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A possible state transition in the low-mass X-ray binary XSS J12270-4859

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Referred to by ATel #: [5651](#), [5652](#), [5747](#), [5890](#), [6162](#)



Spurred by the recent state change in the "missing link" pulsar binary system PSR J1023+0038 (ATel #[5513](#), #[5514](#), #[5515](#), #[5516](#); Stappers et al. 2013, arXiv:1311.7506; Patruno et al. 2013, arXiv:1310.7549) we report on optical, radio, X-ray and gamma-ray observations of the low-mass X-ray binary XSS J12270-4859, conducted between 2012 March 29 and 2013 December 10.

XSS J12270-4859 has previously been proposed as the only low-mass X-ray binary seen as a Fermi gamma-ray source (1FGL J1227.9-4852/2FGL J1227.7-4853; de Martino et al. 2013, A&A 550, A89, Hill et al. 2011, MNRAS 415, 235). The recent state change of PSR J1023+0038 has been accompanied by a five-fold increase in gamma-ray luminosity, suggesting that XSS J12270-4859, and similar systems, may also show gamma-ray variability and perhaps transition between the LMXB state and the radio pulsar state.

Optical monitoring of XSS J12270-4859 over the past four years shows that the source decreased by 1.5 to 2 magnitudes in brightness some time between 2012 November 14 and 2012 December 21 ([B. Monard, 2013](#)). Optical spectra obtained with EFOSC2 at the NTT on 2013 November 8 show weak absorption lines of hydrogen alpha and beta as well as the sodium doublet at 5890 and 5896 Angstrom. The spectral type is consistent with late-G/early-K. This spectrum is in marked contrast to those obtained with the same instrument in 2012 March 29 to April 1, which show strong hydrogen and helium emission lines, comparable to the spectrum published in [Massetti et al. \(2006, A&A 459, 21\)](#). R-band photometry of acquisition images obtained during the 2012 and 2013 spectroscopic observations confirms the 1.5-mag decrease in the brightness of the source.

More recently, XSS J12270-4859 was observed in X-rays with a 2-ks pointed Swift/XRT observation carried out on 2013 December 10 at 06:26:00 UT. The 0.3-10 keV count rate is approximately 0.015 ct/s, which is more than a factor ten lower than the 0.3-10 keV average count rate reported by [de Martino et al. \(2013\) \(0.2-0.3 ct/s\)](#). This flux corresponds to a 0.3-10 keV X-ray luminosity of approximately $1e32$ - $1e33$ erg/s for an assumed power-law model with spectral index between 1 and 2, a negligible absorption, assuming a distance between 1 and 3 kpc. This count rate is also at least a factor 2 lower than the minimum count rate observed by [de Martino et al.](#) during the dips of this source, confirming that XSS J12270-4859 has likely

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changed state.

The public Fermi gamma-ray light curve of 2FGL J1227.7-4853 shows a hint of a decrease in gamma-ray flux coincident with the decrease in optical brightness ([link](#)), though we note that the public light curve may be contaminated by photons from unrelated sources as no background subtraction is performed. The gamma-ray change, if real, does not appear as pronounced as what has been observed in PSR J1023+0038 (Stappers et al. 2013, arXiv:1311.7506).

The optical and X-ray monitoring of XSS J12270-4859 suggests that this source has a very similar phenomenology to PSR J1023+0038 and that it has transitioned from a quiescent low-mass X-ray binary state into a new faint state where no signatures of accretion are visible. This suggests that a radio millisecond pulsar may now be visible in the system. As part of an approved DDT campaign, we are acquiring Parkes pulsar search data. Analysis of those data is ongoing.

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