Automated follow-up of Transient Alerts with SAAO's "Intelligent Observatory" program

The South African Astronomical Observatory (SAAO) has embarked on the "Intelligent Observatory" or "IO" programme (Potter et al. 2024) to upgrade its telescopes, instruments and data analysis to have them intelligently working together in a coordinated fashion. The objective is to not only deliver greater efficiency and agility but to enable the exploration of new science opportunities particularly in the era of multi-messenger and time-domain astronomy. One of the core activities in this regard has been the fully robotic implementation of the SAAO's 1-m Lesedi telescopes. In addition, integrating this telescope into a SAAO-version of the open-sourced Observatory Control System software (OCS)[1] developed by the Las Cumbres Observatory (LCO) to manage user-submitted observing requests and schedule observations into a dynamic queue, has allowed for the submission of computer generated observing requests via an API allowing for response to transient alerts without a physical observer being involved.

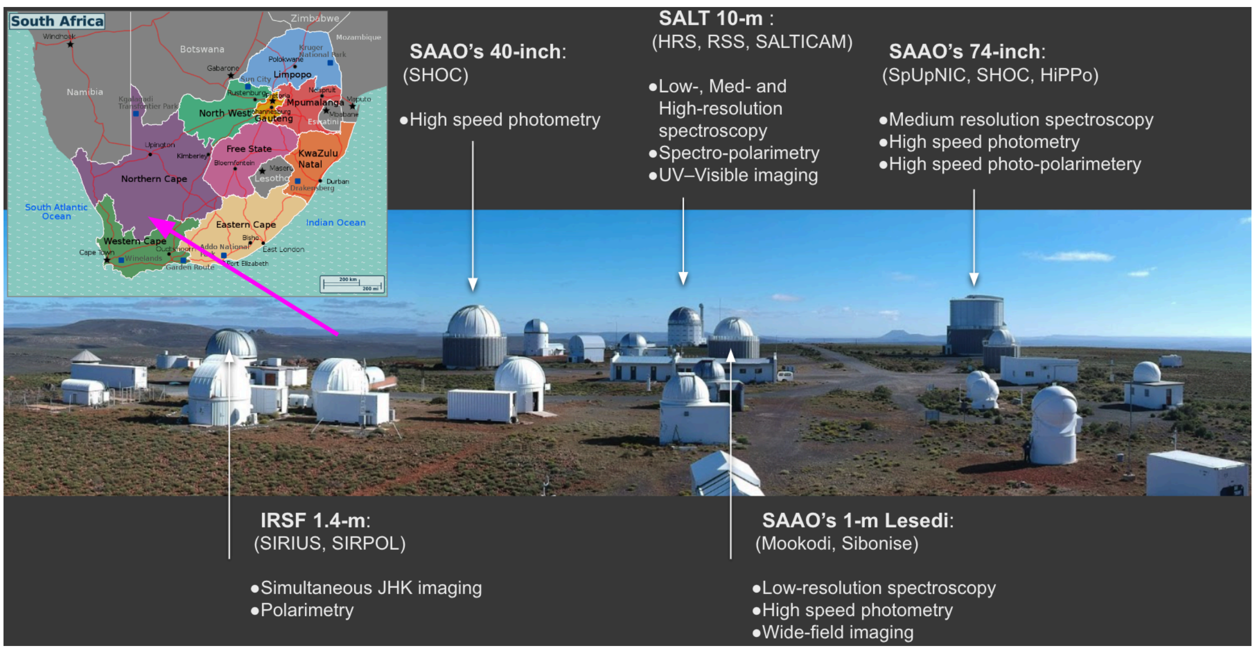

Figure 1: Panorama of the SAAO's observing site in Sutherland showing the Lesedi telescope that is now nominally operated as a fully robotic telescope able to autonomously respond to transient alerts without any human intervention.

To exercise this new capability the SAAO's IO team has implemented a program where we autonomously respond to new transients discovered and reported to the Transient Name Server (TNS)[2] using Lesedi's Mookodi instrument (Erasmus et al. 2024) that can do both low-resolution spectroscopy and multi-filter photometry. To date the program has triggered over 100 alerts with observing requests of which many were executed successfully and data collected. However, the majority of the collected data remains unexamined and unanalyzed.

The aim of this project is to examine all the data (both spectroscopy and photometry) collected during this program to ascertain the quality of the data and to derive statistics of success (e.g. for how many of the executed observations was the transient detected and a useful spectrum taken). For those observations where useful data was collected of a transient it will also be the student's responsibility to reduce the data

[1] https://observatorycontrolsystem.github.io/

[2] https://www.wis-tns.org/

with existing reduction pipelines in order to generate spectrum that can be used for generating reports that can be submitted to the TNS. Therefore it will be an opportunity for the student to be the main author of possibly several TNS classification reports like these:

https://www.wis-tns.org/object/2024dgn/classification-cert

(see also https://www.wis-tns.org/object/2024dgn and Figure 2)

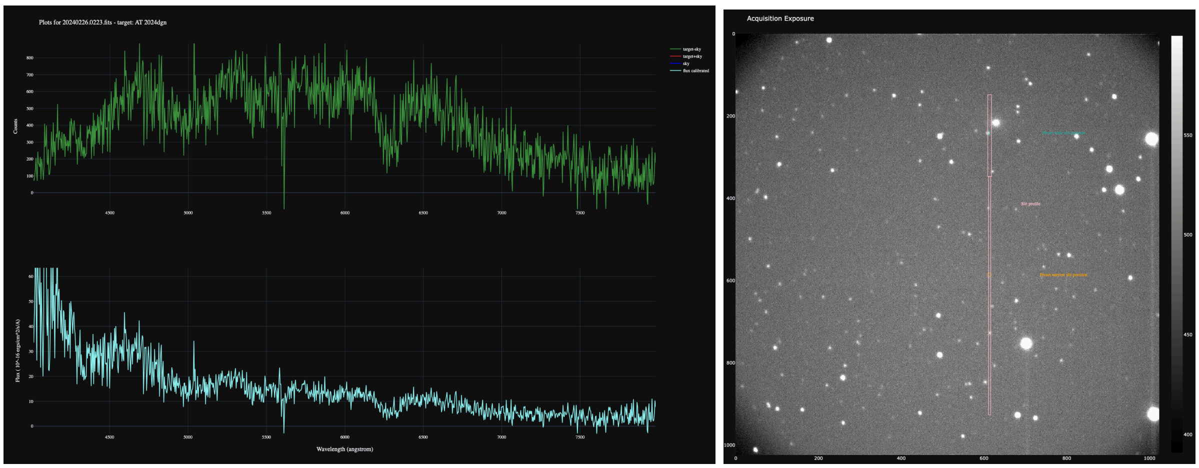

Figure 2: (Left) Example spectrum taken with Mookodi of Transient Name Server object AT 2024dgn that was subsequently classified as a Type Ia supernova by the SAAO team and the classification report submitted to the TNS: https://www.wis-tns.org/object/2024dgn The distinct broad-featured silicon absorption line around 6200 Å of Type Ia SN clearly present. (Right) Acquisition image showing the SN correctly placed on the slit (pink box) of Mookodi's spectrograph. Target acquisition is done completely autonomously with no human intervention.

Further reading:

Potter et al. 2024: https://doi.org/10.1117/12.3018154
Erasmus et al. 2024: https://doi.org/10.1117/1.JATIS.10.2.025005

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