KHI #1 Movie Captions

Figure12.mp4: Animation of Figure 12 showing the vorticity field evolution due to Kelvin-Helmholtz (KH) billow interactions in a local region where two billow cores (extending top to bottom) have varying phase along their axes. The evolution is visualized using the parameter, $\lambda\_2$($x$,$y$,$z$), which identifies the rotational component of a vorticity field (see paper). Varying KH billow phases induce formation of a vortex tube on the deformed intervening vortex sheet (inclined from top left to lower right). The local KH billows have vorticity toward upper right and cause the vortex sheet to have vorticity toward upper left. The evolution spans $\sim$0.9 buoyancy periods (Tb) and shows 1) initial linkage of the vortex tube to adjacent billow cores forming “knots” at upper left and lower right, 2) roughly orthogonal vortex knot interactions driving twist waves, 3) rapid fragmentation of the weaker KH billow cores, 4) weaker twist waves along the vortex tube, 5) simultaneous entrainment and intensification of the vortex sheet around the vortex tube, 6) twist wave interactions driving strong turbulence, and 7) successive tube and knot dynamics at much smaller scales on the entraining and intensifying vortex sheet. See text for details.

Figure13.mp4: As in Figure12.mp4, but viewed from above and right (positive $x$ and $z$) as shown at several times in Figure 13.

Figure14.mp4: Animation of Figure 12 for the region in which two parallel vortex tubes link to a single KH billow core and viewed from above. In this case, 1) the two vortex tubes are inclined from upper left to lower right, 2) the KH billow core is again roughly orthogonal to the vortex tubes, 3) initial knot interactions drive strong, large-scale twist waves that rapidly fragment the KH billow core, 4) also propagate along, and fragment the vortex tubes, and 5) yield strong successive interactions and intensifying turbulence thereafter. See text for further details.

Figure15.mp4: As in Figure 14.mp4, but for Figure 15 viewed from above and right (positive $x$ and z).

Figure17top.mp4: Animation of the vorticity field evolution for KH billows in a region largely without the influences of tube and knot dynamics. Initial, very weak, large-scale vorticity is confined to the KH billow cores and the intensified vortex sheet wrapping around the billows. Thereafter, 1) small-scale secondary KHI (or vortex tubes) with roughly spanwise (bottom to top) alignments arise on the intensifying vortex sheet, 2) very thin, weak secondary convective instabilities (CIs) aligned largely streamwise (along $x$, left to right) emerge in the KH billow exteriors, 3) secondary vortex tubes on the vortex sheet exhibit interactions where they are roughly orthogonal that are smaller-scale (by $\sim$10 times) versions of the larger-scale initial knot dynamics, 4) these smaller-scale knot dynamics excite very small-scale twist waves that are well within the dissipation range of turbulence, 5) CIs in the KH billow exteriors achieve finite amplitudes and distort and intensify the adjacent vortex sheet causing intensifying small-scale vortex sheets, 6) secondary KHI induce intensity variations along x in the CIs where they become strong in close proximity as they intensify, and 7) these dynamics drive intensifying, very small-scale vortex sheets also within the turbulence dissipation range. See text for further details.

Figure17ahead.mp4: As in Figure17top.mp4, but viewed from larger $x$.