COMMISSION 15: PHYSICAL STUDY OF COMETS, MINOR PLANETS AND METEORITES (L'ETUDE PHYSIQUE DES COMETES, DES PETITES PLANETES ET DES METEORITES)

Report of Meetings 26 and 27 November 1985

PRESIDENT: C. R. Chapman VICE PRESIDENT: L. Kresak

ACTING PRESIDENT: J. Rahe

I. BUSINESS SESSION

Commission 15 had one business and three scientific sessions. During the business session new officers and members of the Organizing Committee were elected:

President: L. Kresak

Vice President: J. Rahe

Organizing Committee: M. F. A'Hearn, C. Arpigny, C. R. Chapman, O. V. Dobrovolsky, H. Fechtig, A. W. Harris, H. F. Haupt, L. M. Shul'man, J. T. Wasson, S. Wyckoff, V. Zappala

Tribute was paid to those members of Commission 15 who had passed away since the last General Assembly: Drs. Bappu, Beyer, Demenko, Krinov, Opik, Simonenko, Swings, Vseksvyatskij.

Three working groups were established and it was suggested that additional members be added to the ones already proposed:

Working Group on Comets: C. Arpigny (chairman), J. C. Brandt, O. V. Dobrovolsky, A. C. Levasseur-Regourd

Working Group on Minor Planets: A. W. Harris (chairman), H. F. Haupt, V. Zappala

Working Group on Meteorites: J. T. Wasson (chairman), M. Fulchignoni, Y. Yavnel.

It is expected that these Working Groups coordinate the corresponding Commission 15 related activities, and assist the Commission 15 President in submitting his report to the IAU General Secretary before the next General Assembly.

A "Catalogue of Cometary Emissions" covering the spectral range from the ultraviolet to the near infrared is being prepared in Liege. A preliminary version of this catalogue will be available in early 1986 in form of a computer printout. Interested persons may obtain further information from C. Arpigny, Institut d'Astrophysique, Universite de Liege B-4200 OUGREE-LIEGE (Belgium).

II. SCIENTIFIC SESSIONS

One scientific session of Commission 15 was dedicated to "Asteroid Research". It was chaired by P. Farinella. Several short presentations reviewed a number of activities related to physical studies of asteroids,

which mostly imply or require some coordination and cooperative effort at an international level.

P. Farinella reported on an international workshop held in Pisa, Italy, on July 30 - August 2, 1985, on "Catastrophic Disruption of Asteroids and Satellites". He stressed the usefulness of discussions and cooperation among planetary astronomers, solid-state physicists, and researchers carrying out laboratory experiments on related phenomena, which appear very important for an understanding of the evolution of small solar system bodies.

V. Zappala reviewed the present status of the determination of asteroid rotational poles, discussing both the different methods currently used and their relationships, and the preliminary statistics of the results for a few tens of objects. A larger sample of pole data appears to be needed to reach firm conclusions on the existence of anisotropical pole distributions at least for large asteroids. These conclusions will constrain future models of asteroid collisional evolution.

T. Gehrels discussed the possibility of observing small asteroids during space missions like Galileo, Venera and CRAF, which will carry out flyby studies of large asteroids. Hundreds of asteroids with a diameter of a few km will be within range of the cameras of these spacecraft. Earth-based telescopes could identify suitable candidates, refine their orbits and provide pointing data for spacecraft CCD cameras.

H. Schober presented a report on the planned flyby of 476 Hedwig by the CRAF mission, and described an accepted proposal for asteroid observations by the Hubble Space Telescope.

A. H. Harris gave a report on the activity of the Commission 15 working group formed in Patras to prepare an updated and comprehensive file of asteroid rotational properties. The file which will be ready within a short time, will include a standard list of data to be used for statistical studies, a list of all relevant references and a more detailed set of data to be used for planning the observational work. Results from the statistics of asteroidal rotational periods were discussed.

T. Bowell provided information on a new system to predict asteroid magnitudes as a function of phase angles, which was also discussed by Commission 20. It allows a direct comparison between asteroid and satellite magnitudes.

Z. Knezevic described the joint work on asteroid families in progress by groups in Belgrade, Nice, Turin, and Pisa. An essential condition for future physical studies of families appears to be a better procedure to define proper orbital elements, since the available analytical theories appear to be unable to provide stable elements over timescales comparable with the ages of families.

L. K. Kristensen and P. Gammelgaard presented their recent work on the analysis of photometric lightcurves of 51 Nemausa. Using many observations it was shown that the lightcurves have four maxima, while constant B-V values probably exclude albedo variations. The rotation periods in B and V give an external test of mean errors. Inconsistencies were found in the proposed new slope parameter G for the magnitude vs. phase angle relationship.

D. Olsson-Steel summarized the results of a study on the impact rates of asteroids against terrestrial planets. Using Kessler's (1981, Icarus 48, 39) general method, lifetimes of planet-crossing asteroid populations were calculated for Mercury, Venus, the Earth, and Mars. For asteroids larger than 1

km, the derived impact rates are one per 5 million, 300,000, 160,000 and 300,000 years, respectively.

Finally C. Keay reported briefly on the current status of the theory of anomalous sounds produced by large meteor fireballs, soliciting attention to this topic by the scientific community represented in Commission 15.

Two sessions focussed on "Comet Research" and "Comet Halley". They were chaired by L. Kresak and J. C. Brandt, respectively.

J. C. Brandt described the International Cometary Explorer (ICE) encounter with the plasma tail of comet Giacobini-Zinner (G/Z) on September 11, 1985 at a tailward distance of 8,000 km. The spacecraft was in the comet for roughly 3-1/2 hours with about 20 minutes of this in the central tail region.

The initial scientific results indicate: (1) that the magnetic field capture and draping model, originated by Alfven, is correct; (2) that comets contain energetic ions, probably produced by the "pick up" process; (3) the presence of intense plasma wave activity; (4) that the central plasma tail is dense and cold; (5) that the principal ions are in the $H_2O^+ - H_3O^+$ group; (6) that the bow wave, as seen on the flanks, is not a shock but an extended interaction region; (7) that impacts of micron-sized dust particles with the spacecraft were detected.

The ICE spacecraft apparently survived the encounter with comet G/Z unscathed and is on the way to become an upstream monitor of Halley's Comet. It may detect comet Halley in early April 1986.

W. F. Huebner presented an update on modeling coma chemistry and solar wind interaction. The following processes are now taken into account: (1) energy balance at the nuclear surface - coma interface, (2) chemical kinetics including dissociation, ionization, and dissociative ionization, (3) coma energy balance and optical depth effects, (4) multifluid flow for the rapidly escaping atomic and molecular hydrogen, the heavier bulk fluid, and the plasma with separate temperatures for electrons and the remainder of the gas, (5) transition from a collision dominated inner region to free molecular flow of neutrals in the outer region, (6) pickup of cometary ions by the solar wind, (7) counter and cross streaming of neutrals with respect to the plasma which, outside of the contact surface, also contains solar wind ions, and (8) magnetic fields carried by the solar wind.

The electron temperature and density and the outstream velocity that his model predicts for comet Giacobini-Zinner are in good agreement with the measured values from the ICE intercept at 8000km from the nucleus, just at the onset of the plasma tail: $T_e = 2 \times 10^4$ K, $n_e = 700 cm^{-3}$, v=1km/s.

J. Rahe summarized recent observations of comet Halley and discussed the physical properties which could be derived from these measurements. K. R. Sivaraman presented observations of comet Halley obtained in India during the last months.

P. D. Feldman described observations of comet Halley obtained with the International Ultraviolet Explorer satellite between Sept. 12 and Nov. 4, 1985. The OH (0,0) band brightness (in a 10" x 15" aperture) is 150 R on Sept. 12.1 and 340 R on Sept. 21.9. The derived OH production rate (using the vectorial model) is 2.0×10^{28} s^{-1} for Sept. 12.1 and 4.1×10^{28} s^{-1} for Sept. 21.9. In addition, 700 R of HI Lyman-a (in a similar aperture) was detected on Sept. 22.1, which is consistent with a primarily water ice source for the H and OH. Further observations on Oct. 19 and Nov. 4 showed the water

production rate to be increasing.

A. C. Levasseur-Regourd described the Halley Optical Probe Experiment (HOPE) on board the Giotto spacecraft; it is designated to provide in situ photopolarimetric data in both the dust cloud and the gaseous atmosphere in Halley's coma. The changes in number density and grain size distribution, the spatial distribution of various emissions, and the gas to dust mass production ratio, should be obtained as a function of the probe position in Halley's coma.

V. G. Shkodrov described the observations of P/Halley and P/Giacobini-Zinner, carried out at the Rozhen Astronomical Observatory with the 2-m and the Schmidt telescopes between November 1984 and November 1985. He pointed out that observations made during this time seem to indicate that comet Halley's nucleus is not single.