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## Science and Technology

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# Soviets flaunt beam-weapon lead

by Charles B. Stevens

According to a UPI wire of Aug. 20, White House press coordinator Larry Speakes warned on that day of Soviet superiority in space-weapon development. "There is also a growing threat of attack, Speakes said, as the Soviets continue research that could result in the launch of the first prototype of a space-based anti-satellite laser battle station 'in the late 1980s or early 1990s.'" One week before that report, *Pravda*, the Soviet party newspaper, carried a major article which appears to confirm Speakes' warning. The Aug. 12 *Pravda* piece, titled: "The Professions of Atomic Beams," is written by Evgenii Velikhov, vice-president of the Soviet Academy of Sciences for Physics and one of the world's most proficient beam-weapon scientists.

The Velikhov article announces that Soviet scientists working on intense ion and neutral beam systems at the Kurchatov Institute in Moscow, the Novosibirsk Nuclear Institute in Siberia, and the Institute of Physics in Kiev are about to receive "the U.S.S.R. State Prize." And while the article makes no overt mention of military applications, it does note the superiority and priority of Soviet research in areas which, indeed, are well known in the West as being crucial for anti-missile beam weapons.

### Ion and neutral particle beam weapons

It has long been known that intense, high-energy particle beams offer one of the most efficient and effective means of intercepting ballistic-missile-launched nuclear weapons in space and the upper atmosphere. The reason is that high-energy particle beams, consisting of ions or neutralized fast ions (atoms), can be "tuned" to penetrate into the interior of warheads where they destroy the delicate electronic controls of the offensive missile and warhead.

The result is that the particle beam can achieve neutralization of offensive missiles at energy costs millions of times less than those of any other means—such as laser beams and/or physical-intercept systems—and at any phase of their trajectory.

As Lt.-Gen. James Abrahamson, director of the U.S. Strategic Defense Initiative, has detailed in recent months, major progress with both charged and neutral particle beams

has been demonstrated and experimental prototypes are in operation. What has not been reported is the fact that these U.S. developments are almost entirely based on pioneering Soviet research.

Velikhov's *Pravda* piece emphasizes this reality, and even reveals new Soviet accomplishments in the field, with particularly important weapon applications, to emphasize the point: "The source of negative ions, created by using the plasma-volume method, and working in a continuous regime, is more economical than the analogous system used abroad. That is, the model which several foreign laboratories focused on when creating their own designs for negative ion sources was that of the plasma surface source."

According to leading beam experts at Los Alamos and the Rand Corporation, the U.S. particle-beam weapon program has, indeed, concentrated on plasma surface—as opposed to the more "economical" plasma volume—sources for ions because it was believed until recently that this was the only way to achieve a well-focused beam during acceleration of the ions extracted from the plasma. Plasma volume sources have been used in the United States for neutral particle beam heaters on magnetic fusion experiments. In this case the poorly focused beam is acceptable, since the target at which the beam is being directed is only a few feet away.

But as the Los Alamos and Rand experts pointed out, just recently U.S. researchers have concluded that it is possible to utilize the more effective plasma volume source and still maintain a well-focused beam during acceleration, and research along this line has just begun. The point is quite significant, since the use of plasma volume sources will permit an increase in beam currents in the same accelerator by as much as a factor of 10, and a similar increase in beam power.

Therefore, Velikhov's little passage about plasma volume versus plasma surface sources is quite revealing: 1) both the U.S. and Soviets have utilized plasma volume sources in magnetic fusion experiments; 2) the successful U.S. Los Alamos White Horse neutral particle beam weapon program has concentrated on utilizing surface plasma sources; 3) Velikhov reveals that Soviet scientists have succeeded in utilizing plasma volume sources in beam systems, while "foreign laboratories" have been limited to the less efficient plasma surface sources.

Given the testimony of U.S. experts, it is clear that Velikhov is flaunting the apparent superiority and priority of Soviet particle beam weapon work. The sad truth is that in terms of pioneering concepts, most U.S. particle beam research is based on concepts derived from Soviet work.

### How accelerators work

As Dr. Velikhov notes in his *Pravda* article, the general public has long been acquainted with the practical applications of electron beam accelerators, such as TV, x-ray machines, and electron beam welders. Ion beams are less well

known, though they too were first realized more than a half-century ago.

Both electron and ion beam accelerators have attained extremely high energies at which the charged particles are traveling at near the speed of light. But these high-energy accelerators have been limited to very low beam currents, and, therefore, low beam power.

New types of accelerators have had to be developed in order to achieve high-current, high-energy particle beams. And in the case of ions, which, because of their much greater mass, promise to have a much greater punch than electrons, Soviet beam scientists have pioneered the most important concepts.

All accelerators utilize an electric field to accelerate electrically charged particles. This electric field can be either oscillating or continuous, and, it can be combined with oscillating or continuous magnetic fields. But the chief problem is to damp motions of the ion perpendicular to the direction of acceleration. These "transverse" motions cause the ion beam to become defocused and hit the wall of the accelerating chamber.

The difficulty with high current ion beam accelerators is that the possible modes for coupling accelerating energy into unwanted transverse beam motions is greatly increased by the non-linear interaction of the beam particles which appear at higher beam currents. But these non-linear effects become beneficial once the ion beam has been accelerated to near the speed of light. (At this point these non-linear interactions produce a sort of beam self-focusing phenomenon.) Therefore, it is during the startup and first phase of beam acceleration that the greatest difficulties are encountered.

This resolves down to two distinct areas: 1) ion sources; 2) the first accelerator stage.

The Soviet Union has led the way in both areas in terms of the parameters needed for beam weapons. While the U.S. pursued positive ion sources, needed for neutral beam heaters on near-term magnetic fusion experiments, the Soviet program pursued negative ion sources which are applicable to either long-term fusion reactor requirements or near-term neutral particle beam weapons.

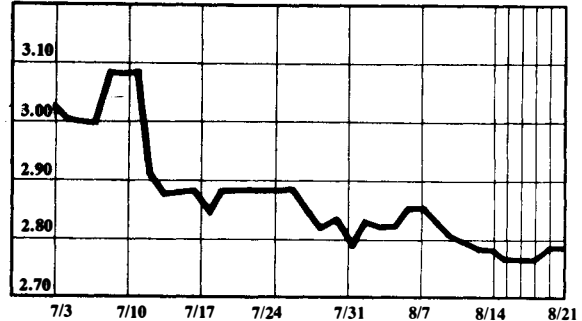
Neutral beams of high energy atoms have major applications to both magnetic fusion and space-based beam weapons. In both cases, ions are first extracted from a plasma source and accelerated to high energies. They are then passed through a gas cell in which they become neutral atoms once again without a loss of energy or direction. For higher energy and current beams, negative ions can be gas-cell neutralized more efficiently than positive ions.

In terms of accelerators, the leading technology for high current beams being concentrated on in the West is that of the Radio Frequency Quadrupole (RFQ). This concept was pioneered by Soviet scientists. But despite the great success with the RFQ in the West, the Soviets apparently are concentrating on another concept, the alternating phase accelerator; a concept which is yet to be seriously pursued in the West.

## Currency Rates

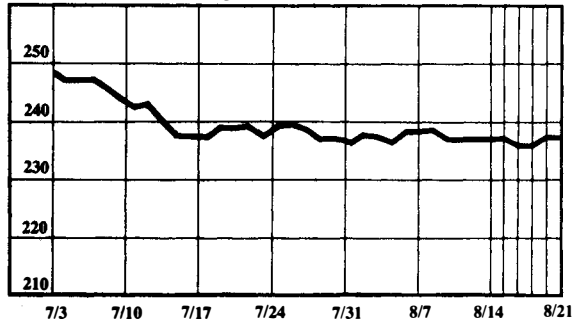
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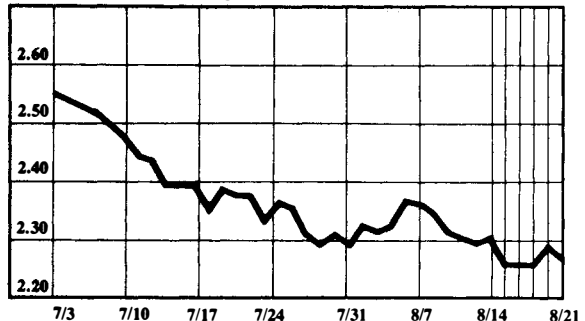
### The dollar in yen

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### The dollar in Swiss francs

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### The British pound in dollars

New York late afternoon fixing

