STRUCTURE OF H_2O MASER OUTBURST IN ORION KL NEBULA

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Abstract

The H_2O outburst in Orion KL had been observed by the VLBI technique in 1979-1983. The line profile is asymmetrical. The flux density and line width are variable and correspond to a partially saturated maser. The outburst region had a compact and a less compact one whose sizes are equal to 0.3 and 2.5 a.u. respectively. The fine structure of the profile corresponds to knots whose size is smaller 0.2 a.u. The brightness temperature of the region, $T_b \simeq 10^{17}$K, implies a high emission directivity.

In August-September 1979 a strong H_2O maser outburst happened in Orion KL nebula. Its velocity was ~ 8.1 km/s, the maximum flux density about 2×10^6 Jy. On September 25, 1979 we observed the outburst on Simeiz-Pushino interferometer. The fringe size was equal to 2.5-4 mas and frequency resolution 2.2 kHz [1]. On November 16, 1979 Orion KL was observed on the Simeiz-Effelsberg and Green Bank-Haystack interferometers. The fringe size was 1.3-10 mas and the frequency resolution 25 KHz. The observations repeated each year include Simeiz-Evpatoria-Pushino interferometer, [1]. The outburst emission was measured in the linear and left circular polarizations.

The line profile of the outburst is asymmetrical and has a high frequency tail. The fine structure of the profile is complex and variable. The flux density and the line width are changing with time and correspond to a partially saturated maser.

The fringe visibility of the outburst region changes with the interferometer hour angle, polarization, line velocity and time. The fringe visibility corresponds to complex structure of the outburst. The central and the high velocity part of the profile were radiated by a region whose size is equal to ~ 1 mas (~ 0.5 a.u.). The flux density of this region $F \simeq 0.65\ F_{tot}$, the line width $\Delta f \simeq 20$ kHz and polarization $P \simeq 60\%$. The brightness temperature of the region $T_b > 10^{16}$K.

The main part of polarization emission was determined by a region

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whose size is equal to $\sim$ 0.5 mas (0.25 a.u.), and corresponds to the central part of the line. The polarization is equal to P $\gtrsim$80% and bandwith to Δ f < 20 KHz.

The low velocity emission of the outburst was determined by a region whose size is equal to 6 mas, the flux density F $\simeq$ 0.35 F_{tot}, Δf $\simeq$ 50kHz and P $\simeq$ 50%.

The fine structure of the line profile perhaps connects with knots which are located inside the compact region. The line width of the features Δf $\simeq$ 5 kHz and corresponds to a low temperature of the knot medium T_k $\simeq$ 60 K.

In 1982 the line width increased Δ f = 40-50 KHz and the size of the compact region increased too. Perhaps the line width Δf is determinated by the differential velocity of the emission region. The extra brightness temperature of the outburst region assumes high beaming of emission.

Reference

1. Matveyenko L.I., Loran D.M., Genzel R., 1982, Pis'ma Astron.Zh., Vol 8, No 12, p.711

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