High-Precision Particle Tracking for MUSE at PSI
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Introduction
MUSE will simultaneously measure \( ep \) and \( \mu p \) scattering to help solve the Proton Radius Puzzle (Fig. 1). I will visit PSI, during Aug. '18, to analyze the Straw-Tube Tracker (STT) detector (Fig. 7). Scattered particles ionize gas inside of each straw tube, creating a signal at the central anode wire in “drift time”.

Objectives
STT analysis will generate highly precise cartesian “tracks” of scattered particle trajectories. Signal processing (Fig. 2) uses TRB3 FPGA’s (Fig. 4) with PASTTREC readout cards. The signal from each particle is amplified, shaped, digitized, and processed by trigger logic to create an “event” and measure drift time.

Approach
MUSCOOKER generates analysis through user-defined C++ plugins. Drift time (Fig. 5) yields particle location with spatial resolution of 150 \( \mu m \). A Hough transform plugin will map the cartesian particle positions to lines in rho-theta space. Last summer I helped assemble an STT prototype (Fig. 8). This August the final STT model will be operational.

Results and Conclusions
Rho is the distance from the coordinate origin and theta is the line rotation angle in degrees. The intersection of curves in Hough space corresponds to the particle track in cartesian space shown in Fig. 10. The circles in Fig. 10 are straws in four different planes and their size is the drift distance of the particle as measured by the raw data.

References