



**Title of Project : Establishment of Integrative Multi-level systems biology and its application**

**Term of Project : FY2010-2014**

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**【Purpose of the Research Project】**

Biological functionality is multi-level from the molecule level to the whole organism level. Also, there are subdivided and fragmented huge biological data in a variety of contexts. Because we now have much information than we handle in the brain, data explosion at all levels makes it difficult to get the big picture of the biological systems. Life scientists confront this issue. To understand basic concepts of life, we need methodologies for the integration of biological elements across multi-level.

The ultimate goal of this project is to establish the integrative multi-level systems biology, where physiological and pathological information can be described in high-definition across multiple scales of time and size. This project is an inter-disciplinary project, which focuses on the interactions between different levels of organisms. During the 5 years of this project, we aim to develop the appropriate software platform for multi-level functional simulation. Moreover, we try to develop a whole heart model together with pharmacokinetics for the assessment of the heart proarrhythmic risk of drugs.

**【Content of the Research Project】**

This project has three research groups. Researchers in these three groups are going to collaborate toward the development of new methodologies for this area.

Research group A01, "research and development of software platform for integrative multi-level systems biology", works on developing better software platform for multi-level modeling/simulation in systems biology. For example, this group develops markup languages, computational tools, techniques, and ontologies to organize biological knowledge and access to databases.

Research group A02, "multi-level systems biology of the electrical activity of the heart", works on the integrative research of the cardiac conduction system. This group aims to understand system structure and function of cardiac electrical activity based on the experimental studies in each level, and to explore the causes of the disease such as

arrhythmia.

Research group A03, "multi-level systems biology of small molecular dynamics in circulation", works on the research of the homeostatic systems that are coordinately maintained by multiple organ functions. This group starts out with pharmacokinetics and investigates the crucial mechanism for absorption, distribution, metabolism, and excretion (ADME) systems.

We are trying to provide a technical and theoretical framework for the high-definition physiology, and to lay the foundation for "predictive medicine".

**【Expected Research Achievements】**

Our project can innovate the research field of systems biology toward multi-level systems biology or "predictive medicine". We will launch our software platform into a public domain and promote sustained advancement of the integrative life science. The new findings will expand and deepen our knowledge of function of life.

Moreover, researchers in this project take the leading role in decision about a common model representation format, which is important to take international initiatives for the intellectual processes concerning human life and welfare.

**【Key Words】**

multi-level of organisms: molecule, cell, tissue, and organ levels.

systems biology: a biology-based inter-disciplinary study field that focuses on the systematic study of complex interactions in biological systems.

**【Homepage Address】**

<http://hd-physiology.jp/>