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**Stochastic Lagrangian Dynamics of Vorticity in Wall-Bounded Flows: General Theory**[1] GREGORY EYINK[2], The Johns Hopkins University, AKSHAT GUPTA , Technical University of Munich, TAMER ZAKI, The Johns Hopkins University — The Lagrangian properties of vorticity for a smooth Euler solution have been extended to Naver-Stokes solutions by Constantin-Iyer (2008,2011) using a stochastic Lagrangian approach. This is best understood within the Kuz'min-Oseledets formulation of Navier-Stokes, in terms of the "vortex-momentum" associated to a continuous distribution of infinitesimal vortex rings. This theory provides an infinite set of exact Lagrangian conservation laws for Navier-Stokes vorticity, the "stochastic Cauchy invariants". These are preserved only backward in time, due to the irreversibility of Navier-Stokes dynamics. For wall-bounded flows, these invariants allow a complete representation of interior vorticity in terms of vorticity generated at a solid wall, as it is advected, stretched and rotated by the flow. We present a Monte Carlo method to calculate the stochastic Cauchy invariants and their statistics by solving the SDE's for ensembles of stochastic Lagrangian particles. We test the method using a space-time database of turbulent channel-flow at $Re_\tau = 1000$, verifying the conservation of mean values of the stochastic Cauchy invariants. Their variances grow exponentially in time, reflecting Lagrangian chaos in the channel flow and implying large cancellations in the conserved means.

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