

SEMINAIRE DE LABORATOIRE

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Chaotic mixing of yield stress fluids

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Pasty materials academically referred to as “*yield stress*” materials are ubiquitous in daily life whether we think of food products (e.g. mayonnaise, mustard, ketchup etc.), beauty products (e.g. hand creams, hair gels, shower gels etc.), construction materials (cement, mud) or we try to understand the geophysical scale dynamics of volcanic magmas and land slides. A key issue that has been little (or not at all) addressed so far is rather basic and may be shortly phrased as “*How do we mix such materials?*” which sets up the global aim of the present contribution. To address this issue, first I will first reveal a catastrophic failure of the mixing by the laminar chaotic advection induced by the presence of the yield stress. Next, I will dwell deeper into the physical reasons underlying this fact in terms of both a systematic Eulerian frame and a systematic Lagrangian frame analysis. As a key finding, I will show a clear departure of the spectra of fluctuations of the passive scalar from the analytical prediction proposed by G. K. Batchelor for a temporarily random and spatially smooth flow in terms of the emergence of a spectral peak that blocks the passive scalar cascade. The additional space scale related to the position of the spectral peak is related to the characteristic size of un-yielded materials. Finally I will discuss two simple solutions able to alleviate to some extent the loss of mixing without paying a hefty energetic price.



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