DYNAMICAL AND THERMAL PATHWAYS IN THE EVOLUTION OF CENTAUR OBJECTS.

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Introduction: The structural and thermal evolution of small Solar system bodies may be strongly dependent on their dynamical history and environment. Objects that occupy planet-crossing orbits are more prone to gravitational perturbations that de-stabilize their orbits. Such are the Centuars, which are conjectured to be a transient and intermediate population, between the relatively stable trans-Neptunian objects (TNOs) and the short-lived Jupiter family Comets (JFCs) [1].

Most known Centuars have an asteroid-like dormant appearance. However, several objects have been known to exhibit cometary-like emission activity at various times [2]. This kind of activity, at such large heliocentric distances, is peculiar and provides a good reason for modeling their thermal and structural evolution. The dynamical role, as a transition phase between the TNOs and JFCs, may indicate that these objects experience intermediate levels of internal processing, at different periods of hteir lives.

A careful examination of the evolution of several of the best-characterized Centaur objects, both in orbital and physical parameters, can help categorize the different states and origin and evolution scenarios in the outer Solar system.

Modeling Issues: We apply our well-tested and robust thermal code to the modeling of several specific objects [3,4]. We examine the effect of various initial conditions on the thermal evolution of objects on different unstable orbits. For this purpose, we set different scenarios for the succession of Centaur origin and emplacement – either as 'a chip of the old block' of larger TNOs [5], which scattered inwards, or as a 'rolling stone' from out beyond Neptune, which diffused inwards.

The dynamical state of these specific objects is examined through N-body intergrations, utilizing the SWIFT integration package [6]. This is achieved by using many clones of specific objects, where the initial conditions for the clones are centered In the phase space, around known orbital elements. The orbits of such objects are highly chaotic and as such, characterizing their orbital stability reveals some of the intricate dynamical states present in the current configuration of the outer Solar system.

Results: Here we present some results and considerations, regarding the link between dynamical and thermal evolution of Centaurs. Profiles of temperature, structure and composition are calculated for the different objects, which represent slightly varying dynamical groups, and for different orbits of the same object, which represent specific orbital evolution pathways. This has an influence on the internal stratified structure, through an adapting thermal response of the nucleus.

The determination of the dynamical groups is achieved through statistical analysis of the results of our orbital integrations. Although previous studies showed that the intrinsic Centaur population is highly dispersed in orbital configurations [7], the statistics of large clone samples of specific objects can yield valuable information about their current states and future fates. Specifically, and with greater importance to the thermal modeling, we focus on the dynamical lifetimes and mean orbital elements. The latter are considered during the relatively stable and non-diffusive phase of orbital evolution.

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