A new construction technique of high granularity and high transparency Drift Chambers for modern High Energy Physics experiments

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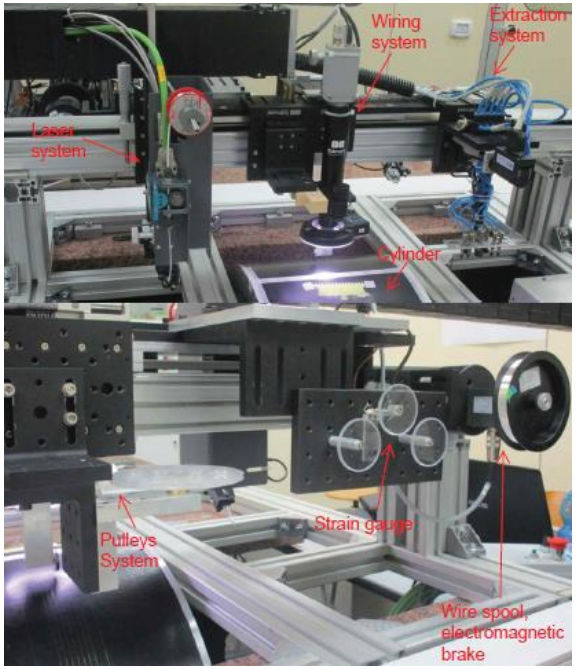
SUMMARY:

We present a newly developed construction technique for ultra-low mass Drift Chambers, it consists of:

- a semiautomatic wiring machine with a high degree of control over wire mechanical tensioning and over wire positioning;
- a contact-less IR laser soldering tool designed for a feed-through-less wire anchoring system;
- an automatic handling system for storing and transporting the multi-wire layers to be placed over the drift chamber end-plates.

These techniques have been successfully implemented at INFN-Lecce and University of Salento and are currently being used for the construction of Drift Chamber of the MEG upgrade experiment.

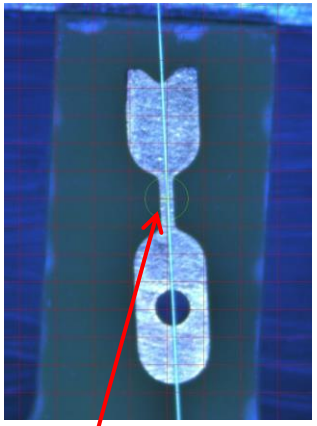
The MEG upgrade Drift Chamber is a challenging apparatus made of a enormous numbers of wires. Electrostatic stability considerations and the total length of the chamber, ~2m, require that all the different wires be stretched at a precise mechanical tensions during all the different assembling stages. To fulfill this goal, we have developed two different and complementary measuring systems both designed to determine the wires first harmonic resonant frequency.



The wiring robot features:

- ~20 μm of accuracy on wire position;
- ability to wind continuously variable pitch and stereo angle configurations;
- settable wire tension (±0.2g);
- controlled soldering procedure to avoid the modification of mechanical property of the wire;
- all parts must work precisely and synchronized, the use of the real-time system is needed.

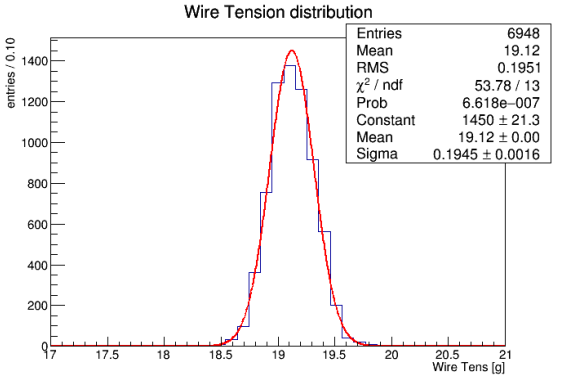
40 μm Al WIRE POSITIONING

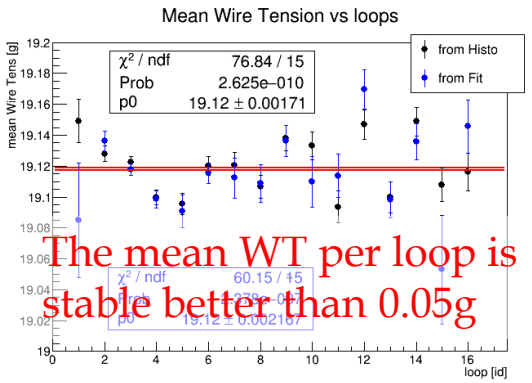


125 μm Strip pad

THE WIRE TENSION SYSTEM:

The mechanical Wire Tension (WT) is set by an electromagnetic brake with an online feedback related to the strain gauge value.

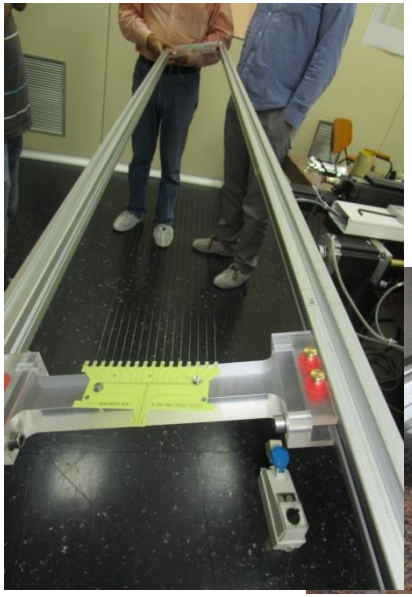




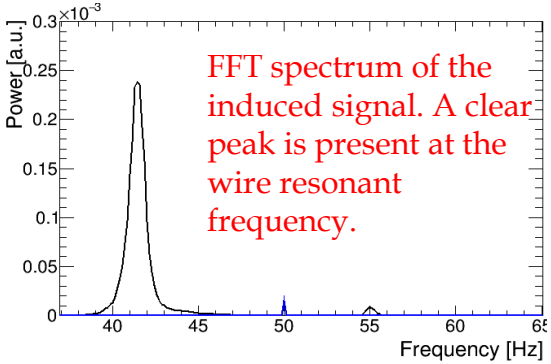
The mean WT per loop is stable better than 0.05g

WT CHECKING SYSTEM BY RESONANT FREQUENCY MEASUREMENT:

To monitor the WT of all the 12000 wires during the different assembling stages two independent systems were developed to measure the first harmonic resonant frequency of the wires:

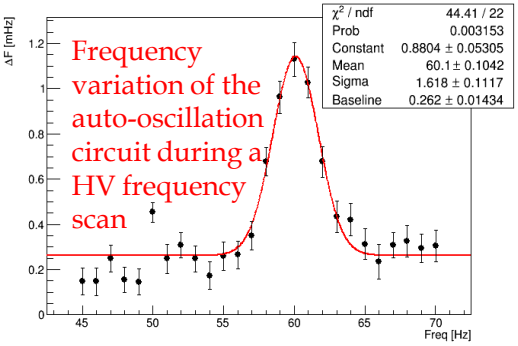


An acoustic based system developed by INFN Roma-1



FFT spectrum of the induced signal. A clear peak is present at the wire resonant frequency.

A sinusoidal HV based system developed by INFN Lecce



Frequency variation of the auto-oscillation circuit during a HV frequency scan

Conclusion:

We developed a novel technique for wiring high transparency drift chambers by using ultra-thin wires anchored with a feed-through-less strategy. It makes use of an automatic system for a precise positioning and for a well controlled and uniform mechanical. Two orthogonal systems to measure the wires resonant frequency have been developed. These techniques are currently used for the construction of the Drift Chambers of the MEG upgrade experiment at PSI.