

Transient Follow-up in the ZTF/LSST Era – an NCOA Initiative

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Spokesperson Today

The NCOA Time-Domain Followup Project

The Zwicky Transient Facility is a wide-field imaging facility based on the Palomar Schmidt telescope, equipped with a 24K x 24K camera. With a 30 second exposure (median depth R=20.4) the camera can survey 3750 deg²/hr. The system is operational, and delivering ~500K alerts/nt.

*Partially supported by an NSF MSIP grant. For more information see ztf.caltech.edu

Background

LSST is rapidly approaching first light in 2022. The time to prepare for the onslaught of data is now. In 2015 the National Research Council convened a committee to define a "Strategy to Optimize the U.S. Optical and Infrared System in the Era of the Large Synoptic Survey Telescope." This committee's report, known as the Elmegreen report, led NSF in turn the Kavli Futures Symposium. "Maximizing Science in the LSST Era", organized by NOAO and LSST.

Among the symposium recommendations highlighted as critical:

- Development of both general-purpose and specialized public alert broker(s)
- Increasing the availability of follow-up telescopes in queue-scheduling modes, spanning a range of apertures, instrumentation, and geographical locations

Coordinating Follow-up Observations

A major aspect of time domain projects is the coordination of follow-up observations across a range of manually operated, remotely controlled, and fully automated facilities. A Target/Observation Manager (TOM) may be a human and/or software designed to interact with and complement the functionality of the alert broker. The interface accepts targets selected from the alert stream by pre-defined filters. Observation requests for those targets can be submitted via an Application Programming Interface (API) to robotic facilities, while observers on remotely operated or manual telescopes can choose targets from online tables. Alternatively, targets can also be submitted to non-robotic telescopes that are equipped to accept them. Coordination between facilities can be improved by enabling both robot and human operators to indicate when a target is selected for observation and whether the observation has succeeded or failed.

Open Issues

There are open design decisions, some of which depend on how scientists choose/prefer to manage observing and data in the time-domain era. Our vision is to eventually link a variety of U.S. System (and possibly international) facilities into an NCOA Follow-up service – the technical and social heterogeneity of such an effort is formidable.

At present, funding and collaborations are aligned for phases 1 and 2.

About ZTF*

The Zwicky Transient Facility is a wide-field imaging facility based on the Palomar Schmidt telescope, equipped with a 24K x 24K camera. With a 30 second exposure (median depth R=20.4) the camera can survey 3750 deg²/hr. The system is operational, and delivering ~500K alerts/nt.

See the ZTF First Light image of Orion in a separate poster.

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Follow-up Components

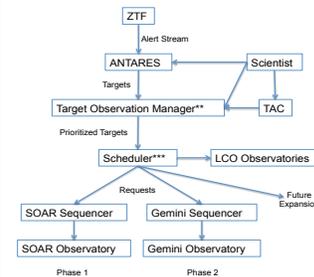
ANTARES: an alert broker that accepts transient event alerts from one or more surveys and tries to classify the objects based on position, color, and light curve information. Catalog matching and artificial intelligence algorithms are often used. Users can configure filters in order to extract objects of interest.

Target Observation Manager (TOM): These are observation management tools for specific research projects. They collect alerts from surveys or brokers and allow the teams to review data, manage data access rights (some TOMs are used by multiple teams), make decisions, and submit observations to the observatories on which the teams have observing time. TOMs may need to communicate with each other. Las Cumbres is currently raising funds for a community TOM development effort and may produce TOM development kits.

Scheduler(s): This is an algorithm that schedules the telescopes on the network. There can be a single network scheduler or individual telescopes can have their own schedulers or both. The Las Cumbres scheduler schedules all the nodes of the network approximately every 15 minutes.

Telescopes: These are the individual nodes of the network. They may participate with less than 100% of their time and instruments. They must be able to broadcast their current observing status (closed, open, what observing), receive the observation plans from the scheduler, and execute the observations.

Schematic Control Flow for NCOA Time-Domain Follow-up



* Observing status and products flow generally upstream from the observatories for monitoring and coordinating observing programs, and for distribution to scientists.
 ** There can be more than one!
 *** Relate the LCO scheduler, for SOAR, but with addition of facilities, there may be a new scheduler and/or coordinated schedulers.

The Schedule

Phase 1	Connect ZTF alerts via ANTARES via LCO Scheduler to SOAR	2019
Phase 2	Add Gemini with increasing time-domain access	2020-21
Phase 3*	All AURA and LCO facilities integrated	2022
Phase 4*	Prepare to accept additional telescope nodes; support LSST operation	2022+

* notional

The ZTF surveys

The initial 3-year survey will include a private consortium component and a community survey. The community survey will commence with two parts:

- A galactic plane survey in g and r, with 300 visits/year
- An all-northern-sky survey in g and r with visits every 3 days

Community data will be distributed as:

- Transient alerts from the community survey issued nightly
- Catalog data released after 1 year and then every 6 months

The ZTF Community Science Advisory Committee

The ZTF CSAC represents community interests in execution of the ZTF community survey, and supporting activities. Expect a survey review soon after the first data release (~summer AAS of 2019). Please contact any of us at any time for discussion or to coordinate input to the ZTF project:

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Todd Boroson	Marc Pinsonneault
Mukremin Kilic	Stephen Ridgway
Juna Kollmeier	