thermalization. This explains simultaneously both the anomalous $L_i/H_i$ ratios as well as the comparatively small spread of the observed relative intensities.

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Note Added in Proof. After this paper had been sent to press, there appeared the paper of C. Gordon, S. Collin-Souffrin, and D. Dultzin-Hacyan (Astron. Astrophys., 103, 69 (1981)), which is devoted to the influence of a velocity gradient in emission clouds on the formation of the hydrogen spectrum of Seyferts and quasars.

LITERATURE CITED

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ELLiptic Stellar Disks: Equilibrium Solutions In
The Presence of A Halo and In Binary Systems

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The properties of equilibrium solutions are investigated for elliptical stellar disks with quadratic gravitational potential in the field of the tidal forces of a neighboring galaxy in a binary system or in a homogeneous spheroidal halo. The regions of existence of such solutions are constructed. It is shown that these regions are restricted either to disks in which the gravitational along one of the axes is balanced by the centrifugal force or to dust disks, in which there is no spread of the velocities of the stars at any point. Disks in binary systems can be elongated along the axis joining the centers of the galaxies or compressed along this axis. Dust solutions are possible only for compressed disks in binary systems. It is shown that dwarf galaxies in the field of tidal forces of a giant galaxy can be situated much closer to the companion in the compressed form than in the elongated form because of the greater resistance to disruption. A method for estimating approximately the upper limit of the ratio of the masses of galaxies in pairs from their relative geometrical parameters is given.

1. Introduction

There have been many theoretical studies of stellar systems having the shape of disks. These studies have provided the basis for models of spiral galaxies, which contain an appreciable fraction of the matter in the Universe. As a rule, spiral galaxies consist of...
of two or several subsystems. Besides the disk subsystem there is a spherical system with mass comparable to or greater than the mass of the disk. The majority of galaxies occur in pairs or groups, in which they are situated in the field of the tidal forces of the neighboring galaxies. Under the influence of the tidal forces, the stellar disks may adopt a noncircular shape.

Investigation of the properties of noncircular stellar disks surrounded by a halo or belonging to a binary system is a complicated problem involving solution of the collisionless Boltzmann equation with self-consistent gravitational field. The simplest models of such systems are stellar clusters with gravitational potential in the form of a quadratic function of the coordinates. Allowance for the tidal forces, and also a homogeneous halo of ellipsoidal shape does not destroy the quadratic nature of the potential.

An analog of systems with quadratic gravitational potential among models of gaseous stars is provided by figures of an incompressible fluid, which also have a quadratic gravitational potential. The equilibrium and stability of such figures have been investigated in very great detail theoretically. Many results of these investigations can be found in Chandrasekhar's book [1].

Models of a quadratic gravitational potential for isolated stellar systems in the form of elliptic disks and cylinders, and also biaxial and triaxial ellipsoids were first obtained in [2-4]. In [5, 6], some new equilibrium solutions with quadratic gravitational potential were obtained; in [7], there is an investigation into the properties of equilibrium solutions of this type. We note that noncircular stellar disks always have the shape of ellipses in the framework of models with quadratic gravitational potential.

In [8], solutions with quadratic gravitational potential were obtained for stellar disks in binary systems. The influence of the second component was taken into account in the tidal approximation. In the present paper, we investigate the properties of equilibrium solutions with quadratic gravitational potential for stellar disks in pairs. We obtain solutions with quadratic gravitational potential for stellar disks surrounded by a homogeneous halo, and we study the properties of these solutions for halos of spheroidal shape. We find the regions of existence of solutions with quadratic gravitational potential for disks in spheroidal halos and in pairs.

In binary systems, it is possible for compressed or elongated disks to exist. In the first case, the companion lies on the continuation of the minor axis of the ellipse; in the second, on the continuation of the major axis. Dust solutions are absent for elongated disks and occur only for compressed disks [8]. The property of closed orbits to be compressed in a binary system also persists in the case of limiting mass concentration at the center — in the Roche model [9]. In a strong tidal field, only compressed disks of sufficient oblateness can exist, since for them the possibility of disruption of the galaxy by tidal forces is minimal. Thus, dwarf galaxies near giants must be compressed along the axis joining them. This is true for both disk as well as elliptical galaxies; in the latter case, they take a shape close to that of a compressed spheroid. The observed shape of the satellites of the giant galaxy NGC 4435 (see [10]) must be due to their real compression in the field of the tidal forces, and is not due to random projection of a circular disk onto the plane perpendicular to the line of sight. We outline a method for estimating the upper limit of the mass ratio of the galaxies in a binary system using the geometrical characteristics of the pair.

1. Forces and Potentials in Elliptical Disks

In models with quadratic gravitational potential, a noncircular disk has the shape of an ellipse with density distribution

$$\tau = \tau_0 \sqrt{1 - \frac{x^2}{a^2} - \frac{y^2}{b^2}}.$$  (1.1)

The gravitational potential \(\Phi_d\) of such a disk is (the normalization is not important)

$$\Phi_d = a_0 x^2 + b_0 y^2.$$  (1.2)

The coefficients \(a_0\) and \(b_0\) can be expressed in terms of the parameters of the disk by means of elliptic integrals [4]:

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