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eROSITA view of the NGC 2516 field

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Abstract

Stellar clusters are remarkably rich astrophysical laboratories for studying stars and some interesting exotic binary systems. These compact stellar populations have a wide range of stellar masses in similar age and metal abundances which provide great insight in dynamically investigation of the single and binary stars. In this study, we present preliminary results for one of these rich stellar clusters, NGC 2516. This young cluster observed by eROSITA during the calibration and verification phase (CalPV). Nearly 1600 X-ray sources were detected with eROSITA, many of them for the first time in X-rays. Almost all of the X-ray sources are main sequence stars and detected due to their coronal activity. However, one object attracted our particular attention due to the periodic modulation of its X-ray light curve by deep, eclipse-like dip features that occurred on a 106 minute timescale. SALT spectroscopy, TESS photometry and Gaia astrometry revealed this object to be a non-member, distant background object. The optical spectrum of SRGE J075818-612027 shows hydrogen Balmer emission lines indicative of an accreting system. The short period found in both X-ray and optical photometry allowed to further subclassify the object as a magnetic cataclysmic variable (AM Herculis star or polar) at a distance of about 2.7 kpc.

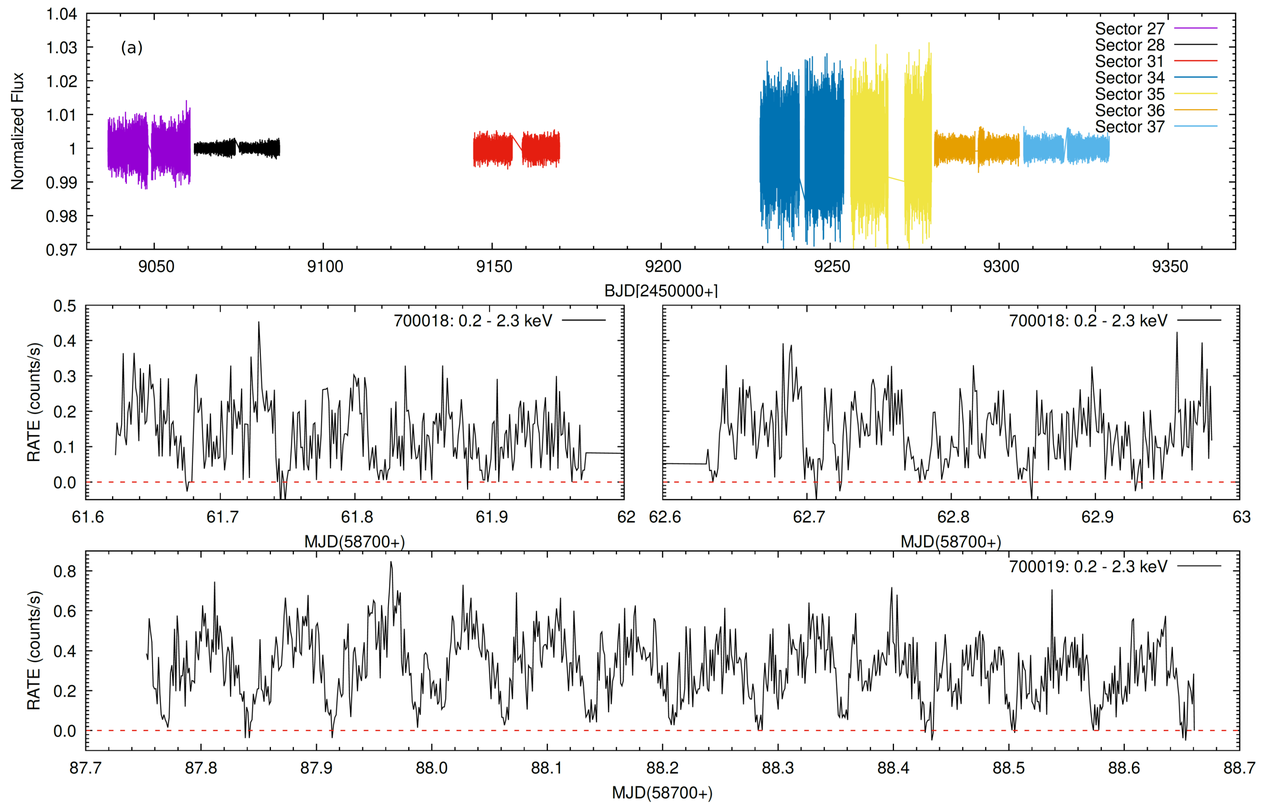

Fig.3 *Upper panel: Long-term optical TESS light curve, normalised by the mean flux in each sector. Lower panel: X-ray light curve of SRGE J075818 obtained on November 5, 2019 (OBS ID of 700018) and November 31, 2019 (OBS ID of 700019) with eROSITA.*

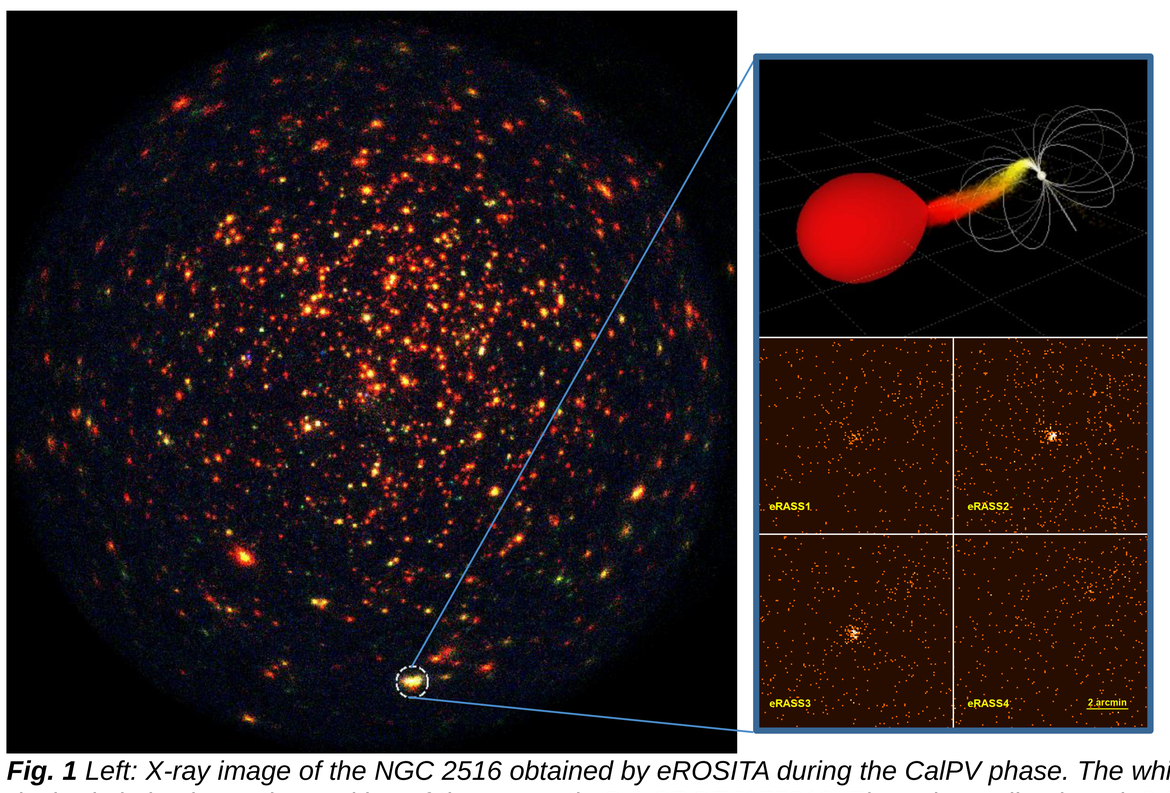

Fig. 1 *Left: X-ray image of the NGC 2516 obtained by eROSITA during the CalPV phase. The white dashed circle shows the position of the magnetic CV, SRGEJ075818. The color coding is red: 0.2 - 1.1 keV, green: 1.1 - 2.3 keV and blue: 2.3 - 5 keV. The image shows an area of 1×1 degree. Upper right: Sketch of a magnetic CV. Lower Right: Images of the CV during the 4 eROSITA All sky surveys in the 0.2 – 2.3 keV range. During eRASS4, the object is in a low state*

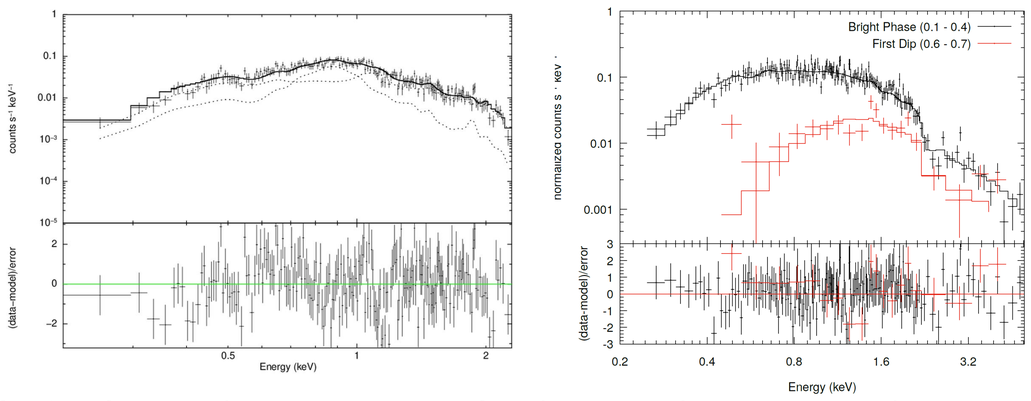

Fig. 2 *Left: Example X-ray spectrum of a cluster member, a young main-sequence star. The spectra of the member stars can be fitted by a 2 component APEC model. The typical value for higher temperature is 1 keV. Right: Phase resolved X-ray spectra of SRGEJ075818. Red: spectrum during the dips. Black: spectrum outside the dips. The temperature is 9.7 keV with increased absorption during the dips.*

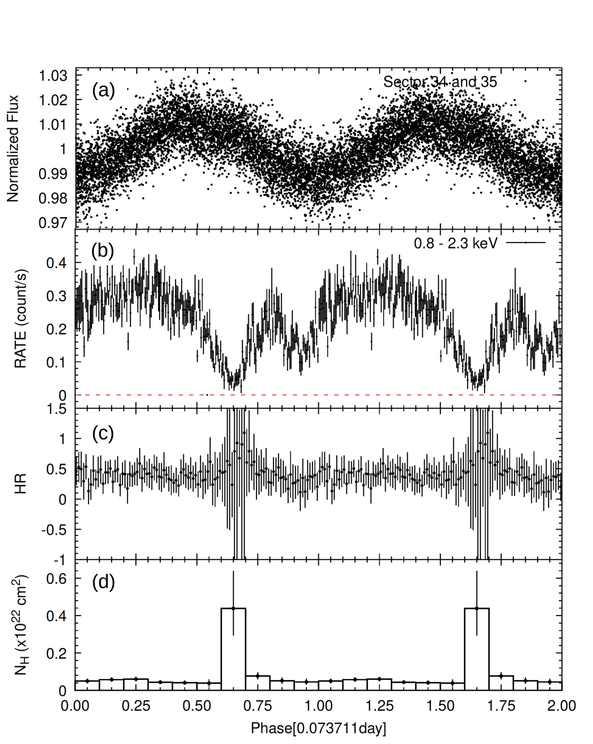

Fig. 4 *(a) Folded optical TESS light curve.*
(b) folded X-ray light curve in the 0.8 – 2.3 keV band. The light curve was grouped into 200 phase bins and folded according to 0.073711 day photometric period.
(c) Hardness Ratio (HR) variation. The HR has calculated with photons which have 0.2 - 0.8 keV and 0.8 - 2.3 keV energies. HRs increased during the times of the first dips.
(d) N_{H} variations of SRGEJ075818. The column density shows remarkable increase corresponding to the first dip only at 0.6 - 0.7 phase interval with large error margins (0.43(15)× $10^{22} cm^{2}$).

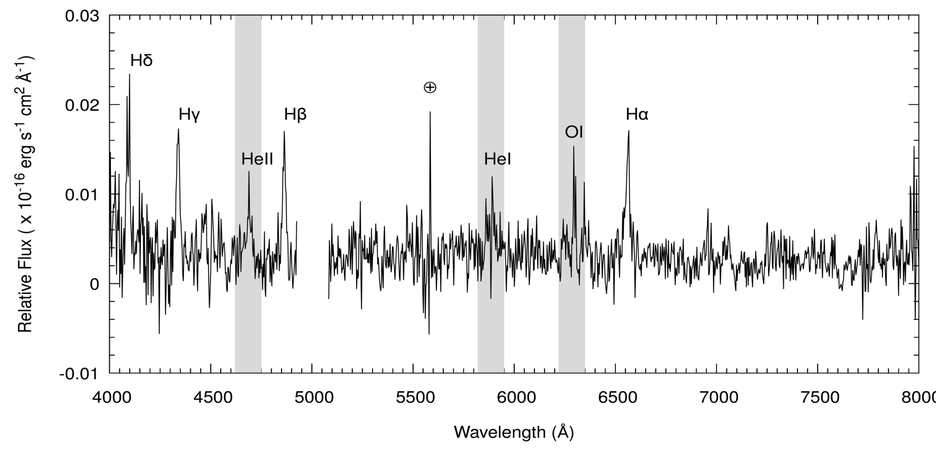

Fig. 5 *The SALT spectrum of the SRGEJ075818. Wavelength ranges which are strongly contaminated by sky lines or cosmic rays are indicated in grey.*

Observations

TESS observations were performed between July 5, 2020 and April 02, 2021. The X-ray observations of the object obtained on November 5, 2019 (OBS ID of 700018) and November 31, 2019 (OBS ID of 700019), during calibration and performance verification (CalPV). The eROSITA All Sky Surveys were performed in June 2020 (eRASS1), December 2020 (eRASS2) and June 2021 (eRASS3), respectively

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