Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Upscaled models for heterogeneous reactions in porous media[1]
MATTEO ICARDI, FEDERICO MUNICCHI, University of Nottingham — Although the basic understanding of the macroscopic limit of linear advection diffusion reaction equations is well understood since the early developments of porous media theory, its extension to complex flow regimes is still currently an open question, even in presence of well-separated spatial scales. This is due to the presence of non-trivial microscopic equilibrium configurations (compared to the trivial constant solution obtained by standard periodic homogenisation), or of dynamic equilibrium configurations. For example, when dealing with fast surface reactions, large microscopic gradients can develop locally. Similarly, a conservative solute in the vicinity of a concentration source (injection) undergoes a dynamic evolution of the local microscopic configuration in time and space before reaching the asymptotic self-similar profile. These are only two examples when the classical upscaling approaches fail, and effective macroscopic equations are often found either empirically or by resorting to generic random walk models. In this talk, we present some (old and) new theoretical frameworks to overcome these limitations, by computing local spectral properties (eigenvalues and eigenfunctions) of the underlying transport operators.

[1]This work has been funded by the European Unions Horizon 2020 research and innovation programme, grant agreement number 764531, "SECURe Subsurface Evaluation of Carbon capture and storage and Unconventional risks".

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Date submitted: 31 Jul 2019 Electronic form version 1.4