54th IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (A4)
SETI 1: SETI Science and Technology (1)

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TECHNOSIGNATURE SEARCHES WITH VERY LONG BASELINE INTERFEROMETRY (VLBI)

Abstract

Recent advances in radio telescope technology, combined with a surge in exoplanet discoveries, have significantly refined the search for extraterrestrial intelligence (SETI). Researchers now integrate machine learning techniques, sophisticated data pipelines, and dedicated observing programs to accelerate radio SETI investigations. In particular, future instruments such as the Square Kilometre Array (SKA) and the next-generation Very Large Array (ngVLA) are expected to further enhance detection capabilities and broaden the scope of these studies. However, SETI faces challenges from numerous human-made radio frequency interference (RFI) signals. To tackle this, Very Long Baseline Interferometry (VLBI) is employed, providing a powerful method to distinguish nearby artificial signals from potential extraterrestrial sources. Specifically, VLBI can filter RFI by analyzing signals across multiple baselines, enabling precise localization and trajectory determination of detected signals. This approach was demonstrated using the Long Baseline Array (LBA). Our project includes characterizing planetary satellite signals, conducting wide-band VLBI surveys of exoplanets in habitable zones, and performing follow-up VLBI observations of promising SETI candidates initially identified by Breakthrough Listen surveys. A notable example is the VLBI observation of signals from multiple satellites at X-band. The fluctuating phase and delay rates, driven by the satellites' motion, show how VLBI can effectively rule out RFI sources within a few hundred astronomical units of Earth. To support these efforts, we have developed specialized data reduction and analysis pipelines tailored for VLBI-based SETI observations. These pipelines are expected to play a key role in future high-sensitivity surveys, advancing the search for extraterrestrial intelligence with unprecedented precision and reliability.