Systematic Radio-Observations of UX Arietis: Analysis of Its Variability

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UX Arietis is an active binary system with an orbital period of 6.44 days. The presence of long lasting large spots on the surface of the more active star has been deduced from optical observations (Vogt & Hatzes 1991).

The observations presented here have been performed from December 1992 until October 1994 using the Effelsberg 100 m telescope. The instrument was available for this program in the gaps between previously scheduled observations. For this reason our observations span a frequency interval between 1.4 GHz (21 cm) and 43 GHz (7 mm), depending on the scheduled receiver at each observing time. These data, which are an extension of those published by Neidhöfer et al. (1993), are shown in Fig. 1, plotted in terms of the known orbital period (6.44 days). The search for different periodicities (by using the Phase Dispersion Minimization method) has shown the existence of two main other periods: at 156 days and at 24 days (Massi et al., in preparation).

The presence of a minimum, discernible in Fig. 1 around phase 0.4 of the orbital period, becomes more evident if only radio fluxes above 50 mJy are selected, averaged in phase and plotted. In contrast to this, radio fluxes below 50 mJy appear to be evenly distributed over the orbital period. This minimum could be interpreted in terms of a geometrical effect strictly linked to the rotation of the system. A source of enhanced radio emission localized near the surface of the active star, e.g. above a star spot, would be a good candidate for the explanation of this periodicity. Alternatively, a change in the orientation of the magnetic field could also give a flux decrease, appearing as a shadowing of the source.

Since the strong emission *only* suffers from the geometrical shadowing induced by the system rotation, it follows that the high intensity emission is more localized (and organized, if one thinks in terms of magnetic field) than the low intensity emission. We deduce that the emitting system is composed by a compact region where the strong initial phase of the flare takes place and by an extended halo, too large to be obscured, where the flare then develops and fades. This picture is in complete agreement with the conclusion derived by Mutel et al. (1985) from VLBI observations and with the model proposed by Franciosini & Chiuderi-Drago (1995). Since the shadowing in the emission does not last very long, $< 1/10$ of the orbital period, the compact region must have a typical size

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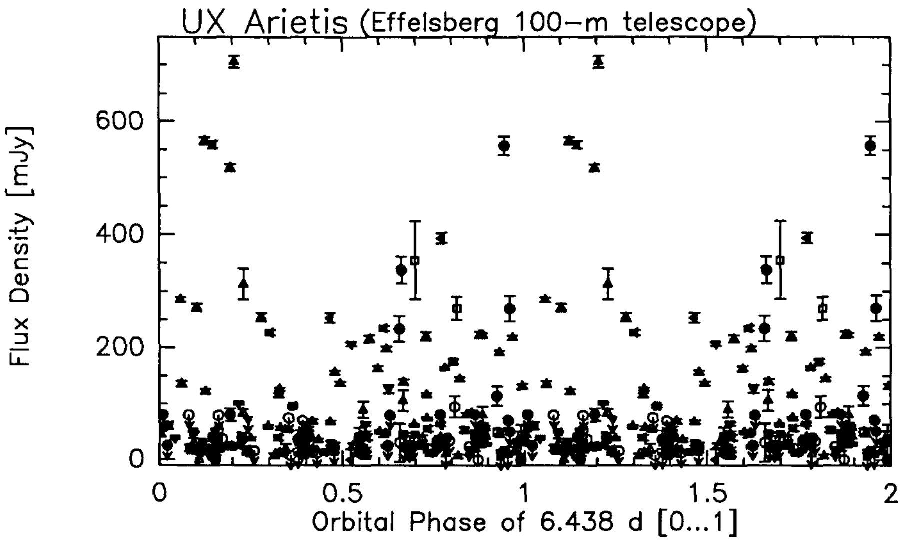

not much smaller than the stellar disk.

Some flare spectra can also be derived from the available data. A first analysis shows that:

a) A long-lasting ejection of accelerated particles is necessary to explain the time scale of the rising phase of some flares which can last as long as two days.

b) The flares observed in the rising phase always show a range of frequencies in which the spectrum slope is positive ($F \sim \nu^{\alpha}$, $\alpha > 0$) but not as steep as in the self-absorbed limit (i.e. it is $\alpha < 2.5$). A possible interpretation in terms of accelerated particles diffusing along the magnetic field lines in wider and wider regions of space is in progress (Torricelli et al. in preparation).

c) The flare decaying phase can be explained as due to the temporal evolution of a population of non-thermal electrons undergoing radiative and collisional losses (Chiuderi-Drago & Franciosini 1993, Franciosini & Chiuderi-Drago 1995).

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