Dynamical regulation in living systems

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Interactions among the biochemical components that constitute and regulate living systems are frequently nonlinear. This allows for nontrivial dynamical behaviors such as limit-cycle oscillations and pulses, which arise even in the presence of stationary environmental conditions. In this talk I will review recent work on the dynamical regulation of cells and cellular populations, discussing a variety of cell types, regulation modes and environmental conditions. In particular, both gene expression and metabolic regulation will be considered, with a special focus on the behavior of bacterial populations under nutritional and energy stress. In all the cases studied, dynamics provides a significant survival advantage with respect to alternative stationary behaviors, by allowing for instance the periodic release of stress that enables a population to maintain its viability under limiting conditions, by balancing conflicting needs such as nutrient access and protection against external attacks.