Departmental Seminar
Department of Chemistry

Monday, November 30, 2015
Time 15:00
Bldg. 51 Room 015

Prof. Nathalie Q. Balaban
Racah Institute of Physics,
The Hebrew University of Jerusalem

Distinguishing between stochasticity and determinism:
Example from cell cycle duration variability

Cell-to-cell variability was observed long ago in the cell cycle duration, however its sources are still unknown. A central question is whether the variance of the observed distribution originates from stochastic processes, or whether it arises mostly from a deterministic process that only appears random. A surprising feature of cell cycle duration inheritance is that it seems to be lost within one generation but to be still present in the next generation, generating poor correlation between mother and daughter cells but high correlation between cousin cells. This observation suggests the existence of underlying deterministic factors that determine the main part of cell-to-cell variability. We developed an experimental system that precisely measures the cell cycle duration of thousands of mammalian cells along several generations and a mathematical framework that allows discrimination between stochastic and deterministic processes in lineages of cells. We show that the inter and intra generation correlations reveal complex inheritance of the cell-cycle duration. Finally, we build a deterministic nonlinear toy model for cell-cycle inheritance that reproduces the main features of our data. Our approach constitutes a general way to identify deterministic variability in lineages of cells or organisms, and may help predict, and eventually, reduce cell-to-cell heterogeneity in various systems, such as cancer cells under treatment.