Building the Son of X-Shooter infrastructure: a web interface for scientists

Sergio Campana (sergio.campana@brera.inaf.it)
Marco Landoni (marco.landoni@brera.inaf.it)
INAF - Osservatorio Astronomico di Brera, via E Bianchi 46 Merate (LC)

1. Introduction

The Son Of X-Shooter (SOXS) is a new spectrograph for the European Southern Observatory (ESO) 3.6m New Technology Telescope (NTT). SOXS is an international project, led by INAF, with participation of Weizmann Institute (Israel), Turku University (Finland), Millenium Institute of Astrophysics (Chile), Queen's Belfast University (QUB, UK), Tel Aviv University (Israel), and Niels Bohr Institute (Denmark).

The instrument is expected to start operations in early 2021 and the consortium will be awarded with 180 observing nights per year for five years.

2. Scientific rationale and state of the art

SOXS comes from the idea that the number of transient and variable sources discovered every day is growing hugely thanks, mainly, to optical wide-field surveys. These new transient sources remain however unexplored, lacking a spectroscopic follow-up. The situation will worsen in the future with the start of very large projects like ZTF (now), LSST (2021), as well as new high-energy missions (Swift, SVOM), radio (SKA and its precursors), very high-energy (CTA), and gravitational wave experiments (Ligo & Virgo) and neutrino experiments.

All these experiments call for a spectroscopic follow-up, to secure a distance (redshift), and to exploit their science content.
In this context, a unique database able to collect data from any survey with the possibility to store the photometric history of any transient,

queryable and easy to use (especially fast) is a key step for a worldwide successful instrumentation (like SOXS).

3. The proposed project

The SOXS consortium will manage the NTT observing schedule for the 5 years. The idea is to have a dynamical schedule that have to be updated day by day by SOXS scientists to include the most urgent transients to be observed. The schedule can also be changed on the fly if, e.g., a GW event takes place and should also be able to manage, at the same time, SOXS targets and ESO community targets (for the other half of the observing time), keeping a record of all the observations performed.

Nowadays there is an ESO public survey, called ePESSTO, with similar aims as SOXS, but *with a limited number of nights and scientific aims* (it is focussed on supernovae). ePESSTO has a software system to manage the observations, called Marshall base at QUB and it should provides the start for the SOXS infrastructure. Our infrastructure will also have to interface with ESO archive and overall database system.

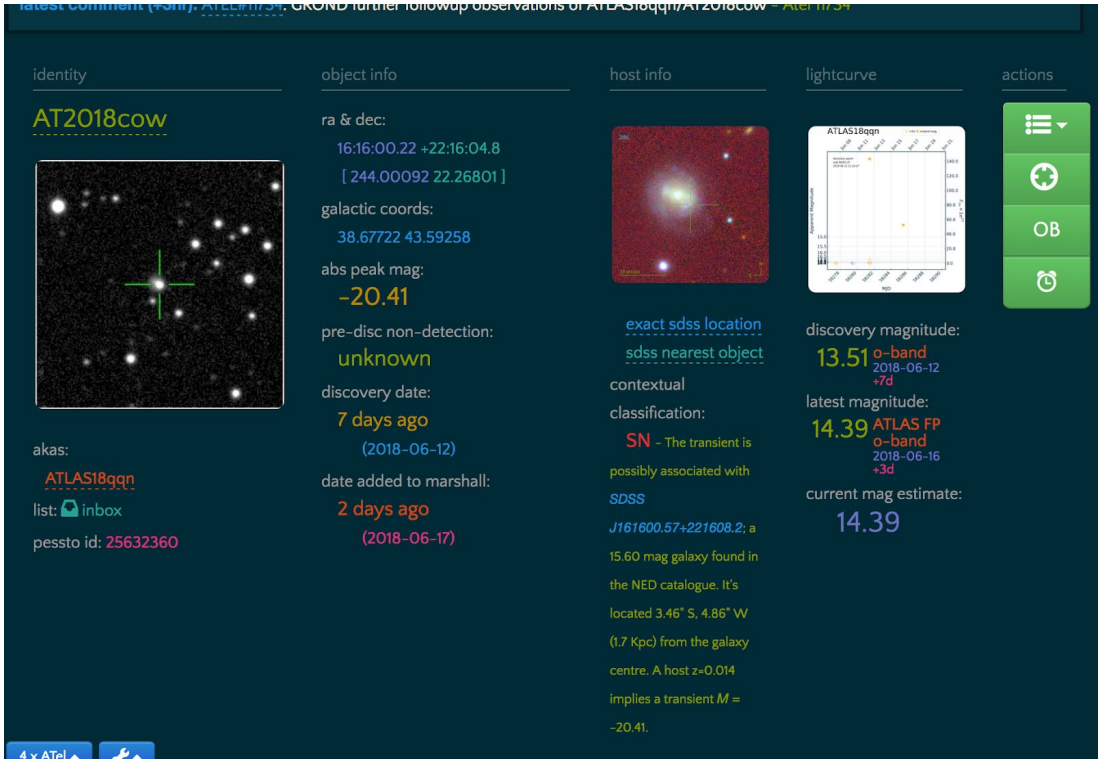

Fig. 1 Example of Marshall information for one source.

The PhD project is then targeted on the development of a web interface to include directly sources from different ongoing (mainly optical) surveys, characterise them in terms of database searches with other catalogs, provide finding charts from existing surveys, generating Observing Blocks (i.e. the instructions from a suited software to perform the observation) and, a posteriori, to keep the raw SOXS spectra, apply the analysis pipeline, and work out the final 1D spectrum.

4. Technology behind

The design, implementation and fruitful dissemination of the proposed project, which involves both killing science and technological challenges, require to investigate proper IT platform in terms of computational environment (such as main Cloud Platforms) and state-of-the-art scripting and application language (like *Node JS, Python*).

In particular, we propose to implement a full, **scalable** and **reliable** Web interface able to cope with the main features available in ePESSTO with the great advantage to include sources from different ongoing (mainly optical) surveys. This will require to investigate proper databases systems and big data technology (noSQL, SQL, …) to cope with the huge amount of gathered data.

Finally, the student will be able to deploy the full infrastructure to the SOXS community using current cloud platform services (e.g. *Google Cloud Platform*, already used for scientific purposes on our Institute) to drop the cost of ownership while maintaining the necessary infrastructure to run a scalable application.

5. Lesson learned and outlooks

The student involved in this project will gather the main skills required in the field of big data and technology applied to astrophysics with a great

outlook on important IT and data analysis standards exploitable both in research and industrial R&D.

He/She will also work in an international environment with close interaction, at least, with QUB and ESO, possibly with short periods (~month) spent outside to learn first and set up a proper interface later.

The student will be inserted in a large international collaboration. The PhD thesis work will not only be limited to software development. In order to properly assess the needs of a scientist the student will get acquainted with all the classes of transient sources and pursue her/his research line in the field.