FACULTY CENTER

Quantum Leap

This gifted physicist couldn't resist an attraction to black holes

On Professor Donald Marolf's web page, students can find information about his Physics 211 course, including a syllabus, lecture summaries, and other materials they might expect. They'll also find a link to a bit of verse called *Ode to Newton's Laws (with apologies to Dr. Seuss)*.

An excerpt: "Mechanics stems from Newton's Laws/We're here to study effects they cause/We'll see how objects move and shake/Will the bridge stand? Or will it break?/From friction, falling, levers, and slopes/To rockets, wheels, springs, and ropes!/No matter how we use these tools/Their motion follows from Isaac's rules."

MIKE PRINZO

Marolf's approach to physics instruction strikes a chord with his students, and with good reason: He's not much older than they are.

Marolf, 25, graduated from college at age 15. By 19, he had a Ph.D. in physics. He came to SU last September from the University of California at Santa Barbara, where he had done post-doctoral work for two years.

The young physicist makes light of his experiences as a prodigy. A native of Kansas City, Missouri, he entered William Jewell College in nearby Liberty at age 12. "It was great," he says. "When I got to college I looked a little bit older than I was, so no one knew that I was this young kid. It was just hang out, blend in, don't tell anybody, and when they found out six months later it was no big deal."

Marolf earned a Ph.D. at the University of Texas at Austin, where he worked in the general field of relativity. He then spent a year at SU doing post-doctoral work. "At the time, there was a very large group working here in relativity and quantum gravity," he says. "Syracuse historically has an extremely good reputation in this field."

Founded in the late forties by Peter Bergmann—who was a post-doctoral student under Albert Einstein for five years—SU's relativity research group currently includes three faculty members active in nearly all areas of theoretical gravitational physics.

Marolf's field is quantum gravity—an area of study that doesn't really exist. "Everyone who works in this field is actually trying to create it," Marolf explains with a grin. "The basic problem is that there's this thing called gravity—you have some idea of how it works—and there's this thing called quantum mechanics, which you may have heard of. Things like electrons, protons, even photons, particles of light, etc.—they don't really act the way you think they do. They follow a set of rules that are very different from Newton's laws of classical mechanics."

During a conversation in his office, Marolf looks around for something to illustrate his point. He spots a folder and grabs it. "Obviously, things like electrons and protons are affected by gravity," he continues, holding the folder over his desk. "This is made up of electrons and protons, and when I drop it, it falls. But we don't really have a satisfactory description of electrons interacting with

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electrons through a gravitational field. The idea of quantum gravity is to try to invent a description of these quantum objects interacting gravitationally. We understand how quantum objects interact through electric phenomena—like electrons in orbits around atoms—but the gravitational interactions, these we really don't understand."

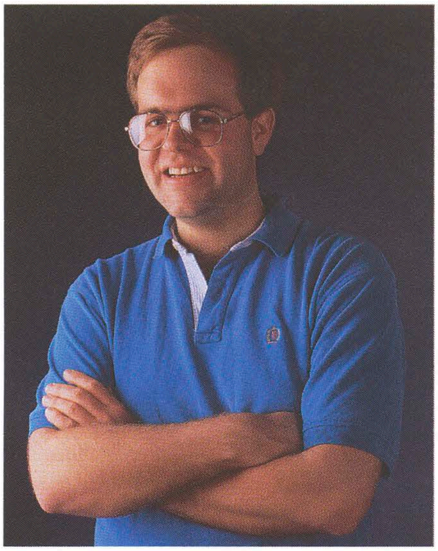
Marolf's research at SU includes the interface between black holes and thermal dynamics—"thermal properties of black holes, heat and temperature, that sort of thing"—and the study of simplified models of quantum gravity. "It's a very complicated field," he says, "so you try to derive systems that are qualitatively similar to the gravitational phenomena, but are much simpler to study because you study them by hand."

Marolf traces his interest in physics to a childhood fascination with astronomy. "That came from going on family camping trips and looking up at the night sky and saying, 'Wow,'" he explains. "I think a lot of kids have that reaction, but my parents' response was, 'So you like stars, huh? Well, here's the public library.'"

While reading astronomy books, Marolf came upon descriptions of exotic objects like pulsars, neutron stars, supernovae, and black holes. "A black hole is a very complicated object, which leads you to the study of Einstein's Theory of General Relativity because that's the only way to describe black holes. Black holes are the sites of very strong, very intense gravitational fields, and because the fields are so strong, quantum-gravity effects can be important in black holes. This is how I was led into it. Quantum gravity is a very interesting part of the general relativity theory and strong gravitational interactions, so it was a natural progression."

Abhay V. Ashtekar, who researched gravitational physics and relativity at SU for 13 years, says members of the relativity group were impressed by Marolf's abilities. When Ashtekar and others moved to Penn State in 1993 to create a center for the study of gravity, Marolf went with them and completed a second year of post-doctoral work before moving on to Santa Barbara.

"He is one of the most balanced people I have ever met in terms of what he wants to do in life," says Ashtekar, now chair of Penn State's physics department. "He is very much at ease with himself, which I think is remarkable for somebody who is a prodigy."



PHOTOS BY STEVE SARTORI

Physics Professor Donald Marolf is considered one of the rising stars in the study of gravitational physics.

Ashtekar says Marolf is considered one of the rising stars in his field. He was one of the top 24 people from around the world invited to attend a workshop on gravitational physics in Vienna last year.

"He's exceptionally bright and creative—and not just for his age. Even if he was 10 years older, he would still be a very bright and creative person," Ashtekar says. "The relativity group in Syracuse has been one of the leading players for 40 years. With Don's appointment, the group is again very well poised to take the leadership role it had for decades."

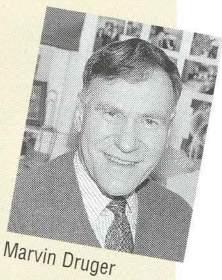
Along with his research, Marolf taught introductory physics classes last semester, and is now developing an advanced undergraduate class in relativity and cosmology to deal with such questions as why we can't travel faster than the speed of light. The course will cover things that first drew him to physics—like black holes.

"I'll spend a lot of time on it this summer, deciding what I want to say and how I'll put it all together," he says, and for a moment he's that kid again, looking up at the night sky during a family camping trip.

"I'm really excited about this."

—*Gary Pallassino*

MEREDITH PROFESSORSHIPS



Marvin Druger

➢ *Marvin Druger, professor of biology* and science education and chair of the Department of Science Teaching, and Shiu-Kai Chin, professor of computer engineering, have been named the 1997 Laura J. and L. Douglas Meredith Professors of Teaching Excellence.

Established in 1995, the Meredith Professorships are made possible by a bequest from the estate of L. Douglas Meredith '26. Each three-year professorship carries a $20,000 annual supplemental salary award; an annual $5,000 grant for professional development, hiring of student assistants, and sponsorship of guest lecturers; and a $1,000 fund for joint activities among Meredith Professors.

Shiu-Kai Chin

The selection of Druger and Chin brings the total number of Meredith Professors to seven. The others are Linda Alcoff, professor of philosophy in The College of Arts and Sciences; William Coplin, professor and director of the Public Affairs Program in The College of Arts and Sciences and the Maxwell School; Bill Glavin, professor of magazine journalism in the Newhouse School; Samuel Clemence, professor of civil engineering in the L.C. Smith College of Engineering and Computer Science; and Jerry Evensky, professor of economics in The College of Arts and Sciences and the Maxwell School.

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