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Relativistic pulsar winds: structure, shocks, reconnection.

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Using the latest multi-wavelength observations of the inner-most regions of Crab nebular, we develop a model of relativistic pulsar winds that reproduces the detailed morphology of the Crab inner knot. We infer that a large equatorial sector of the wind, responsible for the production of the inner knot, is a low-magnetized flow - we see directly the surface of the termination shock. At intermediate polar angles the wind is highly magnetized. Using analytical and numerical approaches we develop a model of explosive reconnection events in relativistic highly magnetized post-shock plasma, and apply the model to explain the Crab gamma-ray flares. Flares are produced during explosive merger of macroscopic current-carrying magnetic flux tubes. During the merger small relative number of particles are accelerated to energies well above the average magnetic energy per particle.

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