

Fascinating Pluto

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DeTar and Gottlieb reply:
Herbert Neuberger is a principal developer of the exact chiral overlap formulation of lattice fermions, a significant achievement in lattice field theory. The domain wall formulation, also cited in our article, is closely analogous. Although Neuberger apparently would have preferred an article reviewing lattice field theory, highlighting his contributions, we were instead asked to focus on recent computational successes of numerical lattice quantum chromodynamics. Those successes were achieved with an inexact chiral formulation that includes an approximation known as the “fourth root trick” to produce the correct number of quarks.

The question under lively debate is whether the approximation is justified, not strictly as a local lattice field theory, as Neuberger insists, but as a controllable approximation to continuum QCD. The international community is divided between skeptical purists and practical optimists who are encouraged by recent successes.

Some 40 physicists outside our collaboration currently use gauge configurations that we generated with the inexact chiral formulation, so our optimism is widely shared. Three collaborations other than ours contributed to the promising results we featured. So far, nothing comparable has come from the vastly more computationally expensive, exact methods.

Our purpose was to view the history and goals of numerical lattice QCD in unified terms, discussing past and present successes and looking forward to progress that will come, possibly through exact methods. Measured objectively by results, the formulation of improved algorithms for the inexact method and the companion analytic formalism for overcoming its limitations was unquestionably a nontrivial advance.

The MILC collaboration’s computer allocations amount effectively to modest grants to each of us. Pooling them makes progress, such as that described, possible. We also participate in and support small innovative projects. On a national level, very substantial resources being developed by the US lattice gauge theory community under grants from the Department of Energy will be devoted to domain wall and overlap fermions. This is as it should be.

In the early days of quantum field theory, many physicists, including Paul Dirac, abhorred the poorly justified treatment of the infinities encountered in renormalization prescriptions. Of course, we now understand full well how to justify those prescriptions. Neuberger’s logic, however, would have deprecated the early remarkable successes of perturbative quantum electrodynamics.

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Fascinating Pluto

The special PHYSICS TODAY issue on planetary diversity (April 2004) describes many fascinating objects in our solar system. But the controversy over Pluto’s planethood and the interest in new objects beyond Neptune shouldn’t mask the fascinating nature of Pluto itself. A recent consortium in which we participated used a total of nine telescopes, in Hawaii and California, to observe Pluto when it passed in front of a star. From the way the starlight faded, we could tell that Pluto’s atmosphere has expanded since it was detected in another occultation 15 years ago. From spikes of intensity in the fading starlight, we could even tell about kilometer-scale structure in Pluto’s atmosphere. We hope that the *New Horizons* spacecraft gets to Pluto before the expansion is inevitably reversed, which may cause the atmosphere to condense on the surface or freeze and fall as snow.

We are planning to observe more occultations by Pluto and other objects in the outer Solar System in the upcoming years. This effort often requires extensive international collaborations, so we would like to hear from others interested in collaboration. Large telescopes are not required for observing the brighter occulted stars.

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