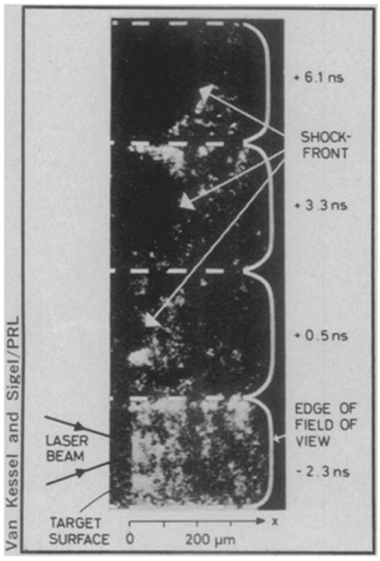
Physical Sciences

Laser-fusion shock waves



The promise of deriving power from thermonuclear fusion induced by laser light depends on a crucial expectation: If a spherical pellet of solid deuterium (or perhaps something else) is irradiated from all sides by laser light, the ablation of the outer surface of the pellet by the energy of the light should cause a shock wave that compresses the rest of the pellet to the point where fusions occur.

The question has been tested indirectly, but C. G. M. van Kessel and R. Sigel of the Max Planck Institute for Plasma Physics in Garching, West Germany, decided to see whether they could directly photograph the effect. To do so they used the technically easier geometry of a single laser beam striking a plane-faced target. With a streak camera they succeeded in photographing the progress of such a shock wave in a solid hydrogen target. They report in the Oct. 21 PHYSICAL REVIEW LETTERS that a peak pressure of two millibars results from a 10-joule, five-nanosecond pulse from a neodymium laser.

In addition to laser-fusion studies van Kessel and Sigel believe their technique will be useful in a wide range of studies of solids at high pressure. With a properly programmed laser beam one might even be able to observe directly the transition of solid hydrogen into a metallic structure that theory expects at high pressures.

A three-part X-ray source?

There are a number of pulsating X-ray sources in the sky that are of great interest to astrophysicists because they may contain black holes or neutron stars. It has been generally supposed that these objects are binary systems in which a very compact dark object is gravitationally bound to and rotating around some other star. The X-rays come from matter falling onto the dark companion, which may be a neutron star, a black hole or even a white dwarf. One such object, Cygnus X-1, is explicitly put forward as a black-hole candidate.

In the latest ASTROPHYSICAL JOURNAL LETTERS (vol. 192, p. L128), Kenneth Brecher and Ira Wasserman of the Massachusetts Institute of Technology suggest the possibility that some of these sources may be triple systems. They are led to this by a peculiar nine-month fluctuation in the signal of Hercules X-1.

The idea could weaken the hypothesis that Her X-1 is a neutron star since an explosion is needed to make a neutron star, and that might more easily have disrupted a triple system than a binary one. For Cyg X-1 it might strengthen the suggestion that it is a triple system with a neutron star rather than a binary with a black hole because the presence of the third object in the calculation would shift the mass of the dark object from the range appropriate to the one to that appropriate to the other.

Technology

Superconducting films for power

The time when superconducting transmission lines carry much of the country's electrical power may have been substantially advanced by recent work at the Los Alamos Scientific Laboratory, reported in THE ATOM. By depositing a thin film of niobium germanide on copper tubes, scientists at the laboratory have developed a power transmission medium that retains its superconducting characteristics at significantly higher temperatures than other materials.

Previously, designs for long-distance superconducting transmission lines had to deal with liquid helium as a coolant in order to obtain a low enough temperature. But helium is expensive, nonrenewable and would have a different temperature at one end of a line than at the other. The new process uses a hydrogen slush—a mixture of liquid and solid hydrogen—which is much cheaper, renewable, and maintains a constant temperature all along the line (because the solid hydrogen melts rather than warms up as it absorbs heat).

A practical transmission line is still some time off, but if initial experiments give a correct indication of what may follow, currents as high as one million amperes per square centimeter can be carried by the films, meaning that a medium-sized city could receive its electricity through a pair of pencil-sized, superconducting tubes. The hydrogen pumped along the line to keep it cool would also be available for use as a fuel.

A rubber dam for Venice

Venice, the city of picturesque canals, is slowly sinking and a massive study has been launched to find a way to save it (SN: 11/24/73, p. 331). Now the Pirelli Tire Corp. and the Furlanis Construction Co. believe they have a solution —an inflatable rubber dam.

According to their plan, huge polyester tubes impregnated with rubber would be anchored in each of the channels between the Venice Lagoon and the open sea. The largest would be 1,000 yards long, 50 feet high (when inflated) and 100 feet wide. When storms approached, the tubes would be inflated with water and act as a barrier to the waves that now raise the water level in the lagoon high enough to flood famous St. Mark's Square. The creators say the inflatable dam would be the cheapest of proposed methods for saving Venice and they plan to construct a test demonstration model next month.

Briefs

William W. Bannister of Lowell Technological Institute, Mass., has developed a new technique for cleaning up oil spills: Spread readily soluble amines around the perimeter, which jell the oil into a lard-like consistency, containing it until it can be removed.

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Three engineering students at U.C.L.A., led by Gregory Richardson, have developed what they believe is an earthquake-proof wall for use in dams, abutments or building foundations. The technique involves damping the motion of the wall's concrete blocks with perpendicularly attached steel strips, covered with earth.

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When a 180-foot section of Sweden's Varberg Castle ramparts collapsed, geologist Rolf Söderblom tried to find out why. His conclusion: Detergents from a nearby drain turned the underlying clay to mud.