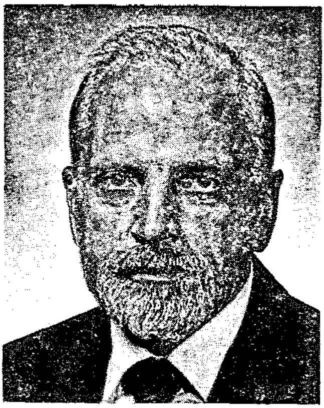
☆ STAR DUST

Volume XXXVI January 1980 Number 5

HANEL TO PRESENT VOYAGER-JUPITER I-R SURVEY



DR. HANEL

Dr. Rudolph A. Hanel, Goddard Space Flight Center, will present the results of the infrared investigation on Voyager, at the January 5 meeting of National Capital Astronomers.

The Michelson interferometers on Voyagers 1 and 2 yielded spectra of Jupiter and its satellites between 4 and 55 μm. Atmospheric gas composition, temperature profiles, and several other parameters can be derived from the spectra; discovery of the sulphur dioxide atmosphere of Io is an example. Dr. Hanel will discuss the implications of these results in the dynamics of the Great Red Spot and other features of Jupiter. He will stress the importance of combining the infrared results with the information contained in pictures from the Voyager cameras.

Dr. Hanel is a senior scientist at Goddard Space Flight Center working on remote sensing of planetary atmospheres. He has been the Principal Investigator of the infrared investigations on Voyager, Mariner 9, and several Nimbus and Tiros projects. He received his Ph. D. in 1953 from the Technical University in Vienna, Austria.

Dr. Hanel spoke to National Capital Astronomers in 1972 on the Mariner 9 spectroscopy of Mars.

JANUARY CALENDAR — *The public is welcome.*

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

Friday, January 4, 11, 18, 25, 8:00 PM — Observing with the NCA 14-inch telescope with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. 960-9126.

Saturday, January 5, 6:15 PM — Dinner with the speaker at the Thai Room II, 527 13th Street, NW. Reservations unnecessary.

Saturday, January 5, 8:15 PM — NCA monthly meeting at the Department of Commerce Auditorium, 14th and E streets, NW. Dr. Hanel will speak.

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

DECEMBER LECTURE

This year marks the 100th anniversary of the birth of Albert Einstein. At the December 1 meeting of National Capital Astronomers, Dr. Stephen S. Holt of Goddard Space Flight Center discussed some of the results obtained from the High-Energy Astronomical Observatory-2 (HEAO-2), named the Einstein Observatory. The name is apt, since interpretation of the results from HEAO-2 relies heavily on many Einstein theories.

Before HEAO-2, X-ray experiments were simple proportional counters behind eggcrate collimators. They detected a diffuse background and several dozen point X-ray sources typically lying in the plane of the galaxy. This meant they were in the galaxy, but far from us. Often they were neutron stars in binary systems, but they could also be white dwarfs, or perhaps even black holes. X-ray pulsars are well understood, being rotating neutron stars with strong magnetic fields taking matter from their optically visible uncollapsed companion stars. Using the Doppler shifts of the pulse and of the companion's lines, and the eclipse of the pulsar by the companion, all the details of such a system can be accurately predicted.

The HEAO-2 is an *imaging* X-ray telescope, using grazing-incidence optics to form actual X-ray pictures of the universe for the first time. There are two spectrometers on board the spacecraft. Besides the X-ray sources seen by earlier satellites, HEAO-2 can see clusters of galaxies, supernova remnants, stars, and extragalactic compact objects, listed in order of decreasing understanding of these systems.

Supernova remnants are moderately easy to explain. In most remnants, a star at the end of its life collapsed catastrophically then exploded, sending out a shock wave which heated up the expelled material to X-ray-emitting temperatures. In the case of the Crab nebula, the remains of the star's core after the explosion formed a neutron star whose intense magnetic field accelerates electrons to near-relativistic energies and causes them to emit characteristic synchrotron X-ray radiation. Previous experiments could barely produce a characteristic iron spectrum from these objects, but HEAO-2's high-resolution spectrograph can produce lines identified as resulting from sulphur, helium, neon, magnesium, silicon, argon, and calcium. Models assuming only thermal radiation from these elements fit the data very well.

X-rays emitted by clusters of galaxies also fit well into models of these objects. Using optical means, only 10 percent of the mass needed to bind a cluster of galaxies together can be observed. Signatures of another 10 percent or so can be seen in the X-ray region, including hydrogen and helium-like silicon, and sulphur. Early theories predicted this gas to be in equilibrium, but as the gas emits radiation, it cools and falls into the cluster center. Thus the gas looses itself by X-ray emission, so the binding mass at the center is increasing. Not all of the missing mass of the galactic clusters has been found, but HEAO-2 has yielded a better understanding of how these systems are bound together.

X-ray-emitting stars are more difficult to understand. HEAO-2 sees not only hot O-stars, but it also sees X-rays from stars of all spectral types, all the way to M dwarfs. This suggests that all stars have a hot corona of from one to several million degrees. How the 10, 000 K temperature at the star's surface can produce the hot corona is still unexplained. Acoustic pressure can explain up to perhaps one million degrees, but many stars seem to have coronal temperatures of several million degrees. One possible explanation is that nearly all stars have star-spots which are centers of magnetic disturbances which discharge extremely hot plasmas into the star's corona.

The diffuse background and its relationship to quasars is the least understood of all. HEAO-1 showed the Andromeda galaxy as a weak source. HEAO-2 can see over 60 new extragalactic compact objects, compared to only 200 total X-ray sources (all within the Milky-Way galaxy) known up to 1975. Since HEAO-2 can see so many extremely distant objects, such as quasi-stellar

NCA WELCOMES NEW MEMBERS

Lincoln Anderson
4808 Wellington Drive #310
Chevy Chase, MD 20015

Nancy Blaney
9167 Broken Oak Place
Burke, VA 22015

Michael B. Irvine
3225 Coquelin Terrace
Chevy Chase, MD 20015

Cliff Alan Joslyn
PO Box 2803
Reston, VA 22090

Corey S. Powell
4630 Hunt Avenue
Chevy Chase, MD 20015

NOTES ON CURRENT RESEARCH

Writing in *Nature*, 29 November 1979, G. Burbage reviews evidence concerning the associations between QSO's and galaxies, with similar redshifts, and pairs with very different redshifts. He concludes that both kinds of associations are likely to be real.

In the same issue, a theory of terrestrial catastrophism is proposed by Napier and Clube of the Royal Observatory, Blackford Hill, Edinburgh, U.K. The time sequence of terrestrial catastrophies and other solar-system phenomena is apparently stochastic, but with an underlying galactic modulation by passage of the solar system through spiral arms every few 10^7 years. Such passages may result in temporary accumulations of captured planetesmals which would be rapidly dissipated by planetary encounters and hyperbolic ejection. The authors argue that the cratering flux record, the current distribution of comets, and the existence of many dynamically short-lived bodies in the solar system are best explained as consequences of this single mechanism.

THIRD MEMORIAL VON BRAUN LECTURE IN JANUARY

The National Air and Space Museum of the Smithsonian Institution will present the third annual Werner Von Braun Memorial Lecture on Wednesday, January 23, 1980, at 8:00 PM in the NASM Theater. The free lecture, "Jupiter and Saturn: New Views and Discoveries," will be given by Edward C. Stone, Project Scientist, NASA Voyager Program.

---

objects (QSO's or quasars), Seyfert I galaxies, and BL Lac objects, it is tempting to explain the diffuse background in terms of these objects. Unfortunately, these most distant of all known objects are smaller than the 1-arcsecond resolution of the highest-resolution HEAO-2 experiment.

Differences in their spectra notwithstanding, these distant objects are all small (less than 0.1 parsec), they have a central region which emits broad lines indicating high velocity dispersion, and they have high electron densities since no forbidden lines are observed. It seems they have a huge black hole of 10^8 solar masses or more at their centers, and in many cases this region is surrounded by a larger volume emitting narrow lines. These objects are the most powerful emitters in the universe, radiating 10^{45} to 10^{46} ergs per second. Modeling of these objects is impossible, since there are too many ways such a huge black hole can generate the energy we see.

In the 3-keV to 50-keV region seen by HEAO-2, one can fit the diffuse background with QSO and Seyfert-I spectra only over part of the range. Other astrophysicists disagree, but Dr. Holt suggests that one possible way to explain the diffuse background spectrum is that QSO's are the source of the low-energy background, Seyfert-I objects radiate the high-energy background, and a hot intergalactic gas with 100-keV energy (which redshifts to 40 keV) explains the middle-energy region. Such a gas would have a mass of roughly one-third that necessary to make a closed universe — the model that appealed most to Albert Einstein.

mt

EXCERPTS FROM THE IAU CIRCULARS

1. October 26 — Kaluzienski and Holt, Goddard Space Flight Center, detected a nova-like X-ray outburst from a source in Sagittarius with the Ariel-5 all-sky monitor.

2. November 1 — A. Dollfus, Observatoire de Paris, photographed an outer ring of Saturn using a focal coronagraph with the Pic du Midi reflector. The ring extended from the A ring to 3.4 Saturn radii.

3. December 9 — J. D. Mulholland, University of Texas, photographed another satellite of Saturn, designated 1979 S 3, with the 760-cm McDonald Observatory reflector.

4. December 11 — The occultation of SAO 115946 by (3) Juno was observed photoelectrically by R. Elliott of the University of Wisconsin and by W. Osborn of Central Michigan University. Occultations of 1^m07^s and 1^m18^s were recorded, with no definite secondary events. rnb

★ STAR DUST
WASHINGTON, D.C.
Published eleven times yearly for NATIONAL CAPITAL ASTRONOMERS, INCORPORATED, a non-profit, public-service organization promoting interest and education in astronomy and related sciences. President, Mary Ellen Simon. *STAR DUST*: Robert H. McCracken, 5120 Newport Avenue, Washington, DC 20016. Deadline: 15th of preceding month.

SCHNALL, JEROME,
2801 QUEBEC ST NW,
WASHINGTON, DC 20008

FIRST CLASS MAIL

WASHINGTON, DC 200 PM DEC 1979