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Design of the Mu2e Straw Tracker Detector

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The Mu2e experiment in Fermilab will search for the coherent neutrinoless conversion of a muon into an electron in the field of an aluminum nucleus, improving sensitivity by 4 orders of magnitude over existing limits and indirectly probing new physics beyond the reach of current or planned high energy colliders. To achieve a single conversion event sensitivity better than $3e-17$, the experiment requires a high precision measurement of the ~ 105 MeV/c electron momentum while reducing to negligible all background contributions in the signal window. The primary detector element is a low-mass straw tracker chamber, comprising $\sim 21,000$ thin straw drift tubes of 5 mm diameter, arranged in a 3 m long cylinder of radius 700 mm, and operated in a magnetic field of 1 T and in vacuum. The tracker is designed to reconstruct the momentum of conversion electrons with a resolution of <180 keV/c. The distance of an electron track from the straw sense wire must be extracted within $200\text{ }\mu\text{m}$ from a TDC timing measurement, while time division yields the hit position along the straw within 3 cm. The straws are also instrumented with an ADC for dE/dx capability to separate electrons from highly ionizing protons. We will present the status and design of the tracker and the scheme for its front-end electronics, which handles amplification, shaping, digitization and readout of the straw signals.

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