Search for μe conversion with SINDRUM II

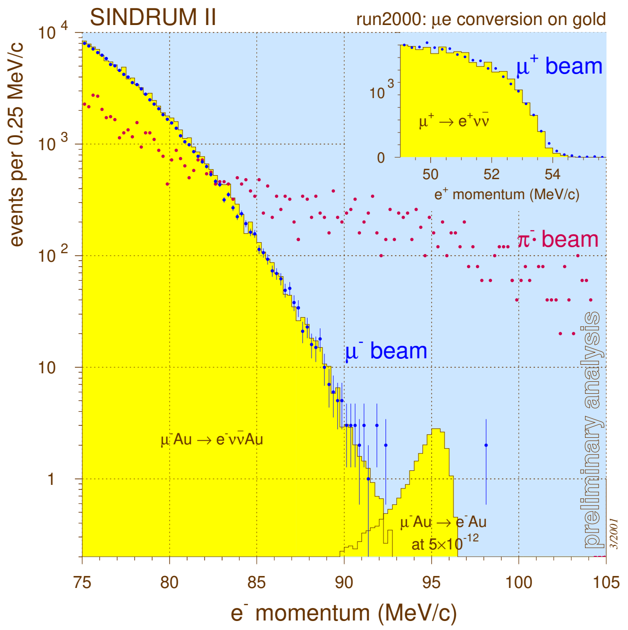
the year 2000 gold run

overview

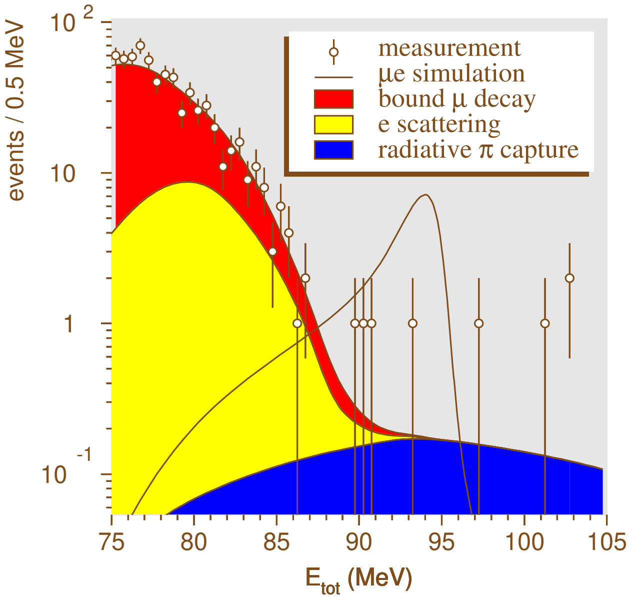
- μE1$\rightarrow$ πE5
- spectrometer
- event reconstruction
- trigger
- background
  - μ decay in orbit
  - cosmics
  - radiative π capture
- event selection
- beamline
- pion contamination
- momentum spectra for μ^+, π^- and μ^- beam
- nr of μ stops
- (in)efficiencies / single event sensitivity

Nufact'01, London, July 2002

going from μE1 to πE5

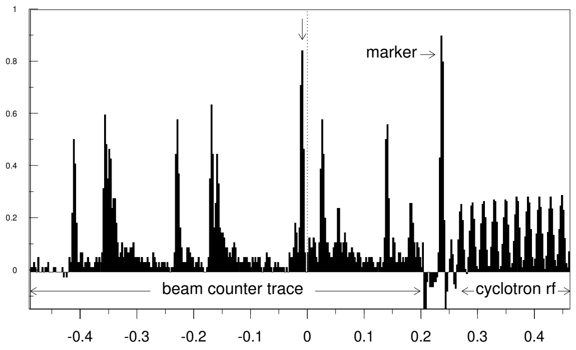


πE5:
2.5 months on 60 g gold



μE1:
2 weeks on 420 g lead

Cosmic and prompt events removed.

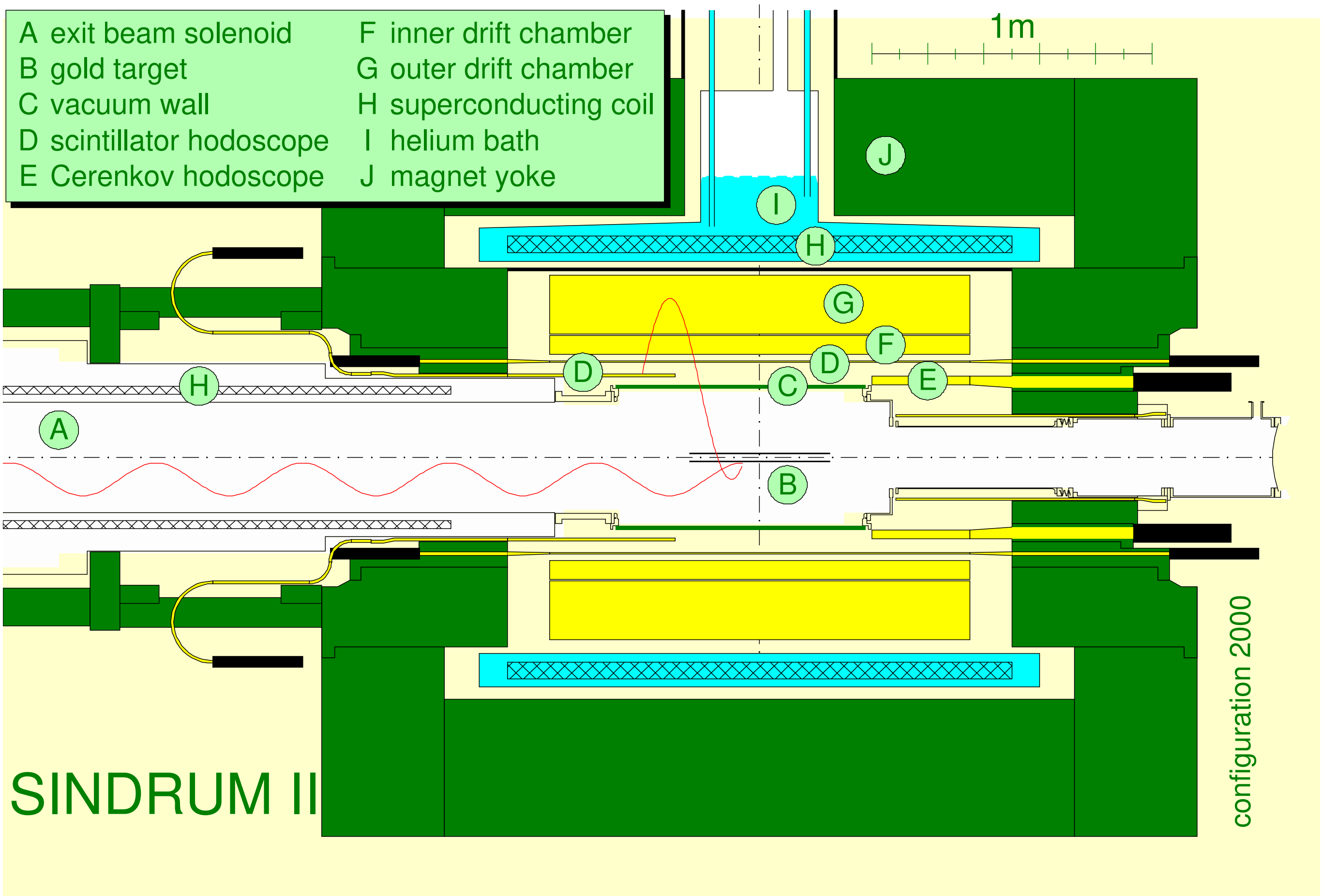


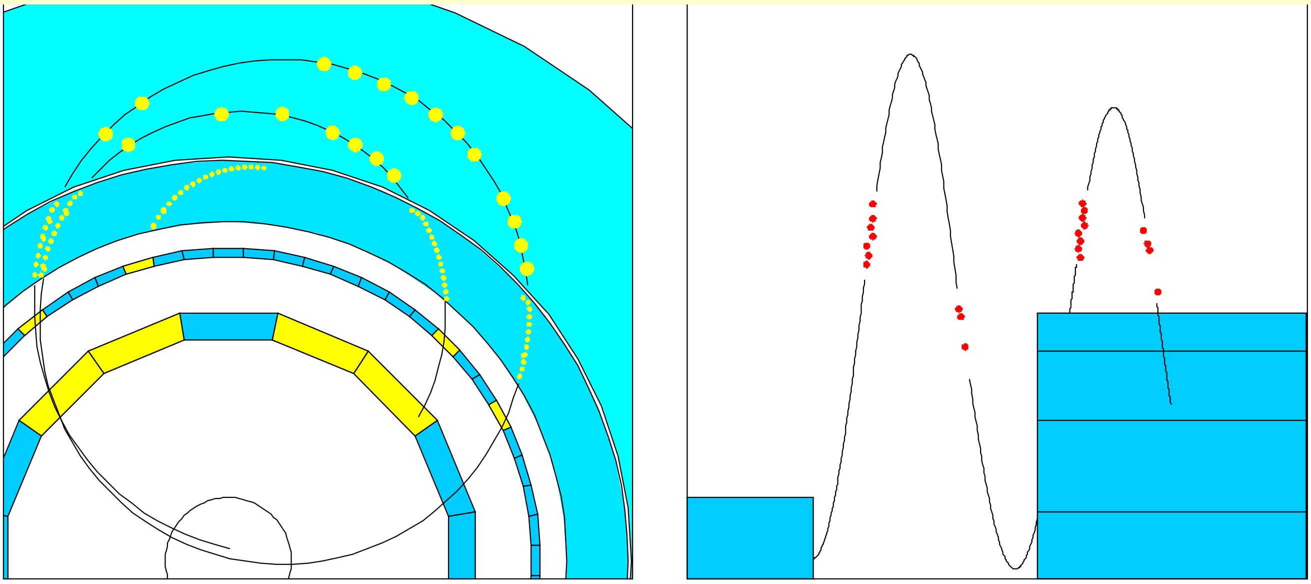
Likelihood observables in the energy region of interest.

$E_{\rm tot}$ (MeV)	Δt (ns)	z_0 (cm)	$t_{\rm rf}$ (ns)	θ (deg.)	P_i (%) μe	$\mu\nu$	ee'	$\pi\gamma$
89.9	10.7	9.1	4.0	65	7	26	0	67
90.2	21.1	3.2	13.2	72	7	14	0	79
90.9	155.8	16.3	11.8	70	32	20	48	0
93.0	26.9	0.9	1.5	102	19	0	0	81

$B^{\rm Pb}_{\mu e} < 4.6 \times 10^{-11}$ (90%C.L.)

SINDRUM II at πE5

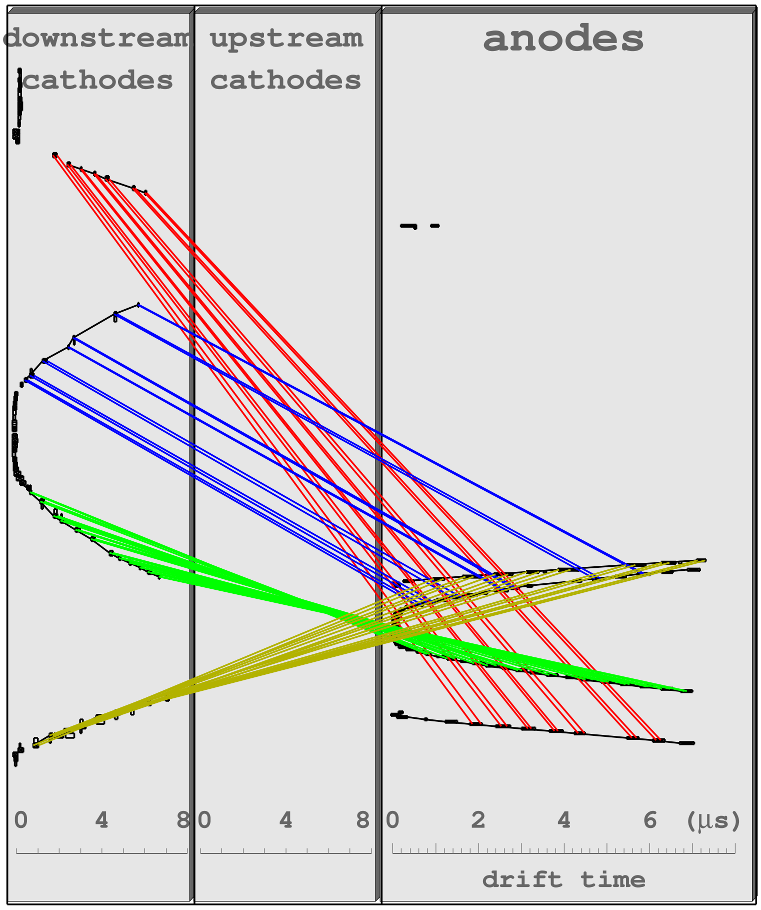




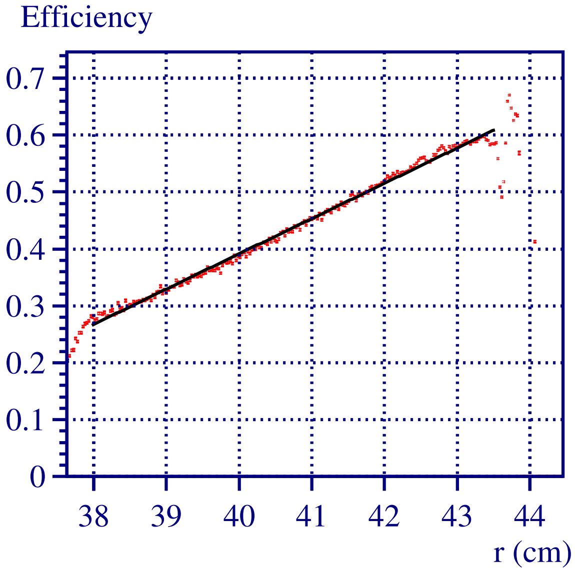
- tracks left by a ≈100 MeV/c electron

event reconstruction

DC1 track elements



- anode and cathode elements are combined on the basis of time overlap



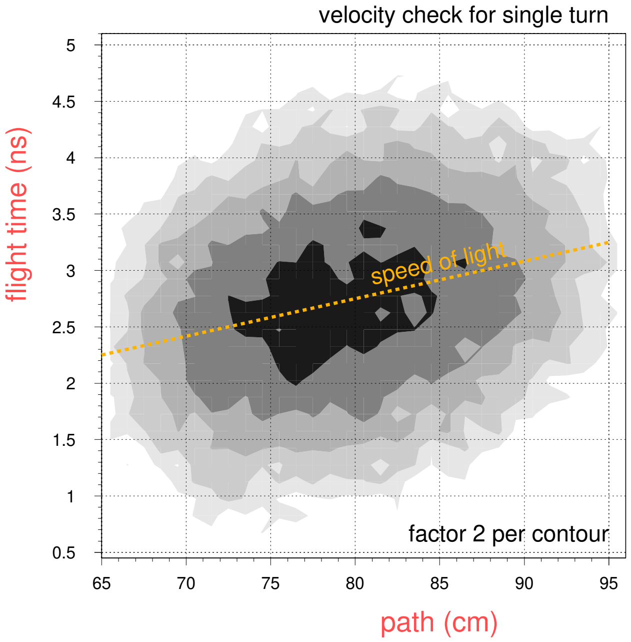
- cathode efficiency per hit during year 2000 data taking

event reconstruction

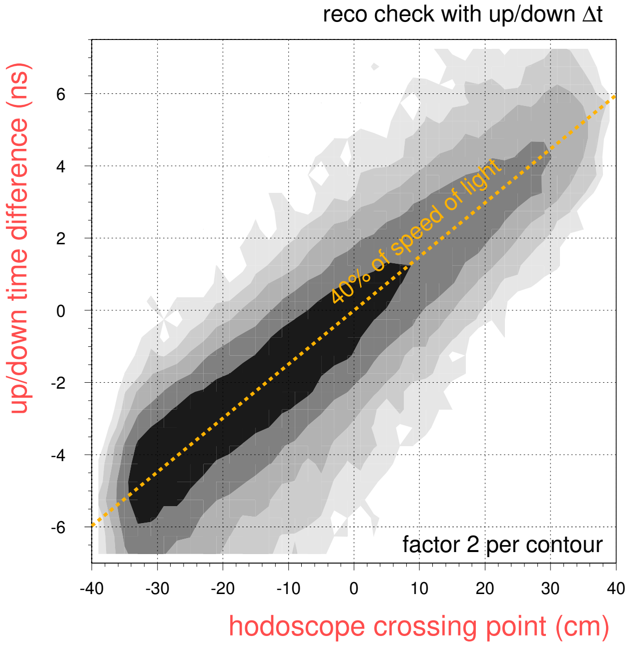
DC1 full turns

reco2

consistency of trajectory and hodoscope timing information

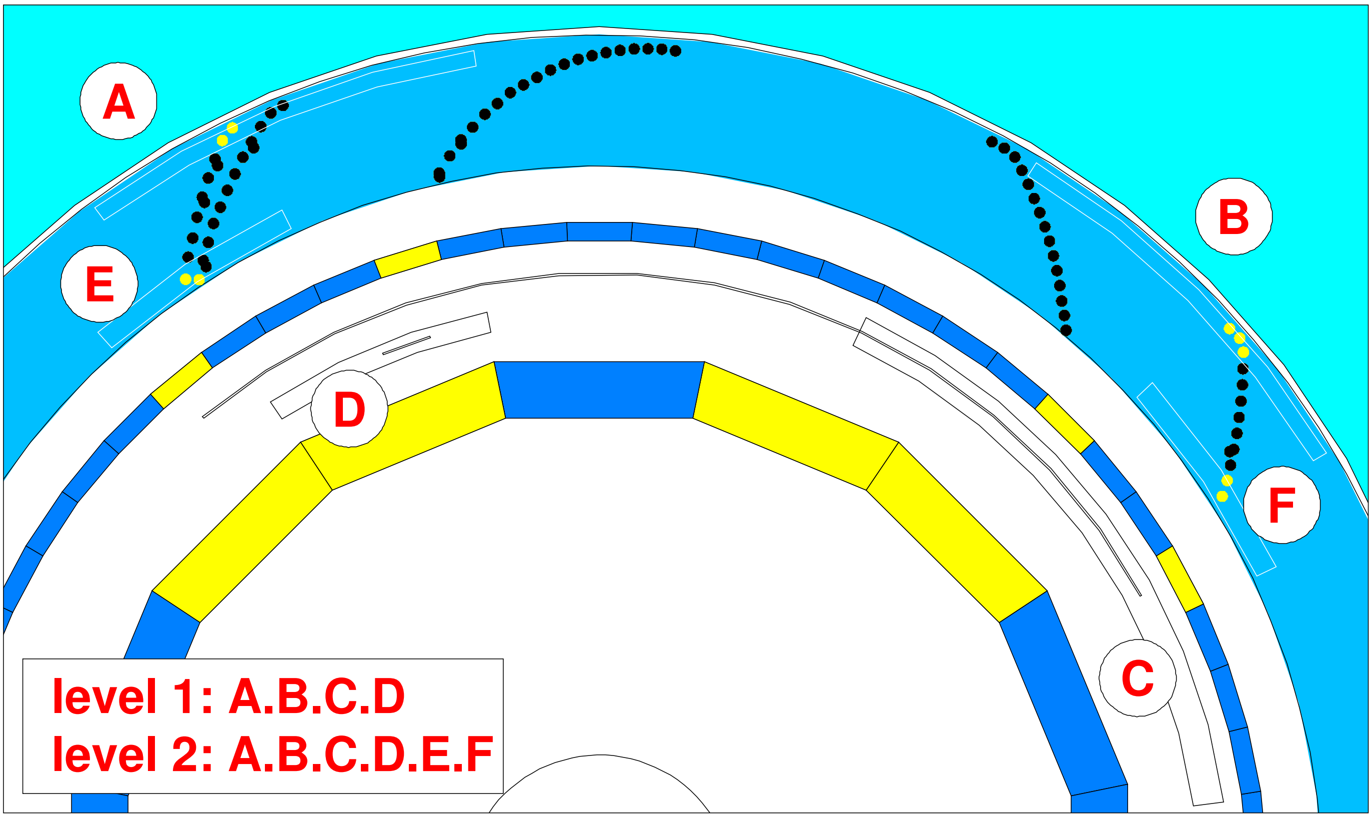


- velocity between first two hodoscope crossings



- effective light velocity in hodoscope

readout trigger



level 1: A.B.C.D
level 2: A.B.C.D.E.F

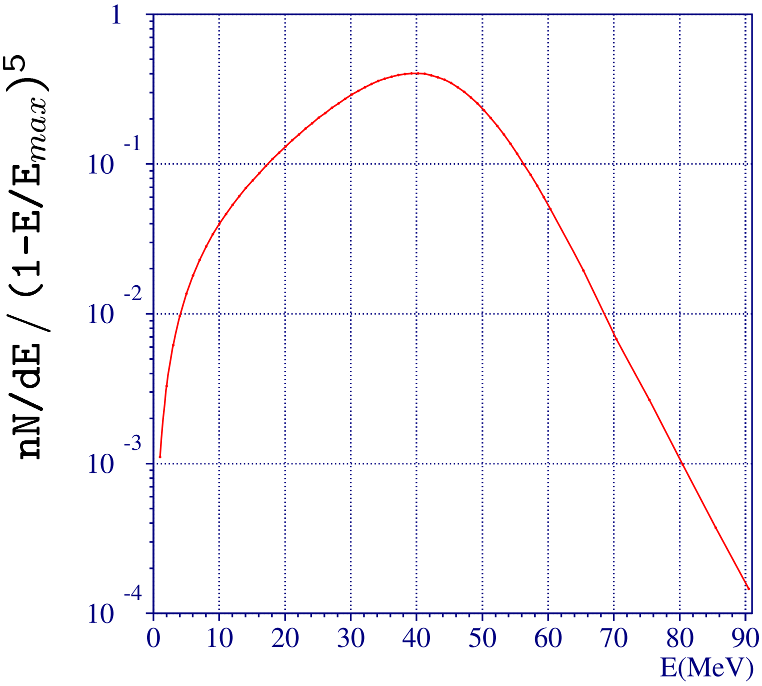
- level 1 takes about 100 ns
- level 2 has to wait for 8 μs drift time of DC1

Background processes

μ decay in orbit

The theoretical spectrum for μ decay in orbit was scaled from the lead spectrum

R. Watanabe *et al.*:
Atom. Data and Nucl. Data Tab. **54** (1993),165



- fit to tabulated rates

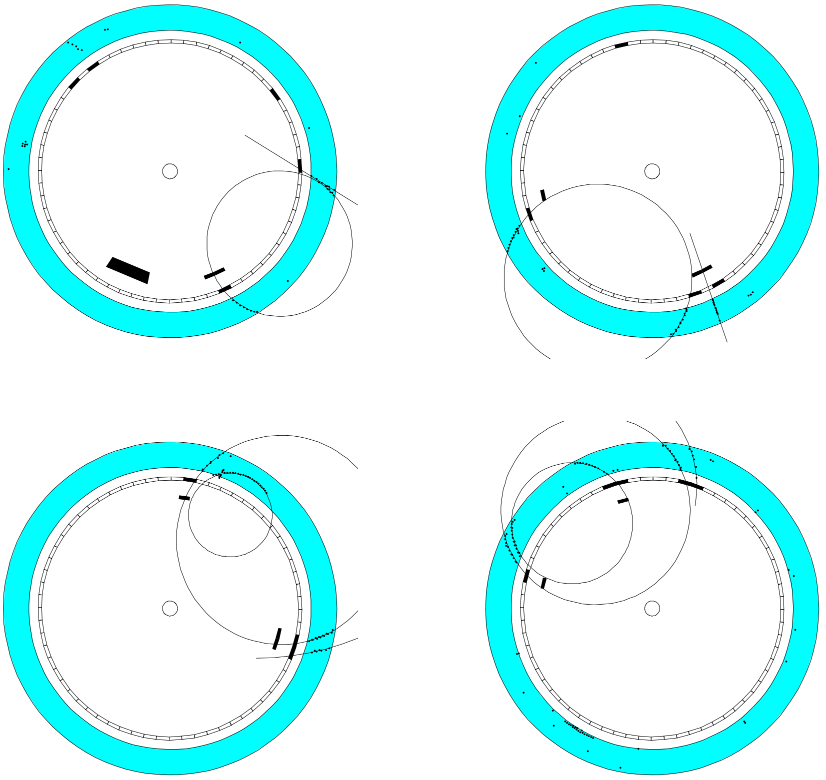
rate v.s. energy threshold for decay of muonic gold

threshold (MeV)	partial rate
70	1.72×10^{-5}
75	2.11×10^{-6}
80	1.64×10^{-7}
85	6.66×10^{-9}

Background processes

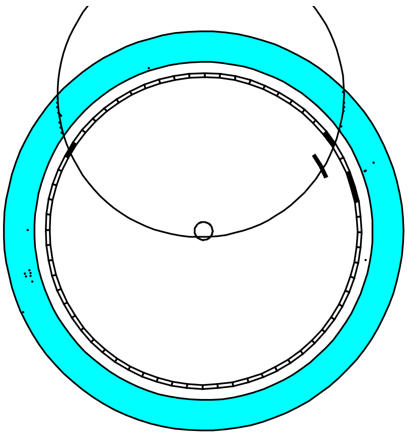
cosmic background

background2



Examples of cosmic background recognized by the track reconstruction.

These events do not enter the sample of contained events



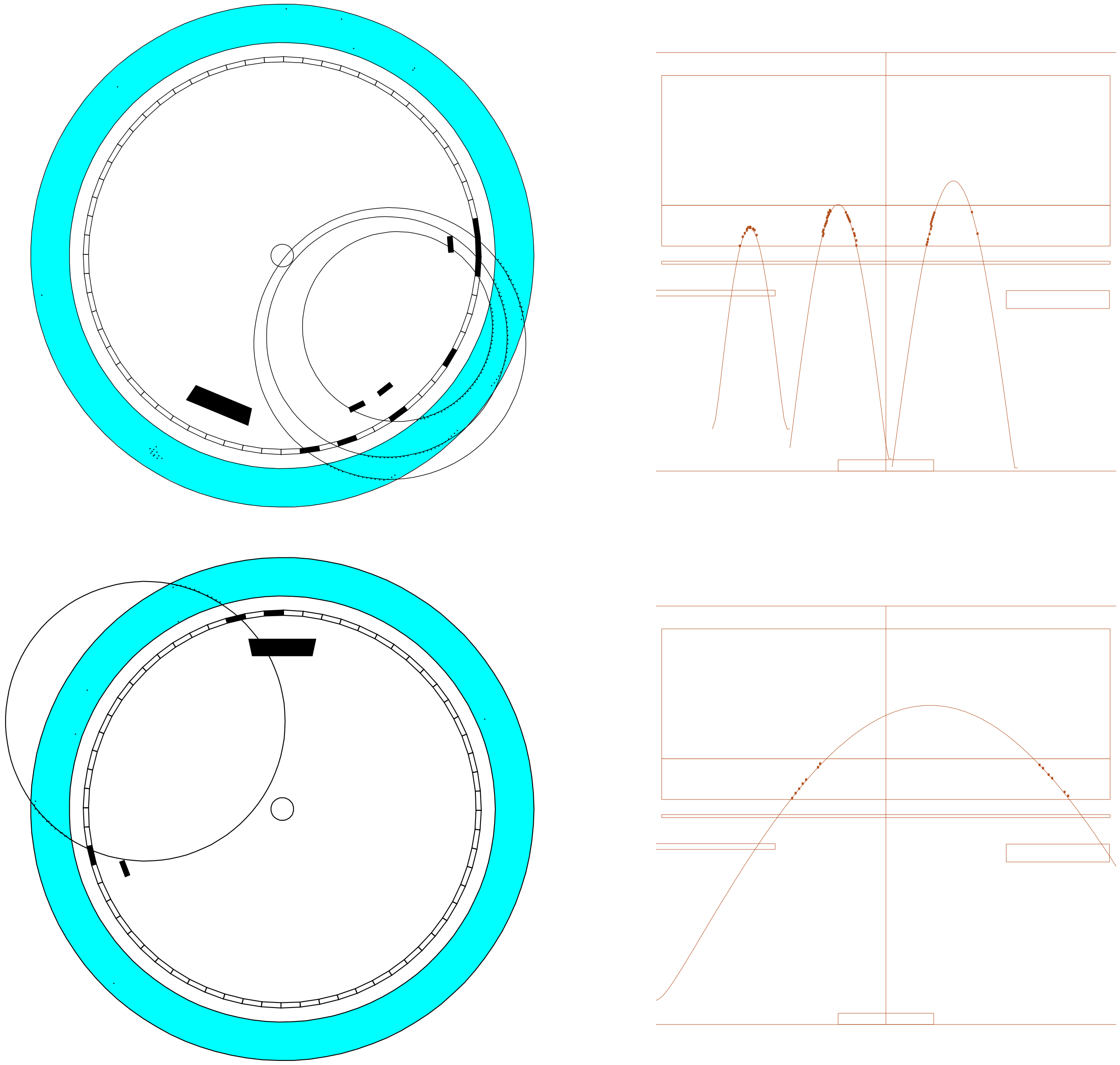
Cosmic background event recognized by the occurence of additional detector signals.

Such events do enter the sample of contained events

Background processes

cosmic background

background2



- these contained events are characterized by opposite end-cap signals

Conversion on gold

event selection