

- [About](#)
  - [Quick Info](#)
  - [Science](#)
  - [History](#)
  - [Organization](#)
  - [Photo and Video Gallery](#)
  - [Diversity](#)
  - [Education](#)
  - [Safety](#)
  - [Sustainability and Environment](#)
  - [Contact](#)
- [Newsroom](#)
  - [Spotlight](#)
  - [Press Releases](#)
  - [Fact Sheets and Brochures](#)
  - [Fermilab Today](#)
  - [symmetry](#)
  - [Interactions.org](#)
  - [Photo and Video Archive](#)
- [Resources for ...](#)
  - [Employees](#)
  - [Researchers, Postdocs and Graduate Students](#)
  - [Job Seekers](#)
  - [Neighbors](#)
  - [Industry](#)
  - [K-12 Students, Teachers and Undergraduates](#)
  - [Media](#)
- [Science](#)
  - [Particle Physics](#)
    - [Neutrinos](#)
    - [Fermilab and the LHC](#)
    - [Dark matter and dark energy](#)
    - [Muons](#)
    - [More fundamental particles and forces](#)

- Theory
    - Scientific Computing
    - Research & Development
    - Key Discoveries
    - Benefits of Particle Physics
  - Particle Accelerators
    - Leading Accelerator Technology
    - Accelerator Complex
    - Illinois Accelerator Research Center
    - Fermilab Accelerator Science and Technology Facility
    - LHC and Future Accelerators
    - Accelerators for Science and Society
  - Particle Physics 101
    - Science of Matter, Energy, Space and Time
    - How Particle Physics Discovery Works
    - Worldwide Particle Physics Discoveries
    - Questions for the Universe
    - Ask a Scientist
- Tevatron
  - Tevatron Timeline
  - Tevatron Accelerator
  - Tevatron Experiments
  - Tevatron Operation
  - Shutdown Process
  - For the Media
  - Video of Shutdown Event
  - Guest Book
- Tevatron Impact
 

June 11, 2012

  - About the Symposium
  - Symposium Agenda
  - Travel & Lodging
  - List of Registrants
  - Organizing Committee
- Tritium at Fermilab
  - Frequently asked questions about tritium
  - Tritium in surface water
  - Tritium in sanitary sewer water
  - Atmospheric release and solid waste
  - Fact Sheet (pdf)
- Visit
  - Hours, Maps and Directions
  - Tours, Programs and Events
  - Transportation
  - Science Next Door Community Newsletter
  - Education Programs
  - Lederman Science Center
  - Fermilab Cultural Events
  - Fermilab Natural Areas
  - Folk and Barn Dancing

August 26, 2014

FOR IMMEDIATE RELEASE

## Do we live in a 2-D hologram?

### New Fermilab experiment will test the nature of the universe

*Note:*

For photos, please visit this link:

[http://www.fnal.gov/pub/presspass/press\\_releases/2014/2-D-Hologram-20140826-images.html](http://www.fnal.gov/pub/presspass/press_releases/2014/2-D-Hologram-20140826-images.html)

A unique experiment at the U.S. Department of Energy's Fermi National Accelerator Laboratory called the Holometer has started collecting data that will answer some mind-bending questions about our universe – including whether we live in a hologram.

Much like characters on a television show would not know that their seemingly 3-D world exists only on a 2-D screen, we could be clueless that our 3-D space is just an illusion. The information about everything in our universe could actually be encoded in tiny packets in two dimensions.

Get close enough to your TV screen and you'll see pixels, small points of data that make a seamless image if you stand back. Scientists think that the universe's information may be contained in the same way and that the natural "pixel size" of space is roughly 10 trillion trillion times smaller than an atom, a distance that physicists refer to as the Planck scale.

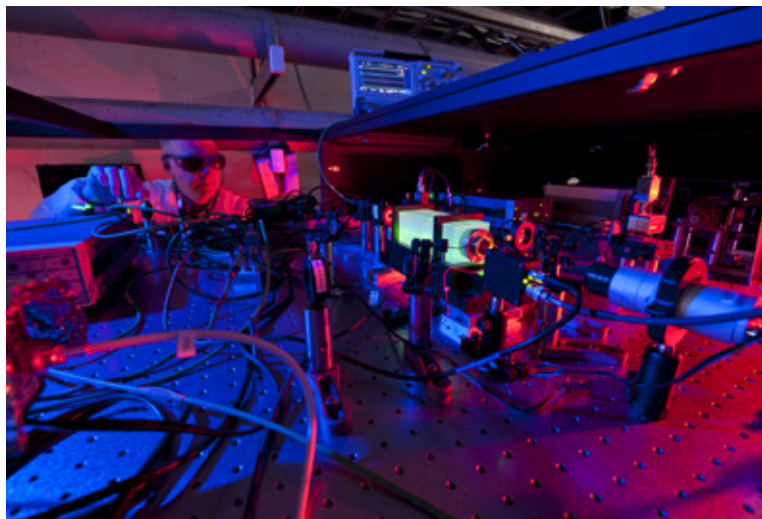
"We want to find out whether space-time is a quantum system just like matter is," said Craig Hogan, director of Fermilab's Center for Particle Astrophysics and the developer of the holographic noise theory. "If we see something, it will completely change ideas about space we've used for thousands of years."

Quantum theory suggests that it is impossible to know both the exact location and the exact speed of subatomic particles. If space comes in 2-D bits with limited information about the precise location of objects, then space itself would fall under the same theory of uncertainty. The same way that matter continues to jiggle (as quantum waves) even when cooled to absolute zero, this digitized space should have built-in vibrations even in its lowest energy state.

Essentially, the experiment probes the limits of the universe's ability to store information. If there is a set number of bits that tell you where something is, it eventually becomes impossible to find more specific information about the location – even in principle. The instrument testing these limits is Fermilab's Holometer, or holographic interferometer, the most sensitive device ever created to measure the quantum jitter of space itself.

Now operating at full power, the Holometer uses a pair of interferometers placed close to one another. Each one sends a one-kilowatt laser beam (the equivalent of 200,000 laser pointers) at a beam splitter and down two perpendicular 40-meter arms. The light is then reflected back to the beam splitter where the two beams recombine, creating fluctuations in brightness if there is motion. Researchers analyze these fluctuations in the returning light to see if the beam splitter is moving in a certain way – being carried along on a jitter of space itself.

"Holographic noise" is expected to be present at all frequencies, but the scientists' challenge is not to be fooled by other sources of vibrations. The Holometer is testing a frequency so high – millions of cycles per second – that motions of normal



A Fermilab scientist works on the laser beams at the heart of the Holometer experiment. The Holometer will use twin laser interferometers to test whether the universe is a 2-D hologram. *Credit: Fermilab*

matter are not likely to cause problems. Rather, the dominant background noise is more often due to radio waves emitted by nearby electronics. The Holometer experiment is designed to identify and eliminate noise from such conventional sources.

“If we find a noise we can’t get rid of, we might be detecting something fundamental about nature – a noise that is intrinsic to space-time,” said Fermilab physicist Aaron Chou, lead scientist and project manager for the Holometer. “It’s an exciting moment for physics. A positive result will open a whole new avenue of questioning about how space works.”

The Holometer experiment, funded by the U.S. Department of Energy Office of Science and other sources, is expected to gather data over the coming year.

*The Holometer team comprises 21 scientists and students from Fermilab, the Massachusetts Institute of Technology, the University of Chicago and the University of Michigan. For more information about the experiment, visit <http://holometer.fnal.gov/>.*

*Fermilab is America’s premier national laboratory for particle physics and accelerator research. A U.S. Department of Energy Office of Science laboratory, Fermilab is located near Chicago, Illinois, and operated under contract by the Fermi Research Alliance, LLC. Visit Fermilab’s website at [www.fnal.gov](http://www.fnal.gov) and follow us on Twitter at @FermilabToday.*

*The DOE Office of Science is the single largest supporter of basic research in the physical sciences in the United States and is working to address some of the most pressing challenges of our time. For more information, please visit [science.energy.gov](http://science.energy.gov).*

## Media contact:

- Andre Salles, Fermilab Office of Communication, 630-840-3351, [media@fnal.gov](mailto:media@fnal.gov)

## Science contact:

- Craig Hogan, Director of the Fermilab Center for Particle Astrophysics, 630-840-5523, [cjhogan@fnal.gov](mailto:cjhogan@fnal.gov)

---

[Return to Current Press Releases](#)

Last modified 08/25/2014 | [email Fermilab](#)



**U.S. DEPARTMENT OF ENERGY** | Fermi Research Alliance LLC

Fermi National Accelerator Laboratory

[U.S. Department of Energy](#)

Managed by Fermi Research Alliance, LLC

[Security, Privacy, Legal](#)

[Use of Cookies](#)

## Quick Links

[Home](#)

[Contact](#)

[Phone Book](#)

[Fermilab at Work](#)

[For Industry](#)

[Jobs](#)

## Interact

[Facebook](#)

[Twitter](#)

