# Measuring branching fractions for $\Lambda \to p\ell^-\bar{\nu}$ using CLAS at Jefferson Lab

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Semi-leptonic hadron decays provide a testing ground for deviations from Standard Model (SM) predictions in which lepton flavor universality (LFU) is presumed. For example, in 2015 the LHCb Collaboration reported a 2.1-$\sigma$ discrepancy between the branching ratio of semi-tauonic to semi-muonic $\bar{B}^0$ decays and the corresponding SM prediction. Other experimental results such as the muon $g-2$ anomaly and the proton radius puzzle suggest that seeking violations of LFU may have promise for revealing new physics. The semi-leptonic decays of hyperons, in particular $\Lambda \to p\ell^-\bar{\nu}$, present opportunities for similar measurements. Though such decays have been studied since the late 1960s, some channels are poorly constrained; *e.g.*, the world dataset for $\Lambda \to p\mu^-\bar{\nu}$ comprises only 28 events, and the branching fraction for this decay carries a relative uncertainty of more than 20%. We present the status of a measurement of the branching fractions for the $\Lambda \to p\mu^-\bar{\nu}_\mu$ and $\Lambda \to pe^-\bar{\nu}_e$ decays using the CLAS detector at Jefferson Laboratory. Hyperons were produced via the reaction $\gamma p \to K^+\Lambda$ by bremmstrahlung photons from a 4.023-GeV electron beam. The dataset contains approximately $1.861 \times 10^6$ fully reconstructed $\gamma p \to K^+\Lambda$ events in which the $\Lambda$ decays via the dominant hadronic mode ($\Lambda \to p\pi^-$). Identification of semi-leptonic decay events is complicated by two factors: by the missing momentum carried by the neutrino, and by hadronic decay events in which the pion decays via $\pi^- \to \ell^-\bar{\nu}$ near the $\Lambda$ decay vertex. We demonstrate that a boosted decision tree analysis based on a combination of standard kinematic quantities and vertexing information is sufficient to separate the semi-leptonic decay events from the hadronic decay and other backgrounds, and thus decrease experimental uncertainties on the branching fraction for the $\Lambda \to p\mu^-\bar{\nu}_\mu$ decay. The techniques presented are easily adaptable and will benefit from the increased vertexing capabilities of the next generation of nuclear physics experiments.