Contribution ID: **692** Type: **Poster (+) Presentation**

Effect of non-uniform passive advection on A+B->C radial reaction-diffusion fronts

Monday, 31 May 2021 19:35 (1 hour)

The interplay between chemical and transport processes can give rise to complex reaction fronts dynamics, whose understanding is crucial in a wide variety of environmental, hydrological and biological processes, among others. An important class of reactions is A+B→C processes, where A and B are two initially segregated miscible reactants that produce C upon contact. Depending on the nature of the reactants and on the transport processes that they undergo, this class of reaction describes a broad set of phenomena, including combustion, atmospheric reactions, calcium carbonate precipitation and more. Due to the complexity of the coupled chemical-hydrodynamic systems, theoretical studies generally deal with the particular case of reactants undergoing passive advection and molecular diffusion. A restricted number of different geometries have been studied, including uniform rectilinear [1], 2D radial [2] and 3D spherical [3] fronts. By symmetry considerations, these systems are effectively 1D.
Here, we consider a 3D axis-symmetric confined system in which a reactant A is injected radially into a sea of B and both species are transported by diffusion and passive non-uniform advection. The advective field $v_r(r,z)$ describes a radial Poiseuille flow. We find that the front dynamics is defined by three distinct temporal regimes, which we characterize analytically and numerically. These are *i)* an early-time regime where the amount of mixing is small and the dynamics is transport-dominated, *ii)* a strongly non-linear transient regime and *iii)* a long-time regime that exhibits Taylor-like dispersion, for which the system dynamics is similar to the 2D radial case.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

[1] L. Gálfi, Z. Rácz, Phys. Rev. A 38, 3151 (1988);
[2] F. Brau, G. Schuszter, A. De Wit, Phys. Rev. Lett. 118, 134101 (2017);
[3] A. Comolli, A. De Wit, F. Brau, Phys. Rev. E, 100 (5), 052213 (2019).

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