1SCA-05 確率的な ERK 活性ダイナミクスと細胞増殖制御
Stochastic ERK activity pulses induced by noise and cell-to-cell propagation regulate cell density-dependent proliferation
Kazuhiro Aoki (Kyoto University, Graduate School of Medicine, Imaging Platform for Spatio-Temporal Information)
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 CRaf protein accelerated cellular proliferation. Taken together, these findings reveal a role of the stochastic ERK activity pulses in cell proliferation.

1SCA-06 細胞内シグナル伝達経路の情報コーディング
Information coding of cellular signaling networks
Shinya Kuroda, Shinsuke 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 information, so that messages can be robustly transmitted despite noise and variation in molecular activities between individual cells. Information coding will be discussed as a general property of cellular signaling.

1SCA-07 タンパク質膜透過促進因子 SecDF の構造と機能
Structure and function of SecDF, a membrane integrated protein translocation enhancing factor
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In bacteria, SecA, the translocation ATPase and SecYEG, the polypeptide-conducting channel, play central roles in protein translocation across the cytoplasmic membrane. Membrane proteins SecDF, conserved throughout the bacterial kingdom, form a complex with SecYEG and are required for efficient protein export. Thus, it is important to elucidate mechanisms of the SecDF enhancement of translocation. We discuss structure and function of SecDF on the basis of the crystal structure of the T. thermophilus ortholog and structure-instructed biochemical analyses of the E. coli system including site-directed in vivo photo-crosslinking. Based on the results, we propose that SecDF functions as a cation-driven molecular motor to pull a translocating polypeptide from the SecYEG.

1SDA-02 細菌べん毛ディスタルロッドの構造解析
High-resolution structure of the bacterial flagellar distal rod
The flagellar rod is a competent drive shaft that transmits torque through the hook to the filament to propel the bacterial locomotion. The distal part of the rod is a helical assembly of FlgG, which shows an obvious sequence similarity with the hook protein. However, the mechanical property of the rod and the hook is quite distinct; the hook is a flexible universal joint, and the rod is a rigid drive shaft. To elucidate the structural basis of the mechanical property of the rod, we crystallized a core fragment of FlgG (FlgG47-227) and solved the structure at 2.0 Å. On the basis of the high resolution X-ray structure and the density map of the poly-rod obtained by electron cryomicroscopy, we will discuss the structure and mechanical property of the flagellar distal rod.

1SDA-03 パチルス属細菌のべん毛モーター固定子のイオン選択性と動性
One stator that couples to multiple different ions: flagellar stator and motility of Bacillus spp.
Masahiro Ito (Fac. Life Sci., Toyo Univ.)
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 alkalophilic 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.

1SDA-04 バクテリア運動の驚異
Wonders of bacterial motility
Howard C Berg (Department of Molecular & Cellular Biology and of Physics, Harvard University)
Much is known about the motile behavior of Salmonella. and Escherichia coli. I will mention some history and then describe two recent vignettes, involving adaptation at the output of the sensory-transduction pathway. Receptor methylation is required for adaptation on the second time scale, which enables cells to make temporal comparisons and swim up spatial gradients of attractants. Without methylation, one still observes partial adaptation, on the minute time scale, as the motor shifts its operating point. The motor also adapts to changes in viscous load. When the load suddenly increases, additional force-generating units are added one by one; thus, the motor is a mechanosensor.