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A black-hole breakthrough in Brownsville

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By KAREN HASTINGS / Special Contributor to The Dallas Morning News

BROWNSVILLE – Compared to Newton's famous apple encounter, astrophysicist Manuela Campanelli's "eureka moment" in gravity science actually took up most of last summer. That's when her supercomputer simulations of colliding black holes finally stopped crashing.

BRAD DOHERTY/Special Contributor
'It's not about the place, but the people who achieve,' says Dr. Manuela Campanelli of the University of Texas at Brownsville.

At first, Dr. Campanelli and her team of university collaborators were thrilled but cautious: Could it really be the Holy Grail of their scientific field, the solution to a famously stubborn problem in using computers to solve Einstein's theory of general relativity?

Last month, the scientific world welcomed Campanelli and company's breakthrough in gravitational wave astrophysics.

A nod to the wave center

It came from a seemingly unlikely spot: not Caltech or MIT, but a former community college just an apple's throw from the Texas-Mexico border.

"I'm hearing the excitement in the scientific community because this has been stuck for so many years," says Dr. Campanelli, an associate professor of physics and astronomy at the University of Texas at Brownsville and associate director of its Center for Gravitational Wave Astronomy. "We provide a role model to show that this kind of work can be done here at UTB. It's not about the place, but the people who achieve."

Dr. Campanelli's achievement is the latest for UTB's gravitational wave center, which has put this border university on a map.

Only 4 years old, and on a relatively shoestring budget, the center is involved in some of the most sophisticated research today in the field of gravitational waves.

Last December, UTB followed cities like Kyoto and Rome as host of the 10th annual international Gravitational Wave Data Analysis Workshop.

Gravitation waves – ripples in the fabric of space-time caused by huge celestial bodies such as black holes – are predicted by Einstein's theory. By detecting and studying these gravitational disturbances, scientists hope to create a new window into the universe, reaching back in time and space to its very beginnings.

So far, scientists have not yet directly detected gravitational waves, but two high-profile government-funded projects are racing to accomplish that milestone. The up-and-running Laser Interferometer Gravitational Wave Observatory (LIGO), of which UTB is a scientific collaborator, and the space-based Laser Interferometer Space Antenna (LISA), now in development, both aim to find these space-time ripples.

UTB's work is important because colliding black holes provide the kind of celestial thud most likely to produce detectable gravity waves as they radiate outward at the speed of light. For years, attempts to create and study 3-D computer simulations of these cataclysmic space wrecks were stalled by computer crashes.

Roadblock ends

By jumping this complex roadblock, the UTB team of Dr. Campanelli, Carlos Lousto and Yosef Zlochower were able to reproduce the merger of two spinning black holes.

Their advancement, along with parallel work by other university teams, gives scientists new help in designing LISA, and a better idea of what to look for when gravitational wave data from these projects starts to arrive.

"For more than 35 years we have been trying to solve this problem. People thought it was impossible," says Dr. Campanelli, a Swiss-born Italian who came to Brownsville from the prestigious Max Planck Institute in Germany. "We came across this discovery, and the computer codes didn't crash anymore. It turns out it's not so complicated."

But it was the big boys at NASA's Goddard Space Flight Center who got all the national press last month, with a news conference and science headlines about their similar and near simultaneous black hole breakthrough. Goddard had independently attacked the same problem, achieving what it called the "largest astrophysical calculations ever performed on a NASA supercomputer."

It was Dr. Campanelli and her team – with their relatively tiny UTB supercomputer, less than one-twentieth the size of NASA's behemoth – who took the solution a step further. Both discoveries appeared in the March 24 issue of the prestigious *Physical Review Letters*, with UTB's received on Nov. 9, 2005 – nearly a week before the NASA Goddard team's submission.

Not that anybody's counting.

Building a program

Ten years ago, Mario Diaz came to Brownsville to build a physics program for a fledgling UTB, which shares a campus with Texas Southmost College. Since then, the department has collected multimillion-dollar National Science Foundation and NASA grants, created the Center for

Gravitation Wave Astronomy, launched a master's degree program and collected a stable core of scientists. Dr. Diaz notes the program is attracting quality graduate students, and has already trained several post-doctoral researchers for positions at Loyola University, Caltech and NASA Goddard, among others.

Richard Price, a veteran of 30 years on the faculty of the University of Utah, came to UTB because of its "potential for change and improvement and excitement."

"I may have overshot. There's too much excitement," says Dr. Price, a highly published name in physics. "We want to be the best group in this field of gravitational wave analysis, and we already have a claim on that."

Before coming to Brownsville, Dr. Campanelli, husband Lousto and other collaborators had already made headlines in their field of "numerical relativity" with a project called Lazarus, also concerned with the black hole simulation problem.

Dr. Campanelli says UTB's recent breakthrough shows what a small university can do if it focuses on centers of excellence. "We competed with NASA and Caltech with much less resources. We can do it. We've proven it. It's a dream that can be realized."

Dr. Fredrick Jenet, 34, who specializes in the detection of gravitational waves through "pulsar timing," joined UTB last year from NASA's Jet Propulsion Laboratory at Caltech. Twice a year he travels to Australia to collaborate with top-ranked pulsar scientists there.

In August, he and other Brownsville physicists head to Nanjing, China, to teach introductory workshops in gravitational wave astronomy, and recruit new students.

Dr. Jenet believes astrophysics has a romantic appeal. "It's a science that tries to answer a lot of the same questions religion does: How did we get here and where are we going? By studying gravitational waves, we'll essentially be able to see very far back into the creation of the universe. We'll be staring the creator straight in the eyes."

Dr. Jenet also believes astrophysics has the chance to help people on the border by improving science education. He and other UTB physicists are helping include high school and college students in real scientific research by tapping into cutting-edge astronomy projects.

"We're showing this university what it means to be excellent," Dr. Jenet says. "There's Caltech on the West Coast and MIT on the East Coast. Why can't there be UTB on the Gulf Coast?"

Karen Hastings is a freelance writer based in Harlingen.