



UNIVERSIDAD TECNICA
FEDERICO SANTA MARIA

DEPARTAMENTO
DE FÍSICA

Defensa Seminario de grado para optar al grado de Licenciada en Astrofísica.

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Tema: The Effect of irradiation on period bouncers: Simulations in Post-Minimum period systems.

Comisión:

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Sala Conferencias Dr. Luciano Laroze, E300**

Abstract:

Cataclysmic variables that have evolved beyond their minimum orbital period, known as period bouncers, constitute fundamental interactive binary systems for our understanding of stellar evolution in compact systems. These systems, composed of a white dwarf accreting material from a degenerate substellar companion, represent a critical evolutionary phase that allows us to explore mass transfer mechanisms, angular momentum loss, and irradiation effects under extreme physical conditions.

However, there exists a striking discrepancy between theoretical models and observations: while population synthesis simulations predict that between 40-75% of all cataclysmic variables should be in this phase, current observations identify only 1.54% of systems in this state. This fundamental disparity challenges our understanding of the physical processes governing the evolution of these systems.

In this thesis, we implement numerical simulations using the MESA stellar evolution code to model the complete evolution of period bouncer systems from their pre-bounce phase to their final stage. We develop a new module that incorporates, for the first time, a quantitative treatment of mass loss induced by X-ray irradiation from the accreting white dwarf. The model considers the interaction between high-energy radiation and the donor star's atmosphere through an efficiency coefficient (c) that relates the mass loss rate to the mass transfer rate. Additionally, we formulate a new parametrization of CAML that incorporates both the traditional mass flow toward the white dwarf and an inverse component due to the ejection of irradiated material, thus establishing a more realistic treatment of these systems' orbital evolution.

The results reveal the existence of a critical value for the irradiation efficiency coefficient ($c \sim 0.05$) that determines a fundamental transition in system evolution. Above this threshold, systems experience rapid destabilization leading to a common envelope phase and to the merger of both stars

We propose that this accelerated evolution, driven by the coupling between irradiation, mass loss, and angular momentum, provides a natural explanation for the observed scarcity of period bouncers.