XMM-Newton Observation of PSR B1957+20

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ABSTRACT: The "Black Widow pulsar", PSR B1957+20, is a millisecond pulsar which is in a 9.16-hour binary system. Hα bow-shock nebula created by the interaction between the relativistic wind of the pulsar and the surrounding ISM and ablation of the low-mass companion star by the pulsar wind were observed. We report on a 30 ksec observation of PSR B1957+20, using the EPIC-MOS detector on-board the XMM-Newton Observatory. The detect X-ray diffused emissions detected from this source is consistent with the result derived from Chandra observations. The spectrum of the nebular emission can be modeled with a single power law spectrum of photon index 2.3 ± 0.2. The extended emission generated by accelerated particles in the post shock flow is considered to explain this result.

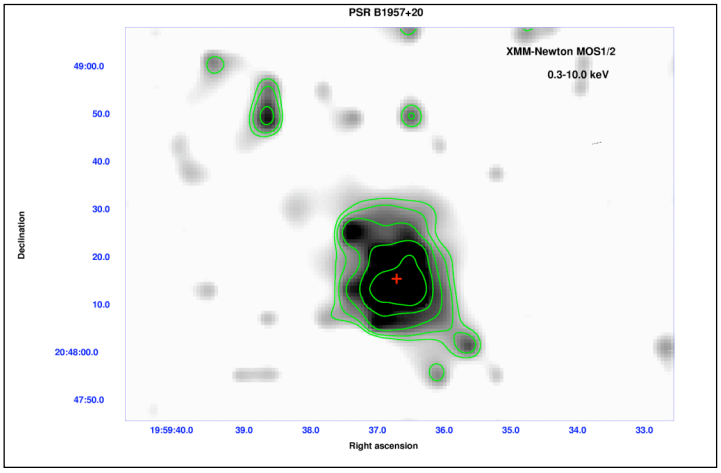

Figure 1. XMM-Newton MOS1/2 image of PSR B1957+20 with the overlaid contours. Adaptive smoothing with a Gaussian kernel of σ < 4 pixels has been applied to the image which has the binning factor of 6 arcsec. The contour lines are at the levels of (5, 6.3, 9.3, 16.1, 31.9, 68) x 10^{-6} cts s^{-1} $arcsec^{-2}$. The red cross indicates the position of the pulsar.

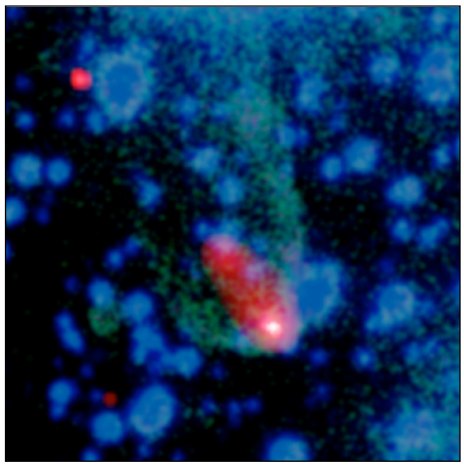

Figure 2. This composite X-ray (red/white) and optical (green/blue) image reveals an elongated cloud of high-energy particles flowing behind PSR B1957+20 (white point-like source). Credit: X-ray: NASA/CXC/ASTRON/B. Stappers et al., Optical: AAO/J.Bland-Hawthorn & H.Jones

A 30-ksec observation obtained from XMM-Newton MOS1/2 was conducted. An elongated morphology associated with PSR B1957+20 in the energy range of 0.3 - 10.0 keV was obtained (Figure 1). This is in line with the previous results derived from the Chandra data (Stappers et al. 2003).

After subtracting the background photons, in total 369 source counts were available in our analysis. The X-ray spectrum in the 0.3- 12.0 keV energy band can be modeled with a single power law spectrum of photon index 2.3 ± 0.2 (Figure 3). The unabsorbed fluxes are 8.62 x 10^{-14} and 9.44 x 10^{-14} erg sec^{-1} cm^{-2} in the energy range of 0.1-2.4 and 0.3-12.0 keV, respectively.

Reference:

• Arzoumanian, Z., Fruchter, A. S., Taylor, J. H., 1994, ApJ, 426L, 85

• Becker, W., Truemper, J., 1999, ApJ, 341, 803

• Stappers, B. W., Gaensler, B. M., Kaspi, V. M., van der Klis, M., Lewin, W. H. G., 2003, Science, 299, 1372

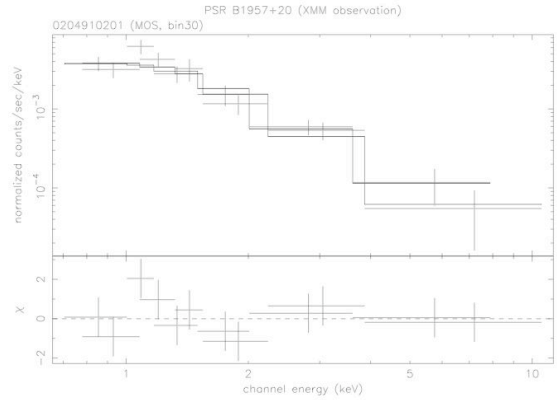

Figure 3. Energy spectrum of PSR B1957+20 obtained from the XMM MOS1/2 data. The X-ray spectrum can be fitted with an absorbed power law model.

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