Nanophase Separation in a Slit Pore: From Picture to Numbers and back

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We consider an interesting effect of nanoscale separation of alcohol and water in a slit pore between a mica crystal and a graphene sheet, as observed in scanning force microscopy. The case is interesting as showing quite a complex interplay between the experiment using modern imaging techniques, and the mature predictive theory, in our case statistical thermodynamics. The first questions to be answered are: what is seen, what relevant information is contained in the image, and how can this information be extracted. None of these questions can be answered without having a solid theoretical description of the situation. We discuss how and to what extent the effective interaction potentials between the molecules can be obtained from the image, and how they can be used in order to predict other important properties of the system, those that cannot be immediately obtained from the experiment. Our discussion will touch several basic issues of foundations of statistical mechanics, theory of statistical inference, and inverse problems, and may be much more interesting than the experimental observation itself.