ASTR 670: Interstellar medium and gas dynamics

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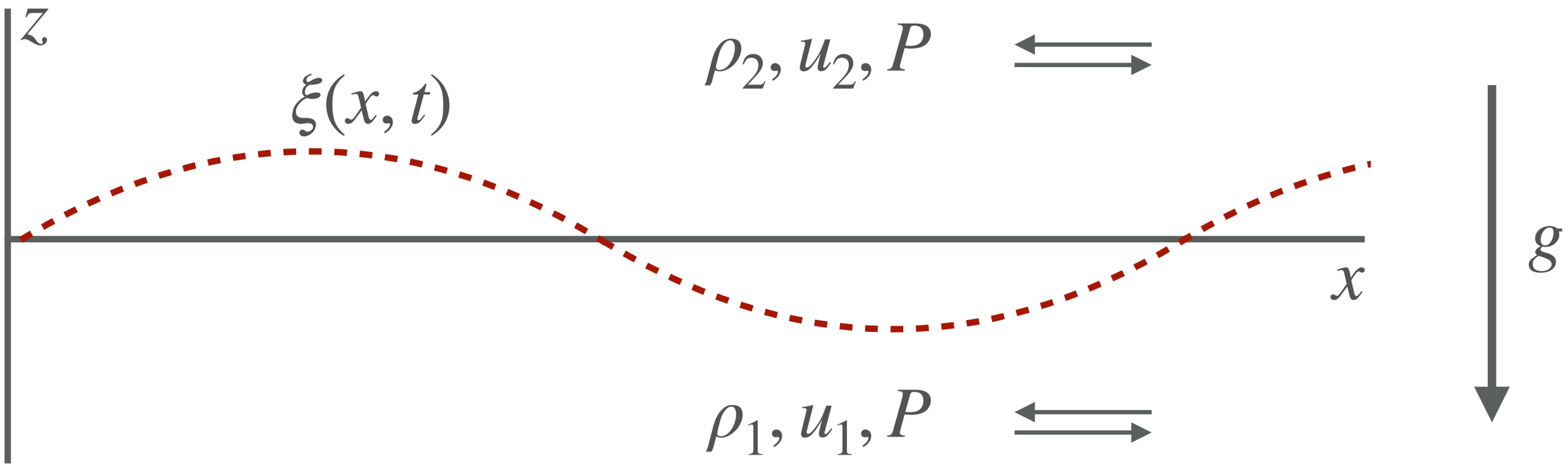
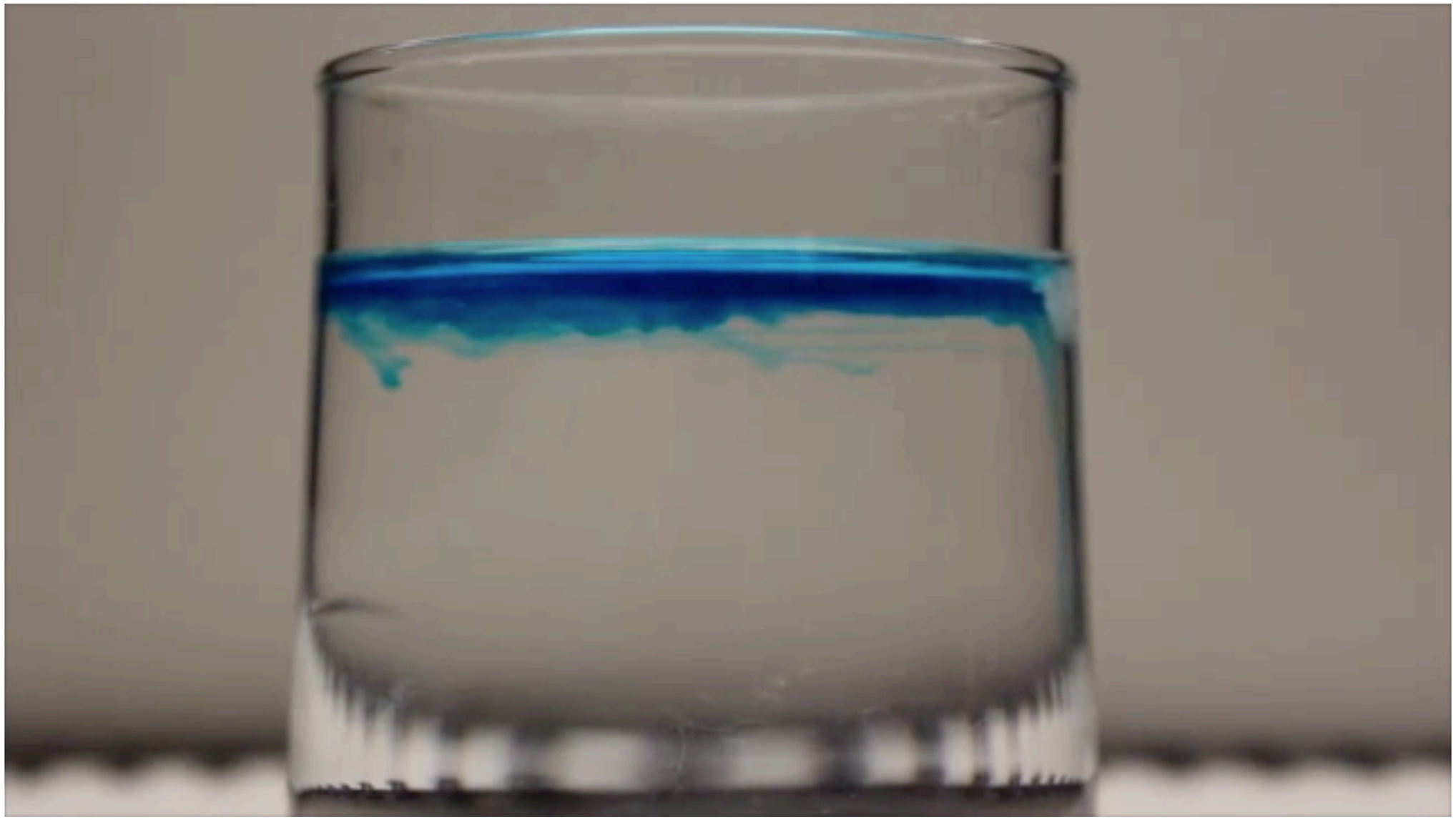
Chapter 9 • Fluid instabilities

Instabilities at a two-fluid interface



Rayleigh-Taylor instability

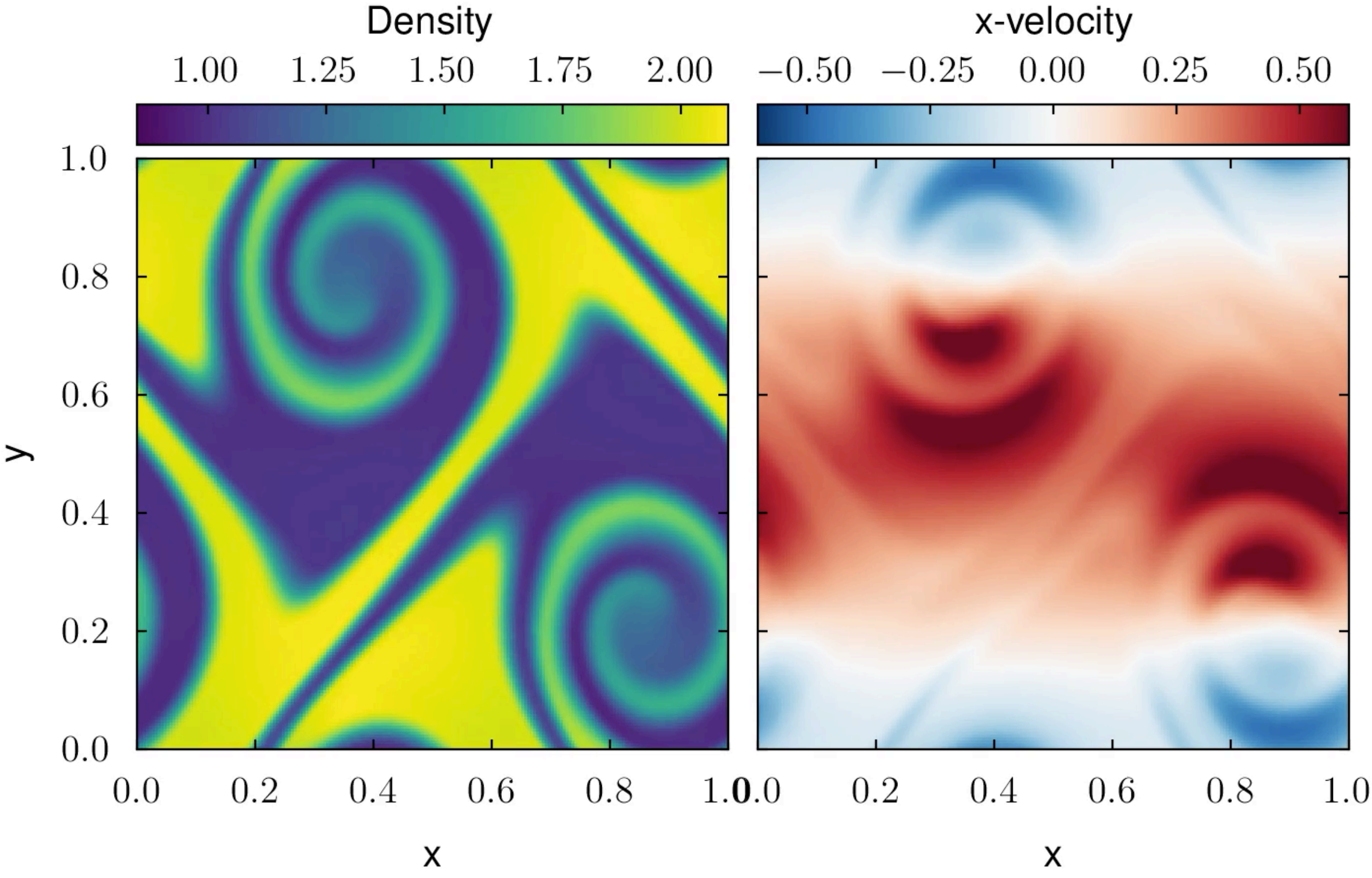


Jens Niemeyer (youtube)

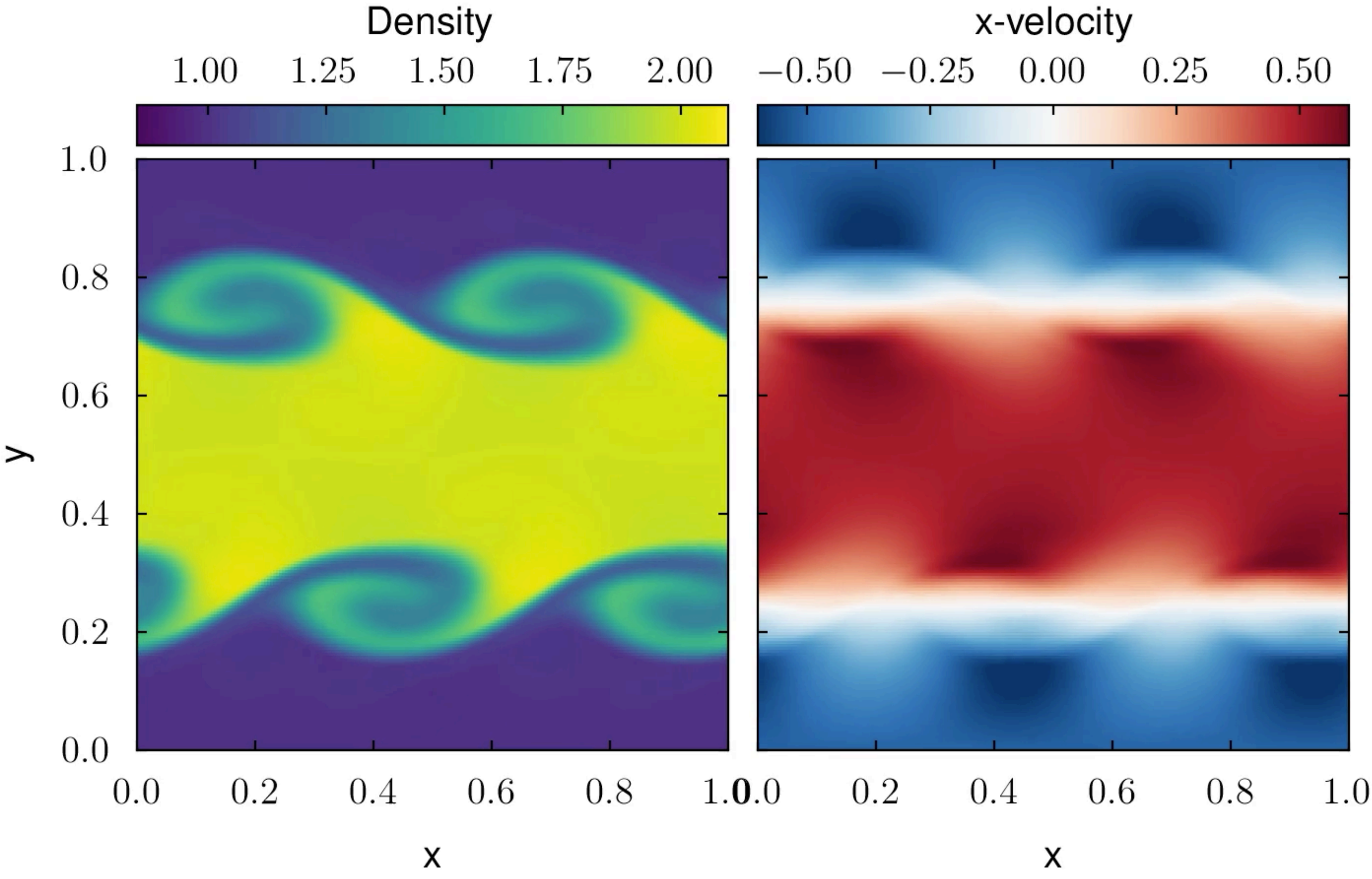
Rayleigh-Taylor instability

Rheologic (youtube)

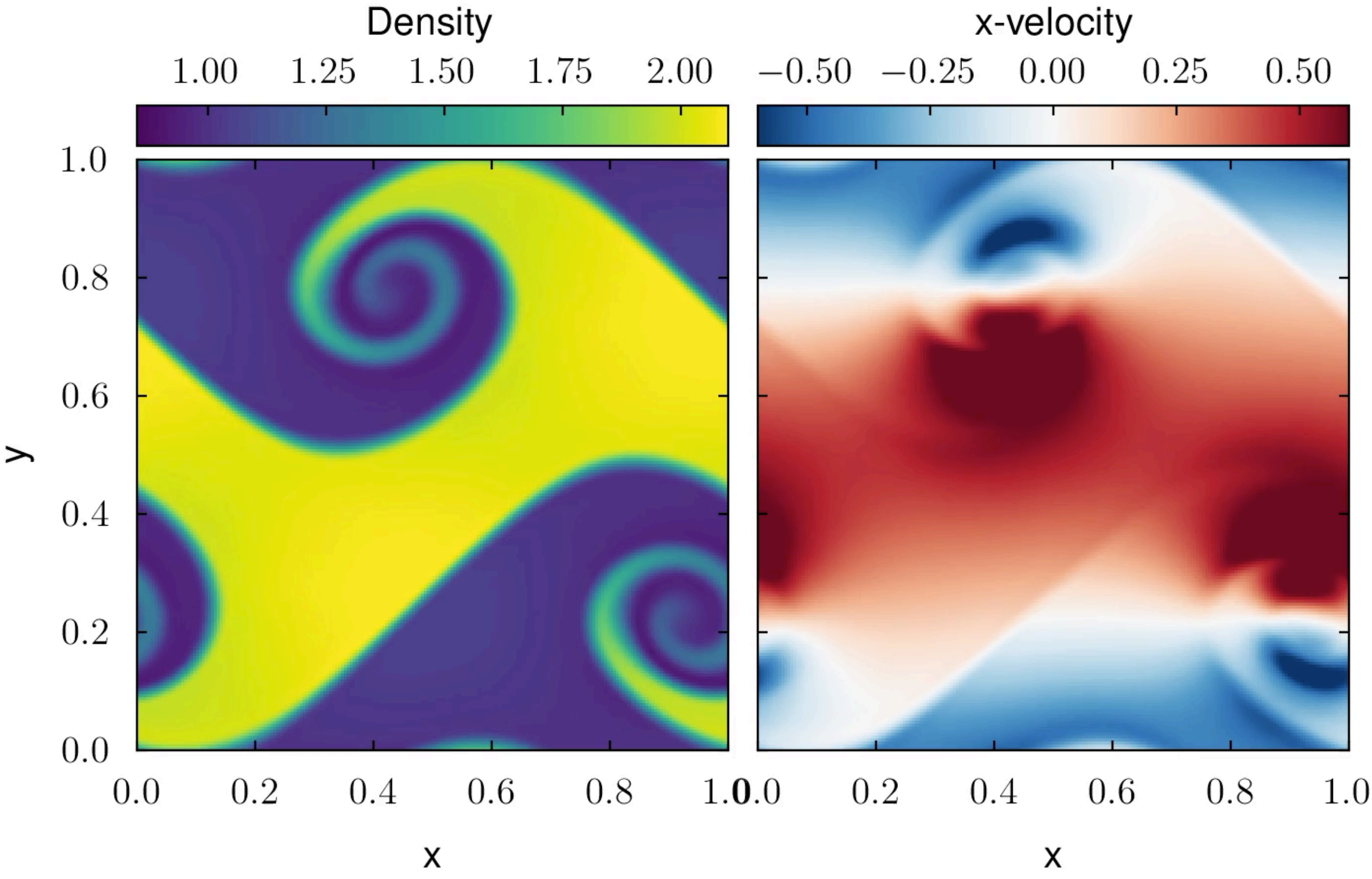
Kelvin-Helmholtz instability



KH instability: insensitivity to wavelength



KH instability: sharp initial conditions

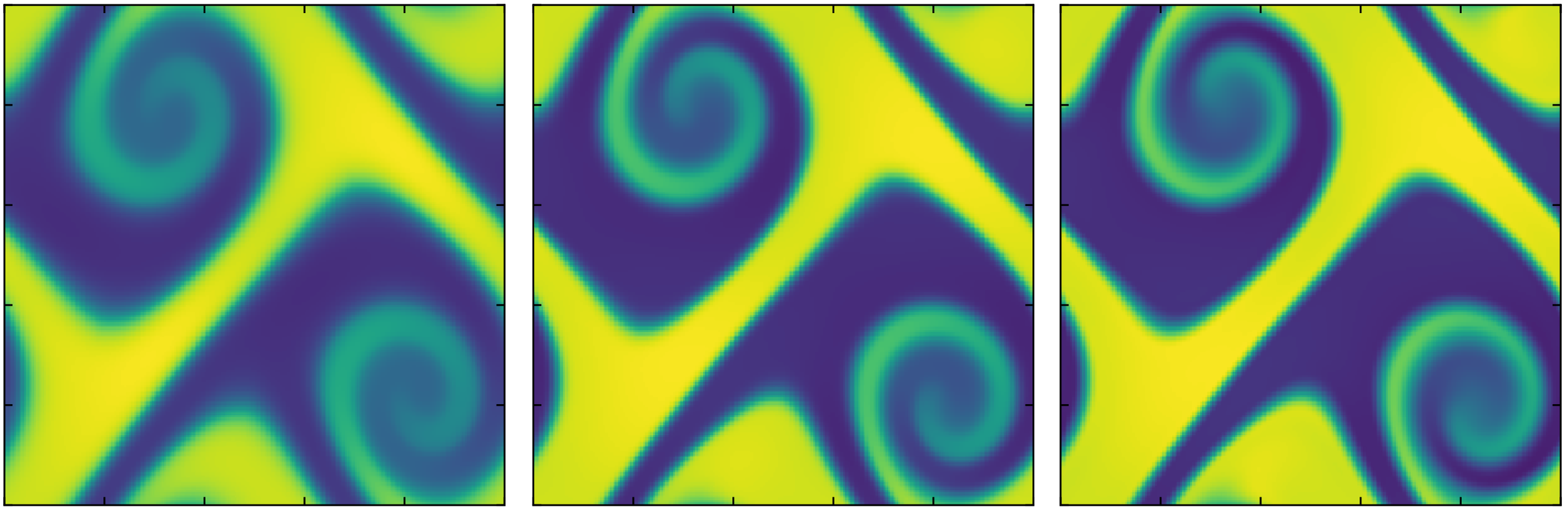


Kelvin-Helmholtz instability: algorithm

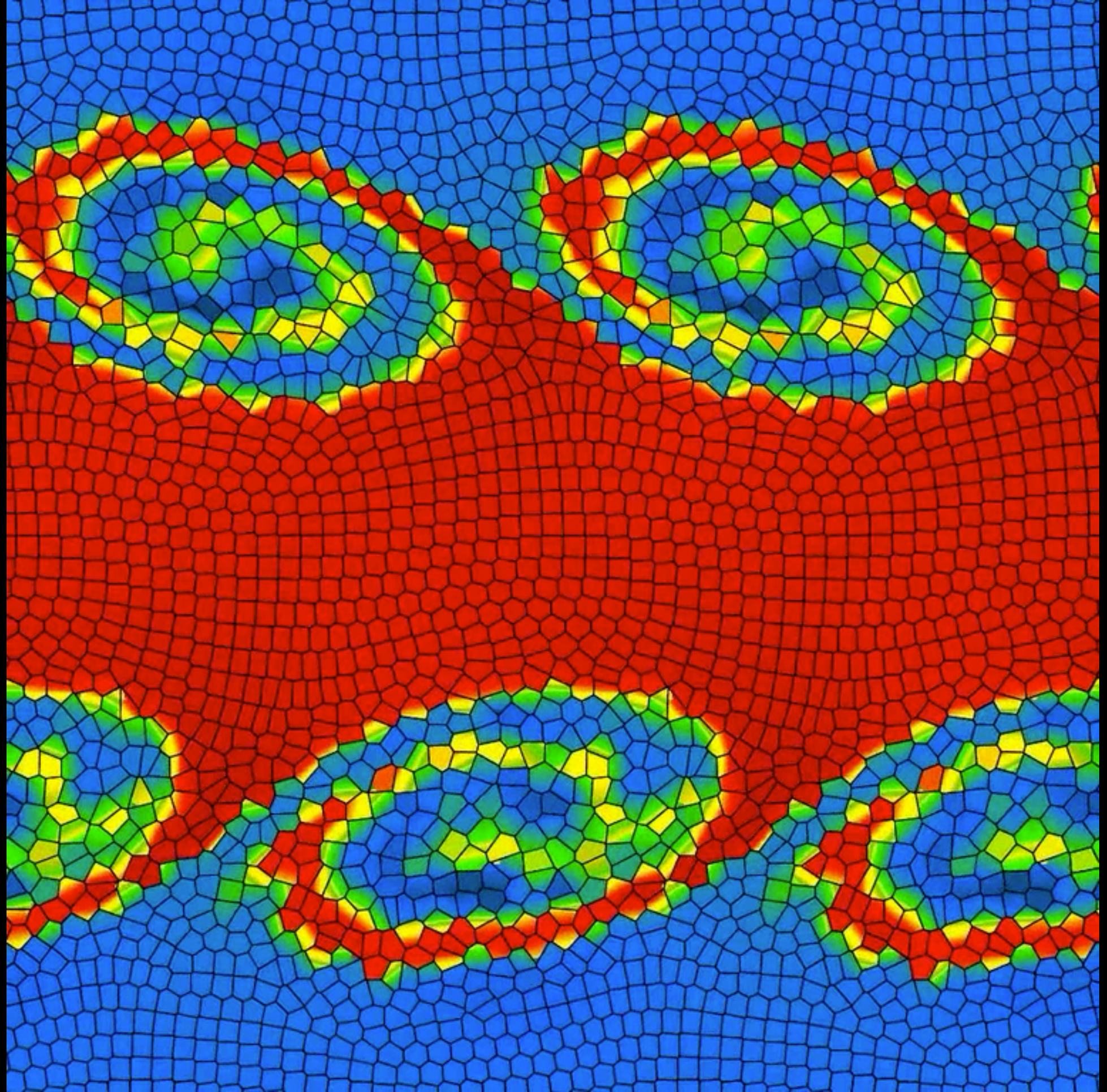
MinMod

van Leer

MC



Arepo



Arepo (Springel 2010, movie page)

Instabilities

Instability	**Density ρ**	**Velocity u**	**Gravity Φ**	**Assumptions**
Sound waves	$\rho_0 + \rho_1$	$u_0 = 0$	0	adiabatic
Jeans	$\rho_0 + \rho_1$	$u_0 = 0$	$\nabla^2 \Phi_1 \propto \rho_1$	adiabatic
Surface waves	$\rho_2 \ll \rho_1$	$u_1 = u_2 = 0$	gz	steady, $\omega = 0$
Rayleigh-Taylor	$\rho_2 > \rho_1$	$u_1 = u_2 = 0$	gz	steady, $\omega = 0$
Kelvin-Helmholtz	no constraint	$u_1 \neq u_2$	0 or gz	steady, $\omega = 0$

Reading

- Recommended: CC §10.1-2
- Additional: Shu §8