Inside Science Research — Physics News Update

Number 732 #2, May 24, 2005 by Phil Schewe and Ben Stein

Water's Chemical Formula May Always Be H_20

Water's chemical formula may always be H_2O, and not different on shorter timescales, according to a new paper. In earlier experiments, a research group reported that neutrons and electrons interacting with room-temperature water molecules for very brief times (0.1-1 femtoseconds) saw a ratio of hydrogen to oxygen of roughly 1.5 to 1, suggesting a chemical formula of H1.5O for water at short timescales (Update 648).

According to the data analysis of those researchers, incoming neutrons scattered from at least 25% fewer hydrogen nuclei (protons) than expected. They proposed that quantum entanglement between protons (hydrogen nuclei) on a sub-femtosecond timescale was causing this anomalous scattering. This result stimulated a flurry of theoretical and experimental activity, including a new experiment at Rensselaer Polytechnic Institute in Upstate New York that now disputes these earlier results.

The experimenters, coming from Ben Gurion University and RPI (Raymond Moreh, morehr@rpi.edu), use higher-energy neutrons which interact with pure liquid water, pure D_2O, and mixtures of the two liquids, on shorter timescales (0.001-0.01 femtoseconds) than in the earlier experiments. (Theorists had predicted that the shorter timescales would lead to an even more pronounced scattering anomaly, since quantum decoherence would have less time to spoil the proposed entanglement between protons.)

However, the Ben Gurion-RPI team did not detect an anomalous dropoff in n-p scattering. They conclude that no entanglement takes hold and water is accurately described as H_2O, after all, at these shorter timescales. They cite several advantages of their experiment, including the following: they looked at a single, simpler scattering signal arising from the three nuclei of the water and D_2O molecules (as opposed to the separate neutron scattering signals for oxygen, hydrogen, and deuterium in the earlier experiments); and their data did not require complicated processing, leading to a much simpler data analysis than was necessary in the previous work.

Researchers from the earlier experiments contend that the new experiment does not probe the timescales that they originally explored; the new team counters that their data does address the original team's timescales. In addition, Moreh and colleagues argue that one would have to shake many well established notions in physics to explain the suggested scattering anomaly. (**Moreh, Block, Danon, Neumann (http://link.aps.org/abstract/PRL/v94/e185301)**, Physical Review Letters, 13 May 2005)

Back to Physics News Update (/pnu)