Division of Mathematical and Physical Sciences	Research field	Low Temperature Physics	Lab. ID MP06
Laboratory web site	http://ltphys.w3.kanazawa-u.ac.jp/wp/		

Research subjects

Macroscopic quantum phenomena such as superfluidity and superconductivity occur at low temperatures because of small thermal fluctuation. Our research focuses on such interesting physical phenomena that occur in low-temperature environments.

The reaseah group led by Prof. Matsumoto and Prof. Abe studies superfluidity of ^{3}He, quantum transition and criticality of heavy Fermion compounds, nuclear magnetism of rare earth Pr compounds, and so on by means of ^{3}He-^{4}He dilution refrigerator and Cu single stage nuclear demagnetization refrigerator in micro Kelvin temperatures. Experiments in such low temperaures are worked at limited laboratories in the world. In milli-Kelvin temperature range, we also study quantum fluid and solid, ^{4}He superfluidity in porous materials, quantum transition from the experiments of specific heat, magnetic susceptibility, thermal expansion, magnetostriction, and acoustic properties using dilution refrigerator, ^{3}He cryostat and cryostat with 15 T superconducting magnet. Magnetic refrigeration that makes use of magneto caloric effect is studied from 1 K to room temperature. We have both magnetic materials and refrigeration system of magnetic refrigeration.

Prof. Yoshida's group mainly focuses on experimental studies of superconductivity and magnetism using scanning tunneling microscopy (STM), a key analytical technique in nanoscience, at very low temperatures, high magnetic fields, and in ultra-high vacuum. In particular, using spin-polarized STM whichi visualizes spin states on an atomic scale, the group studies new types of superconductors such as cuprate, iron-based, and heavy-fermion superconductors, in which magnetism is considered to be intrinsically involved in the mechanism of superconductivity, The group is also working on development of electron spin resonance STM based on spin-polarized STM, synthesis of atomically controlled superlattice thin films (artificial lattices) using a molecular beam epitaxy system, precise magnetization measurements in the mK temperature range and high magnetic fields, and the development of magnetic field angle-resolved physical properties measurement system.

Professor Takahashi's group conducts research on physical properties targeting materials and superconductors that expose the quantum and fluid nature of conduction electrons in solids. We are developing a unique molecular beam epitaxy technique that enables the growth of highly crystalline transition metal oxide thin films and superlattices without scattering of impurities or crystal defects, comparable to clean semiconductors such as silicon and gallium arsenide. Our goal is to study the behavior of electrons in thin films and superlattices mainly by conduction measurements at low temperatures, and to open up new fields of quantum science.

Prof. Ohashi's group (Faculty of Geoscience and Civil Engineering) grows high-quality single crystals of materials that are expected to have strong electronic correlations, such as heavy-fermion materials. They are searching for new quantum phase transitions and critical phenomena by controlling three thermodynamic parameters; high pressure, low temperatures, and high magnetic fields.

Prof. Tsuji's group (Faculty of Education, Institute of Human and Social Sciences) uses a nanoscience technique called break junctions and studies quantum conduction phenomena in point junctions and tunnel junctions at low temperatures.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

Professor Matsumoto, Professor Abe and Professor Yoshida are conducting several experimental groups as main stuffs. Professor Ohashi and Professor Tsujii may also collaborate with them. Each group is consists of graduate couse students and under graduate students, because long period experiments in low temperature need team work. Newcomers will choose research subject on the basis of his interest and belong to an experimental group. We have close discussions between faculty staff and students and conference meeting on all the groups so that experimental results and plans are discussed. Seminor be students and article reading are also carried.

Outcomes are presented at academic meeting and published as journal paper.

Daily life in the laboratory, etc.

Our experimental apparatus are mainly installed in Kanazawa University low temperature laboratory. Low temperature experiments become long period experiments so that it will last late at night and sometimes need machine check in holidays. Then, experiments are carried out in collaboration with group members and faculty stuff. It is necessary to construct original experimental setup, cell, measuring system or both because commercial machines don't have enough performance. Sometimes improvements of commercial machines are required. Technical skill such as machine, electronic work will be necessary to learn.

Researchers and students from foreign countries visit our laboratory. Our low temperature laboratory has collaboration with Kazan Federal University in Russia. Students visited between Russia and Japan.

We have parties and BBQ for recreation.

Message or comments by the laboratory faculty staffs

Cooperative personality will be necessary because of group experiments. We believe that faculty staff and students

are equal as researcher. We hope every student has his own idea and aggressiveness enough to make forward his research and academic interest in other research groups. Alumnus have jobs in various fields, such as academic post, postdoc researcher, high school teacher, researcher in private companies.	
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