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Upgrade of MEG Liquid Xenon Calorimeter

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The MEG experiment yielded the most stringent upper limit on the branching ratio of the flavor-violating muon decay $\mu \rightarrow e\gamma$. A major upgrade of the detector is planned to improve the sensitivity by one order of magnitude.

For the upgrade, 2-inch round-shape photomultiplier tubes (PMTs) on the entrance window will be replaced by $12 \times 12 \text{ cm}^2$ Multi-Pixel Photon Counters (MPPCs) to significantly improve the granularity. The higher granularity will improve the energy resolution from 2.4% to 1.1% and the position resolution from 5 mm to 2 mm around the entrance window.

The MPPC in the upgraded LXe detector is required to have a high photon detection efficiency (PDE) for the LXe scintillation light in the VUV range with a good gain uniformity and to be operational in the LXe temperature (165 K). A UV-enhanced MPPC is being developed in collaboration with Hamamatsu Photonics and were tested in LXe. The single-photoelectron detection capability was confirmed, and the PDE for the LXe scintillation light was measured to be 17%. A new sensor configuration based on a series connection of the sensor segments is being developed to reduce the large sensor capacitance and thus to make the pulse shorter.

The design and the expected performance of the upgraded LXe detector with a comparison with the current detector, the plan and the status for building a prototype and the final detector and the R&D results of UV-MPPC development will be discussed.

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