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Relationships Between Dust Grain Components Responsible for Observed Interstellar Extinction and Polarization

Geoffrey C. Clayton
Washburn Observatory, University of Wisconsin

I. Introduction

Twelve years after Gehrels (1974) published the first observations of interstellar polarization at ultraviolet wavelengths, no further observations have been reported. In contrast, the ultraviolet extinction properties of interstellar dust have been well observed. Although all extinction curves show the same basic shape, significant variations from the "average" curve are common (Massa, Savage, and Fitzpatrick 1983; Witt, Bohlin, and Stecher 1984). In particular, the amount of extinction measured in the visible (E(B-V)), at the 2200 A feature (E(Bump)), and in the far-ultraviolet (E(1550-V)) are only vaguely correlated indicating that at least 3 fairly independent populations of grains contribute to the overall extinction curve.

With the exception of Gehrel's observations toward two stars, observations of interstellar polarization have been confined to visible and infrared wavelengths. Are the grain populations responsible for ultraviolet extinction aware that the third population is aligned by the Galactic magnetic field? Meyer and Savage (1981) found only a weak correlation between λ_{max}, the wavelength at which maximum polarization occurs, and a measure of ultraviolet extinction, (E(1550-3300)/E(B-V), for 91 stars.

A search of the literature was made for polarimetric observations of the 1415 stars included in the extinction catalogue derived from Astronomical Netherlands Satellite (ANS) data (Savage t al. 1985). It was found that about 900 of the stars had at least one unfiltered polarimetric observation, p(%). In addition, 150 stars had calculated values of λ_{max}.

II. Results

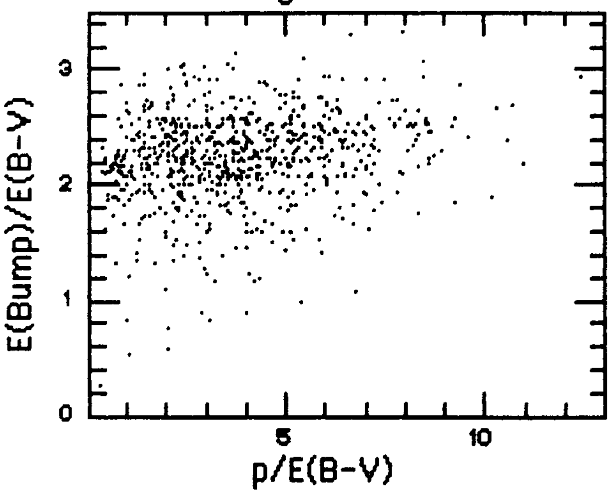
a). λ_{max}

This parameter is usually considered to be related to the mean size of the population of aligned grains (Savage and Mathis 1979; Mathis 1985). The weak correlation found by Meyer and Savage (1981) is also found here in the larger sample. Larger values of λ_{max} have generally weaker far-ultraviolet extinction as measured by E(1550-V)/E(B-V). However, if λ_{max} is plotted against E(1550-3300)/E(Bump) removing the dependence on visible extinction, the correlation virtually disappears. Therefore, changes in the visible extinction reflected in E(B-V) may be responsible for the correlation found by Meyer and Savage.

b) p/E(B-V)

This parameter is a measure of grain alignment efficiency and uniformity of the Galactic magnetic field. It is also a measure of extinction by unaligned grains which contribute to E(B-V) but not to p. The maximum value observed in the Galaxy is 9 %/mag. A weak relationship is found between E(Bump)/E(B-V) and p/E(B-V). As can be seen in Figure 1, stars with very weak bumps have small values of p/E(B-V). Perhaps along these lines of sight the fraction of unaligned grains contributing to E(B-V) is large compared to the aligned grains and the grains producing the bump.

Figure 1



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