Bulges and ellipticals: can formation mechanisms be the same?

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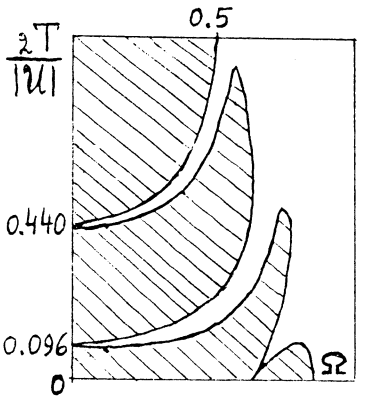
We consider three mechanisms for ellipticals and bulge formation.

1. Mechanisms within a dissipationless collapse scenario: for example, the radial-orbits instability (for non-stationary models see V.A. Antonov & S.N. Nuritdinov, 1981, *Sov. Astr. Zh.*, **58**, 1158; L. Aguilar & D. Merrit, 1990, *Ap. J.*, **345**, 33; Nuritdinov, this issue).
2. Evolution of (proto)galaxy from an anisotropic sphere or a spheroidal model (A.M. Fridman & V.L. Polyachenko, 1984, *Physics of gravitating systems*, Springer). Here axisymmetric oscillations ($m = 0, N = 4$) correspond to the case of a galaxy with a bulge, and the ellipsoidal mode ($m = N = 2$) corresponds to the case of ellipticals. In principle these models can have a halo or a corona with a given mass (Nuritdinov, 1978, *Sov. Astr. Zh.*, **55**, 37).
3. Dissipation phenomena in non-stationary models.

Now we proceed to analyse the role of the "dome" instability during non-stationary evolution in order to check a relation of this instability to the bulge formation problem. Nuritdinov (1987, *Dinamica gravitiruyshchih system i metodi analyt. neb. meh.*, p65) has constructed two phase models of pulsating disk. One of these models is

$$\Psi = \frac{\sigma_0}{2\pi\Pi\sqrt{1-\Omega^2}}\left[\frac{1-\Omega^2}{\Pi^4}(\Pi^2 - r^2) - (v_r - v_a)^2 - (v_\perp - \frac{\Omega r}{\Pi^2})^2\right]^{-\frac{1}{2}}$$

where all notations are according Nuritdinov (this issue). Recently we have studied warps in this disk, assuming vertical displacements of the form $B(t)\frac{1}{\xi}P_N^m(\xi)e^{im\varphi}$, where B is a time function and $\xi = \sqrt{1 - r^2/\Pi^2}$. Here we suffice to give the result for the dome perturbation ($m = 0, N = 3$): the stability region in the $(2T/|\mathcal{U}|, \Omega)$ plane (see figure) shows some interesting narrow channels. Moreover, we have calculated the unstable modes as a function of $2T/|\mathcal{U}|$ and Ω. Our analysis shows that the dome instability can play a role in the formation of bulges.



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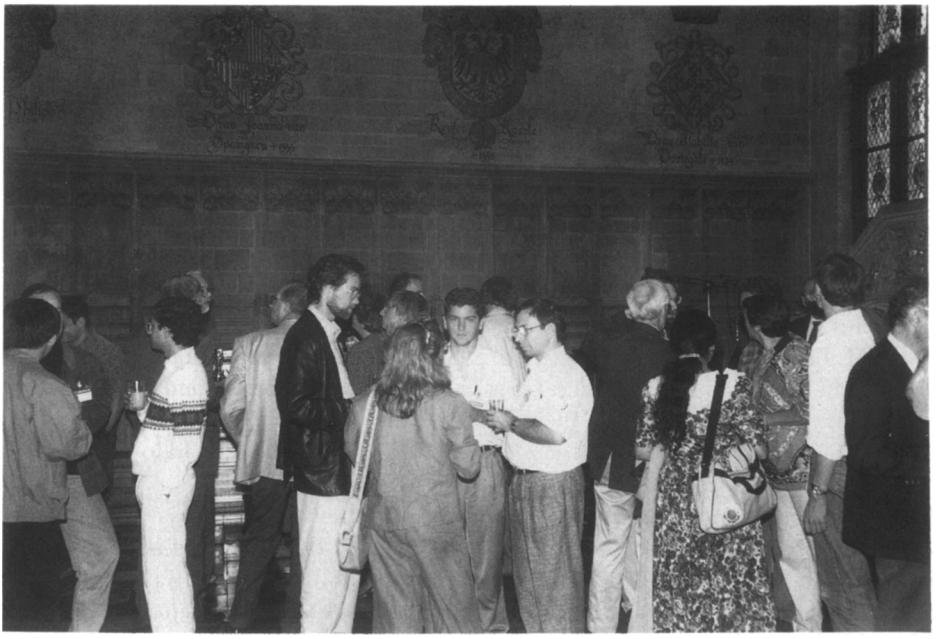

Reception at the town hall

The conference dinner

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