

Researchers using Arecibo Telescope discover never-before-seen pulsar blasts in Crab Nebula ^[1]

Submitted on 23 January 2007 - 2:26pm

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Contact: Blaine Friedlander bpf2@cornell.edu ^[2] 607-254-8093 Cornell University News Service
Bizarre emission spectrum leads to speculation: Is this a third magnetic pole? SEATTLE –
Astronomers and physicists using the Cornell-managed Arecibo Telescope in Puerto Rico have discovered radio interpulses from the Crab Nebula pulsar that feature never-before-seen radio emission spectra. This leads scientists to speculate this could be the first cosmic object with a third magnetic pole. "We never see the strange frequency structure in the main pulse and we never see the really short blasts in the interpulse," said Tim Hankins, acting director of the Arecibo Observatory and a co-investigator on this research. "We fully expected the main pulse and interpulse to be spectrally identical, but what we found is that they are very different. This is the first time seeing this in a pulsar." Hankins, who also is an emeritus professor of physics at New Mexico Tech in Socorro, N.M., will present a poster, "Radio Emission Signatures in the High Frequency Interpulse of the Crab Pulsar," which he made with Jean Eilek, New Mexico Tech professor of physics, on Jan. 8, 2007, at the American Astronomical Society (AAS) convention in Seattle. "This is a cool result," said Eilek. "The fact that the 'left hand' and the 'right hand' of the pulsar – or the north and south magnetic poles – don't know what each other is doing, is very striking. It knocks just about every existing theory of pulsar radio emission for a loop." Because pulses from north and south poles should be identical, Eilek thinks this strange radio emission might be coming from another part of the pulsar. She speculates: "Maybe we've discovered an

unknown, unexpected 'third magnetic pole' somewhere else in the star." Pulsars are important to understand as they allow physicists to confirm Albert Einstein's Theory of Relativity. The magnetic and electrical fields of pulsars are far stronger than any laboratory can generate, and Hankins admits this is a difficult physics problem to understand. In the case of the Crab Nebula pulsar, located in the constellation Taurus, some 6,300 light years from Earth, the numbers boggle the mind: Plasma clouds in the pulsar's atmosphere send out the radio emission blasts in times as short as four-tenths of a nanosecond. This plasma cloud is smaller than a soccer ball. During their short lifetimes, their blasts of radio emission can be as powerful as 10 percent of the power of our sun "These strange emission features are not showing up in other pulsars," says Eilek. The researchers have been using Arecibo on several observation occasions, between 2004 and the present. They last conducted observations in December 2006. "Maybe the magnetic field is not as simple as we think. Right now, we're totally perplexed," she said. ### New Mexico Tech students Jared Crossley, Eric Plum and James Sheckard assisted in this research. Cornell's National Astronomy and Ionosphere Center manages Arecibo Observatory for the National Science Foundation, which funded this research.

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