



Mohapatra on Superstrings: the Ultimate Theory of Nature ?



DR. MOHAPATRA

Dr. Rabindra N. Mohapatra, Professor of physics, University of Maryland, will present the latest thoughts on the superstring theory of cosmic structure to National Capital Astronomers on October 3 at the National Air and Space Museum.

The superstring theory has raised the genuine possibility of unifying all force and matter into a single theoretical framework, and has brought us closer than ever to realizing the dream of Einstein: a unified field theory. At the root of these developments is the radical new concept that the ultimate structure of matter consists not of point particles, as was taught for centuries, but of strings of length 10^{-33} cm or less. The lecture will review the developments leading to superstrings, their implications for the fundamental laws of matter, and origin of the universe.

Rabindra Mohapatra received the M.Sc. in Delhi and his Ph.D. from the University of Rochester. Now a professor of physics at the University of Maryland, he has been a visiting professor at Stonybrook

College, the University of New York, the Max Planck Institute at Munich, and CERN at Geneva. He has authored a book, *Unification and Supersymmetry*, and edited two others, one on superstrings.

OCTOBER CALENDAR — *The public is welcome.*

- Friday, October 2, 9, 16, 23, 30, 7:30 pm — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.
 - Tuesday, October 6, 13, 21, 27, 7:30 pm — Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.
 - Friday, October 2, 9, 30, 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, October 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, October 3, 7:30 pm — NCA monthly lecture in the Einstein Planetarium of the National Air and Space Museum, Seventh Street and Independence Avenue, SW. (Enter Independence Avenue side. Dr. Mohapatra will speak.
 - Saturday, October 10, 7:30 pm — *Exploring the Sky*, presented jointly by NCA and the National Park Service. Glover Road south of Military Road, NW, near Rock Creek Nature Center. Information: 320-3621.
 - Saturday, October 17, 8:00 — Discussion group on optical ray-tracing software and systems. Building 44, Room 301, University of DC. on north side of Van Ness Street, NW, a half block from UDC Metrorail, Red Line. Parking 1st level under building. See page 8.
 - Saturday, October 24, From 4:00 pm through the night — NCA invited to Hopewell Observatory. See page 7.
- For other organizations' events of interest see elsewhere in this issue.

NOVEMBER LECTURE

Dr William C. Erickson, Professor of astronomy, University of Maryland and researcher at the University's Clark Lake, California Radio Astronomy Observatory, delivered the September National Capital Astronomers colloquium at the National Air and Space Museum. He discussed his recent work at dekameter wavelengths, including prediction of millisecond pulsars.

The Clark Lake array is one of four dekameter observatories in the world. Others are in the Soviet Union, India, and Tasmania, where Grote Reber, a former vice president of National Capital Astronomers and known as the "Grandfather of Radio Astronomy," has carried on the work for many years.

The array consists of a 3-km east-west arm of 480 elements, and a 1.6-km north-south arm of 240 elements. Each element is a wideband (10 to 120 MHz) (conical) spiral-helix antenna. Frequency changes can be made in a millisecond, and pointed anywhere in the sky in about 100 microseconds by changing the relative phases.

In general, only non-thermal radiations are observed at dekameter wavelengths; thermal radiation varies with electron temperature and as the square of the frequency (Rayleigh-Jeans law). Non-thermal emission increases with wavelength, i.e., inversely with frequency. The only visible object of sufficiently intense thermal emission to be observable at the dekameter wavelengths is the Sun's corona. Erickson has mapped the coronal streamers by progressively increasing frequency from about 30 MHz to about 75 MHz, to vary the penetration into the corona. The streamers are otherwise seen only during a total solar eclipse. At the higher frequencies, the disk is seen.

Non-thermal (synchrotron) radiations from electrons accelerated to relativistic velocities in the magnetic fields of coronal loops are detected at intensities far greater than those of the thermal radiations from the corona.

Pulsars frequently show impossible energy indices for the usual nonthermal process, which indicates radiation by a different mechanism. Two radiation mechanisms are thus involved in radio astronomy. At these long wavelengths thermal emission is inconsequential; thermal objects are seen in absorption rather than emission. Absorption varies inversely with a power of frequency and temperature.

Galactic cosmic-ray electrons exhibit thermal radiation; below about 10 MHz, this galactic radiation is progressively attenuated by the thermal absorption, which increases with wavelength.

At 30 MHz (10 meter wavelength) the most intense non-thermal radiation is generally along the galactic plane, and particularly toward the galactic center. Erickson showed a H-alpha map of the galaxy at frequencies below 10 MHz (30 meters), where absorption by the H II regions is seen toward the center of the galaxy, around Rho Ophiuchi, and other regions. He showed a 2.1-MHz southern hemisphere map made by Grote Reber (the "Grandfather of Radio Astronomy, and a former Vice President of National Capital Astronomers - which Erickson pointed out. Reber has spent the past few decades in Tasmania, where radio-quiet conditions are ideal for radio astronomy - ed.) Characteristically, Reber insisted on plotting the south pole at the top. At this 150-meter wavelength, the very high absorption shows that the hotter regions are away from the galactic plane.

Erickson showed several galactic radio maps at various wavelengths which depict the stringy-appearing arc feature near the center of the galaxy, jets, high-energy features, and others which can be interpreted as evidence of a black hole at the galactic center.

A disappointment, Erickson says, is that nothing new is observed in supernova remnants; they look the same as those taken with better resolution at much higher frequencies.

Supernova remnants show different energy spectra, but individually the same spectrum throughout; electrons must have the same energy in all parts of a particular remnant. The reason is not thoroughly understood.

At 20 MHz (15 meters) the Rosette Nebula, a thermal source, shows in absorption against the bright background of the Monoceros loop, a supernova remnant, thus resolving the question of whether the nebula is behind or in front of the loop.

A strong source having a very steep spectral index similar to that of pulsars, but unknown to any of the pulsar searches, prompted Erickson to publish his prediction that it must be a pulsar, but so fast as to have eluded detection. It was later found to be a millisecond pulsar. At the higher frequencies, the pulsar spectrum is usually indiscernible from that of the surrounding nebula; this individual had no nebula, however. Another object within the globular cluster M 28 was recently found to exhibit the same evidence. Its strong polarization was another clue. Again, Erickson published his prediction of another fast pulsar. A few months ago it was discovered at Jodrell Bank to be a 3-ms pulsar.

Another observation unique to long wavelengths was the Soviet discovery in Cassiopeia A, at 16 MHz, of a spectral line of carbon in a record high, the 736th, Rydberg state. The orbital diameter of the captured electron is about 50 microns; the binding energy is only a few mev. Such an atom can exist only at near absolute zero. At first there was understandable doubt throughout the scientific world. Studied at Clark Lake, the line was found at frequencies up to about 110 MHz in absorption, and above about 175 MHz in emission. Erickson has also detected this line in several other parts of the galaxy. The discovery promises to be useful for diagnosing conditions in various parts of the galaxy.

At Clark Lake, an electron halo was found about the Coma galactic cluster. This is of considerable interest to the study of the cluster structure.

Unfortunately, Clark Lake Observatory is being shut down for lack of funding, terminating a low-frequency all-sky survey in progress. There is, however, much interest in this work, and it is being continued by the other three low-frequency observatories in the Soviet Union, India, and Tasmania.

However, Erickson is working to equip the VLA with 75-MHz capability. In the future, orbiting wide-spaced arrays may also continue the work above the ionospheric and atmospheric problems.

R.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).

Date	UT Time	Place	Vis Mag	Pent Sunlit	Cusp Angle	Min Aper
Grazing Lunar:						
10-12-87	09:17	Houston, TX,	1.8	72	N	3 cm
10-16-87	07:35	Bowie, MD	8.3	35	4N	10 cm
10-18-87	08:07	Fairplay, PA	7.7	18	1N	8 cm
10-19-87	09:01	Greenbelt, MD	8.1	11	3S	10 cm
11-01-87	03:08	Silver Spring, MD	6.2	76	16S	5 cm
Planetary:						
10-20-87	06:00	W. Hemisphere	9.2	Stellar occultation by Jupiter		20 cm

NCA WELCOMES NEW MEMBERS

Beardsley, Timothy M. 2226 Cathedral Avenue, NW Washington, DC 200089	Hartnett, Thomas P. 11344 Links Drive Reston, VA 2209069
Bowen, Lydia M. PO Box 1423 Forestville, MD 20747	Lepkowski, Jane M. 2232 Coppersmith Square Reston, VA 22091
Davis, Paul S. 241 Rampart Way, Apt. 204 East Lansing, MI 48823	Marsh, Jeffrey A. 14001 Castle Boulevard, Apt. 103 Silver Spring, MD 20904
Gwin, Reginald 218 Wakefield Road Knoxville, TN 37922	Mhley, Mark 6913 Keats Court Rockville, MD 20855

GILBERT ROBERT WRIGHT 1903-1987

It is with deep sorrow that we note the passing on September 6, 1987, of Bob Wright, a dedicated member of National Capital Astronomers for four decades. Bob was President of NCA in 1950, and continued as an active, contributing member until his recent decline in health. He was an early president of the Astronomical League, and served as correspondent for many years. In 1956-57 he chaired the committee for development of the optical satellite-tracking system used worldwide during and following the International Geophysical Year, 1957-58-59. In 1986 the Montgomery County School System Planetarium at the Smith Center was named in his honor, acknowledging his contributions to astronomy education. He will be sorely missed.

NCA INVITED TO HOPEWELL CORPORATION OBSERVATORY

NCA members, families, and guests are again invited to explore the autumn night sky at Hopewell Observatory on Saturday evening, October 24. Come early (any time after 4:00 pm) and bring your prepared picnic dinner if you wish (...and stay as long as you like, of course!) Coffee, tea, cocoa, and soft drinks will be provided by the Hopewell Corporation. The night probably will be chilly so dress warmly; the observatory is not heated (the operations building is, however).

From the Beltway, go west on I-66, 25 miles to the Haymarket exit at U.S. 15. Left on 15, 0.25 mile to traffic light, right on Route 55, 0.75 mile to County Road 681. Right on 681, 3.2 miles to end, left on County Road 601 (gravel) 1.2 miles to County Road 629, Right on 629, 0.9 mile to narrow paved road on right (Directly across from easier-to-see entrance gate with stone facing on left). Turn right, go 0.3 mile to top of ridge, go around microwave station and continue on dirt road through woods a few hundred feet to the observatory.

Carpooling is recommended. Further information? Call NCA: 320-3621.

ASTRONOMY AND PERSONAL COMPUTERS

There are few star catalogs available for personal computers. Star catalogs are normally distributed on 9-track magnetic tape. Virtually all mainframe and minicomputers are equipped with tape readers, but very few microcomputer owners have them; they are quite expensive. However, distribution of star catalogs on floppy disks is very inefficient, as it takes so many disks to store complete star catalogs. The Smithsonian Astrophysical Observatory Catalog, which contains nearly all the stars to 9th magnitude, contains 258997 stars. A format which stores a line of type containing 80 characters of data per star would need 21,719,760 bytes (20 Mb) to store the data, and take more than 57 MS-DOS DSDD floppy disks.

One star catalog available to microcomputer users is the Yale Bright Star Catalog, which is distributed by user groups on floppy disks, and can be found on some bulletin board systems. I was recently given a copy by Irving Price on eight floppy disks in AMPRO DSDD (384 k) format. These are volumes 31 to 38 from the SIG/M library, and are in CP/M format. Irv has also found the software to convert from CP/M to MS-DOS. This version of the YBS is revision 3, as obtained (on magnetic tape) from the National Space Science Data Center in March of 1981. (It should be clearly understood that the NSSD does not distribute data on floppy disks. They have neither the funding nor the manpower for such efforts.) This catalog contains 202 bytes of information on each of the 9110 stars of the catalog, as well as some documentation and examples of software using the star data bases. I can provide the YBS in MS-DOS format, as well as a variety of CP/M formats. The example of software provided with the YBS is in MBASIC, and will not be difficult to Convert to other versions of BASIC.

Joan B. Dunham

EXCERPTS FROM THE IAU CIRCULARS

1. August — IUE experimenters reported the observation of UV line emission due to N III, N IV, N V, Si IV, O IV, and He II in the spectrum of SN1987A. They suggest that the emission is due to photoionized circumstellar material.

2. August 21 — Michael Rudenko Amherst, Massachusetts, discovered a comet of 10th magnitude in Bootes with a 15-cm refractor. Comet Rudenko (1987u) will reach perihelion on October 9.

3. August 23 — Jean Muller discovered a fast-moving asteroidal object of 17th magnitude with the 1.2-m Schmidt telescope on plates taken for the Palomar Sky survey II.

Robert N. Bolster

DISCUSSION GROUP ON OPTICAL RAY TRACING: SOFTWARE AND SYSTEMS

The October 17 discussion group will be held at **NOTE NEW TIME: 7:30 pm** in Building 44, Room 301, at the University of DC., on the north side of Van Ness Street, NW, one-half block west of Connecticut Avenue. Van Ness is just north of the UDC Metrorail station.

The discussion group is intended to be tutorial as well as an idea exchange. Bring your ideas, questions, and problems, or just listen and learn at any level.

U.S. NAVAL OBSERVATORY TOURS IN OCTOBER

The Monday night public tours of the Naval Observatory in October will begin at 8:30 pm (EDT) on October 5 and 19, and at 7:30 pm (EST) on October 26. Passes will be issued to the first 100 persons in line at the main gate at 34th Street and Massachusetts Avenue, NW, beginning at the scheduled time.

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.

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

SPACE TELESCOPE SCIENCE INSTITUTE SPONSORS HUBBLE LECTURE

On Thursday, November 19 at 9:00 PM, professor Martin J. Rees will deliver the second annual Hubble Lecture in the Shriver Hall Auditorium at Johns Hopkins University in Baltimore. For further information call (301) 338-4714.

FOR SALE

Fifteen-year-old Dynamax 8 with wedge and sturdy pier mount on casters, finder scope, 3 eyepieces, RA motor drive. Delivered to your door anywhere in the Washington metropolitan area for best offer over \$250.00. Call NCA member Ted Woolsey at 320-2339 (Bethesda) to arrange a visit to see the equipment.

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