STAR DUST

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SPARKS TO DISCUSS NOVA MODELS

DR. SPARKS

Dr. Warren Morgan Sparks of the Laboratory for Optical Astronomy, Goddard Space Flight Center, NASA, will speak on models of the nova outburst, at the December 7 meeting of National Capital Astronomers.

Dr. Sparks will describe computer experiments with the nova model of Kraft — a binary comprising a red supergiant filling its Roche lobe and a white dwarf. He will compare the resulting light and velocity curves with observational data.

Dr. Sparks was born in Amarillo, Texas. He received a B.S. in physics in 1961 from the University of Texas. He received a M.A. in astronomy in 1964 and a Ph.D. in astrophysics in 1967 from Indiana University.

Dr. and Mrs. Sparks have three children.

DECEMBER CALENDAR — *The public is welcome.*

Monday, December 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, December 6, 13, 20, 27, 7:30 PM — Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall.

Saturday, December 7, 6:15 PM — Dinner with the speaker at Bassin's Restaurant, 14th Street and Pennsylvania Avenue, NW. Reservations unnecessary.

Saturday, December 7, 8:15 PM — NCA monthly meeting at the Department of Commerce Auditorium, 14th and E Streets, NW. Dr. Sparks will speak.

NOVEMBER LECTURE

Current thinking on pulsar theory was surveyed at the November 2 meeting of NCA by Dr. William Rose of the Department of Physics and Astronomy, University of Maryland.

Discovered by Hewish, et al, during a study of quasars at Cambridge University, pulsars were soon identified as rotating neutron stars which had been predicted by theory. The radio pulses emitted by pulsars vary eratically in amplitude, but the period, typically of the order of one second, is quite constant. Slight slowing of the spin, or lengthening of the period with time, yields the strength of the rotating magnetic field necessary to the radiation mechanism, as well as the energy radiation rate. Except for occasional irregularities attributable to structural alterations of the crust, the slowing rates of pulsars are regular, and indicate similar magnetic fields of about 10^{12} gauss within a small factor for all pulsars — approximately the same as the fields found in the cores of immediately pre-nova stars. The reason, Dr. Rose explained, is that the neutron stars have a common genesis in the cores of supernovae; they take

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the core field with them after the shell is blown off. Particles streaming at relativistic velocities from the magnetic poles are constrained by the strong field to follow field lines, consequently are confined to an exit cone of about 15°. Electron-positron bunching of the stream by some mechanism is postulated to account for a radio brightness of as high as 10^{26} degrees K. The structure of the typical neutron star was described by Dr. Rose as comprising a volume filled with neutrons, an outer shell of lesser volume having atoms, chiefly iron, in an extremely dense gaseous state, and a small core having such density that even the integrity of the neutrons is destroyed. There, many more fundamental particles, chiefly hadrons, exist. Internal convection processes maintain the magnetic field. In the pulsar, a substantial angle between the rotational and magnetic axes accounts for the pulsation of the radiation as the star rotates. Many pulsars may be unobservable from the earth because their rotational orientation never directs the exit cone toward the Earth. On the other hand, the Crab pulsar, NP0532, unique for its observable optical synchrotron radiation, has magnetic and rotational axes approximately in quadrature, so that the radiation from both magnetic poles is alternately observed at different amplitudes.

None of the pulsars known until recently is a member of a binary system, although more than half of all stars are in multiple systems. The expulsion of mass from the nova forming the neutron star accelerates the companion star sufficiently not only to expel it from the system, but also to account for the runaway stars — those having extraordinary velocities — known for years. At least two neutron stars which are not pulsars but X-ray stars are now known to be members of binary systems. In these cases, mass transfer from the giant primaries which are overfilling their Roche lobes yields X-ray emission; the pulsar mechanism is damped out by the accretion of mass from the primaries. Recently, at least one pulsar is known to be a member of a binary system. In this case, the companion star is neither a giant nor a main sequence star, but probably is a white dwarf. Dr. Rose conjectured that such systems, if more can be learned about the companion star, will offer interesting tests of general relativity.

NOTES ON CURRENT RESEARCH

Neptune internally heated? — Results from Pioneer 10 indicate that Jupiter radiates about twice as much energy as it receives from the Sun, the extra heating presumably coming from an internal source. R. E. Murphy and L. M. Trafton of the Maryland Academy of Sciences now report a very probable internal heat source for Neptune as well, while Uranus almost surely has none. The observed infrared albedo of Neptune indicates a blackbody temperature of 46 ° K. From their 2-3 μm spectral data, however, the authors infer a temperature of 57° K, implying a flow of heat from Neptune 1.4 times that received from the Sun. Even if Neptune's thick, icy atmosphere produced an extreme greenhouse effect, as on Venus, not all of this heating could be accounted for. (*Astrophysical Journal*, October 1, 1974, 253)

Fluvial origin questioned — Large channels on the surface of Mars, shown in Mariner 9 photographs, have been widely cited as examples of erosion by water. S. A. Schumm of Colorado State University argues that studies in structural engineering show that very similar features can be produced in a variety of materials by structural tension. Comparing geomorphological features of major Earth rivers with Martian channels, he notes significant differences, including lower degrees of sinuosity. Finally, Schumm notes that our lack of morphological understanding of terrestrial valley systems and the insufficient resolution of even the best Mariner photographs makes formation of the channels by structural tension a reasonable hypothesis even if they were later modified by water flow. (*Icarus*, July 1974, 371)

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PIONEER 11 ENCOUNTERS JUPITER DECEMBER 3

Records targeted — After a billion-kilometer journey of almost two years, Pioneer 11 will reach perijove on December 3 at 0522 UT — spectacularly. As it does, the 260-kg craft will set several all-time records. It will approach to within 41,000 km — one-third the distance of Pioneer 10 — from Jupiter. Although Pioneer 10 suffered some radiation damage, Pioneer 11 is expected to encounter a radiation level 10 times as high as did Pioneer 10, and 40,000 times that of the Earth's belts. To limit the total dose to that of Pioneer 10, Pioneer 11 will approach well to the south, sweep quickly at 55° to the equatorial plane, and pass at record speed through the equatorial disc of maximum radiation in about a half hour.

Around the world in .01 day — At perijove, the craft will be moving at more than 171,000 km per hour. That's around the Earth at the equator in less than 15 minutes! The trajectory will be retrograde to Jupiter's rotation, permitting for the first time measurement of a complete rotation of the magnetic field, radiation belt, and surface. Twenty-two high-resolution color photographs will be taken, all from angles unavailable from the Earth, six of the polar regions.

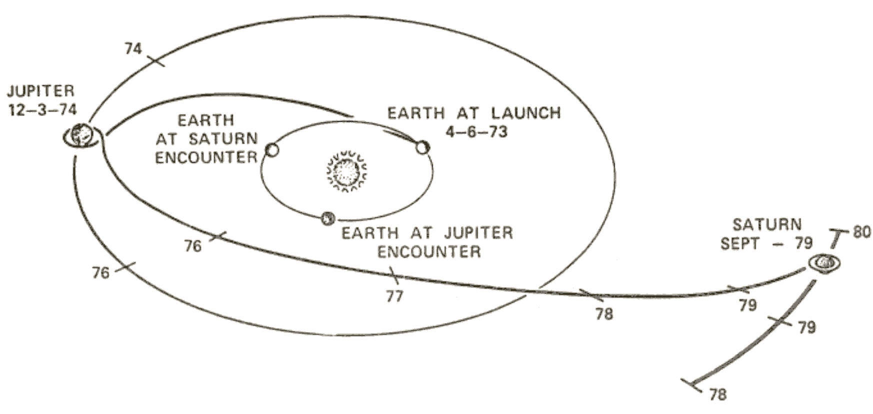
Satellites scrutinized — Infrared, ultraviolet, and polarimetry will also probe the inner satellites during the encounter. Jupiter's tiny, innermost satellite, Amalthea, will be examined and photographed for the first time, and Io, Europa, Ganymede, and Callisto will be studied closely. The electron density of Jupiter's ionosphere and the density and composition of the planet's atmosphere will be studied by radio refraction as the craft passes behind Jupiter for 42 minutes.

To Saturn through strange ways — If Pioneer 11 survives the radiation, it will be deflected by Jupiter's enormous gravity to pass nearly around the planet in a northward semi-spiral. It will cross its approach trajectory as it is gravitationally catapulted from Jupiter at a high inclination to the ecliptic to begin the five-year trajectory back across the solar system to rendezvous with Saturn in September 1979.

En route to Saturn, Pioneer 11 will fly through uncharted space 160 million km north of the ecliptic. There it will provide new information on an unprobed region of the heliosphere.

Threading the needle — The Saturn-encounter geometry offers several options, one of which would send the craft between the rings and the planet! Depending upon which option is selected, Pioneer 11 will then either escape the solar system or enter a large, elliptical orbit around the Sun.

PIONEER 11
SATURN TRANSFER TRAJECTORY



EXCERPTS FROM THE IAU CIRCULARS

1. October -- Margon and Davidsen, University of California, and Mason and Sanford, University College, London, reported that no X-ray emission from the binary pulsar, discovered by Taylor and Hulse, was seen by the 1-3 Å detector aboard OAO Copernicus. The object must be at least three magnitudes fainter than the Crab Nebula pulsar at this wavelength. Bernacca and Ciatti, Asiago Astrophysical Observatory, reported a suspected optical pulsar of magnitude 13.5 within the error box of the radio pulsar position. However, St. John and Regener, University of New Mexico, reported negative results to 17th magnitude on plates made with a 61-cm reflector and a rotating shutter synchronized to the pulsar period. Some candidates were also checked by photon counting with a synchronized multiscaler. Workers at Harvard and MIT also have recently reported negative results.

2. November 9 -- Dr. N. Sanduleak, Warner and Swasey Observatory, discovered an 11th-magnitude nova in Perseus on an objective-prism plate.

3. November 12 -- Dr. S. van den Bergh, Hale Observatories, discovered a comet near M33 in Triangulum. Comet van den Bergh (1974g), of 17th magnitude, is moving southwest.

4. November 13 -- Mr. John C. Bennett, Pretoria, discovered a comet in Hydra. Comet Bennett (1974h), of 9th magnitude, is moving southeast, and will be unfavorably disposed for observation from the northern hemisphere.

This listing courtesy Robert N. Bolster.

★ STAR DUST

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