COLLECTIVE PHENOMENA IN A MULTI-COMPONENT GRAVITATING SYSTEM

A.M. Fridman[1], A.G. Morozov[2], J. Palous[3], A. Piskunov[1],
V.L. Polyachenko[1]
[1] Astronomical Council, USSR Academy of Sciences, Moscow
[2] Volgograd State University, Volgograd, USSR
[3] Astronomical Institute, Czechoslovak Academy of Sciences, Praha, CSSR

ABSTRACT

The paper aims at a demonstration of the principal differences between the oscillation spectra of multi-component systems and a one-component medium. The character of the mutual motions of components appears then to be of importance. Three cases are considered: (1) motionless components in the inertial frame of reference; (2) inertial subsystems moving at constant relative velocities; (3) a rotating n-component system. The oscillation spectra in these three cases have qualitative differences between each other and when compared with those of resting or rotating one-component systems.

(1) It is shown that in the motionless, n-component homogeneous gravitating medium, along with sound (Jeans) oscillations being synphasic, there is a new class of "asynphasic" oscillations having much in parallel with the Langmuir plasma oscillations and with optical oscillations of a crystal lattice. In contrast with the sound oscillations, the new class remains oscillatory at arbitrarily large wavelengths, which alters the conventional point of view that the gravitational condensation of all long-wave perturbations is inevitable. The theorem on the stability of a motionless n-component gravitating medium is formulated. It states that the Jeans instability may develop only on the synphasic branch, the remaing (n-1) different oscillation branches being asynphasic.

(2) For a system consisting of n components moving with constant relative velocities, a theorem on the number of beam instabilities as function of stationary parameters of the components is formulated. The maximum number of instabilities in such a system is n, of which (n-1) are beam instabilities and one a Jeans instability.

(3) For an n-component rotating gravitating disk, the maximum number of unstable regions in the space of perturbation wave vectors is also n. Moreover, the relative rotational motions of the components may

H. van Woerden et al. (eds.), The Milky Way Galaxy, 509–510.

be completely absent, i.e. all the n unstable regions of the k-space will belong only to one unstable Jeans branch. Consequently, the rotation removes the degeneration of case (1), splitting the Jeans "level" into n "sublevels". This once again demonstrates the analogy between rotation and the effect of a magnetic field.

REFERENCES TO RELATED WORK

Morozov, A.G., 1981, Astron. Zhurnal Letters, 7, 9-13.
Polyachenko, V.L., Fridman, A.M., 1981a, Zh. Exp. Th. Phys. (Moscow), 81, 13.
Polyachenko, V.L., Fridman, A.M., 1981b, Astron. Zhurnal Letters, 7, 136.