ARE BOULDERS RELATED TO CRATER-LIKE FEATURES ON THE SURFACE OF (101955) BENNU AND (162173) RYUGU? L. M. Parro[1], N. E. Trógolo[1,] and A. Campo Bagatin[1,2], [1]Instituto de Física Aplicada a las Ciencias y las Tecnologías. Universidad de Alicante. Sant Vicent del Raspeig, Spain (laura.mparro@ua.es), [2]Departamento de Física, Ingeniería de Sistemas y Teoría de la Señal. Universidad de Alicante. Sant Vicent del Raspeig, Spain.

Introduction: Analyses of the two primitive, the C-type and B-type near-Earth asteroids (162173) Ryugu and (101955) Bennu, visited by the Hayabusa2 and OSIRIS-REx spacecraft, respectively, have shown that they are relatively fast-spinning bodies with top-shaped profiles [1, 2]. Their characteristic elevation at the poles and their equatorial ridge, their low bulk density and prominent surface blocks, suggest that they are gravitational aggregate asteroids (rubble piles). Recent numerical models show that bodies with such peculiar shape can be generated naturally due to a catastrophic collision between asteroids [3] and as a result of redistribution of aggregate material by rotation induced by the YORP effect [4]. Such bodies have been found to be currently slowly spun up (Bennu) and down (Ryugu) by YORP [5, 6]. The past spinning history of such bodies is unknown, but they may have been spinning fast up to a critical rate in the past.

Images of the surface of the Ryugu and Bennu asteroids give us a global geological and geomorphological overview of these two asteroids. Different individual morphologies, such as depressions, impact craters, boulders, linear features, fossae, etc., can be characterized on their surface [e.g., 1, 7]. Crater distribution is used to estimate surface ages and understand the history of planetary surfaces, including NEAs. It is therefore important to estimate whether those depressions observed on the surface are created by impacts or by other causes.

Here, we focus on the analysis of individual boulders and blocks, their subsequent orbital behavior around the main body after detachment, due to fast spin. Our aim is to check their potential correlation with some depression or crater-like features observed on their surface.

Mapping of features: We use a global mosaic of images for the two small bodies using data collected by the OSIRIS-REx Camera Suite (OCAMS) and by the Hayabusa2 telescopic optical navigation camera (ONCs) for creating our cartography. The small body mapping tool (SBMT) [8] has also been used to overlap real images collected of both asteroids to their shape models [2, 9]. The aim is to identify and map characteristic features of the asteroids that we are interested in relating with each other. To pursue this task, we identify depressions in the terrain or cratering features by observing the characteristics of the surface. We perform such search with the support from previous work describing such morphology [e.g., 10, 11]. Similarly, it is important to identify, measure and map blocks and boulders, to check if their current position can be dynamically related to some of the observed crater-like features and depressions, which may be their former location.

Dynamical evolution of ejected particles: In this research, we analyze the dynamics of particles that could detach from the surface of Ryugu and Bennu at a time when they were spinning fast enough so that apparent centrifugal acceleration is large enough to overcome local gravity. For this purpose, we developed a numerical code by integrating the equation of motion of sample particles in a non-inertial rotating reference frame [12]. The sample particles representing blocks and boulders are initially placed at the center of the triangular facets that form the shape model of each asteroid [2, 9]. Their dynamical evolution in time and is followed and their trajectories and behavior is checked. In particular, attention is paid to where they detached from at critical spin state, and possible re-entry regions of sample particles are analyzed on the asteroid surface.

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