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The Polarization of the Crab Pulsar with HST

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The linear polarization of the Crab pulsar as a function of pulse phase was observed by the High Speed Photometer on the Hubble Space Telescope in March, 1993. Observations were obtained in a bandpass centered on 2770 A using a 0.25 ms sample time, corresponding to a time resolution of 0.0075 in pulse phase. The UV polarization of the pulsar [Fig. 1] is strikingly similar to that observed in the visible (cf. Smith et al. 1988). The same values of polarization and the same swing of position angle occur through the main and secondary pulses. The polarization pulse profile must be essentially wavelength independent at frequencies above the infrared.

Any model of the emission regions in the Crab pulsar must then be wavelength independent. Our observations support the geometrical model proposed by Smith et al. (1988), which ascribes the double pulse to radiation from regions above the two magnetic poles, and places them at a radial distance of about nine-tenths of the velocity-of-light radius.

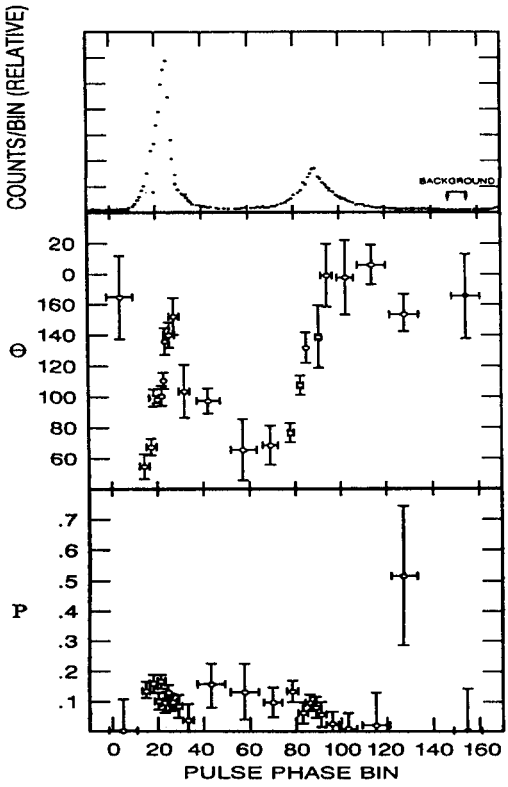

Fig. 1. The polarization of the Crab pulsar in the ultraviolet. One pulse period is divided into 160 equally spaced phase bins at the barycenter of the Solar System. The phase of maximum intensity was arbitrarily assigned to bin 24. Top: the relative intensity as a function of pulse phase in the F160LP bandpass (Percival et al. 1993). The background was taken to be the counting rate in the phase interval denoted. Middle: the position angle of the polarization in the F277M bandpass. Vertical bars denote one standard deviation uncertainties; horizontal bars demarcate the extent of each measurement in pulse phase. Bottom: the fractional polarization, corrected for its non-normal distribution at low statistical significance (Wardle & Kronberg 1974). The error bars have the same meaning as in the middle panel.

References

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