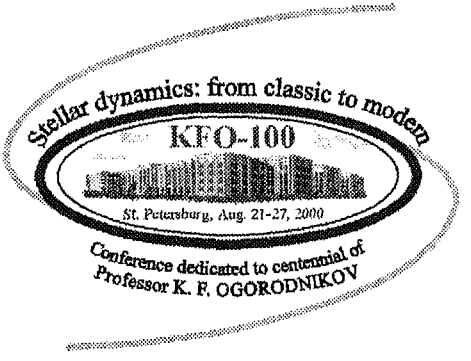
SAINT PETERSBURG STATE UNIVERSITY
Sobolev Astronomical Institute

STELLAR DYNAMICS: FROM CLASSIC TO MODERN

International Conference to be held
in Saint Petersburg, August 21–27, 2000

Abstracts
Participants



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A difficulty of the mathematical problems of mixing consists in the circumstance that mixings are not strictly speaking local, not even local with respect to an orbit. The orbit instability is the necessary condition for the mixing, howerever, it is not sufficient. For example, any close orbits are instable in the problem of two fixed centers, though this problem demonstrate the regularity of all the motions. The mixing is a global concept.

Splitting (Separating) Instability of Gravitating Stellar Systems

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Let consider a thin gravitating stellar system with the surface density $\sigma(x, y)$ and the main plane $0xy$, which rotates with the angular velocity $\boldsymbol{\Omega}(\Omega_x, \Omega_y, \Omega_z)$. The equations of star motion are

$$\begin{aligned} \ddot{x} &= 2(\Omega_z \dot{y} - \Omega_y \dot{z}) + F_x, \\ \ddot{y} &= 2(\Omega_x \dot{z} - \Omega_z \dot{x}) + F_y, \\ \ddot{z} &= 2(\Omega_y \dot{x} - \Omega_x \dot{y}) + F_z, \end{aligned}$$

where $\mathbf{F}(F_x, F_y, F_z)$ is the vector sum of gravitational and centrifugal forces. The configuration has an "oblique" rotation, that results to important consequences. If velocities of some stars in the plane Oxy are different, then Coriolis forces $f_z = 2(\Omega_y \dot{x} - \Omega_x \dot{y})$ will differ. As a result, the system can begin "to inflate" in z-direction. To keep the system from such disintegration the process of swelling should be counteracted by gravitation in z-direction.

Let this system be splitted on a top sublayer with the surface density σ_1, where there are the stars with a high value f_z, and a bottom sublayer with the density σ_2 and smaller value of f_z. A relative acceleration on both elements of sublayers is equal to $2\pi G\sigma$. Comparing the gravitational and splitting forces for these sublayers we find, that the stratification will prevail, if the average inequality $\langle f_z \rangle_{\rm top} - \langle f_z \rangle_{\rm bottom} > 2\pi G\sigma$ takes place. Let the number of stars in interval $(f, f + df)$ is equal to $q(f)\, df$. Criterion of the separating

instability takes the form

$$\frac{\int_f^{f_2} fq(f)\,df}{\int_f^{f_2} q(f)\,df} - \frac{\int_{f_1}^{f} fq(f)\,df}{\int_{f_1}^{f} q(f)\,df} > 2\pi G\sigma,$$

where f_1 and f_2 are boundary values of f_z. This instability can be important for evolution of real flat astrophysical systems.

Local Integrals of Motion in SB Galaxies and Other Rotating Systems

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It is well known that there is no quadratic integral of motion in the equatorial plane of a rotating non-axisymmetric system. However, in some cases an additional integral similar to the quadratic integral was found (Vandervoort, 1979; Contopoulos & Vandervoort, 1992). Additional integrals can be constructed also on some surface of the phase space (local integrals, as they were called by Antonov (1981)).

In the present work we review our investigations of a class of potentials admitting linear and quadratic in velocity components local integrals. In general, these potentials depend on some arbitrary functions of one variable. The degree of arbitrariness for the local integral is determined by a finite number of parameters.

Some of potentials obtained here can be used for modeling SB galaxies. The existence of a local integral with a given value of Jacobi's constant restricts the mixing process, as it plays a role of a barrier.

The existence of a local integal gives a chance to find the trajectory. In some special cases it is possibile to describe it analitically.

Problems like these appear in axisymmetric galaxies, but under taking into account its satellite moving along circular orbit.