

Proposal for external collaboratorship by Gloria Sala

Department of Physics, Universitat Politècnica de Catalunya (Barcelona)
gloria.sala@upc.edu

Nova outbursts are explosive events resulting from a thermonuclear runaway in the H-rich envelope of an accreting white dwarf (cataclysmic variable, or symbiotic systems). Since the white dwarf is not disrupted by the event, accretion is resumed some time after the outburst and the rebuilding of the H-rich envelope on the white dwarf leads to a new nova explosion at some point. Recurrence times range from 1 year to 10000 years. Up to 2019, more than 900 nova outburst have been recorded and cataloged.

Nova events are in general discovered in the optical and followed in almost all wavelength of the electromagnetic spectrum. X-ray emission arises during the outburst from shocks in the ejected shell, and a bright supersoft source is in many cases present during weeks or months after the outburst, powered by the H-rich burning white dwarf envelope. While the novae outburst is usually first discovered in the optical, in some particularly crowded fields, the bright X-ray emission arising some weeks after the outburst start makes them more easy to detect in the X-ray than in the optical.

That is the case in Globular Clusters, where novae are seldom detected. Only three nova detections have been confirmed in GCs of M31 (Henze et al. 2009b and 2013), but no confirmed detection has been reported for Galactic GCs. This may be due to a selection effect: GCs are dense populated environments where the contrast of a nova in outburst is small, and thus difficult to detect by amateur astronomers, usual discoverers of Galactic novae. However, there are a number of known cataclysmic variables in GCs and no reason that should hinder the nova outbursts to occur. In addition, the study of novae in GCs would be of particular interest since the metallicity of the accreted material, which plays a crucial role in the physics of the explosion, could be constrained in the fixed metallicity environment of a GCs. The bright SSS emission of the nova in outburst makes novae in GCs more easily detectable in the X-rays than in the optical.

I propose to make use of the eROSITA data of GCs during the survey to search for SSS that point to a recent nova outburst. The project would combine properly scheduled observations in the optical some months-weeks before the eROSITA visits to each GCs to be able to correlate possible new SSS with optical transients. The monitoring of Galactic Globular Clusters for novae is a project already in preparation with the Telescopi Joan Oró in the Montsec Astronomical Observatory (<http://www.ieec.cat/en/content/206/what-s-the-oadm>). Test data have been already obtained and the pipeline is in testing phase. The nova search in the optical will be performed in the optical using a modified version of the pipeline developed for the Montsec observations included in the projects of nova monitoring in M31 and M81 since 2009 (<http://www.mpe.mpg.de/~m31novae/index.php?lang=en>). The monitoring in the optical would make use of the Montsec Observatory for the northern hemisphere (the proposer is IP of regular nova monitoring projects in the observatory since the first light of the observatory, check proposals by “Sala” in <http://www.ieec.cat/en/content/245/proposals>) and the collaboration with Dr. Alessandro Ederoclite in the Sao Paulo University to have access to similar, robotic telescopes in the southern hemisphere.

eROSITA survey data will be also used to systematically study the accretion status of old novae, as well as search for new novae in globular clusters. Most observing campaigns of novae stop following the novae after H exhaustion and turn-off of the supersoft source. However, the system may remain or reappear as an X-ray source powered by the accretion in the cataclysmic variable system. A few systems were detected by ROSAT during the RASS, and some close by systems are well studied, but in general little is known about the accreting system that has hosted each nova event. The eROSITA survey provides a great opportunity to check on the state of all systems that

hosted a nova explosion. I propose to build a catalogue with all old nova events recorded to systematically check on the status of old nova systems and look for correlations between the accretion state in the CV and the properties of the nova outbursts.

-- potential collaborators:

Frank Haberl, Axel Schwope, Jochen Greiner, Hauke Worpel

-- possible/expected outcome in terms of publications, catalogs, resources...

At least one publication with the correlations of accretion CVs with old nova events, is to be expected.

If a transient SSS is detected in a Globular Cluster, that would make a potential candidate for a nova; if in addition it is correlated with a nova candidate in our optical monitoring, that would provide the first ever detected nova in a Galactic Globular Cluster.

In addition, possible novae in outburst observed during the survey could be studied. With a bright supersoft X-ray phase lasting for months after the nova outbursts and the cadence of the eROSITA sky survey, at least one or two detections per year are to be expected. The bright and soft X-ray emission of novae in outburst would provide us with the spectral evolution even with the short eROSITA visits. I would be interested in contributing also to the analysis of those cases.