

# A Strange Chemical Bond: A Hybrid of Hydrogen and Covalent Bonds

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## EDITORIAL

Covalent bonds and hydrogen bonds are terms that chemistry students are familiar with. Hydrogen bonds are weak electrical attractions, while covalent bonds are strong chemical bonds that keep atoms within a molecule together and are formed when electrons are exchanged among them. New research has discovered a strange bond that behaves like a hybrid of the two, blurring the line between hydrogen and covalent bonds. Its properties pose concerns about the definition of chemical bonds. A group of atoms called bifluoride ions, which consist of a single hydrogen atom sandwiched between a pair of fluorine atoms, were observed in water by a research team to describe the hybrid bond. The hydrogen atom has a covalent bond with one fluorine and a hydrogen bond with the other fluorine, according to conventional thinking.

The researchers used infrared light to vibrate bifluoride ions and then measured the reaction of the hydrogen atoms, showing a series of energy levels at which, the hydrogen atoms vibrated. The spacing between those energy levels would decrease as the atom progressed up the energy ladder in a standard hydrogen bond.

Instead, the researchers discovered that the spacing increased. This behaviour showed that the hydrogen atom was evenly distributed between the two fluorine atoms, rather than being tightly bound to one fluorine atom by a covalent bond and loosely bound to the other by a standard hydrogen bond. According to the report, “the distinction between the covalent and hydrogen bond is erased and no longer meaningful” in this arrangement.

This action is dependent on the distance between the two fluorine atoms, according to computer calculations. The usual hydrogen bond gets stronger as the fluorine atoms get closer to each other, trapping the hydrogen between them, until all three atoms start exchanging electrons as in a covalent bond, creating a single connection that the researchers call a hydrogen-mediated chemical bond. The researchers conclude that the hydrogen-mediated chemical bond cannot be classified as either pure hydrogen or a pure covalent bond. It's just a hybrid of the two. This recent finding has implications for scientists' understanding of basic chemistry concepts. “It goes to the core of our understanding of what a chemical bond is.”

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