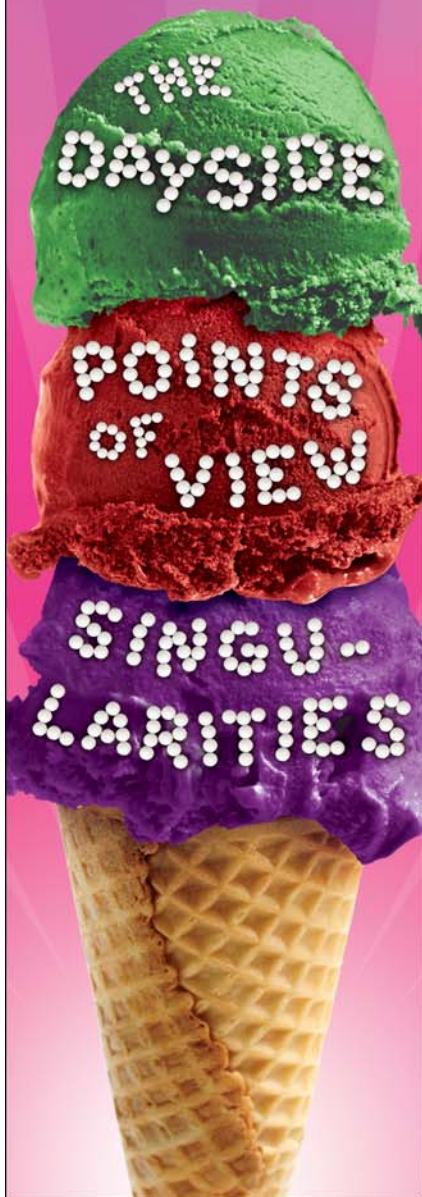


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US pursuit of inertial fusion

The Issues and Events piece (PHYSICS TODAY, March 2011, page 26) about the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) caught my attention. Inertial fusion appears to be on the threshold of ignition. Whereas NIF has low efficiency and no average power, at least two laser concepts could be relevant to energy: diode-pumped solid-state lasers being developed at LLNL and krypton fluoride lasers being developed at the US Naval Research Laboratory.

In the field of magnetic fusion, large new tokamaks and stellarators are sprouting up all over Europe and Asia. The US has no large magnetic fusion experiment and has canceled plans to build a stellarator; all its intermediate-size tokamak experiments are at least 30 years old.

The ground truth is obvious. We are way ahead of the rest of the world in inertial fusion; the rest of the world is way ahead of us in magnetic fusion. In these times of very tight budgets, I suggest that except for a minimal contribution to ITER to satisfy our international obligations, the US should pursue inertial fusion, and the rest of the world should pursue magnetic fusion. Let the best concept win.

Wallace Manheimer
(wallymanheimer@yahoo.com)
Chevy Chase, Maryland

A definition of energy

On reading Lisa Crystal's review (PHYSICS TODAY, April 2011, page 61) of Jennifer Coopersmith's book *Energy, the Subtle Concept: The Discovery of Feynman's Blocks from Leibniz to Einstein*, I remembered having shared Crystal's desire to learn what energy is—that is, energy without such qualifications as mechanical, chemical, nuclear, solar, and so forth. I finally found the answer, from Max Planck: "The energy of a system is, therefore, sometimes briefly denoted as the faculty to produce external effects."¹

That definition suggests to me a philosophical answer, which Crystal says is lacking in Coopersmith's book. I would say that the energy of a system is a measure of its presence in the universe.

Reference

1. M. Planck, *Treatise on Thermodynamics*,

3rd English ed., A. Ogg, trans., Dover, New York (1945), p. 41.

Mariano Bauer
(bauer@fisica.unam.mx)
National Autonomous University of Mexico
Mexico City

Siphoning—a weighty topic

Contrary to the assertion of Arthur Schmidt (PHYSICS TODAY, April 2011, page 11), atmospheric pressure is not necessary to force fluid flow in a siphon. Force, after all, depends on pressure gradient, and the atmospheric pressure gradient in an ordinary siphon is insignificant. Schmidt's comparison of a siphon to a drinking straw fails to account for the large difference in air pressure gradient for the two devices.

In a common argument, the siphon is said to be driven by the weight of the liquid on the longer leg. That is true, but it would be untrue if the liquid had no tensile strength. You cannot siphon sand.

If the tensile strength is sufficient to hold the long-leg water column together, then it is certainly sufficient to do the same for the short-leg water column. That the tensile strength is indeed sufficient is demonstrated by the Geissler mercury vacuum pump that Thomas Edison used for his early lamps.

If there is an air bubble in the siphon column, then atmospheric pressure is also required. Otherwise, atmosphere is needed only to prevent the fluid from evaporating.

John W. Dooley
(john.dooley@millersville.edu)
Millersville, Pennsylvania

Will a siphon work in a gravitational field without an atmosphere, such as on the Moon or in an evacuated bell jar? Sure it will. A siphon depends on gravity and not on atmospheric pressure. Of course, you have to assume a liquid that will not vaporize in a vacuum and cause a vapor lock.

If you are siphoning water into a lake or gasoline out of a fuel tank, atmospheric pressure is a necessary condition to prevent vapor lock of those volatile liquids, but the pressure does not cause the siphon's operation.

James McNeill
(jimcneill@charter.net)
Pasco, Washington

Correction

July 2010, page 39—The data for panels a and b of figure 4 were provided by the DMSP F-13 satellite. ■