# Institute for Materials Research **Engineering for Actinide Materials**

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# - Exotic Actinide Science - Physics and Chemistry

Superconductivity and Magnetism: are they friends or enemies? It is well-known that magnets levitate above a superconductor due to Meissner and/or pinning effect. However, several superconductors are found among magnetic materials, and moreover, superconductivity cooperates with magnetism in some cases. The physics of *f*-electron systems are intriguing, where nearly localized *f*-electrons and conduction electrons show a strong interplay. Owing to the strong interaction between those electrons, a large variety of fascinating phenomena, such as coexistence/competition of magnetism and superconductivity, multipole ordering, non-Fermi liquid, quantum critical phenomena, are realized. We are exploring exotic physical properties as well as novel physics resulting from 5*f*-electrons in actinide compounds.

#### High quality single crystal growth and Fermi surface study





Study under multi-extreme conditions



We aim to discover exotic phenomena and new physics of actinide and rareearth materials, where the f-electrons play crucial roles for their intriguing properties. High quality single crystals of actinide compounds, like jewels, are grown using various kinds of techniques such as, Czochralski pulling, flux, Bridgman, vapor transport methods. Fermi surface properties, which are obtained by quantum oscillation measurements, provide us deep understanding of the mechanism of their electronic structures.



#### Fastest cooling to 100mK! (ADR system)

### **Research Topics**

- High quality single crystal growth of rare-earth and actinide compounds
- Fermi surface study in actinide and rare-earth compounds
- Investigation of new phenomena under multi-extreme conditions
- Development of adiabatic demagnetization refrigerator (ADR) applied for PPMS system