution and high cadence variability characteristics of AGN radio cores (i.e., compact and bright emission regions in radio VLBI images). With such a goal, we have started joint VLBI observations between the KVN and a radio telescope, Mopra, located in Australia. Through commissioning and early science observations, we have successfully observed at all three common frequency bands of 22, 43, and 86 GHz, including the application of linear-to-circular polarization conversion at 43 and 86 GHz. The VLBI beam minor axis is found to be 0.2/0.1/0.05 mas at 22/43/86 GHz respectively due to the KVN-Mopra baselines, while the major axis is comparable to the KVN-only beam (6/3/1.5 mas). Coherence times were found to be approximately 10 seconds at 86 GHz. However, the (up to) 16 Gbps observations provided by the OCTAD backend and Mark6 recorder allowed the detection of fringes on the KVN-Mopra baselines for a number of sources at 86 GHz with flux densities down to 0.2˜0.3 Jy. With careful calibration and imaging, we are able to produce high-resolution CLEAN images, with residual calibration errors of ˜4% in amplitude and ˜3 degrees in phase at 22 GHz. We also find that direct model fitting to the measured visibilities and closure quantities of the data (e.g., constraining the flux density, size, and position of 2-D Gaussian model-fitted jet components) allows us to reconstruct the sub-mas source structure in the vicinity of the radio cores. Based on our initial success, we have expand our observations to relative astrometry observations with the East Asian VLBI Network + Mopra, and regular joint observations between the KVN, Mopra, and the Hartebeesthoek 26m radio telescope in South Africa.

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Session Classification : Poster Session