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A POSSIBLE LOCAL DIAGNOSTIC FOR THE MILKY WAY DARK MATTER HALO TRIAXIALITY

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RESUMEN

En este estudio proponemos restringir a través de la cinemática estelar local la forma global del halo de materia oscura de la Vía Láctea. El principio utilizado es que la forma del halo implica la existencia de familias de órbitas periódicas que sostienen la forma triaxial. Estas aparecerían como grupos cinemáticos co-móviles de estrellas en el halo de la Galaxia. Nuestro análisis utiliza simulaciones de la estructura orbital en halos oscuros con diferentes estructuras. Discutiremos cómo distinguirlos de grupos móviles creados por eventos de acreción en el pasado de la Galaxia.

ABSTRACT

In this study we propose to constrain through the local stellar kinematics, the overall shape of the Milky Way dark matter halo. We base on the principle that the shape of the halo implies the existence of families of periodic orbits that support the triaxial shape. These groups would appear as kinematic co-mobile stars in the halo of the Galaxy. Our analysis uses simulations of the orbital structure in dark halos with different structures. We will discuss how to distinguish them from mobile groups created for accretion events in the Galaxy past.

Key Words: dark matter — Galaxy: kinematics and dynamics

1. INTRODUCTION

The triaxiality of the Milky Way dark matter halo is of great interest to the galactic formation theories. It is considered as a test for the LCDM scenario. There has been some strategies to determinate its shape, for instance the Sagittarius stream (Law et al. 2009) or the hipervelocity stars (Gnedin et al. 2005). However none of this strategies is conclusive. The aim of this work is to introduce a new diagnostic for the shape of the Galaxy dark matter halo based on local kinematics of the stars. This may complement the evidence previously presented of its triaxiality.

In § 2 we will describe our halo model and the numerical calculations that we carried out to obtain the orbital structure generated by its potential.

In § 3 we will discuss our results and the work we are planning to do.

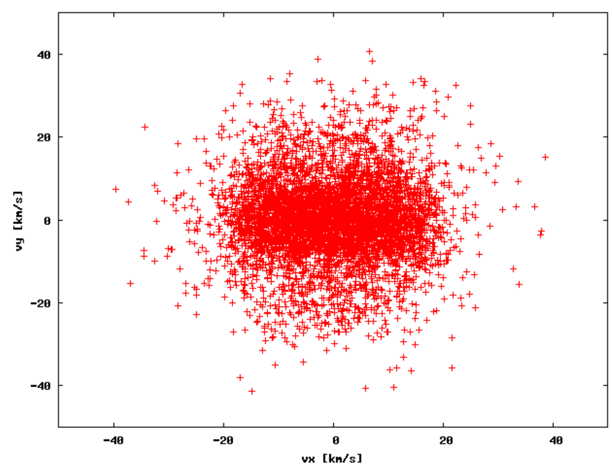

Fig. 1. Phase space proyection on the x-y plane in the solar position.

2. HALO MODEL AND NUMERICAL SIMULATIONS

Our model assumes that the Galaxy is surrounded by a dark matter halo with a NFW density profile. The generated potencial and the orbital structure depends on the shape of the halo. If the halo has a triaxial shape, there will be resonant orbits, but this will not happen if the halo has spherical simetry. This is the key of our analysis. In order to explore the orbital structure generated by our halo, we developed a code that simulates a triaxial halo with main axes $a = 1.47$, $b = 1.22$ and $c = 0.74$, which correspond to a common shape in cosmology simulations. Then we let 8×10^6 particles with random velocities between zero and the

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escape velocity to evolve in its potential for 2×10^9 years, time enough for the sistem to relax. Figure 1 shows the resulting kinematic distribution of stars after performing the simulation in different places. The gathering along the main axis suggests that the stars form kinematical groups that maintain the triaxial shape of the halo over a long period of time. We also simulate the fall of a satellite in the halo potential that is trapped in a resonant orbit and analize the resultant phase space. We observe that the stars remain in the orbit for a long time and tend to form kinematical groups.

3. CONCLUSIONS AND FUTURE WORK

Our work suggests that if the Galaxy dark matter halo is indeed triaxial, then the resonant orbits are allowed and this induces the kinematical groups to form. There are other mechanisms that produce kinematical groups such as tidal disruptions of globular clusters, but these groups will be made of highly homogeneous stars, while the groups associated with the halo shape will have mixed stars. If this strategy to determinate the Galactic dark matter halo shape is successful, it might be benefited by the data from the astrometric satellite GAIA and the follow-ups.

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