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(I) Prion propagation and loss dynamics in single cells

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Prion proteins are proteins that can fold in different structures, where one fold (the prion form) can self-propagate by converting their normally folded proteins into the prion form. In mammals, prions are the cause of untreatable neurodegenerative diseases such as Creutzfeldt-Jakob disease. Intriguingly, prion domains (often disordered sequences) are commonly found in yeast but have also recently been found in bacteria and higher eukaryotes, where they act as a non-pathogenic bistable switch to propagate a functionally distinct cellular state. In bacteria, the prion can be propagated for hundreds of cell divisions, but is stochastically lost through an unknown mechanism in a fraction of the population. It is also unknown whether these bacterial prion domains can attain different prion folds (known as strains or variants) like their mammalian counterparts, and whether the presence of the prions has a general physiological impact on the cell. In this talk, we answer these questions by following thousands of single cells propagating prions for dozens of cell divisions using a microfluidic device and quantitative time-lapse microscopy. We build a stochastic model of the chemical reaction kinetics to recapitulate the properties of the system. I will end by discussing how our findings can provide insights on the biological role of prions in bacteria and on the molecular mechanisms of prion propagation in other organisms.

Author: POTVIN-TROTTIER, Laurent (Center for Applied Synthetic Biology, Concordia University)

Presenter: POTVIN-TROTTIER, Laurent (Center for Applied Synthetic Biology, Concordia University)

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