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Impact of accelerators

The Guest Comment on accelerators in science and technology by James Leiss (July 1981, page 9) probably left most readers with the impression that the impact has been largely positive and that the accelerator community is now moving ahead towards a still brighter future.

I think, however, that it is in the best interests of the peaceful users of accelerators to initiate a full and open discussion on one aspect of accelerator applications, which was referred to only briefly in the Guest Comment: the aspect connected with national defense. Such applications would be considered to be less than positive by many people, and it is therefore useful to inform the physics community (and the public in general) about what these applications might be. I will mention but a few:

▶ It is often forgotten that under the Manhattan Project in the Second World War accelerators were the first to produce appreciable quantities of fissile material. As is well-known, other methods turned out to be more effective in producing larger quantities of such material. Thanks to developments in accelerator technology, the situation has completely changed and there now exists a real danger of additional nuclear proliferation through acquisition of small accelerators for isotope separation.

▶ The application of accelerators to inertial-confinement fusion have a large military interest.

▶ The development of high-current, pulsed particle beams and the study of their propagation is part of a several-hundred-million-dollar weapons program in the US and the USSR. If successful, such programs may have severe consequences for the stability of the strategic-arms balance.

▶ The use of electron storage rings in connection with the free-electron laser is an important part of the laser-beam weapons programs.

▶ The development of new accelerator concepts, such as superconducting cavities, will enhance the feasibility of military applications of accelerators.

Which of these and other imaginable aspects of accelerator technology will turn out to have a concrete future military impact is uncertain. It is clear, however, that the peaceful accelerator community has a responsibility to investigate and—I hope—the power to influence applications that are still in their infancy. The choice of precisely which measures will be taken should be the outcome of an open discussion with the declared purpose of avoiding a new kind of nuclear energy–nuclear bomb dichotomy.

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Extrapolating relativity

Allen D. Allen's letter in August (page 13) contains a very interesting discussion of negation of motion through dimensional collapse, but it should be pointed out that his use of the Lorentz contraction to justify a planar appearance of the universe *from* a frame moving at c with respect to any other frame is a bold extrapolation from special relativity, whose transformation formulae are singular under such conditions, and is certainly not obviously justified or meaningful "in any theory admitting to the Lorentz contraction."

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THE AUTHOR COMMENTS: Although it is quite true that photons are not deemed to have a *rest* frame, they do have a frame in the sense that they interact with other particles. Things happen to photons, and so they are in this sense "observers." In particular, consider a particle π moving with speed v relative to our own frame. Then the speed of π with respect to a photon is well defined as

$$(c - v)(1 - cv/c^2)^{-1} \equiv c.$$

Insofar as the photon is concerned, π then has the extent

$$L_0(1 - c^2/c^2)^{1/2} = 0.$$

(This is speaking relativistically. Things are, of course, somewhat different in quantum mechanics.) One could similarly argue that, insofar as the photon is concerned, π has the infinite mass

$$m_0(1 - c^2/c^2)^{-1/2} = \infty.$$

This is quite accurate since, from the photon's point of view, π is an inertial particle that cannot be accelerated, its speed is always c.

These are indeed singularities; that's my point. Perhaps Bruce Morley's point is that the equations of mechanics must be abandoned in the limit to avoid such singularities. But the latter view runs just counter to recent developments in mathematical physics.[1] V. P. Maslov has shown[2] that singularities arising in mechanics may be only apparent. This has given rise to a new approach called "Lagrangian analysis,"[1] which the modern physicist should find quite useful.

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Early computers

The November issue (page 16) shows J. Robert Oppenheimer and John von Neumann standing in front of a machine identified as "the Institute for Advanced Study's EDVAC computer." Now the machine may have been the EDVAC, but at no time was there any connection between EDVAC and the Institute.

EDVAC was procured by the US Army Ordnance Corps and was the first computer to be designed with the capability of modifying its program depending on the results of computation. (EDSAC, at Manchester University, was the first to be completed. Wilkes did not have the disadvantage of government contracts to contend with.) EDVACwas designed by Samuel Lubkin at the Moore School of Electrical Engineering of the University of Pennsylvania and built at the Moore School. After completion, it was moved to the Ballistic Research Laboratories at the Aberdeen Prooving Ground. It was never at Princeton.

Sam Lubkin also wrote the "Operating Manual for the EDVAC," which was the bible of the computer industry in the late 1940s and early 1950s. He subsequently designed the logic of the SEAC, which was the first computer to use the now almost universal clocked logic, and built the ELECOM 100 (1951) which was the world's first minicomputer. (There is an intriguing description of this machine in a contemporary