been raised. For example, John Bahcall and Marshall Rosenbluth (Institute for Advanced Study) and Russell Kulsrud (Princeton University) have argued that accretion onto a compact object is not the only way to explain the x rays observed from binary systems. They propose an alternative model based on magnetic field twisting, in which the secondary x-ray source can be just a massive main-sequence star. The process is similar to that occurring in solar flares. The field lines linking the two stars become twisted when the two stars get out of phase, thereby producing x rays. No short-term periodicity is expected on this model either. —GBL

NAS-NRC defines goals for weather-modification work

Rapid progress in weather-modification techniques during the last seven years has prompted the National Academy of Sciences to issue *Weather & Climate Modification, Problems and Progress.* This report, prepared by the Panel on Weather and Climate Modification of the NRC Committee on Atmospheric Sciences, covers advances since 1966 (when a similar report was issued) and provides policy recommendations for the 1970's.

Three specific goals established by the panel are

- Identification by 1980 of the conditions under which precipitation can be increased, decreased and redistributed in various climatological areas through the addition of artificial ice and condensation nuclei.
- Development in the next decade of technology directed toward mitigating the effects of such weather hazards as hurricanes, hailstorms, fogs and lightning.
- Establishment of a coordinated national and international system for investigating the inadvertent effects of man-made pollutants, with a target date of 1980 for the determination of the extent, trend and magnitude of the effect of various crucial pollutants on local weather conditions and on the climate of the world.

An increasingly important issue, the report states, is the need to assess "what weather modification activities are in the public interest ... In considering the prospect of controlled weather modification, we are acutely aware that just because science and technology may develop the capability to modify weather there is no reason to assume that society should automatically use that capability."

At the administrative end the panel recommends that the National Oceanographic and Atmospheric Administration be assigned principal responsibility for a national program in weather modification. Further the NSF should continue to support research in all aspects of cloud physics and weather modification and "a national laboratory should be assigned primary responsibility for carrying out large weather-modification experiments involving theoretical, laboratory and field programs."

The price tag for implementation of the recommended program? Not less than $50 million. The panel recommends that "immediate action be taken so that the federal budget reflects increased requirements for cloud-physics research and weather-modification experimentation to the extent of at least a doubling of the current efforts."

Two papers propose laser-induced fission

Over the past two years interest has been mounting over the idea of using a laser to compress a pellet and cause thermonuclear fusion (PHYSICS TODAY, August 1972, page 17 and August 1973, page 46). Now two papers, one from the Lebedev Institute and one from the University of Nevada, propose using a laser to compress a pellet of uranium and cause fission. Such an arrangement could be used to make a miniature fission reactor, an intense neutron source, a particle accelerator or a very intense magnetic field, the authors say.

Both the paper from the University of Nevada, published in *Nature* by Friedwardt Winterberg[1] and the one from Lebedev, published in *JETP Letters* by G. A. Askar'yan, V. A. Namiot and Matvich S. Rabinovich,[2] propose using a laser to strike a uranium pellet surrounded by a hydrogen neutron reflector, and compress it, together with the neutron reflector, so reducing the critical mass by a very large value. Winterberg would use a 4.9-megajoule laser incident on a 3.2-mm-diameter pellet without a neutron reflector, and 2.3×10^5-joule laser for a 1.2-mm-diameter pellet with a deuterium-tritium neutron reflector. The Lebedev group would use a 10^5-joule laser incident on a pellet 0.1 mm in diameter, which would cause the density to increase by a factor of 100. (Compare these lasers with the 10^5–10^6 joules suggested by some laser-fusion proponents.)

A critical mass of about 10^{-2} grams would be expected, Askar'yan and his collaborators say. If one assumes a 10% efficiency, the energy released is expected to be 100 MJ, the equivalent of about 50 kg of TNT. Winterberg calculates a compression of 240 times normal density before the explosion, and a critical mass of about 2×10^{-3} grams (or 0.3 grams for the case in which the pellet has no neutron reflector). The elapsed time for disassembly is about 10^{-9} sec, according to the Winterberg scheme, and 10^{-10} sec, according to the Lebedev scheme.

The neutron reflectors proposed in both papers would be expected to yield more energy, aid in the compression and raise the neutron yield. Winterberg specifically proposes a deuterium–tritium neutron reflector for the additional release of thermonuclear energy.

Winterberg suggests that the scheme might be useful as a small fission power plant, for a combined fission–fusion power plant (a safe breeder reactor) or for space propulsion.

One observer believes a more likely application is for research. The very high intensity, very short burst of neutrons might be used for materials studies or neutron-diffraction cross sections, for example.

The Soviet group proposes using the idea to make a linear accelerator. The pellet would be in a magnetic field and as it is compressed, the field cannot diffuse through the pellet. Because there is motion across the field lines, an electric field is produced that is proportional to the rate of change of the magnetic field. Askar'yan and his colleagues say that one could obtain 1 GeV/cm of acceleration. (The superconducting linear accelerator being constructed at Stanford was originally expected to obtain 10 MeV/meter.) Although the intensity from the Soviet device would be very small, the scheme might be useful for making a very concentrated beam of particles, possibly several hundreds of GeV in energy, with a very small device (capable of producing either electrons or protons), according to one accelerator expert.

Another possibility discussed by the Lebedev group is to use the compression to trap the magnetic field, producing fields as high as 10^9 gauss. Typical experiments using explosives for producing magnetic fields have yielded 20 MG. —GBL

References

1. F. Winterberg, Nature 241, 449 (1973).
2. G. A. Askar'yan, V. A. Namiot, M. S. Rabinovich, JETP Lett. 17, 424 (1973).

in brief

The Joint Institute for Laboratory Astrophysics, a collaboration of the Univ. of Colorado and NBS, has received $380 000 from the NSF Physics Section as funding for the first year of a three-year grant recently authorized by the National Science Board. This is the first NSF low-energy atomic physics block grant. □