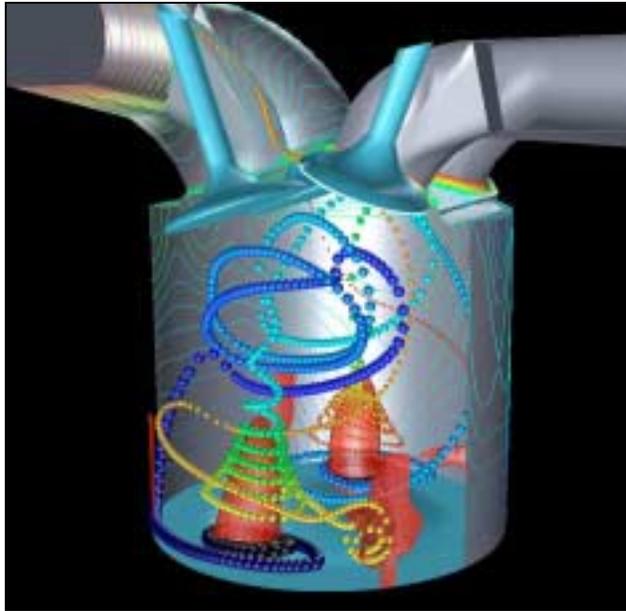


Hydrodynamic interactions in the evolution of a finite particle packet

APS Division of Fluid Dynamics Meeting
November 24, 2002

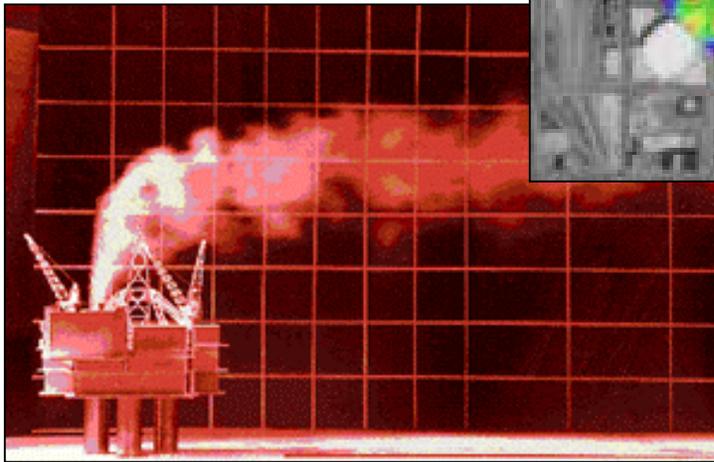
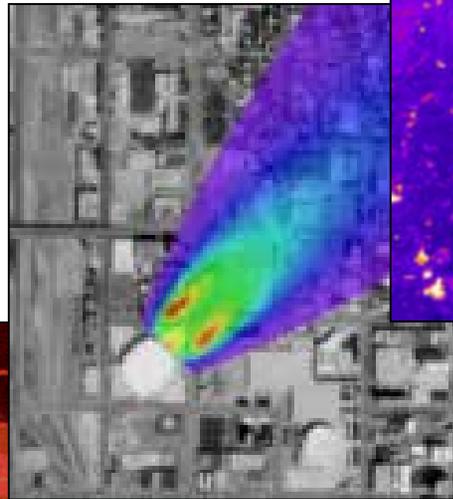
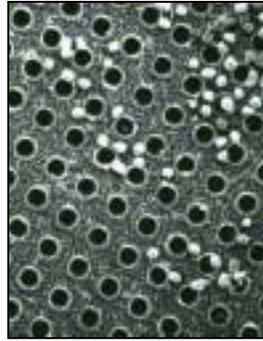
W. Brent Daniel, Michael Rivera, Robert Ecke

Contemporary issues

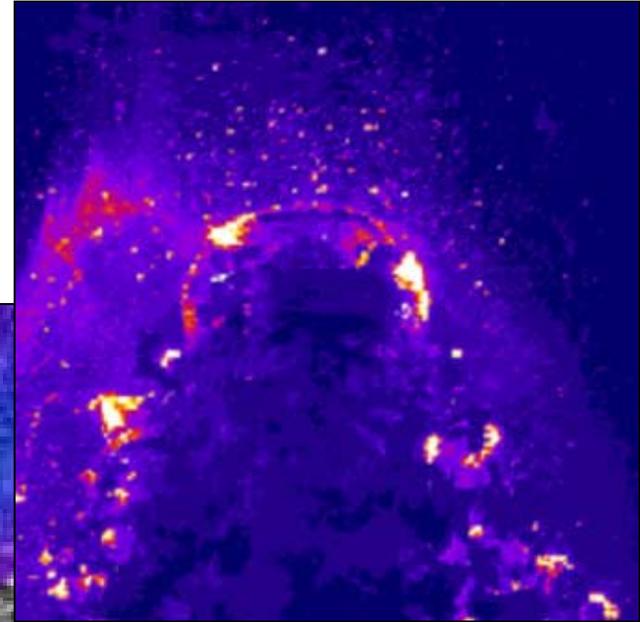


Mixing and combustion

Bioreactors



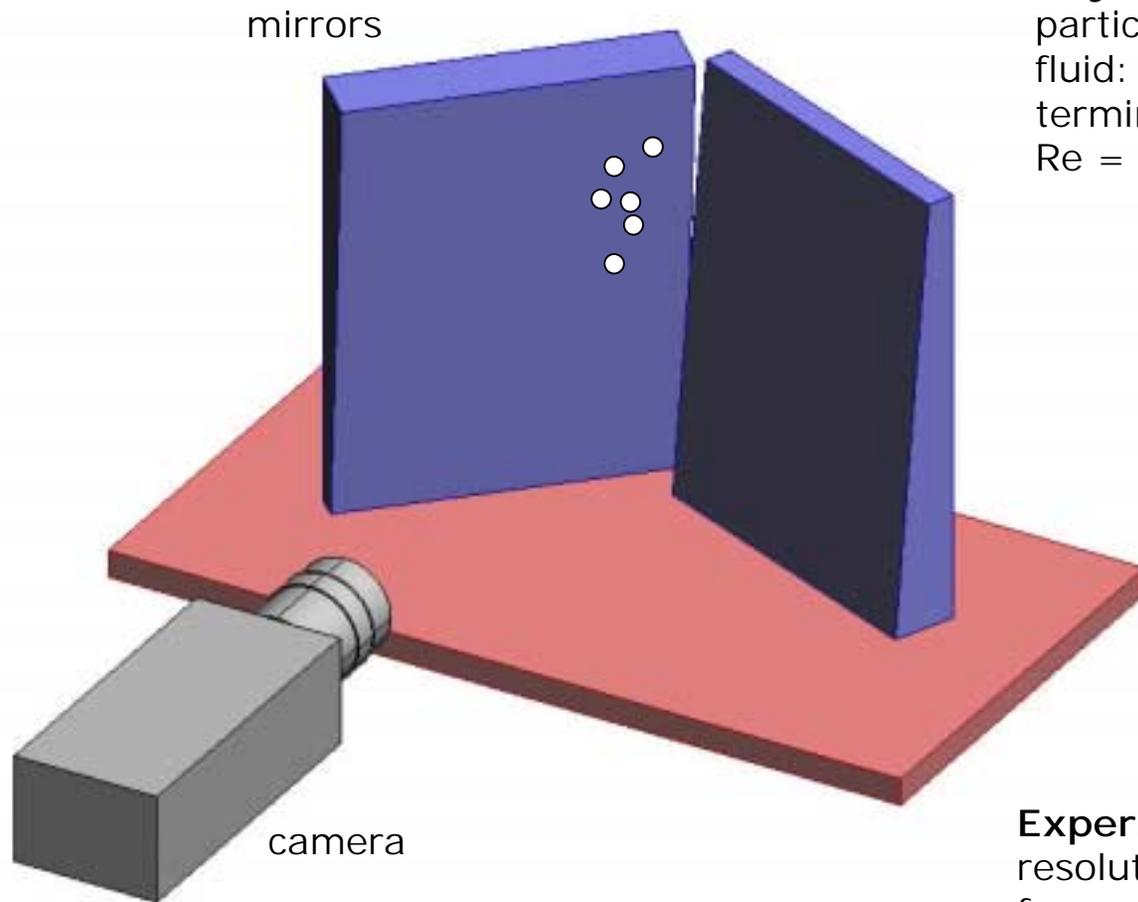
Dispersion of pollutants and toxins



Explosive ejecta

**What problems
could this work
provide insight
into?**

Experiment



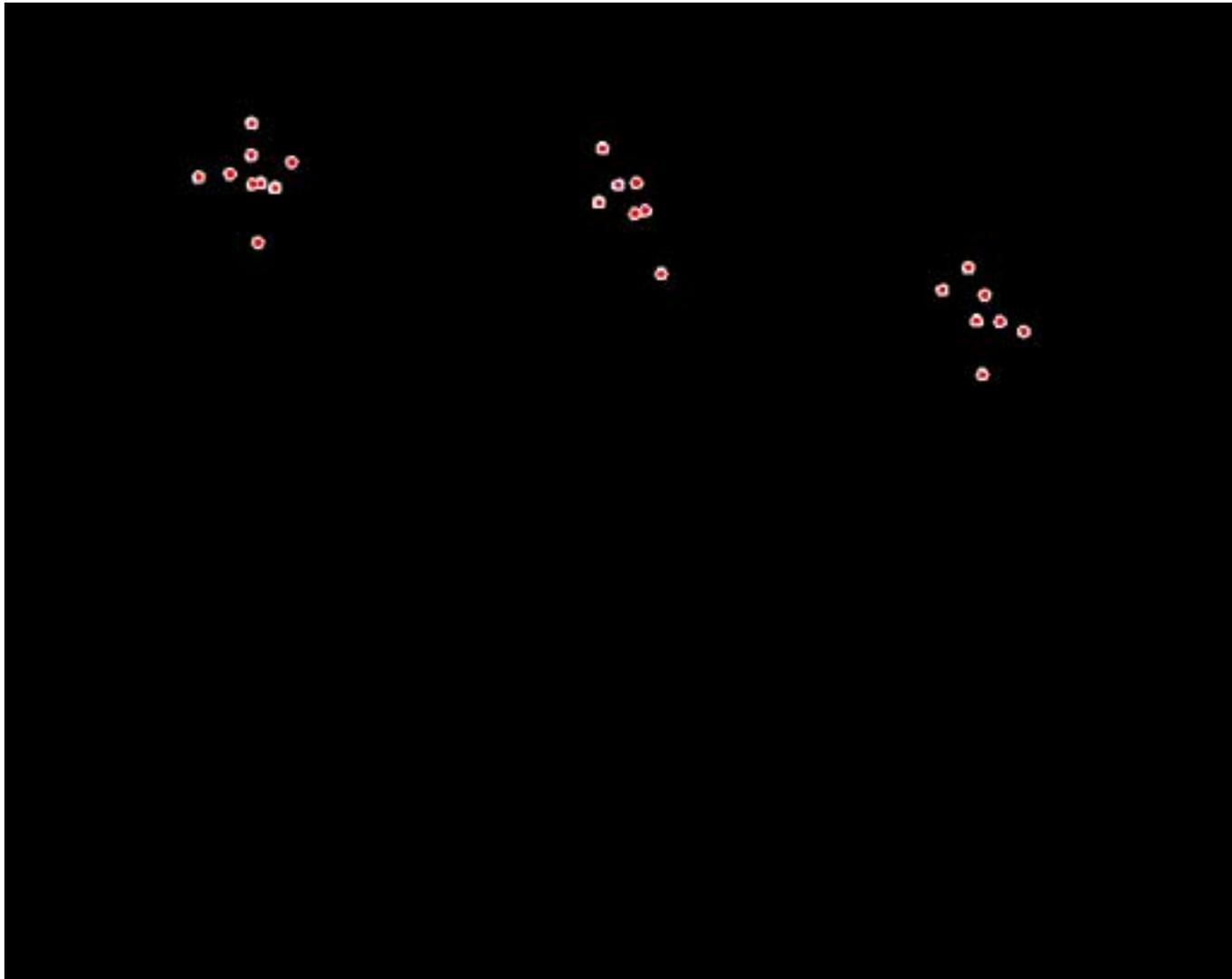
Physical parameters

particle size: 0.075 cm
fluid: water ($\nu = 0.01$ cP)
terminal velocity: 12 cm/s
 $Re = \sim 90$

Experimental parameters

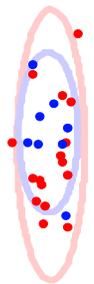
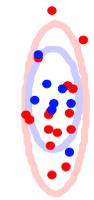
resolution: 1280x1024 pixels
frame rate: 500 Hz
particle diameter: 7 pixels

Images and identification

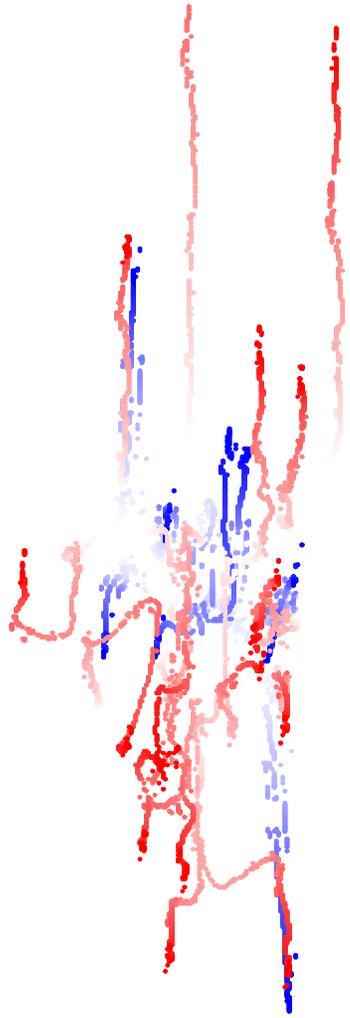


particle image with identified points

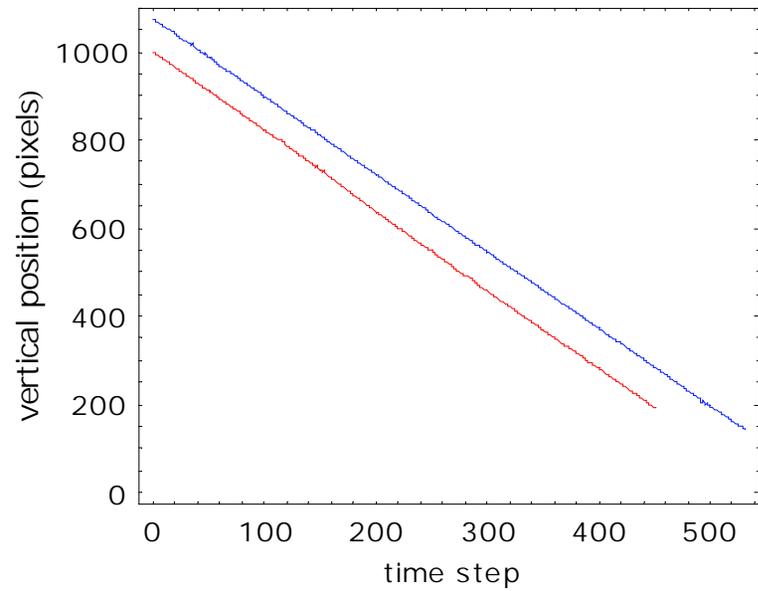
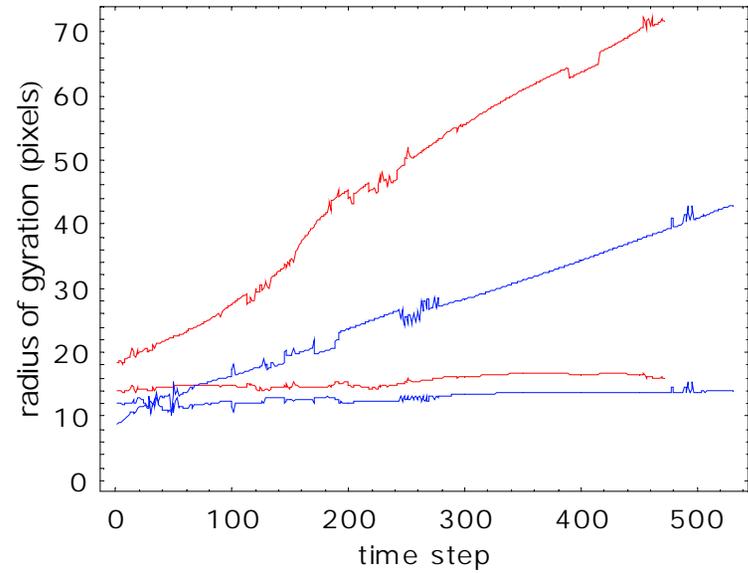
Temporal evolution of packet dimensions



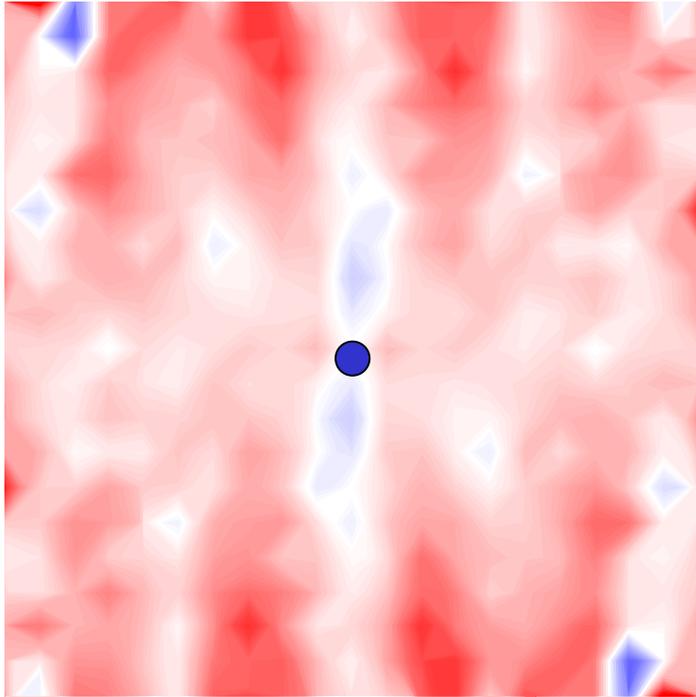
laboratory
frame



center-of-mass
frame



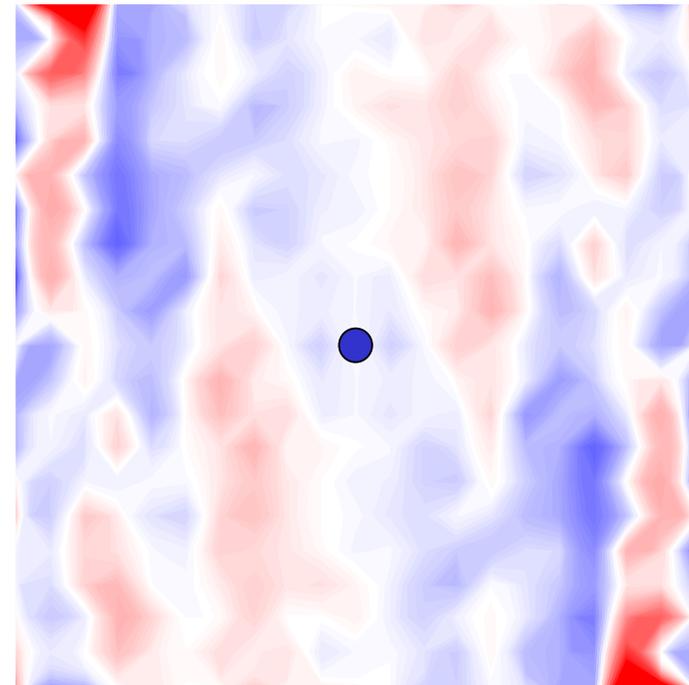
Conditional probabilities



radial velocity

as a function of relative
spatial position

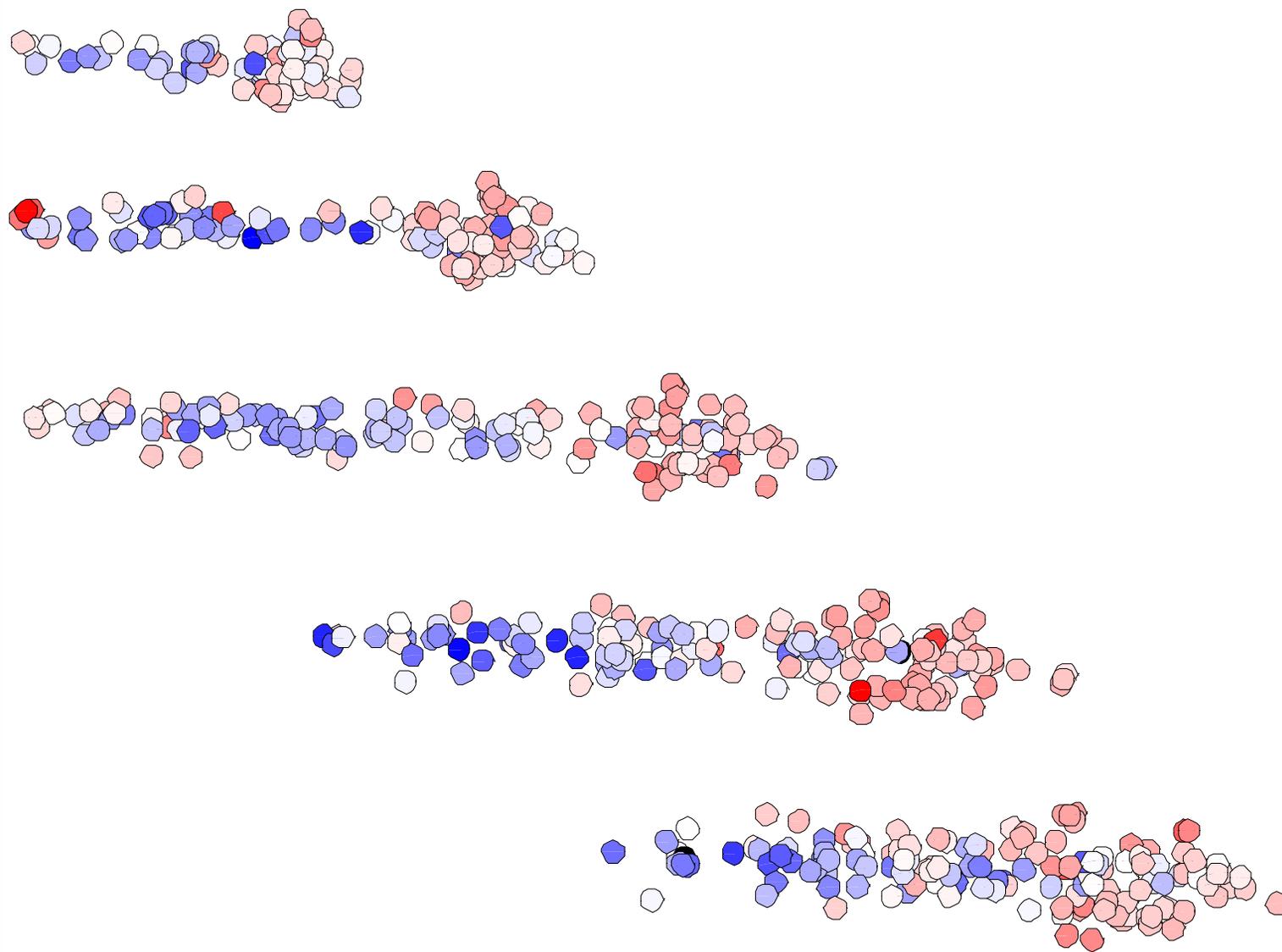
28 particle diameters



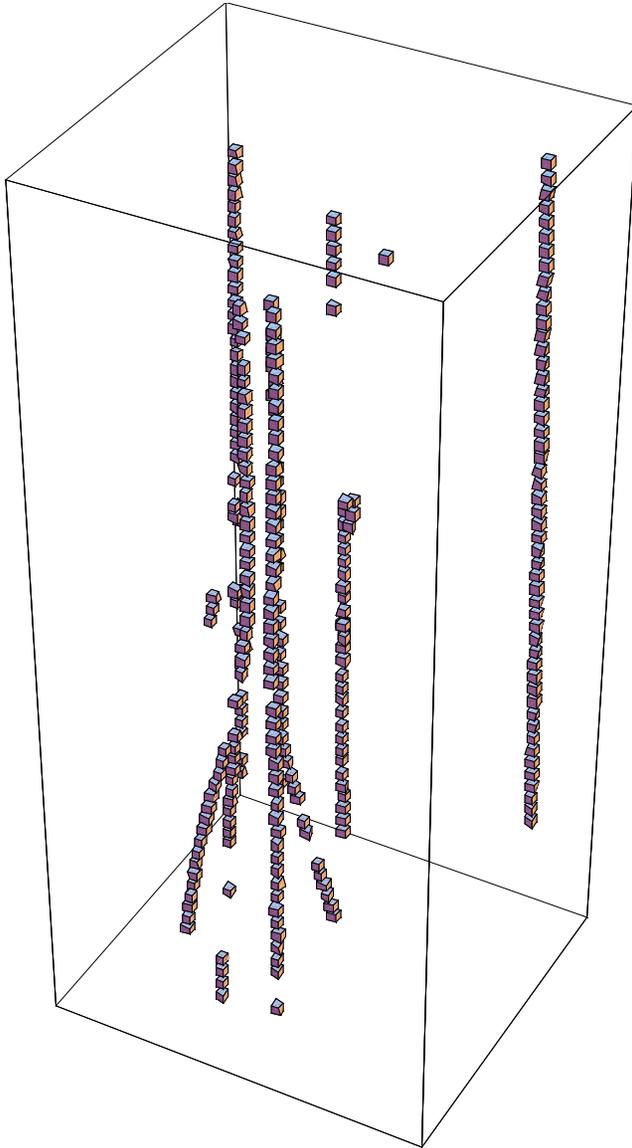
azimuthal velocity

Cap formation

injection point



Future directions and conclusions



Observations

interaction between particles is anisotropic

increased mobility of vertically interacting particle pairs leads to enhanced dispersion in that direction

the entrainment of fluid by the particles can play an important role at larger particle numbers and densities

Future directions

3D particle tracking for extended times

multi-body interactions

interstitial fluid motion and entrainment