STUDIES OF VARIABILITY OF CIRCUMSTELLAR H_2O MASERS

G. M. Rudnitskij
Sternberg Astronomical Institute
Moscow State University
Moscow V-234, 119899
USSR

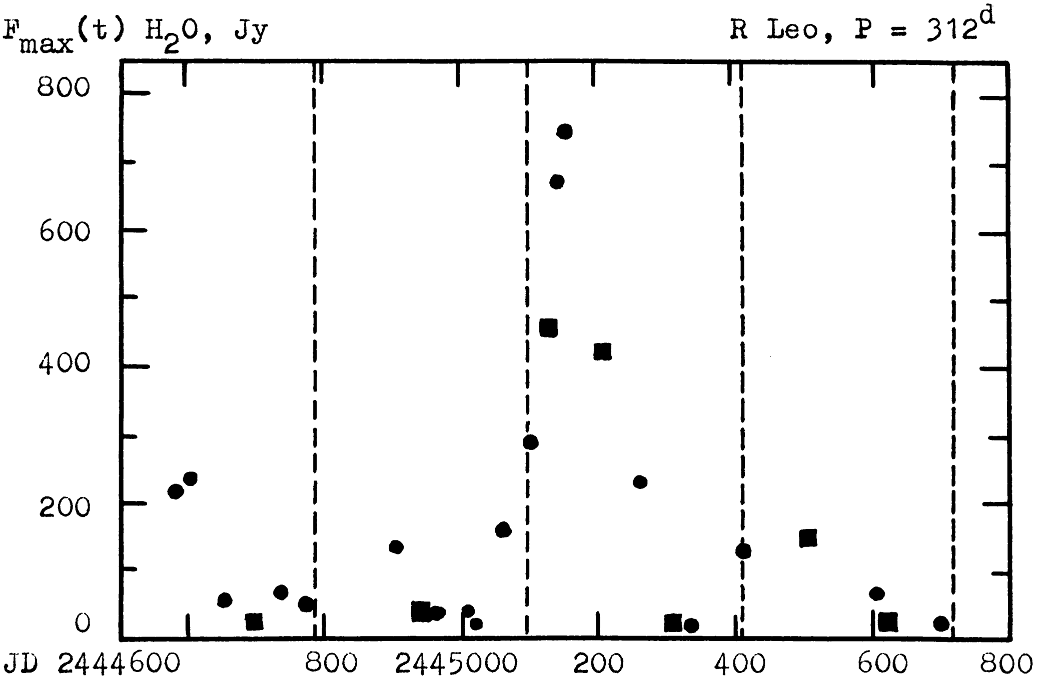
From March 1980 to December 1983, the author took part in regular observations of variability of maser radio emission in the H_2O line at 22 GHz. The observations were carried out at the 22-meter radio telescope of the P. N. Lebedev Physical Institute (USSR Academy of Sciences) in Pushchino (Moscow Region). The interval between consecutive observational sessions was usually 1.5-2 months. The observational program included 21 late-type variable stars (Miras and SRs): R Aql, RR Aql, RT Aql, SY Aql, U Aur, NV Aur, RX Boo, VY CMa, S CrB, KY Cyg, NML Cyg, U Her, W Hya, X Hya, R Leo, U Lyn, U Ori, UU Peg, VX Sgr, RS Vir, RT Vir. The results for eight stars ending June 1982 were published by Berulis et al. (1983). A comparison was made between the time dependences of the H_2O line radio flux F and the curves of visual and near-infrared brightness of the stars. Miras (R Aql, R Leo, U Ori, U Aur), as a rule, have a rise in F connected with the visual maximum (phase 0), the maximum F occurring at phases 0.1-0.2 (see figure for an example). Not all visual maxima (only one out of each two or three) are accompanied by H_2O flares. This Miras' behaviour was also noted earlier in the H_2O line by Berulis et al. (1984), Gómez Balboa and Lépine (1986), as well as in the SiO maser line v=1, J=2-1 by Nyman and Olofsson (1986).

Two models of H_2O line variability, connected with propagation of periodic shock waves in the inner layers of circumstellar shells (where H_2O maser emission is generated), are suggested. Model 1 connects the H_2O flux rise with non-saturated amplification at the H_2O line frequency of free-free radio continuum emission, originating in hot ionized gas behind the shock front. Model 2 explains H_2O maser bursts by fast dissipation of the shock-wave energy in the region of H_2O line generation. As a test, parallel observations of the H_2O line, Hα emission, and cm-wave continuum can be proposed. In Model 1, there must be net

I. Appenzeller and C. Jordan (eds.), Circumstellar Matter, 267–268.

https://doi.org/10.1017/S0074180900156578 Published online by Cambridge University Press

correlation between F H_2O, on one hand, and radio continuum (yielding the background input for the maser) and, accordingly, Hα, on the other. In Model 2, the H_2O flare must follow in time the moment of Hα and radio continuum extinction, when the shock enters the region of maser generation.



Time dependence of H_2O maser emission for the Mira-type variable R Leo in 1981-1983. $F_{max}(t)$ H_2O is the flux density in the maximum of the main H_2O emission peak. Optical maxima of the star (taken from the Bulletin de l'AFOEV) are marked by vertical dashed lines. Dots - this work, squares - data from Nyman and Olofsson (1986).

REFERENCES

Berulis, I.I., Lekht, E.E., Pashchenko, M.I., Rudnitskij, G.M. 1983. Soviet Astr., 27, 179.

Berulis, I.I., Gladyshev, A.S., Lekht, E.E., Pashchenko, M.I., Rudnitskij, G.M., Sorochenko, R.L., Khozov, G.V. 1984. Sci. Inf. Astr. Council Acad. Sci. USSR, 56, 92.

Gómez Balboa, A.M., Lépine, J.R.D. 1986. Astr. Ap., 159, 166.

Nyman, L.-Å., Olofsson H. 1986. Astr. Ap., 158, 67.