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Structure and dynamics of a quasi-binary liquid in 2 and 3 dimensions

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We investigated a quasi-binary liquid of 3-methyl pyridine and heavy water at the critical composition at different temperatures close to the phase transition. When adding antagonistic salt sodium tetraphenylborate the ions form locally lamellar structures that enclose the binary fluid. Then the system becomes 2-dimensional. Looking at the critical fluctuations, the dimensionality is confirmed. The dynamics of the 3 and 2-dimensional system displays diffusion on large length scales (dynamic light scattering) and fluctuations of the boundaries between the domains on small length scales (neutron spin echo spectroscopy). From that we obtain a master curve following the theory of Kawasaki. On the one hand the critical exponent z is obtained that can be rationalized by theoretical concepts. The overall prefactor R of the master curve displays approx. 2 times faster diffusion for the 2-dimensional compared to the 3-dimensional system. This can be explained by much lower viscosities (also measured) of the 2-dimensional system. This is theoretically explained by the lubrication effect.

Looking at the high-Q scattering, we determined the critical correlation-function exponent η that is extraordinarily large for the 2-dimensional system. It seems that the composition fluctuations in the 2 dimensions and the 3rd dimension are orientationally averaged.

A short excursion will also look on an aerogel as porous material that interferes with the binary fluid.

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