

MARCH LECTURE

The March meeting of National Capital Astronomers featured Dr. Richard Mushotzky, NASA Goddard Space Flight Center. He presented new X-ray observational evidence for much of the unobserved mass in the universe required by the recent Grand Unified Theories (GUTS) which account so well for many other observations.

The total mass in the universe governs its future expansion. If the mass does not exceed a critical value, the expansion will never end; but if there is more than critical mass the expansion will reach a maximum, and then the universe will contract.

The directly observed mass in the universe is only about 3 percent of critical mass. However, about 30 percent of critical mass is implied by some dynamical measurements (*dynamical mass*). GUTS imply that exactly critical mass is present. The search for the missing mass is one of the main problems in astrophysics.

Observed mass is derived from the computed ratio of mass to luminosity, m/l , and is called *luminosity mass*, expressed in solar units. In spiral galaxies m/l is about 2 to 5, and about 5 to 10 in elliptical galaxies, larger in larger galaxies. In a rich cluster of galaxies m/l is about 100. It is 300 for the Coma cluster. Again, m/l increases with cluster size.

However, motions of galaxies in clusters, and velocity dispersions of stars within galaxies, indicate in both cases the presence of dynamical mass distributed out to a larger radius from the baricenters than the luminosity mass.

Data from X-ray observations by the Einstein satellite have confirmed such phenomena as the increase of m/l with size. Hot, X-ray-emitting gases have been found which contain heavier elements than hydrogen, such as iron, magnesium, silicon, sulphur, argon, calcium, etc. The presence of the heavier elements, *metallicity*, means that the gases are not primordial material; they have been processed at some time within stars, where nucleosynthesis (from hydrogen) of the heavier elements up to iron takes place. Some gas temperatures as high as 60 to 70 million degrees are measured, where iron is the only element not totally ionized; only iron lines are then present.

An X-ray observation which is not yet understood is that virtually all the clusters of galaxies show almost the same abundances of heavy elements in the gas. Yet, even in the Milky Way galaxy the metallicity of stars varies by a factor of more than 100 between old and young stars.

The Einstein satellite can only measure the average temperature of a system, not the temperature vs. radius. The relative insensitivity allows observation of clusters to only a limited distance. The proposed Advanced X-ray Astronomical Facility (AXAF), if realized, will have substantially extended observational capabilities. John B. Lohman

The questions and answers that followed are paraphrased here:

Q: Are X-ray lines of elements heavier than iron observed?

A: No; those elements are present in amounts far too small to detect.

Q: What does cold dark matter emit?

A: Almost nothing. Hot dark matter emits neutrinos.

Q: Expand on the measurement of velocities?

A: In clusters, we measure the line-center shifts in the spectra of whole galaxies. In individual galaxies, we measure Doppler broadening of the lines of the ensemble of unresolved stars. The calculations depend upon some assumptions about shapes of star orbits and the form of the gravitational field.

Q: Tell us something of your experimental designs?

A: Data are fitted to analytical functions; some of ours are new. In those cases the analyses are not easily comparable with others' work. Where we have comparability different observers' results have a 30- to 50-percent spread. Data at the edges of the images is poor, because there the gamma radiation, which looks like X-rays, contributes a large fraction of the measurement.

Q: How sure is the realization of the AXAF?

A: Not at all. Perhaps it will fly in the 1990's.

The following references are suggested for further reading:

1. Faber, S.M., and Gallagher, J.S., *Masses and Mass-to-Light Ratios of Galaxies*, in *Ann. Rev. of Ast. and Ap.*, 17, 135.
2. Forman, W., and Jones, C., *X-Ray Imaging Observations of Clusters of Galaxies*, in *Ann. Rev. of Ast. and Ap.*, 20, 547.
3. Reports on Progress in Theoretical Physics, 44, 108

OCCULTATION EXPEDITIONS PLANNED

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

Date	UT Time	Place	Vis Mag	Pcnt Sunlit	Cusp Angle	Min Aper
04-02-85	06:22	San Antonio, TX	3.6	85	8N	5 cm
04-23-85	02:02	Deerfield, IL	4.5	07	4N	5 cm
04-23-85	02:04	Gratiot Porter, OH	4.5	07	5N	5 cm
04-28-85	00:59	Daleville, PA	6.8	48	10N	5 cm
05-05-85	01:40	Khartoum, Sudan	2.9	0*	82#	0.5 cm

*During Total lunar eclipse. #Percent of umbral radius from center to event.

Asteroidal:	Star Mag	Delta Mag	Name	Min Aper	
04-11-85 03:25	E. Coast USA	10.5	1.4	(129) Antigone	10 cm
04-15-85 02:20	SE Canada	6.8	5.0	(275) Sapiaientia	3 cm
04-23-85 04:27	Maryland and Ohio	10.3	1.6	(51) Nemausa	15 cm

NCA WELCOMES NEW MEMBERS

Lind B. Karlsen
4523 Gladwyne Drive
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4400 Ridge Street
Chevy Chase, MD

Craig Magargel, #33
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Melvin C. Wiggins
3005 Parkland Drive
Forestville, MD 20747

NOMINATING COMMITTEE APPOINTED

The Nominating Committee has been appointed for the May election of NCA officers: Robert McCracken, Chairman; William P. Pala, Robert N. Bolster, Daniel G. Lewis.

Others may nominate candidates by petition of 10 full members in good standing, presented to the secretary prior to the May 6 election.

NCA GREEN BANK TRIP SET

National Capital Astronomers will visit the National Radio Astronomy Observatory at Green Bank, West Virginia, on the weekend of May 11-12. Mark your calendar for a memorable experience. Plan to bring your camera and plenty of film for both the unique opportunities at the Observatory and the beauty of the West Virginia mountains in the spring.

A number of telescopes will be provided for use under the dark rural sky on Saturday night; the observatory will be visited on Sunday.

We will meet our chartered bus at the Department of Commerce Building for a prompt 9:00 am departure on Saturday, May 11; Special free weekend parking arrangements have been made for participants.

Cost for members will be \$62.50, for non-members, \$75.00, based on double occupancy; single supplement, \$11.00; for third person in room, \$3.00. Transportation and motel costs, but not meals, are included.

Space is limited. To reserve your place, deposit \$25.00 before April 27. Make check payable to National Capital Astronomers, mark it "Green Bank trip," and mail (or deliver at the NCA meeting) to Ruth S. Freitag, Treasurer, 1300 Army-Navy Drive, Arlington, VA 22202.

SPECIAL BEGINNERS PHOTOGRAPHY SESSION WITH NCA 14-INCH TELESCOPE

On April 26 the Moon will be near first quarter and high in the sky. The C-14 observing session that evening will be devoted to lunar photography. Learn and enjoy!

Bring interchangeable-lens single-lens reflex camera, and a T-thread adapter. T-adapters will be provided for Nikon, Canon, Praktica, and Olympus OM-1. Ocular-tube adapters of 1.25- or 2-inch diameter can also be accommodated. Also bring a shutter-release cable and slow-to-moderate-speed color or black-and-white film. For further information, call Bob Bolster, 960-9126.

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EXCERPTS FROM THE IAU CIRCULARS

1. September -- Van der Klis, Jansen, van Paradijs, Lwein, Trumper, and Sztajno, made observations with the EXOSAT spacecraft of the bright galactic bulge source GX 5-1, which showed 25- to 50-ms variations at 1 to 10 keV. Such rapid X-ray variability has never been observed before. Alpar and Shaham suggest that a neutron star with a rotational period of 6 ms may be at the center of the object.

2. November -- Nisenson, Noyes, and Papaliooios, and Stachnik, Center for Astrophysics, reported that speckle interferometry of T-Tauri showed a second source 0".35 north of the primary. Confirmed with the 2.5-m Hooker telescope, it had been first detected a year earlier with the 2.3-m reflector of Steward Observatory.

3. February -- Benzel, Tedesco, and Tholen reported that occultations and transits of Pluto and 1978 P1 (Charon) have begun. Three partial events have been observed. Deeper events, eclipses, and shadow transits may be detected in 1986.

4. February 17 -- Wykoff, Foltz, Heller, Wehinger, Wagner, Schleicher, and Feston reported that spectra taken with the 4.5-m MMT of Comet Halley showed weak lines of CN emission at 387.5 nm and traces of other very weak emission lines.

NASM PLANETARIUM PRESENTS FREE LECTURES, SUN VIEWING

On Saturday, April 6, at 10:00 am, Thomas H. Callen II will speak on *The Milky Way: An Insider's View*. Following the program, weather permitting, Stanley Cawelti and Geoffrey Chester will offer safe telescopic hydrogen-alpha viewing of the Sun.

On Wednesday, April 24, at 7:30 pm, Laurel Wilkening, University of Arizona, will speak on *Comets: Relics of a Cold and Distant Past*.

FOR SALE

Criterion 4000 telescope, complete with tripod, 2 eyepieces, and clock drive. Cost \$600.00, will sell for \$300.00. Call M. Kamelgarn, (703) 833-1415.

Eight-inch Cave delux model reflector with motor drive, finder, 4 eyepieces, 1 Barlow lens. \$450.00. Glen C. Darr, Falls Church, VA, (703) 533-1607.

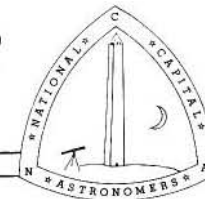
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FIRST CLASS

★ STAR DUST



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WOODGATE HAS NEW SOLAR-MAXIMUM RESULTS



DR. WOODGATE

Dr. Bruce Woodgate, NASA Goddard Space Flight Center, will bring new results from the Solar Maximum Mission (SMM) to the April meeting of National Capital Astronomers.

A periodicity in gamma-ray and hard X-ray production of 155 days, of unknown origin, has been found. Particle energies produced in flares are much higher and appear more rapidly than previously expected or currently explained. Neutrons of up to 600 MeV have been detected at the spacecraft, and gamma rays above 25 MeV have been accelerated in less than 2 s, coincident with hard X-rays. Gamma-ray flares above 10 MeV occur more frequently at the limb of the sun, showing them to be produced from vertically directed particle beams. Gamma-ray spectrum lines show nuclear collisions have occurred by accelerated proton beams. Ultraviolet continuum bursts occur in coincidence with hard X-ray bursts to .1 s, whereas 1- to 2-s delays would be expected.

Coronal mass ejections, a billion tons of matter traveling at a million miles an hour, seem connected with pre-flare upheavals rather than the high-energy flares themselves. The Sun has decreased in total irradiance by 0.1 percent over 4 years. Will it go up again at the next solar maximum? Can we survive all this?

Born in England, Dr. Bruce Woodgate received the B.S. in physics and his Ph.D. in astronomy from the University of London. After 6 years at Mullard Space Laboratory designing and building ultraviolet instruments for solar experiments on the OSO-6 spacecraft, he came to the United States in 1971 and became the Associate Director of the Astrophysics Laboratory at Columbia University, New York. He spent 1974 at the Goddard Institute for Space Studies, where he worked on Landsat under Robert Jastrow. He came to Goddard Space Flight Center in 1975 to work on ultraviolet spectrometers for SMM, and became Project Scientist for SMM in 1983.

MARCH CALENDAR -- *The public is welcome.*

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

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

Friday, April 12, 19, 26 (Special - see p. 31), 8:00 pm -- NCA 14-inch telescope open nights with Bob Bolster, 6007 Ridgeway Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob at 960-9126.

Saturday, April 5, 6:00 pm -- Dinner with the speaker at the Ding How Restaurant, 1221 E Street, NW. Reservations unnecessary.

Saturday, April 5, 8:15 pm -- NCA monthly meeting at the Department of Commerce, 14th Street and Constitution Avenue, NW. Dr. Woodgate speaks.

Saturday, April 19, 8:00 pm -- Discussion group at the Department of Commerce, Conference Room D.