

DECEMBER LECTURE

Dr Timothy M. Heckman, Johns Hopkins and Maryland Universities, presented his recent research on quasars at the December meeting of National Capital Astronomers. He first reviewed current knowledge and questions about quasars.

His results strongly favor the cosmological interpretation; quasars appear actually to be at the distances indicated by their redshifts. The work also offers further indications of quasars' properties.

redshift (Z), the shift of spectral lines toward longer wavelengths by velocity of recession, is given by:

$$Z = (\lambda_o - \lambda_e) / \lambda_e$$

Where λ_o is observed wavelength and λ_e is emitted wavelength.

The familiar Hubble Law states that remote bodies' distances are proportional to their redshifts. By this interpretation, quasars, billions of light years distant, are the farthest observed objects in the universe. They appear to emit energies of about $c^2 \times 10^8$ equivalent solar masses during their existence. (c is the vacuum velocity of light: 3×10^8 meters per second.) This is 10^4 times the energy of an ordinary galaxy. Radiated wavelengths range from radio to gamma. Beams of matter are ejected at apparent velocities of 0.3 to $10 \times c$. Images of the nearby quasar 2C273 taken at one month intervals make the point; they show components seemingly moving apart at five times the velocity of light!

The monstrous engine that drives a quasar cannot be much larger than about the diameter of the solar system. This follows from the rapidity of radiance variations.

Quasars are believed to have been common in the early universe. Qualitatively, they resemble nearby active galaxies, which also have a very bright nucleus, but far less extreme. With slides, Heckman compared quasar 3C273 with galaxy M87, each of which emits a conspicuous jet, and with a seyfert galaxy which has an unusually bright nucleus.

Some major questions about quasars:

A) Are quasars actually at their cosmological distances? Or do unknown laws produce the redshifts in another way?

B) What is the nature of the driving engine of the quasar?

C) What is the environment of the quasar like? What role does it play in fueling the driving engine?

D) Why are some quasars radio-loud and some radio-quiet?

E) What is the host galaxy like? Is it spiral, or elliptical?

Heckman's research addressed the following problems:

A) Obtain deep, detailed images of quasars so as to examine the host galaxies.

B) Obtain the redshift of the surrounding host galaxy and compare with that of the quasar.

C) Measure the radio spectrum of the hydrogen surrounding the quasar.

D) Obtain spectra of any companion objects to the quasar.

Some immediate results of this work:

A) Using CCD's and large telescopes, images of surrounding and companion galaxies of 31 quasars were recorded and analyzed as follows: The quasars are modeled as point sources surrounded by galaxies. The images' point-spread functions (the form of the optical image of point sources) were determined from those of stars in the image field. Host galaxies' assumed sizes were varied, and ranges of radiance ratios between quasar and galaxy were tried for each image.

B) Host galaxies were found to be of typical sizes. Galaxies surrounding radio-quiet quasars appeared to be of spiral type with radiances of about 1.5×10^{10} that of the Sun. Radio-loud quasars were found to be surrounded by giant elliptical galaxies of about 4×10^{10} solar radiance. Many host galaxies were distorted, which suggests tidal interaction with neighboring galaxies.

C) Redshifts of the quasars and their host galaxies were almost always the same. Radio spectra showed neutral hydrogen.

D) Spectra of 21 companions were seen. The Z 's of 19 were measured; 18 matched Z 's of the host galaxies.

E) Quasars are found in unusually dense regions of the universe. Spectra confirm this finding.

Some main conclusions:

A) Some, perhaps all relatively low- Z quasars (the class examined) are really at their cosmological distances. They are active nuclei of galaxies.

B) The host galaxies are generally normal. Interactions with neighboring galaxies are observed frequently.

C) Host galaxies of radio-loud quasars are very luminous giant ellipticals. Those of radio-quiet quasars are less luminous spirals. This is the same difference that is found for comparatively nearby active galaxies.

The question period brought out the following:

Q: Could quasars actually be nearby and we see only the emitted bright jet?

A: No; we never see blue-shifted quasars, which special relativity shows would produce the brightest images.

Q: Please describe some theories of quasars.

A: The most promising theory is that a quasar is a black hole of about 10^8

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	Pent Sunlit	Cusp Angle	Min Aper
01-01-85	03:41	Williamsport, MD	5.4	91	10S	5 cm
01-12-85	04:16	Dallastown, PA	7.2	69	6S	10cm
01-18-85	11:36	Silver Spring, MD	7.4	7	20S	10 cm
01-27-85	01:35	Myersville, MD	8.0	30	11S	8 cm
02-01-85	00:23	Gaithersburg, MD	8.4	77	14S	20 cm
02-01-85	03:03	Grosstwon, MD	8.3	77	6S	20 cm
02-01-85	06:17	White Oak, MD	8.5	78	2N	20 cm
02-01-85	23:29	Sunderland, MD	6.6	85	16S	20 cm
02-02-85	00:24	DC, Bowie, MD	7.6	85	15S	20 cm
Asteroidal:			Star Mag	Delta Mag	Name	
01-03-85	07:44	Texas	9.8	0.6	(6) Hebe	20 cm

NCA WELCOMES NEW MEMBERS

David Darby Family
8523 Hunter Creek Trail
Potomac, MD 20854

Maurice B.K. Edmead
14524 Woodcrest Dr.
Rockville, MD 20853

Jonathan Jarvis
Rt. 1, Box 178, House 73
Weatherford, TX 76086

Robert I. Lohman
3450 Terrace Ct., # 1041
Alexandria, VA 223025

solar masses. Gravitational lensing could be involved; it would intensify the observed image of a quasar.

Q: Have enough quasars been observed to determine whether they are the same in all clusters?

A: Several thousand quasars have been found; they may be superclustered.

Q: What is the present state of former quasars?

A: Probably most of them have "eaten" all of the surrounding stars.

Q, A: It is not known whether black holes would produce the sort of spectra we actually observe.

Q: Please explain the superluminal velocities observed in quasars.

A: Special Relativity shows that at very high velocities time dilation will be observed. This in turn can lead to apparent superluminal velocities (velocities greater than c .)

Q, A: The spectra measured in the "fuzz" surrounding quasars shows internal velocities distributed over a range of about 300 km per second.

Q: About how many CCD pixels are covered by the host galaxies?

A: The images of galaxies surrounding quasars cover about 30 pixels.

Q: How much time can be expected on the Space Telescope for quasar research? How much time can be expected for testing Halton Arp's theories?

A: This is not predictable, but quasar research will probably be deemed sufficiently important to merit considerable Space Telescope time. Decisive experiments to determine the validity of radical theories would be demanded to merit time.

Q, A: Spectral types can now distinguish only between elliptical and spiral galaxies; thus between radio-loud and radio-quiet cases.

Q, A: Theories for the different behavior of spiral and giant elliptical galaxies have only begun to be formulated. John B. Lohman

The following references are suggested for further reading, although not specifically referenced in the above summary:

1. Bothun, G.D., Mould, J., Heckman, T.M., Balick, B., Schommer, R.A., and Keshan, J., 1982, *Astrophysical Journal* 81, 1621.

2. Balick, B., and Heckman, T.M., 1983, *Ap. J.* 265, 21.

3. Heckman, T.M., Bothun, G.D., Balick, B., and Smith, E.P., 1984, *Ap. J.* 89, 958.

4. Bothun, G.D., Heckman, T.M., Schommer, R.A., and Balick, B., 1984, *Ap. J.* 89, 1293.

5. Smith, E.P., Heckman, T.M., Romanishin, W., and Bothun, G.D., 1984, (in preparation).

6. *Physics Today*, December 1984, 17.

EXCERPTS FROM THE IAU CIRCULARS

1. November -- N. Mauron, Pic du Midi Observatory, reported the detection of a gaseous envelope greater than 1 arcminute in diameter around U Cephei. The observation was made in the sodium D line with a CCD on the 2-m telescope.

2. November 17 -- Malcomb Hartley, U.K. Schmidt Telescope Unit, discovered a comet (1984v) of 15th magnitude near Rigel with the 1.2-meter Schmidt telescope at Siding Spring.

3. November 21 -- Carolyn and Eugene Shoemaker discovered yet another comet (1984u) of 14th magnitude in Aries with the 46-cm Schmidt at Palomar.

4. Minoru Honda, Kurashiki, Japan, discovered a probable nova of 10th magnitude in Aquila.

NASM SKY LECTURE, H-ALPHA SUN VIEWING

NCA President Geoffrey Chester will present the Monthly Sky Lecture in the Planetarium of the National Air and Space Museum, at 10:00 a.m. on Saturday, January 5. Following the lecture, weather permitting, he and Stan Cawelti will offer safe, telescopic hydrogen-alpha viewing of the Sun on the deck east of the building.

Future Monthly Sky Lectures will be held at 10:00 a.m. instead of 9:00 a.m. as in the past.

FOR SALE -- Unitron model 160 4-inch refractor with all accessories except photo guide scope. Sturdy, high-quality equipment in excellent condition. Cost over \$3,000; will sell for less than half. John Hoshor, 16606 Brooklyn Bridge Ct. Laurel, MD 20707. (301) 725-4117.

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TROMBKA TO SUMMARIZE NASA'S SPACE PLANS FOR 1990'S



DR. TROMBKA

Dr. Jacob I. Trombka, NASA Goddard Space Flight Center, will address the January 5 meeting of National Capital Astronomers. He will describe NASA's plans for a new, relatively low-cost, two-phase planetary exploration program of *Planetary Observers*.

The first phase is to be initiated by the *Mars Observer*, to be sent into Martian polar orbit in the early 1990's. A full complement of remote sensors will study details of the surface composition, atmospheric properties, and climate for a full year.

Other probes to follow include the *Lunar Observer*, in lunar polar orbit, and a rendezvous with an Earth-crossing asteroid.

The program will study the evolution of the solar system and potential uses of space resources.

The second, rather more ambitious phase, will follow with the *Martiner Mark-II* missions. Contemplated are fly-by of two or three

asteroids and a comet rendezvous near aphelion, to follow through perihelion and some time afterward. The craft will inject a penetrator into the nucleus of the comet to study its chemical, thermal, and mechanical properties.

The 1990's promise to be an exciting time for planetary exploration!

Jacob I. Trombka received his M.S. in 1954 from Wayne State University and his Ph.D. in 1961 from the University of Michigan. Before coming to NASA he was a research physicist at Oak Ridge Institute of Nuclear Studies, a scientist at Oak Ridge National Laboratories, and a senior scientist at Jet Propulsion Laboratory. He is at present a space scientist at GSFC and a visiting professor of chemistry and physics at Maryland University. He won the Lindsay Award for Outstanding Scientific Achievement in 1972 and the NASA Medal for Scientific Achievement in 1973. He recently coauthored with Dr. Carl Fichtel the book, *Gamma-Ray Astrophysics: New Insight into the Universe*. Dr. Trombka is a member of the American Physical Society, the American Nuclear Society, and Sigma Xi.

JANUARY CALENDAR -- *The public is welcome.*

Thursday, January 3, Tuesday, January 8, 15, 22, 29, 7:30 pm -- Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, January 4, 11, 18, 25, 7:30 pm -- Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

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

Saturday, January 5, 8:15 pm -- NCA monthly meeting at the Department of Commerce Auditorium, 14th Street and Constitution Avenue, NW. Dr. Trombka will speak.

Friday, January 11, 18, 25, 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, January 19, 8:00 pm -- Discussion group at the Department of Commerce, Conference Room D. Topic to be announced.