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COMMISSION 21: LIGHT OF THE NIGHT SKY

(LUMIERE DU CIEL NOCTURNE)

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1. SCIENTIFIC HIGHLIGHTS 1997 - 1999

1.1. Zodiacal Light

It has been known that non spherical silicate particles of a size comparable to the wavelength of light, and aggregates of such particles, produce negative polarization in the backscattering region (e.g. Xing & Hanner 1997, Yanamandra-Fisher & Hanner, 1999). It has now been shown that large aggregates of small absorbing particles of fractal dimension about 2 produce a slightly negative polarization at small phase angles (Levasseur-Regourd et al., 1997). The phase-curves strongly differ from those of Mie spheroidal particles. They are likely to be due to scattering by irregular dust particles and/or fluffy aggregates of numerous submicronic absorbing particles (Levasseur-Regourd et al., 1997; Lumme et al., 1997).

A value of (0.15±0.08) is obtained for the geometric albedo of the zodiacal dust at 1 AU (Levasseur-Regourd, 1998). It agrees with the models of dark absorbing dust particles and/or fluffy aggregates. It also agrees with the classical assumption that both asteroidal dust, of higher albedo, and cometary dust, of lower albedo, are the most important sources of interplanetary dust between the orbits of Mars and the Earth.

The various models suggested for the structure of the zodiacal cloud require the existence of (at least) two dust populations. The first one is the flattened, strictly speaking zodiacal cloud, with a solar distance dependence of about 1/R and a latitudinal dependence of about $(\cos b_0)^{20}$; the second one is a spherically symmetrical interplanetary cloud centered on the Sun, whose brightness seems to exceed that of the flattened cloud at elongations below 60 in the helio-ecliptic meridian, and whose solar distance gradient could be steeper, of about $1/R^2$ (Dumont et al., 1998). The mixing ratio of the particles belonging to the two dust clouds thus changes with their location in the cloud. The flattened cloud could be replenished by periodic comets and dust produced by asteroidal collisions; the spherical cloud might be replenished by new non-periodic comets, including comets vaporized in the solar vicinity.

Most of the new findings of the interplanetary dust cloud have come from satellite measurements at infrared wavelengths. It was thought that details of the zodiacal with ground-based detectors would not be possible due to atomospheric scattering and emission. However, the detection of faint emission from the ground has now been accomplished. The first results were obtained with a cooled CCD camera at Haleakala, Hawaii (James et al. 1997). They found the axis of symmetry of the zodiacal light at westerly elongations was significantly south of the ecliptic plane and the axis of the invariable plane of the solar system. Furthermore, the longitude of the position of the Gegenschein is at the antisolar point within the limit of measurement, whereas its centroid is 2.5±0.5 deg. south of the ecliptic.

Ishiguro et al.(1999) presented the first detection of the interplanetary dust bands from ground-based observations in the visible light band. They found the morning zodiacal light shows the presence of dust bands at ecliptic latitudes $\beta = 0$ and ± 10 deg., which confirms satellite data. Furthermore, in the antisolar point region, which was out of the field of view of satellites, the dust bands at $\beta = +2$ deg., -4 deg. and -9 deg have been detected. These results have provided a new and convenient tool to observe the dust bands, and open a new means to study asteroids and interplanetary dust grains, via ground-based observations.

Although the Zodiacal light appears to be smoothly continued into the solar corona, the derived variation of local optical properties of the dust particles was shown not to be compatible with a homogeneous dust cloud (Mann, 1998), which supports the idea of different dust components in the Zodiacal cloud. It was shown that variations in the composition of the near solar dust cloud might lead to an irregular slope of the F - corona brightness which could be interpreted as a circum-solar dust ring. The appearance of brightness features is not correlated to the solar cycle (Kimura and Mann 1998).

1.2. Interstellar Dust

Gordon et al.1998 detected extended red emission in the diffuse interstellar medium using Pioneer 10/11 maps of the zodiacal light plus starlight and galactic background, and they redid the star subtraction using modern on-line star catalogues.

The absorption/emission properties directly derived for the unified silicate core-organic refractory model of interstellar dust (Li & Greenberg, 1997) have been shown to provide a match to the full range of observations of the diffuse galactic emission from the infrared to the millimeter including the COBE and DIRBE results (Greenberg & Li, 1997)

1.3. Cometary Dust

The thesis that all comets are born equal as aggregates of interstellar dust - but may evolve differently - was supported by showing both the similarities and differences in the infrared emission by the dust of both short and long period comets P/Borrelly, Halley, and Hale-Bopp (Li & Greenberg 1998a, Greenberg & Li, 1999) The infrared to millimeter emission in the protoplanetary disk of DF-Pictoris has been shown to be derivable as coming from the dust shed by comets orbiting the star and thus provided a plausible picture of how our interplanetary medium may have looked for the first 10 - 100 million years - a very intense zodiacal light (Li & Greenberg, 1998b).

1.4. Diffuse Extreme Ultraviolet Emission In Clusters Of Galaxies

Bowyer et al. 1999 have obtained new data and have reanalyzed archival data on diffuse Extreme Ultraviolet Emission in clusters of galaxies. They found serious problems with previous studies of this topic and find many of the clusters reported to have EUV emission do not, in fact, have excess EUV emission. However, they confirm that in the Coma cluster excess EUV emission is present confirming that, in at least this cluster, some as yet unidentified process is operative (this paper is listed on the Commission 21 website).

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2. SPECIAL PROJECTS / OTHER ACTIVITIES

Comm. 21 initiated the effort to organize IAU Symposium 204, "The Extragalactic Infrared Background and its Cosmological Implications", at the next General Assembly.

3. MAJOR SCIENTIFIC CONFERENCES 1997 - 1999

The meeting of "The Zodiacal Cloud Sciences" was held in 1997 September in Kobe University as one of satellite meetings of IAU General Assembly at Kyoto. A special issue of "Earth, Planets and Space Vol. 50, Nos. 6,7 1998" was devoted to the Proceedings.

4. MAJOR PUBLICATIONS 1997 - 1999

"The 1997 reference of diffuse night sky brightness" Leinert, C., Bowyer, S., Haikala, L., Hanner, M., Hauser, M.G., Levasseur-Regourd, A.C., Mann, I., Mattila, K., Reach, W.T., Schlosser, W., Staude, J., Toller, G.N., Weiland, J.L., Weinberg, J.L., & Witt, A. 1998. Astron. Astrophys. Suppl. 127, 1-99. (Available on the Commission 21 web site)

"Diffuse infrared radiation and the IRTS". 1997. H. Okuda, T. Matsumoto, & T.L. Roellig (eds.), ASP Conf. Ser. 124, San Francisco

"Interplanetary Dust", 1999. B. Gustafson & E. Grün (eds.), University of Arizona Press, Tucson

"Formation and Evolution of Solids in Space" 1999. J.M. Greenberg and A. Li, (eds.), Kluwer, in press

5. SOURCES OF FURTHER INFORMATION

Commission 21 has developed a web site:

http://sag_www.ssl.berkeley.edu/IAUCom21

Information about the Commission and reprints of articles of interest to the Commission are provided.

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President of the Commission