

## The ALMA Phasing Project Phase 2: Extending and Enhancing the VLBI Science Capabilities of ALMA

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The ALMA Phasing Project (APP) recently developed the hardware and software necessary to coherently sum the signals from individual ALMA antennas and record the aggregate signal in standard Very Long Baseline Interferometry (VLBI) format. These capabilities now allow the ALMA array to operate as the equivalent of a single large aperture antenna and participate in global VLBI networks operating at millimeter (mm) wavelengths. VLBI observations at these wavelengths are capable of yielding angular resolution as fine as a few tens of microarcseconds—the highest presently achievable for observations of astronomical sources. Given ALMA’s extraordinary sensitivity, the addition of phased ALMA to existing mm VLBI networks provides an order of magnitude boost in sensitivity, along with significant enhancements in the ability to reconstruct images of sources.

The first VLBI science observations with phased ALMA were conducted in April 2017 at wavelengths of 3 mm and 1 mm. These observations are expected to probe in unprecedented detail the launch and collimation of astrophysical jets and the physics of black holes on event horizon scales. In parallel, our team has been laying the groundwork for an “APP Phase 2” that will introduce a suite of extensions and enhancements to the existing ALMA Phasing System in order to expand and diversify its scientific capabilities. Major components of this work will include the introduction of a spectral line VLBI mode, the extension of VLBI into the sub-mm (0.7 mm) regime, and the ability to perform ALMA VLBI on sources considerably weaker than current thresholds. This talk will briefly describe the scientific motivation for an APP Phase 2 and review the steps necessary for its implementation at ALMA.