

TIME RESOLVED CIRCULAR POLARIMETRY OF WHITE DWARF PULSARS

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There are two recognized subsets of cataclysmic binaries that contain white dwarfs: the AM Her stars, whose white dwarf components are sufficiently magnetized to ensure synchronous rotation with the orbital period, and the DQ Her stars, which do not maintain synchronism and probably have been spun up by mass accretion. Both groups of stars, recognized also as X-ray sources, are important as probes of the accretion process, and the radiation mechanisms in the vicinity of the white dwarf. So far, we know five objects belonging to the former group (AM Her, AN UMa, VV Pup, 2A 0311-227, and PG 1550+191), and seven falling into the latter: WZ Sge, AE Aqr, V533 Her, DQ Her, V1223 Sgr, H2252-035, and EX Hya, with the corresponding rotation periods of their white dwarf primaries of 28, 33, 64, 71, 794, 805, and 4020 s, respectively. While the main observational and theoretical efforts have been focussed on the AM Her class, the DQ Her binaries have been investigated to much lesser extent. This is probably because the DQ Her stars have been recognized only very recently as a homogeneous class.

The DQ Her-type stars are characterized primarily by the highly coherent oscillations in the optical region, with a quality factor $Q = 1/|P| \approx 10^{12}$. All but one (DQ Her itself) are X-ray emitters with the X-ray flux being modulated on the fundamental period of optical oscillations. The observed oscillations of DQ Her stars are most readily explained by invoking an "oblique rotator" or a "white dwarf pulsar" model with the accretion induced hot spots at the surface of a rapidly rotating, magnetic white dwarf (Lamb 1974). In analogy to AM Her binaries, at least in active state, in DQ Her stars one might expect to observe

some continuum polarization being related to the accretion column phenomena. It has been shown (Lamb and Masters 1979; Chanmugam and Dulk 1981) that the optically polarized light in AM Her objects arises as a result of high harmonic ($m \approx 5$) optically thick cyclotron emission from the shock-heated region above a magnetic pole of accreting white dwarf. In lower fields, ≤ 10 Mgauss, the polarized cyclotron emission is shifted towards infrared, while in high fields, ≥ 100 Mgauss, it moves to the UV domain (Lamb 1979). Because of the existence of large accretion disks around magnetic primaries in the DQ Her stars, and because of rapid rotation of these primaries, one should not expect magnetic fields in these objects to be as large as those observed in AM Her stars. Furthermore, in few cases (eg. H2252-035) one is observing the dominant optical modulation at a period arising as a beat phenomenon between the fundamental oscillation period (i.e. white dwarf rotation) and the orbital period. This is interpreted that the significant fraction of the pulsed optical light arises not from the white dwarf directly, but from the reprocessing of the white dwarf's pulsed radiation in the surrounding accretion disk (Patterson 1980).

The detection of both the circular and linear polarization changes synchronous with the rotation of the underlying white dwarf pulsars in DQ Her binaries would allow us to constrain class of models which have been suggested for these objects. Of particular importance would be the determination of the strength of a pulsar magnetic field. The early results for DQ Her (Swedlund et al. 1974; Kemp et al. 1974), although being on a threshold of detection, seemed to be encouraging: both the circular and linear polarization variations synchronous with the white dwarf rotation have been found. Being stimulated by these early works, and by the subsequent discovery of more members of the class, during later part of 1980 and in early 1981 we have been carrying out a limited survey of circular polarization properties of five objects: AE Aqr, V533 Her, H2252-035, V1223 Sgr, and EX Hya in the blue spectral region. A Pockel cell polarimeter (Angel and Landstreet 1970) attached to either the 122-cm telescope of the University of Western Ontario or the 1-m Las Campanas telescope has been utilized. For rapid rotators (AE Aqr, V533 Her) we used a synchronous data averaging.

This pilot survey has shown that for all objects but V533 Her the amplitude of the periodic component of the circular polarization is not greater than 0.10 - 0.15 per cent in the blue band. In case of V533 Her a $\sim 0.5\%$ sinusoidal changes in a circular polarization have been detected on two nights. This might mean that in DQ Her stars the

dilution by an unpolarized background is very large, and furthermore, that this dilution is variable (the case of V533 Her).

The detailed account on both the observational and theoretical aspects of the circular polarimetry of DQ Her stars will appear in the Monthly Notices of the Royal Astronomical Society.

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