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3D Active Nematics

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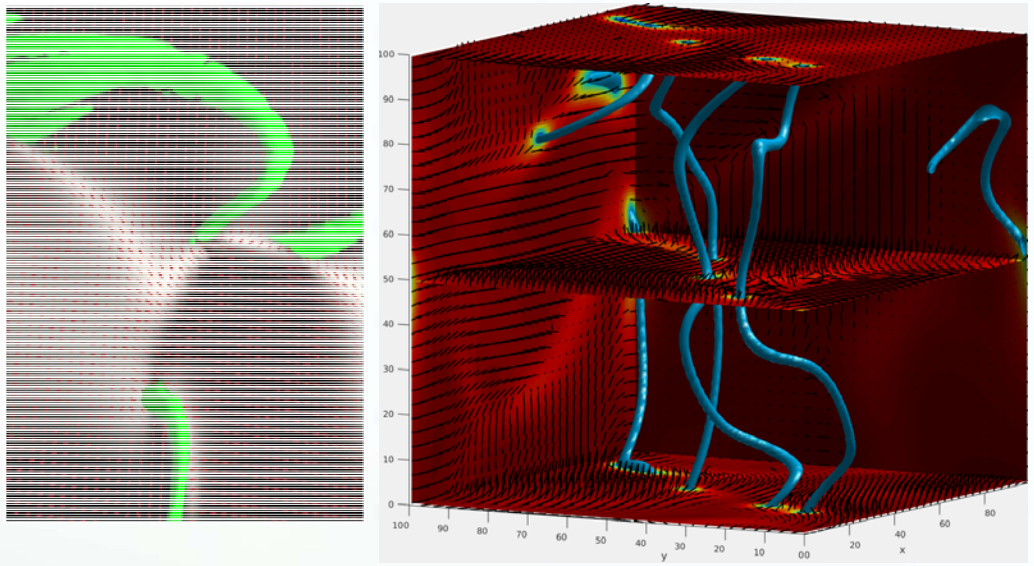
Active materials are continuously driven out of equilibrium by energy input at the particle scale, potentially enabling applications that are not possible with equilibrium materials. However, most current active materials are limited to 2D, whereas practical applications require 3D systems. The MRSEC has developed the first truly 3D active nematic by combining microtubules, molecular motors, and passive rod-like viruses. Using light sheet microscopy we are able to visualize the the system at unprecedented resolution (a snapshot is shown on the right), showing that the system is spanned by a complex dynamical network of disclination lines (localized regions of disorder. Theoretical calculations (bottom image on the right) are being used to identify the mechanisms controlling the formation and dynamics of disclination lines.



Structure of a 3D active nematic. (Left) Light sheet microscopy image, with disclination lines shown by green tubes. (Right) Simulation, with disclination lines shown by blue tubes. The director field (lines) and nematic order parameter (colors) are shown in 3 planes.

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