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Wavelength Shifting Liquid-Filled Capillaries for Optical Electromagnetic Calorimetry Applications

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WLS Capillaries are being developed for optical calorimetry applications, and particularly for sampling calorimetry configurations. The WLS dyes can be tailored appropriately to provide wave shifting for various scintillation materials. Fabricated from radiation hard quartz, these elements are capable of withstanding high radiation doses and could be used broadly for EM applications in fixed target and colliding beam experiments. Structure fabrication, optical characteristics and measurements of the behavior of these structures under gamma irradiation in doses up to 150Mrad will be presented.

Summary

We are developing a liquid wave-shifter and radiation hard quartz capillary structures to read out the scintillation light from highly compact and dense optically-based electromagnetic calorimeters for applications in high energy physics experiments. Our initial focus has been on Shashlik-style modules consisting of alternating layers of dense absorber plates, interspersed with crystal scintillation plates of identical cross sectional area. Such materials afford a dense, compact design, with small Moliere Radius, short physical length and substantial depth in radiation lengths sufficient to contain EM showers. In one such test structure the high brightness of the LYSO:Ce, the density of tungsten and the short optical path lengths allow for a detector design that is both robust against radiation damage and event pile up, central issues for detector operation at high luminosity. Scintillation light from the crystal tiles is waveshifted in liquid core of thick-wall rad hard quartz capillaries which penetrate through the Shashlik structure and transmit the light to photosensors such as SiPM located at their ends. In this presentation, details of the quartz capillary manufacture, optical characteristics and efficiency and radiation hardness will be presented.

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