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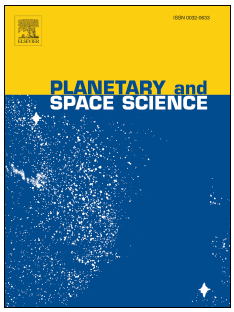

Spin distribution of asteroids - Statistical model revisited

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Spin Distribution of Asteroids - Statistical Model Revisited

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Abstract

The distribution of the rotational frequencies of asteroids is believed to carry important information on their formation and the subsequent evolutionary processes (Burns, 1975). In particular, it is commonly considered that during their formation stage the larger asteroids in the Main Belt have attained a statistical equilibrium (canonical ensemble) in the 3-dimensional isotropic velocity vector space. Subsequently, especially the smaller objects, suffered from various dynamical processes, such as collisions, fragmentation and YORP effect, for example, which modified their spin velocity and direction. In this work we re-examine the spin distribution of asteroids using more recent data and focusing on its statistical aspects, in particular, the dimensionality of the phase space. We find that the presently observed spin distribution of asteroids of any diameter bin is clearly consistent with a 2-dimensional phase space, or even less for the smaller objects. This is true also for those objects with diameter larger than 50km, whose distribution is usually believed to be consistent with isotropic 3-dimensional Maxwellian. The present result casts open questions on the origin of the asteroids spin.

Keywords: Asteroid, spin, statistical aspects

1. Introduction

The spin distribution of asteroids should carry important information on their formation, as well as on their collisional evolution. The initial works on the topic analyzed the angular momentum distribution of a small sample of asteroids (just 27) showing that it followed the same trend as the planets (Hartmann and Larson, 1967; Fish, 1967). Later on, the increase in the dataset of rotational periods, allowed further confirmation of this result (Burns 1975). In their seminal work, Harris and Burns (1979) studied the spin distribution of 182 asteroids claiming to be in excellent agreement with a three-dimensional Maxwellian distribution which would suggest that they are interacting with one another. Farinella et al. (1981), however, cautioned that this simple "kinetic" model of a population of collisionally interacting bodies which exchange angular momentum through purely random processes might not be correct. Indeed, they showed that the Maxwellian curve was not a satisfactory representation of the data due to a strong overabundance of slow rotators compensated by a depletion of objects at the Maxwellian peak.

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