

0.0.1 Upgraded HYCAL, possible alternative to BigCal

Interest in general purpose radiation-hard medium-sized calorimeter that could be used in multiple experiments has been building at Jefferson Lab. A hybrid calorimeter, HYCAL, was used in the Hall B PrimEx I experiment and will be used in the follow-up PRIMEX II experiment in Hall B in 2012. HYCAL consists of an inner section of 1052 $PBW0_4$ scintillating crystals surrounded by 576 lead glass bars which is arranged in a $1.18 \times 1.18 \text{ m}^2$ grouping. The PrimEx I experiment measured position resolution of the $PBW0_4$ section as 2 mm. Also $PBW0_4$ is known to be about 100 times more resistant to radiation damage when compared to lead glass. For this proposed experiment, HYCAL is not a good alternative to BigCal. With HYCAL's smaller size, it would have to be at 5m, so the lead-glass section of HYCAL would have worse radiation damage problems than BigCal.

A Hall D proposal, "A Precision Measurement of the η Radiative Decay Width via the Primakoff Effect", plans to use HYCAL, but also suggests the possibility of upgrading HYCAL by replacing the lead-glass part of the detector with $PBW0_4$ bars and having the same $1.18 \times 1.18 \text{ m}^2$ size. This new detector would be for general purpose use in other halls. This detector could be used in our proposed experiment. The detector would be placed at 5 m away from the target. At this distance away, the full vertical extent of the calorimeter would be used, but only 0.65 m of the horizontal size of the calorimeter would be used. With the 2mm position resolution, the electron angular resolution would be 0.4 mr which is better than expected with the BigCal at 10m. Given that the $PBW0_4$ suffers less radiation damage by a factor of 100, the radiation of the $PBW0_4$ should only reduce the gain by a 8%. This means that UV curing during the experiment is not needed.