Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Rigorous derivation of porous-media phase-field equations[1]
MARKUS SCHMUCK, Maxwell Institute and Heriot-Watt University, Edinburgh, SERAFIM KALLIADASIS, Imperial College, London — The evolution of interfaces in Complex heterogeneous Multiphase Systems (CheMSs) plays a fundamental role in a wide range of scientific fields such as thermodynamic modelling of phase transitions, materials science, or as a computational tool for interfacial flow studies or material design. Here, we focus on phase-field equations in CheMSs such as porous media [1,2]. To the best of our knowledge, we present the first rigorous derivation of error estimates for fourth order, upscaled, and nonlinear evolution equations. For CheMs with heterogeneity ϵ, we obtain the convergence rate $\epsilon^{1/4}$, which governs the error between the solution of the new upscaled formulation and the solution of the microscopic phase-field problem [1,2]. This error behaviour has recently been validated computationally in [3]. Due to the wide range of application of phase-field equations, we expect this upscaled formulation to allow for new modelling, analytic, and computational perspectives for interfacial transport and phase transformations in CheMSs. [1] M. Schmuck & S. Kalliadasis, SIAM J. Appl. Math, accepted (2017). [2] M. Schmuck et al., Nonlinearity, 26(12):3259-3277 (2013). [3] A. Ververis & M. Schmuck, J. Comp. Phys., 344:485-498 (2017).

[1]This work was supported by EPSRC, UK, through Grant Nos. EP/H034587/1, EP/L027186/1, EP/L025159/1, EP/L020564/1, EP/K008595/1, and EP/P011713/1 and from ERC via Advanced Grant No. 247031.

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Date submitted: 27 Jul 2017 Electronic form version 1.4