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MULTICOMPONENT AXISYMMETRIC STELLAR SYSTEM

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The Galaxy is idealized as a stellar system with several stellar components: bulge, thin disk, thick disk, halo, etc. In the regions where the diffusion phenomena are negligible, the dynamics can be determined from a conservative dynamic system, according to the superposition principle with a common potential. Here we describe some kinematic properties and the mass distribution of the thin disk, thick disk, and stellar halo using cylindric galactocentric coordinates r, θ and z, under axisymmetric conditions.

Our model is based in the following two hypotheses:
(a) The stars are moving under a gravitational potential $U(t, \mathbf{r})$ and, since the model is not applied to the inner bulge, gas or corona, the collisionless Boltzmann equation is satisfied for all the components.
(b) According to Oort's approximation, the velocity distribution of one stellar component is idealized by a Gaussian function of the peculiar velocities. Thus, since the superposition principle is satisfied, the velocity distribution function can be taken as a superposition of trivariate normal functions.

For a time-depending axisymmetric model under superposition assumption this situation leads us to adiabatic potentials (*Cubarsi, 1990*) and, for each stellar component, the mean velocity field and the velocity distribution are completely determined.

According to Chandrasekhar's theory, the mass distribution $N(t, \mathbf{r})$ of one component is modeled and constrained by the the potential and by the particular kinematic parameters of the component. However, the imprecise information about numerical values of the Galactic potential, stellar density or velocity distribution in different regions of the Galaxy makes us to use the following schematic version of the potential:

$$U(t, \mathbf{r}) = B(t)(r^2 + z^2) + \frac{1}{r^2+z^2}(q + s\frac{z^2}{r^2}),$$

where q and s are constant.

The resulting potential has one term corresponding to an harmonic function, significant at large distances of the Galactic center, and another term generating a short-range force.

Thus, the density corresponding to the i–th stellar component becomes

$$N_i(t, \mathbf{r}) \propto \frac{exp(-Bk_i(r^2+z^2) - \frac{2k_i(qr^2+sz^2)(1+b_i(r^2+z^2))}{r^2(r^2+z^2)} + \frac{1}{2}\frac{k_i\Omega_i^2 r^2}{1+a_i r^2+b_i z^2})}{k_i^{3/2}(1+a_i r^2+b_i z^2)^{1/2}(1+b_i(r^2+z^2))^{1/2}}$$

depending on especific kinematic paremeters of the stellar components and on the common parameters of the potential.

The resulting mass distribution is dominated by the exponential factor with three differentiated contributions. (a) The first term, due to the harmonic part of the potential and to the specific kinematics of the component. If $B > 0$, this term fixes the scale length of the Galactic components. (b) The second term, dominant near the center, depending on the potential and also on the particular kinematics of the component. If $q < 0$, the short-range force is attractive and this term produces an exponential increasing of the mass density towards the center. (c) The third term, due to the rotation of the stellar component. If the component is fast rotating, composed of young disk stars, it can be more important than other terms.

According to this model, and depending on the values of the parameters, we compare the kinematics and mass distribution of the components. However, since there are not definitive data about the potential, we only discuss the disk components and the stellar halo. The kinematical parameters of the stellar components (young thin disk = $t1$, old thin disk = $t2$, thick disk = T, halo = h) have been taken according to the following table (*Gilmore, Wyse, 1987; Sandage, Fouts, 1987; Cubarsi, 1992*). We only take into account the velocity dispersions and the rotation mean velocity Θ_0.

comp.	$(\sigma_r : \sigma_\theta : \sigma_z)$	Θ_0
$t-1$	$(28:17:17)$	220
$t-2$	$(40:30:25)$	205
T	$(70:50:45)$	175
h	$(130:105:75)$	120

In order to fit the parameter B of the harmonic potential we can adopt two criterions: (a) This value may be obtained by computing the force to maintain an hypothetical object with a circular velocity Θ_0 at the solar position. In this case $B = 400$ kpc$^{-2}(km/s)^2$.(*b*) In order to fix the characteristic length of the thick disk in 4.5 kpc (*Kruit, 1987*), we take $B = 1000$ kpc$^{-2}(km/s)^2$, consistent with the accepted local potential values (*Ninkovic, 1990*), and which is rather different from previous case.

It must be pointed out that these results come from a quite general model, where a multicomponent trivariate normal velocity distribution function has been assumed. Moreover axisymmetric hypothesis has been adopted. Our results are consistent with other models based only in approximation laws for the mass distribution of the galactic components.

The more realistic portrait of the thin disk, thick disk and halo components is obtained fitting the value B of the galactic potential harmonic term around 1000-1600 kpc$^{-2}(km/s)^2$. In this case a characteristic scale length of 4-5 kpc for the thick disk and scale height of 1.5 - 2 kpc have been obtained.

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STATIONARY AND NON-STATIONARY POTENTIALS IN A POINT-AXIAL STELLAR SYSTEM MODELS

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1. Introduction

We consider a stellar system model that verifies the Boltzman equation collissionless and the ellipsoidal hypothesis for the distribution of peculiar velocities of the stars. In the axial case, the potential has been studied for several authors: *Chandrasekhar (1942), Català (1972), Orús (1977)* and *Sala (1987)*, obtaining stationary potentials of stäkel type and time depending potentials that have three isolating integrals in involution. In this work, we determine completely the potential for a such model in the stationary and non-statiotionary cases.