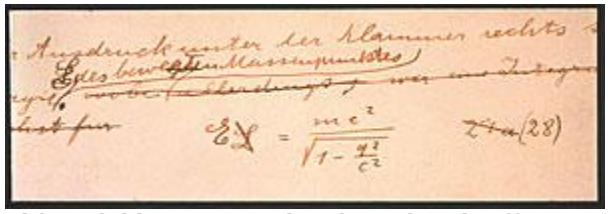
The World's Most Famous Equation Turned 100 in 2005... and Now it is Proven Accurate to One Part in a Million

Posted by Guy Pirro on 1/14/2006 9:20 AM



Although his paper on the Photoelectric effect (which states that light is a stream of tiny packets of energy, later given the name photons) won Einstein the Nobel Prize in 1921, he will always be remembered for his third paper of 1905 -- the one on Special Relativity where he described his revolutionary ideas about light, time, and energy and derived his famous equation E=mc(squared). This original page in Einstein's own handwriting from his manuscript on Special Relativity shows a longer, more complete form of the famous equation E=mc (squared). (Image Credit: Israel Museum, Jerusalem)

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Albert Einstein has once again been proven to be correct in his prediction that E=mc (squared), according to scientists at the Massachusetts Institute of Technology (MIT), the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards - NBS), and the Institute Laue Langevin (ILL) in France. These scientists conducted the most precise direct test ever of what is perhaps the most famous formula in science. In a fitting end to the World Year of Physics 2005, these physicists reported the most precise direct test yet of Einstein's most famous equation, E=mc(squared).

The physicists found that the formula predicting that energy and mass are equivalent is correct to an incredible accuracy of better than one part in a million. That's 55 times more precise than the best previous test.

Why undertake the exercise? "In spite of widespread acceptance of this equation as gospel, we should remember that it is a theory. It can be trusted only to the extent that it is tested with experiments," said team member David E. Pritchard, a Professor of Physics at MIT.

"If this equation were found to be even slightly incorrect, the impact would be enormous -- given the degree to which [it] is woven into the theoretical fabric of modern physics and everyday applications."

In the famous equation, E stands for energy, m for mass, and c for the speed of light. "In the test, we at MIT measured m, or rather the change in m associated with the energy released by a nucleus when it captures a neutron," said former MIT graduate student Simon Rainville.

The NIST/ILL scientists, led by Hans Börner of ILL and the late Richard Deslattes of NIST, measured E. (The speed of light is a defined constant and therefore an exactly known quantity, so it was simply plugged into the equation.)

Specifically, the ILL/NIST team determined the energy of the particles of light, or gamma rays, emitted by the nucleus when it captures a neutron. They did so using a special spectrometer to detect the small deflection of the gamma rays

after they passed through a very pure crystal of silicon.

The mass loss was obtained at MIT by measuring the difference between the mass of the nucleus before the emission of a gamma ray and after. The mass difference was measured by comparing the cyclotron orbit frequencies of two single molecules trapped in a strong magnetic field for several weeks.

Pritchard notes that the mass of the nucleus is about 4,000 times larger than the much smaller mass difference. As a result, "determining the mass difference requires the individual masses to be measured with the incredible accuracy of one part in 100 billion -- equivalent to measuring the distance from Boston to Los Angeles to within the width of a human hair!"

What was the final conclusion?

It’s no mystery -- Einstein has been proven to be right (...again).

For More Information:

http://www.nist.gov/public_affairs/releases/einstein.htm

http://web.mit.edu/newsoffice/2005/emc2.html