# Precision Measurement of the $\pi^+ \rightarrow e^+\nu$ Decay

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In the Standard Model (SM), lepton universality refers to the identical electroweak gauge interactions among the charged leptons. The measurement of the branching ratio

$$R_{e/\mu} = \frac{\Gamma(\pi \rightarrow\ e\nu)}{\Gamma(\pi \rightarrow \mu\nu)} \tag{1}$$

is one of the most stringent tests of lepton universality between the first two generations. Theoretical calculations [1-4] can be very precise in calculating $R_{e/\mu}$ since strong interaction dynamics cancels out in the ratio and structure dependent terms appears only through electroweak corrections. The calculated SM value is $R^{SM}_{e/\mu} = 1.2352(2) \times 10^{-4}$. The current experimental precision (fig. 1) is 20 times worse than the previous theoretical result, and therefore a new experimental effort is needed for matching the theoretical precision. The current experimental value is $R^{PDG}_{e/\mu} = (1.230 \pm 0.004) \times 10^{-4}$. A new measurement of $R_{e/\mu}$ will provide improved constraints to new physics beyond the SM or uncover new scenarios if a disagreement will be found. Many new physics scenarios predict violation of lepton universality and therefore $R_{e/\mu}$ becomes a very sensitive probe, especially for new pseudo-scalar interactions, where the mass reach extends up to 1000 TeV [7] at the level of expected experimental precision. The PIENU experiment at TRIUMF aims at measuring $R_{e/\mu}$ with a precision five times larger the previous experiments ([5],[6]). The experimental technique is based on a high-purity pion beam stopped in an active target. The two decay modes of the pion are detected at the same time with the same detectors and acceptance: in the ratio many uncertainties cancel providing a high-precision measurement. The PIENU detector system is able to accurately measure timings and energies (fig. 2) of the decay positrons from the $\pi \rightarrow e\nu$ and $\pi \rightarrow \mu \rightarrow e$ decay chains. Preliminary results from a blind analysis will be presented.

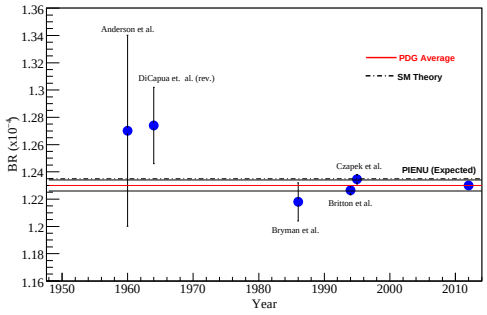


Figure 1: *History of the $R_{e/\mu}$ experimental results and the foreseen PIENU precision reach.*

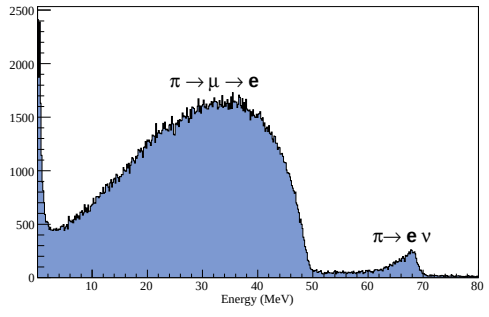


Figure 2: *Energy spectrum of the two decays obtained from the PIENU NaI calorimeter.*

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