PHYSICAL MATHEMATICS SEMINAR

Simple models for complex flows

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Part 1. Luiz Fariz

The modeling of physical phenomena almost always involves a tradeoff between simplicity and thoroughness. Even when a complete mathematical description of the system at hand is available (e.g. Navier-Stokes equations), simple models are useful in revealing the fundamental mechanisms responsible for complexity. In this talk I will focus on the derivation and study of simple/canonical models describing out-of-equilibrium phenomena arising due to a two-way coupling between the fluid and an energy-injecting process. In particular I will present (i) a simple model for deflagration-to-detonation transition in narrow channels, and (ii) a model for Faraday pilot-waves over variable topography.

Part 2. Rodolfo R. Rosales

Detonation waves exhibit a very complex dynamics, with both longitudinal and transversal instabilities. Because of the complexity of the underlying equations, much of the current understanding relies on extensive/costly numerical simulations. This is a good example of the situation described in part 1, where simplified theories are desirable.

The first attempt at a reduced qualitative description is due to Fickett (1979), who introduced a qualitative model as a vehicle to understand the intricacies of detonation theory. Several others followed on his steps. However, these earlier models lack the correct physics behind the observed complex dynamics; they are “too stable”. This lead to the proposal that “no theory” might be possible (Joulin-Vidal 1998).

Recently new and improved models (yet still simple) have been introduced. These new models reproduce the observed dynamics, and can be asymptotically justified. In this talk I will introduce some of these models, sketch their derivations and the stability analysis associated with them, and illustrate the complex dynamics they produce with numerical simulations.

TUESDAY, MARCH 13, 2018
2:30 PM
Building 2, Room 136

Reception following in Building 2, Room 290
(Math Dept. Common Room)

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