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Development of the Diamond based Proton Beam Monitor for COMET Experiment

The COMET experiment searches for the muon-to-electron($\mu - e$) conversion with a sensitivity below 10^{-16} which is 10,000 times better than the present upper limit.
This process is strictly forbidden in the standard model because of the lepton flavor conservation law.
In contrast, its branching ratio can be sizable around 10^{-15} in many models of physics beyond the standard model (BSM).
Therefore the discovery of the $\mu - e$ conversion should be unambiguous evidence of BSM.
Since sufficient amount of muons can be collected owing to the world most powerful pulsed proton beam at J-PARC, the background suppression is the most important to achieve the target sensitivity.
In COMET, the measurement will be done between 500-1000 ns after coming the beam bunch to highly suppress the beam related prompt background.
Even in this case, signals can be detected because of muon's long life time ($\tau_\mu \sim 800$ ns) in a muonic-atom in case of using aluminum.
In this scheme, the "extinction factor", (=(\#of residual protons between two bunches)/(\#of protons in a bunch)), must be less than 10^{-10}.
To ensure such an extremely low extinction factor during the data taking, an innovative diamond detector will be adopted since it has high radiation tolerance to an intensive proton beam such as 10^{12} protons/sec, and a fast time response to identify a single proton after the prompt beam including 10^8 of protons.
Recently, a prototype detector was developed based on a single-crystal diamond with a metal-insulator-metal type structure to perform the direct proton measurement inside the abort beam-line of J-PARC main ring.
The installation was completed in last February and signals of secondary particles caused by beam protons were observed in this April.
In this spring, the direct beam measurement will be conducted with the high intensity pulsed proton beam.
In this presentation, the results of above measurement will be reported together with future prospects.

Experimental Collaboration

COMET

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