Objective of Magnetism Research Laboratory

The Institute for Materials Research (IMR) at Tohoku University has long played a leading role in advancing research on magnetism and magnetic phenomena in Japan since the invention of KS steel by the first director, Kotaro Honda. The Magnetism Research Laboratory has driven this work, and in recent years has focused particularly on the development of high field magnet technologies and the study of physical properties under high magnetic fields. In addition, by collaborating with the High Field Laboratory for Superconducting Materials and working closely with a number of domestic and international research groups, it has spearheaded Japan's high magnetic field research community.

In magnetic fields exceeding 10 tesla, qualitatively different physical phenomena emerge in many materials—including magnetic substances and superconductors—compared to those under low fields. Examples include quantum oscillations unique to strong magnetic fields, multiple superconducting phases in unconventional superconductors, and multi-step magnetic transitions in quantum magnets. Beyond these cases, a wide variety of rich quantum properties appear under strong magnetic fields that are absent in low fields. , and their importance continues to grow, particularly in the context of quantum technology applications.

The Magnetism Research Laboratory is expected to pursue original and pioneering research through experiments on physics in high magnetic fields. In particular, by employing advanced techniques such as highly sensitive transport measurements, thermal and magnetic measurements, multi-extreme condition technologies involving high pressure and ultra-low temperatures, microfabrication methods, and optical measurements under high magnetic fields, the Magnetism Research Laboratory is tasked with opening new frontiers in condensed matter physics broadly related to magnetism. Furthermore, it is essential to work in close collaboration with the High Magnetic Field Collaboratory consisting large high magnetic field facilities in Japan, not only to advance research but also to lead in fostering human resources, expanding international joint research, and building research communities in the field of high magnetic field condensed matter physics. Contributions are also expected in the operation and promotion of joint usage of the High Field Laboratory for Superconducting Materials. As a cooperative graduate school, the Department of Physics in the Graduate School of Science in Tohoku University is most desirable.