Hydrogen bonds: Scientists find new mechanism

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Water's unrivaled omnipresence and the crucial role it plays in life drives scientists' to understand every detail of its unusual underlying properties on the microscopic scale.

Bernd Winter and colleagues, from BESSY, Max-Born-Institut, Uppsala University, and MPI für Dynamik und Selbstorganisation, report in the current issue of *Nature* how water solvates its intrinsic hydroxide (OH-) anion. Unraveling this behavior is important to advance the understanding of aqueous chemistry and biology.

Using a resonance (photo) core-electron spectroscopy technique, with sub ten-femtosecond temporal resolution, and employing synchrotron radiation in conjunction with a liquid microjet, the researchers find that OH- is capable of donating a transient hydrogen bond to a neighboring water molecule. Their experiment thus disproves the classical, so-called proton-hole picture, assuming that OH- is a hydrogen-bond acceptor only.

The weak OH- hydrogen donor bond is responsible for a distinct intensity pattern in the electron spectra, and is connected with a unique energy transfer (intermolecular Coulombic decay) between the oxygen 1s core-excited hydroxide ion and a neighboring water molecule. It is the first time such a process is observed in an aqueous system. To confirm that the measurements exclusively probe the weak OH- hydrogen donor bond at such high sensitivities the team has conducted comparative measurements of halide ions in water.

They find that chloride and isoelectronic fluoride do not exhibit this energy-transfer channel, which corroborates recent structural diffusion models for the unusually migration of the hydroxide ion in water. The work marks a step forward into studying very fast dynamical processes in water and aqueous solutions.

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