

## Metastable Water: What We Know and What We Need to Know

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The subject of water, and particularly metastable water, has perennially been a focus of controversy amongst physicists and physical chemists. Both thermodynamic and relaxation kinetics properties seem to obey power laws in their temperature dependence, implying a critical behavior of some sort, but whether the power laws imply the existence of a true critical fluctuation zone or only the existence of a spinodal stability limit of the phase under study, is not yet clear. The distinction depends on whether the critical zone lies at positive or negative pressures (1). The most convincing account of the available data to date locates the critical point at weakly positive pressures (2), but shows such sensitivity to parameter choices that negative pressure values are not excluded. In one possible scenario, known as the "critical-point-free" scenario, the critical zone is supposed to lie at such large negative pressures that it would merge with the better understood spinodal limit of the liquid with respect to cavitation, i.e. the tensile limit. Indeed this is the scenario most closely according with all the empiricists' extrapolated equations of state (1). In this talk we consider the things we know, and the things we need to know, but at this time, don't. We discuss the most recent developments that promise new information including ultrafast heating rate studies of heat capacity (3), crystallization kinetics, and particularly studies performed at negative pressures (4, 5) where crystallization of ice seems to become less pre-emptive of the interesting behavior (5). Finally we consider some findings on new types of aqueous solutions in which the behavior remains dominated by the anomalies of water, but now the interesting properties are manifesting themselves in a zone where crystallization kinetics are slow and crystallization can be bypassed completely (6).

### References

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