STAR DUST

National Capital Astronomers, Inc.

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Chapman: The Space Station as an Astronomical Observatory

DR. CHAPMAN

Dr. Robert D. Chapman, Senior Program Management Engineer for the Space Station, NASA Headquarters, will speak to National Capital Astronomers at the February Colloquium in the National Air and Space Museum. He will discuss the astronomical research potential of the Space Station.

The United States has started building a permanently manned space station which will be assembled in low Earth orbit in the mid 1990's. NASA has set forth a number of objectives for the Space Station program which include having the station serve as a facility in space for advanced research and development in a wide range of science and technology disciplines. In his 1984 State of the Union Address, The President called upon our friends and allies to be a part of our Space Station Program, and we anticipate substantial internationl participation.

The astronomical community has already started to look at ways in which the Station can accommodate their research requirements. Dr. Chapman will discuss current plans for the Space Station and examples of potential astronomical research.

Robert D. Chapman received the B.S. in physics from Pennsylvania State University in 1950 and his Ph.D. from Harvard in 1964. He was an assistant professor at the University of California at Los Angeles from 1964 until he became a space scientist at Goddard Space Flight Center. He has authored a number of papers and books on solar physics, stellar atmospheres, comets, and atomic physics. His booklet on Comet Kohoutek was chosen by the American Institute of Physics as the best popular work. He coauthored *The Comet Book* with Dr. John Brndt(now at Colorado University). Dr. Chapman recently was detailed for 16 months to the White House, Office of Science and Technology Policy. He is responsible for technical and programmatic direction for utilization of the Space Station for external attached payloads.

FEBRUARY CALENDAR -- *The public is welcome.*

Tuesday, February 2, 9, 16, 23, 7:30 pm -- Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, February 5, 12, 19, 26, 7:30 pm -- Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Saturday, February 6, 5:45 pm -- Dinner with the speaker at the Smithson Restaurant, 6th and C Streets, SW., inside the Holiday Inn. Reservations unnecessary. Use the 7th Street and Maryland Avenue exit of the L'Enfant Plaza Metrorail station.

Saturday, February 6, 7:30 pm -- NCA monthly lecture in the Einstein Planetarium of the National Air and Space Museum, Seventh Street and Independence Avenue, SW. Enter on Independence Avenue side. Dr. Chapman will speak.

Wednesday, February 10, 7:30 pm -- Committee on Human Resources meeting. All NCA members invited. Room A06, Building 42, UDC. (Same location as discussion group.)

Friday, February 12, 26, 8:00 pm -- NCA 14-inch telescope open nights with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob at 960-9126.

Saturday, February 20, 7:30 pm -- Discussion group, Room A06, Building 42, UDC, on Van Ness Street, NW, a half block west of Connecticut Avenue. Park under Building 44. From UDC Metrorail Station, go between columns at 4250 Connecticut Ave, to steps at left, up four flights to elevated walkway to Building 42.

For other organizations' events of interest see elsewhere in this issue.

JANUARY COLLOQUIUM

Dr. David M. Rust, Johns Hopkins Applied Physics Laboratory, addressed the January 2 National Capital Astronomers monthly colloquium at the National Air and Space Museum. He spoke on the status of helioseismology and some results of recent work in this new science.

Rust began with examples of clues to the interior of the Sun found in coronal and surface features, and emphasized the inadequacy of current theory and knowledge. Rust suggested that solar flares might be predicted by better knowledge of interior activity through helioseismology. He cited the paradigm of seismology used to probe Earth for interior structure and activity, for oil, and to detect nuclear tests. Helioseismology has already yielded a precise determination of the internal solar helium abundance, and promises to reveal other details of fundamental importance to the understanding of stellar structure and dynamics.

Surface oscillations are caused by acoustic and gravity waves that have passed through the solar interior. The oscillations may be detected with ground-based and space telescopes by their effects on the atomic emissions from the solar surface.

The 5-minute radial oscillations were discovered about 1960, but were not understood. In the early 1970's they were believed to be relatively small, damped oscillatory atmospheric responces to local disturbances. By 1975 they were found to be global. Rust showed plots of radial velocity vs time (about 2 hours) for an area on the Sun that showed a complex surface network of velocity peaks and valleys separated by about 1 km/s. While the many peaks all have periods approximating 5 minutes, they vary slightly, producing the complex interference pattern as observed. About 10 million likely observable modes are indicated. The sharp nodal separations indicate a very high-Q resonance mechanism; the core of the Sun behaves as a high-Q cavity.

Waves propagated into the depth of the Sun are refracted by increasing velocity as temperature increases. (Acoustic velocity varies as the square root of temperature). Resonances are sensitive to temperature, density, magnetic fields, rotation, and turbulence. Near the equator two sets of resonances are seen, attributed to contra-directional circumsolar, multiple-reflection and bending paths around the interior of the Sun. The difference reveals the interior rotation rate, which seems to be a few percent slower than the surface rate, but the measurements are not yet precise.

More accurate measurement is needed, as some theorize an interior rotation rate ten times that of the surface rate. If true, it would solve the problem of Jupiter's seeming to have most of the angular momentum of the solar system. Fast interior solar rotation would account for higher angular momentum of the Sun. It would also result in a slightly oblate Sun, which could account for irregularity in Mercury's revolution, classically attributed to General Relativity. This might controvert the relativity explanation!

Some difference between 1980 measurements of oscillation periods by the Solar Maximum Mission and more recent measurements indicates a small shift in frequencies. Is the Sun changing size? Some data imply radius changes of about 10 km with solar cycle. The Sun may be a slightly variable star. The neutrino flux is only a third of that expected. If the deficit is caused by a change in the burning rate of the core it will take a hundred thousand years for the change of energy output to propagate from the core to the surface. If the Sun varied with a period of 100,000 years we wouldn't know it! Helioseismology may solve this problem.

Acoustic intensities are measured as a function of wavelength by the usual method of observing Doppler shifts of an optical spectral line. Rapid electronic switching between alternate amplitude measurements of the shortward and longward skirts of the Balmer H-alpha line yields line shift, hence, radial velocity.

Intermodal velocity differences average only about 10 cm/s, the maximum difference being about 15 cm/s. Currently, the necessary measurement precision, about 1 cm/s, can only be attained statistically. The present precision, about 30 m/s, requires averaging of 10 million measurements to achieve the necessary improvement of 3,000 times. (Precision improves with the square root of the number of measurements.) This is done over thousands of positions simultaneously by an imaging spectrometer. Both temporal and spacial fourier analyses are necessary.

An observatory for this work was built at the Applied Physics Laboratory. The imaging spectrometer comprises a 6-in Zeiss refractor equipped with a high-throughput, 0.01-nm-bandwidth Fabry-Perot etalon which allows 0.1-s exposures. The piezoelectrically tuned lithium niobate etalon was polished on a teflon lap to a flatness of .0025 wavelength by an Australian laboratory and was tested at Sacramento Peak Observatory. The free spectral range is .35 nm in yellow, 0.5 nm in red. It is tuned by a field of about 300 V. It has been used up to 7,000 V and seems linear.

To avoid atmospheric effects and eclipses for long intervals of continuous measurements it will be necessary to go into space. A joint plan by NASA and ESA for a space-based Solar and Heliospheric Observatory comprises a Fabry-Perot interferometer, 1,000 X 1,000 pixel CCD, and on-board computer. It is planned to be launched into a halo orbit of the equigravitational point toward the Sun. Other instruments and several satellites will be involved in the plan for an extensive six-year observational program which will include the Van Allen belts, Geotail, and solar coronal spectrum.

Rust showed some candidate spacecraft designs. He hopes to place solar oscillation imagers on several satellites for the planned 1994 launch. Robert H. McCracken

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following occultations. For further information call (301) 495-9062 (Silver Spring, MD).

UT Date	Time	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
Grazing Lunar:						
02-06-88	03:31	Columbia, MD,	7.9	90	10S	20 cm
02-08-88	10:35	Youngsville, NC	5.3	74	15S	5 cm
02-12-88	0944	Chesterfield, NJ	2.9	34	14S	3 cm
02-24-88	03:05	Templeton, VA	5.6	45	5N	5 cm
Asteroidal:			Star Mag	Delta Mag	Name	
02-27-88	02:54	Newfoundland	9.0	4.0	(209) Dido	5 cm

* Appulse. To be observed for possible satellites or path changes.

AIR AND SPACE MUSEUM OFFERS PROGRAMS, TELESCOPIC SKY VIEWING

The folowing free, public programs will be held in the the National Air and Space Museum during February.

Saturday, February 6, 9:30 am -- Dr. James O'leary, Director, Davis Planetarium, will present **"Life and Death in the Winter Sky,"** in the Einstein Planetarium. Following the program, weather permitting, NCA Trustee and NASM Docent Stanley Cawelti will offer safe telescopic viewing of the Sun.

Wednesday, February 17, 7:30 pm -- Dr. Gerrit Verschuur will present **"New Directions in Radio Astronomy,"** in the Albert Einstein Planetarium. Following the lecture, weather permitting, Stanley Cawelti will offer a telescopic tour of the night sky.

ASTRONOMY AND PERSONAL COMPUTERS

Converting among filing systems -- One task which PC's perform admirably is that of maintaining lists, files, data bases, or spreadsheets of information. These lists can be astronomical data, stocks, collections, addresses -- something we might want to keep in an organized fashion. It is almost a certainty that, at some time, the owner of a given list will conclude that it would be better maintained in a different piece of sftware, perhaps even on a different computer. The reason for changing is immaterial. The most important question to answer in performing the change is this: Should the data be converted to the new system using a computer, or would it be faster to replace it? There is the "Myth of the Machine Readable," which is the belief that once something is in machine-readable form, it never again needs to manually reentered. If conversion to another format requires writing of a special program, if there is anything complex or confusing about that program, and if the data set is not particularly large, a good typist will be done with reentry of the data before the program is debugged.

However, retyping is not necessary in most cases when the data in the original source is organized in approximately the same way it will be in the new format. As an example, a data set maintained with a word processor can be converted fairly easily to a form that can be used by a spreadsheet program, file system, database system, or mailing-label program, as long as the records for each entry are easily recognized and have a specific form. For instance, a mailing list maintained with a word processor will be easy to convert to a mailing list program, spreadsheet, or a database, if each entry (for each name) is structured the same as for each other, so that the name, address, city, and state are always in the same place. If this is not quite true, but almost true, it might save considerable retyping to first edit the exceptions to conform to the rest.

A key consideration in successful conversion to another system is that the data not violate constraints of the new system. For example, many spreadsheet, database, and file programs do not allow individual fields in a record to be longer than 255 characters. Sometimes multiple fields can be strung together to hold the long input fields if they are always present. If long fields are there for some records and not others, conversion will be much harder The inconsistency can confuse the software.

It has been my experience that just about all data-set formats from any software on any computer can (eventually) be converted to virtually any other program's format on the same or another computer, keeping in mind the restrictions listed above. Software which maintains its data in formats which are very different from others might first require that the data set be "printed to disk," an option in many programs that results in and ASCII file of the data. It might also be necessary to connect two computers together if they cannot read one another's disks. As an example, converting a mailing list maintained by a word processor on an Apple II+ to a database system on a PC XT might be done with the following steps: The word processor files are binary, not ASCII, so it is asked to print the list to an output RS232 port, which happens to be hooked up with a null modem to the PC. A communications package (like **Crosstalk**) captures the file and stores it on a pc ASCII file. A database program imports the file into an existing database, expecting each field to be a separate line, with one line each for the name, the street number, the city, and the state and zip.

Many inexpensive, and all expensive, PC software systems support conversion from one system to another. It is frequently described as "importing" and "exporting" data in the user's manual.

Joan B. Dunham

EXCERPTS FROM THE IAU CIRCULARS

1. October -- A team from the Naval Research Laboratory, the University of New Hampshire, and Max Planck Institute, detected gamma-ray line emission from 1987A with the Solar Maximum Mission Satellite.

2. November 18 -- Researchers at the Center for Astrophysics determined the diameter of 1987A at several wavelengths by speckle interferometry with the 4-meter Cerro Tololo telescope. The results were between 0.020 and 0.024 arcseconds.

3. December 14 -- R. Evans, Hazelbrook, NSW, while visiting Siding Spring Observatory, viewed NGC 7606 and discovered a supernova of 14th magnitude.

4. December 22 -- Ketelsen, University of Arizona, photographed an antitail 1° long at a position angle of 240° from Comet Bradfield.

5. January 11 --W. Liller, Vina del Mar, Chile, discovered a comet (1988a) of 13th magnitude in Sculptor on plates taken with a 20-cm Schmidt telescope. Robert N. Bolster

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