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Non-equilibrium statistical mechanics tool for study in the Space Plasma; Ehrenfest procedure in Earth's radiation belts and Superstatistics in magnetized plasma.

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A Plasma can be defined as a statistical system that contains a large number of mobile charged particles, where the interaction is long-range given by the electromagnetic force, therefore, collective effects predominate. As a system it is characterized by a large number of microscopic degrees of freedom given by the individual movement of the charged particles[1]. Although this approach may be somewhat vague, it accounts for the enormous range of possibilities of finding matter in the plasma state, mostly in the space environment and with a wide range in the value of macroscopic parameters. This is why we can study plasmas at different scales, with the physics tools corresponding to each scale. We note that non-thermal velocity distributions are ubiquitous to space plasma, as in the solar wind and geomagnetic tail. Among other examples of collisionless plasmas, long-range interactions allow finding stationary states but not thermodynamic equilibrium, described by non-Maxwellian distributions. The treatment of these non-equilibrium systems remains an unresolved issue, which has been addressed in various ways[2]. In this work we propose to deepen the development of tools with a strong basis in statistical mechanics, which allow the study of non-equilibrium systems, such as space plasmas. In particular, we address two study models, one from the macroscopic point of view, which is the Ehrenfest procedure[3], and from the microscopic point of view we will explore the Superstatistics formalism.

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Referencias

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