THE INDUSTRIAL PHYSICIST

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Spin and energy

I enjoy reading *The Industrial Physicist*, since I've spent most of my career in practical applications of physics. I am surprised to find the article "Spin and energy—free?" in the August/September issue. Apart from my skepticism, this is not an "applied research and product development" subject, but one of fundamental physics. In my opinion, applied research should be practiced with all the quality control and peer review of fundamental research. This subject should go through the normal scientific-journal evolution of review, publication, and independent checking before the applications community is alerted to it.

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[A. O. Wistrom replies: The experimental observations of Coulomb torque have been published in Refs. 4 and 5, where we also presented the results of the asymptotic analysis of the predicted torque. Furthermore, in order to set the stage for the full theoretical derivation of Coulomb torque, we derived the general expansion of the surface potentials for a three-dimensional system comprising *N* spherical conductors that was published in Ref. 6, following the procedures outlined in Ref. 2*. Finally, the theoretical basis for Coulomb torque was published in Ref. 3*. So far, our research has been published in four reputable and peer-reviewed journals, which testifies to the soundness of the work.

*See Reprise, *The Industrial Physicist*, October/November, p. 25]

The news brief on three-body Coulomb forces, which seem to induce increasing spin in charged spheres with no outside energy transfer, shows a monopole charge distribution as it is presented. The effect depends on the electromechanical asymmetry of three monopoles induced in the three spheres, if I read the brief correctly. Wouldn't it be more correct to represent the charge distribution as multipole? For example, in the two-sphere case with axial symmetry, the monopoles would represent the net charges at the center of the spheres, while the induced charge asymmetry would give rise to two coaxial dipoles, one in each sphere, with their negative charges facing each other. Similarly, the three-sphere case should give rise to a multipole distribution, which I cannot visualize without an analysis. I think the dynamics of the system would change if higher-order multipoles and their interactions were introduced. These would be different from monopole interactions. Then energy would probably be conserved.

But perhaps Wistrom's analysis included this. I am unable to comment on the experiment without seeing the data, and I should really look up the *J. Phys. A* reference before I try. But I can visualize a situation in which energy is added to the system as charge flows into the fixed sphere, enough to add the torsion energy to the suspension wires.

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[A. O. Wistrom replies: The theoretical analysis is based on a multipole expansion of the potentials using a recently published expression that accounts for an arbitrary number of spheres in three-dimensional space (*6*). We find that the addition of the third sphere introduces an asymmetric surface charge distribution with both polar and azimuthal dependencies that do not cancel for other than a perfect equilateral arrangement of equal spheres and when the spheres are linearly arranged. Indeed, we find it is the higher-order multipoles that give rise to the observed Coulomb torque.]

With regard to the article "Spin and energy—free?" I would hope that actual experiments with the conducting spheres are performed in such a way as to take into account the effect that a rotating sphere has in the presence of Earth's magnetic field. As we know, a moving conductor in the presence of a magnetic field produces a potential in the conductor, and also a current, if there is a return path. For the case of the sphere, the resulting current produces a magnetic field of its own which opposes the inducing field. I point this out only because of how easy it is to forget something so often taken for granted.

Ivan Cowie
Time Domain Corp.
Huntsville, Alabama

[A. O. Wistrom replies: The experiments were electrostatic and were performed with the conducting spheres held stationary in space.]

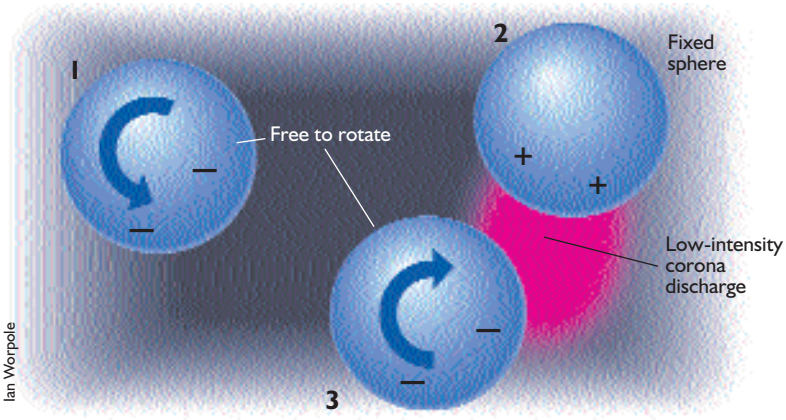
References

4. Wistrom, A. O.; Khachatourian, A. V. M. *Appl. Phys. Lett*. **2002**, *80* (15), 2800–2801; correction *81* (25), 4871.

5. Khachatourian, A. V. M.; Wistrom, A. O. *Europhys. Lett.* **2002**, *59* (4), 521–525: correction *60* (2), 330.

6. Khachatourian, A. V. M.; Wistrom, A. O. A sum rule for associated Legendre polynonomials with sphere triangles. *J. Math. Phys.* **2002**, *44* (2), 849–852; correction *44* (2), 849–852.

I was disappointed to see the article "Spin and energy—free?" in the August/September issue. The articles referenced present theoretical and experimental results that suggest that a net rotation can be imparted to sets of conducting spheres by the introduction of an electric potential.



Ian Worpole

The brief, however, seems to have extrapolated these results to an energy-and-spin-for-free situation. It implies that, in theory, an arrangement of three spheres could transfer unlimited amounts of energy into the spinning spheres—a violation of conservation of energy. The authors of those papers do not make a claim in this regard in either of the original papers. In fact, in the earlier paper, the first figure shows a schematic of the experimental setup, with a power supply clearly indicated. One of the authors of those original papers (A. O. Wistrom) is quoted in the diagram caption, but it is not clear whether the authors were shown an advance copy of this brief. I doubt they are pleased with the association of their work with claims of perpetual motion.

I teach physics to undergraduates and I like to bring in just-published articles and discuss them with the class. *The Industrial Physicist* is especially relevant because of its real-world feel. Undergraduates, however, like much of the general public, seem to have an exaggerated hope that perpetual motion devices, time travel, travel faster that the speed of light, etc., are possible. Finding such a brief in a publication of the American Institute of Physics (AIP) is a potential educational setback of mammoth proportions. I understand that *The Industrial Physicist* is not meant to be a teaching tool. Still, an AIP publication should edit its content more carefully, especially during The World Year of Physics.

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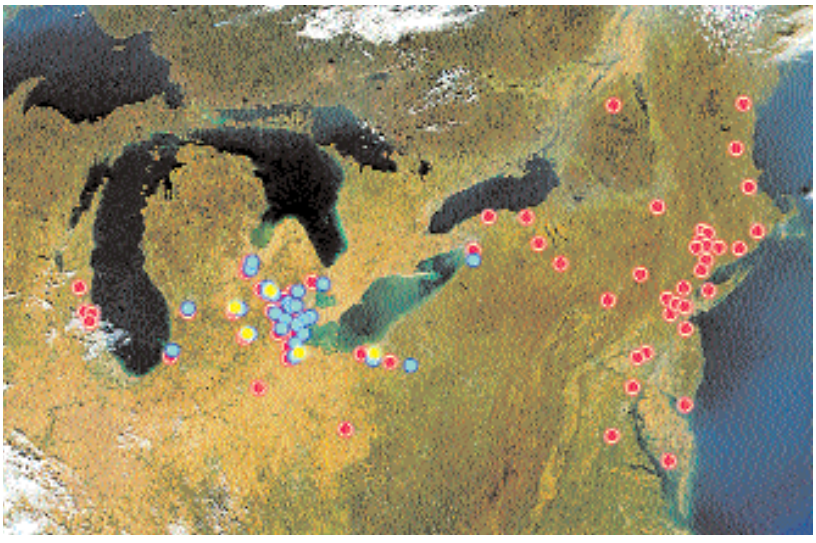
[*Author replies*: It is the policy of *The Industrial Physicist* (TIP) to have researchers review all news briefs for accuracy in advance of publication, and this brief was no exception. In reviewing the article, A. O. Wistrom emphasized that angular momentum is conserved in the system. But he agreed that, in his view, a torque would be continuously applied on two of the spheres. With a low-friction bearing, this would lead to a continous spin-up. Since the third sphere was kept at a fixed potential, but, in Wistrom's view, passed no current, it would not be providing energy. Thus, Wistrom's work does describe an apparent violation of conservation of energy.

We decided nonetheless to publish a description of this work, sensational as it was. The news brief itself made clear the problems, both theoretical and experimental, with the reported work. When a startling claim is published in respected journals, it is only appropriate that news publications like ours draw the attention of the community to such work so that its validity can be discussed and, hopefully, tested by further experiment or explained in a less surprising way.

In my view, the letters we received show that we are succeeding in this intent. The first letter, by George Levin, proposes a plausible alternative explanation, in the form of a corona discharge current that would supply the energy needed to produce a spin.

In reporting spectacular claims, there are



Orbital Imaging Corp. (processing by NASA Goddard Space Flight Center)

two pitfalls of science journalism. One of these is to dismiss all "unorthodox" claims. This risks overlooking real advances, which almost always seem unorthodox at first. The other is to uncritically report the latest speculations (such as "dark energy," "wormholes in space," and so on), which tends, as you fear, to blur the line between science and science fiction. In this case, TIP has tried to avoid both pitfalls with fair, but skeptical, reporting.

Your students could find this process of publication-and-reply a good example of how the scientific community can sift through spectacular claims in a positive way.

Eric Lerner]

The Grid

Thanks for the informative and sensible analysis of the recent electric grid problems ("What's wrong with the electric grid?" by Eric J. Lerner, October/ November, pp. 8–13). As you point out, the solution proposed by the Department of Energy, the Federal Energy Regulatory Commission, and their masters at the Electric Power Research Institute and the Edison Electric Institute will largely benefit energy traders at the expense of consumers—just another example of the recent trend of "government of the people, by the stooges, for the fat cats." As you also point out, the start of a responsible solution—if "our" government is actually interested in serving the people instead of the profiteers—is to repeal Order 888. I, for one, am not holding my breath until the day that happens.

Kim L. Ground
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Great issue as usual, but the article "What's wrong with the electric grid?" was outstanding. It was the first intelligent story I've read on the subject. Good job.

Jimmie Hutchison
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I read Eric J. Lerner's article about the problems with our national power grid and found it enlightening and disconcerting. Lerner's explanations of the physics and realities of the North American power grid explain clearly why we had a blackout and why we will have more in the future.

I was unprepared for the politics and greed of the situation. I understand electricity, and I understand the concept of deregulation. I had always assumed that deregulation meant more independent generating plants within a specific locale selling power into the local power grid. I never envisioned deregulation to mean selling power across local boundaries. That is ludicrous.

Lerner's suggested solution for a return to regulated power monopolies is a step in the wrong direction. Instead, I suggest that power sales be limited regionally and directed to local consumers and/or distributors. If power generation facilities want to sell into other grids in the same manner that Quebec sells into the Northeast, then the generator should be responsible for owning, buying, or leasing unilateral transmission facilities. The solution is: Local power sale/free transmission—Wholesale remote power sale/pay for the wiring.

The issue of reactive power can also be addressed. Local transmission facilities would be required to farm out reactive power requirements to match power generation purchases and, in this manner, better utilize the system and get direct financial feedback for the cost of reactive power.

I don't think the citizens of North America should pay for extensive remote-transmission wiring to facilitate a boondoggle in remote-power commerce. The additional taxpayer cost is not necessary and comes with no financial feedback, whereas requiring the generator to lease lines between sites gives direct financial incentive to create power transmission lines without burdening the taxpayers. Congress could assist in this matter by making the creation of transmission lines less onerous than they are now due to local and fringe civil resistance.

Bob Strachan
Lake George, New York

Thank you for your most informative article, "What's wrong with the electric grid?" Although this problem is not a topic I deal with in my job, my degree is in physics, and I wish to make a few remarks.

First there is the economic problem of reactive power. Generating sources should be economically compensated, mostly in terms of required kVA, not just wattage. It may not be politically possible to reverse all of Order 888, at least in a timely manner, but this economic adjustment must get a high priority. Similarly, stress factors that are not as susceptible to this approach—such as distance between power source and consumption—should be appropriately taxed. The tax could be made more palatable by returning the revenue to research, information sharing, or another related central resource. Finally, information hoarding must be illegal. In the case of the federal government, we have the Freedom of Information Act. The same reasoning can be applied to force the industry to make vital information public. As long as all parties are treated with equal fairness, no legitimate business will be hurt, and all will benefit from such an open exchange.

George Warner
Computer systems engineer
Chantilly, Virginia

In treating the electric grid as a single machine, you do not go far enough. The

lion's share of peaking load is now represented by air conditioning. The major change since 1965 is that air conditioning has become ubiquitous. Furthermore, the vast majority of air conditioners have thermostats. They get switched on in the spring and switched off in the fall, and, for practical purposes, they are part of the single machine. The single machine is automatically trying to respond to the weather. Temperature fluctuations do not cancel over large areas. A scorching day in New York may be a byproduct of a wind blowing from Mexico, and its effects are naturally on a continental scale. I think the parable of King Canute and the tide is applicable.

The electric machine's great weakness is its bureaucratic ignorance of half of its plant. If you think in whole-system terms, you can install large numbers of geothermal heat pumps at attractive prices, thus reducing temperature-induced fluctuations. Similarly, in many climates, solar water heaters with large storage tanks are immensely attractive. Householders are reluctant to plunk down, say, $5,000 for new equipment. Their marginal source of credit is likely to be unsecured consumer credit (e.g., credit cards) at about 25% interest. What electric utilities can do is to act as "risk assumers," undertaking to heat and cool a building to within stated limits for a stated monthly price.

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Corrections October/November

In the article "Plasma self-organization" (pp. 20–21), although Scott Hsu is now at Los Alamos National Laboratory, all the research work reported and the two figures should be credited to Caltech.

In "Reprise" (page 23), middle column, second from the last line, this should read "red" not "blue."

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