S09b On Sub-Keplerian Velocity Distribution of the Maser Source of NGC 1068

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NGC 1068 is considered to be the archetypal galaxy which harbors an active galactic nucleus heavily obscured by a dense molecular torus. In the nucleus of NGC 1068 lies a megamaser source which enables to probe the structure and the velocity field of the innermost part of the molecular torus.

Rcently, Greenhill et al. (1996) observed the water maser emission in NGC 1068 with the VLBA and obtained images with sub-milliarcsecond angular resolution. Their best fit rotation curve is sub-Keplerian; the line-of-sight velocity of the maser source decreases as $r^{0.31\pm0.02}$ for $0.40\,\mathrm{pc} < r < 0.65\,\mathrm{pc}$. Hitherto, no detaild discussion has been done about possible mechanisms for this sub-Keplerian velocity distribution.

In this paper, we propose that an eccentric oscilaltion in the maser disk is responsible for the sub-Keplerian velocity distribution of the maser source of NGC 1068. In order to study the effect of the oscillation modes on the maser source kinematics, we used a simplified disk model and solved a resultant eigenvalue problem in (r, z)-space. We found that there exist global eccentric modes (i.e., z-symmetric $m = 1$ modes) whose amplitude decreases with radius. The position-velocity diagram calculated for the maser disk perturbed by these modes reproduces the observed sub-Keplerian velocity distribution of the maser source in NGC 1068. The present model predicts that if the blushifted maser component were found in NGC 1068, the line-of-sight velocity distribution of the component would be super-Keplerian.

Reference

Greenhill, L.J., et al. 1996, ApJ 472, L21