

Design and Characterization of a Low-Noise and Low-Background Charge Sensitive Amplifier for the Readout of Germanium Detectors

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Abstract—The large enriched germanium experiment for neutrinoless double beta decay (LEGEND) is a ton-scale experimental program to search for neutrinoless double beta ($0\nu\beta\beta$) decay in the isotope ^{76}Ge by means of high-purity germanium (HPGe) detectors operated in liquid argon (LAr). The observation of $0\nu\beta\beta$ decay would have major implications in the understanding of the origin of the matter in the universe and establish neutrinos as Majorana particles, i.e., their own antiparticles. In this framework, the LEGEND ultralow background integrated circuit for germanium detectors investigation (LUIGI) application-specific integrated circuit (ASIC) was designed. The ASIC technology enables the implementation of the whole charge sensitive amplifier (CSA) into a single low-mass chip. The LUIGI ASIC can play a key role to obtain good energy resolution (at 2039 keV, i.e., the $Q_{\beta\beta}$ value of the ^{76}Ge $\beta\beta$ -decay, a value of 2.49 ± 0.03 keV

Index Terms—Charge sensitive preamplifier, germanium detectors, low-dropout (LDO) regulator, neutrino experiments.

I. INTRODUCTION

THE observation of neutrinoless double beta ($0\nu\beta\beta$) decay would have profound implications on our understanding of the origin of the matter in the universe. $0\nu\beta\beta$ decay is a standard model-forbidden, second-order weak nuclear transition that violates lepton number conservation by two units [1], [2]. Searching for $0\nu\beta\beta$ decay is the most sensitive way to probe whether neutrinos are Majorana particles (i.e., their own anti-particles). High-purity germanium (HPGe) detectors enriched in the double beta decaying isotope ^{76}Ge are one of