



CEMS.UL
CENTER FOR MATHEMATICAL STUDIES

SEMINÁRIO

Sistemas Dinâmicos

13 maio 2026 | 14:00 | sala **6.3.62** - FCUL

A kinetic model of quorum sensing

Simon Loin (Université Picardie Jules Verne, Amiens, France)

ABSTRACT:

Bacterial communication poses many purely scientific and applied problems. An important component of social interaction of bacteria is quorum sensing, which refers to the regulation of bacterial function in response to fluctuations in cell-population density. Such regulation operates via the production and release of signal micro-molecules (autoinducers). Here, we present a conceptually different model from the literature, based on kinetic theory, and derive a population equation in a measure setting. We study its well-posedness first, then we show the set of steady solutions is a continuum of convex combination of Dirac masses. In the case where only one Dirac masses can exist, we are able to construct a Lyapunov functional and prove convergence in Wasserstein metric. We then introduce a variant of this model, where we account for small fluctuations in the membrane transport of autoinducers, which results in a parabolic regularization of the population model. We prove an existence result first, then we provide numerical evidence of bistability and steady solutions that consists of at most 3 distributions, and lastly, we prove linear stability in a particular case thanks to a Poincaré-Wirtinger's type inequality. A challenging question still open is the connection between the stationary solutions of the parabolic regularization and the limit model with vanishing fluctuation. This is a joint work with Michael Grinfeld and Erwan Hingant.



UID/04561/2025 - <https://doi.org/10.54499/UID/04561/2025>