Effective Hamiltonian for fluid membranes in the presence of long-ranged forces

F. Dutka[a], M. Napiórkowski[a] and S. Dietrich[b,c]

[a] *Instytut Fizyki Teoretycznej, Uniwersytet Warszawski, 00-681 Warszawa, Hoża 69, Poland*
[b] *Max-Planck-Institut für Metallforschung, Heisenbergstrasse 3, 70569 Stuttgart, Germany*
[c] *Institut für Theoretische und Angewandte Physik, Pfaffenwaldring 57, Universität Stuttgart, 70569 Stuttgart, Germany*

If the constituent particles of fluid phases interact via long-ranged van der Waals forces, the effective Hamiltonian for *interfaces* between such fluid phases contains – in lateral Fourier space – non-analytic terms $\sim q^4 \ln q$. Similar non-analytic terms characterize the effective Hamiltonian for two interacting interfaces which can emerge between the three possible coexisting fluid phases in binary liquid mixtures. This is in contrast with the structure of the phenomenological Helfrich Hamiltonian for membranes which does not contain such non-analytic terms. We show that under favorable conditions for the bulk densities characterizing a binary liquid mixture and for the long-ranged interparticle interactions the corresponding effective Hamiltonian for a model fluid *membrane* does not exhibit such non-analytic contributions. We discuss the properties of the resulting effective Hamiltonian, with a particular emphasis on the influence of the long range of the interactions on the coefficient of the bending rigidity.