Performance study of LYSO crystal for the Electromagnetic Calorimeter in the COMET experiment

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The purpose of the COMET experiment is searching the charged Lepton Flavor Violation process within the muon to electron conversion. Since the process is greatly suppressed in the Standard Model including the neutrino oscillation, the detection of $\mu - e$ conversion can show the existence of BSM immediately. The COMET experiment is planed to be constructed at J-PARC and use high-intensity bunched proton beams[1] . Single event sensitivity is $\sim \mathcal{O}(10^{-15})$ at Phase-I and $\sim \mathcal{O}(10^{-17})$ at Phase-II. In the case of using aluminum target, electron having monochromatic energy of 105 MeV is expected to appear. Different detectors are used to search the electron at each stage. In the Phase-II, a straw tracker and an electromagnetic calorimeter (ECAL) are used to detect signal electron and the requirement value of energy resolution is less than 5% at 105 MeV. The ECAL is composed of inorganic scintillator, Avalanche Photo Diode (APD), and uniquely developed readout electronics. Regarding inorganic scintillator, LYSO crystal is the base design to achieve such a strict requirement.

There are three candidate companies manufacturing LYSO crystal, Saint-Gobain, OXIDE, and JTC respectively. In addition Saint-Gobain makes two types of LYSO crystal, "Standard LYSO" and "Engineered LYSO". The properties of LYSO are generally short decay time, high light emission and high density. However these properties are slightly different due to the difference of manufacturing process. Since the performances of all crystals need to be took into account in the ECAL construction, It is necessary to know the crystal performance in terms of the difference of manufacturing company or the sample variation. Saint-Gobain's crystals and JTC's crystal were compared from the point of relative light yield and decay time at the laboratory test. As a result, Saint-Gobain's Engineered LYSO has the best performance of the three companies and great advantages for the ECAL. This poster reports the detail result of the performance study.

References

[1] Y. Kuno and on behalf of the COMET Collaboration, A search for muon-to-electron conversion at J-PARC: the COMET experiment, Progress of Theoretical and Experimental Physics 2013 (2013).