High Energy Pulsations from PSR J2022+3842

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PSR J2022+3842[1] is a young, energetic pulsar with a characteristic age of 8.9 kyr and spin down power 3.0 x 10^{37} erg s^{-1} . Located in SNR G76.9+1.0, and spatially coincident with a Fermi LAT source[2], pulsations with a period of ~48.6 ms have been observed in radio by the GBT, as well in the X-ray band by Chandra, RXTE, and XMM-Newton[3]. Large amounts of timing noise typical of young pulsars combined with the radio-faint nature of this pulsar makes deriving a global timing solution that smoothly connects all individual observations challenging. Analysis with the Fermi LAT, although complicated by high levels of background in the target region, can help bridge these gaps. In this work we present a preliminary analysis of data from NuSTAR showing strong pulsations from PSR J2022+3842 in the 3-79 keV energy range. Continuing a Fermi LAT analysis which confirmed MeV-GeV pulsations[4], we now analyze over 10 years of Pass 8 data at energies >60 MeV.

Chandra (0.3-12 keV)

54 ks

PSR J2022+3842 discovery data.

RXTE (2-60 keV)

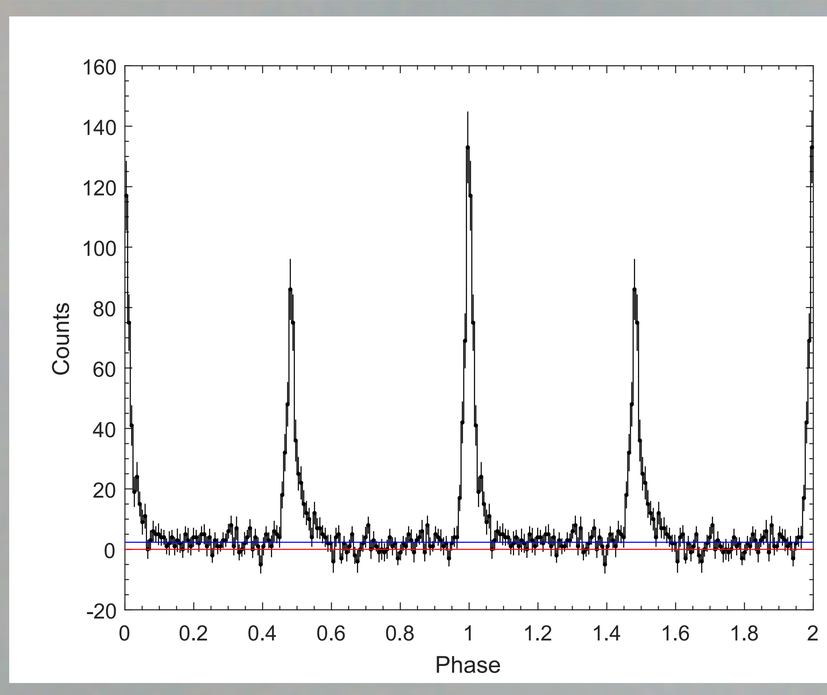
99 ks

XMM-Newton (0.5-12 keV)

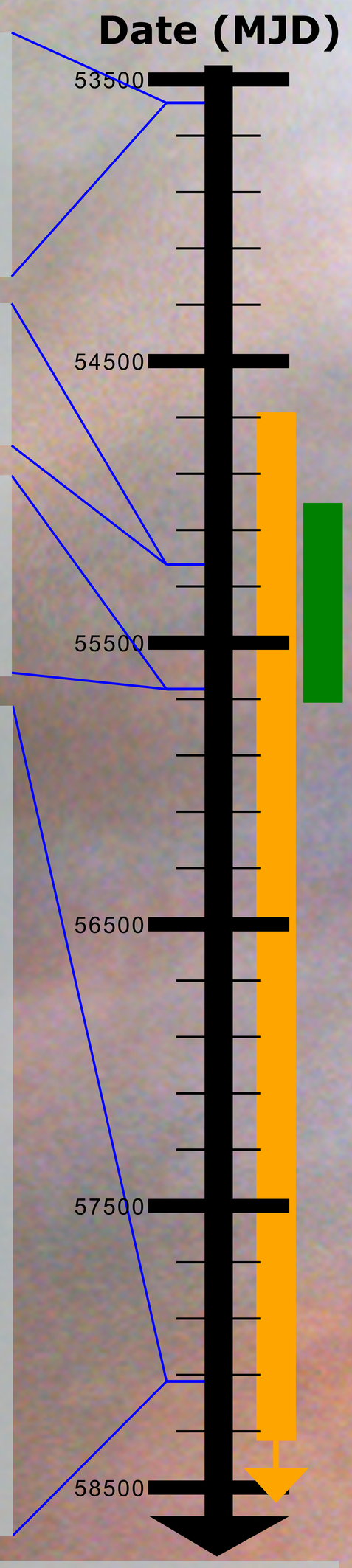
110 ks

NuSTAR (3-79 keV)

54 ks



New NuSTAR observations show a pulsed profile (black) consistent with that of previous x-ray telescopes. The background-subtracted zero point is shown in red, and the average count in off-pulse bins is shown in blue.



Fermi LAT (60 MeV - 30 GeV)

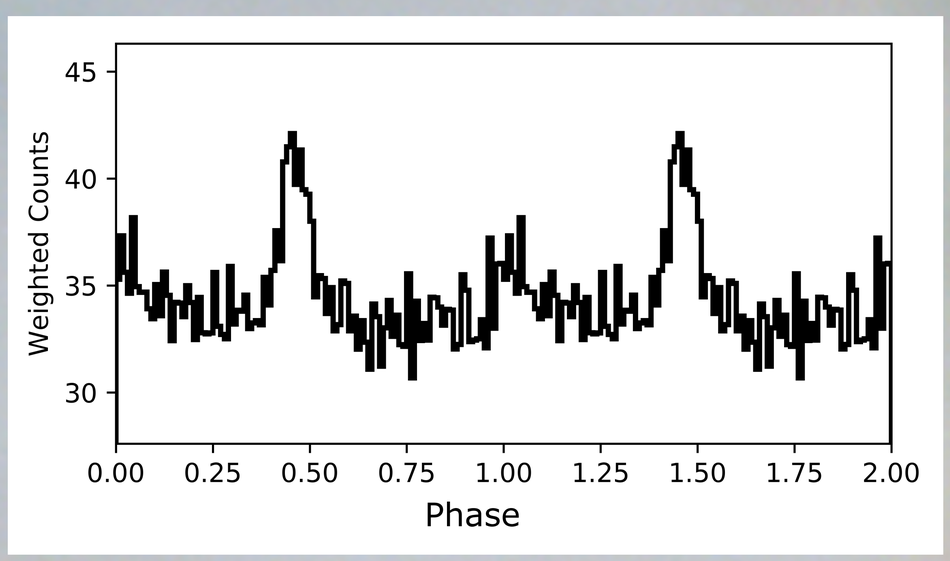
10 years +

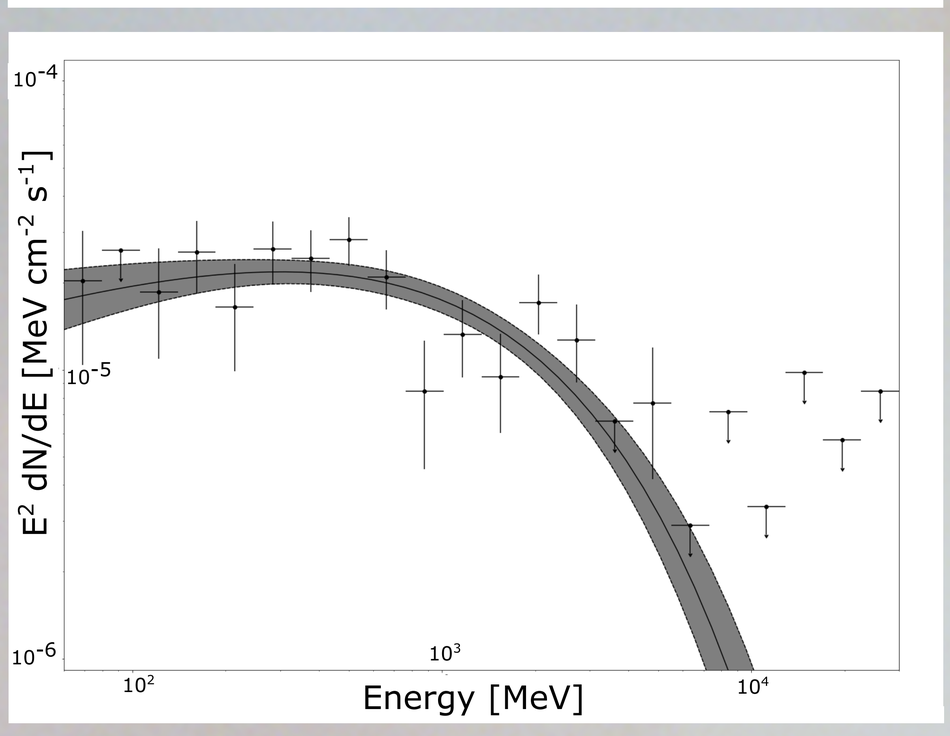
The Fermi LAT provides long term, high energy analysis of PSR J2022+3842.

Fermi LAT: Preliminary

709 Days

Analyzing a small fraction of Fermi LAT data confirms that PSR J2022+3842 pulses in the gamma-ray spectrum. This timing solution will be extended to connect observations from RXTE, XMM-Newton and NuSTAR. It was used to produce a phase-resolved SED, which will likewise be improved when the timing solution expands.





[1] Z. Arzoumanian et al. (2011). Discovery of an Energetic Pulsar Associated with SNR G76.9+1.0. The Astrophysical Journal.

[2] Kuiper and Hermsen (2015). The Soft gamma-ray Pulsar Population: a High-Energy Overview. MNRAS, Volume 449, Issue 4, Pages 3827-3866.

[3] P. Arumugasamy et al. (2014). XMM-Newton Observations of Young and Energetic Pulsar J2022+3842. The Astrophysical Journal, Volume 790, Number 2.

[4] H. Ohuchi et al. (2015). Does PSR J2022+3842 emit gamma-rays?. 2015 Fermi Symposium.