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Muon Nuclear Data/ミューオン核データ

The nuclear muon capture reaction is the capture of a negative muon by a proton in a nuclear medium via weak interaction from the 1s state of the muonic atom. When the muon stops in the matter, the muonic atom is formed and deexcited to the 1s state by emitting muonic X-rays. The reaction probability of the muon capture is more than 90% for the muonic atom with heavy elements. The excitation energy populated by the reaction is distributed around 10–50 MeV, producing several radioactive nuclei followed by particle emissions. The importance of nuclear muon capture is now focused in the many fields of the natural sciences and applications, such as nuclear physics, nuclear transmutation for nuclear waste, muon-induced radioactive isotope production for medical use, radiation safety data in the muon facilities, cosmic muon-induced soft error in modern semiconductor devices, and cosmogenic production of radioactive nuclides for geological studies. Despite those demands, nuclear data of this muon-induced reaction is rarely known or investigated thus far.
Thanks to the recent advances of the low-energy muon facilities, Muse at J-PARC MLF, RIKEN-RAL muon facility, and MuSIC at RCNP, new muon nuclear data has become available. A new methodology called the in-beam activation method was invented to obtain the production yields of radioactive nuclei by muon capture, and a state-of-the-art detector system with digital pulse shape analysis has been developed to obtain energy spectra of charged particles from the reaction. Those new nuclear data will provide crucial information for understanding the reaction mechanism and for progress in many applications.
In the workshop, I will overview recent experimental and theoretical activities related to the muon-induced nuclear reaction and introduce the nuclear muon data project in Japan.

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