X-Ray Studies of the Central Compact Objects in Puppis-A & RX J0852.0-4622

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ABSTRACT: The Supernova remnants (SNRs) Puppis-A and RX J0852.0-4622 (Vela-Junior) are located along the line of sight towards the outer rim of the Vela SNR. Central compact objects (CCOs) were discovered in each of them. Both CCOs are thought to be the compact stellar remnants formed in core-collapsed supernova explosions. Nevertheless, the emission properties observed from these sources are completely different from what is observed in other young canonical neutron stars. Based on observations with the X-ray observatories Chandra and XMM-Newton, we present the most recent results from a detailed spectro-imaging and timing analysis of these two enigmatic sources.

CCOs are generally characterized by their locations near to the expansion centers of SNRs, the high X-ray to optical flux ratios and the lack of long term flux variability. These evidences suggest that this group of enigmatic compact objects is a new manifestation of neutron stars, though their physical nature has not been completely resolved. Recently, we have presented results from a detailed X-ray analysis of the CCOs in Puppis-A and RX J0852.0-4622 (cf. Hui & Becker 2006a and Becker, Hui, Aschenbach & Iyudin 2006 astro-ph/0607081).

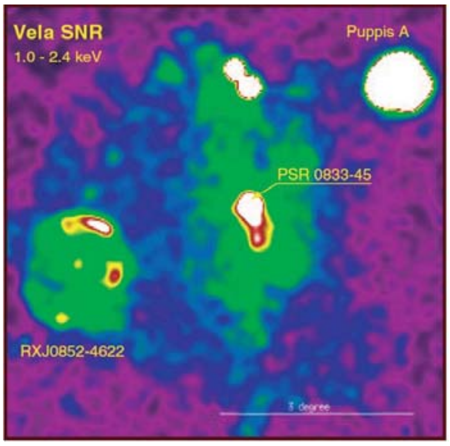

Fig. 1: *Vela & Friends:* The two SNRs Puppis-A and "Vela Junior" are both located at the edge of the Vela supernova remnant. The image is taken from the ROSAT-all sky survey.

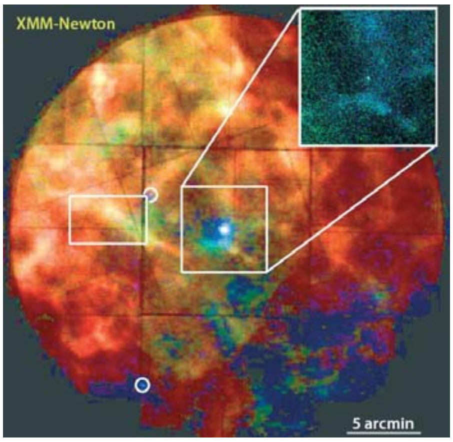

Fig. 2: XMM-Newton MOS1/2 false color image of the inner 30 arcmin central region of Puppis A (red: 0.3-0.75 keV, green: 0.75-2 keV and blue: 2-10 keV). The central source is RX J0822-4300. The inset shows the squared region as observed by the Chandra HRC-I. Two other hard X-ray sources detected in the field of view are encircled.

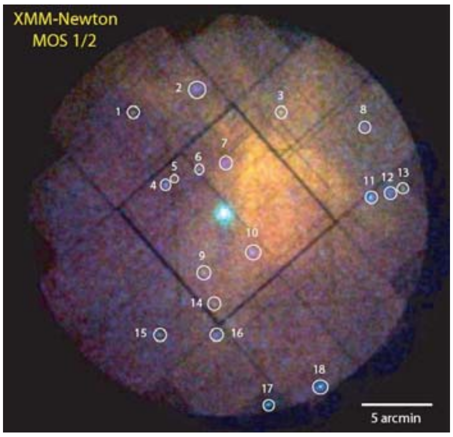

Fig. 3. XMM-Newton MOS1/2 false color image of the inner 30 arcmin central region of RX J0852.0-4622 (red: 0.3-0.75 keV; green: 0.75-2 keV and blue: 2 -10 keV). The central bright source is CXOU J085201.4-461753. It is located at the edge of a faint diffuse X-ray structure which emits mostly in the soft band below ~ 2 keV. 18 other point-like sources, marked by circles, are detected in the field of view.

A detailed analysis of the CCO, RX J0822-4300, in Puppis-A has made use of all the XMM-Newton and Chandra data available from it by the beginning of 2005 (Hui & Becker 2006a). The point source spectra from two XMM-Newton observations were simultaneously fitted to a number of spectral models. A double blackbody yields the best description of the observed energy spectrum (reduced χ^2 =1.20 for 465 dof). The fitted parameters are the column density N_H= (4.11-5.03)$\times10^{21}$ cm^{-2} , the temperatures T_1=(2.35-2.91)$\times10^6$ K and T_2=(4.84-5.3)$\times10^6$ K and the black body emitting areas R_1=(2.55 - 4.41) km and R_2=(600 - 870) m, respectively. This suggests the emission is thermal origin and is emitted from areas with an anisotropic heat distribution. Comparing the energy fluxes as measured from the XMM-Newton and Chandra data with the energy flux which was measured by ROSAT about 10 years ago shows no long term variability. The X-ray image taken with the Chandra HRC-I camera allowed for the first time to examine the spatial nature of RX J0822-4300 with sub-arcsecond resolution. This constrains the point source nature of the CCO down to a FWHM of 0.59±0.01 arcsec. A search for X-ray pulsations from RX J0822-4300 revealed an interesting periodicity candidate which, if confirmed, does not support a scenario of steady spin-down. Very recently, we have examined the possible proper motion of RX J0822-4300 with two Chandra HRC-I observations separated by ~5 years (Hui & Becker 2006b; please see also poster JD02-60). The position of RX J0822-4300 is found to be different by 0.574±0.184 arcsec, implying a proper motion of 107.49±34.46 mas/yr with a position angle of 241±24 degree. For a distance of 2.2 kpc, this proper motion is equivalent to a recoil velocity of 1121.79±359.60 km/s.

We have observed the CCO CXOU J085201.4-461753 in the RX J0852.0-4622 with XMM-Newton for several times (Becker et al. 2006). The spectrum of CXOU J085201.4-461753 is best described by a double blackbody (reduced χ^2 =1.08 for 429 dof). The double blackbody yields the column density N_H= (3.52-4.18)$\times10^{21}$ cm^{-2} , the temperatures T_1=(3.52-4.26)$\times10^6$ K and T_2=(5.42-9.62)$\times10^6$ K and the black body emitting areas R_1=(0.32-0.41) km and R_2=(16-123) m, respectively. On the contrary to the Chandra observation reported by Kargaltsev et al. (2002), we did not find any indication for the line feature in these XMM-Newton observations. In the timing analysis, no period was found down to a 3% (3-σ upper limit) for any pulsed fraction.

References:

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