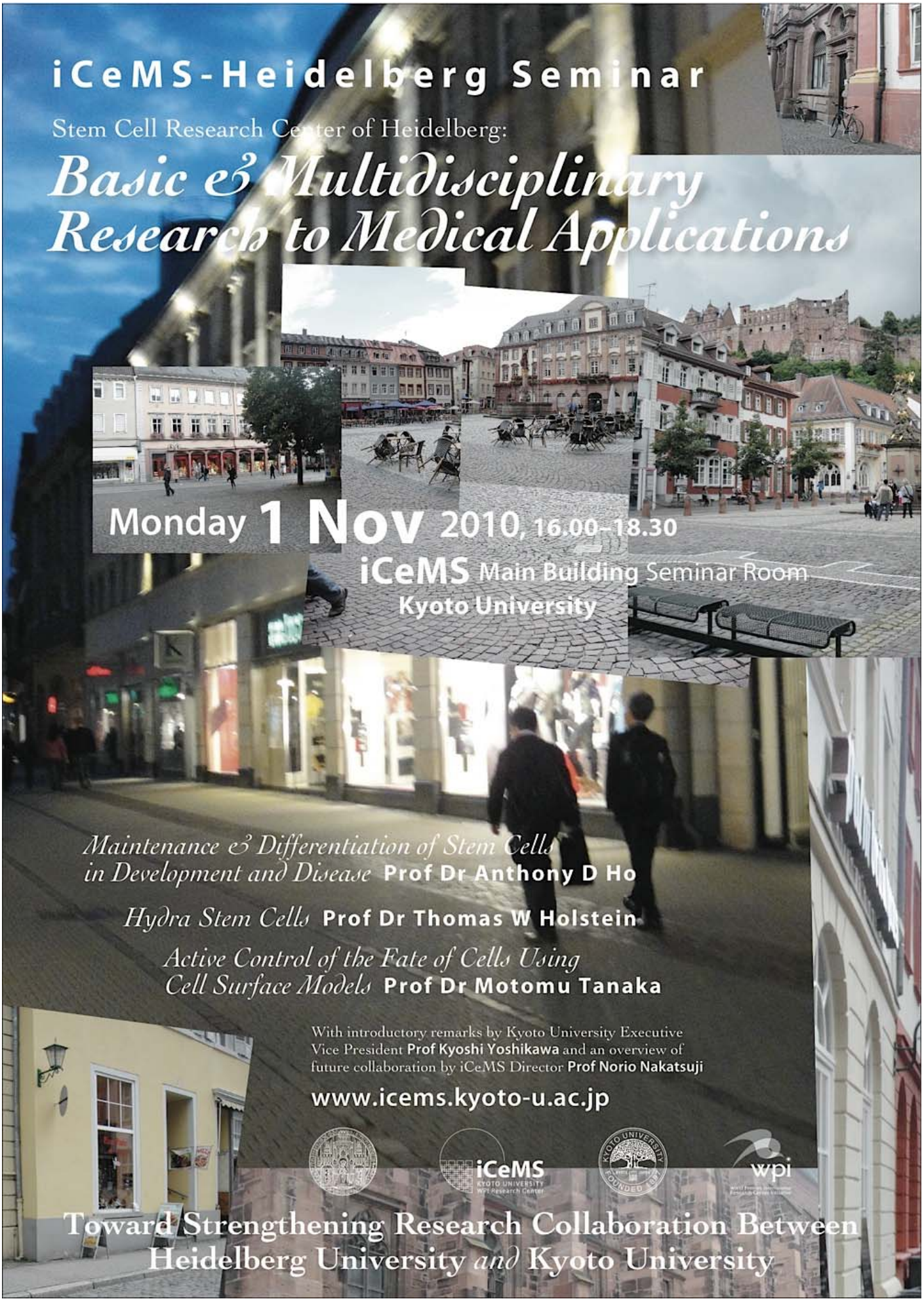
iCeMS-Heidelberg Seminar
Stem Cell Research Center of Heidelberg:
Basic & Multidisciplinary Research to Medical Applications
Monday 1 Nov 2010, 16.00–18.30
iCeMS Main Building Seminar Room
Kyoto University
Maintenance & Differentiation of Stem Cells in Development and Disease Prof Dr Anthony D Ho
Hydra Stem Cells Prof Dr Thomas W Holstein
Active Control of the Fate of Cells Using Cell Surface Models Prof Dr Motomu Tanaka
With introductory remarks by Kyoto University Executive Vice President Prof Kyoshi Yoshikawa and an overview of future collaboration by iCeMS Director Prof Norio Nakatsuji
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Toward Strengthening Research Collaboration Between Heidelberg University and Kyoto University

iCeMS - Heidelberg

SEMINAR

Basic and Multidisciplinary Research to Medical Applications

Mon 1 Nov 2010
16:00-18:30

Venue: 2nd floor Seminar Room (#A207)
Main Building iCeMS Complex 1, Kyoto University

<Part1- 16:00-16:05>

Welcoming Remarks

Prof. Kiyoshi Yoshikawa, Executive Vice President, Kyoto University

<Part2- 16:05-16:45>

"Maintenance and Differentiation of Stem Cells in Development and Disease"

Prof. Dr. Anthony D. Ho

Chair, Department of Medicine V, Heidelberg University, Germany

<Part3- 16:45-17:25>

"Hydra Stem Cells"

Prof. Dr. Thomas W. Holstein

Heidelberg Institute of Zoology, Heidelberg University

<Part4 17:25-18:05>

"Active Control of the Fate of Cells Using Cell Surface Models"

Prof. Dr. Motomu Tanaka

Biophysical Chemistry Laboratory, Institute of Physical Chemistry
Heidelberg University

<Part5 18:05-18:20>

"Future Directions of Collaboration"

Prof. Norio Nakatsuji, iCeMS Director

Contact: iCeMS Nakatsuji Lab at nakatsuji-g@icems.kyoto-u.ac.jp
Hosted by: iCeMS (Institute for Integrated Cell-Material Sciences), Kyoto University

iCeMS - Heidelberg

SEMINAR

Basic and Multidisciplinary Research to Medical Applications

Abstract of the seminar by Prof. Ho on Nov. 1

The long-term goal of this Collaborative Research Center is to define the regulatory principles underlying the balance between stem cell maintenance and differentiation in diverse organisms on a mechanistic level. This objective will be accomplished by studying the intrinsically and extrinsically controlled self-renewal process in various model systems including *Arabidopsis*, *Hydra*, *Drosophila*, *Medaka*, *Xenopus*, as well as mouse and human. The basic principles controlling stem cell self-renewal and differentiation are strikingly conserved during evolution, despite the fact that individual pathways can differ between various stem cell systems of the same organism as well as between homologous stem cell niches in different organisms. Since the regulatory pathways that control stem cell function in highly complex mammalian systems are often difficult to study and frequently show significant molecular redundancy, our Consortium will also take advantage of simpler model systems to illuminate the cellular and molecular mechanisms governing stem cell function. Thus the overall objective of this Consortium is to bridge the gap between experimentally amenable model systems and highly complex mammalian systems. By comparing divergent and conserved modules of stem cell control across the kingdoms of life, this SFB will fundamentally advance our understanding of the principles and molecular mechanisms that control stem cell function during development, homeostasis, injury repair and disease.

The Consortium will therefore focus on two major areas:

(A) Mechanisms of stem cell self-renewal

Using suitable model systems of lower complexity we will elucidate essential molecular mechanisms of stem cell control and identify conserved and divergent regulatory modules governing the fundamental decision process of self-renewal and differentiation. These results will serve as a resource for comparative studies in more complex systems including mouse and human to define the pathways regulating stem cell fate during development and disease.

(B) Cell-cell interactions in the stem cell niche

In addition to intrinsic mechanisms, extrinsic cues mediated by the microenvironment, commonly referred to as the "stem cell niche" do not only maintain stem cell fate but also control the balance between stem cell self-renewal and differentiation. This group of subprojects will focus on the nature and function of the cell types comprising the niche and on the molecules involved in the bi-directional interactions between the niche and the corresponding stem cells in normal and diseased states. Cross species and cross kingdom comparisons will be used to identify the most relevant components that generate the functional stem cell-niche units.

In summary, our initiative will focus on two central aspects of stem cell biology, namely control of self-renewal and niche interactions, and study these features in a number of diverse model systems in vitro and in vivo. Thus, we will address similar questions across species and kingdom boundaries, opening new avenues to identify the fundamental components of stem cell control circuitries. This unique knowledge base will allow us to relate validated molecular functions of core regulatory modules with abnormal stem cell behavior during human disease.

Contact: iCeMS Nakatsuji Lab at nakatsuji-g@icems.kyoto-u.ac.jp

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SEMINAR

Basic and Multidisciplinary Research to Medical Applications

Abstract of the seminar by Prof. Holstein on Nov. 1

Hydra are famous for their almost unlimited regeneration capacity. Hydra are also remarkable because they are immortal, a feature they share together with plants and which cannot be found in higher animals. Hydra's immortality can be ascribed to its asexual mode of reproduction that requires a tissue consisting of stem cells with continuous self-renewal capacity. We study the mechanisms mediating the self-renewal capacity of Hydra stem cells and the recruitment of stem cells during pattern formation processes in during regeneration. Our overall objective is to understand the regulatory network controlling stem cell recruitment and differentiation.

Our data on Wnt, Bmp and Nodal signaling indicate that these pathways have an important role in the maintenance and differentiation of Hydra stem cells, both in steady state and in regenerating animals. By complimentary approaches we analyze the regulatory network controlling stem cell renewal in Hydra, which is essential for its almost unlimited regeneration capacity. The availability of genomic resources and novel technologies provide approaches to analyze these cells in vivo. Studies of stem cells in Hydra can therefore open important insights into basic mechanisms of stem cell biology, i.e. the role extrinsic signals in cell fate determination and tissue homeostasis. Furthermore, they can provide insights into the principles of cellular senescence, lineage programming and reprogramming. Thus, the critical phylogenetic position at the base of the metazoan branch in the tree of life makes Hydra to an important system in unraveling the basic mechanisms of stem cell biology and the evolutionary origin of stem cells.

Abstract of the seminar by Prof. Tanaka on Nov. 1

Biological membranes are vital components of all living systems, forming the outer boundary of living cells or of organelles. They consist largely of a lipid bilayer that imparts a fluid character. Proteins embedded in the bilayer and carbohydrates attached to its surface facilitate communication and transport across the membrane. These features enable membranes to act as important filters: processes (some of which may be incompatible) are confined to the organelles they occur in and toxic substances are kept out of the cell, while specific nutrients, wastes and metabolites can pass the membranes of organelles and cells to reach their destination.

Functional modification of solid surfaces with plasma membrane models draws an increasing attention as a straightforward strategy to bridge soft biological materials and hard inorganic materials. Both artificial and native membranes can be deposited on ultrathin polymer supports that mimic the generic role of extracellular matrix and glycocalyx.

The main part of my talk provides with a brief overview about how the functions and mechanics of such soft interfaces can be fine-adjusted quantitatively. I will present some of our studies where we combined physical techniques in real and reciprocal space to probe the fine-structures of soft matters over wider length scales. In the second part, I will introduce some of our new interdisciplinary challenges towards the application of such tailored soft surfaces as a cue to understand/regulate the fate of cells.

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