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General-relativistic pulsars magnetospheres

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Pulsar magnetospheres are shaped by ultra-relativistic electron/positron plasmas flowing in a strong magnetic field and subject to strong gravitational fields. The former induces magnetospheric currents and space charges responsible for the distortion of the electromagnetic field based on pure electrodynamics. The latter induces other perturbations in these fields based on space-time curvature. The force-free approximation describes the response of this magnetosphere to the presence of currents and charges and has been investigated by many authors. In this context, general relativity has been less discussed to quantify its influence on the neutron star electrodynamics. It is the purpose of this paper to compute general-relativistic force-free pulsar magnetospheres for realistic magnetic field configurations such as the inclined dipole. We performed time-dependent simulations of Maxwell equations in the 3+1 formalism of a stationary background metric in the slow-rotation approximation. We computed the resulting Poynting flux depending on the ratio R/rL and on frame-dragging through the spin parameter as. Both effects act together to increase the total Poynting flux seen by a distant observer by a factor of a few. Moreover we retrieve the sinˆ2 chi dependence of this luminosity, chi being the obliquity of the pulsar, as well as a braking index close to n=3.

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