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Interpreting the GeV and TeV pulsar emission

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Fermi-LAT observations have provided a wealth of data in the GeV band. Moreover, recent observations from ground-based imaging atmospheric Cherenkov telescopes have revealed multi-TeV pulsed emission. The consensus from the latest theoretical modeling is that the high-energy pulsar emission is produced in the equatorial current sheet outside the light cylinder. I will discuss how the observational data along with theoretical considerations constrain the various emission processes (curvature, synchrotron, inverse Compton). I will show that the entire Fermi pulsar population (young and millisecond pulsars) lies on a Fundamental Plane that connects the total gamma-ray luminosity, the cut-off energy, the spin-down power, and the stellar surface magnetic field, which is consistent with curvature radiation emission. Nonetheless, synchrotron radiation can reproduce the lower energy (up to infrared) segment of the pulsar spectrum, while its photons can serve as the seeds that produce emission up to multi-TeV radiation in IC interactions with the high-energy curvature emitting electrons. Finally, I will present our innovative kinetic PIC models of global pulsar magnetospheres that validate the above description.

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