

COMMISSION 15: PHYSICAL STUDY OF COMETS (L'ÉTUDE PHYSIQUE DES COMÈTES)

Report of Meetings, 19 and 22 August 1970

PRESIDENT: L. Biermann.

SECRETARY: J. Rahe.

First Meeting

I. ADMINISTRATIVE MATTERS

During the meeting the following administrative matters were discussed:

As new officers of the Commission were proposed and unanimously nominated by the Commission for approval by the Executive Committee of the Union: President: V. Vanýsek; Vice-President: A. H. Delsemme.

As new members of the Commission were approved: J. C. Brandt, B. Donn, M. Harwit, D. Malaise, A. Mrkos, J. Rahe, Z. Sekanina.

W. F. Huebner was suggested as Consultant.

II. SCIENTIFIC PRESENTATIONS

The following communications were presented during the meeting of the Commission, in order of their presentation:

Comments on OAO Observations of Comets 1969g and 1969i (A. D. Code)

An extensive H-envelope was discovered in Comets 1969g and 1969i. Comet 1969g was optically thick in $L\alpha$ up to about 500000000 km. The intensity of the nucleus was approximately 70 kR for 1969g and 72 kR for 1969i and measurable out to about 2, respectively 3°. Variation of $L\alpha$ with heliocentric distance was not linear but showed a decrease in brightness near perigee. The H-atom temperature was found to be 1600 K. The (0,0) band of OH at 3090 Å was observed. OH was optically thick to about 3' from the nucleus. The number density of OH is of the order $N = 2 \times 10^{23}/r^2 \text{ cm}^{-3}$. Variations of OH intensity with solar distance yield a dependence on distance to -5.8 power.

Internal Motions in the Head of Comet Ikeya-Seki 1965 VIII from High Resolution Spectra (Z. Sekanina)

Doppler displacements of the emission and absorption lines of Comet 1965 VIII have been compared with predicted radial velocities from the comet's orbit. The emissions suggest a blue shift corresponding to a residual radial velocity of, on the average, 0.8 km/sec; the absorptions indicate a red shift of about 2 km/sec. The deviations should be interpreted in terms of internal motions of ejected material in the comet's head.

Solar Wind and Comets (J. C. Brandt)

The analysis of a new theoretical treatment of the orientation of ionic comet tails indicates that the effects of coplanarity on the determination of the average solar wind velocities are small.

A report is given on a new telescope that has been designed and built specifically for observations of the large scale structure of comets (field-flattened $f/2$ Schmidt with 14" corrector plate, 23" mirror, 4" \times 5" film or plate size, $8 \times 10^\circ$ field). First results are presented that indicate the great potential of colour photography in cometary research.

Physico-Chemical Phenomena in Comets

(A. H. Delsemme)

The photometric profile of the continuum and the molecular bands as predicted by Delsemme's new model of the cometary head (*Planetary Space Sci.* **18**, 709–30, 1970) is compared with the observed continuum and C₂ emission in Comet Burnham.

A Search for Radio Emission from Formaldehyde in Comet 1969i

(L. E. Snyder, W. F. Huebner)

L. E. Snyder reported on the unsuccessful search for the 1₁₀ – 1₁₁ transition of formaldehyde in emission at 4830 MHz from Comet 1969i using the 140 ft NRO radio telescope at Green Bank, W. Va. An upper limit of the H₂CO projected density is placed at approximately 10¹⁴ molecules/cm².

Search for Microwave H₂O Emission in Comet 1969i

(T. Clarke, B. Donn, W. Sullivan)

W. Sullivan reported on the unsuccessful search for the 6₁₆–5₂₃ rotational line of H₂O at 22235 MHz (1.347 cm) in the nucleus of Comet 1969i on April 1, 1970. Assuming a kinetic temperature of 100 K and a molecular cloud of 1' in diameter, an upper limit is placed at 10¹⁸ H₂O molecules/cm² in the nucleus.

Second Meeting

I. ADMINISTRATIVE MATTERS

During the meeting the following administrative matters were discussed:

The Draft Report of the Commission was approved.

As members of the Organizing Committee were elected by the Commission: Biermann, Herzberg, Levin, Richter, Roemer, Whipple, Wurm.

II. PROPOSALS AND SUGGESTIONS

The following propositions were presented and discussed:

Dr J. Virginia Lincoln suggested that Institutions making observations on the geometry or physical characteristics of comet tails suited to solar-terrestrial studies notify 'World Data Center A, Upper Atmosphere Geophysics, ESSA, Boulder, Colorado 80302, USA' annually (e.g., in March) or oftener concerning their observing programme since their last report. This should include the identity of the comets observed, the periods of observation and the general nature of the observations. The Commission recommended to support the proposal and established the following working group that will be concerned with the matter: Babadjanov, Dossin, Rh. Lüst, Marsden, Rahe, Vanýsek.

Dr F. D. Miller suggested the exchange of information on filters, and standardization. At the present time it is difficult to intercompare comet observations made with different sets of filters, and the UBV system is not suitable for this work. It is therefore suggested that there be a discussion of the characteristics of filters suitable for isolating particular components of comet radiation (C₂ bands, scattered sunlight, etc.). Interference filters are not very expensive, and it would be possible for an observer to have a 'standard' set, as well as filters designed according to his own ideas.

The President proposed to submit the suggestion to the working group for international cooperation in the physical observation of comets that was established at the XIII General Assembly in Prague 1967. Dr Delsemme agreed to succeed Dr Biermann as chairman of the working group.

Following a suggestion by Dr F. D. Miller, consideration was given to the desirability of alerting observers by telegram when a comet shows some sudden and particularly interesting physical development. The Central Bureau for Astronomical Telegrams agreed to cooperate in this matter. This type of message does not conform with the existing categories of telegrams, however, and subscribers are therefore requested to contact the Bureau if they would like to receive such messages; suggestions concerning the type of information that might be transmitted are also solicited.

III. PROGRESS OF COMET ATLASES

Dr Rahe outlined the plans for the second part of the *Atlas of Cometary Forms* (J. Rahe, B. Donn, K. Wurm, 1969) which will deal with cometary ion tails as discussed with Dr Donn and Dr Wurm. A letter from Dr Wurm was read suggesting to limit the second part of the Atlas to a few selected items thus avoiding long delays in the publication.

The Commission was informed of Dr Richter's plan to publish a second part of the *Isophotometrischer Atlas der Kometen* (W. Högnér, N. Richter, 1969). Dr Levin suggested that in the second part a scale in km is included for each picture.

Dr Haser summarized the plans for an extension of the *Atlas of Representative Cometary Spectra* (P. Swings, L. Haser, 1955) including in particular the high dispersion spectra obtained since the publication of the Atlas.

It was suggested by the President that the Commission recommend the publication of additional parts of the *Atlas of Cometary Forms*, the *Isophotometrischer Atlas der Kometen*, and the *Atlas of Representative Cometary Spectra*.

IV. SCIENTIFIC PRESENTATIONS

The following communications were presented during the meeting of the Commission, in order of their presentation:

Observations of Comets 1969g and 1969i in L α (L. Biermann)

From discussions with Code it appears that Code's value of the OH density ($2 \times 10^{23}/r^2$) refers to regions in which the larger part of the OH is likely to be already dissociated. A report is given on the work of Bertaux and Blamont on Comet 1969i. The total number of H-atoms seen around the inner part that is optically thick in L α , is 1.2×10^{36} each of which is excited every 350 sec.

L α Observations of Comet 1969g (E. B. Jenkins, D. W. Wingert)

E. B. Jenkins reported that Comet 1969g had been photographed by an objective grating camera launched in a rocket on January 25, 1970. A preliminary interpretation of the picture suggests that the hydrogen cloud appears as a nearly circularly symmetric peak whose width (FWHM) equals $0.5 (5 \times 10^5 \text{ km})$. There is some suggestion that in addition to the broad peak a small nucleus may be visible, and if further analysis confirms its existence, one could infer that the main cloud is not optically deep to L α radiation.

Photographs of Comet 1969g in L α (F. L. Whipple)

Professor Whipple presented several photographs in L α of Comet Bennett. The image of the comet

shows a large elliptical coma of about 1 million km in diameter which is in agreement with the $L\alpha$ measurements made with OAO 2 and OGO 5.

The 'Dust' Effect in $L\alpha$ Cometary Radiation

(V. Vanýsek)

Possible effects of the dust content in comets on the $L\alpha$ radiation of comets are discussed.

The scattering of the solar $L\alpha$ line on small particles depends strongly on the actual albedo in the UV region and most probably is generally weak.

More important, however, seems to be possible additional net and continuous production of neutral hydrogen atoms from the dust particles in the cometary tail. The production of 10^6 atoms per second per particle in a 'dust-rich' comet can lead to significant prolongation of isophotes and therefore also to the misinterpretation of the observed distribution of the UVB cometary radiation.

Interpretation of $L\alpha$ Emission in Comets

(L. Biermann)

An interpretation of the $L\alpha$ observations is given following JILA Report No. 93, 1968. The H-atom temperature found by Code was 1600 K as compared to 2000 K assumed then which means a reduction of the probable velocity of the outflow by $\geq 10\%$ to ≈ 5 km/sec. With this the production of H-atoms was estimated to be $\geq 10^{29}$ /sec ster. The light pressure in $L\alpha$ reduces the flow velocity in the solar direction by 40% over a distance from the nucleus of $\approx 10^6$ km.

UV-Spectroscopy from Stabilized Rockets

(L. Haser)

3 payloads for the observation of the UV spectrum of comets with a resolution of 30 Å are being prepared for a launching period beginning 1972.

Collisional Effects in Cometary Atmospheres

(J. Malaise)

see *Astron. Astrophys.* 5, 209–7, 1970.

The Spike of Comet 1969g

(F. D. Miller)

In Comet 1969g a faint spike or 'antitail' (projected length 230000 km, at most a few 1000 km thick) was visible on December 26 and January 2, but not on January 8. Miller has no plates between January 2 and January 8.

Particulate Matter in Comets as Studied in the Infrared

(C. R. O'Dell)

Infrared observations are reported for Comets 1969g and 1969i. The optical albedo of the particles is about 0.3 and the emissivity drops from about 0.7 at optical wavelengths to about 0.2 at 10μ producing temperatures significantly higher than for black bodies. An average particle radius of 0.1μ could be derived.

The 0.9–1.6 μ Spectrum of Comet 1969i

(R. P. Kovar)

Emissions due to the CN red system and the C_2 Ballik-Ramsay system are tentatively identified, emission due to the C_2 Phillips system appears to be absent. Preliminary analysis seems to indicate that the C_2 molecules are formed in a triplet rather than a singlet state.