POLARIZED EMISSION IN THE BROAD SiO FEATURE FROM R LEO

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ABSTRACT

Linearly polarized SiO emission spread over 12 km/s has been detected from the star R Leo. The position angle of polarized emission varies systematically with respect to the spectral line center. Interpreted in terms of radiative transfer theory, this change in position angle may be due to magnetorotation, which allows the determination of the magnetic field ($9 \times 10^{-3}/\cos\theta$ Gauss), and the SiO systemic velocity (-1 ± 2 km/s).

In 1978 Snyder et al. reported a weak maser emission pedestal associated with SiO emission from the first vibrational state. They argued that this emission, which is quite spread out in frequency, is non-thermal because they could not detect ground vibrational state emission in the same objects at appropriate levels for thermal emission. Recent observations are reported of linearly polarized emission spread over 12 km/s from the SiO maser source R Leo, as large a velocity spread as has been reported for this source.

Data were taken for the SiO maser source R Leo using the v = 1, J = 2-1 transition during December 1978, April 1979, and May 1979, consecutive phases of 0.1, 0.4, and 0.7. Equipment and technique are described by Troland et al. (1979). During this period, the peak intensity decreased less than a factor of 2, which is consistent with saturated maser theory. In the May 1979 data linearly polarized radiation is detectable over a large range of velocity, approximately 12 km/s. Figure 1 displays Stokes parameters I, $(Q^2 + U^2)^{1/2}$, and position angle of the linearly polarized radiation. Resolution is 100 kHz or about 0.3 km/s. The abscissa is channel number centered on -2 km/s, and velocity increases to the right.

An immediate conclusion is the confirmation that the broad radiation is maser emission, because of the presence of polarization (first suggested by Snyder et al., 1978).

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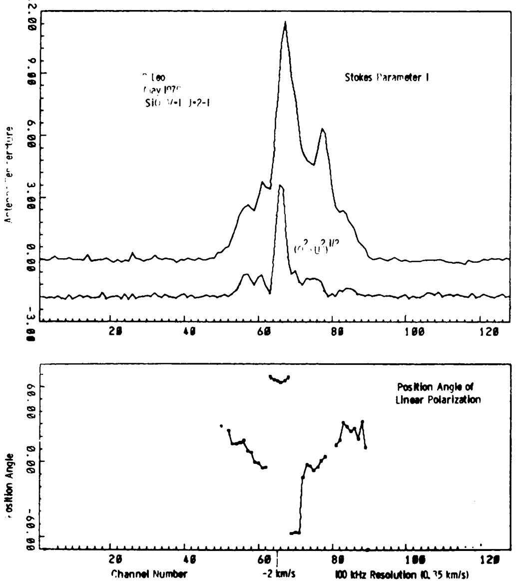
Goldreich et al. (1973) predicted a rotation of the plane of polarization which should be most apparent for unsaturated off-resonant transfer, appropriate for the broad emission component:

$$\Delta\Phi \propto B\cos\Theta \;/\; (\nu-\nu_0)^2$$

where Φ is position angle, B is magnetic field, ν is frequency, and Θ is the angle between the magnetic field and the line of sight. This result appears to be a reasonable explanation for the position angle data reported, where the position angle of the narrow feature is not considered. This equation allows a calculation of the magnetic field in the region where the broad emission originates:

$$B \sim 9 \times 10^{-3}/\cos\Theta \text{ Gauss.}$$

There is an even more exciting implication of the Goldreich et al. theory. If this interpretation is correct, the centroid of the position angle change denotes the systemic velocity, the stellar velocity of R Leo. The theory predicts a rapid change near resonance. However the centroid may be reasonably estimated from the wings as -1 km/s with an estimated error of 2 km/s. This is an independent line of evidence in support of the stellar velocity as the centroid of the broad SiO emission (Reid and Dickinson 1976).



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