

Objectives of Research Exchange (including the five years after the project finishes)

Superconductivity is a most extraordinary phenomenon in nature, exhibiting absolute zero resistance, expulsion of magnetic field, quantization of magnetic flux, etc. By making use of fast growing nanotechnology, development of new science and technology in superconductivity is rapidly emerging and progressing. Typical examples are development for applications in superconducting materials such as quantum computations and Josephson junction devices utilizing quantum coherence. By making sub-micron sized superconductors, which could not be done in the past, and by investigating the properties of them, it is of great importance to establish the solid bases of new quantum mechanical science and technology for the 21st Century. This research initiative aims at setting up the international global collaborations between most advanced research institutes in the world and establishing a world leading center in Japan in this fast developing research field in superconductivity.

Results to the present

Last year we discovered phenomena continuously emitting intense THz electromagnetic waves from intrinsic Josephson junctions made by high quality high temperature superconducting single crystal $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+d}$ as a result of international collaboration between Japan and US. The power of the emission amounts to about 5 μW , which is rather strong, so that it can even be detected by the cheap conventional dielectric detectors. It also emits continuously, it can be used for some applications. The most important research aim here is to understand the emission mechanism, then establish the conditions to make it stronger and develop possible applications.

Concerning global networking, the EU group has set up ESF-NES for 5 years based on the previous activity since last May. The group in US has applied the materials global networking plan to establish the US-EU-Japan international collaborative network system to NSF. This finally leads to the realization of the international global networking in Nanoscience and Engineering in Superconductivity (NES) among three axes of developed countries EU, USA and Japan, which has been desired as in the initial plan.

Summary of FY 2008 Exchange Plan

Researcher Exchanges

Since there are many important international conferences and workshops, etc. are expected in this year, it is very important for the purpose of public announcement of research activities and the researcher exchange program. Making use of these occasions at the international conferences, young researcher are expected to adapt their international research sense by interacting with the world leading researchers and to become leading persons in this international atmosphere. From these reasons, three people for the 25th International Conference on Low Temperature Physics (LT25) in Amsterdam, three people for the 2008 Applied Superconductivity Conference (ASC 2008) in Chicago, two people for ESF-NES Workshop Proging Superconductivity at the Nanoscale are considered. Frequent chances are provided for the young scientists through the international conferences with presentation on the important subjects like elucidation of the mechanism of coherent THz emission, improvement of out put radiation power, improvement of detection sensitivity, imaging applications, etc.