A Workshop on Future Directions in Fractional Calculus Research and Applications

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Fractional Dispersion and Mixing Driven Reactions

Abstract

For reactions to happen reactants must come into contact with one another. Mixing is the process that does this, enabling reactions to actually occur. In classical systems it is Fickian diffusion that drives mixing. The local nature of Fickian diffusion confines where and how quickly chemical reactions can occur. However in many natural systems it has been observed time and time again that reactions can and do happen in regions precluded by traditional theories and at rates that are very different from those measured in the laboratory. In this talk we explore what happens when Fickian diffusion is replaced with space fractional dispersion. Specifically we will study two types of bimolecular mixing driven chemical reaction of common interest: (i) an instantaneous equilibrium reaction and (ii) a kinetic irreversible reaction. For (i) we will explore how dimensionality and order of the space fractional dispersion process influences how quickly and where in space chemical reactions occur, while for (ii) we will demonstrate how fractional dispersion can suppress incomplete mixing effects, accelerating chemical reactions relative to Fickian systems.