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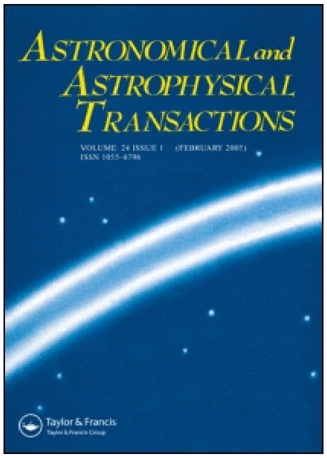


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## Proceedings of the conference held in Kosalma

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# Proceedings of the Conference Held in Kosalma

## GENERAL DISCUSSION

*Ossipkov*: I wish to return to the problem of constructing self-consistent models of stellar systems. Until now, two main classes of analytical self-consistent models have been considered:

a) models for which a distribution function is given and a potential is to be found;

b) models for which a density law is given.

Then the Poisson equation allows to find the augmented density and the problem reduces to solving some integral equation. Historically, the second kind of models was considered as a semi-empirical one for, in principle, observations give us the density law.

But in reality observations cannot give us information concerning the dark matter or faint-star distribution. So we do not know the total density law for real systems, and the empirical base of such models is weak.

However, velocities of stars or gas temperature are governed by the total gravitational potential. In recent decades, observations provided velocity dispersions for clusters of galaxies and temperature profiles for some systems. So, opportunities appear to construct models which would be really semi-empirical ones. And we need to develop methods for constructing such models. Some works of this kind are in progress, but I believe some more efforts are necessary.

*Ossipkov*: I wish to return to the problem of constructing self-consistent models with non-integrable potentials. I think the following way can be proposed. Let $I$ be an approximate third integral. We consider $I$ as a new phase coordinate, the action variable. Then it is possible to find the angle coordinate $\psi$ conjugate with respect to $I$. The distribution function will be as follows:

$$\psi = \psi(E, L_z\ ;\ I, \psi).$$

For integrable systems, a dependence of $\psi$ disappears, and for quasi-isolating (in Contopoulos' sense) third integral, the dependence is weak.

*Hunter*: The method suggested by Professor Ossipkov may provide only a rather restricted class of distribution functions. Much work has already been done in constructing distribution functions for near-integrable systems by integrating large numbers of orbits for a long time, evaluating their orbital densities, and then assembling them self-consistently (e.g., Schwarzchild, 1979, and many later papers). It seems to me that the method of determining a third integral presented earlier today by V. V. Orlov is somewhat related to this approach. It constructs a third integral, making use of the velocity field of an orbit, but determining this will also require a detailed investigation of the orbit, somewhat similar to a long numerical integration.

*Ossipkov*: I agree with Professor Hunter. But using Scharwarzschild's method gives us no information about the analytical form of a third integral. By the way, 20 years ago I suggested a method for finding an approximate analytical form of a third integral using numerous orbit calculation as in Schwarzschild's method (*Astron. Zh.*, 1974). Professor Kuzmin, a referee of my work, gave another modification of the method (and it is in my paper). But at that time I had no possibility to perform necessary calculations.
*Orlov*: Short comments on the black hole in the galactic centre. We carry out a joint work with Sergei Fabrika (Special Astrophysical Observatory), Sverre Aarseth (University of Cambridge) and my student Yuri Yudin. We consider a central black hole of our Galaxy encountering the globular clusters, in the model of Kutuzov-Ossipkov and the modified Miyamoto-Nagai model. The evolution was followed during a few billion years. The basic result for the black hole with the mass $10^6$–$10^7 M_\odot$ and clusters with $3 \cdot 10^5$ and $10^6 M\odot$: the amplitude of the black hole oscillations is about 1–10 pc; its velocity is about 0.1–1 km/s.
*Chernin*: Can you describe the model in more detail?
*Orlov*: Yes. We consider the three-body problem: black hole, globular cluster, and the Galaxy. The clusters pass by the hole one after another inside a sphere of impact motions. The directions of the velocities of the globular clusters on this sphere are isotropic inwards the sphere.
*Khoruzhii*: I will discuss the following problems:

a) parameters of the central stellar cluster;

b) placing of spiral and other structures in the centre;

c) why the young stars;

d) what are the radial velocities near the centre of the Galaxy.

The results presented in the paper of Eckart *et al.* (*Ap. J.* **407**, L77, 1993) imply that the central stellar cluster is an isothermal cluster with the core radius $3.8'' \pm 1.3''$ ($0.15 \pm 0.05$ pc). Several stars in the central cluster exhibit strong and broad Br $\gamma$, Br $\alpha$, and He I line emissions indicative of dense fast winds (Forrest *et al.*, 1987, in *AIP Conf. Proc.* **155**, The Galactic Centre, Ed. D. C. Backer (New York, AIP), 153; D. A. Allen *et al.*, 1990, *MNRAS*, **244**, 706; T. R. Geballe *et al.*, 1991, *Ap. J.* **370**, L73; A. Krabbe *et al.*, 1991, *Ap. J.* **382**, L19). They may be $T \geq 30000$ K blue supergiants or Wolf-Rayet stars with masses $\geq 30 M_\odot$. According to J. H. Lacy *et al.* (1991, *Ap. J.* **380**, L71) kinematic properties of different parts of SgrA-West imply the following orientations of planes of the motions:

Nothern arm: inclination $i = 60°$–$70°$ with respect to the face-on-view and the position angle of the intersection with the sky plane of p.a. = 20°;

Western arm: $i = 60°$–$70°$, p.a. = 12°;

Molecular disk: $i = 60°$–$70°$, p.a. = 0–30°. Line-of-sight velocity near SgrA varies in the range from at least −400 to +100 km/s.