

# Puzzles and Solutions in Astrobiology

**When:** May 14 – 18, 2018

**Where:** Earth Life Science Institute, Tokyo Institute of Technology, Tokyo, Japan

**What:** For decades (if not *centuries*) scientific researchers have wondered about the existence of extra-terrestrial life. Due to recent technological advances we now know that the Milky Way galaxy is filled to the brim with planets of all shapes and sizes, opening up the prospect of other galaxies hosting similar worlds.

The field of Astrobiology is an umbrella term that combines scientific expertise from astrophysics, planetary and Earth science, chemistry, biology and other scientific disciplines to understand how habitable worlds form and evolve with time. Yet the nature of the formation and evolution of these worlds and their proclivity to support a (long-term) biosphere remains obscure. It makes sense at this time to synthesise what we know, highlight key points of agreement and contention, and to provide recommendations for scientific progress.

**Focus:** Our goal is to host a small meeting of thirty to thirty-five people of broad scope with key speakers of international standing. We aim to unite ourselves to discuss barriers to progress, propose solutions and identify and foster future collaboration that will advance the field as a whole. We intend to formulate a coherent pathway towards the necessary conditions that nurtures extra-terrestrial life on billion-year timescales.

**Structure:** The meeting will last four and a half days and will be a *mélange* of presentations and discussions. All days will consist of contributed presentations from invited members showing the current state-of-the-art in their fields, and possible summary presentations at the end. The final session before dinner comprises an open forum for discussion and voluntary contribution of new ideas and/or results that encourage understanding and future collaboration.

**Venue:** ELSI Hall conference hall inside the new ELSI 1 building at the Tokyo Institute of Technology campus. The campus has easy access to nearby cafés, restaurants, hotels, public transport and other amenities.

**Scientific and Local Organising Committee:** Muriel Gargaud (France) and Ramon Brasser (Japan) (co-chairs), Henderson Cleaves (Japan), Satoshi Akanuma (Japan), Carlos Briones (Spain), Manuel Güdel (Austria), Emmanuelle Javaux (Belgium), Purificación López-García (France), Daniele Pinti (Canada), Sudha Rajamani (India) and Franck Selsis (France).

## General schedule

Morning (Tue,Wed,Fri):

09h00 – 10h20: 2 talks of 40' (30' + 10' for Q&A)

10h20 – 10h35: coffee break

10h35 – 11h55: 2 talks of 40' (30' + 10' for Q&A)

11h55 – 12h30: General debate (speakers + the SOC members concerned)

Morning (Mon,Thu):

09h00 – 10h20: 2 talks of 40' (30' + 10' for Q&A)

10h20 – 10h50: coffee break

10h50 – 11h30: 1 talk of 40' (30' + 10' for Q&A)

11h30 – 12h30: General debate (speakers + the SOC members concerned)

12h30 – 14h00: lunch and informal discussion

Afternoon: (Mon,Tue,Thu):

14h00 – 15h20: 2 talks of 40' (30' + 10' for Q&A)

15h20 – 15h50: coffee break

15h50 – 17h10: 2 talks of 40' (30' + 10' for Q&A)

17h10 – 18h10: General debate (speakers + the SOC members concerned)

18h15 – 18h30: Miscellaneous announcements

## Detailed Programme

### Monday

#### 1) The host star: what matters for planetary atmosphere formation and evolution?

**Chair: Ramon. Discussion leaders: Manuel.**

**Speakers:**

- Feng Tian, Tsinghua University, China
- Theresa Lüftinger, University of Vienna, Austria
- Jim Kasting, Penn State University, USA

#### 2) Do we need plate tectonics for the emergence of life, and for long term habitability?

**Chair: Muriel. Discussion leaders: Daniele.**

**Speakers:**

- Tilman Spohn, DLR, Germany
- Lena Noack, Freie Universität Berlin, Germany
- Vinciane Debaille, Université Libre de Bruxelles, Belgium
- Jean Bédart, Natural Resources Canada, Canada

#### Short presentation on the astrobiology encyclopaedia

### Tuesday

#### 3) Prebiotic chemical inventory: "Plausible" vs "Viable"

**Chair: Sudha. Discussion leaders: Jim.**

**Speakers:**

- Kensei Kobayashi, Yokohama National University, Japan
- Dougal Ritson, University of Cambridge, UK
- Addy Pross, Ben-Gurion University of the Negev, Israel

- Irena Mamajanov, ELSI, Japan

**4) Replication-first vs. metabolism-first**

**Chair: Satoshi. Discussion leaders: Carlos.**

**Speakers:**

- Andrew Pohorille, NASA Ames, USA
- Daisuke Kiga, Waseda University, Japan
- Ulrich Muller, University of California San Diego, USA (replication-first)
- Kunihiko Kaneko, University of Tokyo, Japan (metabolism-first)

**Short introduction about the next meeting in Vietnam April 2019**

**Wine and cheese party**

**Wednesday**

**5) Origin of eukaryotes/multicellularity/complexity: chance vs determinism**

**Chair: Emmanuelle. Discussion leaders: Puri.**

**Speakers:**

- Eugene Koonin, NCBI, USA
- Shin-ichi Yokobori, Tokyo University of Pharmacy and Life Science, Japan
- Maureen O'Malley, University of Sydney, Australia

**Outing to Kamakura (weather permitting)**

**Thursday**

**6) Early Earth environment and the emergence of life**

**Chair: Muriel. Discussion leaders: Jim.**

**Speakers:**

- Akihiko Yamagishi, Tokyo University of Pharmacy and Life Science, Japan
- Hervé Martin, Université Clermont Auvergne, France
- Pierre-Alain Monnard, University of Southern Denmark, Denmark
- Francis Albarède, École Normale Supérieure de Lyon, France

**7) Astrodynamical processes: planetary migration and accretion**

**Chair: Daniele. Discussion leaders: Ramon.**

**Speakers:**

- Sean Raymond, Université de Bordeaux, France
- Audrey Bouvier, University of Western Ontario, Canada
- Guillaume Avice, California Institute of Technology, USA
- Stephen Mojzsis, University of Colorado Boulder, USA

**Banquet dinner**

**Friday**

**8) The early (isotopic, morphological, molecular, mineral) traces of life: how reliable are they?**

**Chair: Puri. Discussion leaders: Emmanuelle.**

**Speakers:**

- Mark van Zuilen, Institute de Physique du Globe de Paris, France
- Linda Kah, University of Tennessee Knoxville, USA
- Julie Cosmidis, Penn State University, USA
- Yuichiro Ueno, Tokyo Institute of Technology, Japan

**13h – 15h: Encyclopaedia meeting with editors only.**