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AlCap: Measurements of the particle emission spectra following nuclear muon capture for muon-to-electron conversion experiments

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Observation of neutrinoless muon-to-electron conversion in the presence of a nucleus would be unambiguous evidence of physics Beyond the Standard Model. Two experiments, COMET at J-PARC and Mu2e at Fermilab, are under construction and will search for this process with a detection sensitivity of 10^{-16}, 10,000 times better than previously reported. The AlCap Experiment was jointly developed by COMET and Mu2e to measure Standard Model processes that could ultimately limit their sensitivity. Knowledge of the particle emission spectra after nuclear muon capture in candidate target materials is important for optimizing the new experiments to suppress potential background and noise rates, as well as for developing normalization techniques. AlCap performed three data-taking campaigns between 2013 and 2015 at the Paul Scherrer Institut. Robust results require careful modeling of the muon beam stopping profile in ultra-thin target foils, which is needed to generate the response matrix for the silicon detector system employed for the reaction products inside a vacuum vessel.
Systematic effects arising from those quantities are strongly mitigated by a symmetric detector setup around the AlCap target. The analysis demonstrates that the extracted heavy charged particle spectra produced in muon capture are stable against changes in the unfolding parameters and particle identification cuts.
In this talk the results for the AlCap proton spectra from Al and Si targets with a full systematic analysis will be presented for the first time.

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