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Implementation of an offset-dipole magnetic field in a geometric pulsar emission code

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Abstract content
   (Max 300 words)

The field of gamma-ray pulsars (rapidly spinning and highly magnetized neutron stars (NSs)) has been revolutionized by the launch of <i>Fermi</i> Large Area Telescope (LAT) in June 2008. <i>Fermi</i> LAT will soon release its second pulsar catalogue describing the properties of some 117 gamma-ray pulsars. The light curves (LCs) of these pulsars show great variety in profile shape, and may be divided into three general profile classes based on the relative phase differences between their radio and gamma-ray pulses. Such diversity hints at distinct underlying magnetospheric and / or emission geometries for the individual pulsar classes. Detailed geometric modelling of the radio and gamma-ray LCs may therefore provide constraints on the magnetospheric and emission characteristics. We implemented an offset-dipole magnetic field in an existing geometric pulsar modelling code which already includes static and retarded dipole fields. The magnetic field lines of an offset dipole undergo small distortions due to retardation and asymmetric currents, therefore shifting the NS's polar caps (PCs) by different amounts and directions. This offset is characterized by a parameter ε, which gives the relative shift in units of the stellar radius (with $\varepsilon = 0$ corresponding to the static dipole case). We constructed sky maps and LCs for several pulsar parameters, magnetic fields, and geometric models, studying their effect on the resulting LCs. Standard two-pole caustic (TPC) and outer gap (OG) emission geometries were used. As an application, we compared our model LCs with <i>Fermi</i> LAT data for the bright Vela pulsar, and inferred the most probable configuration based on the <i>Fermi</i> data, thereby constraining Vela's low-altitude magnetic structure and system geometry.

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