

Observation of the hyperfine spectrum of antihydrogen

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Close-up of the ALPHA apparatus. Credit: CERN

A Canadian-led investigation has opened a new chapter in antimatter research. In a study published today in *Nature*, the ALPHA Collaboration, which includes 50 physicists from 17 institutions, reports the first detailed observation of spectral lines from an antimatter atom.

"Spectral lines are like fingerprints," says lead author Michael Hayden, a Simon Fraser University physics professor. "Every element has its own unique pattern."

There is one (possible) exception: matter and [antimatter](#) are believed to be mirror images of one another, and so the spectral lines of antimatter

[atoms](#) should be precisely the same as those of their normal atom counterparts. Whether or not this is true is unknown. Until now, scientists have only had glimpses of antimatter spectral lines, and comparisons with normal matter spectral lines have been coarse.

The ALPHA Collaboration studies antihydrogen, the antimatter counterpart of the ordinary hydrogen atom. Their experimental results show a particular set of [spectral lines](#) in antihydrogen match those in hydrogen very well. The team plans to zoom in much closer to check if subtle discrepancies exist between the two atoms on a yet finer scale.

Conducted at the CERN laboratory in Geneva, the research involves irradiating [antihydrogen atoms](#) with microwaves, similar to those used to communicate with satellites. When this is done, the anti-atoms reveal their identity by emitting or absorbing energy at very specific frequencies. That pattern, or spectrum, of frequencies corresponds to the "fingerprint" described by Hayden.

"One of the challenges we face is that matter and antimatter annihilate when they come into contact with one another," says Justine Munich, an SFU physics PhD candidate. "We have to keep them apart. We can't just put our anti-atoms into an ordinary container. They have to be trapped or held inside a special magnetic bottle."

"By studying the properties of anti-atoms we hope to learn more about the universe in which we live," says Hayden. "We can make antimatter in the lab, but it doesn't seem to exist naturally except in miniscule quantities. Why is this? We simply don't know. But perhaps [antihydrogen](#) can give us some clues."

More information: M. Ahmadi et al. Observation of the hyperfine spectrum of antihydrogen, *Nature* (2017). [DOI: 10.1038/nature23446](https://doi.org/10.1038/nature23446)

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