Abstract Submitted
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Polymer-nematic textures in spherical confinement: a coarse-grained model of DNA packing[1] GREGORY GRASON, Dept. of Polymer Science & Engineering, University of Massachusetts Amherst, HOMIN SHIN, Dept. of Materials Science & Engineering, Univerisity of Illinois at Urbana-Champaign — Inspired to understand the complex spectrum of space-filling organizations the dsDNA genome within the capsid of bacterial viruses, we study a minimal, coarse-grained model of single chains densely-packed into a finite spherical volume. We build the three basic elements of the model–i) the absence of chain ends ii) the tendency of parallel-strand alignment and iii) a preference of uniform areal density of chain segments–into a polymer nematic theory for confined chains. Given the geometric constraints of the problem, we show that axially symmetric packings fall into one of three topologies: the coaxial spool; the simple solenoid; and the twisted-solenoid. Among these, only the twisted-solenoid fills the volume without the presence of line-like disclinations, or voids, and are therefore generically preferred in the incompressible limit. An analysis of the thermodynamic behavior of this simple model reveals a rich behavior, a generic sequence of phases from the empty state for small container sizes, to the coaxial spool configuration at intermediate sizes, ultimately giving way, via a second-order, symmetry-breaking transition, to the twisted-solenoid structure above a critical sphere size, which we estimate to be within the range of bacteriophage capsid dimensions.

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