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Are Large Families in The Main Belt Homogeneous?

Ivan G. Slyusarev

Department of Astronomy and Space Informatics,
V.N. Karazin Kharkiv National University,
61022, Kharkiv, Ukraine
email: i.slyusarev@karazin.ua

Abstract. Using color indexes from SDSS and albedos from WISE we tested the homogeneity of 56 large Main belt families from Nesvorny list using the "color - albedo" plots. 25% of the analyzed families are non-homogeneous in terms of albedos and colors. Only two families (Flora and Vesta) contain low, moderate and high albedo asteroids, that are separated in a "color-albedo" plot. The fraction of the low albedo asteroids in bimodal families is not negligible $(10-30\%)$. Seven bimodal families may contain members from two overlapping families.

1. Introduction

Asteroid families were formed during collisional disruptions and their physical properties provide unique information about the internal material of the parent bodies. From analysis of data on physical properties of the family members we can also find possible interlopers in homogeneous families or we can distinguish overlapping families in the (ap,ip,ep) space. We perform an analysis of the physical homogeneity of 56 large Main belt asteroid families based on the color and albedo data. Main belt asteroid families were taken from Nesvorny (2015). We have considered only numbered asteroids in our analysis. We use WISE albedos from Mainzer *et al.* (2016), and a* which is the first principal component in the r-i versus g-r SDSS color-color plane (Parker *et al.* 2008) to plot albedo distributions and "albedo - color" diagram for each family.

2. Results

Using data of albedo (p) and color index (a*) from WISE and SDSS databases for large main belt asteroids families we find that all points on a* - albedo plots for all families can be separated in to three subgroups: I ($p < 0.1$; $a^* < -0.05$); II ($0.1 < p < 0.25$; $a^* < 0.05$) and III ($p > 0.15$; $a^* > 0.05$). In all bimodal families with some exceptions are present the dark subgroup I and high albedo subgroup III. Only two families (Vesta and Flora) include all three subgroups. Analysis of taxonomic interpretations of these three subgroups gives a clear result only for subgroup III - these are S-type asteroids (also may include V and E-type). Subgroup I is a mixture of dark asteroids that belong to B, F, C, P, D types. Subgroup II probably can be consistent with the M-type asteroids. Presence of subgroup II is a characteristic only for the Flora region (2.2 a.u.) and Karin region (2.8 a.u.). Outside these two regions this subgroup is absent. Analyzed families are divided into homogeneous: (37 families); bimodal (13 families); and trimodal families (2 families Vesta and Flora). Families Aeolia, Xizang, Aeria and (15477) have not shown bimodality in their color and albedo distributions, but they contain asteroids that are intermediate between low (I) and middle albedo (II) subgroups. All these families are

located very near to 2.7 A.U. More deep analysis of the distribution of proper elements for subgroups and V-shape plots for each bimodal family show that several families may consists of two overlapping families as in the case of Nysa-Polana. In the Flora family it is clearly seen that the core of the family is characterised by prominent V-shape which belong to the moderate albedo subgroup which are consistent with M-type objects.

3. Conclusions

A significant fraction (25%) of the analyzed families are inhomogeneous in terms of albedos and colours. A fraction of the dark subgroup (I) in bimodal families is not negligible ($10 - 30\%$). In seven bimodal families asteroids from different subgroups have a slightly different proper elements distributions.

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