Proposed abstract - BTTB

Precise knowledge of detector material for particle detectors is crucial both during the R&D phase and during operation as an input to simulations, in particular for tracking detectors in which both momentum and position resolution are highly sensitive to traversed material. Most past and current projects rely on coarse-grained estimates derived from a nominal design, the accuracy of which can be heavily impacted by difficult-to-estimate components or physical realities of the final detector construction, often resulting in uncertainties on the detector model exceeding O(10%). Direct radiation length measurements of individual components or larger assemblies as part of the R&D phase for new detectors can assist in allowing well-informed choices of materials and components, and in substantially reducing final uncertainties on the detector model.
This talk will introduce a mature methodology for measuring material content via the multiple scattering of electrons at test-beams. The purpose-built low-mass MONSTAR telescope will be introduced, alongside a discussion of the relationship between telescope design, beam energy, and available measurement range supported by simulation results. Two testbeam campaigns will be discussed, including a recently published exploratory measurement of an ATLAS ITk Pixel module at the CERN PS T9 beam [1,~~2~~], and a follow-up campaign at the PSI PiM1 beamline that measured over 500 cm^2 of detector samples (modules, support structures, and electrical interconnects) from ATLAS, Mu3e, and ETH Zurich, as well as dedicated calibration samples. Results from both campaigns will be presented alongside an overview of the analysis methodology and tools, a comparison of theory and simulation- or calibration-based models for multiple scattering, and a discussion of the scalability and wider applicability of the methodology.

[1] Koch, S.F., Moser, B., Lindner, A. et al. Measuring the ATLAS ITk pixel detector material via multiple scattering of positrons at the CERN PS. Eur. Phys. J. C 85, 381 (2025).
~~[2] ATLAS ITk Collaboration, Radiation length measurement of an ATLAS ITkPix v1.1 module using 1.2 GeV positrons at the CERN PS, ATLAS Public plots: ITK-2023-002, 2023.~~