Luminosity Evolution of Rotation-powered, High-energy Pulsars

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The Fermi, VERITAS and MAGIC experiments have detected pulsed signals from the Crab pulsar up to 400 GeV. The light curves and the spectra obtained from the Crab and other rotation-powered pulsars, suggest that the gamma-ray pulsars have high-altitude emission zones, which avoid super-exponential cutoff due to magnetic pair production. I thus examine the outer-magnetospheric emission model and demonstrate both analytically and numerically that their gamma-ray luminosity is naturally proportional to the square root of the spin-down luminosity [1], which is consistent with the Fermi observations (fig.).


Fig: Luminosity evolution of pulsar outer-magnetospheric accelerators as a function of the neutron-star spin-down luminosity. Two extreme chemical compositions of the neutron-star envelopes are considered: The red curves correspond to a heavy element envelope, while the blue and black ones a light element envelope. The solid, dash-dotted, and dash-dot-dot-dot curves represent numerical solutions [1]. The green filled circles designate the normal gamma-ray pulsars, while the blue filled squares do those detected by the gamma-ray blind search technique.