Stochastic ERK activity pulses induced by noise and cell-to-cell propagation regulate cell density-dependent proliferation

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The ERK MAP kinase plays a central role in the signaling cascades of cell growth. Here, we show that stochastic ERK activity pulses regulate cell proliferation rates in a cell density-dependent manner. A biosensor based on the principle of fluorescence resonance energy (FRET) revealed stochastic ERK activity pulses fired spontaneously or propagated from adjacent cells. Frequency, but not amplitude, of ERK activity pulses exhibited a bell-shaped response to the cell density and cell proliferation rates. Consistently, synthetic ERK activity pulses generated by a light-switchable CrA protein accelerated cell proliferation. Taken together, these findings reveal a role of the stochastic ERK activity pulses in cell proliferation.

Information coding of cellular signaling networks

Shinya Kuroda, Shinzuke Uda (Biophys. Biochem., University of Tokyo)

Cellular signaling network can be regarded as a communication channel in the framework of Shannon’s information theory. We can measure the distribution of phosphorylation of ERK and CREB and expression of IEGs products at a cell population level. We found that information transmission was generally more robust than averaged signal intensity despite pharmacological perturbations, and information transmission through unperturbed signaling pathways compensatorily increased in many signaling pathways. We propose that cells use information entropy as a communication channel in cellular signaling.

Information coding will be discussed as a general property of cellular signaling.

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The bacterial flagellum acts as the propeller for cell locomotion in a variety of environments. The flagellar motor, consisting of the rotor and the stator, rotates the flagellar filament. All the bacterial flagellar motors characterized so far are energized by either transmembrane electrochemical gradients of protons or sodium ions that are coupled to motility via membrane embedded stator complexes. There are at least four groups of flagellar motors in alkaliphilic Bacillus species as determined by the properties of each flagellar stator. In 2012, our group identified a novel type flagellar motor which stimulates swimming speed under elevated K+ or Rb+ concentrations. In this symposium, we report our current progress on the novel type flagellar stator from Bacillus.