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A novel wiring technique to build ultra-low mass high-wire density drift chambers

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Ultra-low mass drift chambers, with Helium-based gas mixture and high wire density are ideal trackers for high-precision experiments in the intensity frontiers of particle physics. In the search for Lepton Flavor Violation the MEG~II experiment at the Paul Scherrer Institut represents the state of the art in the search for the $\mu^+ \rightarrow e^+ \gamma$ decay. The Cylindrical Drift CHamber (CDCH) is a key detector for MEG~II with single-hit, angular and momentum resolutions < 120~μm, 6.5~mrad and 100~keV/c respectively, measured on data. Wire breaking problems arose during the assembly and commissioning phases due to galvanic corrosion of the 40-50~μm Silver-plated Aluminum cathode wires in presence of ambient humidity. A R&D work started to find an alternative wire solution and explore the possibility to build a new chamber. The CDCH2 project was approved and is currently in the construction phase at INFN Pisa. Given the high wire density (12~wires/cm^2), a modular assembly is used. Wires are not strung directly on the through-hole endplates but fixed at both ends on the pads of two PCBs, which are then radially stacked on the endplates. Al (5056 alloy) 50~μm cathode wires without Ag coating were chosen, since their immunity to corrosion. A hybrid wire fixing technology was developed since the known difficulties to solder very thin Al wires, due to the natural oxide layer. Automatic laser micro-soldering and micro-gluing stations are integrated in the wiring machine, which ensures a 50~μm and ± 0.5~g wire placement and mechanical tension accuracy. A special soldering tin with acid flux core allows the Al wire soldering and electric contact. A drop of epoxy glue is then used to mechanically secure the Al wire. This novel technique is now well established, allowing to reach the 70\% of the CDCH2 assembly. The completion goal is set in June 2024.

Collaboration

MEG

Role of Submitter

I am the presenter

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