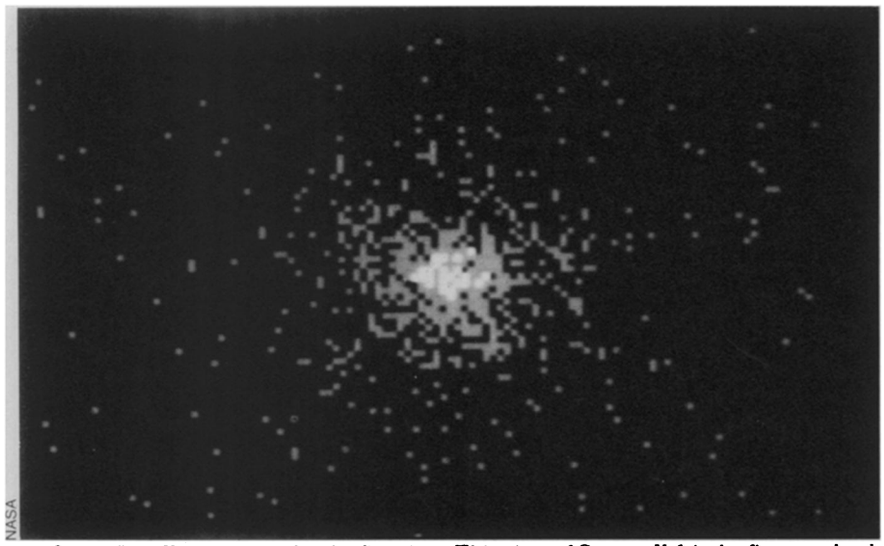
The X-ray eye of Einstein the satellite



"Seeing" an X-ray source for the first time. This view of Cygnus X-1 is the first sent back by the imaging X-ray telescope on the second High Energy Astronomy Observatory satellite (nicknamed Einstein), which was launched last week (SN: 11/18/78, p. 343). X-rays generally penetrate solids when they strike perpendicularly, but at glancing incidence they can be reflected from some metals. An imaging telescope can be built by using an arrangement of metal plates to urge the X-rays gently to a focus. X-ray images are, of course, invisible, but they can be transmuted electronically to a pattern on a video screen, and that is what has been done here. Thus X-ray astronomy now gets imaging capabilities parallel to those long available to optical and radio astronomers, and principal investigator Riccardo Giacconi of the Harvard-Smithsonian Center for Astrophysics is described as overjoyed.

Cygnus X-1 is thought by some astrophysicists to contain a black hole. If that is so, then the image here represents X-rays coming from matter in the act of falling into the black hole. That would be a picture of radiation from as close to a black hole as anybody has yet been able to record.

Fusion: Increasing the options

Recent reviews of the fusion-energy program have urged a "broadened base of physics, technology and engineering" from which to choose the best reactor design, said John F. Clarke, deputy director of the Office of Fusion Energy, last week. As if gently restraining an over-eager child, changes prompted by the recommendations of a group of experts last June (in what is now known as the Foster Report) will modify the current policy of rushing the most advanced reactor concept toward completion. However, those changes will not significantly affect the scheduled date for the commercial availability of fusion power, set at 2025, Clarke said at a meeting sponsored by the Council for the Advancement of Science Writing in Gatlinburg, Tenn.

Even though the tokamak (a doughnut-shaped reactor in which an ionized gas or plasma is confined within a magnetic field) is currently the most advanced design, Clarke said, it may not be the best concept for ultimate commercial use. The Foster committee recommends that the Department of Energy examine all available options by bolstering its experiments on concepts other than the tokamak.

Perhaps the major policy change outlined by Clarke—one first announced September 18 by John Deutch, DOE's director for research and development programs — is the decision to produce only one commercial prototype reactor by around the year 2000. Previously, a prototype reactor was planned for each of the program's major research efforts. The more advanced effort is called the magnetic fusion energy program, of which the tokamak is representative. It is based on the confinement of a plasma by a magnetic field, either in a "closed" system (like the tokamak) or in a linear, "open" system. The second major program is called the inertial confinement fusion program. In this system, energetic beams, such as lasers, compress small pellets of fusion fuel.

Though some in the nuclear industry have speculated that the decision to make only one commercial prototype reactor will likely mean a slowing of the magnetic confinement program and an acceleration of the inertial confinement program, Clarke says the Foster committee's recommendations stress pursuing parallel programs and "absolutely do not" mean a slowing of magnetic confinement work.

In terms of a development schedule, Clarke says the tokamak will likely be the first to produce more energy than it requires, probably by 1983. He anticipates that the inertial system will prove itself by 1985 and the open magnetic system, the farthest behind, will succeed about the same time. The decision to build an engineering test facility — a pre-prototype reactor that will produce sufficient power to test any engineering questions—will be made in 1984. While Clarke says it will "most likely" be a tokamak, he noted in an interview that a design center now forming at Oak Ridge is creating plans for every possible system. The crucial choice for the commercial prototype, or engineering prototype reactor, will be made in 1990, he says, and it will begin operation in 2000. By 2015, the schedule calls for three 1,000-megawatt facilities; by 2025, the beginning of commercial availability; and by 2050, full use of fusion energy.

Other recommendations of the Foster report include:

- More should be learned about the plasma and materials in magnetic confinement systems.
- Open magnetic confinement concepts should get more attention.
- Of the 14 alternate magnetic confinement projects, a few should be selected for support.
- In the inertial confinement program, more emphasis should be put on developing alternate "drivers" (the pulsed beams that force the fuel pellets together) and on examining the physics and efficiency of such systems.
- The classification of inertial confinement program data that have military applications should be reviewed.

Since the report's release in June, DOE has been translating the recommendations into practice. In magnetic confinement research, existing experiments on plasma impurities at Oak Ridge National Laboratories have been rebuilt and new ones are planned. "Extra effort" is being made to strengthen the physics and build a data base for open magnetic systems. An ad hoc concept review committee has recommended "at least two" alternate magnetic confinement systems which are ready for "proof of principle" or a testing of their critical physics, Clarke said in a later interview. The recommendations, if approved by Deutch and Robert Thorne, assistant secretary for energy technology, will be announced in two weeks.

In addition to Lawrence Livermore Laboratory, a second facility to evaluate alternate drivers for inertial confinement systems is in the planning stages and will probably be located at Los Alamos Scientific Laboratory, Clarke said. Little action has been taken on the problem of classification of data. However, Clarke says, as foreign nations develop the technology such data will become declassified. □