Prospects explored by Intense Low Emittance Ultra Slow Muon Beam

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The accelerator complex of the Japan Proton Accelerator Complex (J-PARC) has been constructed, in the south part of Tokai-JAEA site, which consists of a 181 MeV (400 MeV in future) LINAC, and 3 GeV and 50 GeV proton synchrotron rings. About 90 % of 3 GeV, 333 μA (1.0 MW) is sent to the Materials and Life Science facility (MLF) for the production of the intense pulsed neutron and muon beams.

As one of the principal muon beam line at the J-PARC muon facility (MUSE), we are planning to install the Super Omega Muon beam line, which consists of a large acceptance solenoid made of mineral insulation cables (MIC) and a superconducting curved transport solenoid. There, we can extract 4 x 10^8 /s surface muons towards the experimental hall. At the super omega line, we are aiming to create a new type of muon source; the intense ultra-slow muon source by resonant ionization of thermal Muonium (designated as Mu; consisting of a μ^+ and an e^-) atoms generated from the surface of a hot tungsten foil.

When the production of intense ultra-slow muon source is realized, the use of its short-range penetration depth (eg. 1 nm resolution at a penetration of 1 nm, and 10 nm at a penetration of 6 nm in Gold) will allow muon science to be expanded towards a variety of new scientific fields such as,

1) Surface/boundary magnetism utilizing its spin polarization and unique time-window.
2) Surface chemistry, utilizing a feature of a light isotope of hydrogen; such as catalysis reactions.
3) Muon Microscopy
4) Precise atomic physics such as QED,
5) Ion sources and towards m^+ m^- collider experiments in high-energy physics.

At the symposium, status of the super omega muon beam line for the intense low-emittance ultra slow muon source and its scientific prospects will be reported.