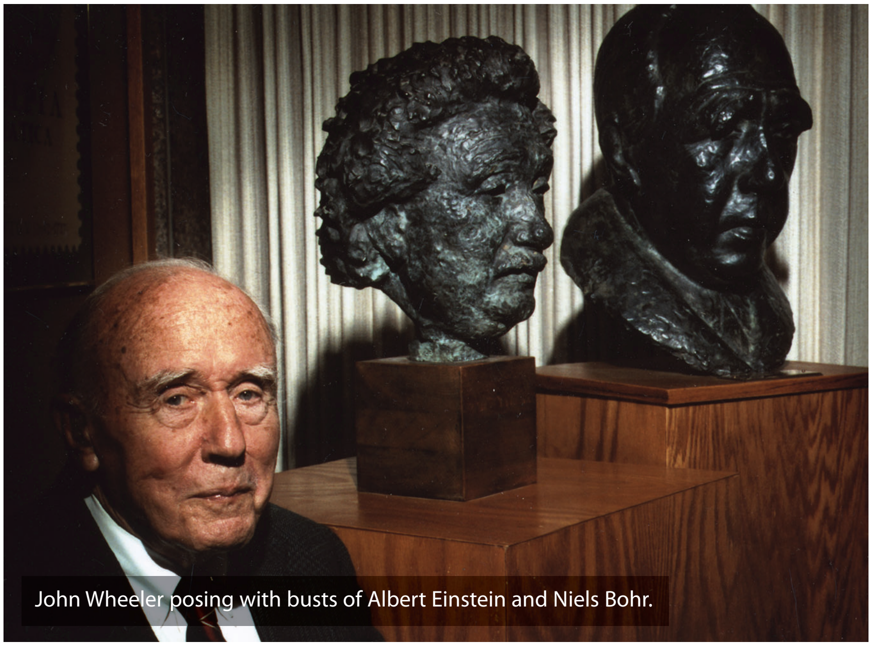
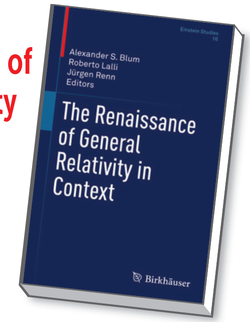
AIP EMILIO SEGRÈ VISUAL ARCHIVES



John Wheeler posing with busts of Albert Einstein and Niels Bohr.

Einsteinian ebbs and flows



The Renaissance of General Relativity in Context
Alexander S. Blum, Roberto Lalli, and Jürgen Renn, eds.
Birkhäuser, 2020. $119.99

One might wonder what it means for a theory to have a "renaissance." After all, we tend to think of them as binary—proven or not. Once we know that one is right, it goes into the textbooks and becomes part of the body of accepted knowledge. *The Renaissance of General Relativity in Context*, though, contends that theories' fortunes can change long after they are verified. Consider, for example, general relativity. The theory was accepted following the 1919 eclipse expeditions that measured the gravitational deflection of starlight by the Sun. Didn't that establish its status as a pillar of modern physics?

The real story is more complicated. Historians of science have noticed that Albert Einstein's theory had an unusual trajectory after its verification: decades of stagnancy and disinterest—the "low-water-mark" period—followed by a resurgence of interest and activity, the "renaissance" of the book's title. The present volume is the result of several years of examination of that renaissance by researchers connected to the Max Planck Institute for the History of Science. Authored by some of the world's leading experts on general relativity, the essays are deeply researched and tightly argued pieces of scholarship that combine approaches from history, sociology, physics, and big data.

The group's first task was to establish whether general relativity had such a renaissance and, if so, what exactly it entailed. That is where big data and similar innovative tools helped create a new kind of history. They allowed the authors to discern connections between scientists working in particular areas that would otherwise be difficult to notice. For instance, the vague sense that general relativity was not in vogue between 1920 and 1950 can now be replaced with a precise statement: Plenty of people were working on the theory, but they were generally working independently. Moreover, their efforts were tangential to the core of contemporary physics.

The Renaissance of General Relativity in Context shows, in beautiful graphs, how the theory went from idiosyncratic to the cutting edge of research. It even exposes novel kinds of networks—not just social networks of coauthors, but semiotic networks of scientific representations and semantic networks of research agendas and conceptual interpretations.

Once uncovered, those networks can point to fascinating developments. For example, most of the physicists working on relativity before World War II were pursuing alternatives to Einstein's theory, whereas research in the 1950s and 1960s marked a return to the "original" version—and a renewed sense that its physical consequences were worth looking for. Particularly interesting is the role of humble postdocs in connecting disparate researchers in the networks that were the essence of the renaissance. In addition to those network studies, the book includes focused explorations of many of the major figures, concepts, and projects involved in the renaissance, such as Vladimir Fock, Leopold Infeld, Peter Bergmann, gravitons, the cosmological constant, dark matter, and the Virgo interferometer.

Appropriately, John Wheeler gets particular attention. His conversion in the 1950s from nuclear physics to general relativity is a microcosm of the field's resurgence. The success of quantum electrodynamics drove him to look for new approaches that might be equally successful. He took advantage of his position at Princeton University—namely, being near Einstein and his friends at the Institute for Advanced Study—and developed both a research program and one of the first courses in general relativity. He trained new students in the fundamentals of the theory and illustrated the benefits it might bring to physics. New textbooks, publications, and conferences followed, and they provided the infrastructure necessary for the theory to thrive.

Wheeler's story is also helpful in answering one of the great questions about the renaissance: Why did it happen when and where it did? Was it because of Wheeler's connections to the resources of the military-academic-industrial complex, what the volume calls the "sugar daddy" scenario, or was it due to his aesthetic embrace of a beautiful, rediscovered theory, the "sleeping beauty" scenario? Both possibilities are explored in some detail, along with other important factors, such as private patronage from wealthy figures who were unhealthily obsessed with the hypothetical phenomenon of antigravity.

The renaissance of general relativity provides a rich case study for thinking about fundamental problems of scientific change. How are theories used and not used? What is the difference between healthy and withering research programs? Can the resurgence of a theory be explained by new observational discoveries? Technological advances? Individual personalities? Social and political developments? The book is a great cross section of those different approaches, which will make it valuable to scholars in history and sociology of physics—although it might set a fairly high methodological barrier to entry for nonspecialist readers. Nevertheless, *The Renaissance of General Relativity in Context* will quickly become a classic in the history of the field, and it will perhaps spur new research programs of its own.

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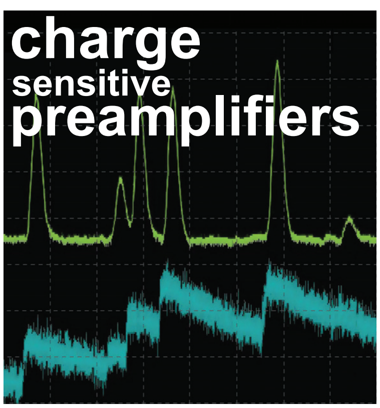

readout signals from:
pin photodiodes
CdTe/CZT semiconductor detectors
photomultipliers
proportional tubes
surface barrier/PIPS

shaping amplifiers

detect femtojoule light pulses

Great for amplifying pulsed optical signals or pulses from nuclear radiation detectors. Our modules are designed to be plugged into your detection instrumentation. Evaluation boards and housings are available.

product specifications and application notes at:
http://cremat.com
Cremat Inc. West Newton, MA USA

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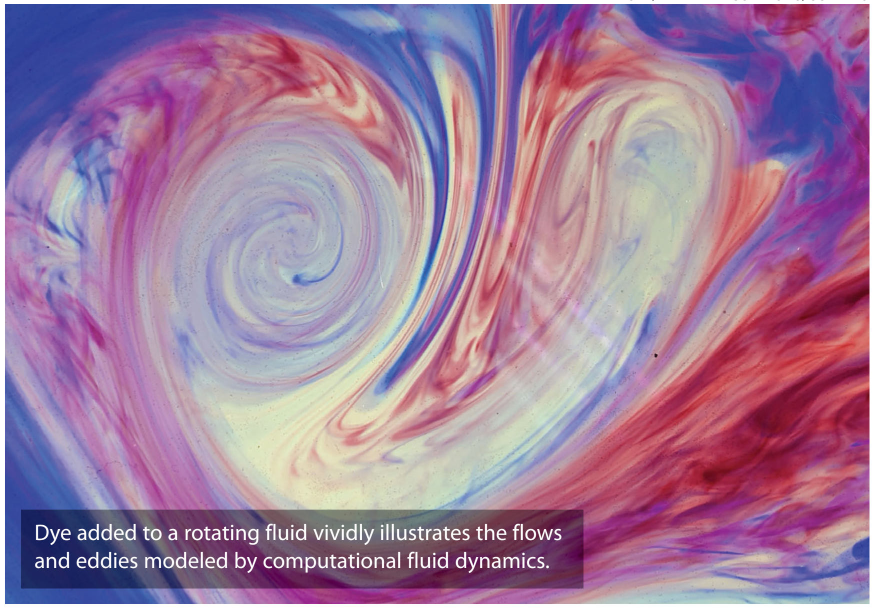
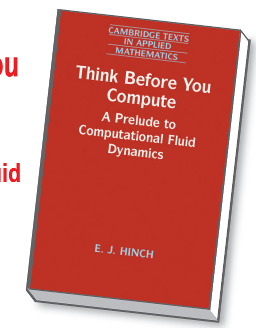


Dye added to a rotating fluid vividly illustrates the flows and eddies modeled by computational fluid dynamics.

Numerical methods: A user's guide



Think Before You Compute
A Prelude to Computational Fluid Dynamics
E. J. Hinch
Cambridge U. Press, 2020. $79.99

The equations governing the flows of fluids are inherently nonlinear, so exact solutions are rare and gemlike. Approximate solutions of the equations are thus critical to understanding most of the interesting behaviors seen in fluids. Although analytic approximations have been used to glean insight into fluid phenomena since the field's beginning in the 19th century, numerical approximations provide a complementary way to learn about the behaviors of the solutions. In his new book, *Think Before You Compute: A Prelude to Computational Fluid Dynamics*, renowned fluid dynamicist Edward John Hinch provides an introduction to those techniques.

The titular exhortation outlines the book's objective: To help readers develop intuition about the physics and the mathematics necessary to formulate a problem, learn the techniques and algorithms used to solve the equations approximately, and understand the meaning of the results. The product of decades spent teaching the subject, *Think Before You Compute* is a superb introduction to the basic methods underlying the theory and practice of computational fluid dynamics (CFD).

The book is split into three parts. The first part starts with an invitation to jump directly into the deep end of the pool and solve the two-dimensional Navier–Stokes equations for flow in a cavity with a driven lid, which is a classic problem that encompasses and highlights all the major issues of CFD. The section discusses different formulations of the problem; issues associated with the pressure singularity at the corners; questions of stability, consistency, and accuracy in the finite difference discretization; and various iterative and projection-based methods. Helpful ready-to-run MATLAB codes are available on the author's website. (A better solution might be to host the code on GitHub and permanently link to the repository from the publisher's site.)

Hinch makes the case for part 1 to be covered in about three lectures and a few exercises. I tried that recently, and it works. The approach of using a single example to illustrate the main difficulties of the field is a refreshing change from other books in the genre that often take too long to spin up.