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Swift/XRT associates X-ray brightening episode in M15 to a source in its core

ATel #5396; *Arash Bahramian, Craig O. Heinke, Gregory R. Sivakoff (U. of Alberta), Diego Altamirano, Rudy Wijnands (U. of Amsterdam)*
on 17 Sep 2013; 15:18 UT
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Subjects: X-ray, Globular Cluster, Neutron Star, Transient

Referred to by ATel #: [5490](#)

Following a MAXI report of brightening from a source in M15 (ATel #[5327](#)), we performed a ~1 ks Swift/XRT observation of M15 in PC mode on September 7, 2013 at 6.35 UT (Obs.ID 91683028).

Using the online tool to build XRT products, we found the centroid of the X-ray emission to be RA=21h 29m 58.67s and Dec=+12deg 09' 58.4" with a reported radial error of 3.5". This appears inconsistent with the positions of the two previously known bright persistent sources (AC-211 & M15-X2) in the core of M15, as it is 7" from the nearest. We compared the known positions of AC 211 and M15 X-2 (White & Angelini 2001, ApJ, 561, L101) to the measured centroid of the X-ray emission from M15 from previous Swift/XRT PC observations during more typical X-ray emission from the cluster, and noticed a few arcsecond (~6") offset in some cases. Therefore, we cannot rule out that the currently bright source is one of the known persistent sources. The shape of the PSF, with only one saturated hole, indicates that the active transient is located in or close to the core (otherwise AC211 and M15 X-2 would produce a second detectable hole in the PSF due to saturation). Note that M15 X-2 was responsible for at least one similarly bright X-ray flare (ATel #[3393](#)), and that other persistently bright ultracompact X-ray binaries exhibit similar flaring episodes (in't Zand et al. 2007, A&A, 465, 953).

The source is heavily piled-up in this observation. Following the UKSSDC pile-up thread, we extracted a spectrum from an annulus with radii 17 to 120 arcsec.

Fitting an absorbed power-law in Xspec (tbabs*pegpwlw, with abundances from Wilms et al. 2000, ApJ, 542, 914 and photoelectric absorption cross-sections from Verner et al. 1996, ApJ, 465, 487) yields a (interstellar + intrinsic) column density of $N_H = (1.6 \pm 0.2)e^{21} \text{ cm}^{-2}$ and a photon index of 1.86 ± 0.06 , with a reduced chi-squared of 0.76 for 82 degrees of freedom. Assuming a distance of 10.3 kpc, the total flux in the 0.5-10 keV band is $(1.18 \pm 0.04)e^{37} \text{ erg s}^{-1}$. We note that the best-fit column density is significantly larger than that reported for the cluster (either $4.6e^{20} \text{ cm}^{-2}$ Janulis 1992, Baltic Astr., 1, 25 or $6.7e^{20} \text{ cm}^{-2}$ Hannikainen et al. 2005, MNRAS, 357, 325). A fit with N_H fixed to the cluster value gave a reduced chi-square value of 2.2. This could indicate either that there is substantial N_H intrinsic to the binary during this observation, or that a power-law is not an accurate description of the spectrum. As an example of a more complex spectral fit, we tried a disk blackbody (diskbb in XSPEC) plus power-law, and were able to find reasonable (reduced chi-square of 0.84) spectral fits with the

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N_H fixed to the cluster value, giving $kT_{in}=0.8 \pm 0.1$ keV and a power-law photon index of 1.3 ± 0.2 . We do not claim that this is the best or most appropriate spectral fit, merely that a spectrum with intrinsic curvature can remove the need for intrinsic N_H .

We thank the Swift team for rapidly scheduling our observation.

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