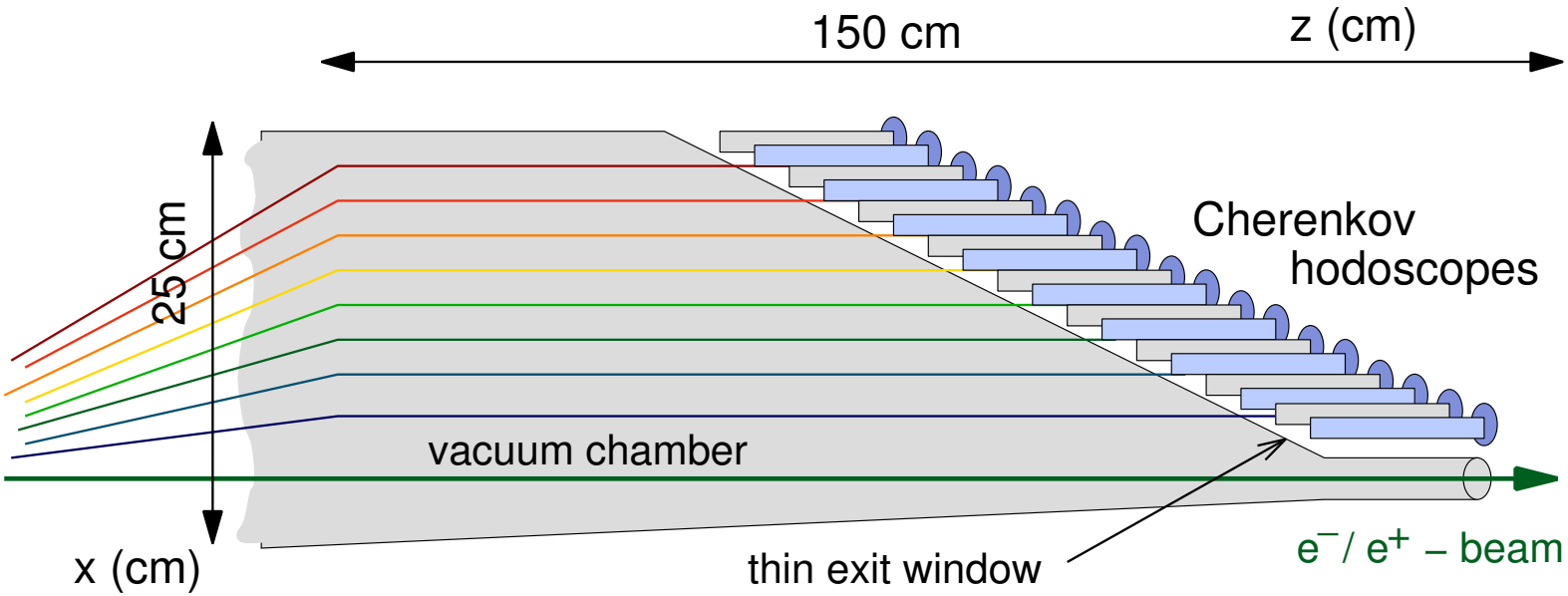
Polarimetry:
Prototype Design for the Cherenkov Detector

Daniela Käfer
daniela.kaefer@desy.de

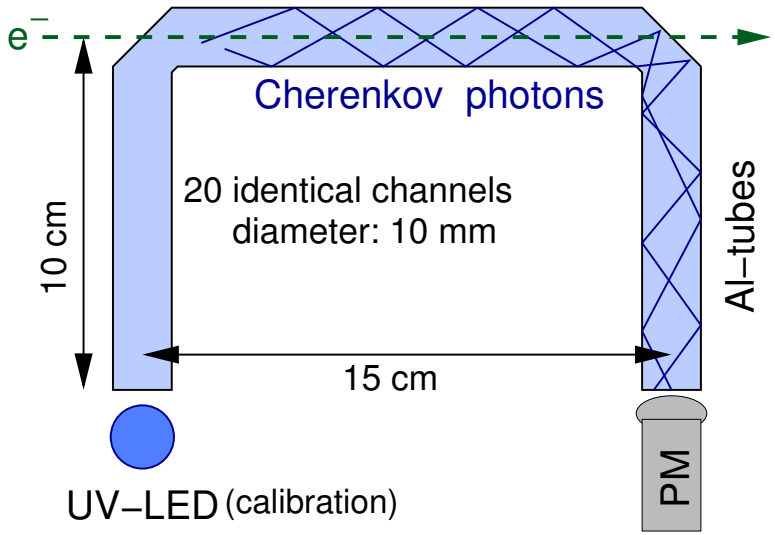
Workshop on Polarization and Energy Measurements
Berlin-Zeuthen – April 9-11, 2008

1. Cherenkov Detector Prototype
   - How does it look like?
   - Testbox: Concept & Prototype Design
2. Another Testbeam Period
   - Where? . . . and what for?
   - Planning the procedure
3. Summary & Outlook

Upstream Polarimeter: Cherenkov Hodoscope



- scatter & deflect $\approx 10^3$ electrons/bunch
- the Compton edge is always at the same spot in the Cherenkov detector
- spectra are indep. of beam energy



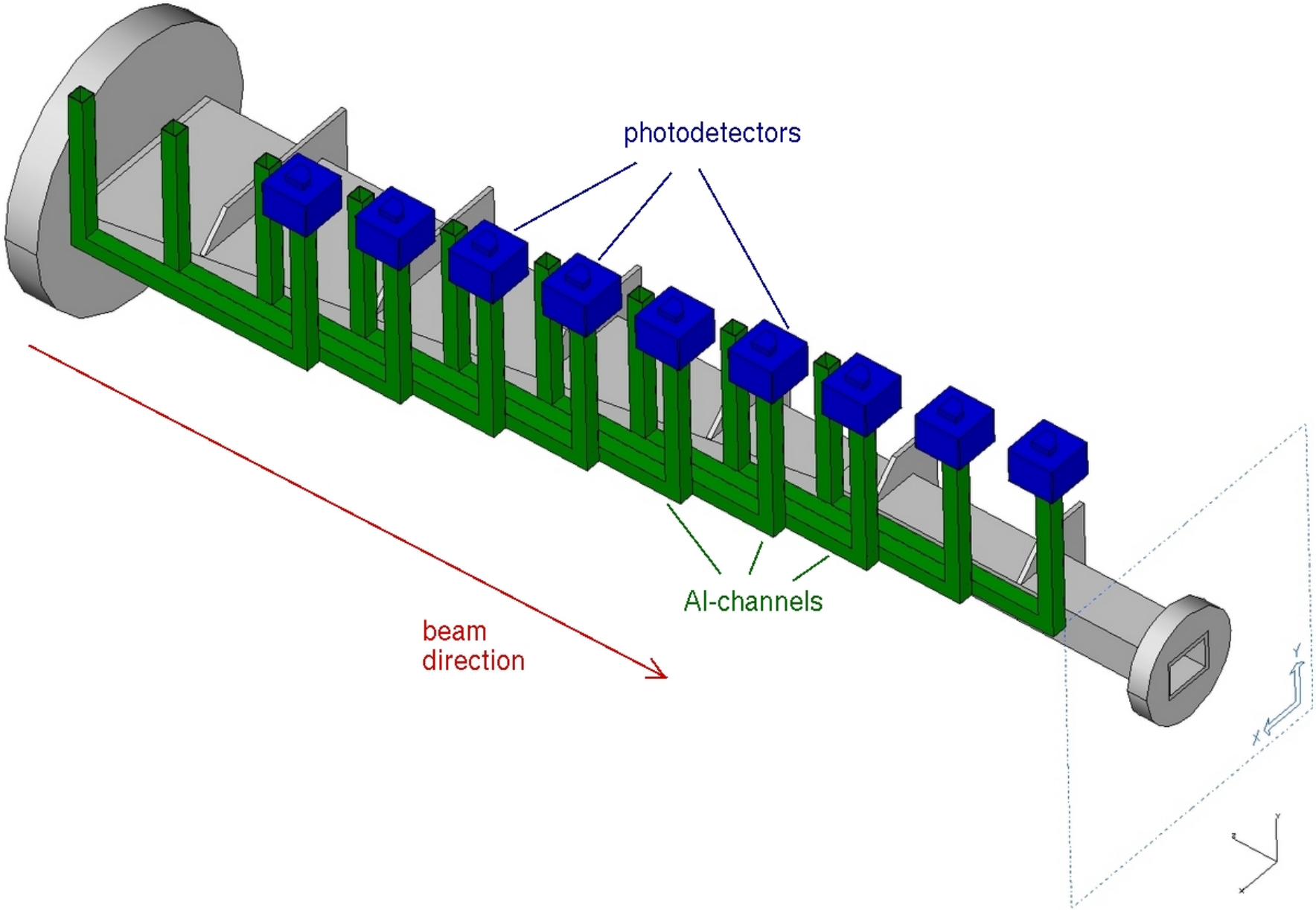
The Cherenkov Detector I

How it could look like in the ILC:

- beam stay clear of 2 cm of the beam pipe
- tapered beam pipe with thin exit-window to avoid the creation of wake fields as much as possible . . .
- staggered aluminum channels (U-shaped pipes)
  - ⋆ one end occupied by an LED for calibration purposes
  - ⋆ the other end equipped with a photodetector
- each aluminum channel equipped with its own gas system

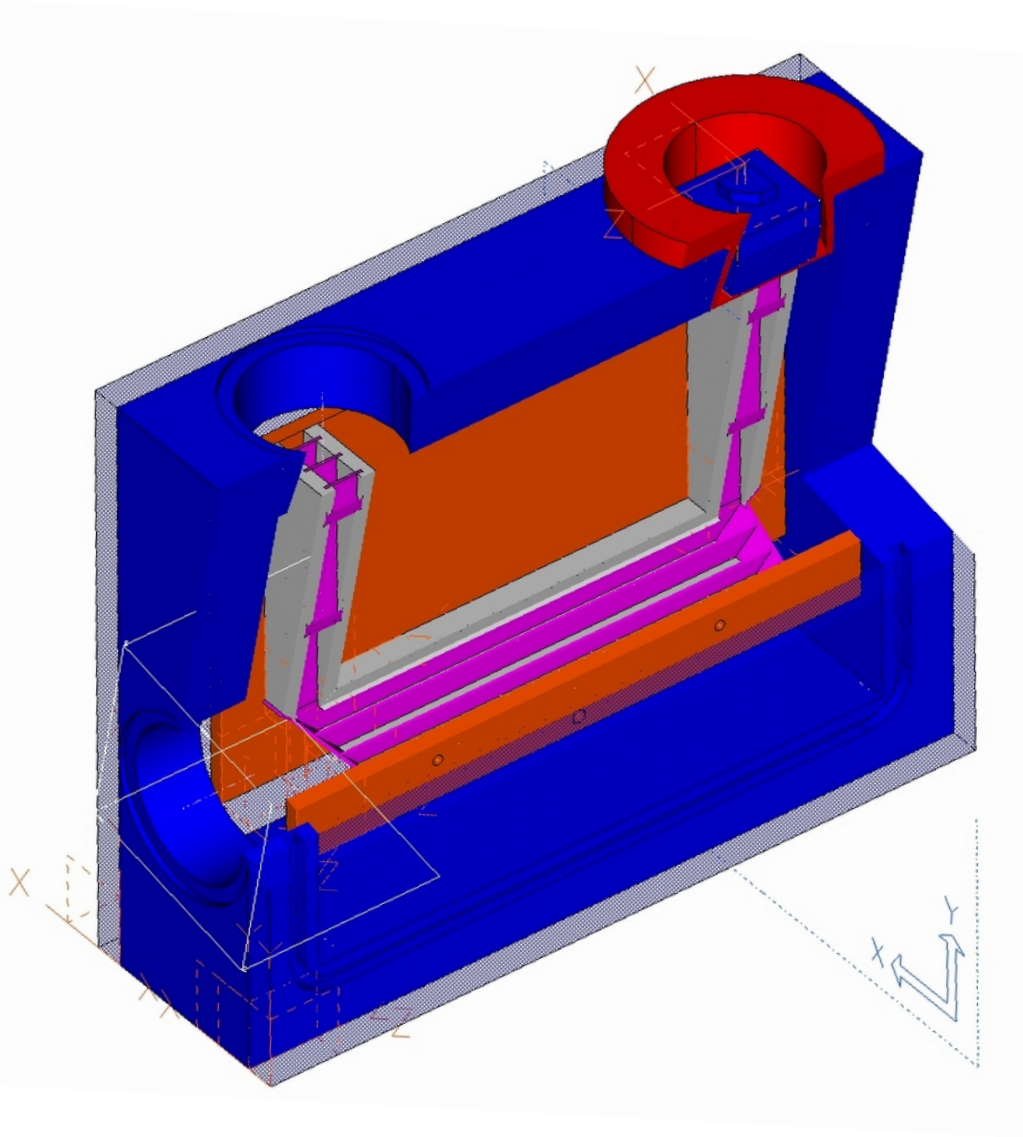
  (still needs a lot of design & engineering work)

The Cherenkov Detector II



Testbox: Concept & Design

- aluminum box with two channels
- thin walls of 0.5 mm
  (maybe even 0.3 mm)
- thin entrance (and exit) window
- flanges for a calibration system
  (LED-housing or laser)
  and for photodetector modules
  (quick & easy exchange)
- entire box flooded with gas
  (most likely: C_4F_{10})
- thin bottom side ($\approx$ 1 cm)
  for setup @ELSA in Bonn . . .



. . . want Testbox with 3 Channels

Why three channels & two flanges? . . . to study:

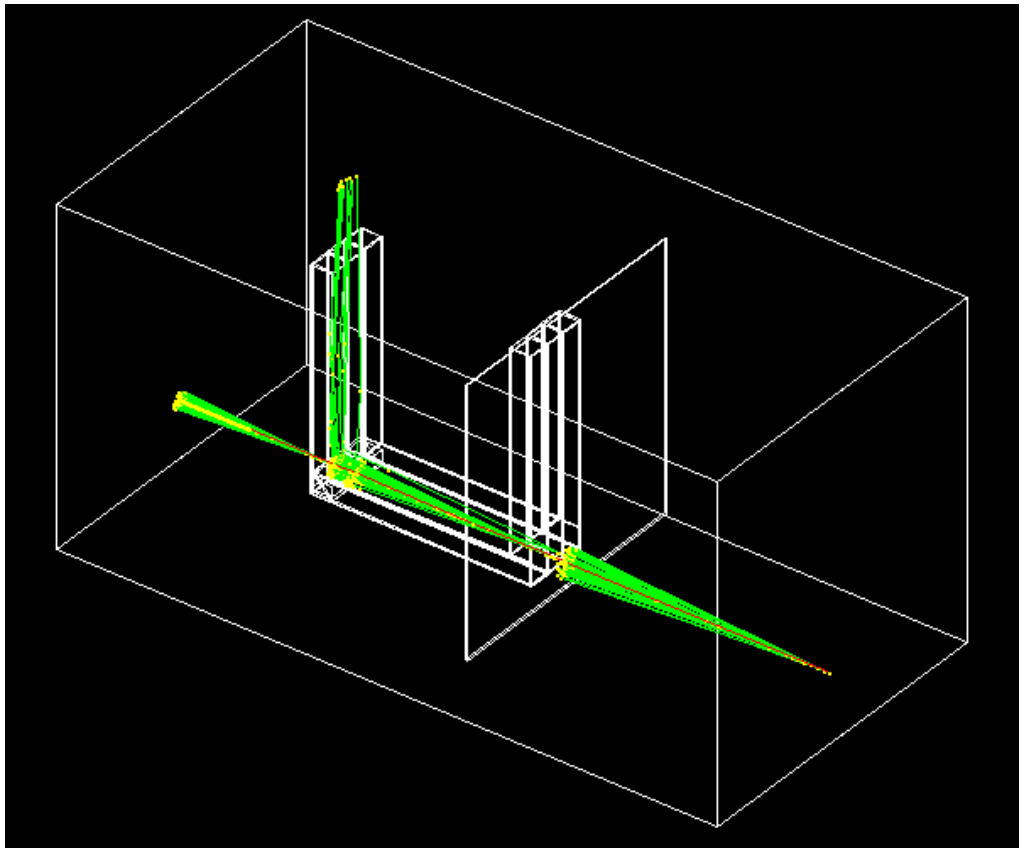
- different photodetectors at once
- crosstalk between channels
- different readout modes, depending on photodetectors, e.g. multianode photodetectors (see talk by C. Helebrant)
- different calibration systems, i.e. either via LED- or laser-light (housing or thin throughput window)
- effect of wall thickness / beam spread . . .

Some Simulated Events I

Simulation of the testbox:

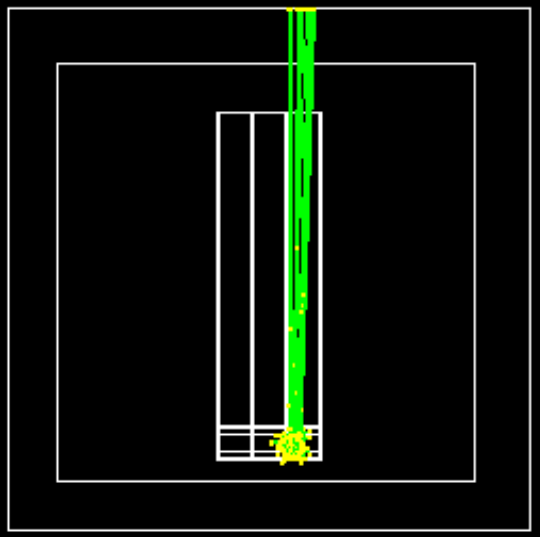
- 3 channels of polished aluminum
- thin entrance window (Al so far, might be changed)
- the photodetectors are not simulated in GEANT;

  choose a modular setup (e.g. ROOT macros) to be able to quickly exchange different photodetectors

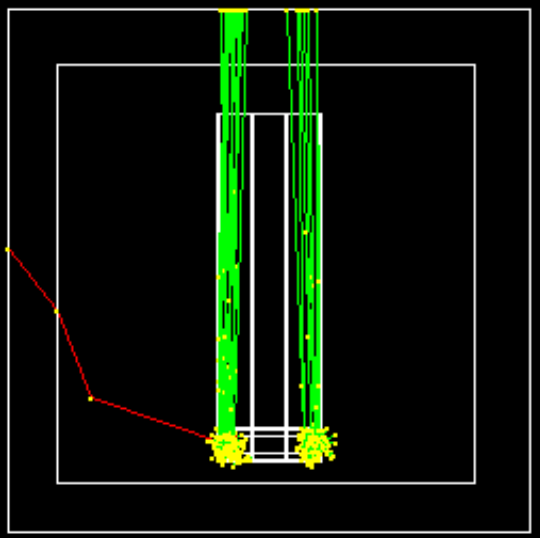


vacuum chamber filled with C_4F_{10}

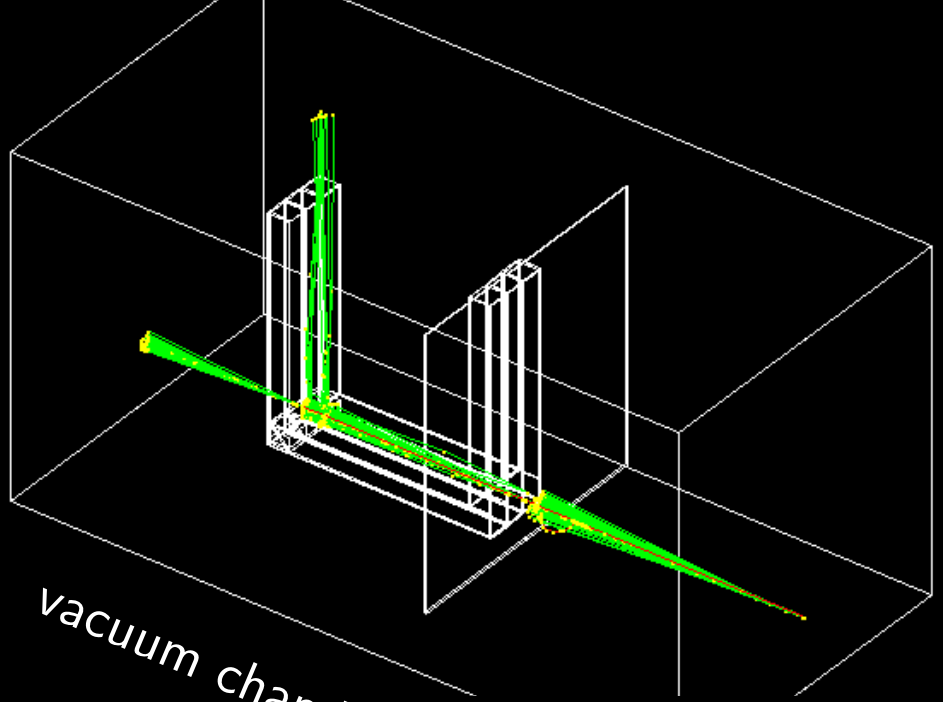
Some Simulated Events II



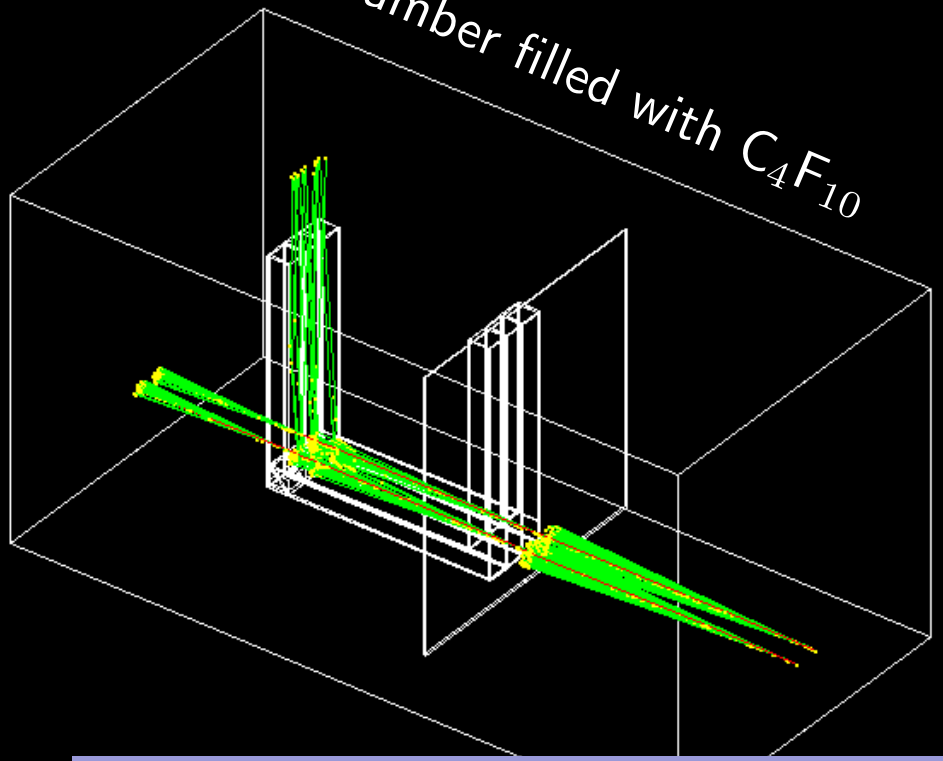
one e^- incident



two e^- incident

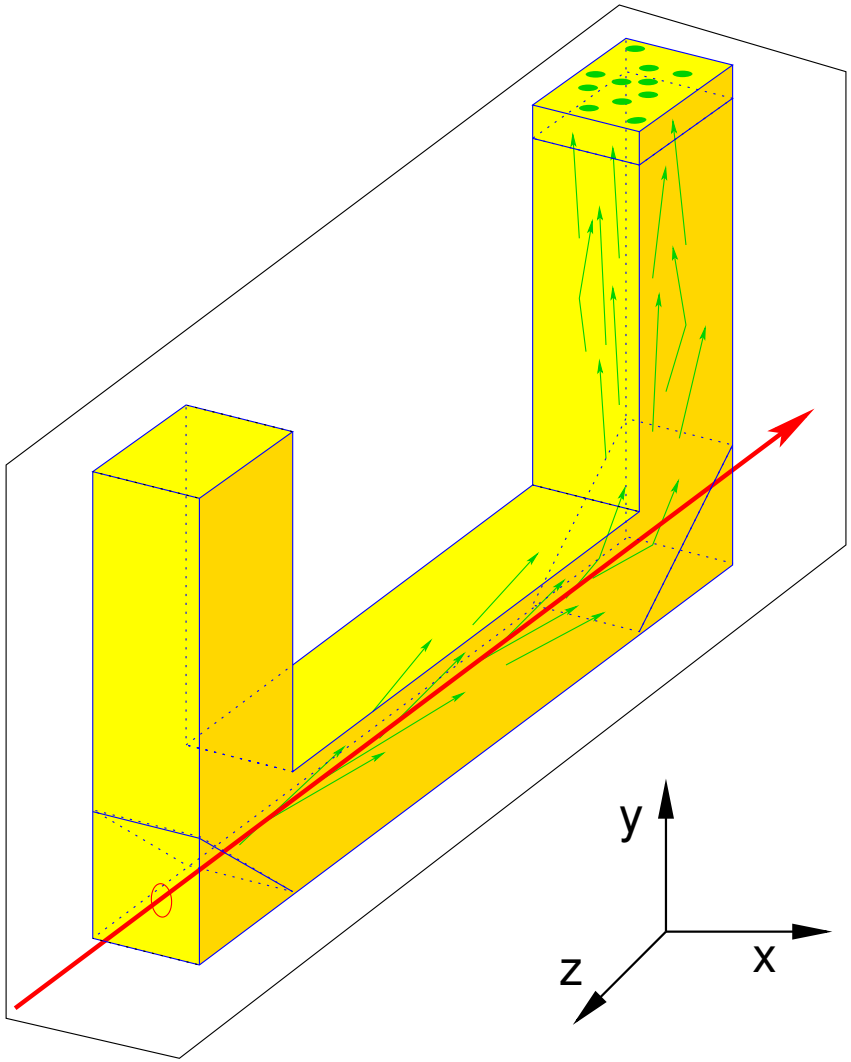


vacuum chamber filled with C_4F_{10}



Advantages of U-shaped Channels I

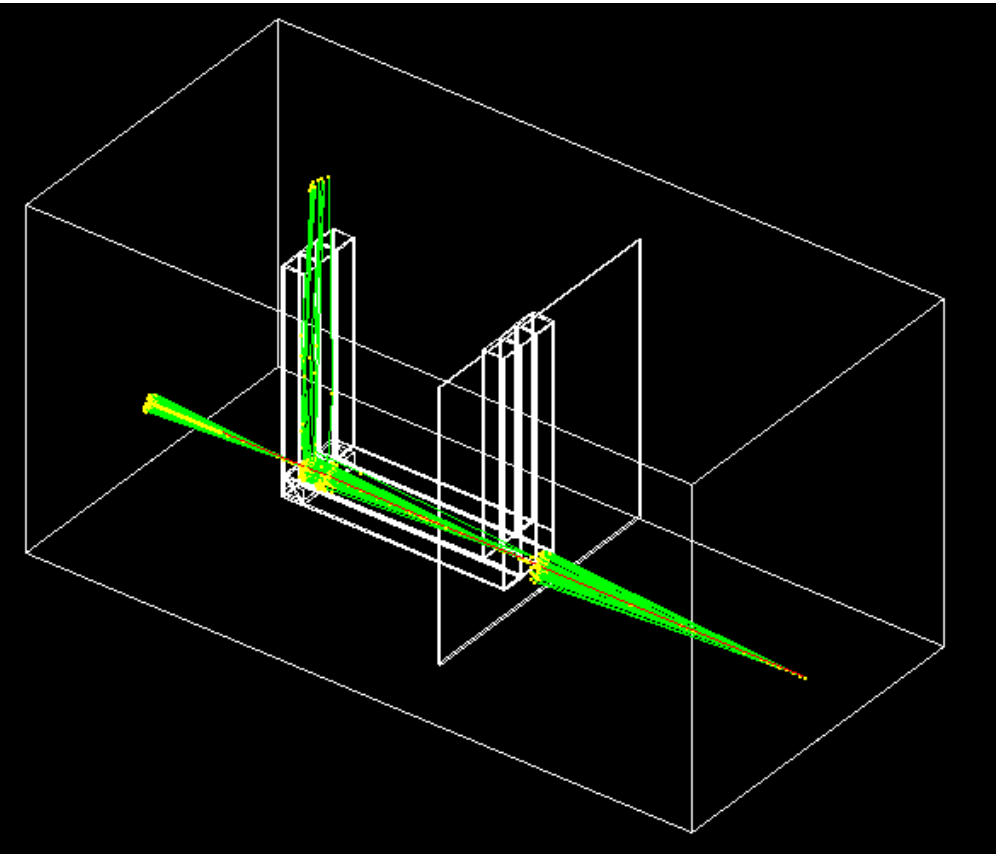
- no synchtroton radiation incident on the photodetectors
- no (or much less) crosstalk between different channels (compared to a layout in the x/z-plane)
- only $\approx$ 2-3 reflections
  $\longrightarrow$ reflectivity does not have to be extremely good (e.g. 92-94% sufficient)

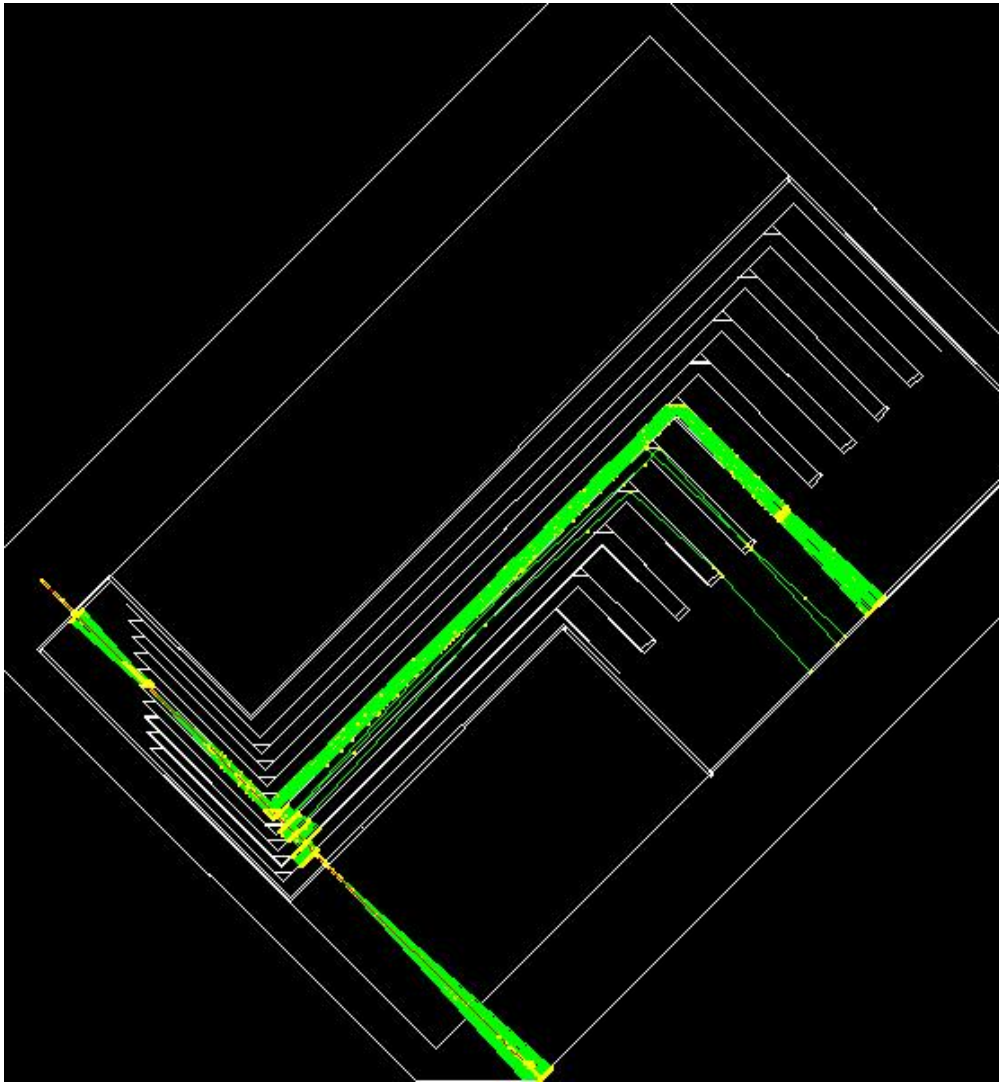


Advantages of U-shaped Channels II

Comparison: U-shaped testbox versus planar SLD-layout

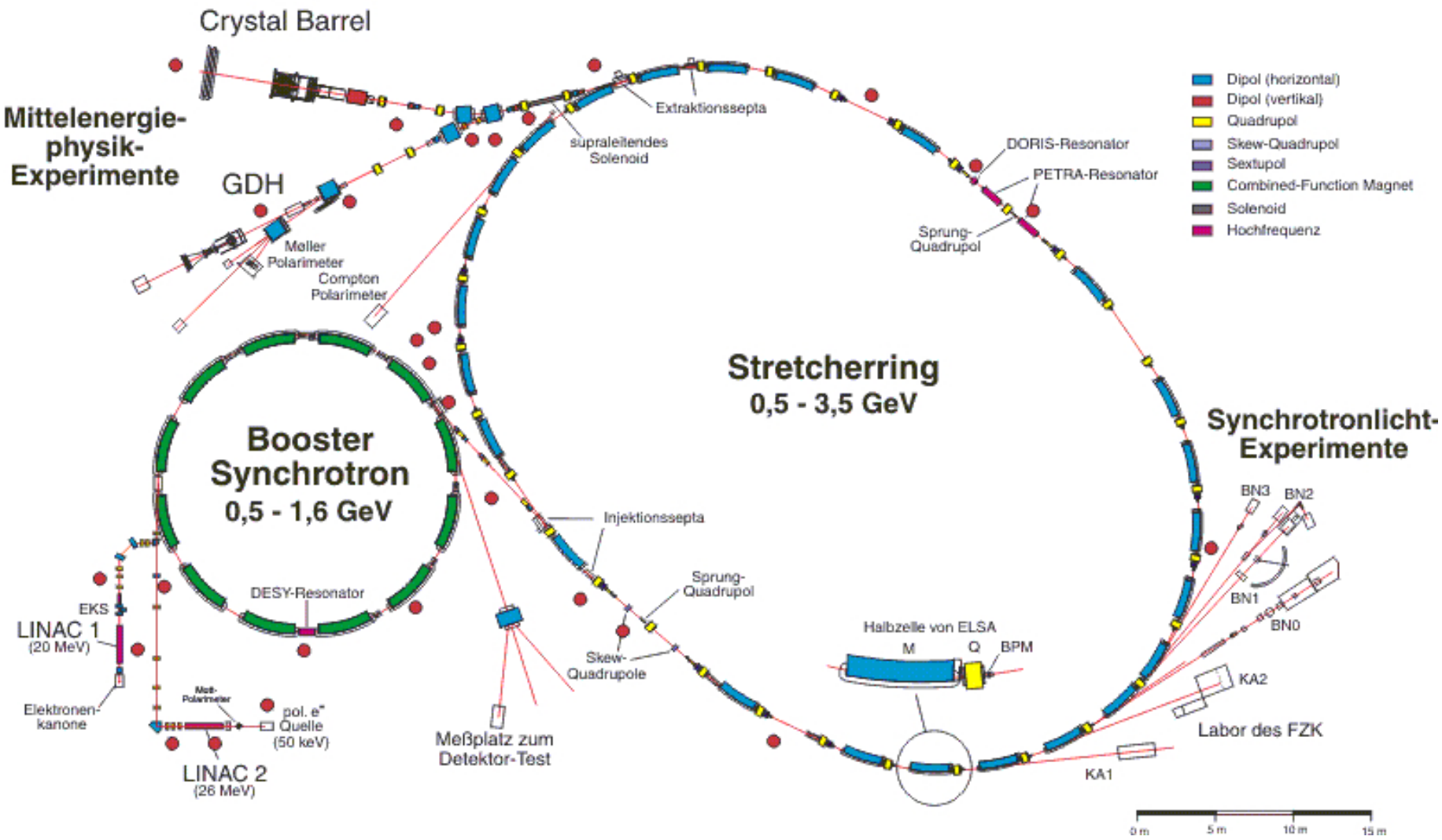
⇒ no, or at least, largely reduced crosstalk !





Testbeam at ELSA

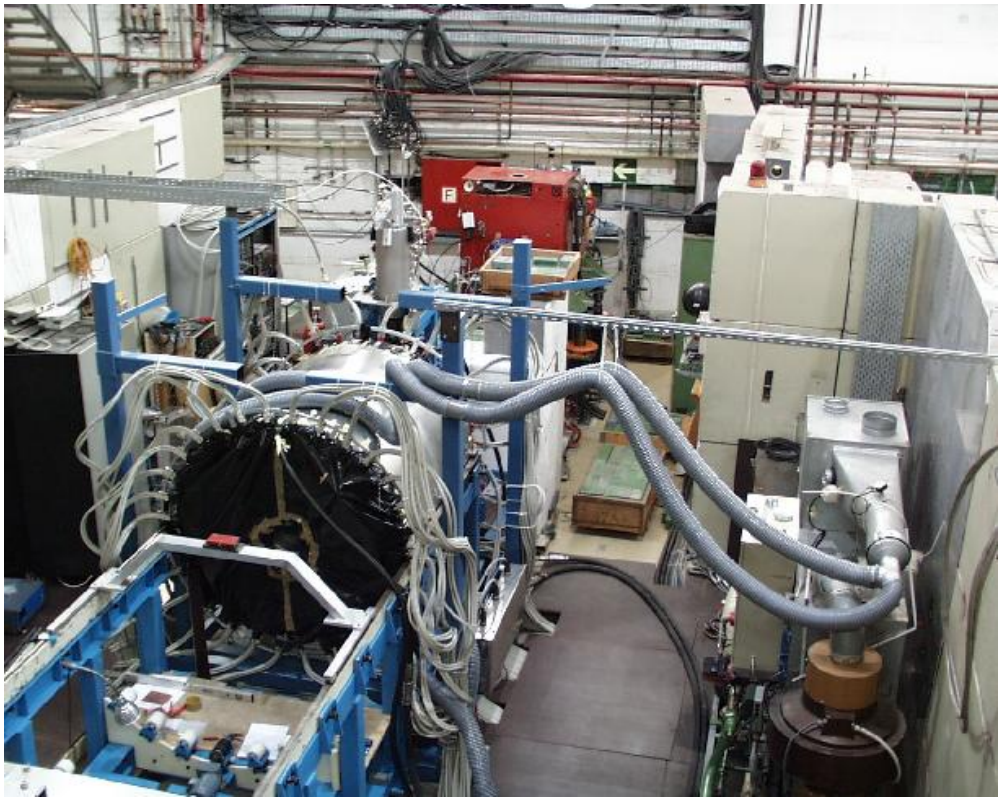
ELSA: Elektronen-Stretcher-Anlage



View of the ELSA experimental area

Why @ ELSA ?

- because the DESY-testbeam is terciary → very low rate, only single electrons
- @ELSA: higher rates (10-100 nA, maybe 1000 nA)
- more electrons, not just single electron events
- but energy still only about 3 to 3.5 GeV
- will do thorough simulation studies & LED-tests before moving the testbox to ELSA.



Possible Testbeam Setup

Might operate parasitic to other testbeam users...

- but need new/different beam dump @ ELSA
- probable placement right after beam extraction
- parasitic user due to small size of the actual testbox
- When? - early next year (winter/spring 2009)

Testbox Setup & Support

To allow parasitic testbeam time together with other experiments:

- install testbox right after the beam extraction
  (on top of a block of concrete, where the electron beam is bent down and dumped when a photon beam is used afterwards)
- thus: need very flat support table
  (movable in x- and y-direcions)
- thin entrance and exit windows to reduce beam scatter and synchrotron radiation (radiation safety issues)

Summary & Outlook

Summary & Outlook

- Conceptual design for the testbox is ongoing
- Testbox construction planning has also started
  (will most likely be built using resources at Uni-HH)
- Simulation studies of testbox and ILC-prototype are ongoing
- Proposal for testbeam time (schedule) @ELSA written
  (hoping to hear some good news soon)