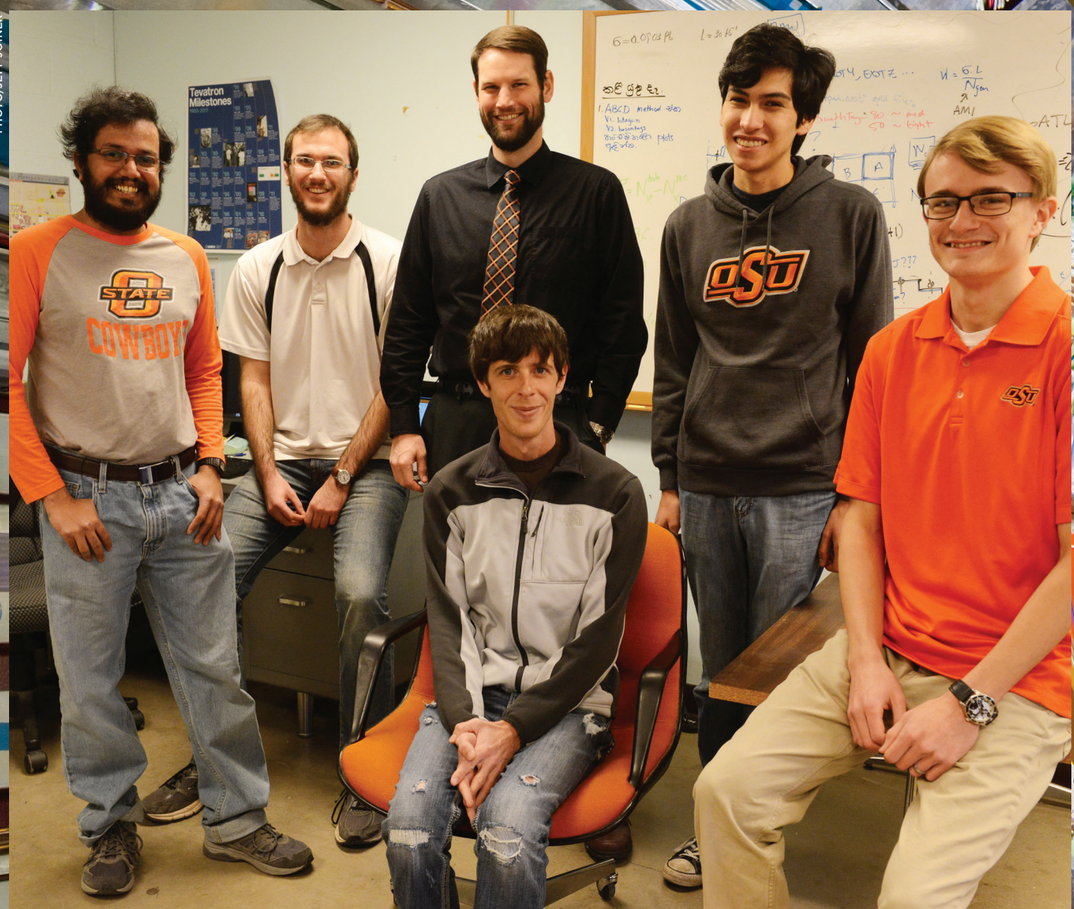
Writing the Rules of the Universe

BY BRYAN TRUDE

PHOTO COURTESY CERN

Built in 1952 by a consortium of 12 European nations, the European Organization for Nuclear Research laboratory occupies a large space near Geneva, Switzerland. Better known as CERN (a French abbreviation for the European Council for Nuclear Research, the group that founded the lab), it is home today to some of the world's largest and most powerful particle accelerators and decelerators, including the Large Hadron Collider (LHC), the largest and most powerful accelerator built by human hands.

PHOTO/JEFF JOINER



Physicist Joseph Haley with his laboratory students on the OSU campus. The group includes (from left) M.R.D. Madhuranga Thilakasiri and Evan Van de Wall, graduate students, Haley, Leland Palmer, a sophomore, Cameron Racz, a junior/senior, and David Mayes (front), a senior. A CERN scientist in Switzerland (below) works on the inside of the ATLAS cryostat, which cools liquid argon to minus 290 degrees Fahrenheit.

Research at CERN has led to some of the largest and most significant discoveries in particle physics in human history, expanding mankind's understanding of space and time. In Stillwater, a team of Oklahoma State University scientists and students help push humanity's knowledge of reality forward.

Joseph Haley, assistant professor of physics, serves as the point man for a team of OSU faculty, students and postdoc researchers working with scientists and institutions from around the world on the ATLAS Experiment.

Short for "A Toroidal LHC Apparatus," ATLAS is an experiment aimed at utilizing the energy output available from the Large Hadron Collider to observe phenomena not previously observable through lower-energy colliders. The goal is to illuminate theories of particle physics beyond the "Standard Model," a formulation developed in the mid-1970s that attempts to explain how matter behaves at the subatomic level.

"The basic idea is that it boils down to Einstein's Theory of Relativity," Haley says. "It works well, but we know it has problems. … It explains almost every measurement we've done, it's the best tested theory in history, but if we use it to calculate what should happen at higher energies, certain calculations give nonsense answers, such as probabilities greater than 100 percent."

As matter approaches the speed of light, Haley says, Newtonian mechanics begins to break down, so Einstein's Theory of Spatial Relativity is used to predict how matter will behave at near-light speeds. The Standard Model serves a similar function in particle physics, allowing scientists to say how particles will behave at certain energy levels. As interactions begin to take place at higher and higher energy levels, however, the Standard Model begins to no longer fit, so a new theory is needed.

ATLAS was created to help discover that theory.

Along with Fiera Rizatdinova and Alexander Khanov, Haley leads a small team of assistants and scientists searching for new particles created in the collisions produced at CERN by the LHC facility. Members of the group work both on-site at CERN and from facilities in Stillwater.

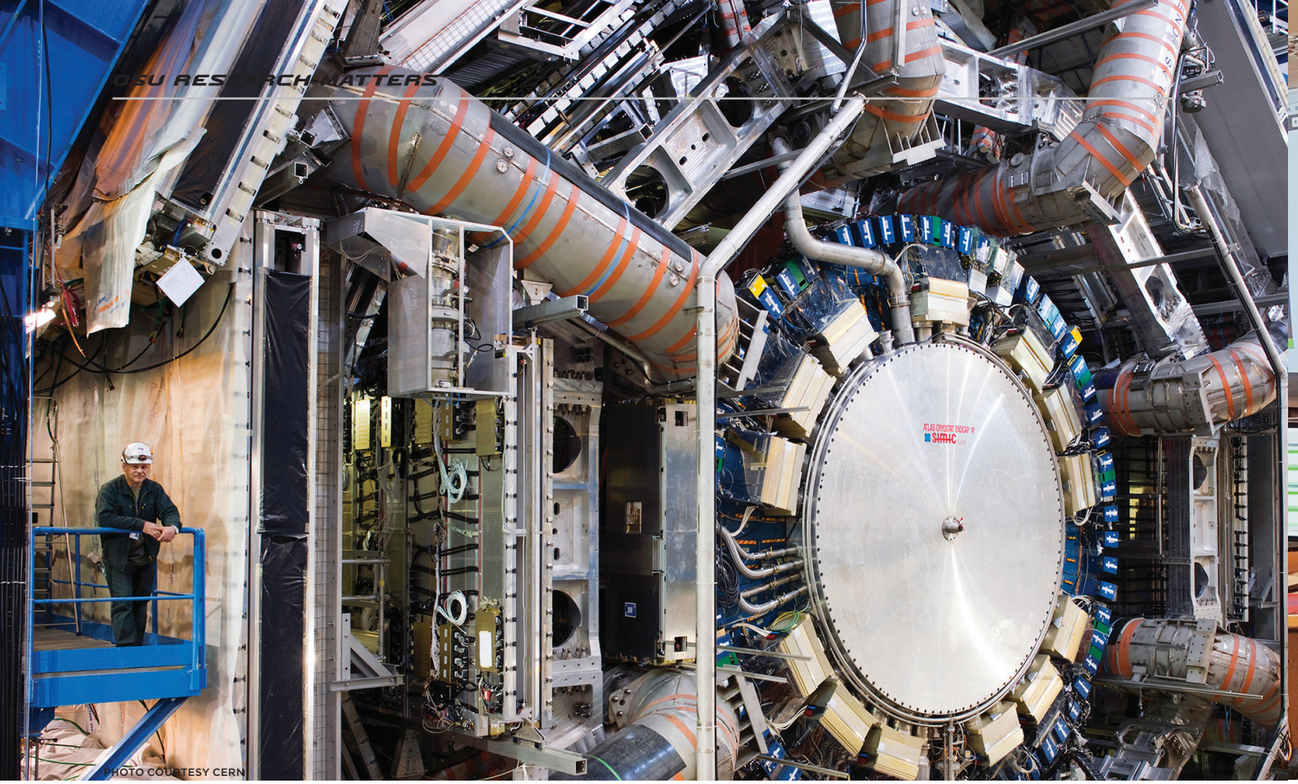


PHOTO COURTESY CERN

A technician stands on a platform to show how large the ATLAS particle detector is. The collection of instruments that makes up ATLAS is 82 feet in diameter.

The allure of working with such a globally recognized facility such as CERN and the LHC proved to be a big draw for some of the younger assistants. Currently, three undergraduate students, two graduate students and two postdoctoral researchers work in Haley's group.

"I got involved my freshman year when I decided to start doing research, and I sought out Dr. Haley," says sophomore Leland Palmer, an undergraduate assistant on ATLAS. "I heard about CERN in high school, and I was very interested in it. [Haley] had me read many things for background at first, but after a month or so, I began doing more complicated things."

For many researchers, including Haley and his team, working at CERN is both a big draw and a source of pride, especially considering the lab's place in popular culture following the completion and first test of the LHC in 2008.

Even today, the LHC and CERN remain popular tabloid fodder for conspiracy theories ranging from secret weapons tests to the creation of black holes and portals to hellish realms.

"It is kinda funny, because when you get down to the nitty gritty of it, it's just a bunch of scientists — not really the most glamorous people — who just want to get some science done," Haley says .

One of the biggest benefits of participating in ATLAS, in Haley's opinion, is the camaraderie and experience of being immersed in a global scientific culture, with people from all nations working together for the benefit of humanity.

"I would love to send students to CERN," says Haley, who has been there as a postdoc researcher. "I think that would be so awesome. … If you can stay there a couple of months, you can start to do real research and be part of the culture."

David Jamin, an OSU postdoc researcher stationed at CERN, remembers the feeling he had the first time he set foot on the lab's Swiss campus, after finishing his Ph.D. work in Marseille, France.

"I got my diploma, [broke up] with my girlfriend, and left the city where I spent four years to do my Ph.D., a switch that happened in two days," Jamin says.

PHOTO COURTESY JOSEPH HALEY

OSU postdoctoral researchers, Josu Cantero (left) and David Jamin work in the ATLAS control room at the station that monitors the central tracking detectors. A team of OSU scientists and students work at the ATLAS experiment in Europe.

"Packing my life in to a truck, driving 400 kilometers to start a new life."

Through the work of Jamin, Haley, Palmer and the rest of the OSU ATLAS team, Cowboy scientists get to indulge in the history of human advancement and help break new boundaries and have a hand in new discoveries.

"Spending time at CERN is a little like visiting a museum. It makes me very proud and motivated to make great things," Jamin says. "I get to see the building where the World Wide Web was born, the bubble chambers from past experiments. The most impressive thing I've seen is the underground chamber for the ATLAS detector on the LHC.

"We can explore new areas of physics, thanks to the unique collider there. … Here, we can access and test the limit of the boundaries of human knowledge. This is a work that makes every day unique, different, sometimes hard and sometimes magic. ORM

PHOTO/JEFF JOINER

Joseph Haley, assistant professor of physics.