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Upgrade of the MEG liquid xenon calorimeter with VUV-light sensitive large area SiPMs

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The MEG experiment searches for the muon lepton flavor violating decay, $\mu^+ \rightarrow e^+\gamma$. An upgrade of the experiment is ongoing, aiming to reach a sensitivity of $\text{Br}(\mu^+ \rightarrow e^+\gamma) = 5 \times 10^{-14}$, an order of magnitude better than the sensitivity of the current MEG. To achieve this goal, all of the detectors are being upgraded.

In MEG, the energy, position and timing of the gamma ray were measured by a liquid Xe calorimeter, which consists of 900 l of liquid Xe and 846 2-inch round-shaped photo-multiplier tubes (PMTs). In the upgrade, the granularity at the gamma ray incident face will be improved by replacing 216 PMTs with 4092 SiPMs (MPPCs) with an active area of $12 \times 12 \text{ mm}^2$ each. The energy resolution for the gamma ray is expected to improve by a factor of 2, because the efficiency to collect scintillation light will become more uniform. The position resolution is also expected to improve by a factor of 2.

In collaboration with Hamamatsu Photonics K. K., we have successfully developed a high performance MPPC for our detector. It has excellent photon detection efficiency for the liquid xenon scintillation light in VUV range. The size of the chips is large so that it can cover large area with a manageable number of readout channels. The characteristics of the MPPCs are being tested in liquid Xe, and also at the room temperature. The results of the tests will be presented, together with the expected performance of the upgraded detector.

Collaboration

MEG-II collaboration

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