Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

True topology of 3D unsteady flows with spheroidal invariant surfaces[1] MICHEL SPEETJENS, SEBASTIAN CONTRERAS, HERMAN CLERCX, Eindhoven University of Technology — Scope is the response of Lagrangian flow topologies of 3D time-periodic flows consisting of spheroidal invariant surfaces (ISs) to perturbation. Such ISs have intra-surface Hamiltonian topologies comprising of islands and chaotic seas. Computational studies predict a response to perturbation dramatically different from the classical case of toroidal ISs: said islands and chaotic seas evolve into 'tube-and-shell' structures by 'resonance–induced merger' (RIM). This study provides conclusive experimental proof of RIM and advances the corresponding structures as the true topology of realistic flows with spheroidal ISs; the latter are singular entities that exist only for ideal conditions. Theoretical analysis reveals that RIM ensues from perturbed periodic lines via two possible scenarios: truncation of tubes by (i) manifolds of isolated periodic points emerging near elliptic lines or by (ii) segmentation of lines into elliptic and hyperbolic parts. This furthermore demonstrates that RIM indeed accomplishes tube-shell merger by exposing the existence of ISs that smoothly extend from tubes into chaotic shells. These phenomena set the response to perturbation – and true topology – of flows with spheroidal ISs fundamentally apart from flows with toroidal ISs.

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Date submitted: 31 Jul 2019 Electronic form version 1.4