

Development of a calorimeter for the next-generation rare pion decay experiment: PIONEER

Friday, 14 February 2025 11:45 (15 minutes)

PIONEER is a next-generation pion decay experiment that will run at the Paul Scherrer Institute in Switzerland. In its initial phase, the primary objective is to improve the measurement of the branching ratio: $R_{e/\mu} = \frac{\text{BR}(\pi \rightarrow e \nu(\gamma))}{\text{BR}(\pi \rightarrow \mu \nu(\gamma))}$. This measurement aims to surpass by more than an order of magnitude the precision achieved by the most precise measurement to date performed at TRIUMF. Such level of precision would match that of the Standard Model (SM) calculation, providing a stringent test of the SM. At this precision, PIONEER will provide the best test of the hypothesis that charged leptons have identical weak interaction strengths, otherwise known as lepton flavour universality.

This talk will focus on the PIONEER calorimeter, specifically the option for a liquid xenon (LXe), light-only readout, calorimeter. The calorimeter will detect positrons and gamma rays from radiative decays. The energy deposited in the calorimeter, as well as timing and position information, allows discrimination between the different types of decays and identification of pileup events. Given the level of precision targeted, it is crucial to design a calorimeter with high energy resolution and good containment of electromagnetic showers. A large prototype LXe calorimeter is being designed to characterize and test the performance of the unique calorimeter design. This ongoing work includes the development of optical Geant4 simulations which will be validated with the results of the prototype as well as preliminary hardware development for the prototype.

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