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Knotted Vortices: Entropic Lattice Boltzmann Method for Simulation of Vortex dynamics[1] FABIAN BOESCH, SHYAM CHIKATAMARLA, ILYA KARLIN, ETH Zürich — Knotted and interlinked vortex structures in real fluids are conjectured to play a major role in hydrodynamic flow dissipation. Much interest lies in determining their temporal stability and the mechanism through which knots dissolve [1-3]. Kleckner and Irvine [1] recently have shown the existence of such knotted vortices experimentally by accelerating hydrofoils in water. In the present work we employ the entropic lattice Boltzmann method (ELBM) to perform DNS simulations of the creation and dynamics of knotted vortex rings inspired by the experimental setup in [1]. ELBM renders LBM scheme unconditionally stable by restoring the second law of thermodynamics (the Boltzmann H-theorem), and thus enables simulations of large domains and high Reynolds numbers with DNS quality [4-5]. The results presented in this talk provide an in-depth study of the dynamics of knotted vortices and vortex reconnection events and confirm the existence of trefoil knots in silicio for the first time.

[1] Klecker et al, Nature Physics, 9 (2013)
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[3] Ricca et al., J. Fluid Mech., 391 (1999)
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