Liquid crystals and interacting dimers

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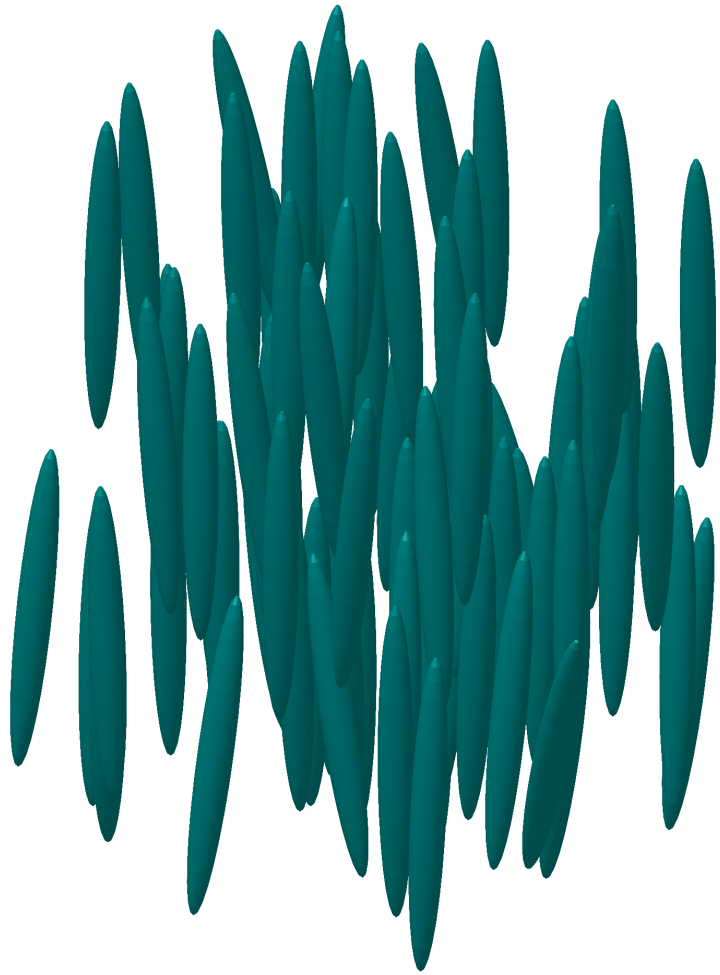
Nematic liquid crystals

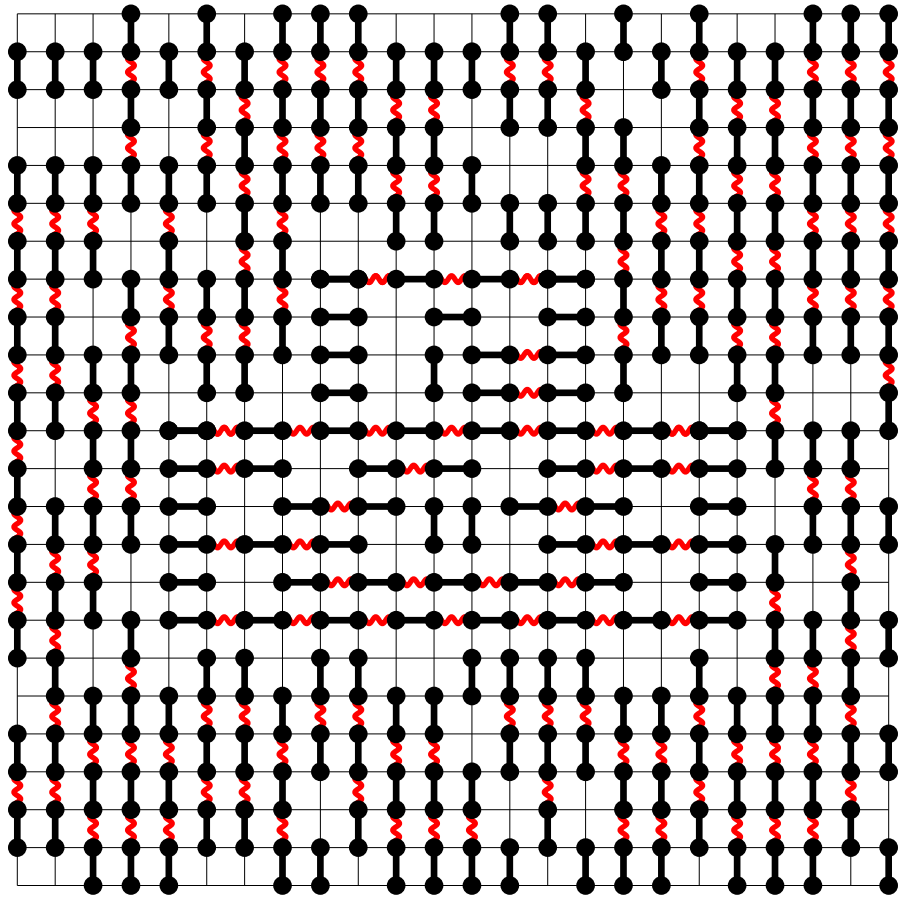


Nematic liquid crystals

- **Long range orientational order**: molecules tend to align, and maintain their alignment over macroscopic distances.
- **No positional order**: the locations of the centers of the molecules are decorrelated.

Heilmann-Lieb model

[Heilmann, Lieb, 1979]



Heilmann-Lieb model

- Probability of a configuration (grand-canonical Gibbs distribution):

$$\text{Prob(conf)} = \frac{1}{\Xi} z^{\#\text{particles}} e^{J \ \#\text{interactions}}$$

  - Ξ: partition function
  - $z \geqslant 0$: activity
  - $J \geqslant 0$: interaction strength

- Regime $J \gg z \gg 1$.

[Heilmann, Lieb, 1979]

- *Theorem*: given $x, y \in \mathbb{Z}^2$, the probability that there is a horizontal dimer attached to x and no horizontal dimer attached to y tends to 0 as $J, z \to \infty$. (**Orientational order**.)
- *Conjecture*: given to edges e and e', the probability of finding a dimer on e and another on e' is independent of e and e', up to a term that decays *exponentially* in $\mathrm{dist}(e, e')$. (**No positional order**.)