Radio emission physics in the Crab pulsar

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ABSTRACT: Our high time resolution observations of individual giant pulses in the Crab pulsar show that both the time and frequency signatures of the interpulse are distinctly different from those of the main pulse. The main pulse can be resolved into short-lived, relatively narrow-band nanoshots. We believe these nanoshots are produced by soliton collapse in strong plasma turbulence. The high-frequency ($\gtrsim 5$ GHz) dynamic spectrum of the interpulse, on the other hand, contains microsecond-long emission bands which occur regularly over $\gtrsim 2$ GHz bandwidth. These bands cannot be explained by any current model of pulsar radio emission; we discuss some possible new models. In addition to having different spectra, giant interpulses have different polarization and dispersion characteristics. It follows that two types of coherent radio emission, and different magnetospheric propagation conditions, are occurring in this star.