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Instability patterns in thin nematic & smectic films

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The formation of spatially periodic patterns is a well-known phenomenon in physics of liquid crystals. Nevertheless, new experiments often pose questions which cannot be answered by the existing theories. For example, the experiments in the group of Anne-Marie Cazabat in Paris, demonstrated that thin nematic films, spread on liquid substrates, exhibit a long-wavelength periodically deformed stripe state up to the thickness of 20 nm. The formation of this instability pattern can be attributed to the response of the system to the antagonistic boundary conditions. To get a theoretical insight on the experimental findings, we (re)consider the onset of stripe instability and (re)examine the role of surface-like terms. Another experiments, performed by Giorgia Tordini and Peter Christianen in Nijmegen, suggest the formation of a finger-like pattern, when smectic order, characterised by equally spaced layers, is imposed on the bent nematic structure. I propose a simple geometric approach of constructing the space-filling energy minimising structure, which accounts for the bending of smectic layers and yields two distinct wavelengths, compatible with experimental data.

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