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Swift follow-up observations of outburst from H 1658-298

ATel #8046; *A. Bahramian, C. O. Heinke (Alberta), R. Wijnands (Amsterdam), N. Degenaar (Cambridge), G. Ponti (MPE)*
on 12 Sep 2015; 19:33 UT
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Subjects: X-ray, Binary, Neutron Star, Transient

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Following reports of the new outburst from the X-ray binary H 1658-298 (ATels #7943, #7946, #7947), we monitored the source with Swift/XRT. Here we report an initial analysis of these observations:

Observations on Sep. 7th and 9th were taken in multiple segments a few hours apart and we extracted the spectrum from each segment separately. In the first observation of this campaign on Aug 25, 2015 (ATel #7947), the source had shown an unabsorbed flux of $6e-10$ erg/s/cm² (0.5-10 keV band). However, later observations of our campaign indicate an increase to an average flux of $1.2e-9$ and $1.0e-9$ erg/s/cm² on September 7th and 9th respectively. We performed spectral fitting in the 0.3-10 keV range for the XRT photon counting mode data and 0.6-10 keV for the XRT windowed timing mode data. We find that the spectra are slightly better described by a power-law model (reduced chi-squared of 1.1 for 515 d.o.f), compared to a disk-blackbody model (reduced chi-squared of 1.2 for 515 d.o.f) in which we notice a clear trend in residuals in the high energy tail (> 5 keV) of the spectra. However, the power-law fit shows a trend in residuals at low-energy (< 1.0 keV). Adding a partial covering absorption model (pcfabs in XSPEC) improves the fit and eliminates these trends (reduced chi-squared of 1.0 for 513 d.o.f).

Fitting with the absorbed partially covered power-law model yields a variable NH between $1e21$ and $4e21$ cm⁻² and power-law photon index between 1.6 and 2.0. We tied the partial covering parameters between all epochs - excluding epochs with detected dips - and found a covering fraction of $0.6(+/-0.2)$ and absorption of $1.1(-0.3/+0.5)e22$ cm⁻².

This partial covering is consistent with the previous observations of the source as it has shown eclipses and dipping behaviour in the past indicating an edge-on view (Cominsky & Wood 1984, ApJ, 283, 765). We also observed evidence of dips (in observations on Sep 7th and 9th) and a faint X-ray burst (on Sep 9th).

The burst shows a peak flux of $6.7e-9$ erg/s/cm² which, assuming a distance of 10 kpc (e.g. Oosterbroek et al. 2001, A&A, 376, 532) corresponds to a luminosity of $\sim 5e37$ erg/s (0.5-10 keV). We tried fitting the spectrum from the burst with either a power-law or blackbody. In both cases we used absorption and partial covering models and fixed their parameters to values found from spectral analysis of the epoch in which the burst occurred (analysis performed with excluding the burst interval). Fitting the burst with a power-law gives a very hard photon index of $0.5(+/-0.2)$ and reduced chi-squared of 1.0 for 23 d.o.f. However replacing this with a blackbody model gives a blackbody temperature of 1.6 keV and reduced chi-squared of 0.9 for

23 d.o.f. The normalization of the blackbody gives an inferred radius of $\sim 7^{(+2)}(d/10 \text{ kpc})^2$ km. Considering the uncertainties in the distance to this source, and that X-ray burst spectra are slightly harder than blackbodies causing the radius to be underestimated, this is consistent with emission from the neutron star surface.

Further Swift/XRT observations of this source are planned. We thank the Swift team for rapidly scheduling our observations.

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