

Outline of Selected Project

Host institution	Keio University
Center name	Human Biology–Microbiome–Quantum Research Center
Head of host institution	Kohei Itoh
Prospective Center director	Kenya Honda
<p><Project Summary></p> <p>Human homeostasis is maintained through complex interactions between multiple organs, and its disruption causes a wide range of diseases. Our center aims to understand how humans process external information and maintain homeostasis by dispersing and integrating signals among cells/organs. We will investigate how homeostasis and human biology are regulated by the epithelial, immune, nervous, and metabolic systems, with an emphasis on the microbiome, an important factor that remains one of the “black boxes” of the human body. Our center will thus establish a new form of life science aimed at understanding human multiorgan homeodynamics at resolutions higher than those achieved so far. We will implement quantum computing together with artificial intelligence (AI) to analyze the collected multiomics data and elucidate the multiorgan interaction pathways underlying human disease. Furthermore, we will also establish a reverse–translation workflow to decipher the causal relationships within the newly uncovered pathways.</p> <p>The Human Biology–Microbiome–Quantum Research Center, namely the “Bio2Q”, will develop state-of-the-art technologies in microbiome analysis, metabolomics, connectomics, organoids, humanized animal models, and in situ structural analysis. We will also establish new methods of applying quantum computers to biology, thereby forging an interdisciplinary research area that will lead to groundbreaking progress in elucidating the regulatory mechanisms of human homeostasis. In the long term, we will develop new prophylactic/therapeutic approaches to promote healthy longevity.</p> <p><Remarks></p> <ol style="list-style-type: none"> 1. This is a challenging proposal aiming to clarify the linkage between intestinal microbiome and various organs and their relationship to diseases by using computational science, especially pioneering the application of quantum computing to speed up the multi–omics data analyses, which are of great importance today. 2. The proposed director is one of the top leaders in the field of microbiome, and the researchers in the field of each organ are also leaders in their respective fields. The host institute, 	

Keio University, is one of the front runners in quantum computing research in Japan. The synergistic effects of these groups will work well to achieve the goal of the project.

3. The host institution has committed strong support to the center in terms of infrastructure, personnel and funding. The center is aligned to the strategic vision for the future of the host institution.