The new drift chamber of the MEG II experiment

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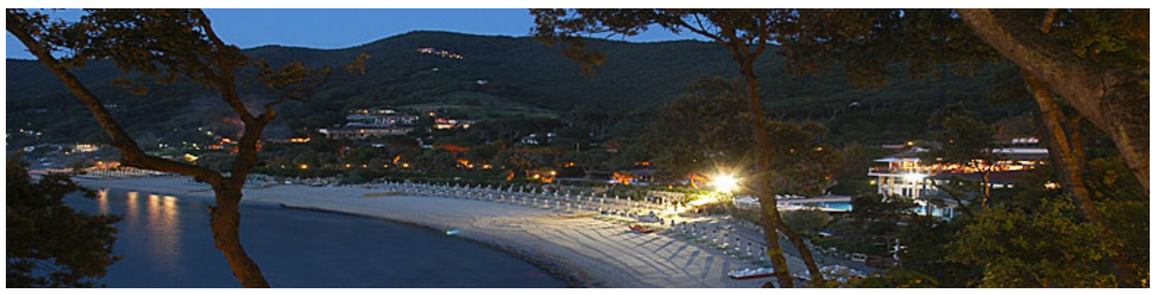
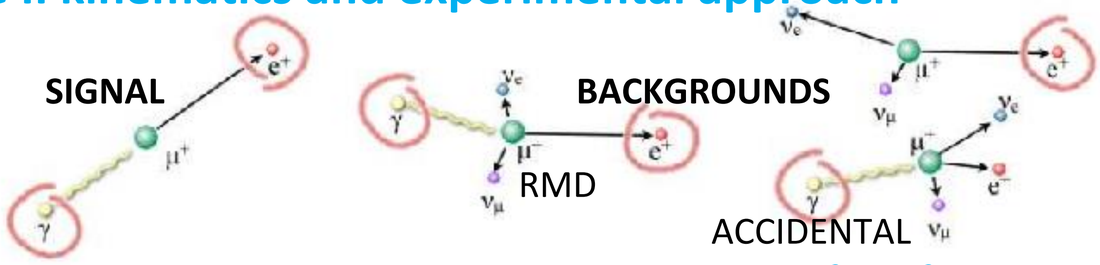


The final MEG results and its upgrade MEG II

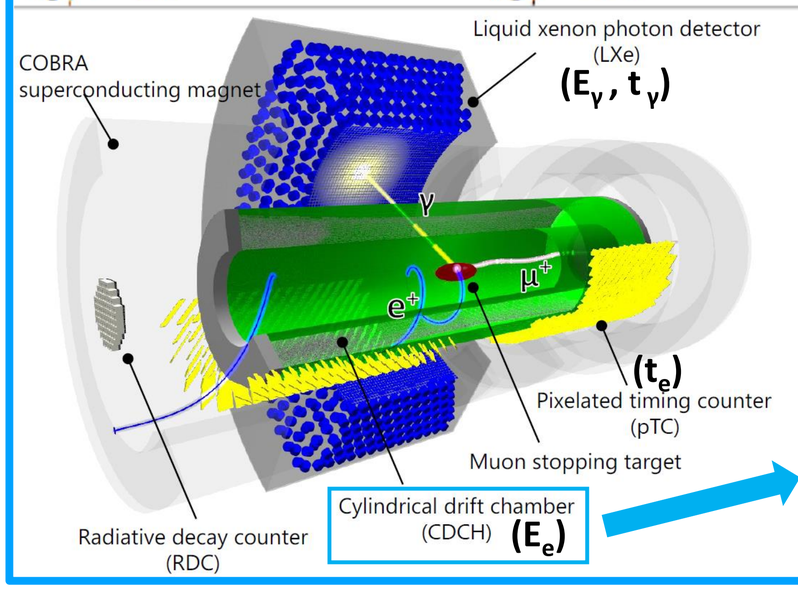
The MEG experiment represents the state of the art in the search for the **charged Lepton Flavor Violating** (cLFV) **decay $\mu^+ \rightarrow e^+ \gamma$**. The MEG collaboration presented the final results of the experiment, exploiting the full statistics collected during the 2009-2013 data taking period at **Paul Scherrer Institut** (PSI). The final analysis resulted in the new best upper limit on the **$BR(\mu^+ \rightarrow e^+ \gamma) < 4.2 \times 10^{-13}$** (90% C.L.). The MEG experiment has practically reached its ultimate level of sensitivity, limited by the resolutions on the measurement of the kinematic variables of the two decay products. Therefore an **upgrade** (**MEG II**) **of the experimental apparatus** has been approved and is presently under construction. MEG II aims at reaching a sensitivity enhancement of one order of magnitude compared to the final MEG results, in three years of data taking, by improving the detector figures of merit and the muon stopping rate.

MEG II kinematics and experimental approach



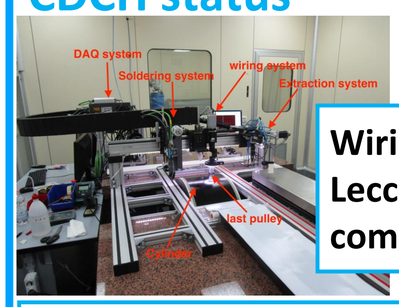
$BKG_{ACC} \propto R_\mu \Delta E_e \Delta E_\gamma^2 \Delta \Theta_{e\gamma}^2 \Delta t_{e\gamma}$
$BKG_{RMD} \approx 10\% \times BKG_{ACC}$

$E_\gamma = 52.8$ MeV	$E_\gamma < 52.8$ MeV	$E_\gamma < 52.8$ MeV
$E_{e^+} = 52.8$ MeV	$E_{e^+} < 52.8$ MeV	$E_{e^+} < 52.8$ MeV
$\Theta_{e\gamma} = 180°$	$\Theta_{e\gamma} < 180°$ [1]	$\Theta_{e\gamma} < 180°$
$T_{e\gamma} = 0$ s	$T_{e\gamma} = 0$ s	$T_{e\gamma} \Rightarrow$ flat

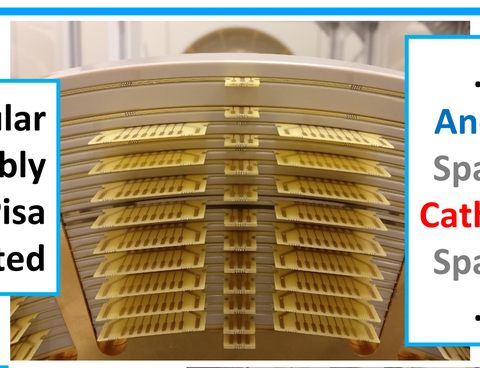


- **Full 2π azimuthal coverage around μ^+ stopping target**
- **New e^+ tracking procedure down to TC**
- **×4 hits more than MEG**
- **Better e^+ energy resolution**
- **Larger tracking efficiency**

CDCH status



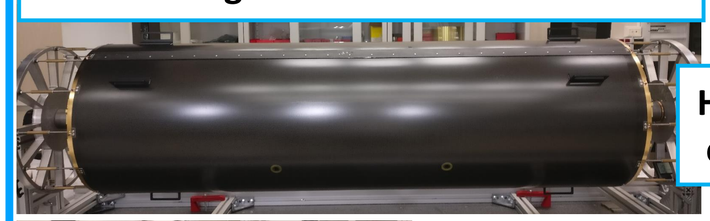
Wiring in Lecce completed



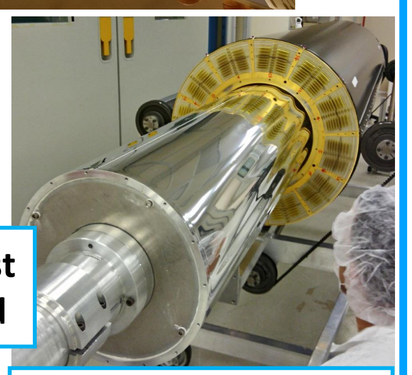
Modular assembly in Pisa completed

…
Anode
Spacer
Cathode
Spacer
…

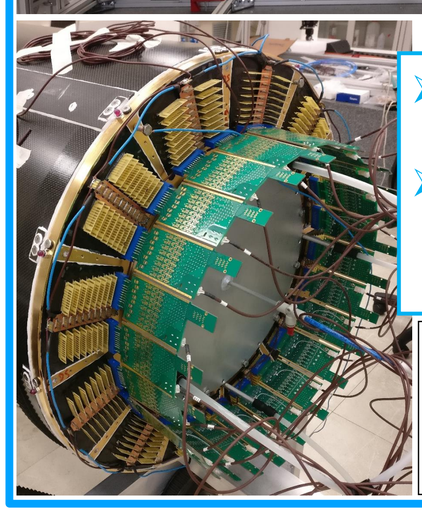
Carbon fiber support structure mounted
- **Maintains proper wire tension**
- **Encloses gas volume**



He leak test completed



Inner 20 μm Al Mylar foil mounted
- **Separates CDCH gas volume from He filled target region**

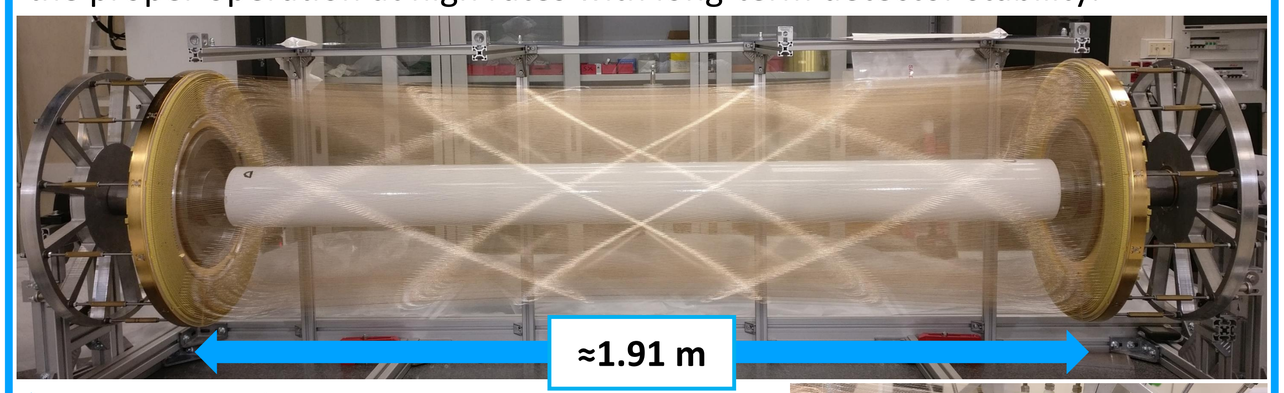


- **Final HV test ongoing**
- **Shipping to PSI foreseen next month**

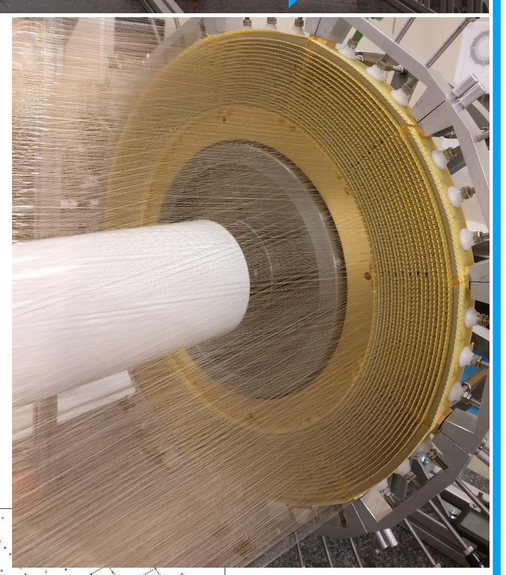
References:
- *Charged lepton flavour violation: An experimental and theoretical introduction*, L. Calibbi and G. Signorelli, La Rivista del Nuovo Cimento Volume 41 Serie 5 Numero 2 (2018)
- *Search for the lepton flavour violating decay $\mu^+ \rightarrow e^+ \gamma$ with the full dataset of the MEG experiment*, A. M. Baldini et al., Eur. Phys. J. C (2016) 76: 434
- *MEG Upgrade Proposal*, A. M. Baldini et al., arXiv:1301.7225
- *The design of the MEG II experiment*, A. M. Baldini et al., Eur. Phys. J. C (2018) 78: 380
- *Single-hit resolution measurement with MEG II drift chamber prototypes*, A. M. Baldini et al., *JINST* 11 P07011 (2016)

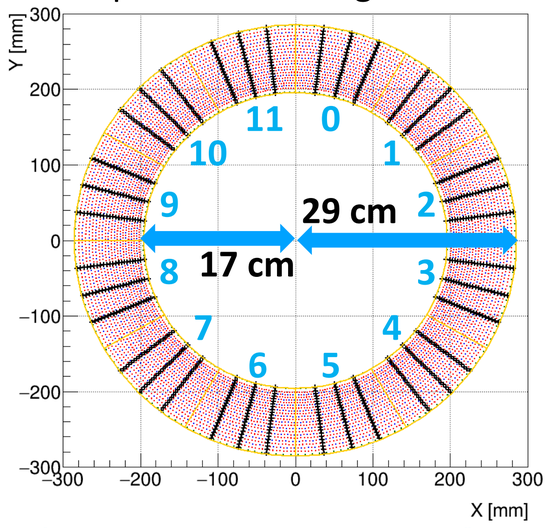
The MEG II Cylindrical Drift CHamber (CDCH)

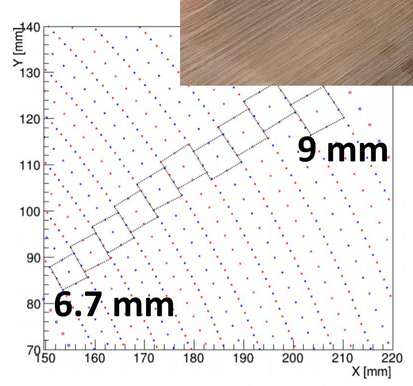
The new **Cylindrical Drift CHamber** (CDCH) is a key detector for the phase 2 of MEG. CDCH has been built by the **INFN groups of Pisa, Lecce and Rome** and is designed to overcome the limitations of MEG e^+ tracker and guarantee the proper operation at high rates with long-term detector stability.



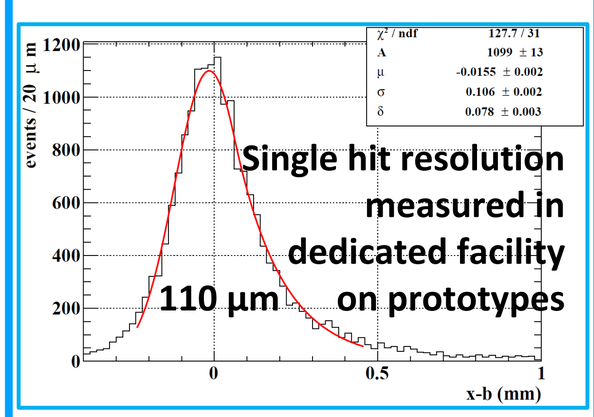
- Single cylindrical volume
- **low-mass He:Isobutane (85:15) gas mixture**
- High granularity
- **9 concentric layers** azimuthally divided in 12 identical 30° sectors, 16 drift cells wide
- Each layer consists of 2 criss-crossing field wires planes enclosing a sense wires plane





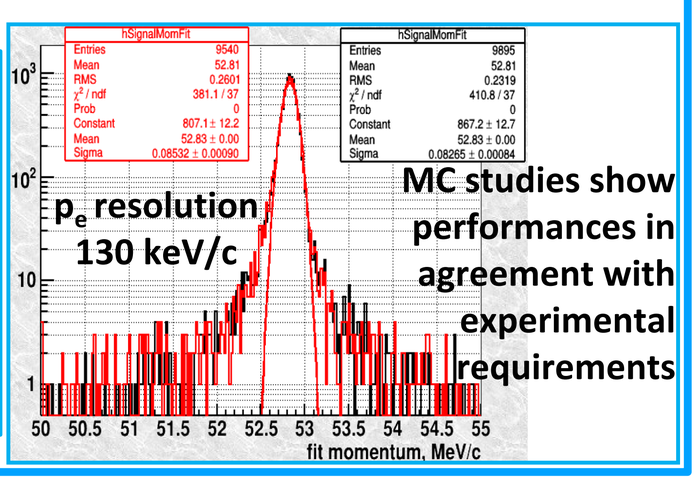


- Alternating signs stereo configuration for longitudinal hit localization
- Stereo angles range from 6° to 8.5° while radius increases
- Few mm wide drift cells
- The single drift cell is quasi-square with a 20 μm Au-plated W sense wire surrounded by 40/50 μm Ag-plated Al field wires
- **Field-to-Sense wires ratio 5:1** and total number of **≈12000 wires**
- Minimization of the material budget in the sensitive volume
- Radiation length per track turn **$1.5 \times 10^{-3} X_0$**
- Reduction of Multiple Coulomb Scattering contribution



Single hit resolution measured in dedicated facility on prototypes

110 μm



p_e resolution 130 keV/c

MC studies show performances in agreement with experimental requirements