STAR DUST

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Crannell to Describe New Balloon-Borne Solar Study

DR. CRANNELL

Dr. Carol Jo Crannell, NASA Goddard Space Flight Center, will address the December 3 National Capital Astronomers colloquium in the National Air and Space Museum. She will discuss the MAX '91 Long Duration Balloon Program being developed to obtain coordinated observations of a wide variety of phenomena associated with solar flares. Hard X-ray and gamma-ray telescopes and spectrometers will be carried to high altitudes for periods exceeding eight days. Arcsecond resolution of solar flares and magnetic structures is expected.

The unusually rapid rise of solar activity from the recent 11-year minimum heightens the urgency of the program schedule. It would be interesting inded to have had the program operational for the past few years.

The Gamma Ray Imaging Device (GRID) will employ an array of scanning modulation subcollimators to obtain Fourier components of source distributions. Sources will then be imaged by aplying the inverse Fourier transform to the data in exact analogy to the process of imaging with microwave radio interferometry data.

Dr. Crannell received her B.A. in physics from Miami University in 1960, and her Ph.D. from Stanford University with a dissertation in high-energy physics in 1967. She is the Principal Investigator for the Gamma Ray Imaging Device (GRID) on a balloon, which has just been selected for the MAX 91 program.

DECEMBER CALENDAR -- *The public is welcome.*

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

Saturday, December 3, 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, December 3, 7:30 pm -- NCA monthly colloquium in the Einstein Planetarium of the National Air and Space Museum, Seventh Street and Independence Avenue, SW. Enter Independence Avenue side. Dr. Crannell will speak.

Tuesday, December 6, 13, 20, 7:30 pm -- Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, December 16, 23, 30, 8:30 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.

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

A gift NCA membership will last all year!

CALL NCA: (301) 320-3621 for details.

NOVEMBER COLLOQUIUM

Dr. Kenneth Johnstom, Chief, Radio and Infrared Astronomy Branch, U.S. Naval Research Laboratory, addressed the November 10 NCA Colloquium at the National Air and Space Museum. He reported the status and recent progress of optical interferometry at Mount Wilson Observatory. Johnston's talk emphasizing the astrophysical aspects of interferometry complements the presentation by James Hughes, who discussed the astrometric aspects at the March 1988 NCA colloquium, reviewed in the April issue of Star Dust.

Johnston recounted the history of interferometry from Michaelson's instrument in the 1890's to today's radio and optical interferometers.

As an example of the general method and status of interferometry, Johnston considered the National Radio astronomy Observatory's 27-antenna Very Large Array (VLA) at Socorro, New Mexico. Cross-correlation of the powers received from all of the antennas of an interferometer array yields n(n-1)/2 correlated independent pairs. The VLA thus yields 351 pairs. A brightness image of the source is then obtained by a Fourier transform of these data. The images may then be emended and enhanced by a number of algorithms to display hitherto unseen features such as jets emanating from active galactic centers. Further processing through self-calibration algorithms can reveal the mechanism of energy transport out to the radio lobes, from galactic centers suspected of containing black holes.

The National Academy of Sciences report, "Space Science in the Twenty-first Century," expresses a need for a Large Space Telescope array, or long-baseline optical space interferometer, for which a variety of preparatory technological studies will be required. As a feasibility study in pursuit of this objective, the technology developed at radio wavelengths is now being applied at the much more difficult optical wavelengths to obtain milliarcsecond resolution.

Both astrometry and astrophysics will benefit from the improved resolution. At 1 kiloparsec, positions to 0.1 milliarcsecond are needed for 10 percent accuracy in distance. The distance scale can be improved by direct measurement of the masses of Cepheid variables. The masses of very close binaries can be derived from accurate measurements of their relative motions on an absolute scale.

Such measurements will advance the study of stellar evolution. Stellar luminosities can be derived directly from accurately measured diameters, distances, and apparent magnitudes. It is hoped eventually to measure diameters and distances to within 1%. Lunar occultation measurements have given about 90 stellar diameters within about 10%. Such accuracies will make possible detailed imaging of stellar limb darkening, star-forming regions at infrared wavelengths, direct study of compact sources, such as stellar dust shells, and, with narrow spectral lines, the expansion rates of circumstellar clouds. With later developments and increased sensitivity, orbiting objects such as planets can be sought. Faint, compact objects such as SS 433, Becklin-Neugebauer objects, and collapsed objects such as neutron stars could be studied. Sensitivity of the present prototype system is limited to about 9th magnitude.

Johnston compared these advances to those made in biology by the invention of the microscope. Early interferometers required patience and careful adjustment, perhaps for hours, to obtain fringes.

The present program was started in 1982 with a two-element Michaelson interferometer. A tracking delay line was developed with an accuracy of 100 angstroms, the position read with a laser to 50 angstroms. A separate 1-kHz dither delay line searches for fringes and provides input for the computer to adjust the tracking delay line. Last year, with a baselines 12 m north-south and 9 m southeast, the system measured the diameter of Mu Pegasi at 6 or 7 milliarcseconds. This year, the north-south baseline was extended to 30 m with different spacings, which brings the system into the milliarcsecond range.

Under complete computer control, the present automated system can acquire program stars, adjust delay lines, track Earth rotation, compensate atmospheric turbulence, deliver fringes within seconds, maintain fringes for ten minutes, recover phase and amplitude, and develop an image of a source from the Fourier-transformed data.

Johnston observes, however, that it is not quite as easy as it may seem. Great care is required to maintain the necessary stability of the baseline, for example, which must be known to a fraction of a micron. The positions of the piers drift about a micron per hour. Walking around the site causes baseline shifts. Laser measurements determine the precise positions of the 25-cm diameter siderostats. The two signals to be combined are transmitted through evacuated pipes. The turbulent atmospheric differential path length between the two mirrors is 10 to 20 microns, which the system must compensate.

For astronometry, many observations must be made of a star at various hour angles to calibrate the baseline. This requires that the instrument be totally automated.

With care, the present instrument determines star positions within 0.06 arcseconds of the FK5 positions -- which is the accuracy of the FK5 catalog. This means the measured positions are better than those of any other source or instrument, so there is nothing accurate enough to compare them to. Least-squares analysis indicates ten milliarcsecond accuracy, but the only confirmation available depends upon repeatability of measurements over a few years. The HIPARCOS satellite, scheduled to be launched next year, will help. It is expected to attain 3 mas positional accuracy, but reduction of the data will take two or three more years.

A future hope is for an 11-element optical array analogous to the 27-element VLA

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following occultations. For further information call the NCA-IOTA Information Line: (301) 474-4945 (Greenbelt, MD).

UT Date Time	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
Grazing Lunar:					
12-17-88 01:07	Bedford, PA,	7.1	59	16S	6 cm
12-20-88 01:23	Oraville, MD	4.6*	88	18S	6 cm
12-31-88 08:00	St. Louis, MD	4.8	48	13S	3 cm
01-03-89 10:48	White Marsh, MD	9.1	20	19S	20 cm
01-04-89 11:00	Back River Neck, MD	3.0	13	-20N	6 cm

Asteroidal:	Star Mag	Delta Mag	Name	
12-11-88 06:15	Bahamas	9.4	2.8	(690) Wratislavia	8 cm
12-21-88 10:39	South Texas	5.2	9.5	(104) Klymene	8 cm

*Double: A=5.1 mag, B=5.7 mag, separation=1.2 arcsec, position angle=212°

JUNIOR DIVISION NEWS J. Leith Holloway

NCA president Nissen has re-appointed me Director of the Junior Division, a post I had to give up twenty years ago when I moved from Washington, DC. I am very happy to be back home now so that I can resume this rewarding and challenging work of providing astronomical activities for NCA junior members.

In planning my work, it would be helpful to me to know who our junior members are and what their astronomicl interests are. If you are a junior who wants to get more out of your membership, please call me any time at 654-8588 and let me know what you are interested in.

This time around, I hope to get more adult members involved in teaching astronomy to our juniors. Several members have already voluntered to lead junior activities. The more senior members who help, the less demanding, and the more effective and gratifying this important work will be for each.

ASTRONOMY AND PERSONAL COMPUTERS Joan B. Dunham

Using the PC as a Timer -- A topic of Discussion at the 1988 IOTA business meeting in Houston was programming the PC as a timer for reducing observer data tapes from grazing occultations. Two members from San Antonio had prototypes of software to use the PC as a stopwatch. Their idea was to start a timer at the minute mark closest to the start of the data and tap a key whenever the observer reported an event. The number of seconds from the start of the data would then be used to compute the time of the observations reported. They stored the data from all of the observers, and produced a plot at the end. They were given many suggestions for improvements, and probably left the meeting with completely different ideas on how to finish the software than they had when they came.

First of the discussion was on how accurately events could be timed with a PC. The occultation timing software was written in BASIC, and can be run under interpreted BASIC, which is the standard mode of IBM's BASICA, of Microsoft's GWBASIC, as well as Applesoft BASIC, and many others. The advantage of interpreted BASIC is that statements can be changed easily, as well as the fact that it is usually the least expensive computer language on any given PC, often provided at no extra charge. The disadvantage is that interpreted BASIC software is the slowest. The question is whether or not it is too slow to use as a timer to record events to the nearest 0.1 second. Interpreted BASIC runs a certain amount slower for each statement it must process. I created a test to see what the effect is of adding one print statement in a loop that uses the timer. In a loop that executed 20 times, the execution time on my machine was increased 0.49 seconds.

I was more interested to see that the timer function reports to 0.01 second, but does not appear to measure them more accurately than 0.05 seconds. The GWBASIC manual states, "Fractional seconds are calculated to the nearest degree possible." I tested this by storing results from successive calls to the timer function and printing them after 20 iterations. The time incremented in steps of 0.05, 0.05, 0.1, 0.16, 0.16, etc. Assuming no other delays, this coarseness of timing is satisfactory for reducing visual observations of grazing occultations, but is not very useful in situations where accuracy of 0.05 second is desired.

My conclusion was that, for my machine, a "turbo" PC XT clone that runs at roughly twice the speed of a standard IBM PC XT, the interpreted BASIC is too slow when both the coarseness of time measurement and the effects of executing statements are considered. I did try compiling the small test program iran, and found that the timer function could not measure the time it took to execute 20 print statements.

New Celestial Mechanics Book -- J.M.A. Danby has produced a second edition of his classic text, "Fundamentals of Celectial Mechanics," revised to include, among other things, example software in BASIC for the IBM PC. The publisher, Willmann-Bell, is selling both the book and diskettes of the software at very reasonable prices ($20 for the book and $16 for the software, plus $1 for handling). They can be contacted at (204) 320-7016, or at PO Box 35025, Richmond, VA 23235. Note that Virginia residents must pay 4.5% tax.

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radioastronomy interferometer at Socorro, New Mexico.

This year, final designs based on this prototype system are being made for an instrument to generate catalog positions to 10 mas. It is hoped to be finished by about 1992. Johnston calls it the true "Electric Transit Circle." (Unlike the transit circle, however, the interferometer is not constrained to measurement of meridian-transit times -- ed.) Robert H. McCracken

EXCERPTS FROM THE IAU CIRCULARS Robert N. Bolster

1. September -- Occultations of three stars by Neptune were observed on August 2 with 1-m and 3.6-m telescopes at the European Southern Observatory on August 25 with the 3.6-m Canada-France-Hawaii telescope at Mauna Kea, and on September 12 with the 1.93-m telescope at Haute Province Observatory and the 2-m telescope at Pic du Midi. No secondary events due to rings were seen.

2. October 11 -- O.C. St. Cyr, Goddard Space Flight Center, discovered another sungrazing comet on images from the Solar Maximum Mission. It was estimated to have been brighter than magnitude -4.

3. October 12 -- G. Garradd, Tamworth, New South Wales, discovered a nova of 11th magnitude in the Large Magellanic Cloud on photos taken with a lens of 300-mm focal length. IUE spectra on the 14th showed P-Cyg structures indicative of high expansion velocities.

4. October -- Unsuccessful searches for Comet Machholz after perihelion with telescopes as large as 2.3 m indicate that it has become fainter than 20th magnitude.

AIR AND SPACE MUSEUM OFFERS PROGRAMS

The following free, public programs will be held in the National Air and Space Museum during December:

Saturday, December 3, 9:30 am -- Robert Smith, NASM Historian and professor at Johns Hopkins University, will present **Galaxies, Galaxies Everywhere (and Not One to be Seen),** in the Einstein Planetarium. Safe telescopic viewing of the Sun will follow the program, weather permitting.

Wednesday, December 14, 7:30 pm -- Frank Borman, Astronaut, will present **The Past, Present, and Future of Aerospace in the United States,** in the Langley Theater. Telescopic viewing of the sky will follow the program, weather permitting.

NASA GODDARD COLLOQUIA SCHEDULED FOR DECEMBER

The following collowquia will be held at 330 pm in Building 3 Auditorium:

Friday, December 2d -- **The Solar Nebula and Before,** Donald D. Clayton, Rice University.

Friday, December 9 -- **The Role of Impact Cratering in the Geological History of the Earth,** James Garvin, Goddard Space Flight Center.

Friday, December 16 -- **Atmospheric Holes and the Small Comet Hypothesis,** Lou Frank, University of Iowa.

Coffee and tea will be served from 3:00. Enter the main gate and obtain a visitor's pass from the guard. Ca;; 286-8701 for further information.

FOR SALE

Brandon 80-mm apochromatic refractor. Includes tripod mount, tripod, and 20-mm Brandon eyepiece. Very good condition. Asking $250.00. Call [illegible]

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