COMMISSION 21 : LIGHT OF THE NIGHT SKY (LUMIERE DU CIEL NOCTURNE)

Report of the Meetings November 20, 22, 23, 27

PRESIDENT: R.H. Giese

SECRETARIES: A.C. Levasseur-Regourd
K. Mattila

ADMINISTRATIVE SESSION

20 November 1985

The President welcomed the few members attending the General Assembly at New Delhi and reported the sad news about the dead of Dr. F. Link, presenting a short necrology taking into account the very fruitful and versatile work of Dr. Link in many fields of Astronomy and Geophysics including the field of Commission 21. Members stood up in silence in memoriam of this outstanding scientist and friendly colleague.

The President reported about activities in the passed triennium: A circular plus Newsletters No 7 and No 8 were sent out forward latest information in preparation of IAU Colloquium No 85 and of the General Assembly and to ask for inputs and suggestions for these events, membership of the new Organizing Committee and concerning "Reports on Astronomy". The President acknowledged with thanks the valuable response and stated that the contribution of Commission 21 to Reports on Astronomy was based on drafts kindly prepared by R. Dumont, K. Mattila and H. Tanabe and on very helpful inputs from other members of the Organizing Committee. It was further reported about preparations and the final success of IAU Coll. No 85 "Properties and Interactions of Interplanetary Dust" at Marseille, which was organized by our commission, supported by Commissions 15, 22 and 49 and by COSPAR. 91 papers were presented by 78 participants from 14 countries. The proceedings are now available at Reidel Publ. Comp., Dordrecht, 1985 (R.H. Giese and P. Lamy, eds).

Concerning membership and officers it was agreed to propose to the IAU Executice Committee following list for approval:

President: K. Mattila
Vice-President: A.C. Levasseur-Regourd
Organizing Committee: R. Dumont, Yu.I. Galperin, R.H. Giese, M.S. Hanner, P. Lamy, T. Mukai, H. Tanabe, J.L. Weinberg
New Members: In addition to E. Grün, who was already included in the latest IAU Commission 21 member list the following names were added

a) V.V. Agashe, O.I. Belkovich, S. Bowyer, S. Hong, J. Houck, F. Paresce, M. Woolfson.
b) J.J. Lopez-Moreno, M. Lopez-Puertas, A. Molina, R. Rodrigo, M.L. Sanchez-Saavedra, N.N. Shefov.
c) F. Giovane.

List a) refers to experts, who were invited by the Commission and who agreed to become members in order to strengthen or to extend the expertise of Commission 21 concerning night sky radiation outside the visual range. List b) and c) refer to new IAU members proposed by the national adhering bodies or by presidents, respectively.

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It was further agreed to invite M.G. Hauser (IRAS) to become a member or consultant. One proposal of the national bodies was not yet adopted by Commission 21 since it seemed to be out of the field of the Commission. The following List of Conciltants was adopted to be given to the IAU General Secretary:

J. Buitrago	D.J. Kessler	J. Michael	G.H. Schwehm
C. Classen	W. Kokott	A. Mujica	G.N. Toller
A. Frey	G. Lopez	A.W. Peterson	M.R. Torr
B.A. Gustafson	J. Maucherat	H. Radoski	K. Weiß-Wrana
M.G. Hauser	J.A.M.McDonnell	R. Schaefer	H. Zook
	R.D. Mercer	A. Schulz	

It was noted, that about 1/3 of the commission members did never respond to any circular or questionaire. It should be checked on an individual base if this is due to mailing problems or to definite change of the field of interest.

Future activities were presented for discussion by K. Mattila (Colloquium on galactic and extragalactic backgrounds) and by H. Tanabe (Dust Colloquium 1989 Japan).

The President thanked the members for their cooperation and those present for participation. The incoming President expressed the members' thanks to the retiring president for his work on behalf of the Commission during the past triennium.

SCIENTIFIC SESSIONS

22 November 1985
(Common Session with Commission No 22)

The review R.H. Giese: 3D-Models of the Zodiacal Cloud was included in this session. Complete program: See report of Commission 22.

23 November 1985
(Chair persons: A.C. Levasseur-Regourd, H. Tanabe)

P.V. Kulkarni: Temperature Measurements in the Earth's Atmosphere and on the Stellar Objects with Simple Optical Techniques. - Ground based observations related to optical measurements from natural and artificial atmospheric glows were briefly summarised. It was shown that with natural airglow photoelectric filter photometric and spectroscopic techniques can be used to estimate the temperature in the 85-90 km region of the earths atmosphere from measurement of OH rotational vibrational band intensities.

In the 250-300 km altitude region, line width of 6300 A emission by a Fabry-Perot high resolution spectrometer gives satisfactory results. F.P. also is sussessfully used to estimate the temperature profile in the altitude range 120-270 km region by monitoring an artificially released Na vapour trail. With Ba-Sr release of blobs in the upper atmosphere temperature of those regions can be estimated from experimentally determined diffusion coefficients.

In the stellar situation, only one application of F.P.I mapping coronal temperatures at the time of two total Solar eclipses (1980, India; 1983 Indonesia) was given (literature: Proc. Ind.Acad.Sci. 89, 109 (1980), JATP 32. 1235 (1970), Plan. Space Sci. 23, 273 (1984)).

H. Tanabe, A. Miyashita and A. Takechi: A Star-eliminating Photometer. - A new photoelectric photometer was designed and constructed, which measures the brightness of only the extended light source with automatic elimination of the starlight in the field of view by utilizing the difference between extended and point light sources.

The photometer has a square field stop with a moving wire in the focal plane of a telescope. During the motion of the wire from one end to the other of the field stop, inverse pulses are produced when the wire covers star images. The photometer with a micro-computer measures the total light flux and depth of each inverse pulse, and calculates instantly the surface brightness of the extended light source.

The photometer can be applied, in future, for a star count by inverse use of the star-elimination by attaching to a large Schmidt telescope. It could be, also, developed to an automatic star-eliminating airglow-separating photometer with utilizing the difference between line and continuous spectra.

J. Houck and M.G. Hauser: IRAS Observations of the Zodiacal Light - A Progress Report. - The IRAS sky survey yielded a very extensive picture of bright diffuse thermal emission from interplanetary dust grains at wavelengths from 12 to 100 micrometers. These data provide insights into the character, spatial distribution, and perhaps origin of these particles which both confirm and expand upon those gaied from previous zodiacal light studies. The zodiacal emission is a major component of the large-scale infrared brightness of the sky at all IRAS wavelengths. It must therefore be carefully characterized both to facilitate study of large-angular-scale sources in the Galaxy and beyond using IRAS data, and to permit optimum design of future space infrared instruments.

A model has been developed which identifies the narrow emission bands discovered by IRAS as arising from debris in the orbits of the Eos, Themis and Koronos asteroid families.

The Infrared Astronomical Satellite (IRAS) was developed and operated by the Netherlands Agency for Aerospace Programs (NIVR), the United States National Aeronautics and Space Administration (NASA), and the United Kingdom Science and Engineering Research Council (SERC).

For additional details see: M.G. Hauser and J.R. Houck, "The Zodiacal Background in the IRAS Data", Proceed. of the Noordwijk meeting, Light on Dark Matter, June 1985. - S.F. Dermott, P.D. Nicholson and B. Wolven, Preliminary Analysis of the IRAS Solar System Dust Data, "Asteroids, Comets, Meteors II", ed. Lagerkvist and Rickman, Uppsala (1985).

A.C. Levasseur-Regourd and R. Dumont: Temperatures and Albedos of Zodiacal Dust, as Inferred from IRAS and ZIP Measurements. - Localizing the information in some points of the line-of sight in optical studies of the zodiacal light has been performed with the method of the "nodes of lesser uncertainty" (see Planet. Space Sci., 31, 1381, 1983 and 33, 1, 1985). An extension to the thermal case is being made on the data of IRAS and of the zodiacal infrared project ZIP (CRAS 300, II, 109, 1985 and IAU Coll. 85, 207, 1985).

There still exist two nodes where the local elemental contribution to the integrated infrared brightness I_ν can be retrieved with lower uncertainty than elsewhere. The knowledge, als well from IRAS as from ZIP, of I_ν at two frequencies allows to determine the temperature of the dust, assumed to radiate like a grey body. Then, the emissivities allow to reach the global emissivity for all wavelengths, which in comparision to the optical scattering coefficient allows to reach the albedo.

The temperature of the dust is found to be (250 ± 25) K at 1 AU. The heliocentric decrease from 1 to 1.4 AU seems to be smaller than would result from a uniformity of composition of the dust. The albedo exhibits a negative heliocentric gradient, from $\sim$0.08 at 1 AU to $\sim$0.06 at 1.4 AU. These results definitely invalidate the old assumption of a homogeneous zodiacal cloud.

The papers V.V. Agashe: Determination of Mesopheric Temperatures from Ground Based Intensity Measurements - and S.Hong: The Connection between IR and Visual

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Zodiacal Light - were only read by title since authors had to cancel attendance due to unexpected obligations.

27 November 1985
(Chairman K. Mattila)

P.C. van der Kruit: Pioneer 10: Surface Photometry of the Galaxy. - The background starlight experiment on Pioneer 10 has provided a distribution of surface brightness across the sky comparable to results of surface photometry of edge-on external galaxies. After reasonable correction for diffuse Galactic light these data can be used at higher Galactic latitude so set constraints on two parameters of the old disk population of stars that have not been determined up till now with great precision. These are the radial scalelength (or e-folding) of the disk population (5.5 ± 1.0 kpc) and the colour of the Galactic disk as seen by an outside observer (B-V) = 0.84 ± 0.15). These parameters are fundamental for an understanding of Galactic structure and evolution, and comparison of our Galaxy to others.

K. Mattila: Some Recent Results on the Galactic and Extragalactic Components of the Light of the Night Sky. - In first part of the talk a review was given on the progress in this field during the past three years. An extensive photographic UBVR surface photometry of the whole Milky Way has been carried out by Schmidt-Kaler et al. Further analysis of the unique Pioneer 10/11 Milky Way photometry (spacecraft outside the zodiacal cloud) has been performed by Toller who has derived information on: (1) the large scale structure of the Galaxy; (2) the scattering properties of the interstellar grains which give rise to the diffuse galactic light; and (3) the extragalactic component of the night sky, for which an upper limit of 3.9 $S_{10}(V)_{G2V}$ at the 2σ level at 4400 A was obtained. The long-standing question of polarization of the Milky Way light has been investigated by Leinert and Richter using observations from the Helios space probes. A marginal detection of polarization was reported with a polarization direction perpendicular to the galactic plane. References to these and some further studies are given in Reports on Astronomy (1981-84), pp. 232-234.

In the second part of the talk a report was given on a study by Mattila, Schnur and Laureijs of the optical and infrared surface brightness in the area of the high galactic latitude dark nebula L1642 (l = 211°, b = -37°). A good correlation was observed between the p.e. optical surface brightness (scattered light) and the 100 μm IRAS flux (thermal emission) as well as the 100 μm optical depth of the dust. The data will be used to derive the albedo and scattering asymmetry parameter of interstellar dust grains. Also, the IR optical depths will facilitate the determination of the extragalactic background light using the method as presented by the author in Astron. Astrophys. 47, 77 (1976).

S. Bowyer: The Diffuse Far Ultraviolet Background from 1200 to 2000 A. - Over the past 10 years, substantial progress has been made in characterizing the diffuse Far Ultraviolet backgrond. Ten years ago the intensity of the background was virtually unknown; published data on the parameter varied by almost three orders of magnitude. It was generally reported that the flux was isotropic, and hence was probably cosmological in origin. The spectrum of the flux was unknown.

A very significant step was made with data obtained with an instrument flown as part of the Apollo-Soyuz mission (Paresce et al, Ap.J. 240, 387, 1980). These data showed the flux was non-isotropic, and was loosely correlated with the total neutral galactic hydrogen column as derived from 21 cm radio data. This was direct proof that the majority of the flux was galactic in origin. These results were immediately confirmed by Maucherat-Joubert et al, Astron. & Astroph., 88, 323 (1980). At the time we have very little evidence as to the source mechanism or mechanisms producing the galactic flux. A substantial number of candidate processes have been advanced including the scattering of starlight by

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interstellar dust, molecular hydrogen fluorescence, two photon emission, emission from an intermediate temperature ($\sim 10^5$ K) interstellar medium, and radiation from old supernovea remnants.

The existing data, when extrapolated to zero hydrogen columm, indicate the existence of an isotropic, diffuse flux of $\sim$ 500 photons/cm^{-2}sec^{-1}st^{-1}A^{-1} which must emanate from the interstellar medium, the summed radiation of galaxies, or some more exotic extragalactic sources.

The task ahead is to identify what processes, galactic and extragalactic are producing the observed flux.

J. Holberg: Voyager Data on the EUV and Far UV Diffuse Background. - New limits are presented on the extreme and far UV diffuse backgrounds, for both line and continuum emission, in the 500 to 1200 A region. These limits are derived from a single spectrum of extremely long integration time (1.5 x 10 s) obtainded with the Voyager 2 ultraviolet spectrometer in the direction of the north galactic pole. This spectrum can be explained solely on the basis of resonant scattering from interplanetary HI and HeII. Limits on any additional sources of sky background radiation corresponding to less than 100 to 200 photons cm^{-2}s^{-1}sr^{-1}A^{-1}, for continuum emission, and 10^4 photons cm^{-2}s^{-1}sr^{-1} for line emission are demonstrated. Comparisons of these upper limits with existing measurements and upper limits is discussed. A first detection of resonantly scattered interplanetary HI Lyman γ (973 A) emission is reported. Additional Voyager observations obtained at lower galactic latitudes exist and indicate the presence of a stellar-like continuum. Both the spectral shape of this continuum and its intensity point to an origin associated with the scattering of starlight from interstellar dust.

A. Davidsen and F. Paresce: The Spectrum of the Diffuse Far UV Background. - The spectrum of the diffuse far UV background has gone through several peculiar gyrations since its measurement was first attempted by means of a 12° x 12° scanning spectrometer on Apollo 17 in trans-earth coast. From the single wide feature having profound cosmological implications of intensity $\simeq$ 300 photons cm^{-2}s^{-1}sr^{-1}A^{-1} at 1400 A reported by Henry et al., 1978 (Ap.J., 223, 437) through the featureless flat continuum with a possible rise beyond 1650 A observed by Anderson et al., 1979 (Ap.J., 234, 415) by means of a 1.4 x 5.8°, 60 A resolution rocket-borne spectrometer, it has progressed to the possibly complex set of weak emission lines superimposed on a very weak continuum advocated by Feldman, Brune and Henry, 1981 (Ap.J. 249, L51). This last result stems from a reanalysis of the Anderson et al, 1979 data consisting essentially of adding together the individual spectra obtained in different directions towards the north galactic pole in the original flight. This technique allows the reasonably confident identification of four prominent features in the 1200 to 1650 A band at 1400, 1490, 1550, 1660 A that cannot be attributed to atmospheric emission.

The reanalysis carried out by Feldman et al., 1981 was prompted by the suggestion made earlier by Jakobson and Paresce, 1981 (Ap.J., 96, 23) that the hot galactic corona could be the source of very weak line emission in the far UV (at most $\simeq$ 200 photons cm^{-2}s^{-1}sr^{-1} in the CIV, 1549 A line). Using a simple two component constant temperature model of the disc and coronal gas and the relation between the expected line intensity I_ℓ and the collisional excitation rate $\gamma_\ell(T)$: $I_\ell = (n_e\, n_i\, \beta\gamma_\ell(T))/8\pi$ Jakobson and Paresce, 1981 predicted the appearance of a number of lines i the UV background. In this equation n_e and n_i are the electron and ion densities and ß is the scale height of the gas. The most prominent in the 1200 to 1650 A band were predicted to be the SiIV, 1398, OIV], 1406, NIV], 1487, CIV, 1549 and OIII], 1663 A lines. The interesting fact that they corresponded almost exactly to the observed features was not lost on the authors involved although the almost two factors of ten discrepancy in intensities tended to cloud the issue somewhat.

Paresce et al., 1983 (Ap.J. 266, L107) suggested a simple explanation for the large discrepancy, however. Rather than fixing the gas temperature in the manner adopted by Jakobsen and Paresce, we allowed this parameter to vary freely to investigate possible observationally allowed regions of the emision measure (EM) - temperature plane. Surprisingly, such an internally consistent region was found at EM $\simeq 10^{-1}cm^{-6}pc$ and $T = 2.5.10^{5}K$. In other words, a single emitting plasma of ≥ 160 parsec extent at this temperature could explain the Feldman et al., 1981 data. Many other lines are expected to be prominent both in the far UV and in the EUV below ≃ 200 A where interstellar absorption is less severe and a measurement of any of these would clearly add significantly to our understanding of the hot phase of the ISM.

The important point to be made in this context is simply that since we have no information at present on either the extent or the distribution of this gas, if it exists, it is impossible to predict accurately the intensity of these lines as a function of view direction. If our calculations are correct and the line emission is due to a disc gas, the expected line intensities at intermediate or low galactic latitudes could become substantial contributors to the far UV background even in broad and observations. Thus, this component cannot be safely ignored when considering possible sources of galactic emission on which the extragalactic component has to be determined.