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Searching for New Physics with Pions

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Pions are fantastic tools to look for new physics! The PIENU experiment at TRIUMF has provided, to date, the most precise experimental determination of $R^{\pi}_{e/\mu}$, the ratio of pions decaying to positrons relative to muons. While more than an order of magnitude less precise that the Standard Model (SM) calculation, the PIENU result is a precise test of the universality of charged leptons interaction, a key principle of the Standard Model (SM), constrains a large range of new physics scenario, and allows dedicated searches for exotics such as sterile neutrinos.

I'll go over a short overview of $R^{\pi}_{e/\mu}$ measurements and their entangled history with the development of the SM and introduce the next generation precision pion decay experiment in the making: PIONEER! This newly proposed experiment aims at pushing the boundaries of precision on $R^{\pi}_{e/\mu}$ and expanding the physics reach by improving on the measurement of the very rare pion beta decay $\pi^+ \to \pi^0 e^+ \nu$. This will provide a new and competitive input to the determination of $|V_{ud}|$, an element of the Cabibbo-Kobayashi-Maskawa (CKM) quark-mixing matrix.

Your Email

chloe.m@cern.ch

Supervisor

Supervisor Email

Affiliation

TRIUMF

Your current academic level,

Professor/researcher

Primary author: MALBRUNOT, Chloé (TRIUMF)

Presenter: MALBRUNOT, Chloé (TRIUMF)

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