

that question is, undeniably, important, and not getting it right could have significant consequences, but the cheap shots in the PHYSICS TODAY story are good neither for the publication nor for the science it is supposed to support.

Although there is significant evidence that global warming is occurring, and models strongly suggest that it is due to human activity, climate change promoters go beyond science to characterize global warming as bad or destructive. That is no longer science but evaluation, which moves their pronouncements into the realm of politics. If they wish to be treated like scientists, they should stick to science—reporting facts as measured and correlations as inferred—and leave the inferences and implications to leaders who are used to and prepared for the vicissitudes of politics. If climate change promoters choose to enter that arena, they must expect to abide by its norms, not the more refined ones we strive for in science.

Proposers should recognize that whether change is good or bad depends on much more than the simple fact of change. To give an example, the opening of the fabled Northwest Passage because of ice melt likely will have a negative impact on the economy of Panama, but it will reduce both transportation costs and carbon monoxide emissions from ships engaged in world commerce.

I certainly agree that science “should be the ultimate tool,” but let’s make it good quality science. If the models are so good, did we just not hear about their predictions of what Toni Feder reports as “decade-long periods with little or no warming”? And if not, why not?

There is no better evidence of the political nature of the actions of climate change proposers than the formation of the Climate Science Rapid Response Team. Neither Charles Darwin nor Isaac Newton needed gangs to support or defend them.

Terrance J. Goldman
(tjgoldman@post.harvard.edu)
Los Alamos, New Mexico

■ **Thank you** for helping to bring to light the actions of the fossil-fuel interests’ cronies. I found it refreshing to see their laundry displayed to the public in such an intelligent publication as PHYSICS TODAY.

Such deplorable acts lose their power when we come together against them in this way.

To freedom of science!

Robert J. L. Thompson
Portland, Oregon

■ **After reading** “Climate scientists not cowed by relentless climate change deniers,” I am dismayed by the bellicose and militant tones in the rhetoric attacking the deniers. Those are the deniers’ tactics—and they are much better at it. We scientists are meant to be calm, rational, fair, and levelheaded. If we aren’t, we will lose to the deniers.

What should we climate scientists do about this very real conflict?

First, we need to understand who the climate change deniers are. Simply put, they fall into three groupings: fossil-fuel interests and others who militantly oppose government regulation of any kind; people with spiritual and religious understandings that conflict with the reality around them; and those who simply don’t understand climate change and are fearful. To be successful in addressing global warming, we will have to change those people’s hearts and minds.

The focus of the actions of individuals and groups mentioned in the article is on global warming deniers in the fossil-fuel industry. The hope is that by presenting the facts to those deniers they will change their ways. A better approach might be to first learn about their milieu and how they cope with their legal and fiduciary responsibilities to their stockholders, employees, communities, government agencies, and rate payers. Knowing those details may point out ways for us, as scientists and fellow citizens, to assist them in taking the difficult and costly actions to reduce or reverse global warming. As beneficiaries and rate payers of the products they have made, we must also be willing to share in the costs of those actions.

Within the grouping of faith-based deniers are those whose fundamental beliefs are based on what are, to them, absolute truths. However, all the major religions have leaders who are striving to reconcile those truths to a changing world. Scientists can help in that process by determining what was humankind’s understanding of the natural world at the time of the holy writings and by reconciling those truths to a changing—and warming—world.

Finally, there are deniers who are wary of change because they don’t understand it and are thus prone to fears of the unknown. Their lack of understanding may be due to shortcomings in their education in math and science and to parental concern about their education. The scientific community has been aware of such shortcomings for

years and has striven to correct them. The problem now is how to reach the adults in this group after they have left school and are now voting. To do that, we should better use mass communication technologies and enlist noted athletes and media personalities to further educate them.

Other actions for solving our problems include the following:

► Be aware that it may be good publicity to scientists that Al Gore shared in the Nobel Peace Prize, but to deniers it is like waving a red flag before a raging bull. To them, he is the symbol for an all-wise elite that regards itself as intellectually superior to them.

► Be alert to acts by the scientific community that reinforce the perception of elitist superiority. The reputation of the scientific community has not been abetted by some scientists’ overreactions to recent oil spills and their effects. What was deemed a “disaster” would have more appropriately been called a “mess.”

Global warming, still at the mess stage, can be stopped and, hopefully, reversed if we use all the available remedial technologies, social and political institutions, and financial resources at our disposal. If we don’t, it will become a disaster, with unimaginable consequences.

Less hubris and a lot more humility would do wonders for the reputations of us scientists and enhance our chances to contribute to remedial actions.

John W. Cooper
(jcooper@stic.net)
San Antonio, Texas

■ **Interesting wording** in “Climate scientists not cowed by relentless climate change deniers.” The word “denier” has already been subsumed by the fabric industry as a measure of weave density—used, for instance, to quantify the opacity of pantyhose. I respectfully propose that we burden the “deniers” with a “y” if they persist with their denying.

Frank Chen
(ffchen@ee.ucla.edu)
University of California, Los Angeles

Boundary conditions and Maxwell’s equations

The article on black hole mergers by Thomas Baumgarte and Stuart Shapiro (PHYSICS TODAY, October 2011, page 32) was extremely well written and informative. I especially appreciated

the use of Maxwell's equations as a mechanism for explaining the concepts, and I much enjoyed carrying out the exercise suggested in box 2. However, it occurred to me that something is missing in connection with the final result as given in equation 2c. Although it is clearly a wave equation and therefore any constraint violations may indeed "propagate away," as the authors suggest, it is also clear that the equation will accept a constant solution or even an exponentially growing one. What remains unclear is why the "propagate away" option is the one that should take precedence in actual calculations.

Jean C. Piquette
(jpiquette@verizon.net)
Portsmouth, Rhode Island

■ **Baumgarte and Shapiro reply:** A good question! The solution to the wave equation depends on the adopted boundary conditions.

Imposing "outgoing" wave boundary conditions, appropriate for most of the problems of interest for us, ensures that constraint violations do indeed propagate away. For a numerical demonstration that employs such boundary conditions for the form of Maxwell's equations in box 2, see reference 1.

Reference

1. A. M. Knapp, E. J. Walker, T. W. Baumgarte, *Phys. Rev. D* **65**, 064031 (2002).

Thomas Baumgarte
Bowdoin College
Brunswick, Maine

Stuart Shapiro
University of Illinois at
Urbana-Champaign

Sexism may be in the eye of the beholder

The February 2012 issue of *PHYSICS TODAY* held a certain irony for me in its juxtaposition of Robert March's review of Leon Lederman and Christopher Hill's book *Quantum Physics for Poets* (page 51) with the article by Rachel Ivie and Casey Langer Tesfaye on women in physics (page 47). I had recently read Lederman and Hill's book because I sought an up-to-date and accessible text for the quantum section of my course on modern physics for nonscience students. Like the reviewer, I also found it a well-written, lively, and contemporary account of quantum physics.

Much as I liked the book, in the end I chose not to adopt it. My reason was

the very example the reviewer touts as an instance of Lederman's engaging writing: the image of a reader peering in the window of Victoria's Secret while Lederman and Hill enlighten him—and it is clearly a him—about wave-particle duality. Read the cited passage in all its detail and it isn't hard to draw several conclusions about how the authors, perhaps subconsciously, view their readers as male; as drawn, in a slightly voyeuristic way, to Victoria's Secret; and as thinking highly of their own sexual allure.

How would a female student react to Lederman and Hill's example? Would it make her feel included among those interested in physics? Would it make her comfortable in the presence of male physicists or her fellow physics students? I think not. Had this example occurred just once, I might have let it go and adopted the book. But Victoria's Secret is mentioned every time the wave-particle duality comes up—which is frequently in this book on quantum physics.

If we're to remedy the underrepresentation of women in physics that Ivie and Tesfaye decry in their article, we'll need enough sensitivity to come up with more welcoming examples than that of a physics-interested male ogling the Victoria's Secret window display.

Richard Wolfson
(wolfson@middlebury.edu)
Middlebury College
Middlebury, Vermont

■ **Lederman and Hill reply:** Perhaps Richard Wolfson would have viewed our work more favorably had he read our first book, *Symmetry and the Beautiful Universe* (Prometheus Books, 2004). There we championed the great mathematician Emmy Noether to the modern science lay audience. We told the story of all of physics through Noether's grand theorem and how it forms a keystone of our understanding of nature. We did so as much to honor one of the greatest intellectuals who ever lived as to show our readership that physics is not a men's club.

More to Mr. Wolfson's point, Victoria's Secret stores can be found in almost every shopping mall in the US. When we pass by, we see as many women as men looking at their windows. Both genders' thoughts may be expected to run to fantasy, yet here is a point of contact between such human experiences and physics. We are leveraging it to inspire the poetic reader to enter a world of altered reality—in this instance, to ponder the quantum world

with the transmission of photons through a glass window and its inherent probabilistic nature.

We hope to invite readers deeper into the magnificent world of atoms, quarks, strings, the conduction band structure of semiconductors, Schrödinger's cat, the Dirac sea, and more. We take some risk, as we are prone to do on other topics such as politics and religion, and we have received numerous complaints concerning our belief in global warming, the creeping superstition, and anti-intellectualism that we see infecting our society today.

We are inclined to disagree, however, with Mr. Wolfson's conclusion about the effect of the Victoria's Secret windows metaphor on our female readers: We have done the experiment of taking the risk, and we have not received a single complaint thus far from anyone else that our book is sexist.

Leon Lederman
Christopher Hill
Fermilab
Batavia, Illinois

Nature's manifest absurdity: A cautionary tale

Alan Chodos, in his commentary in the December 2011 issue of *PHYSICS TODAY* (page 8), summarized the OPERA experiment that supposedly found neutrinos traveling at a speed of $c + \delta c$, where c is the speed of light and $\delta c \approx 7 \times 10^5$ cm/s. He also discussed some theoretical speculations and objections, but he ended his commentary with the odd comment that "if the OPERA result fails to survive, that will not prove that neutrinos don't travel faster than light." Then he presented his own ideas of tachyonic (faster-than-light) neutrinos that would support the "apparent lack of Lorentz invariance in the neutrinos' superluminal propagation" (see the article by Oleksa-Myron Bilaniuk and E. C. George Sudarshan, *PHYSICS TODAY*, May 1969, page 43).

Chodos didn't mention that regardless of neutrino properties, the most serious problem with the OPERA result is that it entails a failure of *causality*. Since the clocks in the rest frame of the experiment are synchronized by GPS in accordance with special relativity, which is accepted as valid, consider the corresponding observations with clocks synchronized in a frame of reference moving with velocity $c - \delta c'$