Declassification reveals progress in laser fusion

One of the plausible approaches to getting power from controlled thermonuclear fusion is to use laser light to induce microexplosions in small pellets of fuel. A burst of laser light striking a pellet of deuterium-tritium mixture a few millimeters across will vaporize and ionize it and induce thermonuclear fusions. Experiments of this sort have been carried out in a number of countries, notably the United States (SN:4/19/69, p. 384), the Soviet Union and France.

By recording the free neutrons produced by the fusion of deuterium and tritium nuclei the experiments have shown that fusions can be induced. They also indicate that much higher laser energies than are now available will be required for getting power. Laser-produced plasmas have a tendency to expand rapidly and this means that very high laser energies are necessary before any gain of thermonuclear energy over the laser energy put in occurs.

At the 7th International Quantum Electronics Conference in Montreal last week a group of researchers from the Lawrence Livermore Laboratory in Livermore, Calif., John Nuckolls, L. Wood, A. Thiessen and G. Zimmerman, reported a scheme whereby the required laser energy can be significantly reduced by achieving a strong compression of the plasma droplet. Publication of the plan was made possible by a decision a week before the meeting to declassify the work.

The method, as Nuckolls described it to the meeting, depends on generating a symmetric implosion in the fuel pellet. To accomplish this, laser beams must strike a spherical pellet simultaneously from all sides. Nuckolls spoke of six beams, but there could be nine or more. The beams could be made by splitting the beam of a single laser or using several lasers.

The first step is to use a low-power light pulse to form a transient "atmosphere" of ionized gas around the pellet. Then a pulse of a particular shape is sent in, which couples its energy to hot electrons in the "atmosphere." The electrons cause an ablation of matter from the surface of the remaining pellet, and in reaction to this ablation, implosion occurs.

The process could compress the pellet to 10,000 times its normal liquid density. The result would be to reduce the energy required for commercial power production by a thousand-fold: from the 10^8 to 10^9 joules estimated for uncompressed pellets to 100,000 or a million joules. Lasers at neither energy level exist now, but the lower range is expected to be reached much sooner than the upper one. As little as 1,000 joules might be the breakeven point where as much thermonuclear energy comes out as laser energy is put in.

If the LLL proposal works, it would make laser-induced fusion a serious candidate to be the basic principle of a thermonuclear reactor. Although microexplosion reactors have been talked of in principle, a detailed plan for achieving one has not been publicly presented before. Few outside the field would have suspected that it had come so far so fast, probably because of the security wraps. People tended to speak vaguely about key aspects of their work and were nebulous when it came to quoting numbers.

The method has not yet been demonstrated, but an experimental program is under way. Nuckolls and his collaborators hope for a demonstration within a year or two. By the end of the decade they foresee the possibility of starting engineering and construction of a power plant that would demonstrate the technical feasibility but not the economic competitiveness of the scheme.

In introducing the subject to the meeting, Edward Teller, director of LLL, remarked that he did not expect to see large amounts of power delivered by this method "before I am either in heaven or a considerably lower place." He does expect to see something else sooner: the use of this sort of device as an internal-combustion engine specifically to power rockets. He speaks of accelerating to velocities 1/300th that of light (1,000 kilometers per second) and commuting back and forth to Mars within two weeks. (At such velocities the moon could be reached in less than 10 minutes.)

"Is it not a little crazy to talk of space rather than power stations?" he asks. And he answers: "Both are crazy." Nevertheless "there is an outside chance that in this century astronauts will use this type of internal-combustion engine."

It was to speed up the chances of using laser-induced fusion that American officialdom decided to declassify this part of the work. They hope other nations will follow suit and that a general unwrapping of work in this line will occur. Teller would like to see a concerted international effort on laser fusion, and others even speak of an international laboratory.

Among foreign groups believed to be working on similar lines is the Lebedev Institute in Moscow, which has an experiment that irradiates a fuel pellet from nine directions. In describing it, Oleg N. Krokhin did not mention implosion but spoke only of more conventional laser-plasma experiments. American listeners suspected that he wasn't telling everything. The next few months will show whether the American initiative leads to more candid statements from abroad. □

Moon impact . . . Descartes soil . . . Shuttle vote

For two years, scientists have been waiting for a meteorite impact on the moon large enough to be detected at more than one of the ALSEP stations left behind by Apollo astronauts. Seismic data from such an impact could be used to determine the material deep in the lunar interior. That impact finally came at 3:49 a.m. CDT, May 13, and all four seismometers that have been set up at the landing sites recorded the impact. Gary Latham of the Lamont-Doherty Geological Observatory, principal investigator for the instruments, says the impact was equivalent to 1,000 tons of TNT, one hundred times larger than the impacts of the Saturn S4-B's that have been used to calibrate seismic signals. The meteorite hit "uncomfortably close" to the Apollo 14 ALSEP station and formed a new football-field-sized crater. After more detailed data are received, Latham says he should be able to pinpoint the crater precisely. The seismic instrument at 14 went "off scale" high from the impact and remained that way until ground control sent a signal to the instrument to reduce its sensitivity.

* * *

In other space news this week, Paul W. Gast of NASA reported that a preliminary investigation of the chemistry of three different soil samples from the Apollo 16 Descartes highland site shows that the material is indeed what some scientists had predicted—anorthositic in composition (SN:4/8/72, p. 235). If the highlands or terrae are indeed what is left of the outer crust of the moon, then scientists had expected to find anorthositic material there. The soil, at least, fits that model.

* * *

Last week, the Senate defeated 61 to 21 an amendment to delete the space shuttle funds from the NASA authorization bill. The House defeated a similar amendment last month, 103 to 11. The Administration has requested $3.4 billion for NASA for 1973, of which $200 million is for the shuttle. This week the House passed the $3.4 billion authorization bill and sent it to the President.