EXCLUSIVE

Fusion Breakthrough Revealed By Polish Scientist

Recent revelations by a Polish scientist at a conference on laser fusion in Oxford, England, promises to have the same stunning impact on the Western scientific community as that of Soviet Academician Leonid Rudakov when he unilaterally declassified portions of his country's highly successful electron beam fusion program 18 months ago. It is now known that in late September a team of Polish scientists succeeded in initiating fusion solely with chemical explosives — a major experimental breakthrough with critical military applications.

The conspicuous disclosure of the Polish breakthrough, like Rudakov's disclosure to American scientists at the Los Alamos Laboratory in July 1976, is a challenge to the U.S.: will this country continue to smother its fusion efforts under a blanket of military security, or will it view these East Bloc achievements as starting points for joint cooperation in developing an unlimited energy source for world peace and development.

What The Poles Did

At the Eleventh European Conference on Laser Interaction with Matter in Oxford, Dr. Sylvester Kalinski, Director of the Polish Institute for Theoretical Engineering, announced to western scientists that his institute has created a fusion reaction in deuterium gas using chemical explosives to supply the energy required for heating and compressing the deuterium fuel. Later, the details of his experiments were described in the Polish Communist Party paper Trybuna Ludu, and in discussions with western scientists visiting his institute in Warsaw.

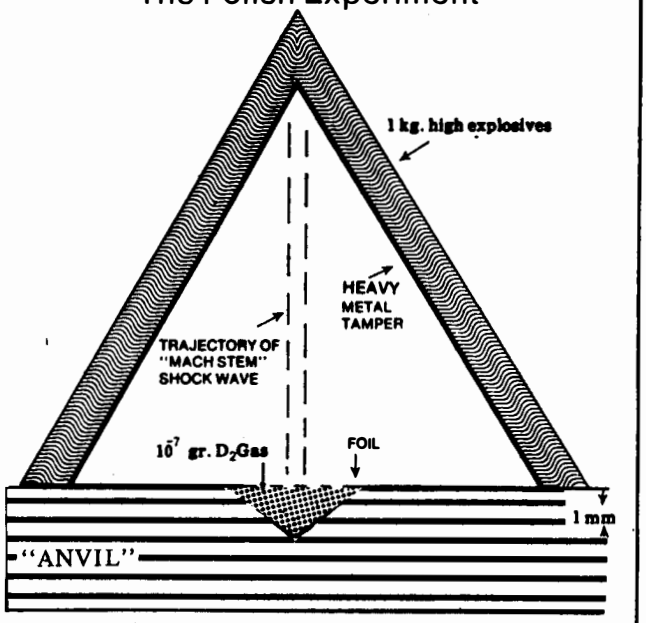
In what western scientists described as a "brilliant and daring" experiment, Kaliski and his group used a charge of approximately one kilogram of high explosives (about 2.5 pounds) to create temperatures of five million degrees and pressures thousands of times that of the atmosphere in a small sample of deuterium gas. Deuterium is the heavy form of hydrogen that undergoes a nuclear fusion reaction (in which two deuterium nuclei combine) to form helium. The fusion reaction releases tremendous amounts of energy.

Kaliski's experiment resulted in close to 30 million fusion reactions, approximately the same amount achieved by the multimillion dollar carbon-dioxide laser facility at Los Alamos scientific laboratory in New Mexico.

The key to Kaliski's experiment is the unique configuration of fuel and explosives. By the use of an elegant and simple application of well-known explosive technologies, the Poles scooped similar efforts in the American laboratories.

As the accompanying figure shows schematically, Kaliski's experiment takes advantage of a highly symmetrical arrangement of high explosives, which forms a shock wave of incredible energy density, driving vertically down onto the target of deuterium fuel, compressing and heating it. The other critical ingredient is a very carefully machined and engineered cone of high explosives. Kaliski's group had to machine the cone

Configuration of The Polish Experiment



Configuration of the Polish experiment. About a tenth of a microgram of deuterium gas, at 1.2 atmospheres pressure, with 7 percent argon added, was implanted under the foil in a small depression in a large "anvil." This geometry is similar to that used in Rudakov's experiments two years ago. Then, a double, conical shell is suspended above the fuel. The inside of the shell is a heavy metal "tamper" which carries the momentum of the cone of high explosives surrounding the tamper. When the shell of high explosives is ignited, a convergent shock wave, called a "mach stem," is formed, which drives vertically down on the deuterium gas, compressing it by a factor of one thousand in volume and heating it to about 500 electron volts, for about a billionth of a second.

within a tolerance of one micron (approximately half a millionth of an inch) in physical dimensions, and carefully check by x-rays the explosives to ensure uniform ignition.

What It Means

The Poles are not the first to attempt production of fusion using chemical explosives. In fact, the main drawback to fusion energy for both weapons and peaceful use is the tremendous energy required to ignite the fusion reaction. Once it is ignited, the fusion process releases astronomic quantities of energy, but it has so far required either *atomic* bombs for ignition (in the case of the hydrogen bomb), or very large and expensive electrical or laser devices (in the case of peaceful use of fusion).

Because of the relatively small expense involved and lack of bulky energy storage devices, the use of chemical explosives for fusion would be very attractive. Kaliski's work represents the first, significant development towards making this a possibility. Kaliski estimated the cost of one trial of his experiment at $500. There are significant problems still to be solved in scaling up the Polish experiment for large scale fusion energy production, primarily in devising a geometry of explosives and fuel which eliminate the need for an "anvil."

But, of more immediate importance is the military implication of these results. Kaliski has created the first stage of a real "neutron bomb." As is well known, the source of longlasting and "dirty" radioactivity in a hydrogen bomb does not come from the fusion reaction which supplies most of the bomb's *energy*, but rather from the plutonium (fission) bomb used to ignite it. If the plutonium could be eliminated, the bomb's energy would be primarily released in the form of neutrons from the fusion reaction.

This neutron bomb has been recently touted by the military strategists of limited or tactical nuclear war, who hope that since the neutron bomb creates little fallout, and can be very small, we can have "little nuclear wars"—a concept which the Soviets have correctly likened to the case of the virgin who was only a little pregnant.

Kaliski's announcement of the East Bloc's breakthrough in fusion research is clearly seen by the East Bloc as relevant to the debate over the neutron bomb in the United States. The Soviet Union has vociferously condemned the concept of a small, neutron bomb nuclear war. At the same time, Kaliski, who is also Poland's Minister of Science, visited Moscow for discussions with Soviet officials and received an honorary doctorate from the University of Moscow. Immediately afterwards, he left for Oxford to announce the results of his experiments.

Where Will The U.S. Go?

Reactions among U.S. scientists to the "Kaliski affair" has so far been shocked silence. While scientists will privately marvel at Kaliski's brilliance and at the striking success of his experiments, the political and military implications have them stunned. At the very least, it is unnverving to hear a Polish leader giving away information on military research which is so classified in the United States that it has not yet been attempted.

The challenges which Kaliski's announcement represents most are answered: If the U.S. wants an arms race intensified with the development of new technologies, then Kaliski, as Rudakov did before him, has shown that the U.S. is dangerously behind. On the other hand, the Director of the Soviet Fusion Program, Dr. Velikov, proposed in the same week that Kaliski was in Moscow, to the U.S. fusion and weapons laboratory at Los Alamos, that the U.S. and the Soviet Union *collaborate* on a brute force, crash program for fusion development. That is the U.S.'s choice.

—Dr. Steven Bardwell