グローバルCOE「生体シグナルを基盤とする統合生命学」

平成23年度大学院講義 新国際基盤生命学特論4 コース 3

Moving towards a systems level analysis of the events of vertebrate embryonic development

Prof. Scott E. Fraser

(California Institute of Technology)

12 月 12 日 (月) 13:30 – 15:00

理学部 2 号館 第 1 講義室(201) (担当：武田 洋幸)

Intravital imaging offers unprecedented opportunities for studying the cell lineages, cell interactions and intercellular signaling that development and function. These powerful techniques are challenged by major tradeoffs between spatial resolution, temporal resolution, and the limited photon budget.

We are attempting to advance this tradeoff by constructing faster and more efficient microscopes that maintain subcellular resolution. This combination of speed and resolution is required as intravital imaging can only generate accurate data on cell lineages and cell migration if it can re-acquire the three dimensional image of the entire specimen before any of the cells can move half of the distance separating them from their neighbors. Failing this, imaging tools can only give information on the averaged behaviors of cells (such as optical flow or PIV), which is often mistakenly taken as revealing cellular mechanism.

We have developed a new microscope, combining the deep penetration of two-photon microscopy and the speed of light sheet microscopy to generate images with more than ten-fold improved imaging speed and sensitivity. As with other light sheet technologies, dramatically faster acquisitions rates results from the collection of an entire 2-D optical section in parallel. This two-photon SPIM is far less subject to light scattering, permitting subcellular resolution to be maintained far better than possible with conventional light sheet microscopes.

In parallel to microscope development, we have been refining Second Harmonic Generation (SHG) nanoparticles as labeling reagents with greater photostability and brightness. These nanoparticles give sufficient signal for clear imaging down to the single molecule level, even in complex optical environments, and avoid the limitations of quantum dots (blinking and bleaching).

Combined, these improvements define a new compromise between spatial resolution, temporal resolution, and the limited photon budget: combining needed resolution, speed and sensitivity to follow complex cell/tissue events over the prolonged periods of embryogenesis. We are applying these tools to study zebrafish in which the FlipTrap vector has been used to create functional fusion proteins that are expressed at normal levels. These fusions permit cellular and molecular imaging of the key events in normally and conditionally mutated embryos, offering systems analyses of embryonic development.

履修届：Web 上（学務システム）から履修登録してください。
成績評価：出席と 2 つのコースに対するレポートにより判定します。
レポート課題：講演の要点と感想を A4 レポート一枚にまとめる。 提出期限： 12 月 26 日(月)
提出先： 題名「新国際基盤生命学特論 4（講師名）」としてメールで下記宛先へ。
gCOE 講義係 <gcoe_lec@biol.s.u-tokyo.ac.jp> (3 日以内に返信がなければ再度確認のこと。)

レポート担当教員：柳澤 春明 生物科学専攻分子生理学研究室（内線 24427）
責任者：渡邊嘉典（分子細胞生物学研究所）ywatanab@iam.u-tokyo.ac.jp （内線 21466）
武田洋幸（理学系研究科生物科学専攻） htakeda@biol.s.u-tokyo.ac.jp （内線 24431）