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Radiative Decay Counter for active background identification in MEG II experiment

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The MEG experiment searched for the lepton flavor violating process, $\mu^+ \to e^+\gamma$, and published result gave a new upper limit on the branching ratio of $B < 4.2 \times 10^{-13}$.
The upgraded experiment (MEG II) will start to achieve one order higher branching ratio sensitivity $O(10^{-14})$ by using the world's most intense muon beam up to $\sim 10^8 \mu^+/\mathrm{s}$ and upgraded detectors with considerably improved performance.
One of the key for the upgrade is to suppress the background rate which is significantly increased with the higher muon beam rate.
We will newly introduce the Radiative Decay Counter (RDC) to identify the background photon from the radiative muon decay (RMD).
The RDC detects the low momentum positron associated with RMD on the beam axis at downstream of the muon stopping target.
We developed the detector which consists of fast plastic scintillators and LYSO crystals with SiPM readout.
By testing the detector with the muon beam, the capability of the background identification was successfully demonstrated.
Further improvement of the sensitivity is possible by detecting the positrons from RMD at upstream of the target.
We designed the detector based on a thin layer of plastic scintillating fibers to minimize the influence on the muon beam.
A series of feasibility studies were performed towards the installation.
We concluded that the influence on the muon beam transportation is expected to be small.
Moreover, by considering the pileup beam muons and the light yield of the scintillating fibers, the detection efficiency for the positrons was evaluated.
By installing both RDC detectors, the improvement of the sensitivity is expected to be 22-28%.

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