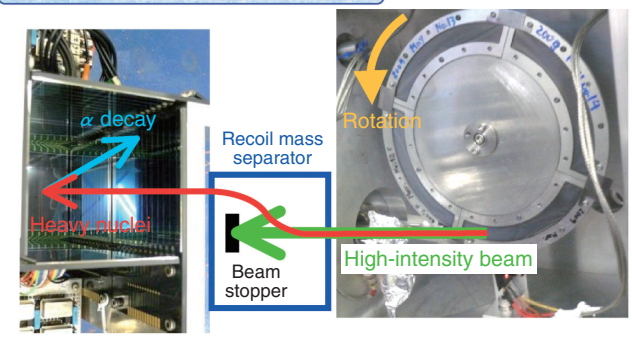
Advanced Basic Research Making Pathways to the Future

In the Advanced Science Research Center, new frontier research of nuclear energy and ionizing radiation which is expected to bear fruit in the future is conducted to discover new principles and phenomena, and furthermore to create new materials and technologies. In order to achieve these aims, we have four basic policies; (1) to pursue research for which the high level research capability (researchers and facilities) in JAEA is effectively used and which is difficult to do in other research organizations, (2) to achieve results before the rest of the world does, (3) to nurture a new basic research area until it becomes fruitful, (4) to explain and apply the research, thus fulfilling our responsibility to society, in conformity with the Third Science and Technology Basic Plan.

The following research is being pursued: nuclear physics and nuclear chemistry of superheavy elements including elucidation of their nuclear shell structure, reaction dynamics and electrochemistry using heavy-ion beams of accelerators; synthesis of uranium and transuranium compounds, and measurement of their macroscopic quantities and electronic structure, clarification of magnetic structure, magnetic excitation, and the mechanism of superconductivity using NMR, μSR, neutron scattering, and theoretical methods; search for novel materials using mega-gravitation and nano-particle deposition, topmost surface studies using high-intensity coherent positron beams; elucidation of the interaction between molecules in supramolecular systems as a biological model by neutron scattering and X-ray spectroscopy, and studying fundamental physico-chemical processes in the interactions of ionizing radiation and heavy elements with living cells and substances (Fig.6-1).

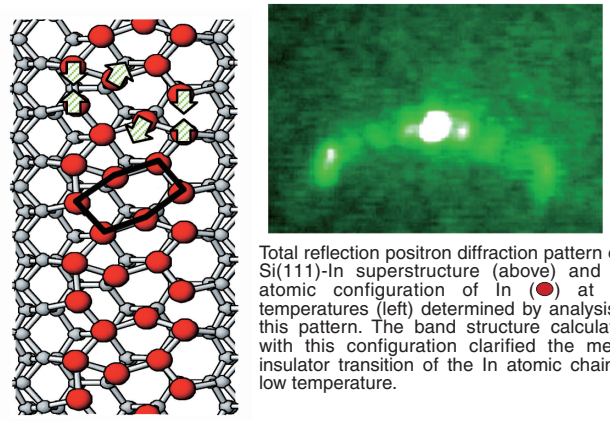
In order to promote this research, we are collaborating with other research sections in JAEA, and several international collaborations are ongoing. In addition, we take on new research subjects based on public suggestions within the framework of the Reimei Research Promotion project of JAEA.

Science of Superheavy Elements



Physical and chemical properties of unknown heavy nuclei are investigated. Nuclei are synthesized in fusion reactions when a rotating target (right) is bombarded by high-intensity heavy-ion beams, separated from the incident beam by a recoil mass separator, and then implanted into a silicon-strip detector (left) which observes the α-decay chain.

Extreme Environment and Substance Science

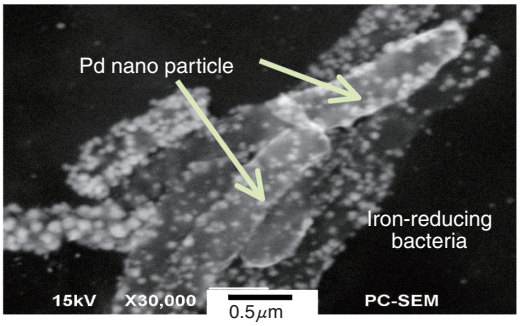


Total reflection positron diffraction pattern of a Si(111)-In superstructure (above) and the atomic configuration of In (●) at low temperatures (left) determined by analysis of this pattern. The band structure calculation with this configuration clarified the metal-insulator transition of the In atomic chain at low temperature.

Actinide Material Science

μSR spectroscopy system installed at J-PARC Muon Facility.
The system is able to detect the extremely small magnetic field to elucidate physical properties of materials, behavior of hydrogen atoms, etc., in substances.

Material and Life Sciences



The ability of some bacteria to accumulate TRU elements from aqueous solution on their cell surface was studied.

Nano particles of Pd precipitated on the cell surface of iron-reducing bacteria (elongate ellipsoids). It was discovered that these nano particles have excellent catalytic ability.

Fig.6-1 Four research fields and collaborations in Advanced Science Research Center