



# UNIVERSITÀ DI PARMA

DIPARTIMENTO DI SCIENZE MATEMATICHE, FISICHE E INFORMATICHE

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COLLOQUIUM di DIPARTIMENTO

Martedì 6 settembre, ore 16:30 Aula A

**Prof. Claude-Michel Brauner**

Université de Bordeaux, France

## About a mathematical question in combustion theory and related topics

The talk will be divided in two parts. In the first one, we will briefly introduce several topics of general interest, such as combustion and flame, reaction-diffusion models, free boundary problems, traveling waves.

In the second part, we will provide a mathematical response to an issue that bothered specialists of combustion theory. We consider a system of two nonlinear reaction-diffusion equations with fractional reaction order  $\alpha$ ,  $0 \leq \alpha \leq 1$ . There are two free boundaries, respectively called the *ignition* and *trailing* interfaces - or there is only one, the ignition boundary. The issue is the following: is there a cut-off value of  $\alpha$  at which the trailing interface disappears? The value  $\alpha = 1/2$  was predicted.

We look for a special solution that travels at constant velocity  $c > 0$ . The trick is to reduce the problem to the study of a non-Lipschitz vector field in dimension 2

$$\begin{cases} x'(t) = y(t), \\ \Lambda y'(t) = cy(t) + x^\alpha(t). \end{cases} \quad (1)$$

If the time to reach the origin is finite, then the trailing interface exists. We shall see that the actual cut-off is  $\alpha = 1$  (see [1,2]).

[1] C.-M. Brauner, R. Roussarie, P. Shang, L. Zhang, *Existence of a traveling wave solution in a free interface problem with fractional order kinetics*, J. Differ. Equ. 281 (2021), 105-147.

[2] R. Roussarie, *Some Applications of the Poincaré-Bendixson Theorem*, Qual. Theory Dyn. Syst. 20 (2021), 1-17.

Tutti sono invitati a partecipare.

Organizzatori: Proff. Adriano Tomassini, Alessandra Lunardi.