

## Phase Transitions, Interfaces and Layering in a Fluid Confined Between a Solvophilic and a Solvophobic Substrate.

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We consider a simple fluid confined between two parallel walls (substrates), separated by a distance  $L$ . The walls exert different surface fields so that one wall is attractive and is wet by liquid (it is solvophilic) while the other is repulsive and may be dry, i.e. wet by gas (it is solvophobic). In the temperature range  $T_{cb} > T > T_w$ , where  $T_{cb}$  and  $T_w$  are the bulk critical and the wetting transition temperatures respectively, a delocalized interface or ‘soft mode phase’ forms that exhibits a liquid-gas interface near  $L/2$  with pronounced thermal fluctuations. Its properties have been investigated [1] using classical density functional theory (DFT) for a model that incorporates dispersion forces. Thermodynamic quantities such as the adsorption, surface tension and total susceptibility satisfy scaling predictions derived from an effective interfacial Hamiltonian approach.

At low temperatures, but above the bulk triple point, the fluid is highly structured in the liquid part of the density profile close to the solvophilic wall and this ordering drives a sequence of layering transitions: as  $L$  is increased, new layers of liquid-like density develop abruptly. In contrast to the case of confinement between identical walls, the solvation force (excess pressure due to confinement) is always repulsive; it jumps discontinuously at each layering transition. The excess free-energy exhibits many metastable minima as a function of the adsorption. We comment on how our results might be relevant to experimental and simulation studies of water confined between hydrophilic and hydrophobic substrates.

[1] M.C. Stewart and R. Evans, *Phys.Rev.E* (2012), **86**, 031601.