PSR J0007+7303 in the CTA1 SNR: New Gamma-ray Results from Two Years of *Fermi*-LAT Observations

A. A. Abdo[1], K. S. Wood[2], M. E. DeCesar[3,4], F. Gargano[5], F. Giordano[5,6], P. S. Ray[2], D. Parent[1], A. K. Harding[3], M. Coleman Miller[7], D. L. Wood[8], M. T. Wolff[2]

ABSTRACT

One of the main results of the *Fermi Gamma-Ray Space Telescope* is the discovery of γ-ray selected pulsars. The high magnetic field pulsar, PSR J0007+7303 in CTA1, was the first ever to be discovered through its γ-ray pulsations. Based on analysis of 2 years of LAT survey data, we report on the discovery of γ-ray emission in the off-pulse phase interval at the $\sim 6\sigma$ level. The flux from this emission in the energy range E $\geq$ 100 MeV is $F_{100} = (1.73 \pm 0.40) \times 10^{-8}$ photons cm^{-2} s^{-1} and is best fitted by a power law with a photon index of $\Gamma = 2.54 \pm 0.14$. The pulsed γ-ray flux in the same energy range is $F_{100} = (3.95 \pm 0.07) \times 10^{-7}$ photons cm^{-2} s^{-1} and is best fitted by an exponentially-cutoff power-law spectrum with a photon index of $\Gamma = 1.41 \pm 0.23$ and a cutoff energy $E_c = 4.04 \pm 0.20$ GeV. We find no flux variability neither at the 2009 May glitch nor in the long term behavior. We model the γ-ray light curve with two high-altitude emission models, the outer gap and slot gap, and find that the model that best fits the data depends strongly on the assumed origin of the off-pulse emission. Both models favor a large angle between the magnetic axis and observer line of sight, consistent with the nondetection of radio emission being a geometrical effect. Finally we discuss how the LAT results bear on the understanding of the cooling of this neutron star.

[1]Center for Earth Observing and Space Research, College of Science, George Mason University, Fairfax, VA 22030, resident at Naval Research Laboratory, Washington, DC 20375

[2]Space Science Division, Naval Research Laboratory, Washington, DC 20375-5352

[3]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

[4]Department of Physics and Department of Astronomy, University of Maryland, College Park, MD 20742

[5]Istituto Nazionale di Fisica Nucleare, Sezione di Bari, 70126 Bari, Italy

[6]Dipartimento di Fisica "M. Merlin" dell'Università e del Politecnico di Bari, I-70126 Bari, Italy

[7]Department of Astronomy, University of Maryland, College Park, MD 20742

[8]Praxis Inc., Alexandria, VA 22303, resident at Naval Research Laboratory, Washington, DC 20375