LMC P3: An Extreme Particle Accelerator

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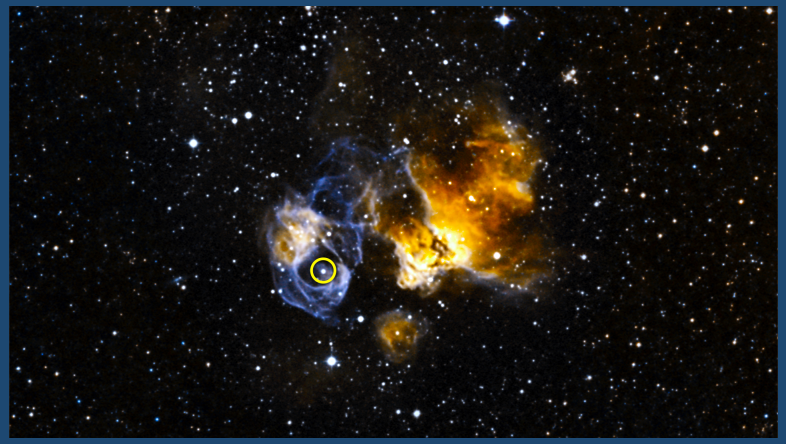
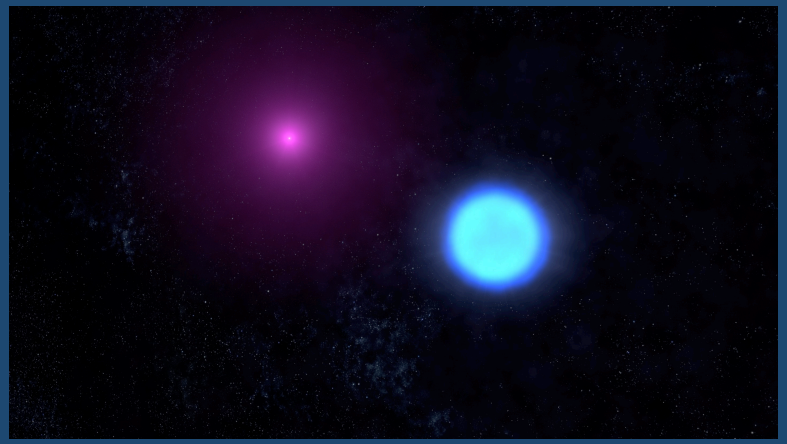
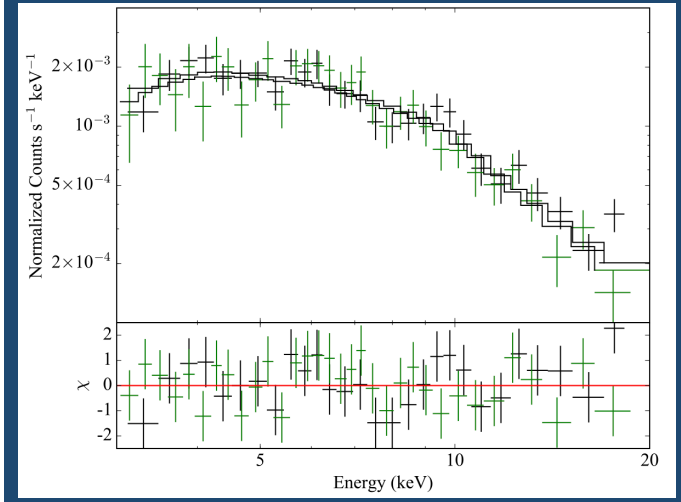




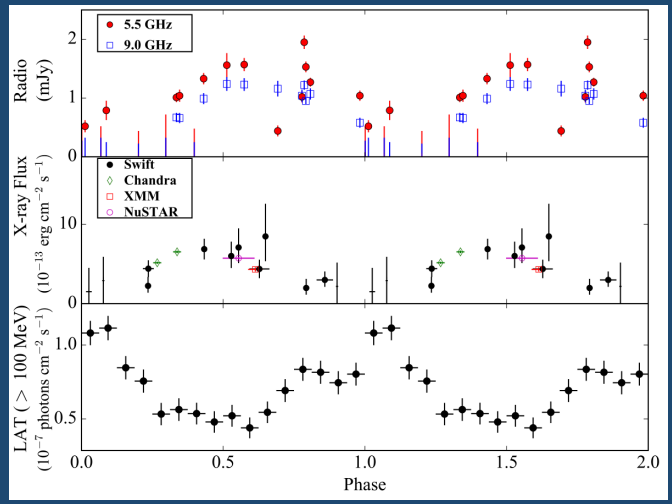
Persistent gamma-ray emission dominates the radiative output of gamma-ray binaries, which are thought to be the evolutionary precursors to X-ray binaries. Often, this is attributed to particle acceleration in the shock from the winds of an optical companion and rapidly spinning pulsar or inverse Compton scattering of UV photons in the relativistic jet of an accreting compact object. We present NuSTAR observations of the newly discovered gamma-ray binary LMC P3 during the X-ray maximum of its 10.3 day orbit. Currently the only gamma-ray binary found outside the Milky Way, Fermi observations revealed LMC P3 to be significantly more luminous than similar binary systems in gamma rays—a characteristic of the source also present in all other observed energy bandpasses. This extreme behavior could possibly be driven by a large spin-down power from the suspected pulsar, as well as a higher UV photon seed density of the O5 III star, but the details of the high energy emission region remain perplexing. We probe the geometry and physical conditions of the high-energy emission region and investigate the nature of the compact object.

NuSTAR X-ray Spectrum

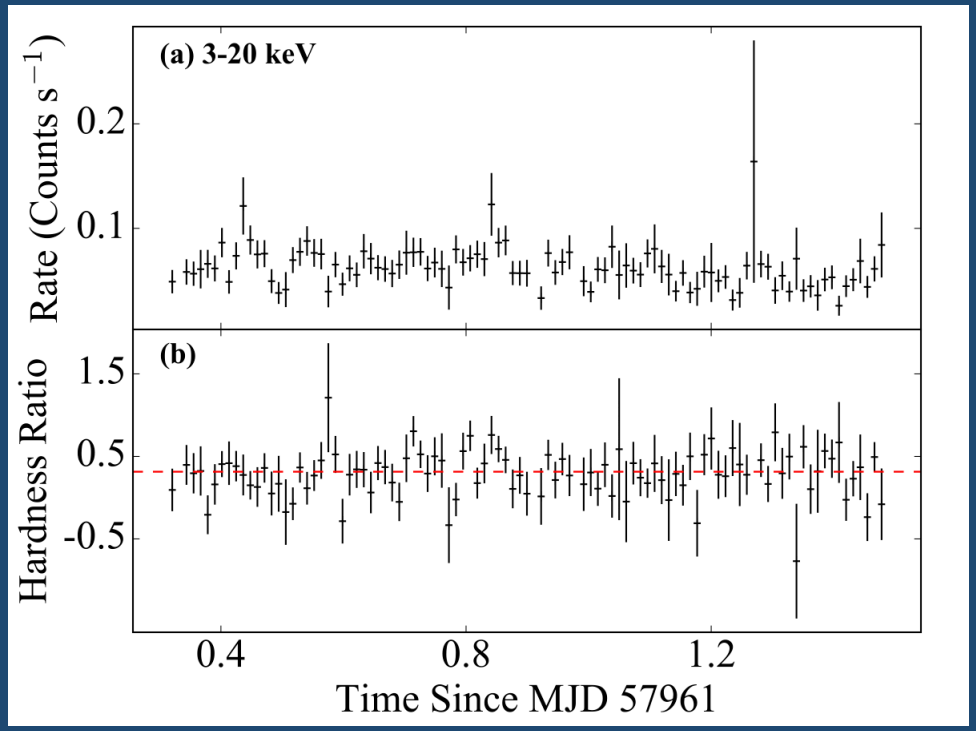


NuSTAR X-ray spectrum in the 3-20 keV band. The continuum is best fit with an absorbed power law with spectral index 1.62±0.06 and X-ray flux $(5.7\pm0.2)\times10^{-13}$ erg cm^{-2} s^{-1} in the 3-10 keV band.

NuSTAR X-ray Spectrum



NuSTAR 3-20 keV Light Curve



Summary

While gamma-ray photons dominate the radiative output of High Mass Gamma-ray Binaires, what makes X-ray radiation of particular importance is it can be used as a proxy to study particle acceleration. With NuSTAR observations in the 3-20 keV bandpass, we find the photon index to possibly be consistent with synchrotron emission. With our new XMM-Newton and NuSTAR observations, we hope to probe key physical parameters of the colliding wind between the probable rapidly rotating pulsar and O5 III normal star.

References:

1) Bamba, A. et al. 2006, A&A, 450, 585
2) Corbet, R. et al. 2016, ApJ, 829, 10
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4) Seward, F. D. et al. 2012, ApJ, 759, 123