The Catalogue of Asteroid Polarization Curves

R. Gil-Hutton[1]

1.- Grupo de Ciencias Planetarias, FCEFN, Universidad nacional de San Juan, y CONICET, Argentina

INTRODUCTION

The variation of the degree of linear polarization as a function of the phase angle α produces a polarization curve described by some parameters that are considered diagnostic of the surface properties. For phase angles <20 degrees, the phase-polarization curve is negative, reaching its minimum, P_{min}, at the phase angle α_{min} ~ 8-10 degrees. Beyond the inversion angle, α_0 ~ 19-21 degrees, polarization becomes positive and increases for larger phase angles with a slope h.

This general behavior characterizes all observed asteroids so far, with some minor differences depending on the optical properties of the surface [1][2][3]. For example, P_{min} and h seem to be related to the geometric albedo of the surface by empirical laws [4][5] and produce characteristic polarization curves for different taxonomic types: asteroids with low-albedo surfaces have a deeper P_{min} and a more pronounced h compared to those with medium or high-albedo surfaces. Therefore, a group of objects with homogeneous mineralogy on their surface is expected to have similar polarimetric properties, but there are always exceptions, so it is necessary to obtain polarization curves for individual objects.

Since 1995, a campaign of polarimetric observations of asteroids has been developed at the Complejo Astronómico El Leoncito (CASLEO) . Combining these data with results obtained by other groups over the past years has allowed the creation of a catalogue of polarization curves and the use of this information to obtain polarimetric parameters for these objects.

REFERENCES

[1] Dollfus et al. (1989) Asteroids II, Univ. of Arizona Press, Tucson, pp. 594-616. [2] Muinonen et al. (2002a) Asteroids III, Univ. of Arizona Press, Tucson, pp. 123-138. [3] Kaasalainen et al. (2003) Icarus, 161, 34. [4] Zellner & Gradie (1976) AJ, 81, 262. [5] Cellino et al. (2006) Torino Ast. Polarimetry V1.0. [7] M. Kaasalainen et al.(2001) Icarus, 153, 37.

Acknowledgements

The author acknowledges the financial support from CONICET through PIP 112-202001-01227 and from the National University of San Juan through a CICITCA grant for the period 2023-2024.

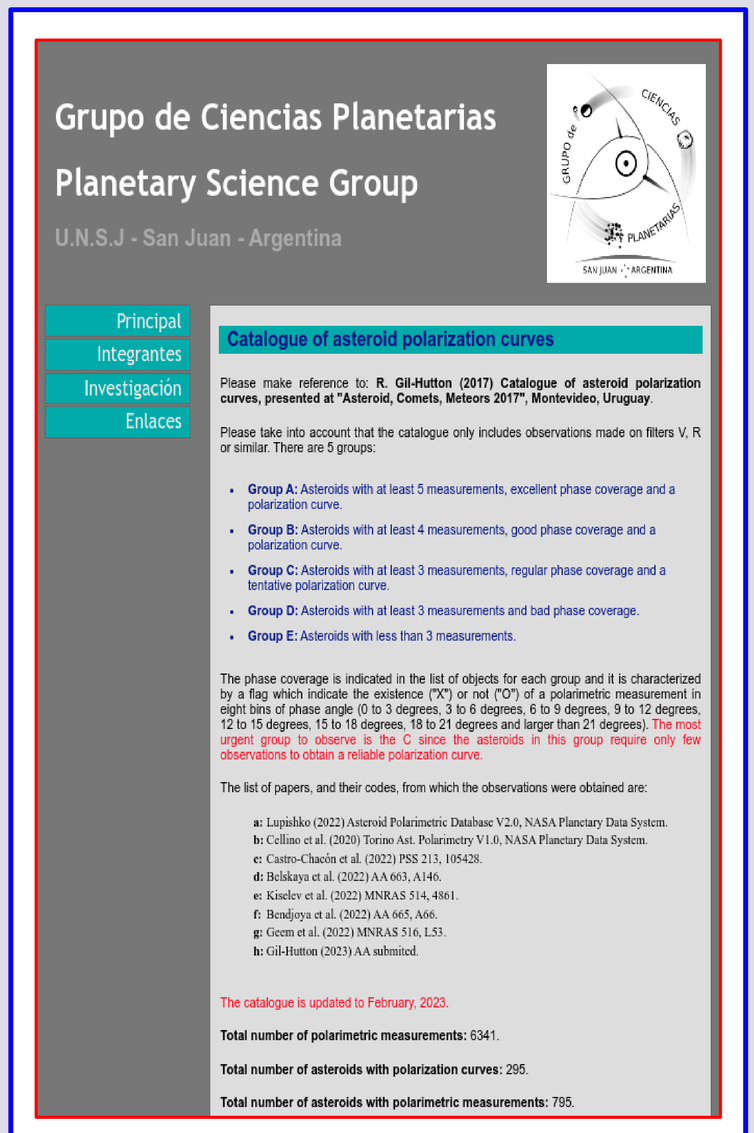

Figure 1. Initial Page of the Catalogue of Asteroid Polarization Curves

http://gcpsj.sdf-eu.org/catalogo.html

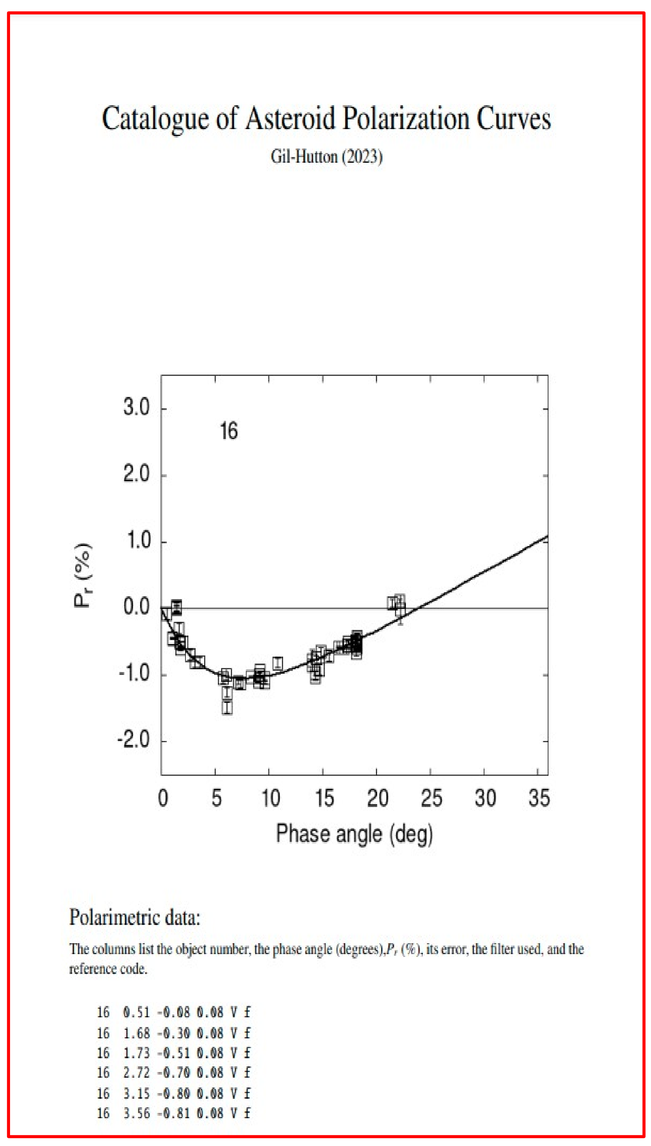

Figure 2. Example of a report for the asteroid (16) Psyche showing graphically the observations and the best fit for the polarization curve.

THE CATALOGUE

The polarimetric data were extracted from the literature, considering only measurements made using V, R, or G filters. The final dataset consists of 6341 polarimetric measurements from 795 asteroids, but for only 295 objects is it possible to fit a polarization curve. In these cases, the data for each asteroid were fitted using a function proposed by [18]:

$$P_r(\alpha) = Coe_1 \left[\exp(-\alpha / Coe_2) - 1 \right] + Coe_3 \, \alpha,$$

where Coe_1, Coe_2, and Coe_3 are constant coefficients.

The catalogue (Figure 1) is available on the Planetary Sciences Group website, where a complete report for each asteroid can be found. This report includes a figure showing the phase angle vs. Pr and the fitted curve, a list of available observations with references to the original paper, the coefficients of the best fit, and the polarimetric parameters of the object with their errors (Figure 2).

The website also provides listings with global reports for different groups, the fitting constants and their errors, and the polarimetric parameters obtained from polarization curves for all asteroids for which a good fit was possible (Figures 2 and 3).

Using this data, it is also possible to create graphs that relate the polarimetric parameters to each other and to other physical quantities such as diameters and albedos from WISE.

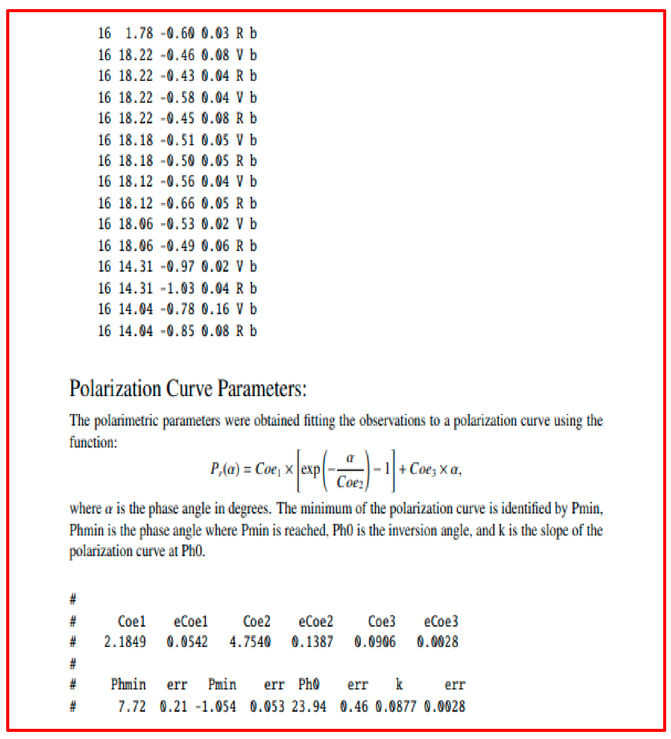

Figure 3. Example of a report for the asteroid (16) Psyche showing the coefficients of the fit and the resulting polarimetric parameters.