

ADVERTISEMENT



Watch free online now

nature
nanotechnology

SCIENTIFIC AMERICAN™

Permanent Address: <http://www.scientificamerican.com/article/chemists-confirm-the-existence-of-new-type-of-bond/>

More Science » Scientific American Volume 312, Issue 2 » Advances

Chemists Confirm the Existence of New Type of Bond

A “vibrational” chemical bond predicted in the 1980s is demonstrated experimentally

Jan 20, 2015 | By Amy Nordrum | [Véalo en español](#) |

Chemistry has many laws, one of which is that the **rate of a reaction speeds up as temperature rises**. So, in 1989, when chemists experimenting at a nuclear accelerator in Vancouver **observed that a reaction** between bromine and muonium—a **hydrogen isotope**—**slowed down when they increased the temperature, they were flummoxed**.

Donald Fleming, a University of British Columbia chemist involved with the experiment, thought that perhaps as bromine and muonium co-mingled, they **formed an intermediate** structure held together by a “vibrational” bond—a bond that other chemists had posed as a theoretical possibility earlier that decade. In this scenario, the lightweight muonium atom would move rapidly between two heavy bromine atoms, “like a Ping Pong ball bouncing between two bowling balls,” Fleming says. The oscillating atom would briefly hold the two bromine atoms together and **reduce the overall energy, and therefore speed**, of the reaction. (With a Fleming working on a bond, you could say the atomic interaction is shaken, not stirred.)

At the time of the experiment, the necessary equipment was not available to examine the milliseconds-long reaction closely enough to determine whether such vibrational bonding existed. Over the past 25 years, however, chemists' ability to track subtle changes in energy levels within reactions has greatly improved, so Fleming and his colleagues ran their reaction again three years ago in the nuclear accelerator at Rutherford Appleton Laboratory in England. Based on calculations from both experiments and the work of collaborating theoretical chemists at Free University of Berlin and Saitama University in Japan, they concluded that muonium and bromine were indeed forming a new type of temporary bond. Its vibrational nature **lowered the total energy of the intermediate bromine-muonium structure—thereby explaining why the reaction slowed even though the temperature was rising**.

The team reported its results last December in *Angewandte Chemie International Edition*, a publication of the German Chemical Society. The work confirms that vibrational bonds—fleeting though they may be—should be added to the list of known chemical bonds. And although the bromine-muonium reaction was an “ideal” system to verify vibrational bonding, Fleming predicts the phenomenon



Credit: [Allewinatis/Flickr](#)

ADVERTISEMENT

also occurs in other reactions between heavy and light atoms.

This article was originally published with the title "New Vibrations."

Buy this digital issue or subscribe to access other articles from the February 2015 publication.

Already have an account? [Sign In](#)



Digital Issue
\$5.99

[Add To Cart](#)

Digital Issue + Subscription
\$39.99

[Subscribe](#)

You May Also Like



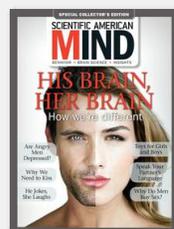
Scientific American
Archive Single Issue



Scientific American
Archive Single Issue



Scientific American
Single Issue



His Brain, Her Brain
Single Issue

Scientific American is a trademark of Scientific American, Inc., used with permission

TRY A RISK-FREE ISSUE

© 2015 Scientific American, a Division of Nature America, Inc.

Next Article



**Understand the Measles Outbreak
with this One Weird Number**

[Read More »](#)