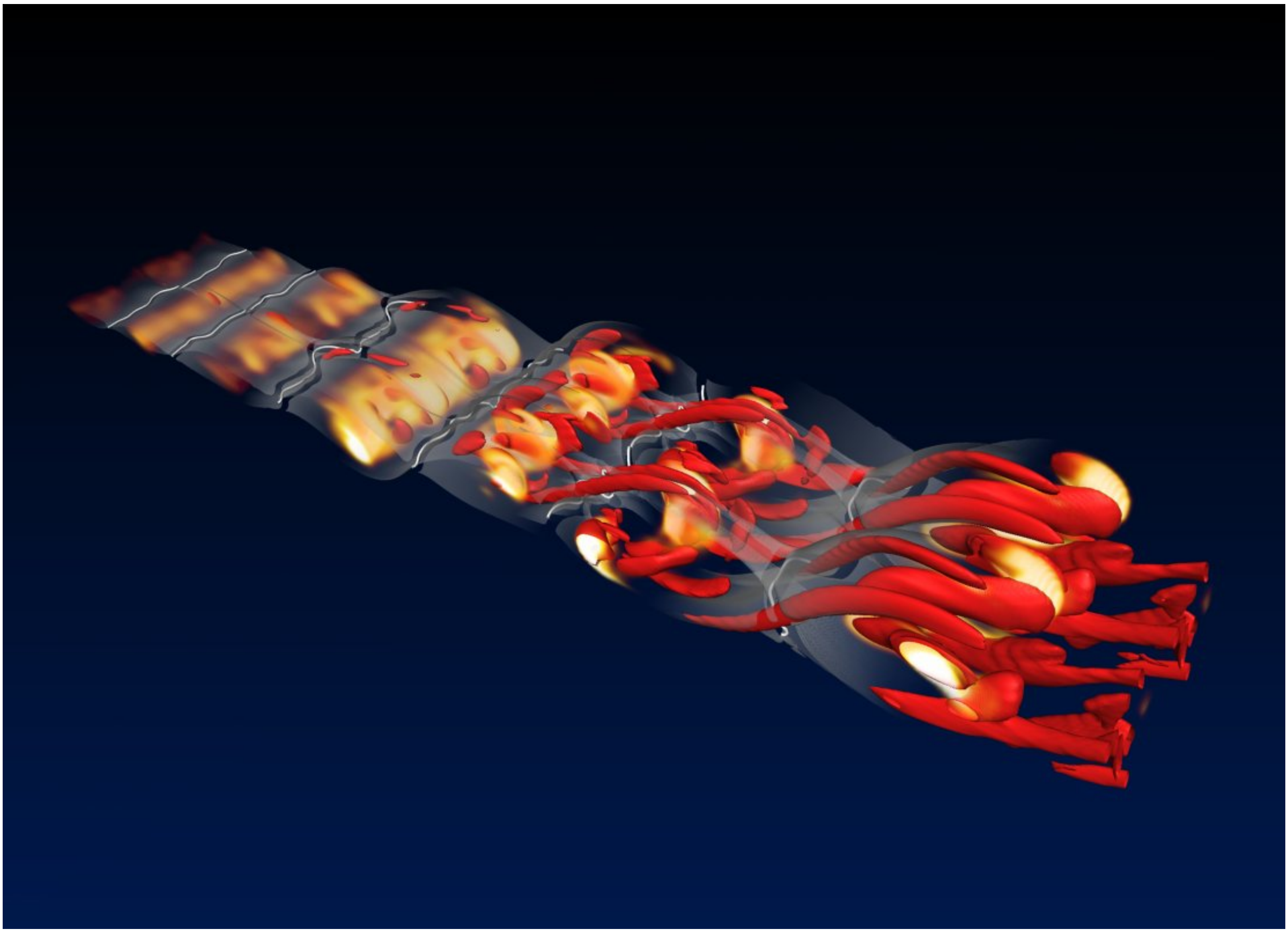

Coherent-Structure Skeleton of a Turbulent Mixing Layer

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The shown snapshot of a 3D mixing layer displays the spatial evolution of Kelvin-Helmholtz vortices, vortex pairing, and the formation of spanwise rib vortices near saddle points. The velocity field has been computed with a pseudo-spectral direct numerical simulation employing the computational domain and boundary conditions of Comte, Silvestrini & Bégou (1998, Eur. J. Mech. B). The Reynolds number is 100 based on the initial shear-layer thickness and convection velocity. The velocity ratio between the upper and lower stream is $3:1$. The primary and secondary vortex structures are elucidated using the Q parameter, which represents both, the source term of the pressure-Poisson equation and the 3D generalization of the 2D Okubo-Weiss parameter.

The primary Kelvin-Helmholtz vortices are pronounced using $Q\cos^2\theta$, where θ represents the local angle between the vorticity vector and the spanwise axis. The negative values of this quantity are identified by a bright volumetric representation. The red iso-surface of $Q\sin^2\theta$ emphasizes the spanwise rib vortices. These secondary structures are aligned with unstable manifolds of saddle points in a frame of reference which moves with the convection velocity. The saddles are marked by white curves at which the streamwise and transverse velocity components vanish. Their stable and unstable manifolds are shown by transparent surfaces generated by streamsurface integration. We acknowledge support of the Amira developer team at ZIB.

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