MEGII experiment at PSI

Hicham Benmansour

INTENSE: Particle Physics Experiments at the Intensity Frontier

Presentation

- Hicham Benmansour: From Paris, France - French-Algerian
- **Bachelor's Degree** in Engineering at *Ecole Centrale de Lyon*, France
- **Master's Degree** in Engineering at *Ecole Centrale de Lyon*, France
- **Master's Degree** in Physics at *Queen's University*, Canada

—> Master Thesis on DEAP-3600, dark matter direct detection experiment
—> studies of WLS fluorescence

- Since September 2021: **PhD** in Particle Physics at *University of Pisa*, Italy

—> PhD Thesis on the MEG-II experiment: hands-on work and data analysis

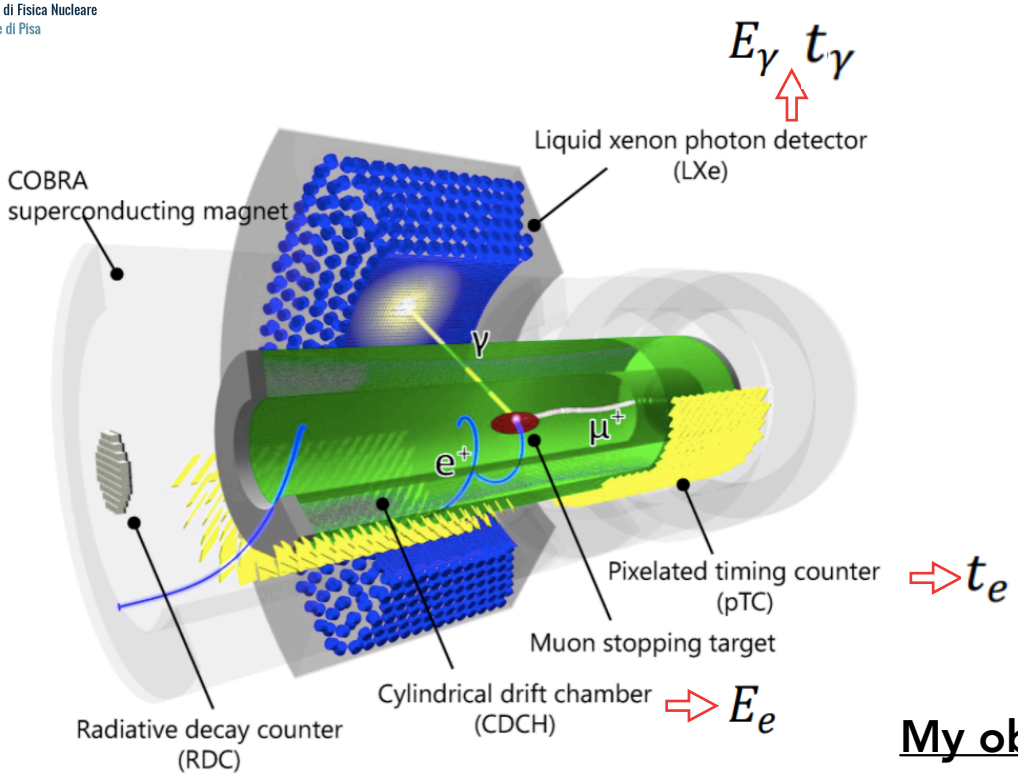
Courses and lectures

- **Particle Physics** - exam: July 4th
- **Instrumentation for Fundamental Interaction Physics** - exam: July 4th
- **Italian, A2 level** - exam: June 14th

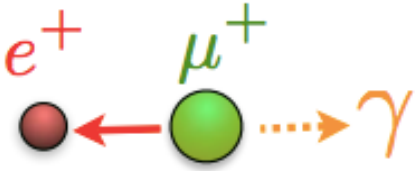
Conference

- 15th Pisa meeting on Advanced Detectors - May 2022

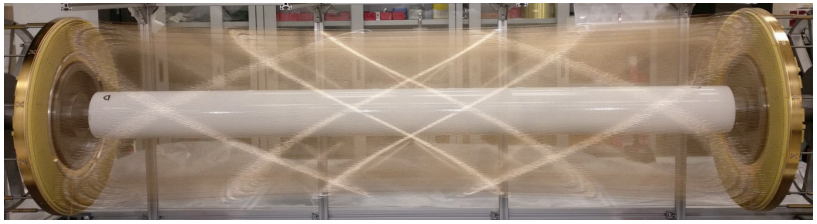
The MEG-II experiment



SIGNAL



$$E_\gamma = E_e = 52.8\ \text{MeV}$$
$$\theta_{e\gamma} = 180°$$
$$t_{e\gamma} = 0\ \text{s}$$



Low-mass single volume detector
—> 9 concentric layers of 192 drift cells defined by ~12k wires

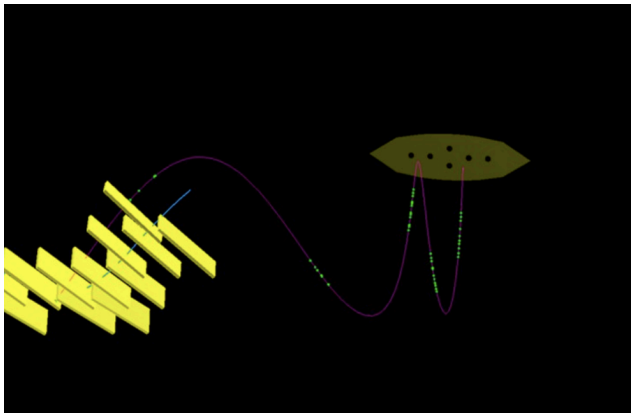
My objectives

1. Perform the positron analysis for the $\mu^+ \to e^+\gamma$ search

2. Study other physics channels that can be exploited with MEGII focused on the positron analysis (X17 search, $\mu^+ \to e^+ X$)

3. Develop new calibration methods for the MEGII experiments

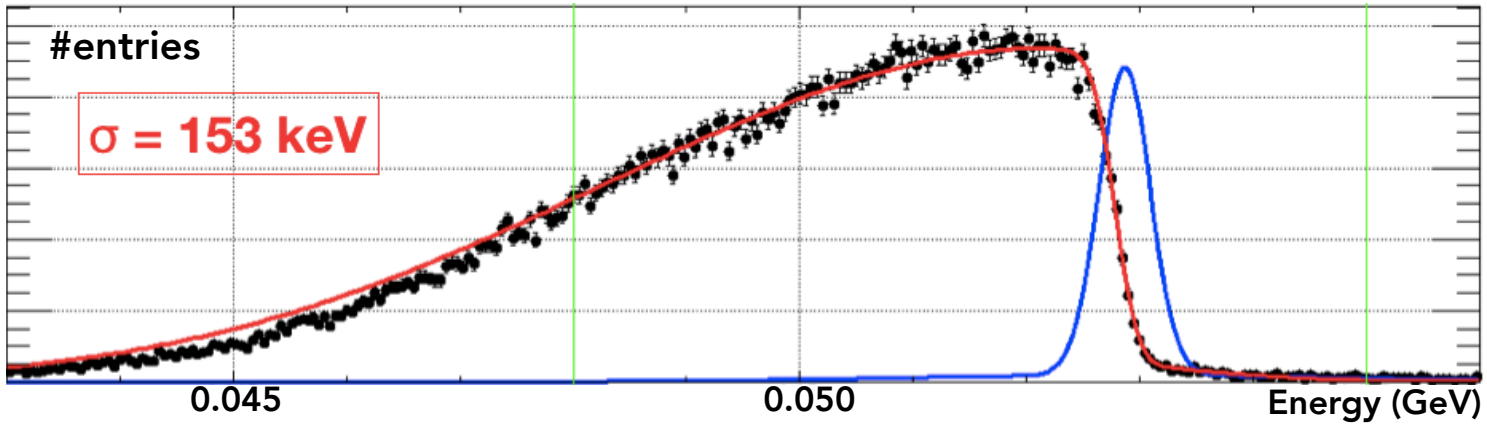
Positron Analysis



- Michel decay is the main (~100%) muon decay channel. The radius of the positron in the CDCH allows to extract its momentum. Fits of the spectra allow to extract resolution of the chamber.
- Fits done with:

(Theoretical Michel spectrum x Acceptance) ⓧ Response

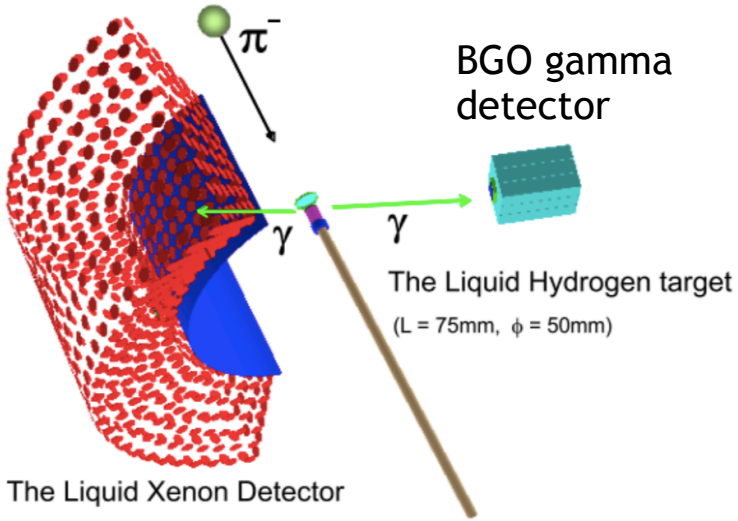
- Best choice of response. Resolution estimation. Uniformity with momentum direction.



The Liquid Hydrogen target

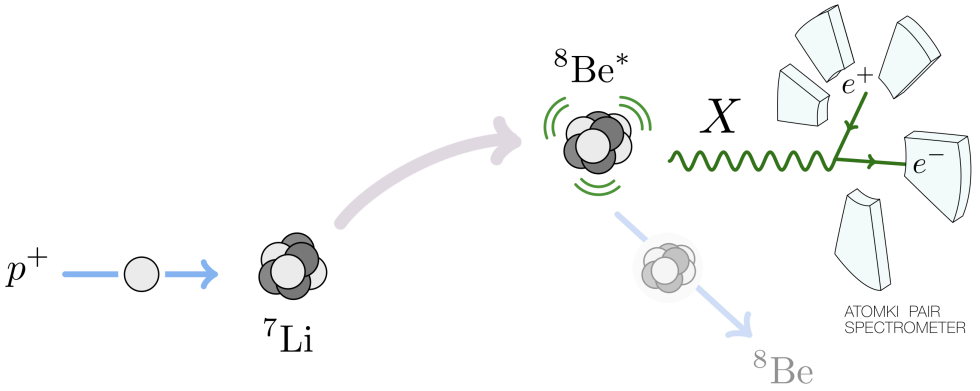
- Shifts during beam time
- Preparation of the Charge Exchange reaction (LXe calibration)

—> LHe circuit and LH2 target assembly
—> hydrogen liquefaction
—> successful CEX run last December



The X17 search with MEG-II

- Objective: measurement of excess in angular opening of:

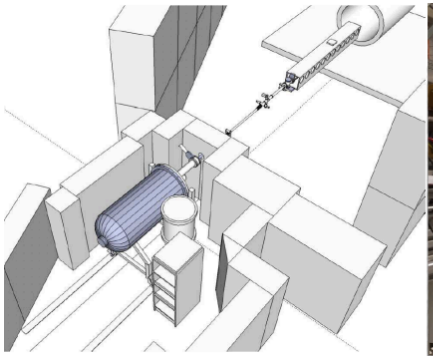


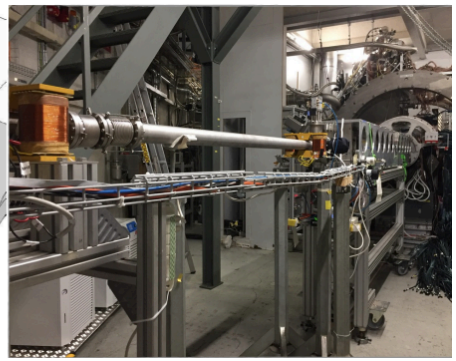
- Three key elements:

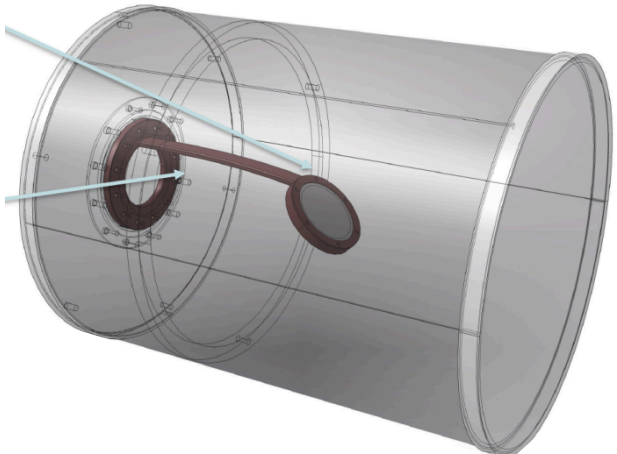
—> **Cockcroft-Walton accelerator** which produces 1.05MeV protons with 1uA current

—> **lithium target** optimized for the X17 search, 5um LiF on 25um copper substrate with copper arm (heat dissipation)

—> the **MEG-II drift chamber** with reduced magnetic field allows to detect the e+/e- pair (momentum ~ 9MeV)







Conclusion

- Positron analysis next steps:

—> find the most accurate model for Michel fits

—> implement polarization correctly

—> compare results with Monte-Carlo simulations

- On the longer term:

—> New algorithm and methods for the CDCH calibrations

—> PDF extractions for the $\mu^+ \to e^+\gamma$ analysis

—> Sensitivity study for $\mu^+ \to e^+ X$