The dynamical relaxation: a possible key to understand Water Anomalies

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ABSTRACT

The anomalous behavior of thermodynamic response functions is an unsolved problem in the physics of water. The mechanism that causes the heat capacity, the compressibility, and the coefficient of thermal expansion to increase indefinitely inside the supercooled regime is unknown.
We explore this problem by analyzing both new and old experimental data on bulk and confined water. Sound propagation data (at ambient pressure) confirm that on decreasing the temperature the liquid undergoes a structural transformation with the onset of an extended hydrogen bond network. On these bases we find that water response functions are governed by the related dynamical relaxation, which is reflected in the frequency and wave vector dependence of the sound dispersion, and is evidence of the invoked liquid polymorphism.
The same it is also confirmed by the evolution of the bulk water thermal response functions studied in a very large region of the pressure temperature phase diagram.
We conclude that, under these conditions, the thermal functions and their corresponding fluctuations remain finite, showing maxima and minima at a precise dynamical crossover temperature.