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STRUCTURE AND EVOLUTION OF STELLAR SYSTEMS

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$$= \frac{\kappa_{1133} - C_{11}C_{33} - 2C_{13}^2}{D_1^2 D_3^2} = \frac{\kappa_{2233} - C_{22}C_{33} - 2C_{23}^2}{D_2^2 D_3^2}.$$

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VELOCITY FIELD IN A STATIONARY POINT-AXIAL GALACTIC MODEL

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1. Introduction

Until now, the axial symmetry has been regarded as a good approximation for stellar system models that verifies: a) the collissionless Boltzman equation, and b) the ellipsoidal hypothesis for the peculiar velocity distribution of the stars. At present however the available observations indicate that the aforementioned hypothesis is not sufficient. They are several evidences in this sense:

1) the velocity curves show a different behaviour by considering different directions in the galaxy;

2) in the solar neighbourhood, the majority of stellar samples present clearly non diagonal second order centred moments, as well as for the angular gradients.

In this work we relax the afore mentioned axial symmetry hypothesis, and we study the kinematics and dynamics of a collissionless stationary point-axial stellar system model with a equatorial plain of symmetry.

2. The galactic model

We adopt a galactic model based on the collissionless Boltzaman equation:

$$\frac{d\Psi}{dt} = \frac{\partial\Psi}{\partial t} + \mathbf{V} \cdot \nabla_{\mathbf{r}}\Psi - \nabla_{\mathbf{r}}U \cdot \nabla_{\mathbf{v}}\Psi = 0 \qquad (1)$$

and the ellipsoidal hypothesis for the distribution of peculiar velocities of stars

$$\Psi(\mathrm{r}, \mathrm{v}, t) \equiv \Psi(\mathbf{Q} + \sigma) \ , \qquad (2)$$

where v is the peculiar velocity, $\mathbf{Q} = \mathrm{v}^t \cdot \mathbf{A} \cdot \mathrm{v}$ and $\mathbf{A}$ and σ are functions of position and time.

Equation (1) under hypothesis (2) gives the well known Chandrasekhar equations (*Chandrasekhar, 1942*), which leads to the elements of velocity ellipsoid. A more detailed description of the model is presented in (*Sanz et al., 1989*). The self consistency hypothesis is not included in the model. The imposition of a quadratic function in the peculiar velocities causes the rotational velocity obtained to have an abnormal behaviour. In the infinite it behaves like $\varpi^{-1}$and therefore does not agree with the observations for the high values of ϖ, which generally speaking indicate a flat rotational curve. However, the fact that with these observations it is possible to reproduce curves such as those in galaxies of little mass (irregular Galaxies, Dwarf Elliptics) and to obtain good partial agreements for massive galaxies, indicates that their behaviour is correct up to point not too far from the maximum of the rotation velocity curve.

3. Discussion

The main results are:

1) The stationarity condition suposes cylindrical symmetry for the potential. Nerverless, the stellar density is a function of the θ angle — the self consistence hypothesis is not included. Thus our model is consistent with point-axial mass distributions.

2) The position and magnitude of the maximums of the radial and rotation velocity components vary according to the direction θ.

3) The integrals of motion presents dependence with the θ angle and generalizes those of cylindrical case.

We must to note that, the number of parameters that appear in the expressions for the vellocity centroids is high. For this reason we have been obligated to introduce some hypothesis to determinate these parameters and so obtain the field vellocities in the galactic plane. These hypothesis are based on the assumption that, although the stellar system is non-stationary, the distribution of peculiar velocities is such that the axiality index (see *Sanz et al., 1989*) is keep constant. The vellocity field of our gallaxiy, furnished by the this hypothesis and ajusted according to the values observed in the solar neighbourhood, exibits an inner ovalshaped contraction zone, surronded by another zone of expansion, that is prolonged to the infinite. The Sun would be situated in this second zone, and close to the first.

References

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