Ph.D. Thesis

Title: QUANTITATIVE ANALYSIS OF INTERSTELLAR GRAINS USING THEORETICAL MODELS

Mohammed Azeez Saeed
Mohammedaziz953@gmail.com
00964 (0) 750 462 2954

ABSTRACT
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This thesis, presents the study and analysis of the optical properties of interstellar dust grains. Attempt is made to select a suitable model which define the structure and composition of these grains, by studying the normalized extinction , linear polarization features , and the equivalent widths of the diffuse interstellar bands , but no one model is completely successful .We shall present the application of the following models :

1- The three component microbial model .

2- Silicate core ice mantle model .

3- The power law model .

4- Drude function model .

5- Serkowski law fit of linear polarization .

In this work we shall present and analysis the following data :

1-Normalized extinction of 10 stars in the Milky Way in the wavelength range $0.29 \leq \lambda^{-1} \leq 9.0 \mu m^{-1}$

2-Normalized extinction of 10 cluster stars in the Milky Way in the wavelength range $3.3 \leq \lambda^{-1} \leq 9.0 \mu m^{-1}$

3-Normalized extinction of 22 stars in the Milky Way in the Infrared $\lambda^{-1} = 0.29$ to $4.0 \mu m^{-1}$.

4-Normalized extinction of 154 luminous stars in the southern Milky Way in the wavelength range $0.45 \leq \lambda^{-1} \leq 2.91 \mu m^{-1}$.

5- Normalized extinction of 6 stars of the Large magellanic Cloud in the wavelength range $0.45 \leq \lambda^{-1} \leq 8.0 \mu m^{-1}$.

6-Average normalized extinction of the Milky Way , LMC , and 30 Doradus .

7-Linear polarization of 6 stars in the Milky Way $\lambda^{-1} = 1.35 - 7.14 \mu m^{-1}$,and $0.32 - 7.69 \mu m^{-1}$.

8-Linear polarization of 6 cluster stars in the Milky Way λ^{-1}= 0.49 - 2.78 μm^{-1} .

9-Linear polarization of 3 LMC stars λ^{-1}= 1.19 - 2.81 μm^{-1} .

10-Energy flux of 6 stars λ^{-1}= 1.35 - 7.14 μm^{-1} .

11-Diffuse interstellar bands for about 150 stars; CH,CH^{+},5780,5797Å , N(HI),and N(HII) .

Using Mie theory , through suitable programs for homogenous sphere, homogenous coated spheres and infinite cylinder , we have found that the three component microbial model (Cylindrical bacteria, Spherical graphite grains, and Spherical dielectric particles of known properties) can be fitted well to both normalized extinction and linear polarization of the Milky Way and LMC galaxies .

It is shown that silicate particles of radius 0.04μm coated with ice up to 0.25μm thickness could account for the normalized extinction in the Infrared .

It is also shown here that the Infrared normalized extinction can be fitted well by the power law relation .

The Drude profile (function) give very good fit into the normalized Ultraviolet and Far- Ultraviolet extinction .

The hollow needle shape cylindrical bacteria can be fit with reasonable agreement to the normalized linear polarization data in infrared to visible region of the spectrum .

Serkowski law fit is still the excellent representation of linear polarization of the starlights of all the stars .

In this work we calculate the complex refractive indices required in the applications for both graphite and interstellar silicate particles at 20 K in the wavelength range under consideration by using Drude model of the optical constants of solid metals . The results are shown in tabulated form suitable for use in future work .