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Pulsars and pulsar wind nebulae at high energies

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Pulsars and their synchrotron nebulae have been extensively observed in the gamma-ray energy band only in the last 10 years. With the advent of the Fermi satellite the number of known gamma-ray emitting pulsars has increased by one order of magnitude, touching the 150 mark. On the other hand, the last generation of imaging Cherenkov telescopes proved that the pulsar wind nebulae are the most populous class of sources radiating in the VHE (>100 GeV) sky.
The now feasible population studies, together with the available high-precision spectral and morphological measurements led to important developments in understanding the physics of the neutron star magnetosphere and their surroundings. In addition a long-term monitor of the gamma-ray sky has revealed evidence of flux variability from the Crab nebula and the PSR J2021+41 pulsar, challenging the constant-emission paradigm.
A couple of more unexpected discoveries moves even forward this ongoing “pulsar revolution”. On the one hand, a new spectral component emerging above the expected synchro-curvature cutoff was observed in two young pulsars, the Crab and the Vela pulsars. In the case of the Crab, this new component reaches the TeV energies, requesting an extreme particle acceleration up to a 5x10ˆ6 Lorentz factor. On the other hand, the old and recycled millisecond pulsars, with 10ˆ-4 weaker magnetic fields with respect to the young pulsars, were established as a new class of gamma-ray emitters.

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