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Light Yield Linearity of the BC-408 Plastic-Scintillator under Electron Excitation

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The PERC (Proton and Electron Radiation Channel) facility, located at the neutron source FRM II of the Technical University of Munich (TUM), serves as a clean source of neutron decay products, namely protons and electrons. PERC aims to contribute to the determination of the Cabibbo-Kobayashi-Maskawa quark-mixing element (V_{cb}), measure the correlation coefficients of free neutron decay (ρ , η , ξ , ζ) and to search for new physics at the TeV scale. While the main detector is a silicon detector, the backscattering detector system of PERC consists of two scintillation detectors with SiPM read-out.

The light output of the plastic scintillator BC-408 is investigated in the low-energy range (0–60 keV) using an electron gun as a beta source and a Silicon Photomultiplier (SiPM). This approach enables continuous testing of the nonproportionality of the light output to the amount of absorbed energy by the scintillator, without relying on the fixed energies of standard radioactive beta sources. Understanding this nonproportionality is an important aspect of the performance of a scintillation detector like the backscattering detector system of PERC. Additionally, the performance of the electron gun is compared to selected calibration sources.

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