Muon Science Laboratory
MUSE at J-PARC

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The Muon Science Laboratory has been the center of research using pulsed muon source at the Booster facility of the PS synchrotron at KEK and is now responsible for the construction of MUSE (muon Science Establishment) and the muon scientific program at MLF (Materials and Life science Facility) at J-PARC. The Interuniversity Research Program used its own facility in Tsukuba before it was shutdown in 2006, and the scientific program has since been utilizing overseas facilities. Now the construction at MUSE is almost complete, with first muon beam delivered to the D1 experimental area on September 26, 2008. Positive muons of 4MeV are produced when the 2cm thick graphite target is bombarded by 3GeV protons, and are transported through a superconducting solenoid into the experimental area. Positron contamination was removed by a DC separator, and the muon beam was focused by quadrupole magnets. This opens the new era of muon science in Japan. We expect the high intensity pulsed positive muons as well as the negative muons of varying energy (from 4MeV to tens of MeV) will be used for a wide variety of material sciences. The most popular application will be the study of electric and magnetic structure including its dynamics by using the muon as a unique local probe.

We are now planning to extend our research program from the characterization of bulk samples to surface phenomena and nano-structure by producing an ultra slow muon beam. With its variable energy (tens of eV to tens of keV) the penetration depth can be varied for structural studies. Also with its sharp beam spot enables us to use tiny amounts of sample. The sharp beam pulse determined by the laser timing allows for very high time resolution studies of fast transient phenomena, as well as muon spin rotation under ultra high fields.

Finally, using high intensity negative muons delivered at MUSE, exotic atomic and molecular states involving muons will be studied, and these muonic atoms and muonic molecules will be used as a new local probe for studying materials structure.