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Particle acceleration in pulsar magnetospheres

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Fermi Telescope has dramatically expanded the sample of gamma-ray pulsars. The quality of pulsar light curves and spectra is exceptional, and allows a direct study of the magnetospheric processes that lead to the emission of gamma-rays. I will review the theoretical understanding of pulsar magnetospheres and discuss how gamma-ray light curves and spectra can be used to determine the location of the emitting zones and the geometry of magnetic field. It is now clear that the emission is coming from the outer magnetosphere, where the deviations from dipolar field geometry due to plasma currents must be taken into account. I will discuss the modeling of gamma-ray light curves in plasma-filled (force-free) magnetospheres. The double-peaked nature of the gamma-ray light curves observed by Fermi tells us that the accelerating regions are related to the location of strong currents sheets in plasma-filled magnetosphere. Plasma physics and particle acceleration in these current sheets needs to be understood, and will be strongly constrained by modeling of the phase-resolved spectra from Fermi. Gamma rays carry a significant fraction of spin down energy in pulsars; thus, Fermi observations are probing the heart of the electromagnetic pulsar machine.