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Phase locked Spectroscopic Imaging of the Crab Pulsar

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Abstract. The MIC photon counting detector developed at UCL has been upgraded to allow time resolved spectroscopic optical data to be acquired on periodical sources such as pulsars. First observing trials have been carried out on the Crab pulsar. The detector was phase locked to the pulsar period and a temporal resolution of 41.4μs employed. The phase locking allowed the co-addition of time slices over a large number of pulsar periods building up quantifiable spectroscopic data when observing in a flux limited regime.

1. The Detector System

Continuous clocking of the CCD in an intensified CCD photon counting detector allows high time resolution, phase locked, acquisition of spectroscopic data from periodic sources such as pulsars. The MIC detector developed at UCL (Fordham et al. 1991) has been upgraded to allow such observations, a temporal resolution of 41.4μs being available.

First observing trials have been carried out, data being acquired on the Crab Pulsar. The nominal apparent period of this pulsar is 33.49ms. This was then split into 809 separate 41.4μs time slices in which spectra were acquired. Accurate phase locking of the detector to the pulsar period was achieved by (1) a GPS as an accurate source of UTC and (2) a computer programme for continuous calculation of the pulsar period using the TEMPO pulsar parameter calculation programme available from Princeton University.

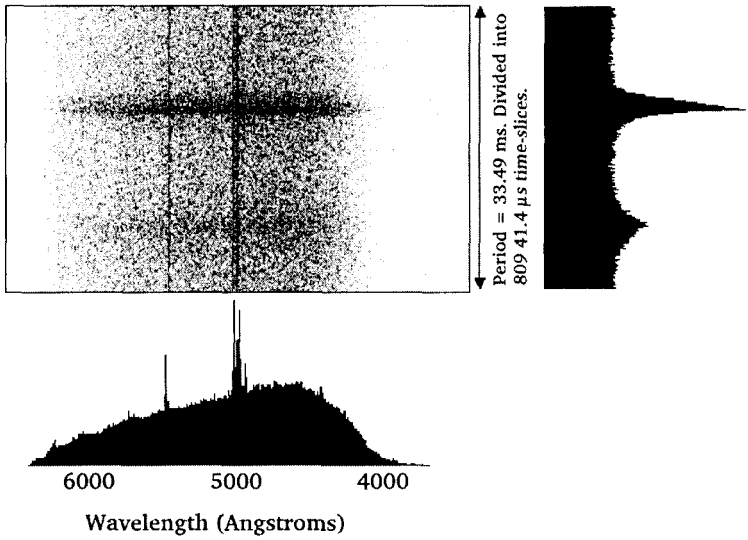

Figure 1. High time resolution spectroscopic image of the Crab Pulsar + Nebula with extracted spectrum and light curve.

2. First observing trials

The initial observations were carried out in January/February 1999 using the 2.1m telescopes at San Pedro Martir and Guillermo Haro observatories. Exposure periods used on the Crab Pulsar were 1000s, this being the sum of ~30,000 pulsar periods. A sample 1000s exposure image acquired at San Pedro Martir Observatory is shown in Figure 1 along with compression of the image in both the temporal and dispersion directions to produce the integral pulsar+nebula spectrum and light curve respectively. A scientific analysis of the light curve data is given in Much et al. (1999).

Evaluation of the light curves obtained has shown that phase locking is accurate to better than 6μs over a 1000s integration.

References

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