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Author Q&A: David Kaiser on physics and its history

The MIT professor of physics and the history of science talks about the new essay collection that covers his dual passions.

Melinda Baldwin

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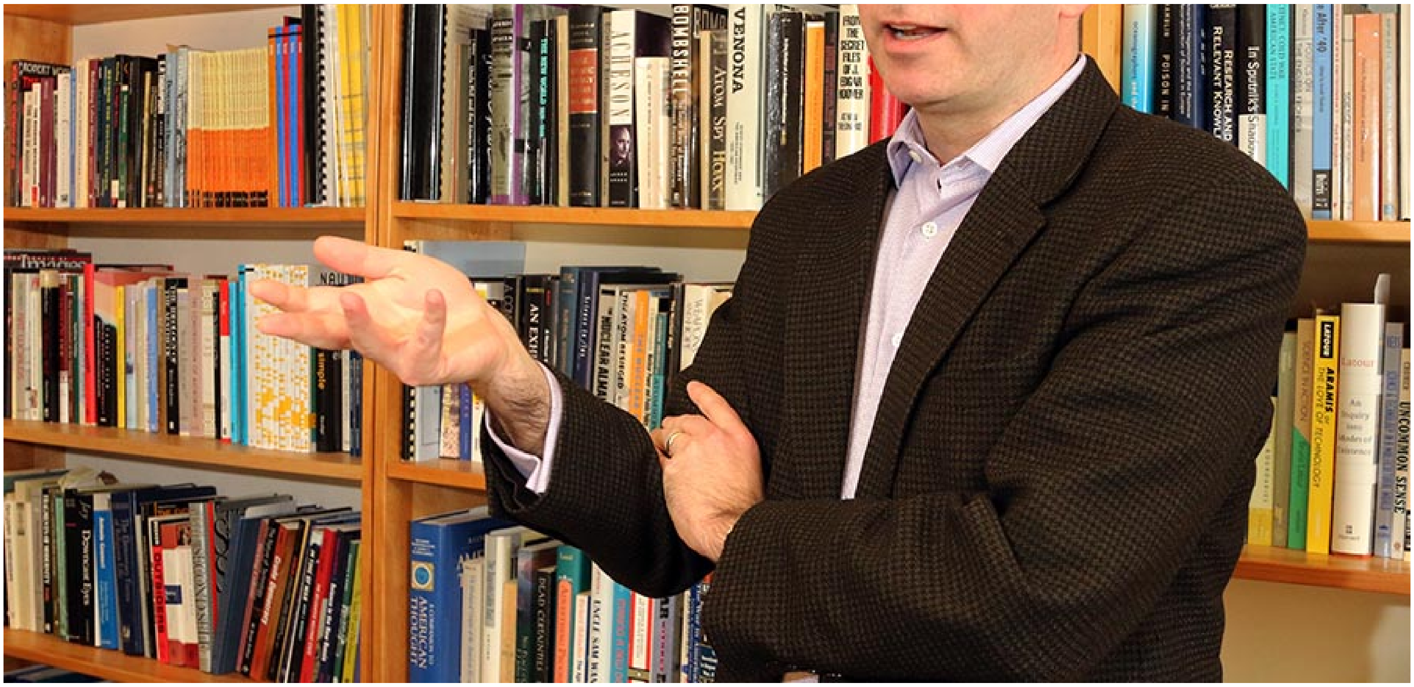

Credit: Allegra Boverman

David Kaiser wears many hats. He's a physicist whose work focuses on particle cosmology. He is also a decorated historian of science. His first book, *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics* (2005), won the History of Science Society's Pfizer Prize for outstanding scholarly book. His next, *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (2011), won the HSS Davis Prize for a book accessible to the general public.

Kaiser's latest book, *Quantum Legacies: Dispatches from an Uncertain World*, is an ambitious collection of essays that merges his two scholarly identities. The collection reflects on historical figures such as Paul Ehrenfest, Bruno Pontecorvo

scientific work. *Quantum Legacies* will be published this month by the University of Chicago Press.

PT: Tell us a bit about your background and training.

KAISER: I came to my undergraduate studies very, very excited about physics. But as an undergraduate, I also fell in love with the history of science. I was able to pursue both topics in graduate school. For the past 20 years, I have been very lucky to teach at MIT, where I'm a professor of the history of science and a professor of physics, and I have active research groups in both areas.

PT: *Quantum Legacies* is a wide-ranging anthology—some of the essays are purely historical, whereas others focus on your own physics research. What was your approach to compiling such a diverse collection?

KAISER: Most of the chapters had originally appeared in some form as essays. I had written them over the course of about a decade, and initially I didn't have a book in mind. But eventually I realized that if they were put together in a certain way, those essays could tell a kaleidoscopic story about modern physics. Crafting the book gave me the opportunity to update the essays, merge some of them together, and try to illuminate shared themes from a few different angles. The result is not a typical history monograph, where the reader has to start on page one and not stop until the end. I found it exciting to play with what was to me a new genre, a different way of trying to make an argument, tell some little-known stories, and convey some of those deeply exciting and strange ideas that we physicists get to play with.

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PT: How do you think your historical training influences your scientific work?

thinking as scientists, but even more so if we want to convey what we're thinking about to nonspecialists.

I think where my historical training really has been especially helpful is in thinking about human-scaled entry points into those phenomena. There's nothing more human-scaled than other humans. I find that embedding stories about physics concepts within stories about people—earnest, smart, hardworking people working together, sometimes in unusual or extreme circumstances, rather than lonesome geniuses working in isolation—can be helpful.

PT: A great example of that is the chapter in your book about your "cosmic Bell" experiment—you discuss both the scientific question you were trying to answer and the mundane process of trying to get telescope time and hoping the skies would clear. Tell us a bit about that collaboration.

KAISER: It's without doubt one of the all-time highlights of my career. It also has a pretty unusual origin point. My book *How the Hippies Saved Physics* had come out in 2011. It was a study of the early history of Bell's theorem and the people who cared about topics like quantum entanglement before they became very mainstream. One of my postdocs who had just come to MIT, Andy Friedman, read the book for fun and started discussing it with one of his very good friends from

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us astrophysicists began thinking about Bell's theorem—now as a new physics project rather than a historical topic.

sure we've tested it is as thoroughly and precisely as we can, constraining or ruling out alternative explanations along the way.

One important ingredient of these experiments is finding some source of randomness that can determine which specific measurements will be performed on each particle, for each experimental run, and trying to ensure that nothing about those random selections could affect the behavior of the particles prior to the measurements. That got us thinking about how we could turn the universe into two uncorrelated random number generators. If we could do that, and if we still continued to measure those spooky correlations among pairs of entangled particles that aggravated people like Albert Einstein and Erwin Schrödinger so much, then we'd have done all we could to shield our experiment from the most stubborn remaining alternate explanations for what could have let those correlations creep in.

To our great joy, Anton Zeilinger, a very accomplished experimental physicist based in Vienna, was excited by the idea when we pitched it to him. Together we were able to build an international team and really do the experiments: first generating random numbers using small telescopes focused on nearby stars, and later using a pair of four-meter telescopes taking in light from very distant quasars.

PT: The second part of your book collects essays on physics pedagogy, a topic you covered in your first book, *Drawing Theories Apart*. What led you to study the history of teaching physics? What do you think we gain from looking at physics classrooms that we might miss if we just focused on the history of physics research?

which we're embedded. What do we think is most important to equip our students with? Why do we think we want to train physicists at all, and who should pay for it? What subfields do we think should be our highest priority? How are all those decisions affected by institutions, by changes in broader society? Looking closely at the activity of making physicists opens up a range of social, institutional, political, cultural, and intellectual facets.

PT: What's been your experience as a physicist with the coronavirus shutdown?

KAISER: I'm sheltering in place like virtually everyone else. We all have a whole host of concerns now in our minds about our families, about our kids who aren't in school, about loved ones, about so many people who are more severely affected than we are. So it's not like our attention is only devoted to finding clever workarounds to enable some research and teaching to crawl forward.

Nonetheless, physicists have been ahead of the curve for decades in using a lot of remote communication tools, and that experience is certainly valuable now. Think about exploiting HTML to share documents among remote collaborations, for example, or developing the arXiv for the easy and accessible sharing of information. So in that sense, I don't think the work will halt.

But I do worry about my friends and colleagues in areas where you really have to have your hands on machines or even on massive, fancy computer simulations. Someone has to be making sure those machines and computer servers are up and

PT: What are you working on now?

KAISER: I have a couple of physics projects under way that focus on various questions in early-universe cosmology. I'm continuing to work with members of the Cosmic Bell Group on some new experiments we could try to conduct. I'm also working on a cosmology textbook with my very dear mentor, Alan Guth, who was my physics PhD adviser. That's especially fun for me because as a historian I've been fascinated by textbooks as historical objects. It gives me an extra perspective.

I have another historical project, a political history of general relativity over the course of the previous century. General relativity can seem ethereal or abstract—literally otherworldly—and yet physicists have crafted our understanding of spacetime while immersed in the here and now. In fact, some of the most significant turning points in our grappling with general relativity have occurred during especially dramatic, bloody, or disruptive times—world wars, the rise of Nazism, the Cold War and nuclear age. What I like about the project is that it necessarily involves many settings. It's not just a United States story, and it's not even just a 20th-century story. So it stretches me as a historian.

PT: What have you been reading?

KAISER: I'm rereading Alan Lightman's novel *Einstein's Dreams*. I read it shortly after it first came out in 1992, and it was so haunting and beautifully written that I recently went to my shelf and picked it up again. So that's what I've been reading at

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