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Numerical Experiments on Magnetospheres of Weak Pulsars YURAN CHEN, Princeton University, FABIO CRUZ, Instituto Superior Tcnico, Lisbon, Portugal, ANATOLY SPITKOVSKY, Princeton University — Recent advances in numerical techniques and computational power have allowed us to simulate the pulsar magnetosphere from first principles using Particle-in-Cell techniques. These ab-initio simulations seem to indicate that pair creation through photon-photon collision at the light cylinder is required to sustain the pulsar engine. However for many rotation-powered pulsars, pair creation operates effectively only near the stellar surface where magnetic field is high. Without efficient photon-photon pair conversion, how these "weak pulsars" fill their magnetospheres and produce radio emission is still an open question. By pushing towards a parameter regime that was not studied in detail before, we discovered a range of self-consistent solutions to the pulsar magnetosphere that do not require pair production near the light cylinder. Depending on the electron-positron pairs produced, the pulsar transitions from a near-death state with little spin-down, through an highly time-dependent state where current is intermittent, to finally approaching a near force-free state with stable spin-down. We show the time evolution of all these different states, and attempt to compare these to the actual pulsar behaviors that we observe.

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