ON THE NATURE OF PROTOSTELLAR H_2O MASERS

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Most sources of H_2O maser radio emission at 1.35 cm, associated with star formation regions, show strong variability with, sometimes, rapid bursts of emission (see, e.g., Liljeström 1984, Rowland and Cohen 1986, and references therein). A preliminary conclusion on the possible cyclicity of H_2O maser variability can be drawn (Lekht et al. 1982, 1983), with a quasiperiod of several years. The "quiet" state of a maser source, with moderate, slowly varying values of the line flux density, turns to the "active" phase with H_2O line bursts (Lekht et al. 1983). The H_2O maser generation region is probably located in a rotating gas-and-dust disc (torus) around a protostar (or young star). This is pointed to by VLBI observations showing in some sources maser features arranged in an ellipsoidal structure around a common centre (presumably, the protostellar object - see Downes et al. 1979), as well as by symmetrical character of H_2O line profiles of many masers (Lekht et al. 1982). As an excitation mechanism for H_2O, collisional pumping in two-temperature medium behind a shock front (with hot heavy particles and cold free electrons or vice versa) is widely accepted (Bolgova et al. 1982, Kylafis and Norman 1986).

I suggest two models explaining variability of protostellar H_2O masers, including their cyclic activity. In <u>Model 1</u> H_2O variability is connected with variable luminosity of the central object, due to nonstationary accretion of matter onto it. As it was first shown by Yorke and Krügel (1977), the accretion onto a protostar can be unstable and can oscillate with a period of several years. At each luminosity rise, the star creates a shock in the encompassing gas-and-dust torus. Behind the shock front, the conditions are favourable for the H_2O maser pumping. At larger distances, the shock expires, and the maser intensity fades. In <u>Model 2</u> the star itself is surrounded by a small circumstellar gas-and-dust ("protoplanetary")

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disc, with the axis tilted to that of the external torus. The small disc would precess in the gravitational field of the torus. The stellar wind blowing from the poles of the disc would impact the surface of the torus' internal cavity, creating there a shock wave. Time- and space-variable shadowing of the torus' surface from the stellar wind by the small disc may also cause maser variability. This model was earlier applied by Rudnitskij (1987) to the explanation of optical variability of cometary reflection nebulae in star formation regions.

Both models can be tested observationally. In Model 1 correlated variations of several emission features in the H_2O line profile should be observed (that was really seen in, e.g., W49N by Liljeström (1984)), connected with the central object's variability (which can be observed in the infrared). In Model 2 the drift of the bright spot of maser emission along the circumstellar torus, due to the small disc's precession, must be observable.

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