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Warping Modes in the Maser Disk of NGC4258

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The high-velocity water maser sources at the circumnuclear region of NGC4258 provide the compelling evidence for the presence of a central supermassive black hole of a mass of $3.6 \times 10^7 M_{\odot}$ (Miyoshi et al. 1995; Nakai et al. 1995). Curiously, the position and velocity distribution of these maser sources are fitted well with a warped Keplerian disk model in which the inner and outer radii of the maser emitting region are 0.12pc and 0.26pc, respectively. The maser disk is so thin that the upper limit of the disk thickness is 3×10^{-4} pc (Moran et al. 1995). Such a near-Keplerian disk can be perturbed by global one-armed ($m = 1$) oscillations (e.g., Kato 1983).

In this paper, using a simple toy model, we examine the characteristics of warping modes supposed to be present in the maser disk of NGC4258. we find that the structure of the fundamental warping mode is consistent with the observed distribution of the high-velocity maser spots of NGC4258. Moreover, we find that the velocity vector associated with the warping mode is roughly parallel to the z -axis; the vertical component of the perturbed velocity field is about an order of magnitude larger than the horizontal components. This feature is also in agreement with the observed near-Keplerian velocity distribution of maser spots of NGC4258.

References

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