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Can Ring-Shaped Structures form Due to the Instability of Vertical Perturbations in a Self-Gravitating Disk?

K.T. Mirtadjieva, C.N. Nuritdinov, F.U. Botirov, J.M. Ganiev
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Abstract: (Springer)
We study the question of whether the instability of the vertical perturbation mode of a self-gravitating disk can lead to the formation of a certain ring-shaped structure. Thus, we have discovered two modes of vertical perturbations. The gravitational instability of these perturbation modes is investigated below against the background of a radially pulsating disk model, which is a nonstationary generalization of the well-known Bisnovaty-Kogan–Zeldovich equilibrium model. The corresponding nonstationary analogues of the dispersion equation of these two modes of vertical perturbations are found. The results of the study are presented in the form of critical dependencies of the initial virial ratio on the disk rotation parameter. It is shown that with an increase in the disk's degree of rotation, there decreases the range of the initial virial ratio at which ring structures can form. The initial physical conditions, criteria and the corresponding mechanisms for the formation of ring-shaped structures due to the instability of the bending mode of the vertical perturbation are determined. A comparative analysis of the gravitational instability increments of the annular horizontal and vertical perturbation modes is also carried out.

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