

Elucidating the Universe's Creation with Neutrinos based on International Science Collaborations



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Purpose and Significance of the Research

Connecting particle physics and astrophysics by using neutrinos, we study how the universe has been evolved from the "quantum fluctuations" in the early universe as shown in Fig. 1. We will attack the outstanding problems in the study of the early universe: inflation, the dark matter, the origin of the asymmetry between matter and antimatter, and the massive black holes. Those problems are addressed by the most-advanced neutrino experiment Hyper-Kamiokande, the CMB telescope Simons Observatory, the dark matter experiment XENON, and the cosmic neutrino telescope IceCube. A major synergistic effect can be achieved by consolidating the development of state-of-the-art technologies (photodetectors, electronic circuits, large-scale data, and AI development and analysis). This proposed system will support young researchers under an independent research environment and to circulate beyond their respective experiments and foster the next generation international researchers.

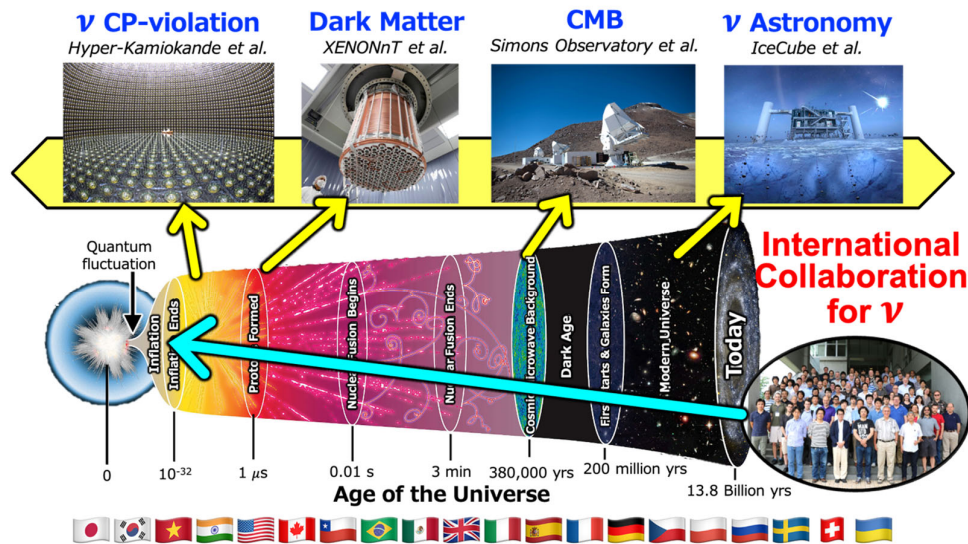


Fig.1 Mystery of the universe's creation and its research subjects

Organization of the Project Team

Four international experiment projects shown in Fig. 2 cooperate through the development of cutting-edge technology and comprehensively challenge the mysteries of the universe's creation in collaboration with theorists.

- **Hyper-Kamiokande experiment:** An international experiment hosted in Japan. Electronics will be built at CERN in Europe, and the detector will be assembled in Japan.
- **IceCube Neutrino Telescope:** in Antarctica. A center at the University of Wisconsin.
- **Simons Observatory CMB Telescope:** in Chile. A center at Princeton University.
- **XENON Dark Matter Experiment:** hosted in Italy. The international collaboration.

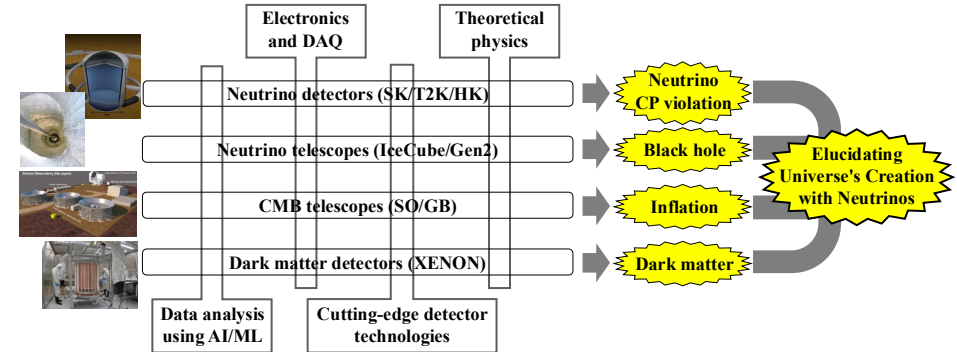


Fig.2 Framework of the International Project Organization

Plan for Fostering Early-career Researchers

With more than 30 young researchers in the program each year, this international research is promoted. A young researcher development program shown in Fig. 3 consists of 'fostering expertise', 'fostering internationalization' and 'broadening horizons'.

- **Fostering expertise:** Education is provided through the creation of a cross-project advanced technology consortium of experts.
- **Fostering internationality:** Provide opportunities for international joint research. About ten (five) students for a short (medium to long) period overseas study each year.
- **Broadening of horizons:** Cross-project fellowships are offered.

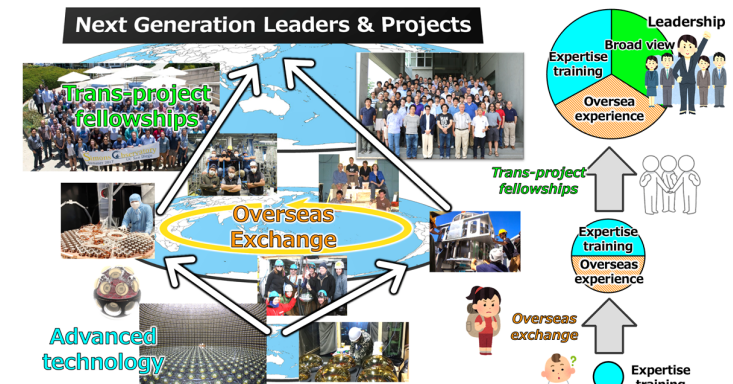


Fig.3 Young researcher development program