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The Very Large Array Sky Survey (VLASS)

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The Very Large Array (VLA) Sky Survey (VLASS) is a new all-sky radio survey that is currently being developed at the National Radio Astronomy Observatory (NRAO). VLASS will cover the entire sky that is visible to the VLA (decl. > -40º) over three observing epochs with a frequency coverage of 2–4 GHz and angular resolution of ~2.5 arcsec. We expect to reach rms ~120 microJy per epoch, with rms of ~70 microJy when the three epochs are combined. Observations are being taken in full polarization. The data products will include full-continuum images, spectral-index and polarization image cubes, and source catalogs. Scientific applications include the study of radio transients, Faraday tomography of radio galaxies, and demographics of the radio loud/intermediate radio-galaxy population.

The observations will require approximately 5550 hours of on-sky telescope time, including time spent on calibration and overheads. Due to scheduling constraints— the necessity to continue normal telescope operations as well as the 16-month cadence of the VLA re-configuration cycle— VLASS observations will take place over 6 configuration cycles with 925 hours per observing cycle, over a period of 7 years. Each epoch will be observed in two separate halves 16 months apart, with an approximate 32-month cadence between epochs for any part of the sky. Observations began in September 2017 and are expected to conclude in 2024. “QuickLook” images have been published for the first observing cycle (one half of the first VLASS epoch).

A survey to this depth in the relatively short amount of observing time compared to previous all-sky radio surveys is possible due to the enhanced observing and software capabilities of the upgraded Karl G. Jansky VLA. Observations use the new On-The-Sky-Mosaicking (OTFM) mode: the antennas are in constant motion performing a back-and-forth raster of the sky while the receivers continue recording. The scan rate for VLASS is 3.31 arcmin/sec, with an integration time of 0.45s to ensure ~10 integrations across the 3-GHz primary beam. The effective integration time for one epoch is equivalent to ~5s of pointed observations.

I will present an overview of the survey and highlight various challenges related to scheduling (e.g. satellite-avoidance), observing (e.g. weather conditions, correlator software), calibration (e.g. correcting for poor or variable calibrators; polarization challenges), and imaging (primarily wide-band and wide-field effects). Commissioning of the various aspects of the survey are on-going with many lessons learned to date.

I will additionally introduce two commensal surveys that are ongoing at the VLA. The VLA Low-band Ionosphere and Transient Experiment (VLITE) runs in parallel to VLA observing, providing ~6200 hours/year of science-ready data products across 64 MHz of bandwidth centered on 352 MHz, and processed by a custom correlator in real-time. "realfast" is a system designed for real-time fast transient searches on the VLA using a dedicated pipeline that processes a high-speed duplicate of the primary VLA observing stream, with the goal of automatically identifying exotic transient systems such as fast radio bursts and milli-second pulsars.