

## THE THEORY OF PULSAR WIND NEBULAE: RECENT PROGRESS

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Pulsar Wind Nebulae are highly intriguing astrophysical objects in many respects. They are the brightest and closest class of relativistic sources, and hence the ultimate laboratory for the physics of relativistic plasmas: several processes observed (or inferred to occur) in other classes of relativistic sources can here be studied with unique detail, like the acceleration and collimation of relativistic outflows, or the acceleration of particles at relativistic shocks.

I will review the current status of our theoretical understanding of Pulsar Wind Nebulae in light of the most recent 2D and 3D MHD modeling of these sources. I will discuss how these studies are taking us to the point when we can reliably use multi-wavelength observations of these nebulae as a diagnostics of the hidden physics of the pulsar wind and of the mechanism(s) through which particles are accelerated at the highly relativistic shock that terminates the wind. Finally I will briefly discuss the role of Pulsar Wind Nebulae as sources of cosmic ray leptons.

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