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Statistical uncertainty studies on various data analysis methods for Stretched Wire Alignment Technology used for the Scorpius Injector

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This paper presents statistical uncertainty studies on data analysis methods employed for the alignment of induction voltage adder (IVA) cell magnets in the Scorpius Injector. The Stretched Wire Alignment Technique (SWAT) was utilized to precisely locate and align the magnetic axis of beamline solenoid magnets. A current pulse with duration of approximately 100 μs was propagated through a stretched wire, generating a traveling wave due to the transverse magnetic force acting on the wire. The resulting transverse displacements in both horizontal and vertical directions were measured as a function of time using laser micrometers. By systematically repositioning the wire relative to the mechanical center of the magnet, the true magnetic axis and its offsets from the mechanical center were determined based on the displacement amplitudes or the magnetic field magnitudes inferred from the wire's motion. Statistical uncertainty analysis of various data analysis methods was conducted to evaluate the reliability of the estimated magnetic axis offsets. The results provide a robust range of offset estimates, ensuring accurate alignment of the IVA cell magnets within the injector system.

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