signal to background

The real world of *Angels & Demons*; CMS digs Roman history; sand and silence in Morocco; carpenters carve an ATLAS; battle of the buzzer at SLAC; what's in your office?

Tom Hanks, Ayelet Zurer and Ron Howard at CERN to promote the movie *Angels & Demons*. Photo: CERN

Physics lessons from *Angels & Demons*

Reyna Pratt spends her days preparing high school students in Virginia for an increasingly competitive world. They learn biology, algebra, English composition, world history, and world cultures.

"I would love to teach my students about nuclear and particle physics," says Pratt, a former theoretical nuclear physicist. "There's just no time in the curriculum and schedule."

Now, thanks to *Angels & Demons*, the big-screen adaptation of Dan Brown's best-selling novel, her students and many others will get a glimpse at those scientific worlds, wrapped in Hollywood glitz and action.

The private girls' school where she teaches is one of about 50 locations in the United States, 10 in Canada, and several in Europe and Asia scheduled to offer lectures explaining the science behind the film, its factual inaccuracies, and what high-energy physics research can do for the world.

"When I saw this opportunity," Pratt says, "I snagged it!"

The film, which stars Tom Hanks, is a detective story about an ancient secret society that tries to destroy the Vatican with a bomb made of antimatter stolen from a particle physics laboratory. Parts of the movie were filmed at CERN's Large Hadron Collider, the world's largest and most complex scientific venture.

In reality, antimatter would be useless as a bomb or energy source; it's too hard to produce and store. The book misrepresents the production and storage of antimatter at CERN and portrays the European laboratory as more opulent than it really is.

Nonetheless, dozens of scientists are seizing on the film as a way to convey the truth about particle physics, using lecture materials prepared by CERN and Fermilab—the only other place in the world that produces and stores significant numbers of antimatter particles.

One of those volunteer lecturers is David Goldstein, a physicist studying acoustics at the Naval Research Laboratory.

"If I can contribute to inspiring someone," he says, "or clear up some misunderstanding, or answer some questions in a way that someone might not otherwise have access to, then so much the better."

Find lectures near your town at www.uslhc.us/Angels_Demons.

Tona Kunz

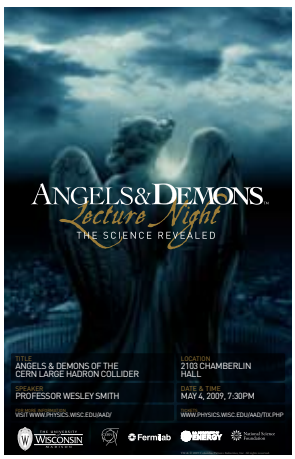


Photo courtesy of CMS

An LHC detector's old Roman roots

Particle physicists probe uncharted territory for remnants of the early universe.

But that is supposed to occur *after* their experiments turn on.

In the case of the Compact Muon Solenoid experiment at CERN's Large Hadron Collider, the discovery of ancient relics began when workers started digging a cavern 100 meters deep to house the 12,500-metric-ton detector.

"The first thing we found was the last thing you would ever want in a construction site—a Roman farm from the fourth century AD," says Lyn Evans, LHC project leader.

Fortunately, the farm's villa sat off to the side of the detector shaft and building footprint, allowing CMS crews to continue work while archeologists toiled nearby for nearly two years. During lunch breaks, workers on the CMS shaft wandered over to watch pots, coins, and stone walls emerge from the dirt.

"We had big earth movers, and they had tooth brushes," says John Osborne, project manager for CMS civil engineering. "It was quite interesting to see the difference in excavation."

Eventually, all but the farm's stone walls were removed and sent to a museum in France.

The walls aligned perfectly with modern-day farm boundaries. Unfortunately, they also sat where the innards of the CMS detector hall were to rest. So workers carefully covered the ruins with layers of blankets, sand, gravel, and rock.

"They are buried again," Osborne says. "But they are protected so archeologists could return to excavate in the future."

The CMS detector sits in the town of Cessy in eastern France, an area where the Romans battled the Gauls in the third century. Later, between 50 and 45 BC, Julius Caesar founded a Roman colony near the present town of Saint-Genis-Pouilly, whose boundaries encompass a large portion of CERN. The ruins of Roman villas, as well as coins, medals, silverware, jewelry, and graves from that period, have been found in the village, according to the tourism office.

Among the most notable things recovered in the CMS dig are coins minted in three areas, including sites near Rome and London.

"This proves the United Kingdom, at least during the fourth century, was part of a single European currency," Evans jokes.

Tona Kunz

ATLAS shrunk

Carpenters working at particle physics labs are used to jobs their colleagues in private industry wouldn't dream of tackling.

But a request to build a wooden replica of the world's largest particle detector took even the carpenters at the German laboratory DESY by surprise.

Scientists asked them to build a model of the 7000-metric-ton ATLAS detector from CERN's Large Hadron Collider at 1/25th actual size—two meters wide and one meter in diameter.

The intricate work took seven months.

To fit tools, paint, and their hands into the model, the crew had to assemble the model from the innermost layer outward. "Sometimes we wished we could just weld things together as though it were the real thing," says head carpenter Werner Biegger.

The team of five had to work out a complicated choreography of tasks to make sure everything could be reached and painted in just the right order. And that's not just one coat of paint: "Foundation, priming, more foundation, sanding down, first coat, sanding down, second coat, then finishing layer," Biegger recites.

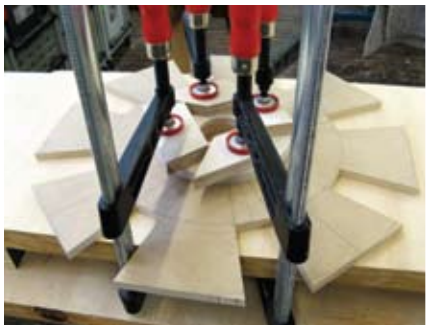
In the finished product, bright-blue muon chambers surround the ATLAS detector like the planks of a wine barrel. Six aluminum magnet coils curve around the inner subdetectors, and a plastic workman balances on the outer beam pipe. The coil and the toy are the only non-wooden parts.

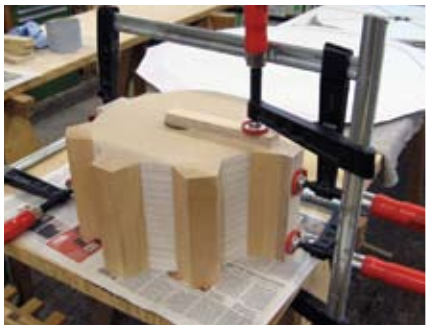
"We wanted to make everything as realistic as possible," Biegger says. "That's why we chose aluminum for the coils; no lacquer on wood could do that job."

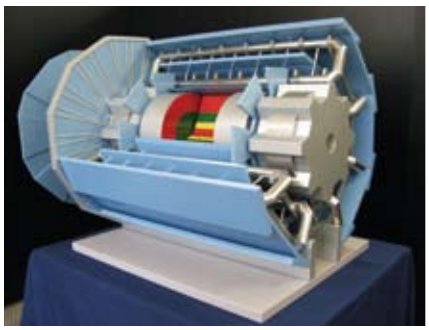
The model made its public debut in October and is now touring the country, showcasing the beauty of ATLAS and helping scientists explain how it works. Requests for other models are already trickling in.

Barbara Warmbein

Photos courtesy of DESY carpenters







A desert quest for no-cell-phone zone

It seemed like a mirage: A shepherd holding a silver tea service crossing barren desert to quench the thirst of strangers.

In their search for a quiet place to build a telescope that will make a 3D map of the universe, Fermilab's Ralph Pasquinelli and Dave McGinnis had entered a different world.

"That area made the Mars landscape look hospitable," McGinnis says.

The two engineers from Illinois had traveled over the Atlas Mountains and through roadless areas of the Sahara desert to the most remote region of Morocco. They endured rain, snow, and blowing sand, and sometimes had to scout on foot for passages suitable for their four-wheel-drive vehicle loaded with 300 pounds of test equipment.

The inhabitants of the area herd goats and sheep. There are no villages, government offices, electricity, or running water. "These people are living the way they did for hundreds of years," Pasquinelli says.

While local people do have cell phones, signal towers are scarce, making this a perfect location for a radio telescope that needs to operate free from interference by radio waves.

The proposed telescope project would use a new strategy to measure the collective emissions of hydrogen in many galaxies at once with unprecedented precision and efficiency. The resulting map should reveal the frozen ripples of cosmic sound waves whose travels through the early universe were shaped by dark energy.

"By measuring the density fluctuations of the universe in 3D, we can hope to understand more about dark energy," McGinnis says. Scientists believe dark energy could explain why the universe is expanding today.

The proposed $20 million to $25 million telescope could be built by a collaboration between Fermilab, Carnegie Mellon University, CEA-Saclay and Orsay labs in France, and Morocco's Al Akhawayan University, which would run the telescope. Proponents hope to get funding from Arab states.

"It is really exciting for Morocco, a developing country, to have this scientific instrument in their back yard," Pasquinelli says. "This would really help to bolster their economy," bringing in roads, water, and other infrastructure and perhaps attracting businesses.

The telescope might even sit on the grazing land of the shepherd who walked three kilometers to their work site to greet them with tea and, according to ancient custom, offer his one-room home for breakfast and lodging.

Rhianna Wisniewski

Photos courtesy of Dave McGinnis

Top: Scientists and team members scouting locations in Morocco take advantage of a local shepherd's hospitality. Right: Engineers set up equipment to search for radio wave signals that could interfere with the proposed experiment. Left: Engineers camp out in the Moroccan desert to search for radio wave signals.

Call for mementos!

An office serves as a home away from home. You personalize it. Make it comfortable. Surround yourself with keepsakes from your family, friends, and career. In a physics lab, these office mementos often go far beyond the usual logo-emblazoned coffee mug or plaque.

For instance, John Cooper, project manager for Fermilab's NOvA neutrino experiment, keeps eight tubes of grey-and-pink granite on a specially made wooden holder. The rock cores came from two sites that competed to host the experiment's underground far-detector hall—including the winner, Ash River in Minnesota.

Do you keep remembrances from experiments in your office? Something that reminds you of the camaraderie of a collaboration or the success of a project?

Send *symmetry* a photo and 100 words describing the memento, its sentimental meaning, and its origin. We'll run the best of the submissions in a future issue. **Send email to *letters@symmetrymagazine.org***

Bowling for science

On what should be a sleepy Saturday at SLAC National Accelerator Laboratory, the air is buzzing. It's the SLAC Department of Energy Regional Science Bowl, and in conference rooms and auditoriums, 24 teams of four race to hit buzzers, quiz-show style, in response to rapid-fire questions about everything from gravitational lensing to butterfly hormones.

After six hours of increasingly diabolical trivia, Homestead High School claimed its third consecutive victory, earning an all-expenses-paid trip to the Washington, DC, Nationals in late April. There the team would vie with 67 other regional champs for a trip to Australia to attend the International Science School, a $1000 grant for their school's science program, and a really, really big trophy.

"I feel like I'm going to wake up any second now," said Homestead senior Jan Wu. "It's been in my head for a while, but I'm still like, 'Oh my gosh, we just won!'"

Students train for the event with an intensity usually reserved for football—poring over scientific tomes, flipping through flashcards, and scrimmaging other teams.

"These kids know things about every branch of science," said moderator Travis Brooks, who runs the SPIRES database at SLAC. "Even very good scientists have no chance at a lot of these questions, because they know just one field very well."

This is Brooks' fourth year joining the 50 or so SLAC staffers volunteering as moderators, scorekeepers, and timekeepers. He said he has a personal reason to take his role seriously.

"In high school, I got cheated once during this type of game," Brooks said. "They asked me for a five-letter word meaning 'money taken illegally,' and I said 'bribe.' They said it was wrong—they wanted 'graft.'" The question eliminated Brooks's team from the semi-finals, robbing them of a chance at scholarship money.

At the end of the long day, enthusiasm was still high, even among those who didn't receive a medal from special guest Martin Perl. Homestead High's Lisa Yao, a senior planning to major in biology, was in the throng that crowded the podium to snag a photo with the SLAC Nobel laureate. Yao said she enjoyed Perl's speech, in which he outlined the advances he hopes to see this next generation of scientists achieve. "It just shows how many doors are open for us right now," Yao said. "That was really inspiring."

Lauren Schenkman

Photo: Lauren Schenkman, SLAC