Development of a 10 mol% Rubidium-doped CsI Crystal for ^{87}Rb Beta-Spectroscopy and Sterile Neutrino Searches

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The third-forbidden non-unique β-decay of ^{87}Rb to ^{87}Sr (Q value = 283.3 keV) provides a critical test for nuclear matrix element calculations and the quenching of the axial-vector coupling constant (g_A). To investigate this, we have developed a novel 10 mol% Rb-doped CsI scintillator using the Bridgman method. The grown crystal (10 mm ∅ × 10 mm) provides an intrinsic ^{87}Rb source with an activity of approximately 100 Bq, enabling a "source-in-detector" configuration that ensures high detection efficiency and minimal energy loss for low-energy electrons from β-decay.

We report on the scintillation performance of this specially designed crystal, including its light yield, energy resolution, and non-linear response. By precisely characterizing the β-spectrum shape, this study aims to provide the first high-resolution measurement of the ^{87}Rb forbidden decay. Furthermore, we explore the potential of its detector to search for heavy sterile neutrinos in the 100 keV/c^2 mass range via kink signatures in the β-spectrum. This work demonstrates the utility of high-concentration doping in alkali halide crystals for fundamental rare-event physics applications.