InClass

A spotlight on faculty and their work

To Infinity and Beyond

As teacher, researcher and science fiction writer, Robert Scherrer takes imaginative leaps into the cosmos. By JONATHAN MARX

SCIENCE IS A DISCIPLINE OF VERIFIable facts and hard mathematical calculations, but it's also a realm where imagination is key to making new advances. All scientists have to indulge their creative side, to push past the limitations of established knowledge. For most, though, science fiction writing would be a frivolous pursuit, an exercise that takes away from valuable research time. For Vanderbilt physics professor Robert Scherrer, it's a natural extension of the work he does in the classroom and the laboratory, a chance to play around with scientific concepts in novel ways. During the last five years, this regarded astrophysicist has quietly nurtured a sideline as a science fiction writer, publishing regularly in the long-running monthly *Analog Science Fiction and Fact* and contributing to the semiannual journal *Paradox*.

"There are some similarities between doing theoretical physics and science fiction," Scherrer observes. "I refer to both of them as disciplined daydreaming, where you're trying to get beyond what we already know, but you can't just dream up anything. It has to be within certain confines." And even science fiction, he explains, has its own measure of rules and guidelines. "It's well known in physics that you have to obey the laws of physics, but science fiction writing has its own set of laws. You can't have warlocks and wizards and unicorns prancing through the scenery."

This kind of disciplined daydreaming has served Scherrer well during his nearly two-decades-long career as an academic. The chair of Vanderbilt's Department of Physics and Astronomy since 2003, he spent the previous 14 years at Ohio State University, where he earned that school's Alumni Award for Distinguished Teaching in 1999. Broadly speaking, Scherrer's field of study is cosmology, or the study of the universe as a whole. Within that area, though, he's engaged a number of topics. He's explored the production of elements during the first few minutes of the Big Bang; he's studied the way galaxies cluster in the universe; and, most recently, he's devoted his energies to understanding dark energy, which he describes as "the hypothesized stuff that's making the universe accelerate."

Scherrer's eagerness to tackle new ideas pretty well defines the man, says his colleague Scott Dodelson, a professor at the University of Chicago and a researcher at Fermilab, the Chicago-based laboratory specializing in particle physics. "If you look at the body of Bob's work going back 20 years, it's not just one specialty," Dodelson says. "Cosmology is a broad topic, and Bob has been contributing in many different areas. That's a striking thing about his work—how diverse he's been."

Scherrer's scholarly pursuits go into realms as infinitesimal as subatomic particles and as impossibly enormous as the universe itself. And yet, he points out, such research is fundamental to our basic understanding of human experience. "We don't think that ordinary matter, the kind of stuff that you and I are made of, actually is the dominant kind of matter in the universe. And so that is a very significant question: What is the universe made of? That's one of the fundamental questions of physics from ancient times, and it's something we're still trying to answer."

In the midst of such challenging queries, Scherrer's fiction writing gives him an outlet to come up with some playful answers. His approach is to toy with a scientific concept and see how it might work out if pushed to an extreme. "That's the style of writing I like—the 'what if' story, the idea-oriented story," he says. "That's just one of many ways to do science fiction, but it's the closest to doing science, I think."

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Scherrer: Teaching is one more way of keeping unanswered questions an active part of the scientific discourse until they yield a solution.

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For instance, in "Copernican Principle," Scherrer creates a kind of meta-science fiction, where he applies scientific and mathematical ideas to the very act of storytelling. In the story a professor struggles to get his half-asleep students to grasp the 16th-century astronomer Copernicus' notion that the earth doesn't occupy a special place in the universe. One kid speaks up, ready to advance the idea that if humanity has been stripped of its unique status in the cosmos, our existence would be even more in line with the Copernican Principle if it turned out we were simply living in a computer simulation. Troubled by the thought, and unable to come up with a counterargument to the student's claim, the professor then suggests we could just as easily be characters in a fictional story—at which point Scherrer answers the question, and the story, with a deft finish.

Stanley Schmidt, the editor of *Analog Science Fiction and Fact*, which during the course of its 76-year history has published stories by Isaac Asimov and Robert A. Heinlein, says it's not uncommon for science professionals to submit stories to his journal. "I like to think of us as the magazine that puts equal emphasis on the words 'science' and 'fiction.' We want the science to be solid and important, but we also want entertaining, well-put-together stories about interesting characters and interesting situations."

That, Schmidt explains, makes Scherrer a perfect fit for *Analog*. "He has a good mixture of scientific speculation and entertaining stories, and I just wish he would write more of them! His stories certainly aren't just about scientific gimmicks. They're very much people stories, too."

Finding that perfect mix of science and fiction is a challenge, Scherrer observes. "A lot of people think it's really easy to write science fiction if you're a scientist because you can just write the stuff you're doing and stick it in a magazine. I think it's actually harder, though, because when you know the subject so well, it's a lot harder to make leaps of the imagination. You're constantly second-guessing yourself. But if everything you write is factual, then you might as well write it up as a physics article. If it's all stuff we know to be true already, then it's boring, right? And if it's crazy, it's not plausible.

"So what you're trying to do is constantly hit the spot between stuff that sounds crazy and stuff that's already known to be true. It's the same when you're doing physics research: You still have to balance between things that are boring and things that are crazy. You want to be able to extrapolate from what we presently know, but not go so far out on the fringe that people think you're a nut-case."

Even more challenging, Scherrer says, is working his own specialized area of research into a piece of short fiction. Knowing the subject so intimately can prove limiting. It wasn't until he'd published his sixth story, "Extra Innings," that Scherrer had ever tried introducing cosmology into one of his plots. The result was arguably his strongest piece to date, mixing his good-natured sense of humor with some of his abiding interests—namely, baseball and the expanding universe—in the story of a friendship that spans from the summer of '69 until the literal end of the cosmos.

If physics research and science fiction require a similar kind of balancing act, the demands that come with writing each couldn't be more different, Scherrer says. For an academic who must choose his words very deliberately, science fiction can be a liberating outlet. "Physics research writing style has this very bloated, heavy use of passive voice and compound nouns and qualifying of everything," he explains. "You don't want to say anything for sure because you might be proven wrong. The fiction writing style is much more peppy and direct, and you try to use colorful, descriptive things to suck the reader in."

Scherrer gave a talk at Fermilab on the subject this past March. To point up the differences in writing styles, he took the opening paragraph of "Extra Innings" and rewrote it as if it were a science paper, riddled with hyphens and past participles. "Most of the people at the talk had read a lot of science fiction and had written physics articles, so it was a natural thing to show them," he says. "That got the biggest laugh of anything in the talk."

The energy Scherrer brings to pursuits both scholarly and creative filters into his teaching as well. For him, the classroom offers the same opportunities for inquiry and discovery as the laboratory. "When you teach, it forces you to examine ideas you might not normally look at," he says. "Even when you teach very elementary subjects, like first-year physics, you can incorporate things going on in forefront physics. And when you're doing research, it allows you to talk about important things people are looking at today. You can bring those into the classroom and use them as examples and as a means of explaining how some of these principles work."

In a field where researchers are constantly reaching for new insights, Scherrer suggests that teaching is one more way of keeping unanswered questions an active part of the scientific discourse until they yield a solution. "On one occasion I was teaching the cosmology portion of a course for first-year students, and afterward I was thinking about something I'd said in the lecture and thought, 'Well, wait a minute, that ought to be something we could resolve.' I thought about it for a couple of weeks and came up with a solution to the problem and wrote a paper on it."

Scott Dodelson, Scherrer's colleague at Fermilab, recalls another time when Scherrer's intellectual curiosity yielded some innovative results. "A few months ago we came on this idea of analyzing baseball statistics in a particular way. Together we wrote up a computer program, got a bunch of data and started analyzing it. Bob's the first colleague I've had in a long time who has that excitement not just for cosmology—some might call it just a plaything. He really got into it, and it was fun to talk to him about it. I think that enthusiasm for all kinds of things distinguishes him."

It's fitting, then, that Scherrer should wind up at Vanderbilt, a campus where he finds himself surrounded by colleagues who share his passion for learning. "The faculty here are really well-rounded and have a lot of intellectual interests," he says. "They tend not to be quite so focused on their own narrow fields of specialization—they're interested in things beyond that." And in the case of Robert Scherrer, a man who has devoted himself to studying the universe in all its infinitude, that excitement for learning truly has no bounds.

Copernican Principle *By Robert Scherrer*

Professor John Rapaport paced back and forth at the front of his Astronomy 111 class, waving a sheaf of papers in the air. "Class," he said, "your performance on the midterm exam was abysmal. Let me correct a few of your misconceptions: Venus is *not* a star. The sun *is* a star. And Pluto is *not*, repeat *not* 'Mickey's dog.'"

John dropped the exams on the lectern and surveyed the faces of his yawning students. Mike McNamara snored in the last row, his enormous forearms folded on the desk, his crew-cut head resting on his arms. Mike had been the football team's star linebacker until that unfortunate incident involving the Chevy dealer.

"Mike, wake up!"

Mike's head shot up. "Yes, Professor Rapaport?"

"Mike, today we're going to discuss the Copernican Principle." John picked up a green marker and wrote "COPERNICAN PRINCIPLE" on the whiteboard. "What is the Copernican Principle?"

Mike stared, his eyes wide and his mouth gaping—a moose caught in the headlights. "Uh, I don't remember."

"Did anyone do the assigned reading?" asked John. "Paul, please tell me that you did the reading."

Paul Kresge put down his newspaper, revealing a face covered with metal studs—pierced ears, pierced nose, pierced lips. Did the man set off airport metal detectors? But at least Paul thought for himself—he was the only one in class who ever challenged anything John said.

"No," said Paul. "I thought this week's reading was boring. I read Chapter 17 instead."

"Not too smart, Paul," said John. "Okay, class, I'll just tell you what the Copernican Principle says. Copernicus showed that the earth is not the center of the universe. The Copernican Principle says that we don't occupy *any* special place in the universe." John sketched a green spiral on the whiteboard and marked an X near the edge. "For example, the sun is not located at the center of the Galaxy. It occupies an unremarkable location about two-thirds of the way out from the center."

"Wait a minute," said Paul. "Last week you told us that our galaxy is larger than average. Doesn't the Copernican Principle mean we should live in an average-sized galaxy?"

John smiled. "Now you're thinking, Paul. The Copernican Principle says that the earth should orbit an average *star*. We're just as likely to orbit one star as any other—"

"—and the bigger galaxies have more stars," interrupted Paul, "so we're more likely to find ourselves living in a big galaxy."

"Exactly!" said John. "Can anyone think of another application of the Copernican principle?"

An awkward silence filled the room, broken only by the faint ticking of the wall clock above the whiteboard. Paul raised his hand. "I've got one for you," he said. "I just read about this guy in England who claims that any advanced civilization will make computer simulations that are just like real life. So if every civilization made a million of these simulations, then the Copernican Principle says that we're more likely to be living inside a computer than in the real world."

"Well, Paul, you shouldn't push these arguments too far."

"And what's wrong with my argument?" asked Paul.

"Well, it's just that ..." John scratched his head. "Let me think about it—I'll tell you tomorrow."

Walt Gustafson slurped a strand of egg noodles in the Chinese dive on High Street where he always met John for lunch on Wednesdays. "That's the problem with theoretical types like you," said Walt, pointing a chopstick at John. "An engineer like me is never going to start believing this kind of nonsense."

"But how can you prove it?" asked John.

Walt tried to pry open a plastic pouch of hot Chinese mustard with his fingers, gave up, and slit it with a knife. "Well for one thing," said Walt, "if we lived in a computer simulation, these mustard pouches would be a lot easier to open."

"Be serious," said John. "I think the kid's argument is basically right—the Copernican Principle says we're more likely to be living in a computer simulation than not."

Walt shrugged. "Theories should follow reality, not the other way around." He cracked open his fortune cookie and pulled out the slip of paper from inside. "Hey, look at this," he said. "It says, 'The system will be shutting down in five minutes. Please save your work.'"

"What!" said John. He lunged across the table and tried to grab the fortune, but Walt pulled it away from his grasp.

"Sheesh," said Walt. "I'm just kidding." He popped the fortune cookie into his mouth. "You're really wound up about this."

"Well, what if they did shut us down?"

"Let me put your mind at ease," said Walt. He slapped the table, rattling the dishes and knocking over a plastic cup. "There, does that sound like a computer simulation to you? Ouch, it hurt, too. That's reality."

"Or it could just be a very convincing simulation of reality," said John.

"Oh, it's going to be hard to convince you, isn't it? I'll tell you what—suppose I can come up with an argument from the Copernican Principle that's so completely absurd that it shows that the whole idea is preposterous. Will you give up and stop worrying then?"

"Like what?" asked John.

Walt leaned back in his chair. "Try this one," he said. "Any advanced civilization is going to produce an enormous number of works of fiction. So the Copernican Principle says that we're actually more likely to be fictional characters than real people. Now you have to admit that *that's* ridiculous."

John was silent for a moment and then chuckled. "That's a good one, Walt."

Walt laughed. "And the funniest thing is that when the story ended, we would just disappear—poof! Now stop worrying and please pass the—"

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