EXCELLENCE IN RESEARCH AND INNOVATION

LEADERSHIP

Collaboratively stripping the cosmic onion

Physics professors Dr. Zisis Papandreou (right), Dr. George Lolos and Dr. Andrei Semenov work at the Detector Development Lab at the University of Regina. DEPARTMENT OF PHOTOGRAPHY, UNIVERSITY OF REGINA

How do you study the glue that holds the universe together? Well, for one thing, you've got to stick with it, according George Lolos and Zisis Papandreou, physics professors at the University of Regina and lead researchers of GlueX, and you need to engage in international collaboration.

It's been a 15-year process for the two researchers, but a recent milestone – the first experiment – amped up the excitement.

"We just received the first particle – the first beam, as we call it – into the detector system at the Jefferson Lab in Virginia," says Dr. Lolos, adding there was unfortunately no champagne in sight to commemorate the momentous occasion.

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> **Dr. David Malloy**
> is the University of Regina's vice president of research

The findings of the GlueX experiments will have implications for everything surrounding us, says Dr. Lolos, explaining that while matter consists of atoms and molecules, he is not interested in anything that big. Instead, his focus is on elementary particles, specifically quarks.

"Let's take a proton that consists of three quarks," Dr. Lolos says. "The problem is that the forces between the quarks are very, very strong." Since the quarks cannot be isolated – they are essentially what physicists call "confined" – researchers have come up with models and calculations about what holds them together.

"The question is, which model is right," Dr. Lolos muses, adding that the experiments will provide answers about the "nuclear glue, the mortar that holds the quarks together."

It's not unusual that experiments tackling problems that large take 15 to 20 years to set up. And a field like subatomic physics – where the data is very complex – requires a strong synergy between the theoretical and experimental, says Dr. Papandreou.

The 120 physicists involved in GlueX are mostly from the U.S., Canada, Australia and Scotland, he says, adding that each participating university is responsible for building a particular subsystem.

One key piece of equipment – the biggest detector weighing 25 tonnes – was built at the University of Regina.

How does a Canadian university in the middle of the Prairies get to play a pivotal role in an international collaboration like GlueX?

It doesn't come as a surprise to David Malloy, the University of Regina's vice president of research, who explains that the "Prairies are and have always been multicultural."

Added to the long-standing tradition of co-operation between, for example, Cree, Irish, Ukrainian, French, Chinese and Philippine cultures is the relative geographic isolation.

"We've had to be entrepreneurial in developing partnerships in order to flourish. And it turns out we're rather good at it," says Dr. Malloy.

The university's strength was recently recognized in its number one ranking in international research collaboration by Research InfoSource, one of Canada's premier research intelligence firms. Dr. Malloy sees this as a testament to "a robust exchange of knowledge across borders and continents, supporting a vibrant research culture and improved student experience, all in a place not typically thought of as a global hub."

The next stage of GlueX may well further boost the university's image.

The recent "engineering run" at Jefferson Lab won't yield physics result yes, says Dr. Lolos. "It's to see whether the components of the very complex detector system are working successfully."

While spinoff technology from setting up the experiments has already found its way into the market, Dr. Papandreou explains that the physics data – which will hopefully reveal the exotic forms of matter that makes up the nuclear glue – will be generated between 2016 and 2021 when the experiment will run continuously.

Drs. Lolos and Papandreou expect profound insights. "Everything in the cosmos is made of layers. We are looking at the deepest possible layer. We want to strip what we call 'the cosmic onion,'" they say.

TRAINING

Aircraft simulator boosts lifesaving skills

The Carleton University Simulator Project (CUSP) has a range of motion that can help pilots prepare for difficult flight scenarios. SUPPLIED

An aircraft simulator currently under development at Carleton University could significantly reduce aircraft-related fatalities by changing the way pilots are trained. According to Dr. Robert Langlois, who is heading up the Carleton University Simulator Project (CUSP), most simulators currently in use lack the range of motion necessary to teach pilots how to respond to the kinds of violent motions real planes encounter as they approach the boundaries of controlled flight.

Most simulators, he says, are six-legged creatures that cannot flip upside down or go into spins and spirals the way real aircraft can, and National Transportation Safety Board data suggest that many airline fatalities on U.S. carriers could have been prevented if pilots had received simulator training that prepared them for these kinds of severe events.

The CUSP project addresses the problem neatly. "The unique thing about our simulator is that it can provide unbounded rotational motion," says Dr. Langlois.

It may look and feel like a funhouse ride at times, but its ability to replicate the kinds of motions real aircraft encounter could make it an invaluable tool for saving lives. "Our simulator will expose pilots to scenarios where they have to react to difficult situations that require a level-headed and experienced response," he says.

Dr. Langlois adds that it will not replace current type-specific aircraft simulator training – to fly a Boeing 767 you have to train on a Boeing 767 simulator -- but rather augment it. "It's more of a part-task trainer that helps pilots learn how to deal with the kind of catastrophic events standard simulators cannot reproduce." That would make it the kind of simulator any and every pilot training facility would want to have in its tool kit.

Easily controllable, efficient, compact, quiet, electrically actuated and affordable, the CUSP project has already attracted the attention of established simulator manufacturers, and a full-size prototype could be ready for testing as early as March of 2015.

BY THE NUMBERS

Universities undertake **$10-billion** worth of research activities.

About **50% to 60%** of research performed by universities is externally funded.

Source: www.aucc.ca/policy-issues/research-and-innovation