Call for candidates for a Master's Thesis or Studentarbeit in:

Vortices in Dense Suspensions: First Steps Towards Experiments at the ISM

Consider a sudden spatial velocity discontinuity in a flow. This discontinuity will generate a shear layer that will roll up into a vortex, grow until it cannot ingest further fluid, and finally convect and decay. From wings to atmospheres, this abstract process is ubiquitous in fluid mechanics and its characterization is imperative to our further understanding of fluid flow.

Now consider the same spatial discontinuity in a dense suspension, which is a matrix containing a disperse solid phase scattered within a liquid carrier phase. The behavior of this phenomena is crucial towards better understanding various geophysical flows, industrial flows, as well as biological and cardiovascular flows. Some have inferred that the presence of the particles can be accounted for by simply correcting the bulk viscosity, while others have inferred that solid particles would disrupt and terminate the process entirely. In turns out that the answer lies somewhere in between. Simply adjusting the bulk viscosity has been shown to be a gross oversimplification with observations failing to collapse with Reynolds number, and yet these vortices still persist, thoughbeit more diffuse and less capable of fluid ingestion. [1]

This is an exciting topic that the ISM eagerly wishes to pursue! However, we lack the experimental facilities to do so. This work represents a first step in developing the necessary facilities and materials to study this topic within the ISM. The student who takes on this project would work on developing, testing and designing the experimental facilities that the ISM would use to investigate dense suspensions in the years to come.

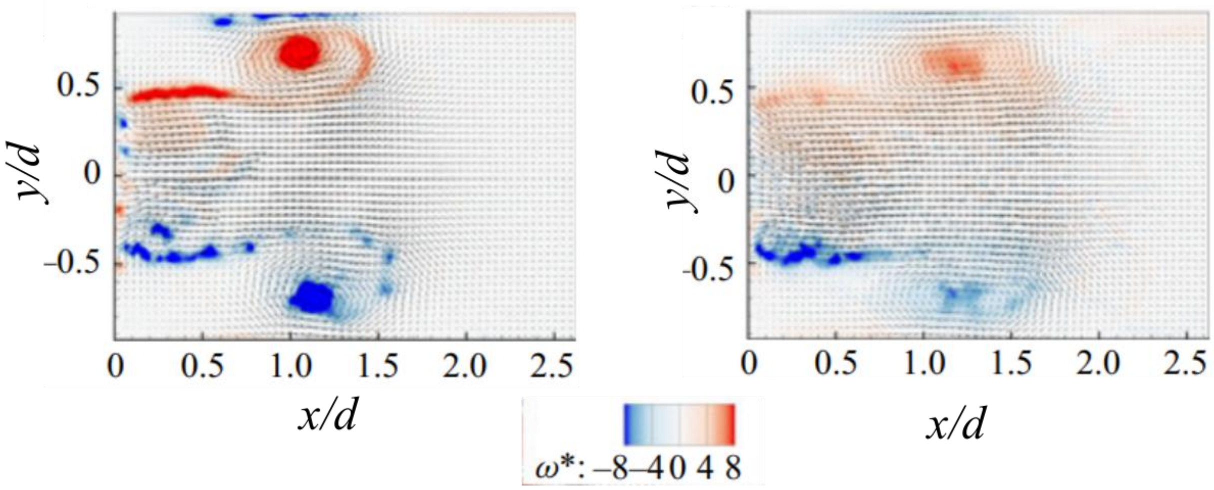

Figure 1: Vorticity fields of two vortex rings (a) within a single phase (b) and within a dense suspension. The images are taken at the same instant in time and both vortex rings share (ostensibly) the same Reynolds number. The vortex rings are seemingly alike and dissimilar in many ways [1].

[1] Zhang, Kai, and David E. Rival. "On the dynamics of unconfined and confined vortex rings in dense suspensions." Journal of Fluid Mechanics 902 (2020): A6.

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