

history, political science, sociology, and other subjects. For example, instead of just teaching about the history of World War II and asking students to repeat information on tests or in term papers, we could ask them what might have happened if the US had entered the war at a different point in time or not at all and then have them consider the logical consequences of each possibility. Getting students to hypothesize and follow a logical sequence should begin well before they study physics or any other science.

William DeBuvitz
(debcrw81@gmail.com)
Mendham, New Jersey

Magnetic monopoles and a cheap detector

The letters from Ken Frankel and Christopher Harrison (PHYSICS TODAY, June 2017, page 13) in response to Arttu Rajantie's article on the history of searches for magnetic monopoles (PHYSICS TODAY, October 2016, page 40) brought back a memory.

After Blas Cabrera's 1982 publication of a candidate monopole event detected with a superconducting loop,¹ three groups²—a University of Chicago, Fermilab, and University of Michigan collaboration; IBM; and Imperial College London—built Faraday induction detectors with larger areas. Using a coincidence technique of two gradiometer detectors in a nonzero but pinned magnetic field, Joe Incandela and coworkers showed that a likely explanation of the candidate event was a flux jump rather than the transit of a monopole.³ I was invited by the organizers of the First Aspen Winter Conference to give a review talk of the hot though cryogenic topic.⁴

I had been a graduate student at the University of California, Berkeley, and had great admiration for Luis Alvarez, so I sent him a draft asking for comments. I had leaned over backwards to give him credit for inventing the Faraday induction technique, as my looking in depth at monopole detection by ionization brought home that there was no way to calibrate the ionization detector, and hence a nondetection could never be definitive. Faraday detection, however, can be calibrated with a "pseudopole," a

very long but small-diameter, tightly wound, magnetic solenoid much akin to a Dirac string.

I was working at my desk when my phone rang, with a furious Luis on the other end. Without any introduction, he barked, "Henry, this was my idea, and I should be the first reference." I was stunned, as I thought I had done him proud, but I managed to say, "Luis, the guys ahead of you are not to be sneezed at—Faraday, Maxwell, Dirac. . . ." Still angry, he said, "Yes, but who are these other guys?" Luis later sent a nice note praising the review, and all was well.

A brief addendum: Sunil Somalwar's PhD thesis followed up on Incandela's superconducting gradiometers by showing that using just copper wire and a field-effect transistor operating at liquid nitrogen temperature, one could build an inexpensive detector, capable of covering large areas and sensitive to a single Dirac charge.⁵

References

1. B. Cabrera, *Phys. Rev. Lett.* **48**, 1378 (1982).
2. J. Incandela et al., *Phys. Rev. Lett.* **53**, 2067 (1984); S. Bermon et al., *Phys. Rev. Lett.* **55**, 1850 (1985); A. D. Caplin et al., *Nature* **317**,



New Cryogen-FREE C-MAG Configurations Include VSM, ESR, and Optical

- Efficient Cryogen-FREE Operation**
 A SINGLE cryocooler operates both the VTI and superconducting magnet.
No liquid cryogenics required
- Flexible Magnet Configurations**
 Up to 14T solenoids
 Up to 7T split pairs
A wide variety of 2 and 3-axis options
- Ultra-Low Vibration Options**
 Mechanically decoupled sample rod via a pneumatic cradle and bellows.
Vibration data available
- Wide Sample Temperature Range**
 <1.8K to 325K using a closed helium loop
He3 and dilution refrigerator inserts available for lower base temperatures
- Measurement Modules Available:**
 Resistivity, Hall Effect, Heat Capacity, Thermal Transport, VSM, and ESR.
More in development



Modular Sample Mount System allows for fast and easy sample changes.

Mounts are available in a variety of configurations.

Visit us in Los Angeles during the APS Conference March 5-8, Booth 708



CRYOMAGNETICS, INC.
INNOVATIVE TOOLS FOR SCIENTIFIC RESEARCH

Scan the QR Code for further information
www.cryomagnetics.com • (865) 482-9551
sales@cryomagnetics.com



- 234 (1985); S. Somalwar et al., *Nucl. Instrum. Methods Phys. Res. A* **226**, 341 (1984).
3. J. Incandela et al., *Phys. Rev. D* **34**, 2637 (1986); J. R. Incandela, "A search for magnetic monopoles using superconducting induction detectors," PhD thesis, U. Chicago (1986).
 4. H. J. Frisch, *Ann. NY Acad. Sci.* **461**, 652 (1986).
 5. S. Somalwar, H. Frisch, J. Incandela, *Phys. Rev. D* **37**, 2403 (1988).

Henry Frisch
Enrico Fermi Institute
Chicago, Illinois

The problem of the electron's mass

As I read "An electron-proton collider could bridge the gap between the LHC and its successor" (PHYSICS TODAY, May 2017, page 29) and how it would serve in high-precision studies of Higgs decays as a portal to new physics, I was disappointed. I saw no mention of a long-standing problem in connection with the electron: What fraction of the electron's mass is due to its interaction

with the quantized electromagnetic field? Despite its enormous success in quantum electrodynamics, renormalization does not solve the problem, nor does it even tell us how to tackle it. Furthermore, the Higgs contribution to the electron's mass is unknown. We also don't know how to measure those respective contributions. Perhaps in thinking about the electron-proton collider, one should be thinking about opening portals to these long-neglected areas as well.

Frank R. Tangerlini
(frtan96@gmail.com)
San Diego, California

Energy efficiency in motion and thought

Simon Sponberg's article (PHYSICS TODAY, September 2017, page 34) addresses important topics in the physics of insect locomotion in terms of muscle motion, sensing, and information processing. However, one especially important and astonishing aspect of physics, common to living objects and

unattainable by manmade machines, is the energy efficiency in both muscle motion and information processing. One impressive example is the energy consumed by the human brain in playing Go or chess with a supercomputer. Although humans now lose both games, the energy consumed by the human brain while playing is five to six orders of magnitude less than that of the supercomputer.¹

Reference

1. See, for example, Y. Yanagida, Y. Ishii, *Proc. Japan Acad. B* **93**, 51 (2017).

Akira Hasegawa
(a.hasegawa@solitoncomm.com)
Osaka University
Suita, Japan 

**PHYSICS
TODAY
JOBS**

Visit www.physicstoday.org/jobs.

Looking for a job?

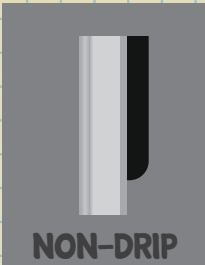
Looking to hire?

See pages 66–69.

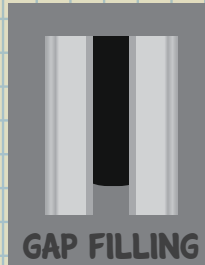
ADHESIVE ACADEMY

HIGH VISCOSITY SYSTEMS

This educational video explains the benefits of utilizing high viscosity and non-drip adhesive formulations for bonding vertical substrates and gap filling.



NON-DRIP



GAP FILLING



Are high viscosity adhesives right for your application?



MASTERBOND®
 ADHESIVES | SEALANTS | COATINGS

Hackensack, NJ 07601 USA • +1.201.343.8983 • main@masterbond.com

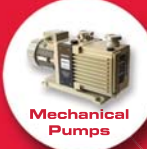
www.masterbond.com

DUNIWAY

STOCKROOM CORP.

Supplying reliable vacuum equipment since 1976





Mechanical Pumps



Ion Pumps



Turbo Pumps



Gauge Controls



Vacuum Sensors



Hardware



Supplies



Diffusion Pumps

www.duniway.com

800.446.8811 (Toll Free) 650.969.8811 (Local) 650.965.0764 (Fax)