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namely, the university—and more or less went, "Clean out your office and turn in the key, and then you'll get your last check." Now, with the decision in the hands of the retiree, hardnosed policies become an impediment. Two of the obvious concerns of potential retirees, beyond having rough parity in paychecks, are "What about my medical insurance?" (once severed from group coverage, can one get or even afford individual coverage?), and "What about professional continuity?" (can one still have an office, access to computers, graduate students, and so forth?).

Thanks to retirement programs (TIAA-CREF, for example), a time graph of actual pay versus retirement benefits of many faculty should cross at some time around the standard retirement age. That is what a retirement program should make happen in the first place (an idealization, I realize). After that, both the university and the professor are arguably losing money. But with the correct incentives (such as budgets for travel and publication charges), the university could easily have the best of both worlds: continuing participation of an active established researcher (who has "retired") and young new replacements on deck at the same time. I'm not an accountant, but my guess is that an attractive set of incentives would not cost more (over the likely average duration of any such arrangements—say, 4–7 years) than the incremental cost of a potential retiree hesitating even a single year.

The day may even come when universities recruit emeritus professors.

F. Curtis Michel
(fcm@curt.rice.edu)
Rice University
Houston, Texas

Numerical Simulation Nixed as 'Juggling,' Reply Is Planely Verse

Even though I'm not a particle physicist, I was fascinated by Frank Wilczek's April 1998 "Reference Frame" essay entitled "Back to Basics at Ultrahigh Temperatures" (page 11). However, I cannot agree with his statement that "chiral symmetry breaking is firmly rooted in experimental facts, and has now been verified directly by numerical simulations." What I contest is not the physics, but the claim made for numerical simulations.

I believe that numerical simulations cannot verify or demonstrate anything in physics. If physics is about the laws of nature, our questions must be addressed to, and answered by, nature itself through direct experimentation, not computer simulations. Of course, computer simulations can be invaluable in furthering our research, understanding the results and suggesting new directions (not to mention their technological applications).

I'm aware that, in many fields, numerical methods are the only way to explore realms forbidden to experiments. In these cases, though, I wouldn't state that computer simulations "verify" a theory, but would prefer to mention them as important and necessary "hints"—and not as substitutes for real experiments.

I have noticed that sometimes a speaker at a conference will give a beautiful talk and show plots that nicely fit some theoretical curve, and only at the end (if ever) will he or she mention incidentally that they are all computer simulations, not measurements. Typically, the next year, the same person will reappear with a completely different set of simulations, on the same subject but now fitting (still nicely) yet another model. I find this to be numerical juggling, not physics.

Ermanno Pinotti
(pinotti@mail.mater.unimi.it)
University of Milan
Milan, Italy

Frank Wilczek replies:

Won't you admit it's a trifle hysterical
To disbelieve *every* result that's
numerical?

How, then, could you use modern
aviation?
For the planes are designed by
simulation.
And are experiments at accelerators
all unsound,
Because they *simulate* the QCD
background?

O why do you recoil in terror
From calculations that control their
error?
Give it up! The symmetry's surely
broken,
The order parameter (its token)
Refuses, by 20 σ, to go away.
What's that, *a coincidence*? No way!

No offense, but it's silly to avert your
eyes
After 10^{18} floating point multiplies.

Frank Wilczek
Institute for Advanced Study
Princeton, New Jersey