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The Typical Lengthscale Characterizing the Glass Transition at Lower Temperatures

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The existence of a static length scale that grows in accordance with the dramatic slowing down observed at the glass transition is a subject of intense interest. A recent publication compared two proposals for this length scale, one based on the point-to-set correlation technique and the other on the scale where the lowest eigenvalue of the Hessian matrix becomes sensitive to disorder. The conclusion was that both approaches lead to the same length scale, but the former is easier to measure at higher temperatures and the latter at lower temperatures. But even after using both methods together, the range of increase in the observed length scales was limited by the relaxation times reachable by standard molecular dynamics techniques (i.e. about 4-5 orders of magnitude). In this paper we therefore attempt to explore the typical scale at even lower temperatures, testing for this purpose two approaches, one based on the idea of vapor deposition and the other on a swap Monte Carlo technique. We conclude that the first approach does not help in getting to lower temperatures, but the second one does so quite effectively. We can reach a typical lengthscale that grows in accordance with at least 18 orders of magnitude increase in the relaxation time, coming close to the best experimental conditions. We conclude by discussing the relationship between the observed lengthscale and various models of the relaxation time.