Title of the subject:

Detonation, entropy, compressible fluids, and constitutive relations

Description of the subject:

Hyperbolic systems of equations describe a broad class of phenomena in which information propagates at finite velocity —for example, compressible fluid dynamics with or without shock waves and detonation fronts. In this setting, entropy plays a central role: its production occurs through shock discontinuities, chemical reactions, and non-adiabatic mechanisms such as heat transfer and viscous dissipation.

A recent study of a specific detonation front shows that reinstating entropy as a central element of the formulation yields an unexpected link between the front velocity and the constitutive relation of the medium. This link cannot be inferred within classical formulations, where entropy is not needed to close the balance laws.

The aim of this thesis is to assess the generality of this result: beyond a specific configuration, is there a systematic relationship between entropy, adiabaticity, and constitutive behavior in more general hyperbolic systems?

Answering this question would:

- deepen our understanding of the intrinsic structure of hyperbolic systems (admissibility, selection principles, and wave/front propagation);

- identify generic mechanisms that connect entropy and wave front velocities;

- open the way to new modelling frameworks in which entropy directly constrains—and potentially determines—propagation properties..