

Template for LSST Italy report

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Abstract

We report the results of our scientific activity in 2018 inherent the LSST preparatory phase. We are increasing the template of Intermediate-Luminosity Optical Transients to be later released to the public classification tools (such as PLAsTiC). We worked, in particular, to provide the first extensive dataset of Luminous Red Novae, and Intermediate-Luminosity Red Transients. Additional work in progress will increase already existing databases of major eruptions of massive stars (the so-called “supernova impostors”) and supernovae whose ejecta interact with pre-existing circumstellar material (CSM). We also contributed to writing a few sections of the LSST TVS Roadmap paper.

1 Quintuplet Information 2018

Please provide names, position and affiliation of the current members of the quintuplet.

- Andrea Pastorello (PI), staff researcher, INAF-Osservatorio Astronomico di Padova
- Elena Mason, staff researcher, INAF-Osservatorio Astronomico di Trieste
- Filomena Bufano, staff researcher, INAF-Osservatorio Astronomico di Catania
- Enrico Congiu, PhD Student, Università di Padova; INAF-Osservatorio Astronomico di Brera
- Yongzhi Cai, PhD Student, Università di Padova; INAF-Osservatorio Astronomico di Padova

Scientific Collaborations: What are the Science Collaborations and/or the Task Forces you joined during the last year?

1. All members of the quintuplet joined the TVS LSST Science collaboration. Primary subgroup for A. Pastorello, E. Mason and F. Bufano was the "Non-degenerate eruptive variables"; for E. Congiu the "Tidal Disruption Events"; for Y. Cai the "Supernovae".
2. E. Mason also joined the "Stars, Milky Way and Local Volume" collaboration, and E. Congiu also joined the "AGN" collaboration.
3. A. Pastorello and E. Mason joined the "LSST TVS Roadmap Paper" task force.

2 Quintuplet Information 2019

Please provide names, position and affiliation of the members of the quintuplet for the next year.

- Andrea Pastorello (PI), staff researcher, INAF-Osservatorio Astronomico di Padova
- Elena Mason, staff researcher, INAF-Osservatorio Astronomico di Trieste
- Laura Inno, Post-doc, INAF-Osservatorio Astrofisico di Arcetri
- Maria Tantaló, PhD Student, Dipartimento di Fisica, Università di Tor Vergata
- Giuseppe Altavilla, staff researcher, INAF-Osservatorio Astronomico di Roma; SSDC-ASI

3 Scientific Activity

Describe the scientific activity of the quintuplet (Limit: 1 page + 1 page for figures/tables.)

The scientific activities of our team have focused in increasing our database of Intermediate-Luminosity Optical Transients (ILOTs; Soker & Kashi 2012) and ejecta-CSM interacting supernovae (e.g. Smith 2018). The light curves and spectra are, in fact, essential comparison tools to identify and classify future transients discovered by LSST. Our data are collected in a website that is not yet of public access, with the exception of the project presentation pages (<http://sngroup.oapd.inaf.it/ilot.html>).

A few months ago, the TVS coordinators (Federica Bianco and Rachel Street) and Gauthan Narayan requested model light curve of transients to be included in the *Photometric LSST Astronomical Time-Series Classification Challenge (PLAsTic)*, designed to automatically classify transients discovered by LSST. The light curve templates should be clean and noiseless.

Our team decided to postpone the release of our light curve templates of unusual transients after the publication of our papers, because the data-sets sent to PLAsTiC would become immediately public. However, some papers will be published soon, incl. Pastorello et al. 2019 (MNRAS, submitted), and Cai et al. (that will be submitted in February 2019). The former analyses a wide sample of *Luminous Red Novae*, that are thought to be the outcome of common envelope ejection events or even stellar mergers. The latter provide new data of a family of *Intermediate-Luminosity Red Transients*, which are believed to be some exotic eruptions of moderate-mass stars or, most likely, faint electron-capture supernovae from super-AGB stars. For both of them, we will publicly release the largest existing datasets for these classes of transients (see Fig. 1), that will be used by PLAsTiC and other classification tools to build templates of rare transients.

Additional efforts have been devoted to increase the existing (but still limited) database of ejecta-CSM interacting supernovae showing direct signatures of pre-supernova outbursts occurred months-to-years before the terminal core-collapse. This evidence arises from the inspection of pre-supernova images available in the public archives (e.g. Pastorello et al. 2007, 2013) and the released datasets of interacting supernovae include also the historical light curve of the variable stars that later exploded as supernovae. This activity has led to the publication of a few papers in 2018 (see Section 4).

4 Scientific and technical deliverables

please list the papers/proposals/documents and/or the technical deliverables in which you have been involved during the last year, if any.

- Our team has contributed to write the LSST TVS Roadmap paper. In particular, A. Pastorello wrote the section *Intermediate-Luminosity Optical Transients* (ordinary LBVs, Giant Stellar Eruptions, Luminous Red Novae and non-degenerate mergers, Intermediate-Luminosity Red Transients). E. Mason instead wrote the sections *Compact Binaries: Neutron Star Binaries* and *Compact Binaries: Cataclismic Variables*.
- A. Pastorello is also co-I of the proposal: *Young Stars and their variability* (PI: R. Bonito).
- Our team is arranging some text for the presentation pages of the *Non-degenerate Eruptive variables* group in the LSST-TVS website.
- Scientific publications of our team in 2018 related with our LSST preparatory activity are:
Reguitti et al. 2019, MNRAS, 482, 2750; Cai et al. 2018, MNRAS, 481, 878;
Elias-Rosa et al. 2018, MNRAS, 475, 2614; Pastorello et al. 2018, MNRAS, 474, 197.

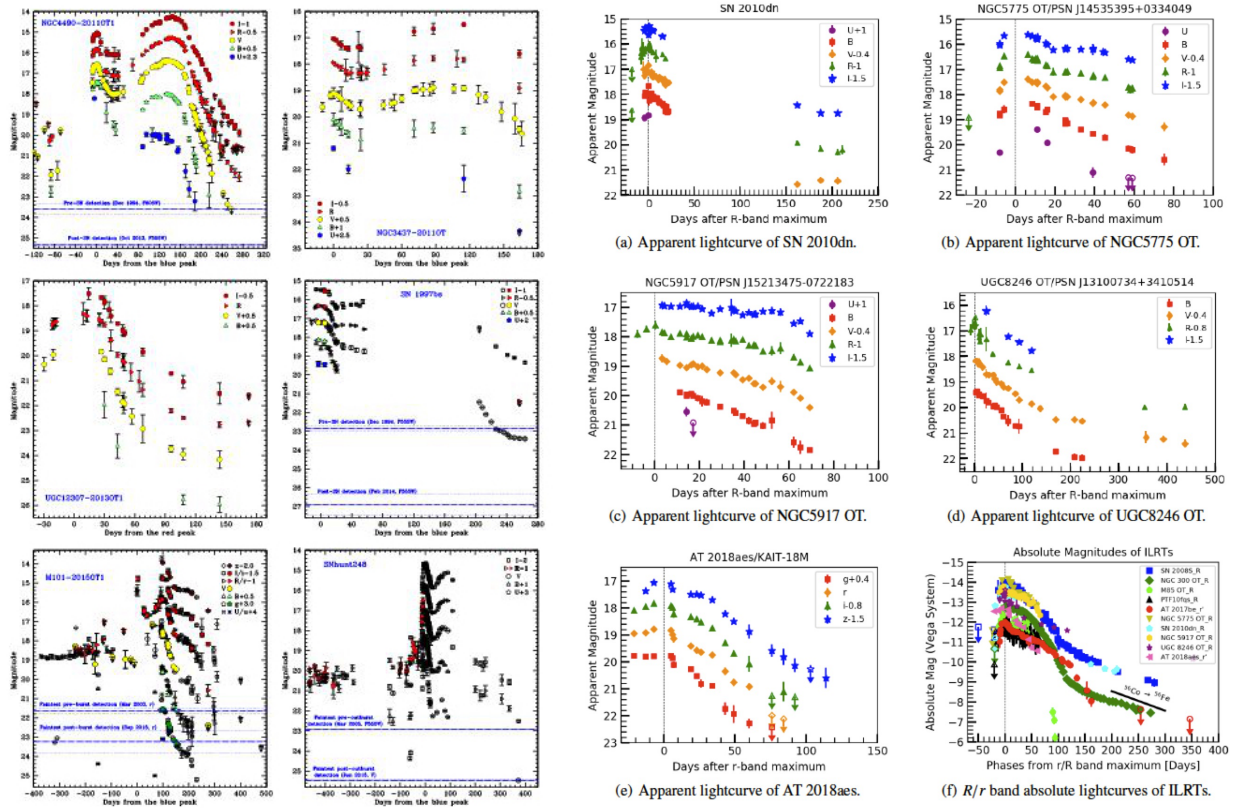


Figure 1: **Left:** light curves of Luminous Red Novae from *Pastorello et al. 2019* sample. **Right:** light curves of Intermediate-Luminosity Red Transients from *Cai et al. 2019* sample.

1. List of attached documents:

5 Other information

Any other information concerning your scientific activity (meetings, zoom/skype).

A. Pastorello joined the INAF-LSSST meeting of Capodimonte and (remotely) the INAF-LSSST meeting of Palermo.

A. Pastorello and E. Mason joined several zoom/skype TVS periodic telecons organised by R. Street and F. Bianco.

6 References

Pastorello, A. et al. 2007, *Nature*, 447, 829

Pastorello, A. et al. 2013, *ApJ*, 767, 1

Smith, N. 2017, *Handbook of Supernovae*, ISBN 978-3-319-21845-8. Springer International Publishing AG, 2017, p. 403

Soker, N., Kashi, A. 2012, *ApJ*, 746, 100