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## Eastman Updates Plasma Boundary Layer Models



DR. EASTMAN

**D**r. Timothy E. Eastman, of the Institute for Physical Science and Technology, University of Maryland, presents "Boundary Layers in Astrophysical Plasmas," at the March National Capital Astronomers Colloquium in the National Air and Space Museum on March 4.

Observations, models, and simulations of plasma boundary layers have resulted in significant progress in understanding modes of acceleration and other processes in active plasma regions where direct,

in-situ satellite measurements are currently available. Several common features characterize plasma boundary layers in very different settings, including the plasmopause, the plasma sheet boundary layer, planetary magnetopause regions, and collisionless shocks. These active plasma regions provide an excellent local plasma laboratory for studying astrophysical plasmas generally, especially where small-scale structures may be important, such as with astrophysical jets. The pre-space-age concept of space was essentially one of a structureless void. A great variety of plasmas, energetic particles, and fields fills this void, and plasma boundary layers provide the structure.

Dr. Eastman received his B.S. in Physics from the University of Minnesota Institute of Technology in 1967, his M.S. in Astrogeophysics from the University of Colorado in 1972, and his Ph.D. in Space Physics from the University of Alaska in 1979. Eastman's extensive research background with a wide range of institutions has included studies of the low-latitude boundary layer on the front side of the Earth's magnetosphere, plasma observations of the Earth's outer magnetosphere, naturally occurring gyro phase bunched particle distributions, and development of a new model for magnetospheric particle sources for the Earth's aurora. He has served as Visiting Senior Scientist, NASA Headquarters, Technical Monitor, Space Plasma Physics, and as Acting Chief, Magnetospheric Physics Branch. He is now a Research Faculty member of the Institute of Physical Science and Technology, University of Maryland.

### MARCH CALENDAR — The public is welcome.

Friday, March 3, 10, 17, 24, 31, 7:30 pm — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Saturday, March 4, 5:45 pm — Dinner with the speaker at the Smithsonian 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, March 4, 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. Eastman will speak.

Tuesday, March 7, 14, 21, 28, 7:30 pm — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, March 17, 24, 31, 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.

## FEBRUARY COLLOQUIUM

Drs. Neil Gehrels, Nuclear Astrophysics Branch, and Harvey Moseley, Infrared Astrophysics Branch, Goddard Space Flight Center, addressed the February 1989 colloquium of National Capital Astronomers at the National Air and Space Museum. They reported their confirmed, coordinated gamma-ray and infrared observations of explosive nucleosynthesis in the shock wave of Supernova 1987A.

For more than 40 years, astrophysicists have theorized that heavy elements could be synthesized in the intense heat of the supernova explosion, but only now, as a result of this event and these observations, do we have definite, indisputable evidence that these processes occur.

Moseley described his infrared observations with a cryogenic grating spectrometer on the 4-meter telescope of the Kuiper Airborne Observatory on a number of flights from Christchurch, New Zealand. On the first flight in November 1987 strong lines of Fe II, cobalt at 18.7 microns, and hydrogen transitions at high excitation levels were seen, probably for the first time in an astronomical source, and at strengths indicating that these were newly created elements. An unexpected continuum was also seen, from free-free emission from hydrogen, iron, and other heavy elements. An extremely high density was indicated, at a temperature of about 6000 K measured by line ratios, not inconsistent with the color temperature. Neutral sulphur was seen at 25.5 microns, both from stable burning and from explosive nucleosynthesis. First, approximately .07 solar masses of an unstable isotope of nickel was created in the explosion. This decayed with a half life of about 6 days to cobalt, which in turn decayed with a half life of 78 days into iron.

The same measurements in March 1988 showed the continuum level to be much lower, as expected, a result of the density having been reduced by expansion. Emission lines from iron and sulphur were stronger, and neutral iron lines were seen. The temperature was little reduced. Although the other lines were stronger, the cobalt line was substantially weaker, consistent with the expectation that the radioactive cobalt 56 with a half life of 78 days was decaying into iron 56. The estimated

iron abundance is approximately what is expected from the cobalt decay as calculated from the optical light curve.

A November 1988 flight showed the continuum in the 10 micron region to have increased from 2 or 3 Janskys to about 10 Janskys. It is probably emission from a heated dust shell emitted by the star in its much earlier red giant phase.

Gehrels participated in NASA high-altitude balloon gamma-ray experiments near Alice Springs in central Australia. The gamma rays appeared a couple of hundred days earlier than expected, evidently because of the clumpiness of the debris and the circulation of radioactive material to the outer layers of the supernova remnant. Gamma rays were first detected from the supernova by the Solar Maximum Mission satellite, but more precise observations required special instrumentation which was sent up by balloon.

The Gamma Ray Imaging Spectrometer consisted of seven large germanium detectors, the largest ever flown, cooled with liquid nitrogen. Typically, the spectrometer was up for about 40 hours. 16 flights have taken place to date. Most significant, two of the gamma-ray emission lines, 847 keV and 1238 keV, expected from the radioactive decay of the cobalt, have been directly observed within a factor of 3 of expected intensities, thus clinching the case even more tightly for nucleosynthesis taking place while we watch. Continuum radiation is also observed by scattering. New lines are expected as the cobalt decays, and other longer lived radioactive elements become dominant.

Other opportunities are ahead. The expanding shell will become resolvable optically; the Hubble space telescope may give us the clearest picture. Gehrels expressed the belief that detection of the pulsar would be the next exciting event in the supernova story. Within a week of his talk, the first evidence of the pulsar was reported from Cerro Tololo and Las Campanas Observatories. (See the IAU Extracts, this issue.) Many more revelations are in store and it is clear that the Magellanic Cloud supernova, already the most exciting astronomical event of the decade, is going to hold and intrigue us for many years to come. John A. Graham

## AIR AND SPACE MUSEUM OFFERS VARIETY OF PROGRAMS

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

- Saturday, March 4, 9:30 am -- Monthly Sky Lecture: "UFO's: Are They Really Out There?," Philip J. Klass. Einstein Planetarium. Safe telescopic viewing of the Sun will follow, weather permitting.
- Wednesday, March 8, 7:30 pm -- The "Exploring Space" series presents Harry Shipman: "White and Brown Dwarf Stars," in the Einstein Planetarium.
- Monday, March 10 -- The new regular planetarium show starts: "Calling All

- Stars: The Search for Extraterrestrial Intelligence." In conjunction with the program, a special lecture series, "The Search for Extraterrestrial Intelligence", will include:
- Wednesday, March 15, 7:30 pm -- "Historical Developments and Future Goals," Michael Papagiannis.
- Wednesday, March 22, 7:30 pm -- The Search for Planetary Systems," David Latham.
- Wednesday, March 29, 7:30 pm -- "Life in the Universe," Andrew Knoll.
- Telescopic viewing of the sky will follow each Wednesday night program, weather permitting.

## IMAGING SCIENCE SOCIETY TO TOUR SPACE TELESCOPE HQ, NCA INVITED

On Tuesday, March 21, plan to visit the Space Telescope Science Institute with The Society for Imaging Science and Technology (Formerly the Society for Photographic Scientists and Engineers, SPSE). Dinner at 5:30

pm, presentation at 7:00. Make reservations (\$18) by March 10. For information on dinner, map, etc., call Richard F. Myers, 763-1972 (Office), or 345-5074 (Home).

## OPTICAL SOCIETY DINNER LECTURE ON HETERODYNE RADIOMETRY

Tuesday, March 21, at 8:00 pm. The National Capital Section of the Optical Society of America monthly meeting will be held at the Office of the Annandale District Supervisor, 4414 Holborn Avenue, Annandale, Virginia. Dr. Alan Migdall, National Institute for Standards and Technology, will present "Using

Heterodyne Detection for Optical Radiometry."

An informal dinner at 6:30 pm will precede the talk, at Squire Rockwell's Restaurant, 8700 Little River Turnpike, Annandale, Virginia. For information and reservations, call Mary Tobin at (202) 394-2046 (Office), or Dick Bulova, 664-6771.

## NASA GODDARD COLLOQUIUM, SEMINARS SCHEDULED

The following colloquium and seminars will be held at 3:30 pm at Goddard Space Flight Center, Greenbelt, Maryland. Coffee and tea will be served from 3:00. Enter the main gate and obtain a visitor's pass from the guard. Call Tracy Parlate, 286-8543, for further information. Scientific Colloquium in Building 3 Auditorium:

Friday, March 3 -- "Puzzles, Paradigms, and Research on the Origins of Solar

Systems," Joseph A. Nuth, Goddard Space Flight Center.

Laboratory for Atmospheres Seminars in Building 21, Conference Room 183:

Tuesday, March 14 -- "Hidden Plasma in Magnetosphere," Charles R. Chappell, NASA Marshall Space Flight Center.

Tuesday, March 28 -- "Effects of Solar Proton Events on the Atmosphere," Charles Jackman, NASA Goddard Space Flight Center.

## U.S. NAVAL OBSERVATORY TOURS IN FEBRUARY

The Monday night public tours of the Naval Observatory begin at 7:30 pm (EST). The next tours are scheduled for March 6, 13, 20, and 27. Passes will be issued to the first 100 persons in line at the gate across from the British Embassy, at Massachusetts Avenue and the southeast side of Observatory Circle. Some form of photoidentification will be required. Parking is not allowed on the grounds for the tours except for the

handicapped; ample parking is available near the gate.

Visitors will see various observatory facilities and, weather permitting, appropriately selected celestial objects, with the historic 26-inch Clark refractor with which the satellites of Mars were discovered more than a century ago.

For details, call the taped Observatory message: (202) 653-1543.

## UNIVERSITY OF MARYLAND OPEN HOUSE SCHEDULED

The Astronomy Program, University of Maryland, holds open house on the 5th and 20th of each month at the University's observatory on Metzert Road in College Park. Talks and slide shows are presented at 8:00 pm, followed by telescopic sky viewing, weather permitting.

Sunday, March 5 -- "Voyager 10 years

after Encounter," Grace Deming.

Monday, March 20, -- "Sunspots," Don Wentzel.

The public is invited; there is no charge, and no reservations are necessary for individuals. Groups larger than ten should call (301) 454-3001 at least 5 days prior to the program.

**EXCERPTS FROM THE IAU CIRCULARS** Robert N. Bolster

1. January 13 — C.S. Shoemaker discovered a comet (1989e) of 13th magnitude in Leo on exposures made with the 46-cm Palomar Schmidt.

2. January 26 — C.S. Shoemaker discovered another comet (1989f) of 16th magnitude in Ursa Major on exposures made January 11 and 14.

3. January 30 — R.O. Evans, Hazelbrook, Australia, discovered a supernova of 13th magnitude in NGC 3627 (M66). Images taken by the Berkeley Automated Supernova Search on January 21 and 30 show the object, at 17th magnitude on the earlier date. Another independent discovery on January 30 was made by F. Manzini in Italy. Spectra show

the supernova to be of type 1a near maximum brightness.

4. February — Space Telescope Science Institute researchers reported that CCD images of 1987A taken by Bond with the 0.9-m reflector at Cerro Tololo in January show a third light echo ring with a radius of 9.8 arcseconds.

5. February — A team of 14 observers and data analysts reported the detection on January 18 of a submillisecond pulsar remnant from Supernova 1987A. The pulse rate was oscillating around a mean frequency of 1968.629 Hz. The observations were made with the Cerro Tololo 4-m telescope.

**SPECTROSCOPIC SOCIETY HOLDS STUDENT NIGHT**

On Thursday, March 16, at Claud's Restaurant, Shady Grove Center, Gaithersburg, the annual student night program of the Society for Applied Spectroscopy will feature research papers by two university students:

"New Glass Frit Nebulizers for Plasma Spectrometry," by R.H. Clifford, George Washington University.

"Continuum Source Atomic Absorption

Spectrometry with a Pulsed Source and a Photodiode Detector," by G.P. Moulton, University of Maryland.

The 7:45 pm talks will be preceded by a buffet and reception at 6:00 pm. For reservations (\$12.00) and further information, call James B. Zink, (301) 439-7141. Reservations are not necessary for the talks only.

**PHILOSOPHICAL SOCIETY LECTURE SCHEDULED**

Friday, March 17, 8:30 pm at the Cosmos Club, Florida and Massachusetts Avenues, NW., the Philosophical Society will present "Treaties to Preserve the

Planet: A New Global Diplomacy," by Richard Elliot Benedick, U.S. Department of State. For further information, call Dr. Thomas Lettieri, (301) 975-3496.

**FOR SALE**

Telescope: 4-inch, F/5.5 Tele Vue refractor with many accessories. Call

for specifics. Daniel Kaplan, (301) 946-7585.

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