Early geodynamo work FREE

Friedwardt Winterberg

Physics Today **59** (10), 14–15 (2006);
https://doi.org/10.1063/1.4797299

affect ground-based astronomy. Astronomers have either removed their telescopes to sites where the impact is minimal or worked with local communities—for example, in Tucson, Arizona, and in the West Texas counties surrounding McDonald Observatory—to reduce the growth of light pollution. Both efforts have been successful.

Light pollution will be controlled through the public's recognition of its detrimental effects on life in general, not through its impact on the small number of research observatories or the relatively small number of professional astronomers in the world. We applaud the IDA and its continued efforts, and we pledge to continue our support for its work.

J. Craig Wheeler
(wheel@astro.as.utexas.edu)
Kevin Marvel
(marvel@aas.org)
American Astronomical Society
Washington, DC

Safer vehicles by redesign

The technical discussion titled "Vehicle Design and the Physics of Traffic Safety" by Marc Ross, Deena Patel, and Tom Wenzel (PHYSICS TODAY, January 2006, page 49) is largely devoted to protecting the occupants of an automobile during an accident. Little is said about designing the car to help prevent the accident in the first place.

The article did mention poor road design and, briefly, driver error; it also referred to a vehicle's center of gravity as a potential problem, particularly if the driver needs to swerve to avoid a collision. However, one big factor not covered is poor car design—in particular that of sport-utility vehicles, which are extremely dangerous to oncoming drivers at night.

The headlights of SUVs and popular pickup trucks are at such a height that they shine directly into the eyes of oncoming drivers. The few seconds of blindness means loss of control by the oncoming driver, and the result may be to drive near or over the edge of the road. The SUV driver may continue on, never realizing that his lights caused the accident. When the police arrive and examine the overturned sedan and injured passengers, they check for alcohol and drugs. If no such evidence is found, they still blame the driver for being asleep at the wheel or suffering a lapse in judgment.

When an SUV and a sedan collide head on, the SUV's high bumper destroys the front end of the sedan and slams the engine into the driver's lap. The characteristic design of an SUV—with higher headlights and a higher bumper—makes it a dangerous vehicle that should be removed from the market.

Romuald Anthony
(rombob2@cox.net)
Santa Barbara, California

The good article on vehicle design and safety mentioned various innovations in the continuing effort to reduce traffic deaths. The best solution, of course, is one that prevents accidents rather than just reduces the severity of injuries. One contributing factor to the better Canadian statistics shown in the article's figure 2 is the mandatory use of daytime running lights in Canada. For 20 years or more, headlights that turn on with the ignition have been required on all new cars sold in Canada, wherever they were made. In daylight they operate at a low power; in twilight or darkness they switch to full power. They greatly improve the visibility of approaching cars in dim light or poor weather, and they were generally credited with a reduction of 10% to 15% in the frequency of collisions when they were introduced. My car is six years old and I have never turned the lights on or off and don't know how it could be done. I switch between high and low beams at night, but the automatic controls handle everything else. They even brighten the lights if I enter a tunnel for more than a few seconds.

Ian Halliday
(ihalliday@idirect.com)
Ottawa, Ontario

Ross, Patel, and Wenzel reply: These two thoughtful letters illustrate the importance of myriad details of vehicle design to dangers and safety in traffic. The height of the lights of most SUVs and trucks, which temporarily blind car drivers at night, is a significant risk (which has been crudely quantified in fatality statistics as around 100 per year). Ian Halliday's comments about daytime running lights are indirectly supported by the impressive fatality reductions that are being achieved in Canada (see figure 2 of our article). Those reductions should inspire Americans to question the less-than-impressive claims of success made for US traffic safety programs.

Vehicle design is critical to traffic safety. Specific design features, such as the heights of car seats versus the heights of "truck" fronts, where the trucks are merely serving as car substitutes, are among the most important issues for safety design. Differences in vehicle structures are important; but as we argued in our article, the laws of physics do not imply that vehicle mass, as such, is a safety feature. Observation suggests it is relatively unimportant in today's fleet.

Marc Ross
(mhross@umich.edu)
Deena Patel
(deenamp@umich.edu)
University of Michigan, Ann Arbor
Tom Wenzel
(tpwenzel@lbl.gov)
Lawrence Berkeley National Laboratory
Berkeley, California

Early geodynamo work

Regarding the February cover article on the quest for a laboratory geodynamo (PHYSICS TODAY, February 2006, page 13), it is important, as Isaac Newton said, to "stand on the shoulders of giants" as we advance our understanding. Unfortunately, the present generation often fails to do so. Consider, for example, the Bullard–Rikitake dynamo theory, which explains not only the axial field but also its periodic spontaneous reversal, as observed in ocean-bottom cores. Here is the background:

In the early 1950s, Edward Bullard and a student of his named Rikitake built a geodynamo at the University of Newcastle upon Tyne in the UK. It consisted of two counter-rotating iron cylinders about two meters in diameter, connected electrically by an equatorial layer of mercury. It generated an axial magnetic field that spontaneously reversed its direction every 20 minutes, as Earth's field is known to do every 10 000 years or so.

The actual geodynamo has yet another peculiar and unexplained property: It is substantially off-center by about 10% of Earth's diameter. Earth's field is about 0.6 gauss in Siberia, and about 0.1 gauss in the diametrically opposite region in the southern Atlantic Ocean, as I pointed out in a paper presented in the 1950s at a symposium at Newcastle. This asymmetry is considerably harder to explain than the field generation itself or its periodic reversals.

I mention this for readers who may be interested in joining this fascinating field of experimental geophysics.

Henry H. Kolm
(henrykolm@comcast.net)
Francis Bitter National Magnet Laboratory
Massachusetts Institute of Technology
Cambridge

The different research groups cited in Bertram Schwarzschild's story about experiments using a laboratory analogue of the geodynamo may have been unaware of my old paper published back in 1963.[1] The diagram of the apparatus in the PHYSICS TODAY story and the corresponding diagram in my paper show almost identical designs. Apart from the Helmholtz coils needed for a dynamo seed field, both figures show two propellers driving the liquid metal in opposite directions. My paper was stimulated by the pioneering work of Walter M. Elsasser.

Reference

1. F. Winterberg, *Phys. Rev.* **131**, 29 (1963).

Friedwardt Winterberg
(winterbe@physics.unr.edu)
University of Nevada, Reno

[*Editor's note: Daniel Lathrop, one of the researchers consulted for the original story, was invited to respond to Friedwardt Winterberg's comments.*]

Lathrop comments: After the first two successful liquid metal dynamos,[1] there has been considerable recent activity in experiments seeking dynamo action in less constrained flows.[2] Much initial motivation for these experiments had been the work of Martin L. Dudley and Ronald W. James[3] from 1989. It is clear now, in hindsight, that Winterberg's 1963 paper[4] predates these experimental attempts and much of the earlier motivating theory. His paper gives a detailed analysis of different experimental possibilities for probing dynamo action using liquid metals.

Plainly, it has been an oversight of the community to not have recognized Winterberg's contribution before now.

References

1. A. Gailitis et al., *Phys. Rev. Lett.* **86**, 3024 (2001); R. Stieglitz, U. Muller, *Phys. Fluids* **13**, 561 (2001).
2. P. Odier, J.-F. Pinton, S. Fauve, *Phys. Rev. E* **58**, 7397 (1998); N. L. Peffley, A. Cawthorne, D. Lathrop, *Phys. Rev. E* **61**, 5287 (2000); E. J. Spence et al., *Phys. Rev. Lett.* **96**, 055002 (2006).
3. M. L. Dudley, R. W. James, *Proc. R. Soc. A* **425**, 407 (1989).
4. F. Winterberg, *Phys. Rev.* **131**, 29 (1963).

Daniel Lathrop
(lathrop@umd.edu)
University of Maryland, College Park

RHIC's future looks bright

Bertram Schwarzschild's Issues and Events piece on the National Research Council's report *Revealing the Hidden Nature of Space and Time* (PHYSICS TODAY, June 2006, page 26) states, "Fermilab's Tevatron is unlikely to outlive the decade. Neither is the PEP-II asymmetric electron–positron collider at SLAC nor the Relativistic Heavy Ion Collider at Brookhaven National Laboratory."

Placing RHIC in this context is odd since the NRC report nowhere mentions it. RHIC is funded by the Office of Nuclear Physics in the US Department of Energy's Office of Science, not by the Office of High Energy Physics, for which the NRC committee was charged with recommending priorities for the next 15 years.

More important, the notion that RHIC is "unlikely to outlive the decade" is misbegotten. The scientific impact of RHIC has been outstanding; its discovery of the "perfect liquid" of quarks and gluons was named the number-one physics story of 2005 by the American Institute of Physics publication *Physics News Update* and garnered media coverage around the world.

Brookhaven National Laboratory is currently working with the Office of Nuclear Physics to implement for RHIC a strategy for the period 2006–11 aimed at a 10-fold luminosity upgrade and detector upgrades. This strategy will place RHIC at the forefront of research in high-temperature quantum chromodynamics (QCD) for at least another 10 years. Furthermore, RHIC is the first and only hadron collider with the ability to accelerate, store, and collide polarized protons at energies up to 500 GeV in the center-of-mass frame. It therefore provides unique opportunities to study the spin content of the nucleon—a program that also will extend into the next decade.

Beyond that is the prospect of using RHIC as the basis for a polarized electron–ion collider, an option for an international next-generation facility for the study of QCD. That option will be discussed by the Nuclear Science Advisory Committee in 2007 as it develops its long-range plan for the field. If longevity is based on compelling science to be done, such a QCD facility—with ion–ion, proton–ion, polarized proton–proton, polarized electron–proton, and electron–ion collisions at high energy—would likely outlive the *next* decade.

Sam Aronson
(samaronson@bnl.gov)
Brookhaven National Laboratory
Upton, New York

Correction

June 2006, page 16—The description of opal's chemical composition is wrong. Opals contain very little calcium carbonate. Their chemical formula is $SiO_2 \cdot nH_2O$, where n is usually between 0.5 and 2. Thanks to Andrew Locock of the University of Alberta in Edmonton for pointing out the mistake. ■