★ STAR DUST

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SOLAR FLARES — A CONTINUING ENIGMA

DR. NEUPERT

Dr. Werner M. Neupert, Head of the Solar Plasma Branch of the NASA Goddard Laboratory for Astronomy and Solar Physics, will address the December 3 meeting of National Capital Astronomers.

Dr. Neupert will describe the OSO-7 solar observations in the X-ray and XUV spectrum and relate them to simultaneous ground-based observations of the solar chromosphere and its magnetic field. He will discuss the contributions made by these studies to the theoretical insight into the causes of the enigmatical solar flares and the mechanisms that may produce acceleration of particles to high energies.

Werner M. Neupert received his B.S. in physics from Worcester Polytechnic Institute in 1954 and his Ph.D. in experimental physics from Cornell University in 1960.

Prior to coming to NASA in 1960, Dr. Neupert gained a variety of experience as a visiting assistant professor at the University of California, teaching and research assistant at Cornell, and as a design engineer at General Electric and Eastman Kodak. He is a member of the American Physical Society, Sigma Xi, Tau Beta Pi, the American Astronomical Society, and the International Astronomical Union, and is the recipient of the John C. Lindsay Award in 1970, NASA Exceptional Scientific Achievement Award in 1971, and Research and Study Fellowship Award in 1973.

DECEMBER CALENDAR — *The public is welcome.*

Friday, December 2, 9, 16, 23, 30, 7:30 PM — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Saturday, December 3, 6:15 PM — Dinner with the speaker at Bassin's Restaurant, 14th Street and Pennsylvania Avenue, NW. Reservations unnecessary.

Saturday, December 3, 8:15 PM — NCA monthly meeting at the Department of Commerce Auditorium, 14th and E Streets, NW. Dr. Neupert will speak.

Monday, December 5, 12, 19, 7:30 PM — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

NOVEMBER LECTURE

Dr. Dennis McCarthy, Photographic Zenith Tube Project Leader, U. S. Naval Observatory, spoke to National Capital Astronomers at the November 5 meeting. He discussed the information that PZT observations yield about the Earth's motion and its mass shifts.

Specification of the Earth's motion about its center of mass is equivalent to specifying the Earth's orientation in space with respect to a fixed coordinate system. This knowledge helps us to understand the planet's internal structure, for the Earth is not a rigid body. Here, astronomy, geodetics, and geophysics meet.

Precession and nutation are aspects of the orientation of the Earth's axis,

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NOVEMBER LECTURE — *continued*

and, with the Earth's crustal motion relative to the axis, of the angle of the local vertical with respect to a point in space. Precession and nutation describe the conical path traced by the motion of the Earth's spin axis while nutation is a periodic variation in this path. The latter traces out a tennis-court-sized area if projected on the Earth.

The motion of the Earth about its center of mass is defined by six dynamic-kinematic equations which assume a rigid Earth on which the moments of inertia about an axis in the equatorial plane are equal.

The principal constants of precession and nutation are sufficiently in error that new ones will probably be adopted in 1979 by international agreement. Perhaps they will even be defined for an Earth axis other than rotational, but the latter will continue to be a reference.

The first PZT was designed by Frank Ross in 1909. The Naval Observatory operates two in Washington, DC and one in Florida. In these instruments, a long-focus objective looks only at the zenith, and a pool of mercury is located half-way between the objective and its focal plane. Errors due to lens tilt are eliminated by the circumstance that the second nodal point of the lens lies outside the glass surface and the photographic plate is placed at this point. Four 20-second exposures are made on each 45-mm square plate as a star crosses the meridian. The plate and the top portion of the PZT are rotated 180° between exposures. What appears on the plate is four images of a star, forming the vertices of a quadrilateral. Relative positions of each star are obtained with a measuring engine, to within 3×10^{-6} meter. These measurements yield the astronomical latitude of the site and, with reference to atomic-clock time, differences in the Earth's rotation time.

Unfortunately, sufficiently accurate right-ascension and declination values for each star are unavailable for computing time and latitude; no star catalog even approaches the 0.01 arc second and 0.001 second time accuracy needed to match the relative position accuracies. Instead, r.a. and decl. values are continually improved by iteration from the preceding series of PZT observations. But error in the principal nutation constant also causes errors in the computed time and latitude; better values of nutation are obtained by solving a long series of time and latitude equations. This still leaves the assumption of a rigid Earth, which is only a first approximation. Observation of some of the larger (e.g., semi-annual and semi-monthly) terms in the nutation constant can be used to evaluate the rigid-Earth model at various frequencies. Currently, the IAU value of the nutation constant is 9.21 second of arc; the Naval Observatory value is 9.206. The IAU value may become 9.2293 in 1979.

The dynamical behavior of the Earth is studied by comparing the values of the nutation constant resulting from rigid-Earth and various other geophysical models, and with nutation values based on tilt- and strain-meter and horizontal-pendulum observations. From these it is apparent that a rigid Earth can no longer be assumed, but no particular alternate model stands out from others.

The position of the Earth's North Pole appears to be drifting toward Washington at a rate of about 0.003 arc second (about 10 cm) per year. Polar motion is a very controversial topic; it is not known whether the motions are permanent or periodic or how terrestrial events like earthquakes affect them.

There are three main components of polar motion: Free nutation (Chandler variation) has a period of 434 days and occurs because the moments of inertia along the equatorial and rotational axes are not equal. There may be a 14-73 year damping period. The annual and semi-annual polar motion components are due primarily to shifts of the great Siberian atmospheric high-pressure system.

The Earth's rotational velocity varies primarily as a result of tidal friction; transfer of angular momentum of the Earth's spin to the lunar orbit causes

OBJECT KOWAL AN ESCAPED SATELLITE? OTHER NEW PUZZLES

Dr. Thomas Van Flandern, dynamicist of the U.S. Naval Observatory and NCA member, in collaboration with Dr. Robert Harrington, has shown that the speculation that Mercury is an escaped Venusian satellite is consistent with the observations and dynamical theory. He has likewise shown that Pluto may be an escaped satellite of Neptune. It is not surprising, then, that he is taking a hard look at Object Kowal as a possible escaped Neptunian satellite. He needs more definitive orbital data which should be available by the end of the year.

Dr. Van Flandern reports some new puzzles from the AAS Division of Planetary Sciences:

A recent eclipse of Saturn's satellite Iapetus by the shadow of the ring system (not by the rings) showed a light decrease of 1.4 magnitude. The Cassini Division, instead of restoring the light, showed a .7-magnitude attenuation. An interpretation is that the division is not open, but filled with invisible material.

New photos of Deimos from 25 km by a Mars Viking Orbiter show the satellite to be crater saturated, but covered with a thick dust layer. Deimos has insufficient gravity to retain such dust under such crater-forming impacts.

There now appear to be seven rings of Uranus. Five are quite circular, equatorial, and very thin. Two are either inclined or elliptical. This is a dynamically inconsistent situation. Perturbations by Uranus' oblateness should spread the rings by differential precession within 20 years.

The albedo of the Uranus rings is less than one percent of that of Saturn's. There is no known material that black.

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following grazing lunar occultations in December. For further information call Dave at 585-0989.

December	UT	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
5	07:40	Frdrksbrg, VA	8.6	35	1N	6"
13	23:21	Hyatstwn, MD	8.2	15	2S	4"
15	23:20	Doswell, VA	6.9	34	5S	2"
16	01:11	Neelsbrg, MD	8.8	35	3S	6"
17	00:44	Dawn, VA	8.9	45	4S	6"
21	07:29	Sil Spg, MD	8.1	84	12N	8"
29	04:17	Frdrksbrg, VA	6.3	88	8N	2"

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angular acceleration of the lunar orbit. As a result, the day length increases 0.002-0.005 second per century. There are also components of rotational velocity variations due to meteorological (annual) solar-tidal (semi-annual) and ionospheric (biennial) causes.

As the length of the day varies, so does the position of the Earth's magnetic field; the lag is 4-5 years. This is the only proof of a relationship between the Earth's fluid core and the mantle, our speaker said.

Dr. McCarthy concluded his lecture by outlining future developments in instrumentation that will improve our knowledge of the Earth's orientation and rotation. These developments include Doppler tracking of Satellites, laser ranging to satellites and the Moon, completion of the USNO 65-cm PZT, which will enable observations of stars to magnitude 11, and short- and long-baseline radio interferometry. The short baseline will be used for time-difference checks and the long baseline for checks of the stability of the coordinate system.

During the question period that followed, our speaker aroused considerable amusement by listing the locations of the five International Latitude Service stations. Except for Gaithersburg, these are all located in major earthquake areas! Tying in the coming satellite and interferometry observations of the Earth's motion with the past decades of conventional observations will be a major problem in this field. ww

EXCERPTS FROM THE IAU CIRCULARS

1. October 15 — J.G. Sanguin, Observatorio Astronomico Felix Aguilar, discovered a 16th-magnitude comet (1977p) in Aquarius. A prediscovery image obtained on September 13 aided Marsden in determining an orbital period of 12.6 years.

2. October 18 — C. T. Kowal, Hale Observatories, discovered a slow-moving object of 19th magnitude in Aries with the 122-cm Palomar Schmidt. Marsden reports that the orbit is still indeterminant, but appears to be of low eccentricity, with an inclination of 5.2 degrees. The object is 14 to 17 AU from the Earth.

3. November 3 — The Purple Mountain Observatory, Nanking, reported the discovery of Comet Tsuchinshan (1977q), of magnitude 14, in Pisces.

4. November 7, 8 — Helin and Shoemaker, California Institute of Technology, discovered fast-moving asteroidal objects (1977 VA and VB) of 15th and 14th magnitude in Aries and Pisces.

This listing courtesy R. N. Bolster.

* STAR DUST *

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