GLOBAL VLBA OBSERVATIONS OF NGC 3079

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1. Introduction

NGC 3079 has very luminous water megamaser from the nucleus, the peak of the spectrum being blueshifted by 180 km s^{-1} from the systemic velocity of the galaxy (V_{sys} = 1131 km s^{-1}) (Henkel et al. 1984, Haschick & Baan 1985). Core-jet like continuum structure is also found in the nuclear region (Irwin & Seaquist 1988). No velocity drift for main features of water maser (V_{LSR} = 941–975 km s^{-1}) has been shown (Nakai et al. 1995). However, the drift was recently detected for the maser of 1190 km s^{-1} (Nakai 1997). HI and OH absorptions were detected in the nucleus (Haschick & Baan 1985, Irwin & Seaquist 1991). Thus this galaxy is very unique object to investigate water masers, continuum structure and absorption features all together with VLBI.

2. Observations and Results

We conducted multi-frequency observations towards the nucleus of NGC 3079 using both Japan VLBI Network (J-Net) and the VLBA with phased VLA and Effelsberg. We detected two continuum components (A and B) which was consistent with the 5-GHz result (Irwin and Seaquist 1988) at 1.4 and 8.4 GHz, while only one component (B) was detected at 15 and 22 GHz. Water masers, around 960 km s^{-1}, are elongated 5.5 mas in North-South direction (P.A.$\sim -20°$) along the galactic plane and are apart 6.7 mas west of B (Figure 1 left). The position vs. velocity diagram of water masers along the major elongation presents no clear evidence of Keplerian rotation disk in this nuclear region. Three HI absorptions were detected towards the continuum components at the velocity of 1015, 1127 and 1230 km s^{-1}. The strong absorptions ($\tau > 0.5$) are clearly separated on A for 1015 km s^{-1}, and on B for 1230 km s^{-1}, with near V_{sys} component of 1127 km s^{-1} on both A and B (Figure 1 right). It should be noticed that this few-pc scale velocity gradient is opposite to the 100-pc scale gradient in HI (Pedlar et al. 1996).

3. Discussion

If we take the velocity drift as the centrifugal acceleration seen in NGC4258 (Miyoshi et al. 1995), this component should be close to the near edge of rotation disk. Furthermore, when the continuum component B represents the real core of the system, we can draw a rotating torus shown in Figure 2. This explains positions of all velocity components by rotation. The absorptions at 1015 and 1230 km s^{-1} come from the torus, on the other hand, the 1127 km s^{-1} feature, which is seen both on A and B, may come from the outer region. The system has different rotating axis from those of the galaxy, as seen in NGC 4258 (Miyoshi et al. 1995), and systemic velocity also.

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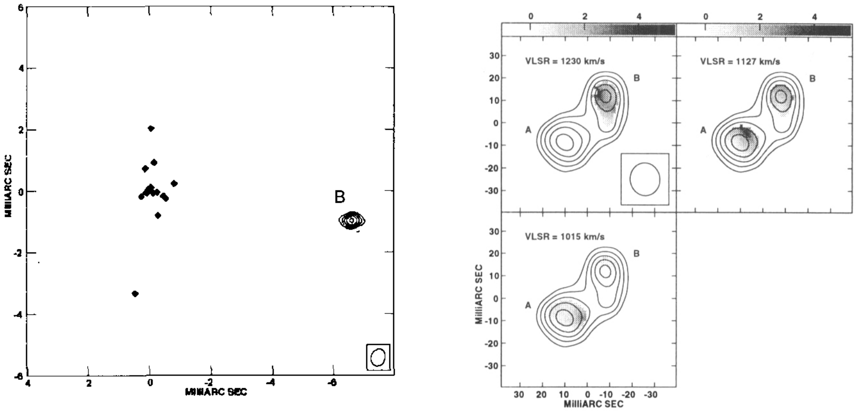

Figure 1. (left) Water masers (V_{LSR}=940–1030 km s^{-1}) and continuum component B at 22 GHz. (right) Contour maps of continuum emission at 1.4 GHz with grey scale images of HI opacity toward the nucleus.

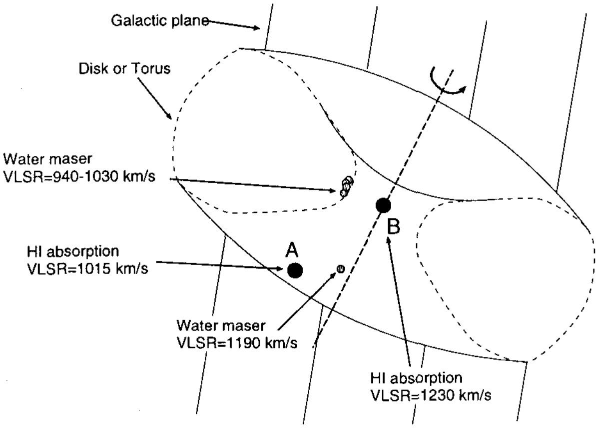

Figure 2. Schematic diagram of the circumnuclear region of NGC 3079. The component B is the nucleus of NGC 3079 and the dynamic center of rotating disk or torus with water maser and neutral hydrogen. Water masers at 940–1030 km s^{-1} are terminal velocity features, and the maser at 1190 km s^{-1} is located near the midpoint of A and B (Trotter et al. 1997), nearly on the plane which contains the rotation axis and observer.

References

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