2015 OCHANOMIZU UNIVERSITY SUMMER PROGRAM IN ENGLISH

Theme II: Time and Forms in Nature

テーマⅡ： 科学の中の時間と形

Teaching staff:	Takayuki ITO	(Professor, Natural/Applied Sciences Division, Graduate School of Humanities and Sciences, Ochanomizu Univ.)
	Tetsuyuki KOBAYASHI	(Professor, *ditto*)
	Toshihiro KONDO	(Professor, *ditto*)
	Rumi KONDO	(Associate Professor, *ditto*)
	Masayuki HATTA	(Associate Professor, *ditto*)
	Yoshihito MORI	(Professor, *ditto*)
	Masahiro MORIKAWA	(Professor, *ditto*)
	Kei YURA	(Professor, *ditto*)

[Outline]

Nature is filled with structurally diverse substances and living creatures, which are altered in a time-dependent manner. The physical nature of form (structure or assembly) and its change are figured out by the sciences, especially mathematics, physics, chemistry, biology and information science. The lectures examine and explain the science on time and forms, and are given in English by teaching staff in the Faculty of Science. Each lecturer will present, in simple terms, the latest areas of interest in their own field of expertise. This will ensure an overall comprehensive approach.

自然界には多様な形をした物質や生物が存在し、時間とともに変化します。その形（構造、集合体）の実態とその変化が何を意味するかについて、数学・物理学・化学・生物学・情報学などの理学的な学問が解き明かしてくれます。本講義では、時間と形に関わるサイエンスを中心に、理学部の教員がオムニバス形式でそれぞれの研究分野の視点から英語で解説します。さらに、各専門分野での最新トピックスについても、わかりやすく説明します。

[Lecture Summaries]

Masayuki HATTA

(Monday 3 August, 9:00-12:10)

Axes and Symmetries in Animal Body Plans

[Evolutionary Developmental Biology　進化発生学]

（動物のボディプランにおける軸と対称性）

Diverse animals are derived from a single ancestor in evolution. This fact suggests that various animal forms are all derivative and that a common ancestral body plan should be hidden in their morphological diversity. What is the principle of animal form, the body plan ? Animals are moving organisms in the planet Earth. This condition has given the axis and symmetry to animal forms. We try to extract the simple principle of animal body plan from diverse animal morphogenesis by focusing on the axis and symmetry.

多様な動物は進化においてひとつの祖先に由来する。この事実は、様々な動物の形は派生的であり、形態の多様性の中に共通の祖先的なボディプランが隠されていることを示唆する。では何が動物の形態の原理、ボディプランなのだろうか。動物は、地球上の動く生物である。この制約は、動物の形態に軸と対称性を与えてきた。軸と対称性に焦点を当てることで、多様な動物の形態形成からボディプランの原理を抽出してみよう。

Takayuki ITO

(Tuesday 4 August, 9:00-12:10)

Shapes Rendered by Computers

[Computer graphics　コンピュータグラフィックス]

（コンピュータが描く時間と形）

Computer graphics is a technology that calculates and displays shapes of objects and scenes. The former part of this lecture briefly introduces fundamental techniques for calculation of time-varying phenomena and shape processing used by computer graphics. The latter part of this lecture introduces "information visualization" which represents daily information by extended techniques of computer graphics.

コンピュータグラフィックスは、情報科学技術を用いて視覚事象を計算し、画面にさまざまや物体や情景を描く技術である。前編ではコンピュータグラフィックスのための形状や時間変化の計算方法を平易に紹介する。後編では身の回りのさまざまな情報を図示する「情報可視化」という応用技術を紹介する。

Rumi KONDO

(Wednesday 5 August, 9:00-12:10)

How does our shape change?

[Molecular evolution 文化進化学]

（生物の形とゲノム）

Organisms on earth possess various morphological traits. Our own face has its individual characteristics. What is behind this remarkable diversity of organism morphology? We will look into genomic variation and evolution and discuss how it may link to changes in morphological traits.

地球上にはじつにさまざまな形や色をした生物がいます。ヒトも一人一人の顔つきが異なっています。このような生物の形の多様性はどのように生じるのでしょうか。生物の遺伝情報（ゲノム）の多様性と進化が生物の形態の違いにどのように結びついているのか一緒に考えてみましょう。

Masahiro MORIKAWA

(Thursday 6 August, 9:00-12:10)

Arrow of time and energy in Physics

[Astrophysics 宇宙物理学]

（物理の中の時間の矢とエネルギー）

What is time? Is it just a coordinate system which describes our experiences and events in a consistent order? According to the fundamental laws of physics, time is just such a straight line. Actually, however, the line has a definite direction; most of the events are irreversible in time.

Then what yields the direction and makes the line an arrow? The conjugate to the time is the energy, which is associated with any form of existence. Then how the energy looks different when the time is a line or an arrow? What else is needed to obtain an actual arrow of time from the fundamental physics?

We start our discussions how to measure time, using oscillations, vibrations, decay, generation, revolutions and rotations. Then we argue the origin of the arrow of time in various cases such as cosmic expansion, ordinary mechanical systems, black holes, heat engine, light propagation, quantum observations, life, and so on.

Attendants are expected to be ready for presenting their opinion on any of the above for extensive discussions on the irreversibility.

Toshihiro KONDO

(Friday 7 August, 9:00-12:10)

Nanoworld: Shape and Time of Atoms and Molecules

[Nano electrochemistry 電気分析化学]

（ナノの世界：原子や分子の形と時間）

"Nano" world means very very small one, namely world of atoms and/or molecules. How do you think that atoms and molecules have shape? If so, do those shapes change with time? In this lecture, “nanoworld" is briefly explained as a first, simple experiments about atoms and molecules are performed by several groups, and then, those results and shape and time of atoms and molecules are discussed.

「ナノ」の世界とはものすごく小さな世界、すなわち原子・分子の世界である。では、原子や分子に形があるのだろうか？また、それらは時間的に変わっていくのだろうか？本講義では、最初に「ナノの世界」について概説した後、何人かのグループに分かれて簡単な実験をしてもらい、その結果と原子や分子の形と時間について討論する形式で行う。

Kei YURA

(Friday 7 August, 13:20-16:30)

Protein Structure: From its folding through static and dynamic structure

[Bioinformatics 生命情報学]

（タンパク質のかたち：構造形成から静的構造と動的構造まで）

Protein plays a major role as an element in forming structure of organisms. Protein is a single chain molecule and its blueprint is encrypted in DNA. Recent studies in computational and molecular biology unveiled how information in DNA converted into a structure of protein and how proteins perform function in a cell. This lecture gives a brief overview of the information flow and mechanisms of protein function through its structure.

タンパク質は、生物のかたちを形成する物質として主要な役割を果たしている。ゲノムに書き込まれている情報が、どのようにしてタンパク質（物質）に変換され、タンパク質がどのようにして生物のかたちや生命活動を担っているのかを、最新の研究成果を含めながら概観する。

Kei YURA, Toshihiro KONDO, Tetsuyuki KOBAYASHI and others

(Saturday 8 August, 9:00-12:10)

General Discussion

（統括ディスカッション）

FIELD STUDY

instructed by Yoshihito MORI & Tetsuyuki KOBAYASHI

(Tuesday 4 August, 13:00-17:30)

[Details to be announced]