

INTERDISCIPLINARY RESEARCH CENTER *for*

Industrial Nuclear Energy

Nuclear Lecture Series

From Material Structure to Multiphysics Modelling in Nuclear Waste Disposal: A Discrete Approach

Abstract

This talk explores how the internal structure of materials—from grains, aggregates, and inclusions to pores, cracks, and material interfaces—shapes deformation, degradation, and internal transport. These effects are central to deep geological disposal of nuclear waste, where natural and engineered barriers must perform reliably in a complex, harsh, and evolving environment governed by coupled thermal, hydraulic, mechanical, and chemical processes. I will introduce discrete modelling approaches that represent this structure directly, drawing on past work modelling diffusion and mechanics in fractured and heterogeneous materials, as well as structure-informed modelling of gas diffusion in nuclear graphite. In the latter, vertices, edges, faces and volumes represent different material features and their distinct effects on diffusion. The most recent work, developed through an Ibn Battuta Scholarship research visit to the University of Manchester, extends these ideas to transport across multiple structural dimensions in geological materials, coupled multiphase thermal-hydraulic-mechanical behaviour in bentonite clay barriers, and an ongoing effort to develop an intrinsic, structure-aware description of mechanics.



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2:00 PM – 3:00 PM



Building 63 – 327 (Nuclear Simulation Lab)

Presenter



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