Thermal inertia of near-Earth asteroids and implications for the strength of the YORP effect

Marco Delbo', Paolo Tanga

Laboratoire Cassiopée - Observatoire de la Cote d'Azur - BP 4229 06304 Nice Cedex 4 - France

A number of recent works[1-9] have shown that the thermal inertia of the surfaces of small, km-sized near-Earth asteroids (NEAs) is in general between two and three orders of magnitude higher than that of large main belt asteroids[10] with sizes in the range between 200 and 1,000 km. This confirms the idea that large main-belt asteroids, over many hundreds of millions of years, have developed substantial insulating regolith layers, responsible for the low values of their surface thermal inertias, whereas km-sized asteroids, which have collisional lifetimes of some millions years, have less regolith, and consequently a larger surface thermal inertia. It is commonly believed that regolith on asteroids forms as a result of impact processes. The capability of a body to develop a layer or regolith is clearly influenced by its gravity and by the porosity of the material at its surface. In particular, the latter affects the amount, the size distribution, and the velocity of the debris ejected during impacts[1,8]. In this respect, a better knowledge of asteroids thermal inertia and its correlation with other physical parameters such as size, taxonomic type, and density can be used as an important constraint for future modeling of impact processes on asteroids.

The value of the thermal inertia also plays an important role in the YORP effect: it has been shown that while the acceleration of the asteroid rotation rate is largely independent of the thermal inertia, this is not the case for the rate of change of the obliquity, in the sense that the higher the thermal inertia the larger the mean value of the obliquity variation[11].

Several questions still remain open: one of the most important is whether small main belt asteroids (with sizes < 20 km) display thermal inertias as high as NEAs of the same size do. In fact regolith on NEA surfaces can be modified by processes such as close encounters with planets causing tidal disruption that do not affect asteroids in the main belt. Such processes might have been able to alter or strip off the regolith of some NEAs. Thus, while NEAs may be a good proxy for small main-belt asteroids, more observations and modeling work are needed to confirm this point.