Autonomous Follow-up Programs at the South African Astronomical Observatory

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Abstract

The pace of transient discovery and alert generation is expected to increase dramatically in the coming years, driven by the anticipated data stream from the Vera C. Rubin Observatory. Current all-sky surveys including Pan-STARRS, the Zwicky Transient Facility (ZTF), and the Asteroid Terrestrial-impact Last Alert System (ATLAS) have already reported the majority of over 160,000 transients to the Transient Name Server (TNS) since 2016, already providing a rich stream of candidates for follow-up observations. To prepare for this evolving landscape, the South African Astronomical Observatory (SAAO) operates the "Intelligent Observatory" (IO) program, with a core objective of future-proofing the observatory's infrastructure for efficient and autonomous follow-up of transient events. Over the past two years, the 1-meter Lesedi telescope at SAAO, equipped with the Mookodi instrument, has operated in a fully robotic, queue-scheduled mode, conducting diverse follow-up and characterisation observations across multiple science domains. This contribution presents several programs that demonstrate the observatory's capability for rapid, fully automated response. Notable examples include the recovery and characterization of newly discovered near-Earth asteroids via NASA JPL's Center for Near-Earth Object Studies (CNEOS) Scout service, and the follow-up of transient alerts directly from the ATLAS survey. The latter is enabled through an active collaboration with the ATLAS transient group and their machine-learning-based ATLAS Virtual Research Assistant (VAR), allowing automated follow-up without human vetting. These programs highlight the maturity and versatility of SAAO's robotic infrastructure in advancing time-domain astronomy.