Electrostatic repulsion-driven crystallization model arising from filament networks

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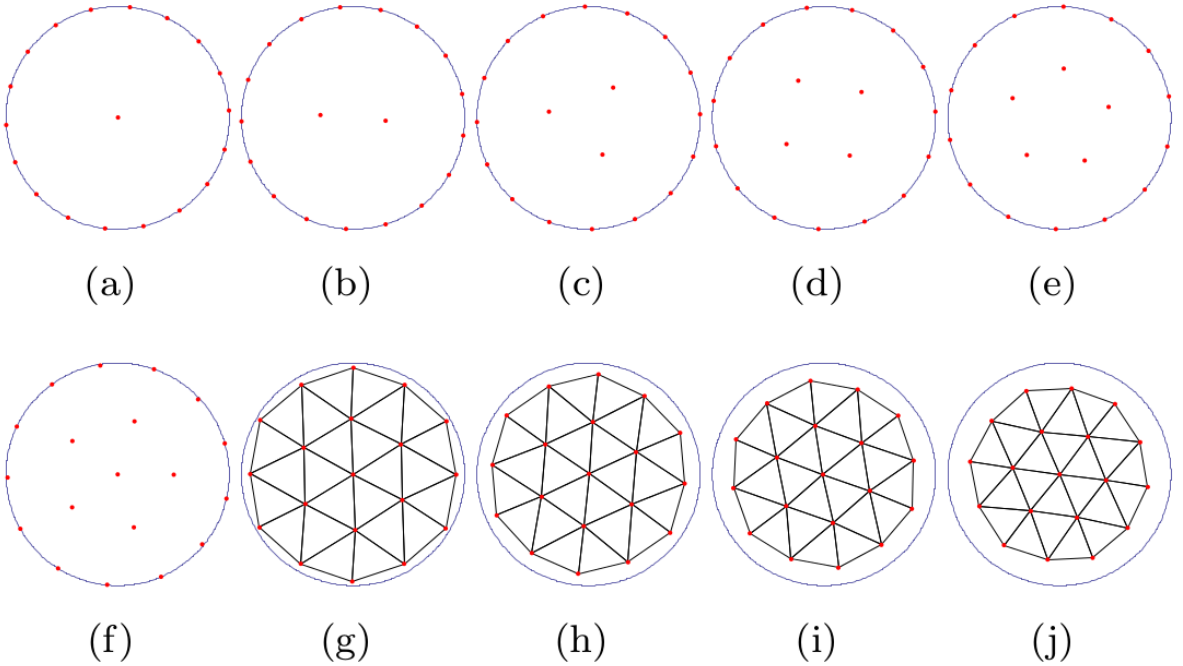
The crystallization of bundles in filament networks interacting via long-range repulsions in confinement is described by a phenomenological model. The model demonstrates the formation of the hexagonal crystalline order via the interplay of the confinement potential and the filament-filament repulsion. Two distinct crystallization mechanisms in the short- and large- screening length regimes are discussed, and the phase diagram is obtained. Simulation of large bundles predicts the existence of topological defects within the bundled filaments. This electrostatic repulsion-driven crystallization model arising from studying filament networks can even find a more general context extending to charged colloidal systems.



The low-energy configurations of 19 filaments (represented by red dots) confined in a bundle (represented by the blue circles). The increasing confinement potential (from a to j) pushes more particles from the boundary of the disk towards its center. Finally, a crystallized state is reached, as highlighted by Delaunay triangulations from (g) to (j).

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