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Measurements of a LYSO Crystal Array for a Rare Pion Decay Experiment

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LYSO crystals are radiation-hard, non-hygroscopic, have a light yield of $\sim 30,000\,\gamma$/MeV, a 40-ns decay time, and a radiation length of just 1.14 cm. Conventional photosensors work naturally at the LYSO peak wavelength of 420 nm. These properties suggest that an electromagnetic calorimeter made from LYSO should be ideal for high-rate, low-energy precision experiments where high resolution is imperative at energies below 100\,MeV. Yet, few examples exist and the performance for previous prototypes did not achieve what the light-yield specifications might suggest for energy resolution. We have been designing a large solid angle ∼spherical calorimeter made of tapered LYSO crystals for possible use in a new measurement of the branching ratio $R_{e/\mu} = \Gamma(\pi^+ \to e^+\nu(\gamma))/\Gamma(\pi^+ \to \mu^+\nu(\gamma))$. The π-to-e decay emits a 69 MeV positron, to be measured against the continuum of < 53 MeV Michel positrons from muon decay. I will present our studies obtained with an array of recently optimized LYSO crystals made by SICCAS. We have obtained excellent results in bench tests with various sources, an array test with a 17.6 MeV γ source from a p-Li reaction, and from a test-beam run at the Paul Scherrer Institute using a positron beam from 30 –100 MeV having excellent momentum resolution.

Mini Symposia (Invited Talks Only)

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