

Abstract Submitted
for the APR17 Meeting of
The American Physical Society

Pulsar magnetosphere: a new view from PIC simulations

GABRIELE BRAMBILLA, CONSTANTIONS KALAPOTHARAKOS, ANDREY TIMOKHIN, ALICE HARDING, DEMOSTHENES KAZANAS, NASA/GSFC — Pulsar emission is produced by charged particles that are accelerated as they flow in the star's magnetosphere. The magnetosphere is populated by electrons and positrons while the physical conditions are characterized by the so called force-free regime. However, the magnetospheric plasma configuration is still unknown, besides some general features, which inhibits the understanding of the emission generation. Here we show the closest to force-free solution ever obtained with a particle-in-cell (PIC) code. The importance of obtaining a force-free solution with PIC is that we can understand how the different particle species support the corresponding magnetosphere structure. Moreover, some aspects of the emission generation are captured. These are the necessary steps to go toward a self consistent modeling of the magnetosphere, connecting the microphysics of the pair plasma to its macroscopic quantities. Understanding the pulsar magnetosphere is essential for interpreting the broad neutron star phenomenology (young pulsars, magnetars, millisecond pulsars, etc.). The study of these plasma physics processes is also crucial for putting limits on the ability of these objects to accelerate particles.

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Date submitted: 29 Sep 2016

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