High Energy Accelerator Research Organization (KEK)

International Center for Quantum-field Measurement Systems for Studies of the Universe and Particles (QUP)

Center Director
Masashi Hazumi

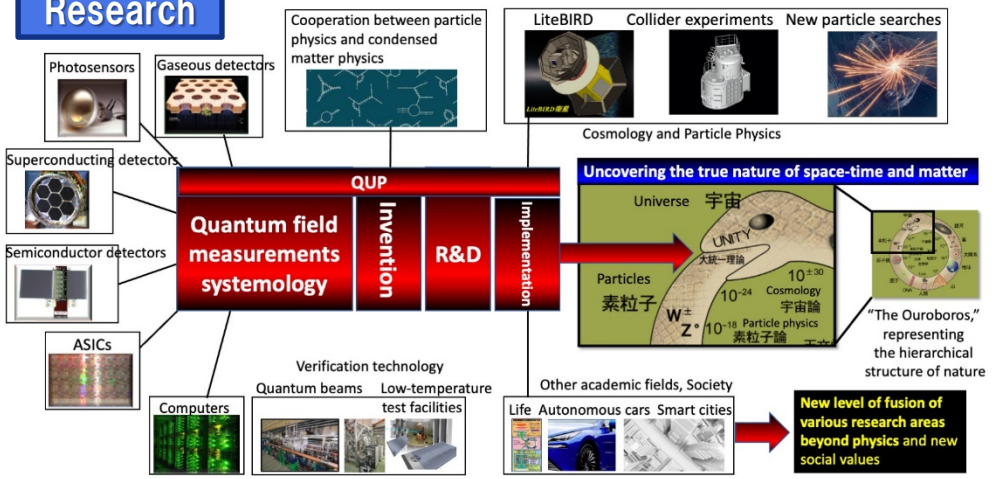
Leading the discovery of CP violation at the B-factory experiment in KEK which led to the Nobel Prize to Professors Kobayashi and Maskawa, I felt like I touched the depths of nature with my bare hands. After that, I succeeded in the first observation of the gravitational lens effect on the polarization of the cosmic microwave background in the POLARBEAR project, and proposed the LiteBIRD satellite project to explore the universe before the Big Bang. My dream as a researcher is to provide new knowledge about "the zero time in the universe" and to bring about the discovery of a novel quantum field in the research activities of this center.

Mission

"Quantum Field" is the the backbone of reality from particles to the cosmos. QUP will:

- integrate particle physics, astrophysics, condensed matter physics, measurement science, and systems science;
- invent and develop new systems for measuring quantum fields and bring innovation to measurements in cosmological observations and particle experiments, and elucidate the true nature of space-time and matter, with fusion of various research areas; and
- establish a new measurement science, quantum field measurement systemology, as a science of means through the above practices and create a new level of fusion of various research areas beyond physics and new social values through application to other fields and social implementation.

Research



1) Development and implementation of the superconducting detector array for the LiteBIRD satellite project.
2) The invention of methods (e.g., those using quasiparticles) for measuring novel quantum fields (e.g., axions), and proposal and promotion of new projects based on these methods.
3) Pioneering the most efficient means for large-scale projects in basic science (e.g., automatic ASIC design generation) and theorizing them based on practice (establishing systemology.)
4) Research with social implementation (e.g., smart cities, autonomous driving, etc.) as an outcome (e.g., application of the Casimir effect to devices) and development of applications in a wide range of academic fields (e.g., neuroaesthetics, archaeology, etc.)

Above are typical examples, and a variety of fusion research that goes beyond these will be carried out.

Identities

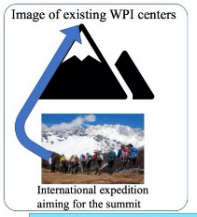
I. The only center in the world that integrates the invention of new measurement principles for experimental cosmology and particle physics, the development of systems to realize these principles, and the execution of projects.

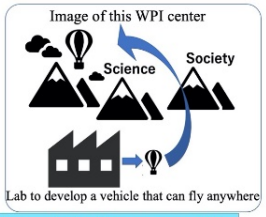
II. This center will conduct interdisciplinary research on "means" or "methodologies." It is at the meta-level, leading to a new level of fusion of various research areas to produce academic and social values. In particular, for social implementation, we are promoting interdisciplinary research that transcends the boundaries between industry and academia with the cooperation of the Toyota Group.

III. Capability of characterizing measurement systems using the various quantum beams provided by KEK's accelerator facilities.

IV. Leveraging our experience as a host of large-scale international collaborative experiments in fundamental research fields to conduct international research collaborations at an unparalleled level.

V. Leveraging our experience as an inter-university research institute, we will lead the world and make significant contributions to the research and education of universities and research institutions in Japan and abroad.





Meta-level interdisciplinary fusion for means, not for a single goal, to produce academic and social values

Satellite Offices

Toyota Central R&D Labs — Research toward Social Implementation

High Energy Accelerator Research Organization (KEK)

Japan Aerospace Exploration Agency (JAXA) Institute of Space and Astronautical Science (ISAS)

University of California, Berkeley

Development of superconducting detectors