

Lewin, Clark, Rappaport, David Hearn, John Doty, Jernigan, John A. Richardson, Francis Primini and Li.

Theory. It is still very early in the game to say for sure what is causing the x-ray bursts, and only some of the ideas will be discussed here. At the High-Energy Astrophysics meeting, John Bahcall (Institute for Advanced Study) discussed work done by him and Jeremiah Ostriker (Princeton), extending some work done by them and independently by Joseph Silk and Jonathan Arons (Berkeley) last year. The original idea was that one could explain a steady-state x-ray source as being caused by a massive black hole (10^2 – 10^3 solar masses) accreting mass onto itself in the center of a globular cluster. To explain the bursts, Bahcall and Ostriker say that a smaller-mass neutron star orbits the black hole and periodically crashes into the thin gaseous disk surrounding the black hole.

Grindlay and Gursky proposed² at the meeting a model for the shape of the bursts, which implies the existence of massive black holes. Gursky feels that certain characteristics of the bursts are the first positive evidence for the existence of such massive black holes. Building on an idea of Philip Morrison (MIT) and Leo Sartori (University of Nebraska) to account for the light curve from a supernova, Grindlay and Gursky argue that the x rays will become harder during the burst because of scattering. They obtain a lower limit of 200 solar masses for the mass of a black hole in the center of a scattering cloud. On the other hand Canizares feels that although the scattering process can account for the shape of the bursts, no massive black hole is required.

Last year C. J. Hansen (University of Colorado) and H. M. Van Horn (University of Rochester) said that an accreting neutron star should build up an outer shell of hydrogen, emitting x rays while it is accreting. When a critical mass is reached, several meters thick, it will literally become a hydrogen bomb—explosively fusing hydrogen and light nuclei on time scales of milliseconds to months. This idea has been applied to x-ray bursts that are separated by hours and with a low level of intervening steady emission by Laura Maraschi (Laboratorio Fisica Cosmica CNR, Milan) and A. G. Cavaliere (Laboratorio Astrofisica Spaziale, Frascati, Italy).

Lewin believes that the aperiodic source in Scorpius is probably a neutron star and a normal star, which form a binary. However, the new observations are unlike anything previously seen from known neutron stars in binary systems, he says.

Lewin and his collaborators say that the newest bursts don't fit any of the theories proposed to explain the earlier x-ray bursts, such as the supermassive black hole and the hydrogen blasts on the sur-

face of the neutron star. The MIT team say they think the new pattern of bursts can be explained by instabilities in the magnetosphere of the neutron star. Details of such plasma instabilities have been worked out by Fred Lamb and R. Elsner (University of Illinois) and by Arons and Susan Lea (University of California, Berkeley). The interstellar gas around the neutron star is gravitationally attracted to it, but the neutron star's strong magnetic field acts as a shield. When the gas pressure becomes large enough, Clark says, the system may undergo an instability so that a finger of gas can punch through the magnetic field. As the gas spirals down, it is heated to millions of degrees and emits x rays. If a lot of gas gets through, the group says, a big burst will be produced, and it will take relatively long for enough gas to accumulate for another breakthrough to occur. If, on the other hand, a small amount gets through, a small burst will be produced

and it will take less time for the next burst to occur.

"Why weren't x-ray bursts seen before?" we asked Clark. He feels that the phenomenon has not been well suited to the earlier experiments. ANS and SAS-3 are pointing satellites; so they can hold on a specific source for a long time. When that was done, the bursts were seen. Uhuru, on the other hand, was a scanning satellite so that its chances of catching a burst were smaller. The British satellite, UK-5, he says, has poor time resolution and little data-recording capability. Copernicus, although it has been used to examine specific objects, just wasn't lucky enough to see any bursts. —GBL

References

1. J. Grindlay, H. Gursky, H. Schnopper, D. R. Parsignault, J. Heise, A. C. Brinkman, J. Schrijver, to be published in 1 May issue, *Astrophys. J. Lett.*
2. J. Grindlay, H. Gursky, to be published in 1 May issue, *Astrophys. J. Lett.*

Brookhaven's prototype magnet reaches 4.5 tesla

For several years an intensive R&D program has been underway to produce a high-quality dipole magnet suitable for use in ISABELLE, a proton-proton storage accelerator proposed by Brookhaven, which would produce 400-GeV center-of-mass energies. Another colliding-beam device, PEP, proposed by SLAC, has just been included in the President's budget for initial construction funds. The Brookhaven device would use superconducting magnets operating at 40 kG (4 Tesla) to reduce the circumference of the rings and the energy required to operate the facility. Recently a prototype superconducting magnet was successfully operated at Brookhaven.

The magnet was energized to its design field of 4 T without "training" (a process in which a superconducting magnet can on successive trials reach higher fields before quenching or making a transition to its nonsuperconducting state). The first quench exceeded 90% of the short sample current. After several additional quenches, the magnet trained to 4.5 T.

Constructed from a single layer of the wide braided superconductor designed at Brookhaven, the magnet employs a closely coupled iron circuit that reduces the magnetic stored energy and stray field while also providing the mechanical structure required to withstand the very high magnetic forces. The new magnet, latest in a series of test magnets, is a full-size prototype: 4.25 meters long and 12-cm bore.

Nicholas Samios, Brookhaven physics department chairman, noted that the modest amount of training displayed above 4 T was attributable to careful at-

tention to the mechanical details of coil construction. The windings were preshrunk at liquid-nitrogen temperature into the iron shield (room temperature) so that they were under very high compressive loading over the entire range of temperatures.

in brief

ERDA has awarded a \$10.2-million definitive cost-type contract to KMS Fusion Inc. of Ann Arbor, Michigan, for continued research and development on laser fusion—this contract replaces the letter contract of 30 June 1975, under which \$6 million had been committed.

The nuclear reactor facility at the Massachusetts Institute of Technology has been newly renovated and now has improved usefulness as a beam source for studies in physics, chemistry and materials science. Otto K. Harling, staff scientist at Batelle Pacific Northwest Laboratory, has been appointed director of the facility, which was renamed the MIT Nuclear Reactor Laboratory.

Construction of the building housing the Multiple Mirror Telescope was recently begun. The telescope, which consists of six 72-inch mirrors, is expected to be assembled by Spring, 1977. The site is atop Mt Hopkins, south of Tucson.

The 158-inch optical telescope at the Cerro Tololo Inter-American Observatory, located near La Serena, Chile, recently was placed in full-time operation. □