Introduction

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on behalf of future $\mu \to e\gamma$ study group

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Study Group for Future $\mu \to e\gamma$ Search Experiment

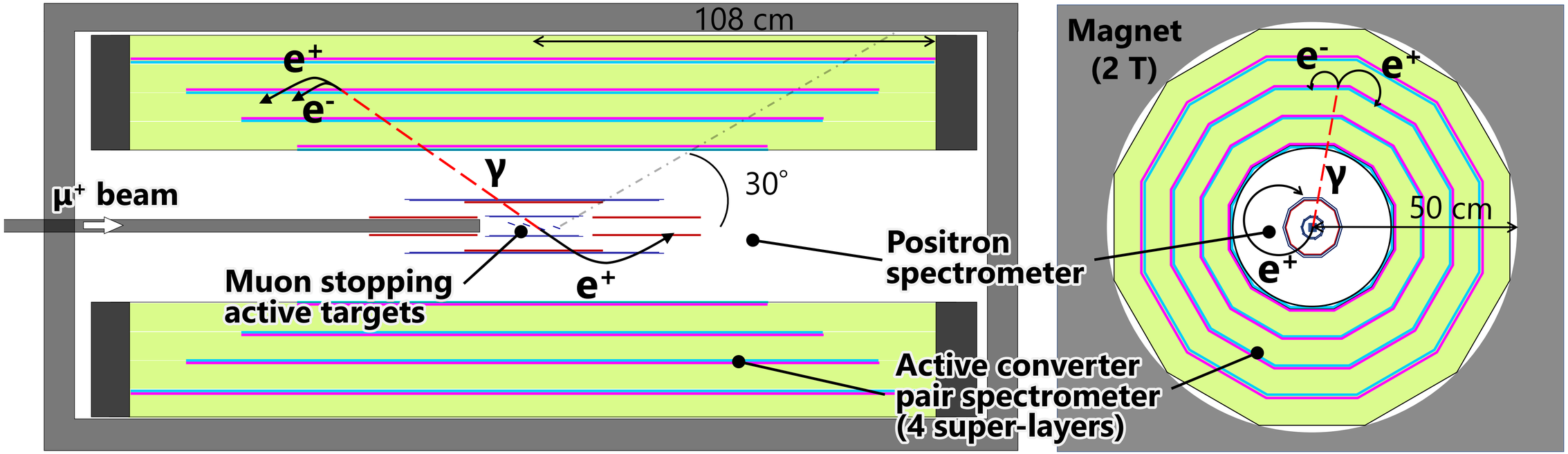
- Set up to follow-up the discussions in HIMB Physics Case Workshop (April 2021) and the write-up (https://doi.org/10.48550/arXiv.2111.05788) and to devise solider experimental concepts for future $\mu \to e\gamma$ search
- Regular meeting every three months
- Open discussions on designs and technologies for future experiment. Not limited to a specific design

  ⇒ Your participation/suggestion/new idea would be greatly appreciated

- Currently working on experimental design based on pair spectrometer with active converter
  - Active converter (WO's talk)
  - Conversion pair tracker (Francesco's talk)
  - Calorimeter option
  - Silicon tracker for positron spectrometer
  - Positron spectrometer with gaseous detector

Experimental Design under Consideration

- Experimental design based on pair spectrometer
  - Photon spectrometer with active converter → higher resolutions (energy, timing, position), angle measurement
  - Positron spectrometer based on Si detector (a la Mu3e) → high rate capability, concurrent search for $\mu \to eee$
  - Separate active targets → higher vertex resolution, further BG suppression
  - Significantly improved acceptance especially for zenith-angle → angular distribution measurement after discovery



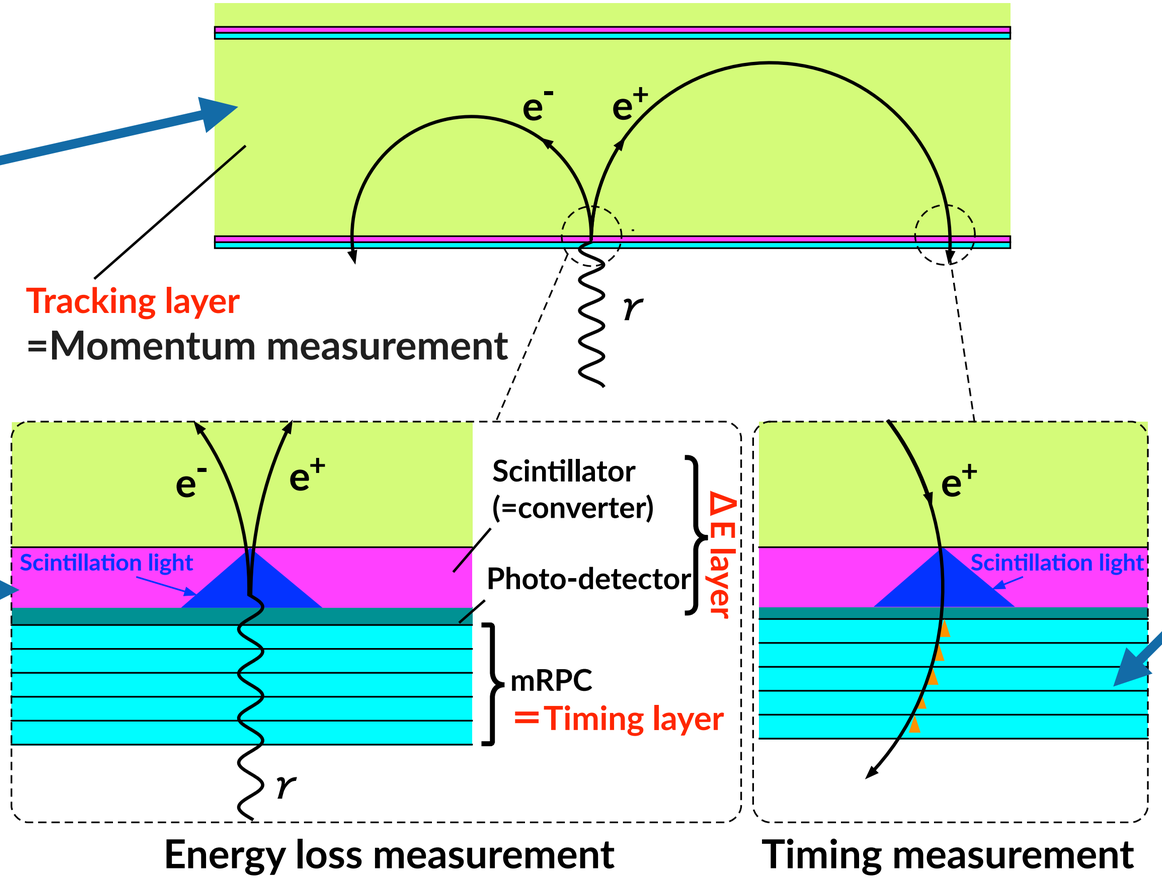
Pair Spectrometer with Active Converter

Tracking layer

- Measure momentum of conversion pair
- Possible technologies
  - Drift chamber (a la MEG II CDCH)
  - Radial-TPC
  - Silicon detector

Active converter (ΔE layer)

- Thin active material to measure energy loss of conversion pair
- Possible technologies
  - Scintillator + photo-detector
  - Silicon detector



Timing layer

- Measure timing of returning conversion pair
- in front of active converter
- Possible technologies
  - Low-mass fast RPC
  - Active converter = timing detector

Positron Spectrometer with Gaseous Detector

- Drift chamber
  - Pros
    - Solid technology thanks to the MEG II experience
    - Synergy with other projects (IDEA detector for FCC-ee, etc.)
  - Cons
    - Severe rate limitations of current drift chambers to be overcome (wire material, gas mixture, reconstruction algorithms, new geometry e.g. transversal wires, new readout techniques e.g. optical)
- Time Projection Chamber
  - Pros
    - No wires
    - High rate capabilities with GEM readout
  - Cons
    - Long drift (⇒ very high diffusion, very high space charge)
    - Small readout plane for a large active volume (⇒ high pileup in readout)

Positron Spectrometer with Gaseous Detector

- Radial TPC
  - Pros
    - Mitigate issues of standard TPC
  - Cons
    - Need to develop a radial TPC with cylindrical MPGD readout, ~ 2 m long and ~ 30 cm radius
    - Need to find a very light gas mixture to operate it with reasonably low diffusion
    - Need to develop advanced algorithms (AI?) for correcting field deformations