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Binary astrophysical system: study of evaporation in a hyperbolic well

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Introduction

We continuous our research about the thermodynamics of open astrophysical systems $[1-5]$. Astrophysical systems of this type are the usual stellar systems (e.g.: globular clusters, elliptical galaxies, etc.), which undergo the incidence of evaporation. This realistic effect involves certain difficulties into the thermo-statistical description. Now, we shall analyze the combined incidence of evaporation and anisotropic effects, which are originated from the system rotation [4] or its proximity to other systems [5]. These studies are of a paramount importance for the development of astrophysical counterparts of the well-known canonical and grand canonical ensembles, as well as to derive the conditions of thermodynamic stability, equations of transport of matter and energy in systems with long-range interactions [5]. Under certain conditions (e.g.: adiabatic approximation), it is possible to divide their analysis into the thermo-statistical of internal and collective degrees of freedom. The study of collective motions is developed by Michea & Velazquez in a closely related paper [6], while we are focused on the thermo-statistics of internal degrees of freedom. The incidence of evaporation is included invoking the called $\gamma-$exponential models $[1-3]$, while the external influence is described by an anisotropic external potential. An observable with primary interest is the threshold energy ε_c for particle escape. Typically, this notion is introduced as an independent phenomenological parameter, but this approach enables its theoretical calculation. For the sake of convenience, we have restricted here to the case of a hyperbolic potential, which allows a straightforwardly application of the methodology for axial-symmetry solutions developed in a precedent work [4].

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