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# Distinguished Alumni Award • Gerald Gabrielse '73

"Gerald Gabrielse's research specialty, antimatter, sounds more like the stuff of science fiction than nuclear physics. In fact, it is the combination of matter and antimatter that propels *Star Trek* 's fictional Starship Enterprise from galaxy to galaxy.

Yet, Gabrielse '73 points out, his experimentation is actually the study of the simplest of particles. "We study just one electron or one antiproton or a few helium atoms at a time," he said.

As simple as Gabrielse makes that sound, creating, separating, collecting and slowing the particles is about as complex a science venture as one can imagine. That's why it is performed in only a few places in the world.

The Center for European Nuclear Research near Geneva, Switzerland, is one of those places and is where Gabrielse conducts his antimatter research.

It is here that Gabrielse, the Leverett Professor of Physics at Harvard University, leads an international team of researchers called ATRAP (for antihydrogen trap). They study antimatter particles at about 455 degrees below zero.

"We make antimatter and then look at it really closely to see if we can detect any differences between a proton and an antiproton (which has the opposite electrical charge)," he said. "In experiments at Harvard, we suspend one electron in empty space while we measure its properties."

Gabrielse and his co-researchers' most recent achievement is the measuring of one electron's magnetic moment.

"If you imagine that inside of each electron is a little bar magnet, then we were able to measure

the size of the magnet to 1 to 1 of the 12th power," he said. "What this does is it allows us to test our most fundamental theories; we are looking to see if we understand reality. No one has ever probed the electron at this level of accuracy. We can now check if what has been calculated is the same as what we've been able to measure."

Successes such as this are what invigorate his research, he said. "We tend to focus on fundamental notions and test them; so far we have only confirmed our understanding of the way things are. If we were to topple a basic theory, a huge revision would be required."

For example, theory argues that antimatter would behave identically to regular matter in terms of gravitation. If Gabrielse and his team were to find that this is not true, it would call for a reformulation of the most basic theories and ideas, he said.

Gabrielse, though, isn't looking to change reality, only to study God's creation.

"I am a Reformed Christian scientist," he said. "That is really not so extraordinary. I believe it makes God happy when I try to figure out how he put the world together."

His research is an attempt to do that. "I do not believe that science and the Bible are in conflict. However, it is possible to misunderstand the Bible and to misunderstand science," he said. "It is important to figure out what of each might be misunderstood."

In his day-to-day experiments, there are many challenges. The result of some of those challenges has also led to some practical applications, which is no surprise in the world of science, he said.

### *More Online*

The Calvin Alumni Association presents the Distinguished Alumni Award to two each year. Nominations are due by October 1 each year.

Visit the physics and astronomy department web site

Gerald Gabrielse's Harvard web site includes info on his ATRAP research team

"We use lasers every day: in CD players, at the grocery store. We carry many transistors in our pocket every day, too. Neither was invented by someone trying to make something practical that would revolutionize our culture," he said. "When we push technology really hard, sometimes we invent things to solve our problems."

As a result, Gabrielse holds a patent on a shield that protects sensitive equipment, such as a hospital's MRI (magnetic resonance imaging) machines, from stray magnetic fields.

"In one experiment, our magnetic field kept changing," he said. "At one point, I said, 'I'm cooked. What am I going to do about this?' That led to the shield invention."

Also, a trap designed by ATRAP to hold antimatter is being used to hold drug compounds so they can be analyzed more precisely than ever before. This could lead to new and better performing drugs.

Gabrielse's work is highly regarded by his colleagues.

"His work is absolutely first magnitude and is the sort of thing of which Nobel prizes are made," wrote Marlan O. Scully, director of the Institute for Quantum Studies at Texas A&M University and professor at Princeton University.

Added Alan Kostelecky, distinguished professor of theoretical physics at Indiana University: "Success in an endeavor of this magnitude requires an individual with exceptional physics and engineering ability and outstanding leadership qualities, which Professor Gabrielse evinces in full measure."

In addition to his cutting-edge research, which has him commuting to Switzerland weekly for at least one-half of the year, Gabrielse continues to teach in the Harvard physics department, involving many of his students in his research.

"As a student at Calvin, I had excellent professors," he said. "John Van Zytveld provided me with an excellent opportunity to develop my lab skills. This is when I came to the realization that this type of work was a lot of fun. I hope to provide my students with the same experience as I was able to take part in as a student."

Gabrielse is the recipient of numerous fellowships, awards and honors, including Harvard's Levenson Prize for Excellence in the Education of Undergraduates, the Harvard Ledlie prize for outstanding research, the Davison-Germer prize of the American Physical Society, and the Alexander von Humboldt Research Award. He also has served as a member of the board of trustees at both Calvin and Trinity Christian College, and was twice a delegate to the Christian Reformed Church synod. He gives upwards of 25 outside lectures on science each year-some of these popular science lectures and some on science and religion.

Gabrielse lives in Lexington, Mass., where his wife, Ellen, is an English teacher at Lexington Christian Academy. His son, Joshua, graduated from Calvin and is a teacher with the Teach for America program. His daughter Abigail graduated from Harvard and is a corporate technical writer. Daughter Deborah is a 2006 graduate of Simmons College in Boston.