The Mu3e Experiment and its Pixel Detector

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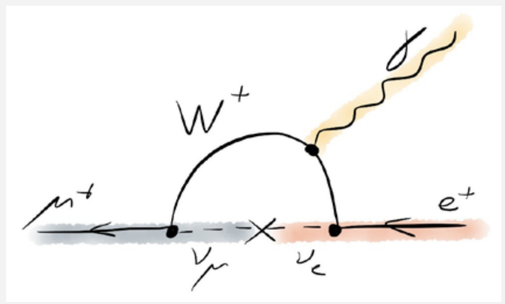
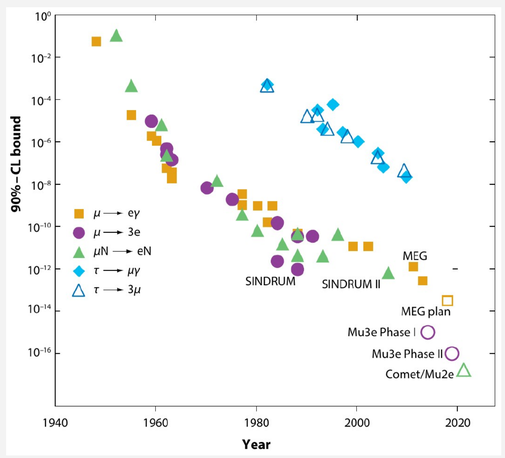
Lepton-flavour violating muon decays

- $\mu \to e\gamma$, $\mu \to eee$, $\mu N \to eN$
- "forbidden" in Standard Model of Particle Physics, e.g. $BR_{SM}(\mu \to eee) \approx 10^{-54}$
- branching fraction close to current limits possible in well-motivated models "Beyond the Standard Model"

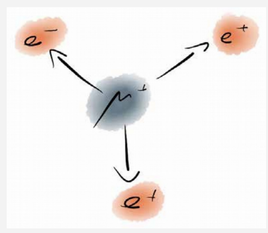
[e.g. Bordone et al., arXiv:1805.09328]

- best upper limits from experiments at PSI
- mu3e aims at 3-4 orders of magnitude improvement

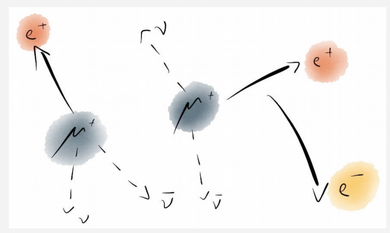




Signal and background



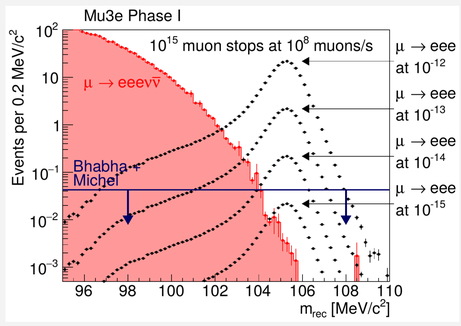
signal

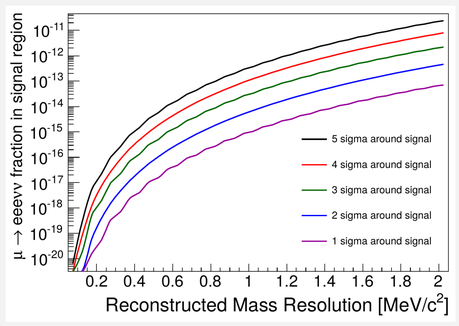


combinatorial background

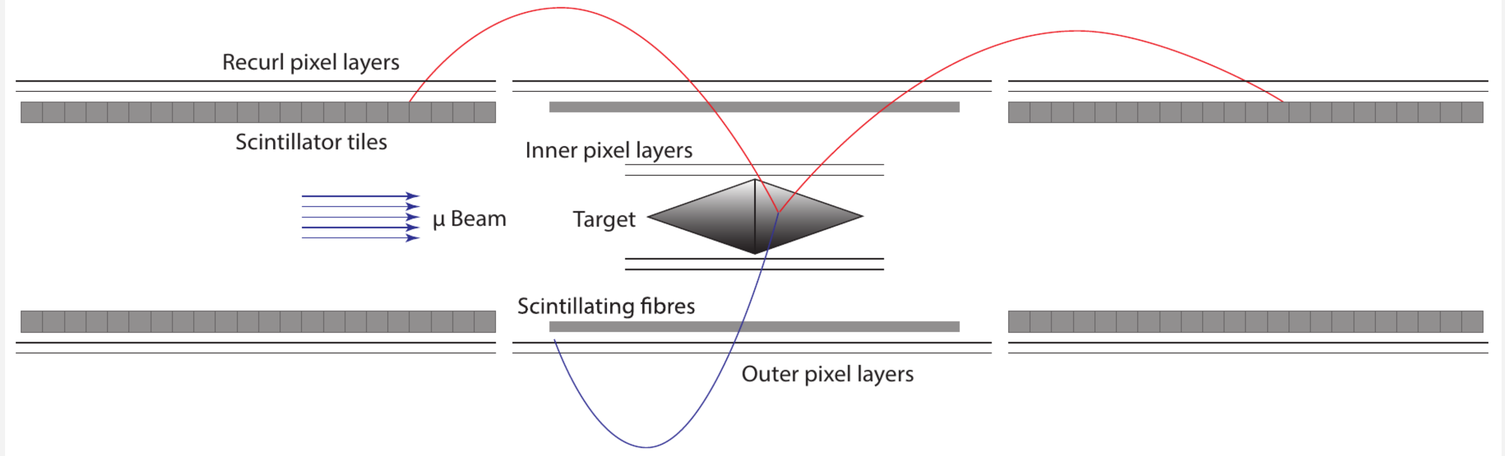
internal conversion background

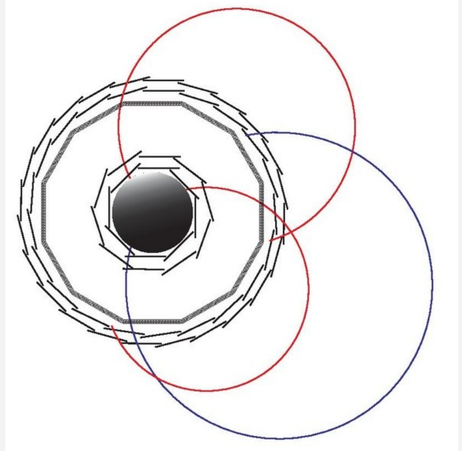
- timing resolution
- vertex resolution
- momentum resolution (invariant mass)





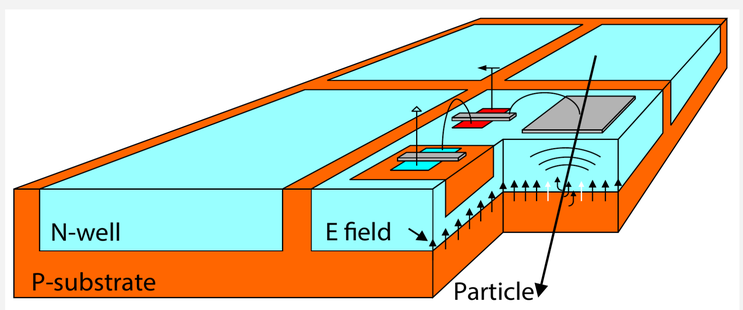
Mu3e detector concept

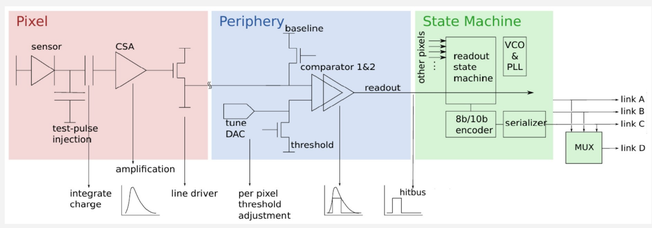


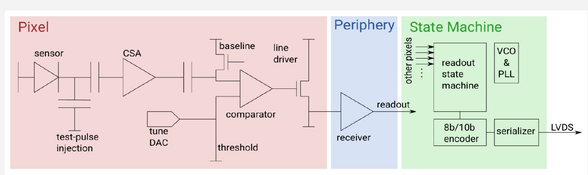


- inner pixel layers for vertex resolution | outer pixel layers for momentum resolution | scintillating fibres/tiles for timing resolution
  - electrons/positrons from muon decays at rest → very low energy → material budget crucial for momentum resolution !

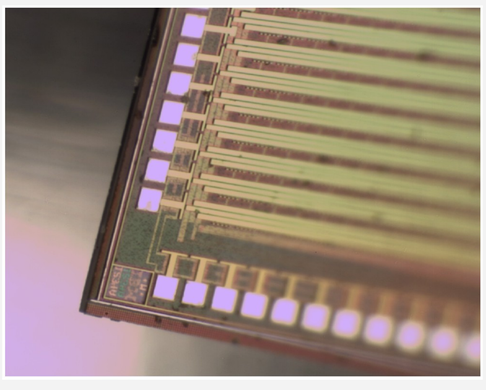
HV-MAPS pixel detectors



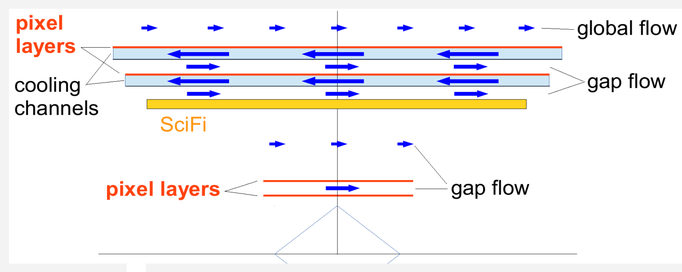




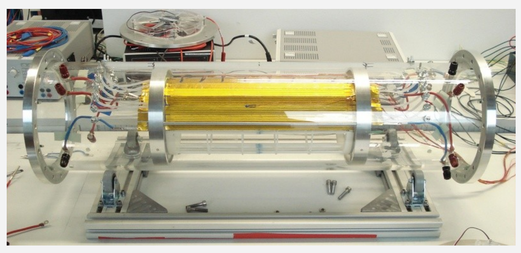
- front-end electronics in HV-CMOS process, embedded inside silicon detector substrate
- low capacitance → low noise → thin detectors ! (prototypes down to 62.5 μm, final goal 50 μm)
- bias voltage up to 100 V → fast signal collection (measured < 15 ns, further improvement expected)
  - expect final prototype by summer 2019



Gaseous Helium cooling



- need to remove about 4.5 kW of heat dissipated by the pixel detector
- need low mass → gaseous Helium
- R&D programme to demonstrate feasibility (required gas flows, stability, vibrations)



Poster prepared for the Open Days of the Department of Physics at UZH, November 1-2, 2018. For more information on Mu3e and proposed UZH contributions to the Mu3e pixel detector, contact Olaf Steinkamp <olafs@physik.uzh.ch>.