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B-type asteroids observed by the Wide-field Infrared Survey Explorer

V. Alí Lagoa (1,2), J. Licandro (1,2), J. de León (3,4), M. Delbó (5), N. Pinilla-Alonso (4) and H. Campins (6)
(1) Instituto de Astrofísica de Canarias, Tenerife, Spain, (2) Departamento de Astrofísica, Universidad de La Laguna, Tenerife, Spain (vali@iac.es), (3) Department of Edaphology and Geology, University of La Laguna, Tenerife, Spain (4) Instituto de Astrofísica de Andalucía - CSIC, Granada, Spain, (5) UNS-CNRS-Observatoire de la Côte d'Azur, Nice, France, (6) University of Central Florida, Physics Department, P. O. Box 162385, Orlando, FL 32816.2385, USA

Abstract

We present simple thermal model fits to data from the *Wide-field Infrared Survey Explorer* (WISE; cf. [14, 9]) and analyzed the obtained diameter, albedo and beaming parameter (D, p_V and η) for B-type asteroids ([2, 3, 7]). We also study the properties of the infrared to visible albedo ratio ($R_p \equiv p_{IR}/p_V$, defined in [10]) in the context of the recent compositional analysis of B-types presented in [5] and [4].

1. Introduction

Visible to near-infrared (VNIR) spectra of a sample of 22 B-types were studied in [5] and classified into three groups based on spectral shape: Themis-like, Pallas-like, and "Others". However, VNIR spectra of 45 B-type asteroids were analyzed in [4] and classified into six "average spectra" or "centroids" by means of statistical clustering analysis [12]. The fact that these centroids show a gradual change in spectral slope, from red to blue, indicates that increasing the size of the sample removes the gap between the two main groups previously identified. Furthermore, the best meteorite matches for the six clusters are all carbonaceous chondrites with a gradual change in degree of hydration.

In this work we analyze the p_V, η and color (R_p) distribution of the B-type population and, in particular, of the groups found in [4] in order to extend our knowledge of their surface composition to the infrared region.

2. Simple Thermal Modelling of WISE data and analysis

In order to obtain best-fitting values of D, η, p_V, and R_p to WISE data, we closely follow the method described in [10, 13] and references therein. In summary, we use the Near-Earth Asteroid Thermal Model (NEATM; cf. [8, 6]) in order to compute the asteroid thermal flux component and estimate the reflected light component (mostly contributing to filter W1) with the H, G system [1].

The values of R_p and p_V help to distinguish different taxonomic clases [11]. In figure 1 we plot the R_p vs. p_V values of the B-type asteroids in [4] that have been observed by WISE. Notice that R_p shows a decreasing trend with increasing value of p_V, i.e. brighter objects tend to be bluer. While the lack of bluest, lowest albedo objects may be explained by an observational bias [11], the lack of redder objects ($R_p > 1$) in the higher albedo seems to be real.

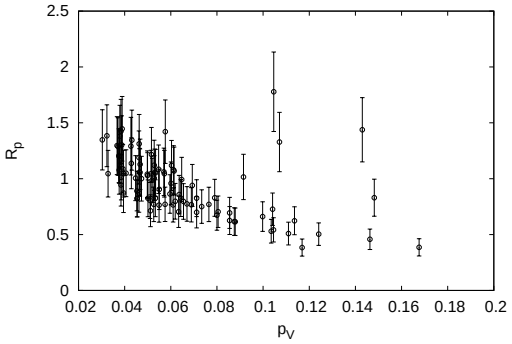

Figure 1: Albedo ratio versus geometric albedo of all the asteroids classified as B-types.

In order to further investigate the properties of R_p we computed the mean value of this parameter within each cluster defined in [4] (see figure 2). The color trend observed in the figure correlates well with the gradient of the spectral slope in the 0.8-2.5 μm region shown by [4]. This spectral gradient seems to be related with the degree of hydration of the materials on the asteroid surface.

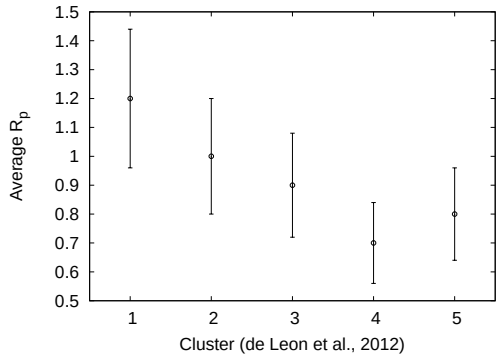

Figure 2: Average values of R_p for each cluster defined by [4]. Note that cluster G6 is not included since it is composed only of one member, 3200 Phaeton, which did not have enough WISE observations to perform a fit.

3. Summary and Conclusions

We study the values of the ratio R_p derived for B-type asteroids by means of simple thermal models applied to WISE data. R_p tends to be lower for higher albedo ojects, which means that higher albedo objects tend to be bluer in the infrared, as is shown in [11]. Additionally, they are also correlated with the spectral slope of the representative spectrum of each of the six clusters identified in [4]. A preliminary analysis of these results suggests that the values of R_p may confirm the fact that most asteroids examined by [4] are hydrated to some extent.

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