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or amorphous solids, and glasses, for example, were notoriously hard to describe mathematically probably due to the lack of an adequate language—that is, until fractional-calculus methods were applied.

Physics of Fractal Operators, by statistical physicists Bruce West, Mauro Bologna, and Paolo Grigolini, is a timely introduction that discusses the basics of fractional calculus. It also considers generalizations of standard physical approaches such as path integrals and the Langevin and Fokker-Planck equations. Those generalizations, whose interrelations and connections are stressed in the book, describe complex, nonlocal systems. Most of the approaches discussed have already proved to be useful, and many things that may seem evident, or at least clear, in classical cases show new and nontrivial facets when revisited in the light of fractional calculus. The book also contains considerable material on techniques that are not widely used but may be potentially powerful. Examples include fractional derivatives of fractal functions and fractional integral transforms.

West, Bologna, and Grigolini's text has an almost singular place in the physics literature, although it might be compared to the often cited book *Applications of Fractional Calculus in Physics* edited by Rudolf Hilfer (World Scientific, 2000). Hilfer's book covers a wider variety of physical topics; however, as in any edited book, it lacks both a single line of argumentation and a continuity of discussion.

Fractional calculus is just as old as calculus itself, yet its approaches and tools are not taught in introductory calculus courses. Nor is fractional calculus familiar to most of the theoretical physics community, which considers it kind of exotic. The time is ripe to start teaching the subject to students. *Physics of Fractal Operators*, which actively promotes the use of fractional calculus in physics, may help teachers develop an appropriate curriculum.

But, as the very first sentence of the book says, "This is not a text book." And that sentence is true, even if some of the book's discussion approaches textbook style. Chapter 1, for example, starts by discussing basic notions of Hamiltonian and Lagrangian mechanics. But it misses the chance to explain how fractal, nondifferentiable functions and involved memories appear from essentially smooth behaviors. The chapter can be understood by those having a profound knowledge of classical statistical physics, but would only confuse beginners. In brief, the

book's abundance of material makes it very useful to researchers working in the field of complex systems and stochastic processes: It should help those who want to teach fractional calculus and it will definitely motivate those who want to learn: But it probably does not work well as a text to closely follow in an introductory course.

Typically, the main drawback of a science book on any still-evolving subject is that it is written too soon. *Physics of Fractal Operators*, however, is somewhat behind the times. Except for "in press" works of the authors themselves, the latest references are to items published in 2000. The years since have seen the field develop rapidly. Progress has been especially rapid with regard to fractional transport equations, a topic covered in the book but in a manner that is definitely too short and partly out of date: For a more comprehensive treatment see the discussion by Ralf Metzler and Yossi Klafter in *Physics Reports*, volume 339, page 1, 2000. Some statements in the book are too bold: They recall the early days of work on fractals, when proponents argued that all physics was fractal and none of classic physics would survive.

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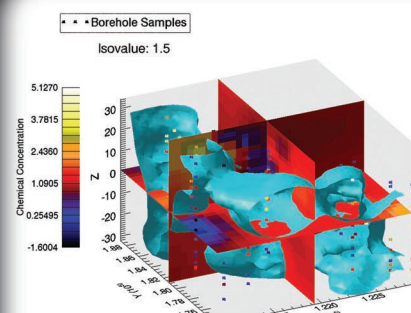
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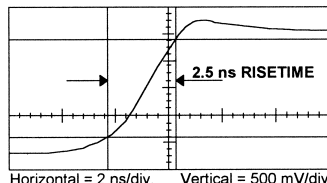
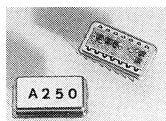
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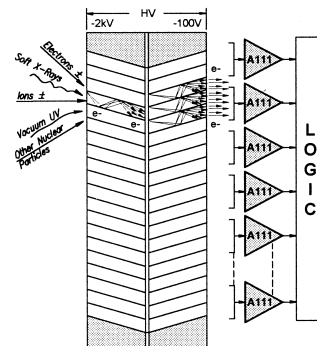
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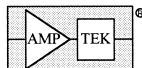
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