

RADIO FLARES FROM CIRCINUS X-1⁺

G. D. Nicolson

National Institute for Telecommunications Research

C S I R

Johannesburg

The galactic x-ray source Circinus X-1 is notable for its periodic flares at x-ray, optical, infrared and radio wavelengths. The flares recur at 16.6 day intervals, but there is considerable variability from one cycle to another. (See Dower et al, 1982, and references therein for a detailed review of the properties of Circinus X-1).

The radio flares at cm wavelengths have been shown to be consistent with a synchrotron source undergoing adiabatic expansion (Haynes et al, 1978). Circinus X-1 is therefore a member of a small group of galactic x-ray sources such as Sco X-1, Cyg X-3 and SS433 which all have marked similarities to extragalactic radio sources. Radio flares in these objects probably originate from mass accretion onto neutron stars and black holes and provide an important starting point for testing models of variable synchrotron radio sources. In particular the periodic nature of the flares from Circinus X-1 makes this object especially amenable to coordinated multiwavelength studies and to VLBI campaigns.

Flux measurements of Circinus X-1 have been made since February 1978 with the 26m telescope at Hartebeesthoek. Observations were made at the expected flare times for 97 of the 120 cycles of 16.6 days that have elapsed since then. Twenty-seven flares ranging from 0.3 to 1.65 Jy were detected. The flares generally had several peaks and lasted between one and three days. There was a distinct tendency for flares to occur in groups, interspersed with low states when the flaring level dropped below the typical detection level of 100 mJy. Two such low states of four and ten months duration were observed. A third low state began in September 1981 and was still in progress in mid 1983.

For fourteen flares the onset time could be determined with an accuracy of less than one hour, and the results were used to determine an ephemeris for the radio flares. This revealed that the period has been decreasing at a rate of 1×10^{-5} . The rms deviation of flare times from the computed ephemeris was less than 2 hours and sets a tight constraint on the timing mechanism for the flares. This result is consistent with the suggestion that Circinus X-1 is a binary system with a large

⁺ Discussion on page 457

eccentricity (Murdin et al, 1980).

The results also suggest the existence of a longer term periodicity. Strong flares of long duration all occurred at intervals of 117 days plus or minus one 16.6 day cycle and at the complementary phase the flares were weaker and of shorter duration.

The current low state has frustrated recent attempts to make detailed VLBI observations. Monitoring is continuing so that further work can be initiated when flaring resumes.

References.

- Dower, R.G. et al: 1982, *Astrophys. Jnl.* 261, pp. 228-250.
Haynes, R.F. et al: 1978, *Monthly Notices Roy. Astron. Soc.* 185, pp. 661-671.
Murdin, P. et al: 1980, *Astron. Astrophys.* 87, pp. 292-298.