

The year ahead in science

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Credit: CERN

Some serious groundwork has been laid. Some amazing instruments are turning on. Some incredible destinations are in sight. If you ask us, 2015 is going to be an awesome year in science.

From [solar system](#) exploration to new adventures in [particle physics](#) to the possible defeat of a microscopic foe, here are some of the science stories we can't wait to follow in the coming year.

Our first good look at Pluto

Our telescopes take amazing images of distant galaxies, but the best pictures of Pluto are fuzzy and difficult to interpret. That's about to change. In 2015 humans will get a good look at the dwarf planet - for the very first time.

After a nine-year journey across nearly 3 billion miles of the solar system, NASA's New Horizons spacecraft and its high-definition cameras are closing in on Pluto. A suite of instruments will start taking scientific measurements on Jan. 15. The closest approach, when the spacecraft gets within 7,700 miles from the planet, is scheduled for July.

Could this be the year of the AIDS vaccine?

Microbiologists say that new insights into the structure of HIV's protein spikes - the weapons the virus uses to enter host cells - have raised hopes for a vaccine. If they are right, it would be a major victory against the virus that causes AIDS.

In the last few years, scientists have realized that some AIDS patients have developed broadly neutralizing antibodies that are not fooled by HIV's infamous ability to camouflage itself. In October, researchers at Yale School of Medicine and the National Institute of Allergy and Infectious Diseases showed that these antibodies were able to attach to HIV spikes and disable them.

"Personally, working in the HIV vaccine field for 16 years, I have never been so positive," said Rogier Sanders, a Cornell University

microbiologist who studies the spikes but was not involved in that research. "I think the coming year will see some major steps forward thanks to this."

CERN comes back, with more power than ever

The Large Hadron Collider, the largest and fastest [particle accelerator](#) in the world, is set to start up again in March after a two-year break. When it is turned on, the two beams of protons that fly around its 17-mile loop at close to the speed of light will collide with nearly double the energy of the previous run.

The collider, which is run by the European Organization for Nuclear Research, or CERN, is buried beneath the border of Switzerland and France, not far from Geneva. In 2012, physicists used the massive machine to find the elusive Higgs boson, a subatomic particle that is key to understanding why there is mass in the universe. The achievement was honored with a Nobel Prize.

Scientists are not sure what they will find this time around, but some possibilities include particles associated with dark energy and dark matter. There may even be particles that could provide evidence for the theory of supersymmetry.

An encounter with a very big asteroid

In March, NASA's Dawn spacecraft is set to rendezvous with Ceres, the largest member of the asteroid belt and one of five dwarf planets in the Solar System. (The others are Haumea, Makemake, Eris and Pluto.)

Ceres is Dawn's second stop; its first was Vesta, which the spacecraft circled from July 2011 to September 2012.

While Ceres and Vesta are both enormous asteroids, they're actually very different. Vesta, the second-biggest asteroid in the belt, is elliptical and very dry, while Ceres is spherical and may harbor a subsurface ocean. Both of these "protoplanets" could shed light on the early solar system's history.

More comet science, courtesy of Rosetta

The world watched breathlessly in 2014 as the European Space Agency's Rosetta orbiter caught up with a comet and, for the first time ever, gently dropped a lander onto its surface.

The lander, Philae, has been silent since Nov. 14. But the mission isn't over yet. Scientists say Philae could turn back on as the comet gets closer to the sun, recharging its solar-powered batteries. If so, it may send more data back to scientists on Earth.

In the meantime, Rosetta will continue to escort the comet as it flies toward the sun, watching as it spews ever larger jets of gas and dust. The comet will make its [closest approach](#) to our star in August 2015. When it does, Rosetta will be right by its side.

The search for ripples in the structure of spacetime continues

Scientists in the BICEP2 collaboration rocked the astrophysics world when they announced in March that they had picked up signs of cosmic

inflation - the universe's giant growth spurt shortly after the Big Bang - as well as evidence of gravitational waves, ripples in the structure of spacetime that have been theorized but never detected. Data from the European Space Agency's Planck spacecraft, however, allowed other researchers to poke holes in the findings, leaving the discovery up for debate.

More findings are set to be published this month, according to California Institute of Technology astrophysicist James Bock, one of the lead scientists on the BICEP2 team. The team will continue to scan the skies in 2015 with their next-generation experiment, BICEP3.

Meanwhile, the Laser Interferometer Gravitational Wave Observatory, or LIGO, is searching for gravitational waves directly at facilities in Washington state and Louisiana. Although the experiment struck out during its 2002-10 run, scientists are set to unleash their newly built Advanced LIGO detectors, which are 10 times more sensitive than their predecessors.

"We're planning to resume our search for [gravitational waves](#) with Advanced LIGO in late summer or early fall 2015," said David Reitze, executive director of the LIGO Laboratory at Caltech. "Hopefully, we'll get some interesting results soon after!"

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