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Resistive Solutions for Pulsar Magnetospheres

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The current state of the art in the modeling of pulsar magnetospheres invokes either the vacuum or force-free limits for the magnetospheric plasma. Neither of these limits can simultaneously account for both the plasma currents and the accelerating electric fields that are needed to explain the morphology and spectra of high-energy emission from pulsars. To better understand the structure of such magnetospheres, we combine accelerating fields and force-free solutions by considering models of magnetospheres filled with resistive plasma. We formulate Ohm's Law in the minimal velocity fluid frame and construct a family of resistive solutions that smoothly bridges the gap between the vacuum and the force-free magnetosphere solutions. The spin-down luminosity, open field line potential drop, and the fraction of open field lines all transition between the vacuum and force-free values as the plasma conductivity varies from zero to infinity. For fixed inclination angle, we find that the spin-down luminosity depends linearly on the open field line potential drop. We consider the implications of our resistive solutions for the spin down of intermittent pulsars and sub-pulse drift phenomena in radio pulsars.

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