# She has a warped sense of reality





*By Sharon Stello/Enterprise staff writer*

Imagine a water droplet stuck on a two-dimensional shower curtain in a three-dimensional room.

What if we are like that drop of water, trapped on a lower-dimensional membrane-like surface, never able to experience or even perceive existing higher dimensions?

And what if there are untold numbers of these planes, infinite in size, flat or warped “like reflections in a fun-house mirror,” each concealing unseen worlds?

Such mind-bending analogies are common from leading physicist Lisa Randall, a Harvard University professor who has captured the attention of physicists and general audiences alike with her theories of hidden extra dimensions. From 1999 to 2004, she was the most cited person in her field. Newsweek calls her “one of the most promising theoretical physicists of her generation.”

Randall — featured in the magazine’s Who’s Next list of 10 people to watch in 2006 — will visit UC Davis on Tuesday night to discuss her theories and latest book, “Warped Passages: Unraveling the Mysteries of the Universe’s Hidden Dimensions.”

Her talk starts at 7:30 p.m. in the Activities and Recreation Center Ballroom on campus. She will also sign copies of her book at 7 p.m. Monday at Borders Books and Music, 500 First St., Davis.

Randall believes there may be hidden dimensions, perhaps infinite in size rather than imperceptibly tiny and curled up into infinitesimal loops as previously hypothesized, beyond the three known dimensions of space — length, width and height — and one of time.

Additional dimensions of space, she says, could solve some problems with other theories. She has done the math to back up her ideas, but must wait for experiments to prove these theories are more than science fiction.

Technology has almost reached the point where this kind of research can be conducted. In 2007, the Large Hadron Collider near Geneva, Switzerland, will be switched on. The world’s most powerful particle accelerator “will bang together tremendously energetic particles that could turn into new types of matter we have never seen before” and leave evidence of particles traveling into or through other dimensions, Randall writes in her book.

Geared to a general audience and written in an entertaining and enlightening way, her book sums up the current state of modern physics, explaining particle physics, string theory and the role of extra dimensions, if they exist.

“Warped Passages” has received critical acclaim and was on the New York Times list of “100 Notable Books of the Year” for 2005 as well as

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LOCAL LINKS

Amazon.com's "Top Ten in Science."

The book is readable — even enjoyable — for those without a science background, but a handy glossary and index in the back of the hefty, 500-page volume prove helpful at times. Illustrations and graphics throughout help the reader visualize sometimes difficult and abstract ideas.

Randall has been investigating particle physics for several years, in particular looking at why particles are lighter and gravity weaker than would be expected. For example, a small magnet can lift a paper clip despite the Earth's entire mass pulling in the opposite direction.

"That's basically the puzzle we want to solve," Randall said in a phone interview.

In 1998, Randall and collaborator Raman Sundrum of Johns Hopkins University put forth one possible explanation for gravity's weakness.

"Our proposal is based on warped geometry, a notion that arises in Einstein's theory of general relativity," Randall writes in her book. "According to this theory, space and time are integrated into a single space-time fabric that gets distorted, or warped, by matter and energy. Raman and I applied this theory in a new, extra-dimensional context. We found a configuration in which space-time warps so severely that even if gravity is strong in one region of space, it is feeble everywhere else.

"And we found something even more remarkable," she writes. "Although physicists have assumed for 80 years that extra dimensions must be tiny in order to explain why we haven't seen them, in 1999 Raman and I discovered that not only can warped space explain gravity's feebleness, but also that an invisible extra dimension can stretch out to infinity, provided it is suitably distorted in a curved space-time. An extra dimension can be infinite in size — but nonetheless hidden."

A year later, Randall and physicist Andreas Karch discovered that "we could be living in a three-dimensional pocket of space, even though the rest of the universe behaves as if it is higher-dimensional."

The idea for these theories came about while she examined supersymmetry, a theory that claims every particle has a partner. Randall wanted to know why particle interactions, which are predicted by that theory, never actually occur.

"There's twice as many particles in the world than we've seen, at least," Randall said. "It looks like an extra dimension could solve that problem."

Perhaps we haven't noticed these dimensions because we are stuck on a "brane," a membrane type of surface — like the shower curtain analogy — that traps worlds in a lower-dimensional subspace. Our world could be lost in a three-dimensional pocket of higher dimensional space.

Research into additional dimensions has led to remarkable concepts from parallel universes to warped geometry and three-dimensional sinkholes.

"Outlandish as they might seem at the moment, they are genuine scientific scenarios that could arise in an extra dimensional world," Randall writes in her book.

The existence of extra dimensions would give humanity another

perspective with which to view the cosmos. It would also point scientists down a new path in the never-ending quest to explain how the universe works.

“We would know we’re on the right track,” Randall said.

Randall was raised in Queens, N.Y., and during high school won the Westinghouse Science Talent Search, now called the Intel Science Talent Search, with a number theory project on complex numbers.

She completed her undergraduate and doctorate degrees at Harvard and went on to teach at Princeton University, where she became the first tenured woman in the physics department, and then moved on to become the first female theorist at the Massachusetts Institute of Technology. Returning to Harvard, she was the third woman to attain tenure in physics.

Her lecture at UCD is sponsored by the High Energy Frontier Theory Initiative and physics department. For more information, go online to particle.physics.ucdavis.edu/hefti/lecture.html.

Admission is $7; free for students. Tickets may be purchased in advance from the UCD Ticket Office at Freeborn Hall or online through Tickets.com (for an additional fee). UCD students with an ID may pick up free advance tickets at Freeborn Hall. Tickets may be purchased at the door subject to availability.

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