The giant, ultra-soft, and luminous X-ray outburst from the optically inactive galaxy pair RX J1242.6-1119: flare of a tidally disrupted star ?

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Abstract. We report the detection of a large X-ray flare from the direction of the previously unknown, optically inactive galaxy pair RX J1242.6-1119 and discuss outburst scenarios.

Observations

RX J1242-11 showed strong variability between two *ROSAT* observations taken 2 yrs apart: Whereas the source is not detected during the *ROSAT* all-sky survey ($CR < 0.015$ cts/s), it is present in a pointed PSPC observation with $CR = 0.3$ cts/s, revealing **variability** by at least a **factor of 20**.

The high-state spectrum is **ultra-soft** ($kT_{\rm bb} \simeq 0.06$ keV when fit by a black body). We derive an intrinsic luminosity of $\mathbf{L_x > 9\,10^{43}}$ **erg/s**.

Optical imaging shows two galaxies in the X-ray error circle (Fig. 1). Other objects are fainter then $\sim 22^{\rm m}$.

Optical spectroscopy performed several years after the X-ray high-state observation reveals that **both galaxies are *non*-active**; no Seyfert-typical emission lines are detected (Fig. 2).

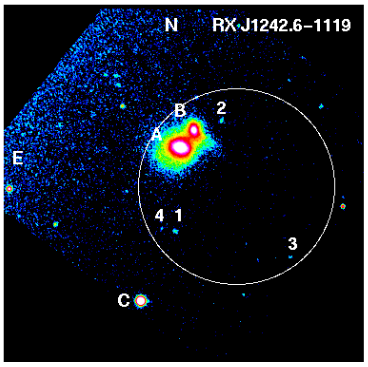

Fig. 1: A 2′.5×2′.5 V band image of the region around RX J1242.6–1119. The circle marks the X-ray position uncertainty of 40″ radius. "A" and "B" denote the galaxy pair, and numbers 1–4 mark faint objects in the error circle, sorted according to brightness: 21.8, 22.0, 22.0 and 22.4 mag, respectively.

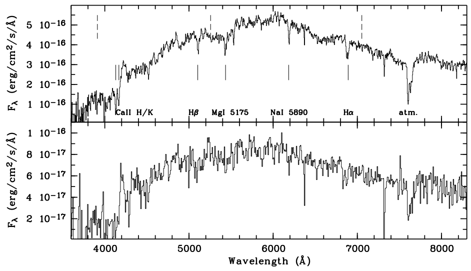

Fig. 2: Optical spectra of the two galaxies. Prominent absorption lines are marked, together with the expected locations of undetected emission lines of [OII]λ3727, [OIII]λ5007 and [SII]λ6717 (dashed lines, from left to right).

Outburst scenarios

Both, the dramatic X-ray variability and the huge outburst luminosity of RX J1242-11 are very rare among *non-active* galaxies. The only previous cases are the UV outburst in NGC 4552 (Renzini et al. 1995; but note that there are indications of permanent low-level activity in this galaxy) and the X-ray outburst of the HII galaxy NGC 5905 (Bade et al. 1996, Komossa & Bade 1999). Potential outburst scenarios are as follows (see Komossa & Greiner 1999 for details):

- *Galactic foreground object*: This is unlikely, since further optical sources within the X-ray error circle are extremely weak. Given the high $L_{\rm X}/L_{\rm opt}$ value, an ISM accreting neutron star might come to mind, but the strong X-ray variability would require an extreme ISM density gradient, thus leading us to reject this possibility.
- *Stellar sources within the galaxy pair* (like X-ray binaries, or a supernova in dense medium) fall several orders of magnitude short in explaining the huge outburst luminosity.
- *Accretion disk instability:* An accretion disk around a central SMBH in one of the two galaxies may exhibit burst-like oscillations due to, e.g., thermal instabilities. However, in case of repeated such outbursts in RX J1242-11, one would expect to see permanent AGN-typical NLR emission lines (like [OI] or [OIII]) in the optical spectrum of one of the two galaxies which are not detected.
- *Accretion event onto a SMBH:* The giant peak luminosity of at least $\sim 10^{44}$ erg/s in the (0.1–2.4 keV) energy band suggests that we have seen the flare of a star that was tidally disrupted by a SMBH (Rees 1988, 1990) at the center of one of the two galaxies.

Such X-ray outbursts provide important information on the presence of SMBHs in non-active galaxies, the accretion history of the universe, and the link between active and normal galaxies. Future X-ray surveys (like the one that was planned with ABRIXAS) will be valuable in finding further of these outstanding sources.

References:

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