Research area in Strategic Objective "Measuring "resilience of life" — Discovery and exploration of unknown biological response mechanisms"

Elucidating the power of life through innovative measurement and analysis techniques

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Overview

Based on the Strategic Objective "Measuring 'resilience of life' — Discovery and exploration of unknown biological response mechanisms," the goal of this research area is to elucidate "the power of life" through a needs-oriented, cross-disciplinary approach that utilizes various measurement parameters. We also aim to develop innovative measurement and analysis techniques to visualize and characterize "the power of life," and to elucidate it utilizing the techniques developed.

In this research area, the concept of "the power of life" encompasses the fundamental properties of life, including the ability to change dynamically while maintaining a certain identity (dynamism), the ability to withstand harsh environments (robustness), and the ability to constrain "fluctuations" caused by external stimuli and internal factors (homeostasis). However, "the power of life" is not limited to these features, and researchers participating in this research area will pursue their own concept of "the power of life" and seek to elucidate and understand it. The term "the power of life" includes both the power that life produces and the power that produces life.

To elucidate "the power of life," we will develop innovative measurement and analysis techniques to meet the demands of life sciences by organizing cross-disciplinary teams among researchers. In addition, we aim to reveal the unexplained elements of "the power of life" by overlaying various parameters, such as measurements over a wide range of temporal and spatial scales of life, and measurements across these scales.

We hope that this research area will create a new view of life through the development of innovative measurement and analysis techniques that meet the demands of life sciences and the elucidation of previously unknown or neglected elements of "the power of life."

Research Supervisor's Policy on Call for Application, Selection, and Management of the Research Area

1. Background

The measurement and visualization of life phenomena is the foundation of life science research, and much of the progress in modern life sciences can be attributed to innovations in measurement technology. To date, advanced technologies have been developed, such as techniques for measuring life phenomena at various time and space scales and measurement technologies for acquiring vast and complex data. However, there are still many challenges in life sciences that can be solved through innovations in measurement and analysis techniques, which requires the development of measurement techniques that combine elemental technologies and truly meet the needs of the life science field.

In this research area, we aim to reveal "the power of life" through the integration of various measurement parameters by taking a needs-oriented, cross-disciplinary approach to the life science field in order to achieve the following two goals: (1) the development of innovative measurement and analysis techniques to visualize and characterize "the power of life", and (2) the elucidation of "the power of life" using the developed techniques.

2. Principle of invitation project and selection

As in the previous year, this research area invites research proposals that challenge the creation of a new view of life through (1) the development of innovative measurement and analysis techniques and (2) the elucidation of "the power of life " by utilizing these techniques. The balance between (1) and (2) in the research proposals is an important selection criterion. In addition, please prepare your research proposal with the aim of including at least 40% of (1) and 20% of (2) as the effort for each element (this is not intended to exclude other research proposals).

(1) Developing innovative measurement and analysis techniques

One of the goals of this research area is to develop innovative measurement and analysis techniques to visualize and characterize the unexplored or neglected elements of "the power of life." We also target research that will lead to a dramatic understanding of “the power of life” by combining existing measurement technology with innovative analytical techniques.

Many of the research proposals submitted in last year were aimed at raising the level of current measurement and analysis technology or expanding the scale of measurement and analysis by combining multiple existing technologies.

This year, we expect research proposals that have the potential to create a paradigm shift in the field of life science, such as acquiring data that is difficult to measure using conventional

techniques or significantly improving measurement accuracy.

In addition, we also welcome research proposals that seek to apply measurement techniques and parameters that have not been previously utilized in the life science fields. Furthermore, research proposals that aim to measure and analyze “the power of life” combined with innovative perturbation and disturbance techniques, and those that verify the measured “the power of life” through constructive approaches are also eligible.

Specifically, we welcome the following types of research proposals:

- Development of measurement technologies for life dynamics under near-physiological conditions or in the presence of other factors.
- Challenges to establish measurement technologies that incorporate technological advances in light, quantum, magnetic, and other fields.
- Improvement of the quality and quantity of measurement data through the use of robotics and other technologies.

In your proposals, please try to develop measurement techniques that meets the demands of the life science field and avoid developing measurement technology for the sake of measurement.

Furthermore, the research proposal should not be solely focused on technological development, but should also include a well-balanced element of elucidation of “the power of life” through the use of the technology.

(2) Creating a new view of life through elucidating "the power of life"

Another goal of this research area is to elucidate the unexplored elements of "the power of life" by utilizing innovative measurement and analysis techniques. As with the note in (1), we request that innovative measurement and analysis techniques be the cornerstone of the research proposal, rather than the sole goal of elucidating “the power of life”.

As in the previous year, we do not limit the definition of "the power of life" and welcome proposals for "the power of life" as conceived by the applicants themselves.

Many of the proposals submitted last year sought to elucidate in more detail the mechanisms and deepen our understanding of life phenomena, which each of the researchers positioned as “the power of life”.

While not excluding any of the above, we expect research proposals in this year not only to elucidate “the power of life” by measuring and analyzing target life phenomena, but also to create a new view of life based on the findings obtained.

As in the previous year, we also expect research proposals to discover a new concept of "the power of life" by using new techniques and parameters to measure and analyze life phenomena whose biological significance has not been understood or neglected.

3. Research periods and research funds

The research period should not exceed five years and six months (2025 - 2030). The maximum budget for a research project is 300 million yen at the beginning (direct expenses).

Please submit your application after carefully examining the amount appropriate to the size of your research team and the amount necessary to achieve the proposed content. Please note that the research budget may be adjusted upon selection as a result of close examination by the research supervisor.
The research budget will be reviewed on an annual basis. As a result of the review, the research budget may be increased or decreased to reflect the progress of the research. After selection, an interim evaluation will be conducted approximately three years after the start of the research. Depending on the results of the evaluation, we may revise the research budget or request a reorganization of the research team.

4. Others

We expect the formation of a research team capable of achieving both (1) and (2) mentioned above. Because of the importance of a cross-disciplinary approach to the development of measurement and analysis techniques, we recommend the formation of a research team consisting of researchers from various research fields. (However, if the existing laboratory or research team is already a cross-disciplinary fusion team, further collaboration with a new group is not required.)