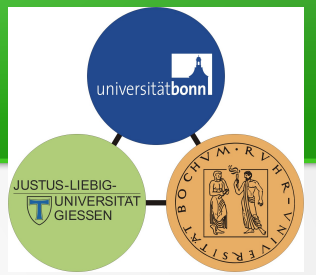

A Compton Polarimeter for ELSA

Rebecca Koop

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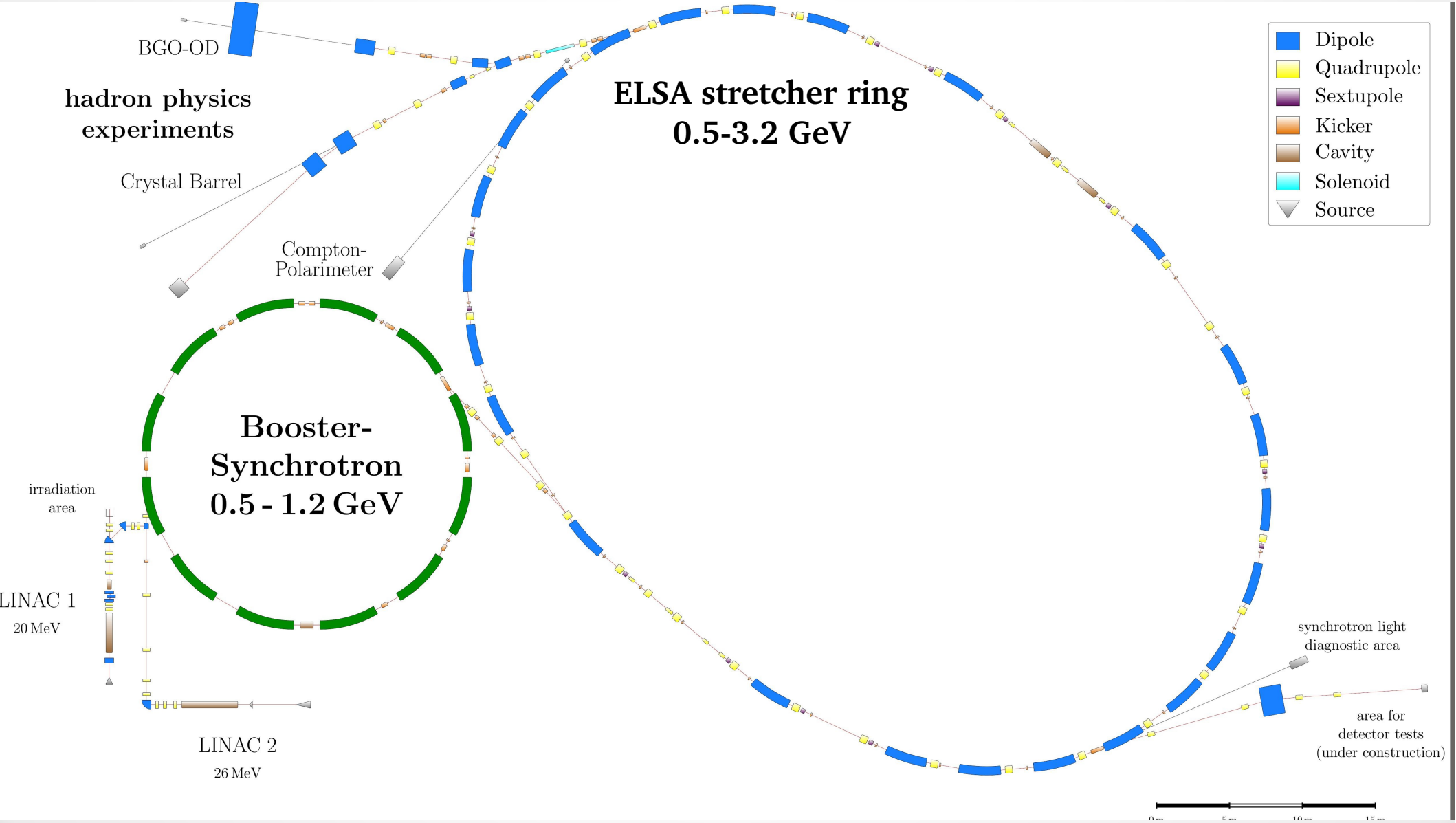
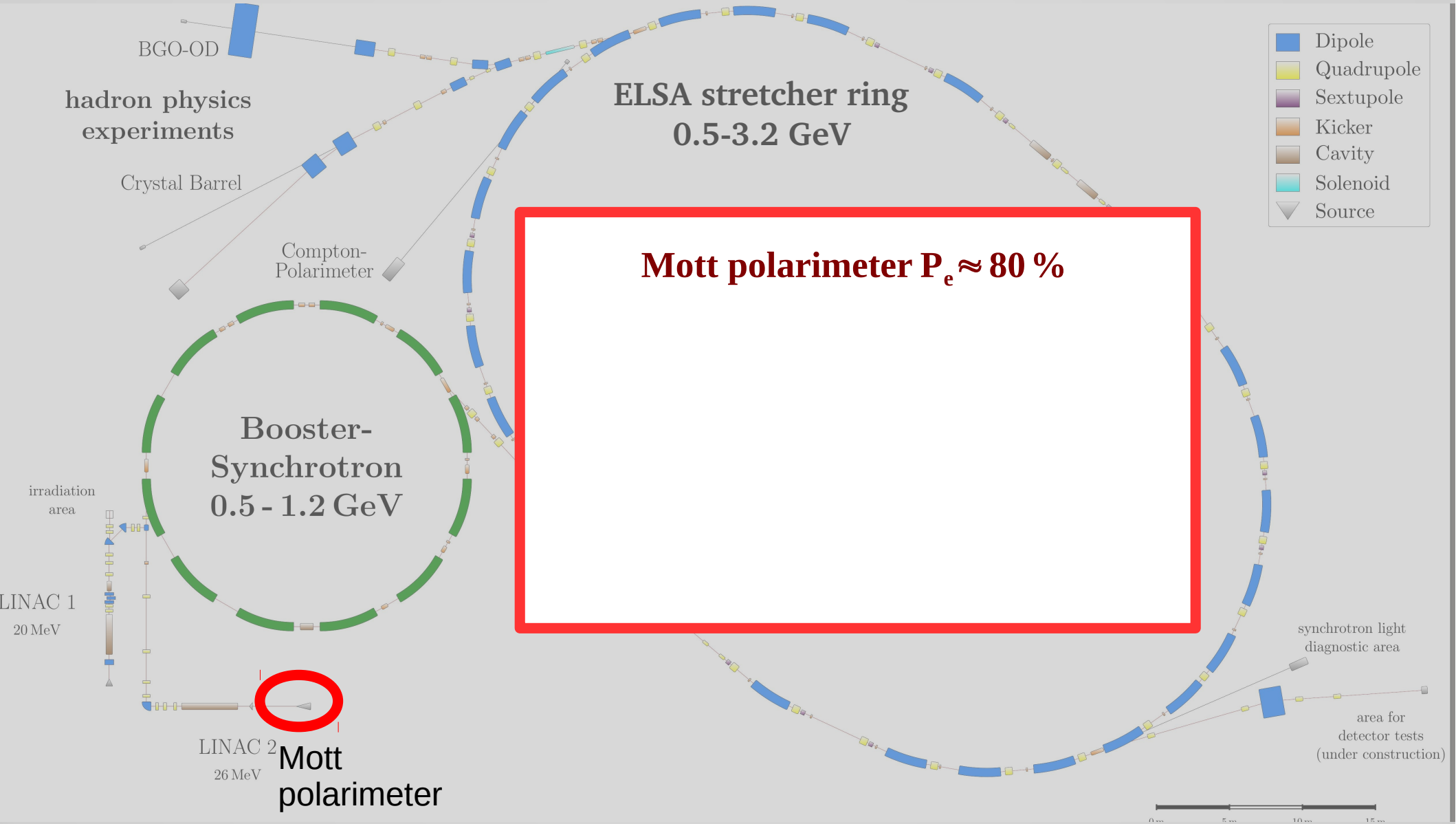
universitätbonn

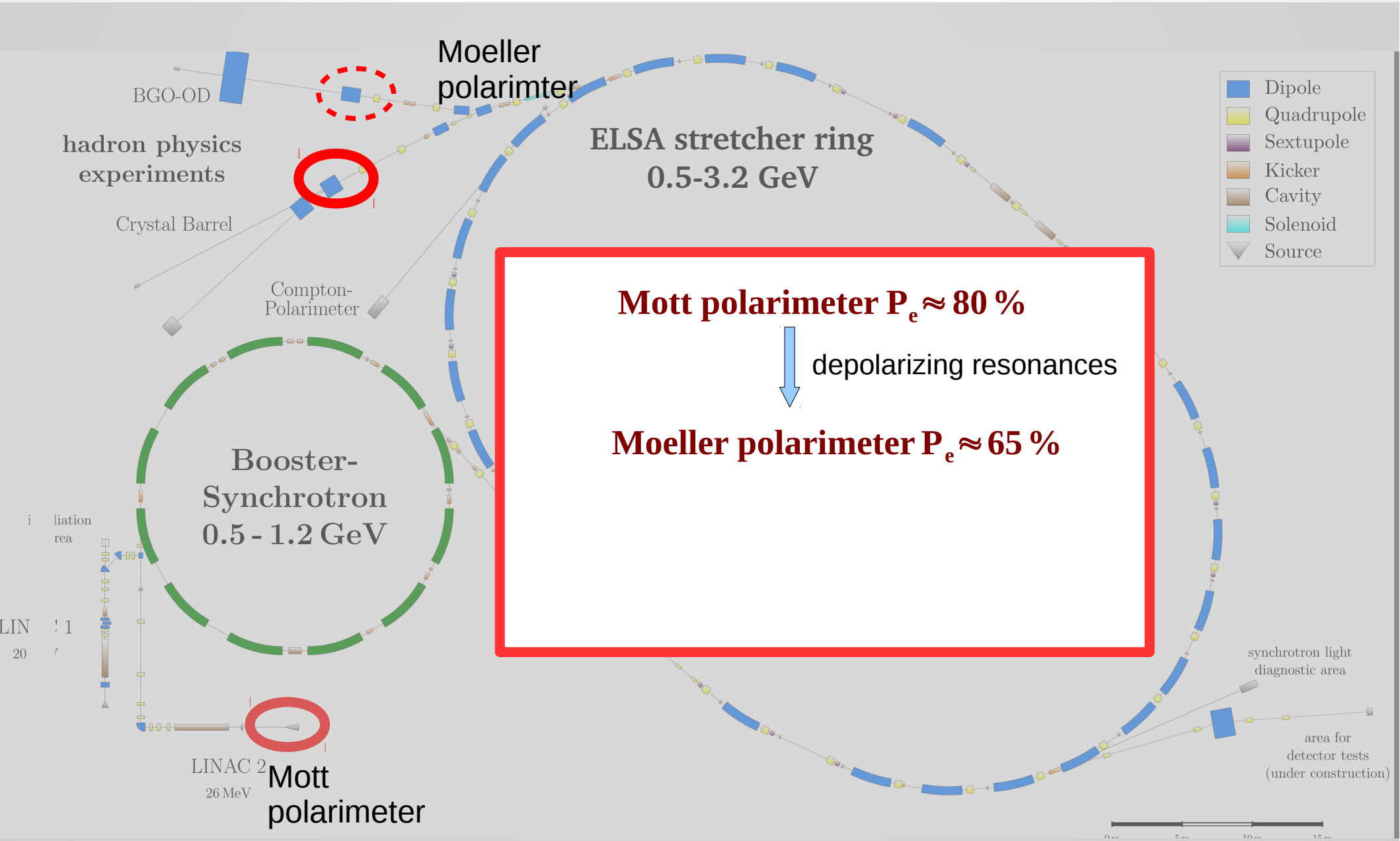
Electron Stretcher Facility ELSA



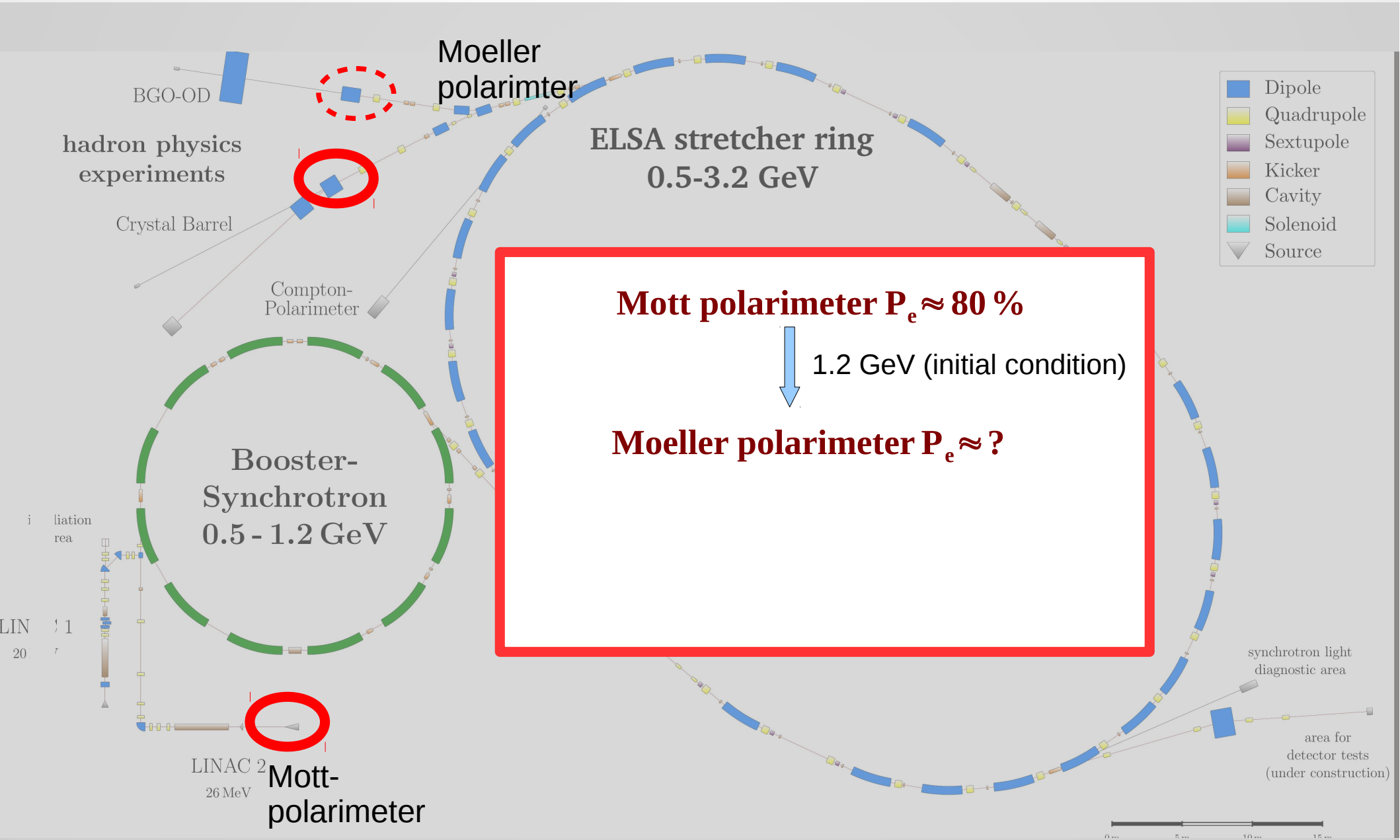
Motivation for Compton Polarimetry



Motivation for Compton Polarimetry



Motivation for Compton Polarimetry

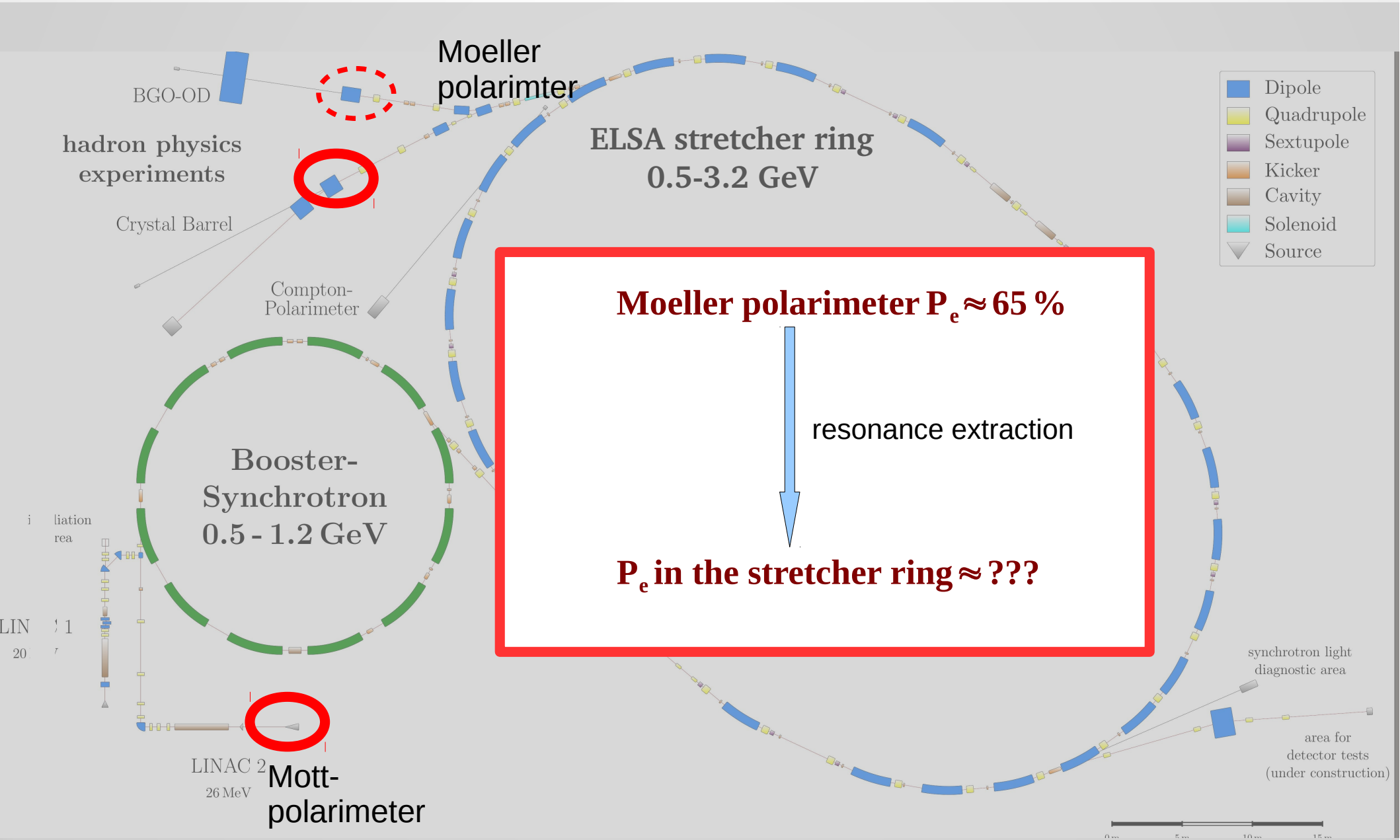


Mott polarimeter $P_e \approx 80\ \%$

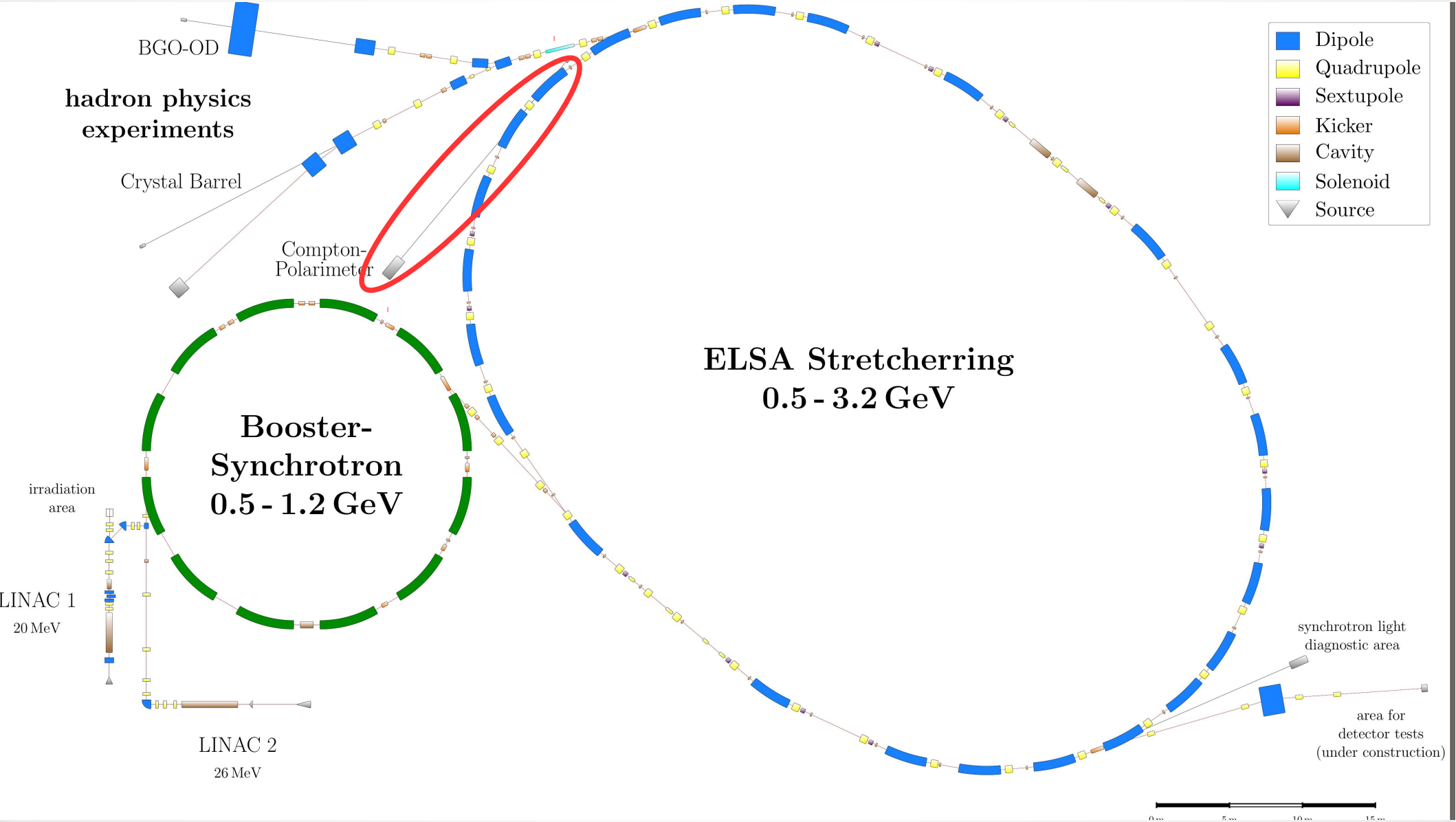
↓ 1.2 GeV (initial condition)

Moeller polarimeter $P_e \approx ?$

Motivation for Compton Polarimetry



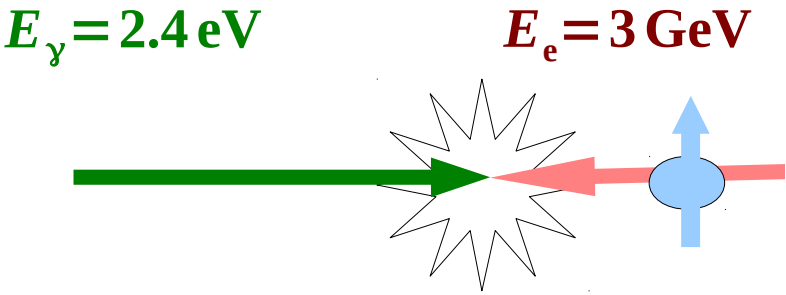
Motivation for Compton Polarimetry



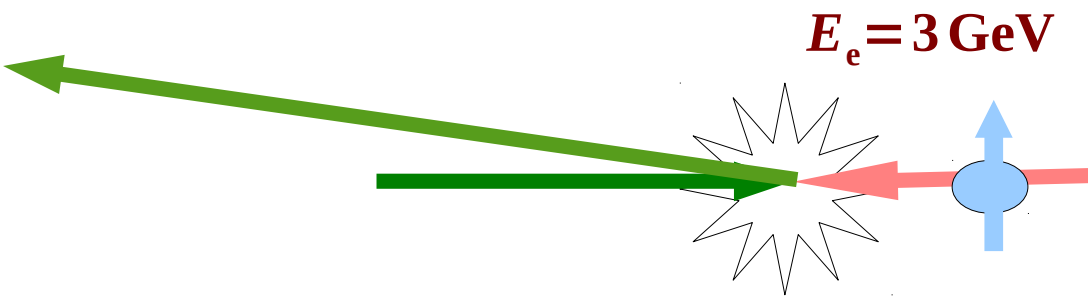
Compton-Scattering for Polarimetry

$E_\gamma = 2.4\,\mathrm{eV}$

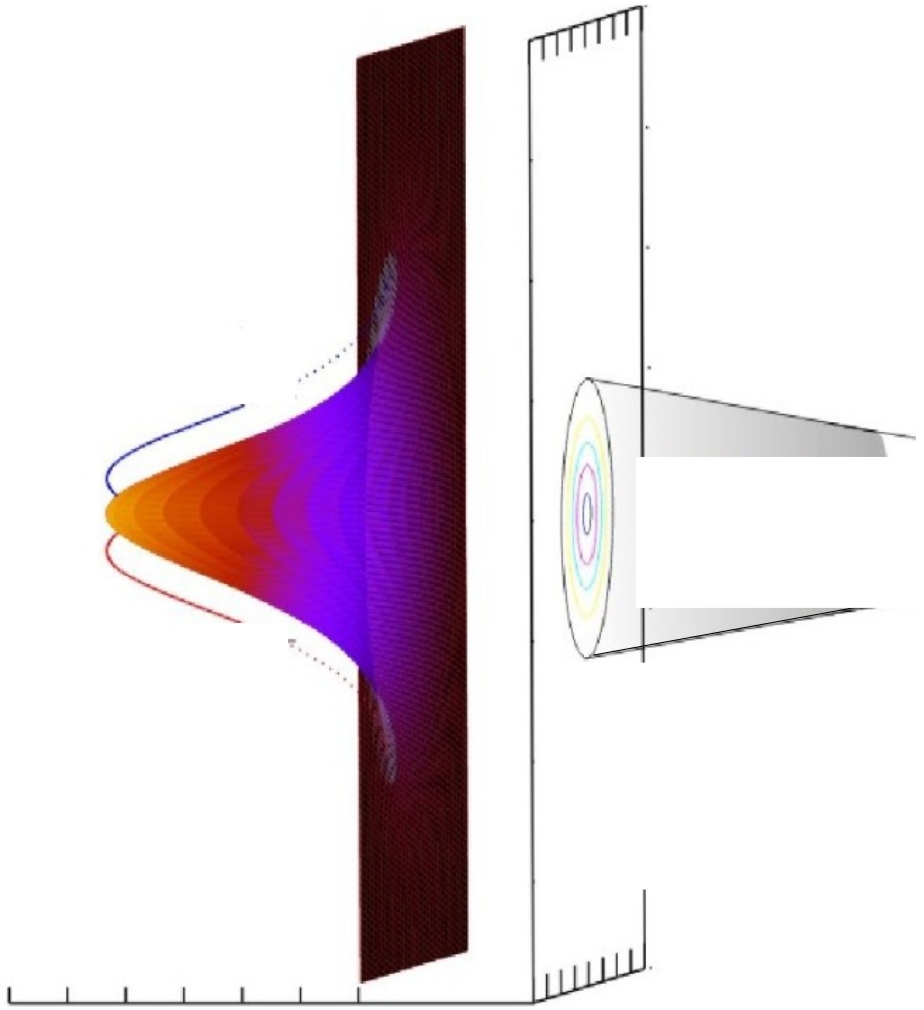
Compton-Scattering for Polarimetry

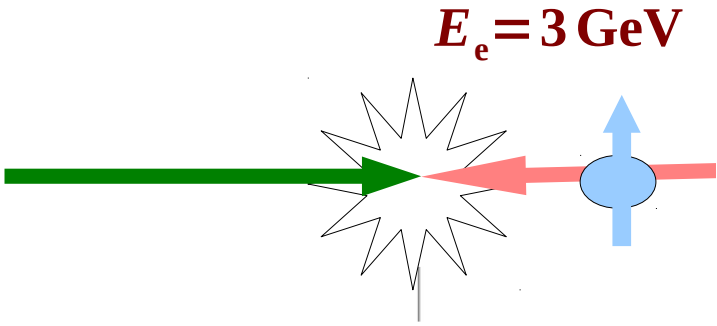


Compton-Scattering for Polarimetry



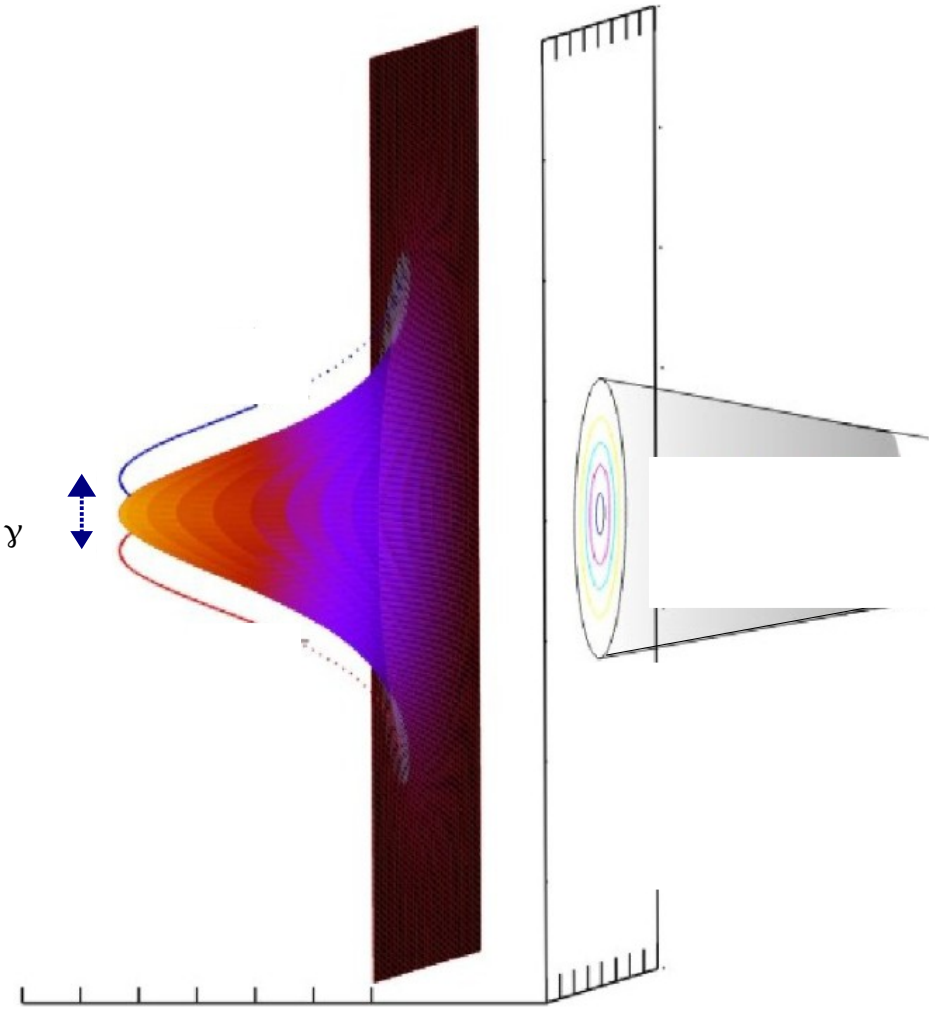
Compton-Scattering for Polarimetry



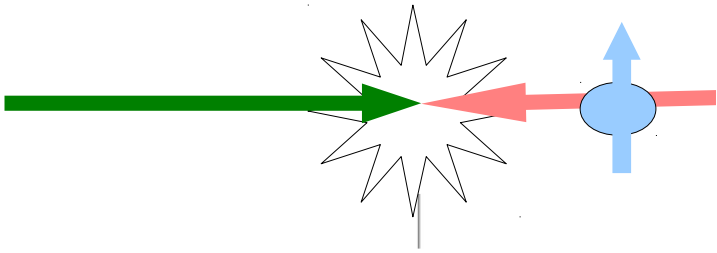


Compton-Scattering

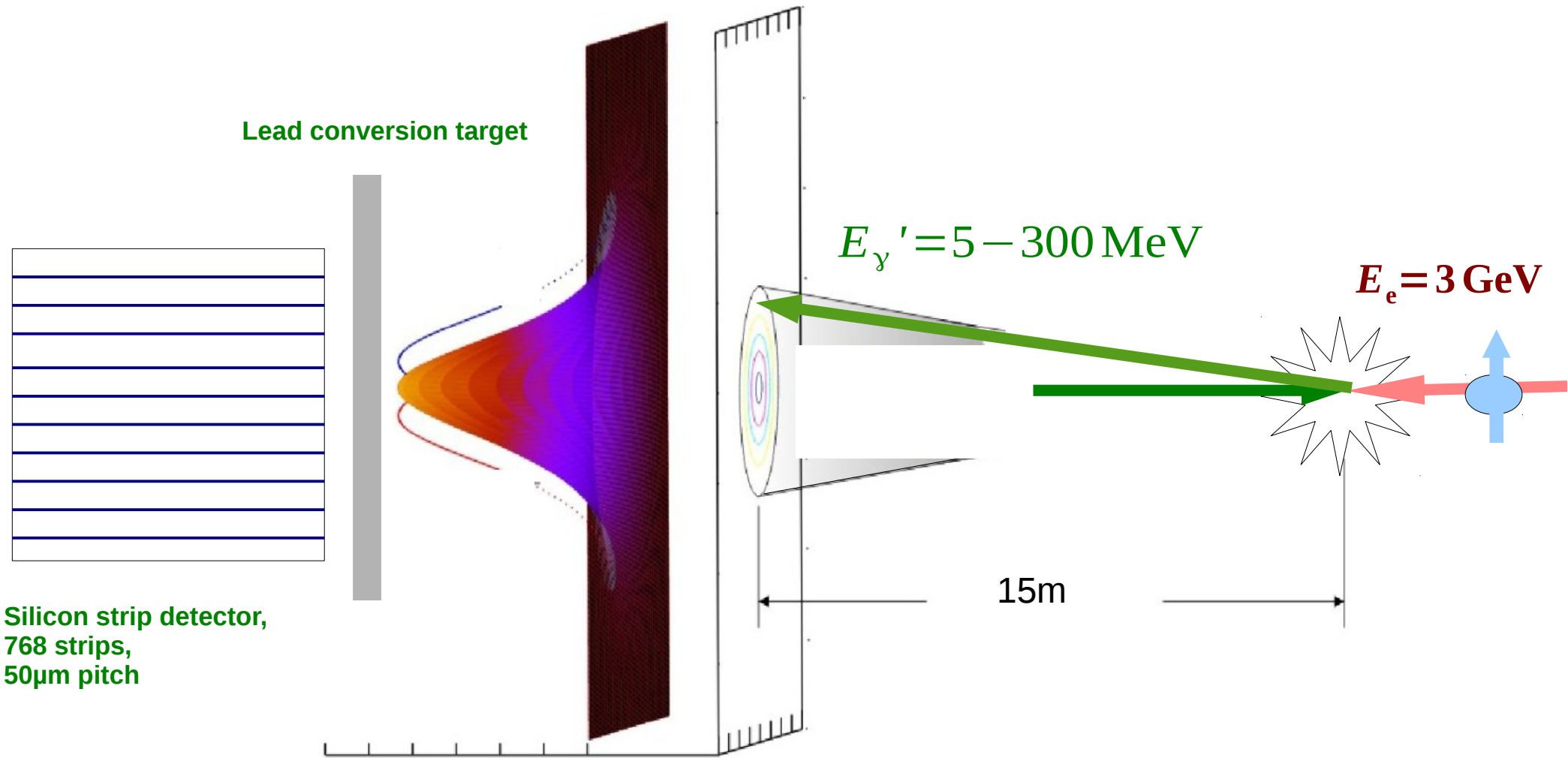
$\Delta \bar{x} \propto P_e P_\gamma$



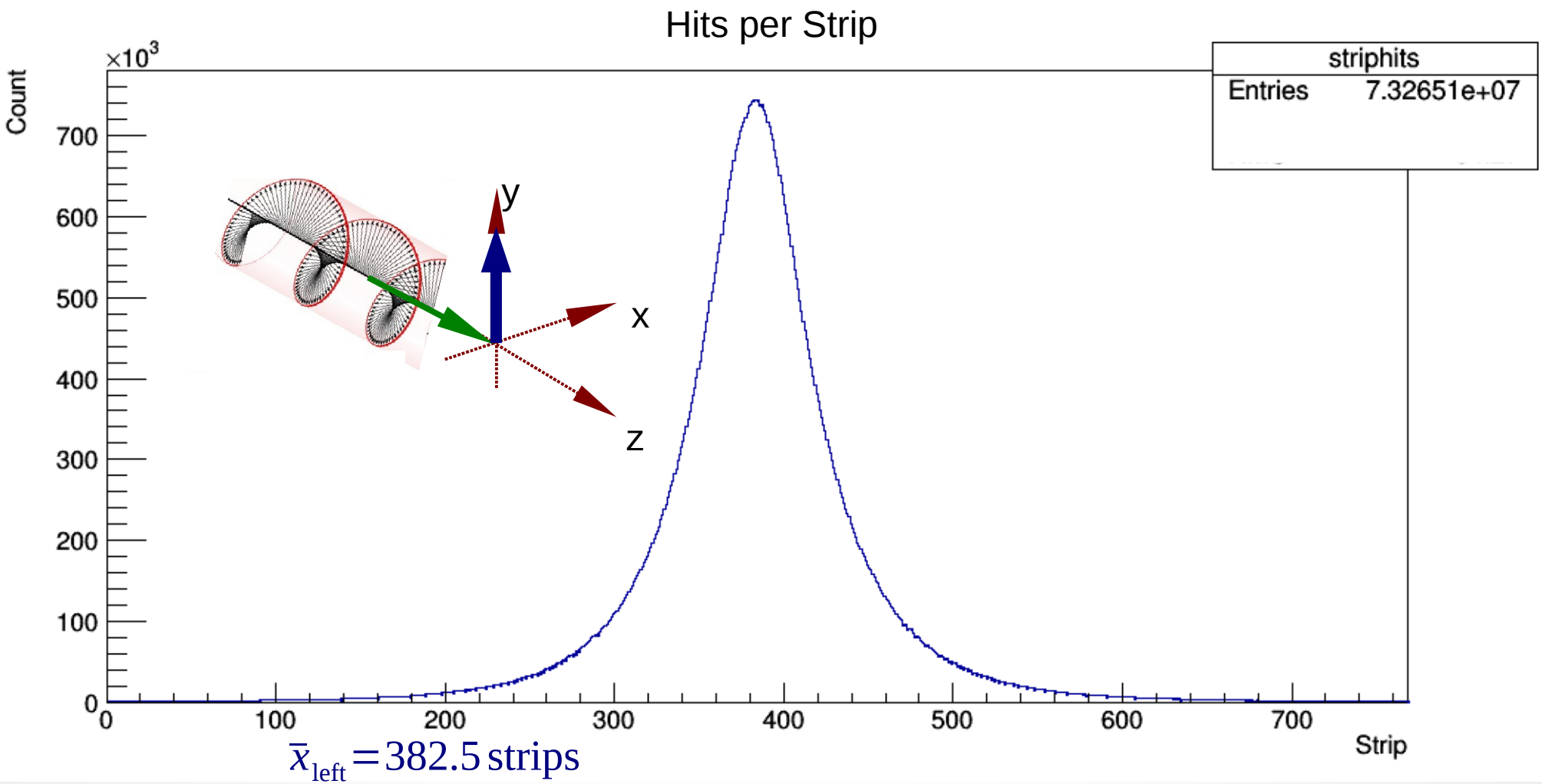
$E_e = 3\,\mathrm{GeV}$



Compton-Scattering

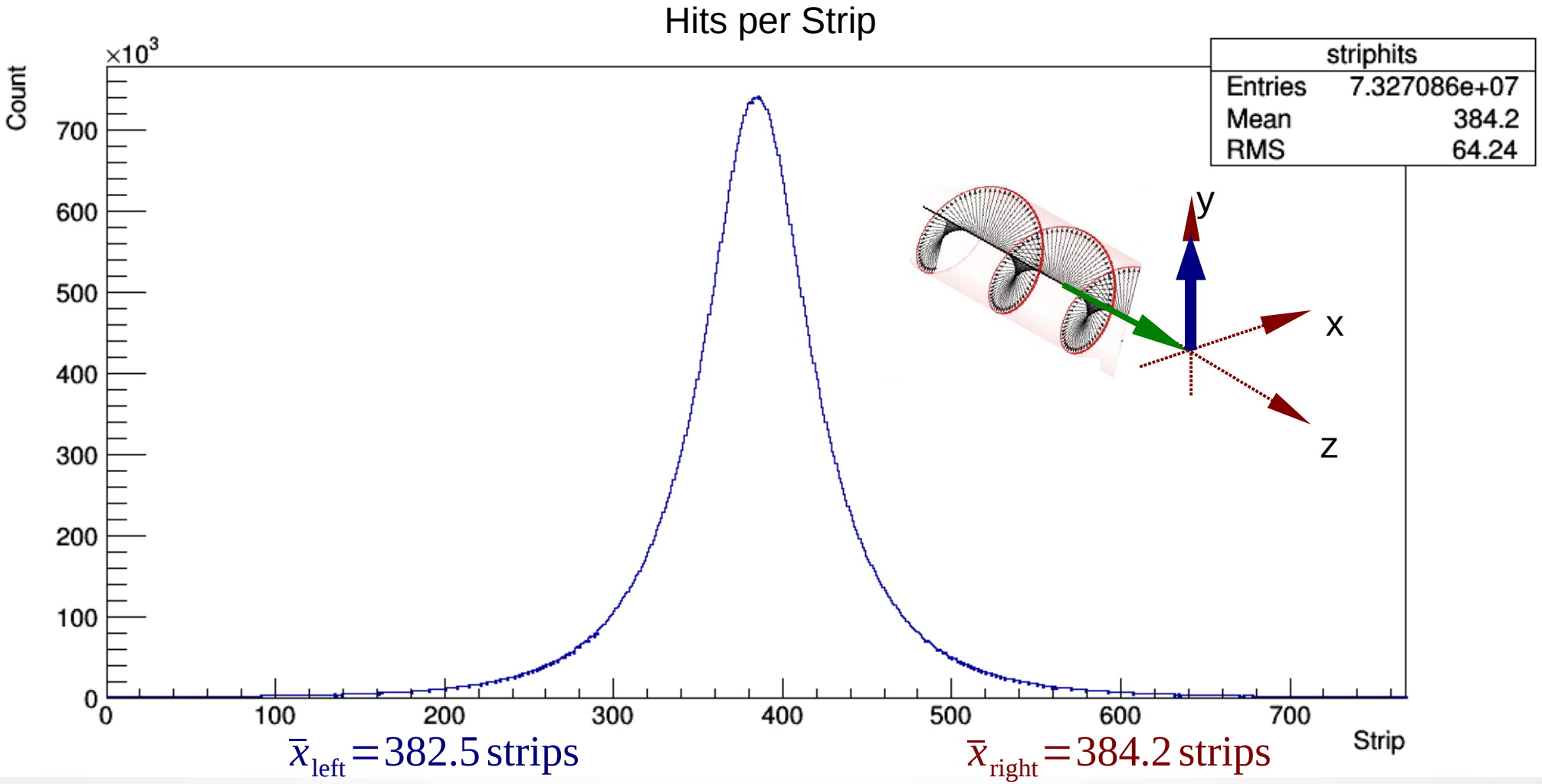


Geant4 Simulation

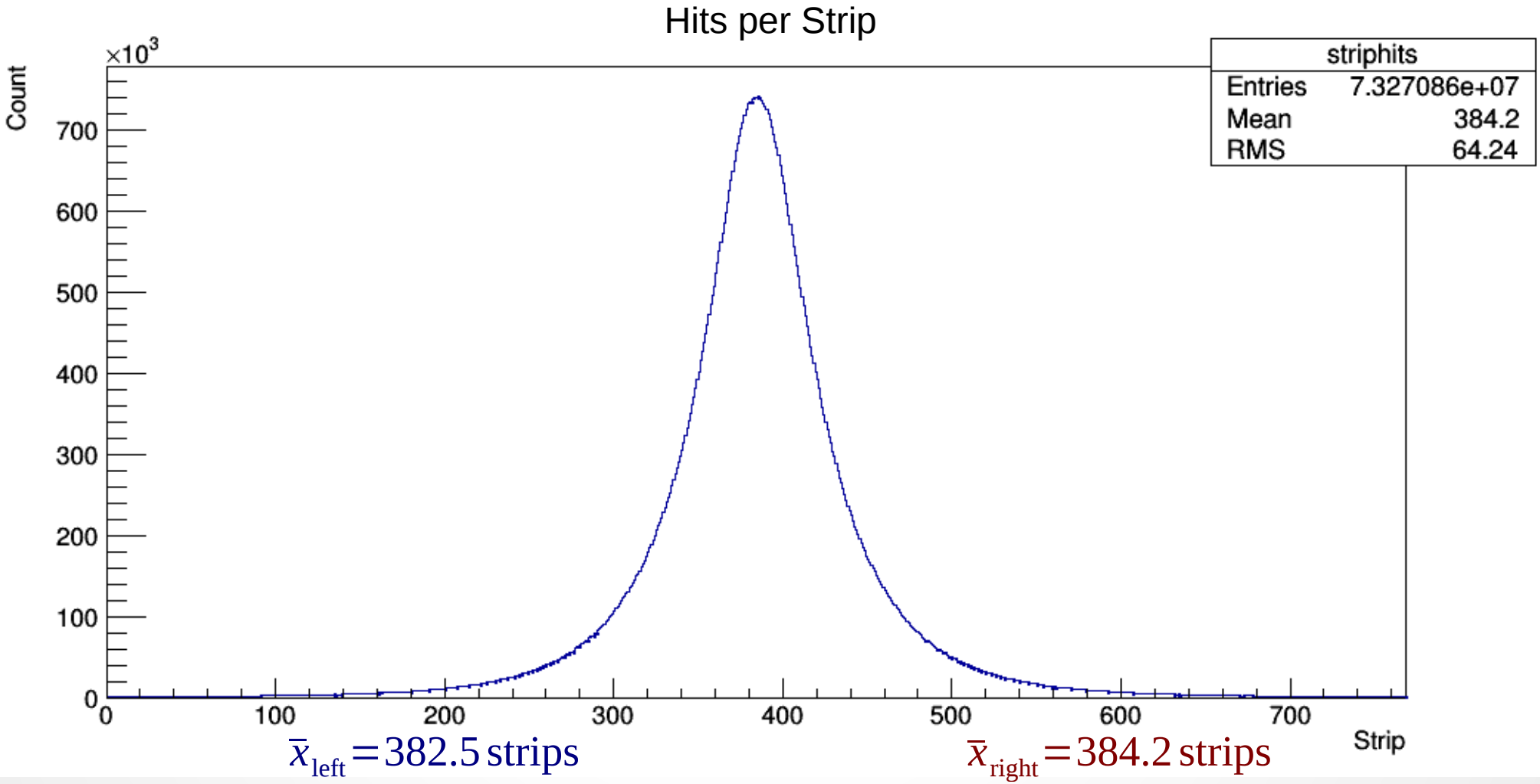


$\bar{x}_{\text{left}} = 382.5$ strips

Geant4 Simulation



Geant4 Simulation



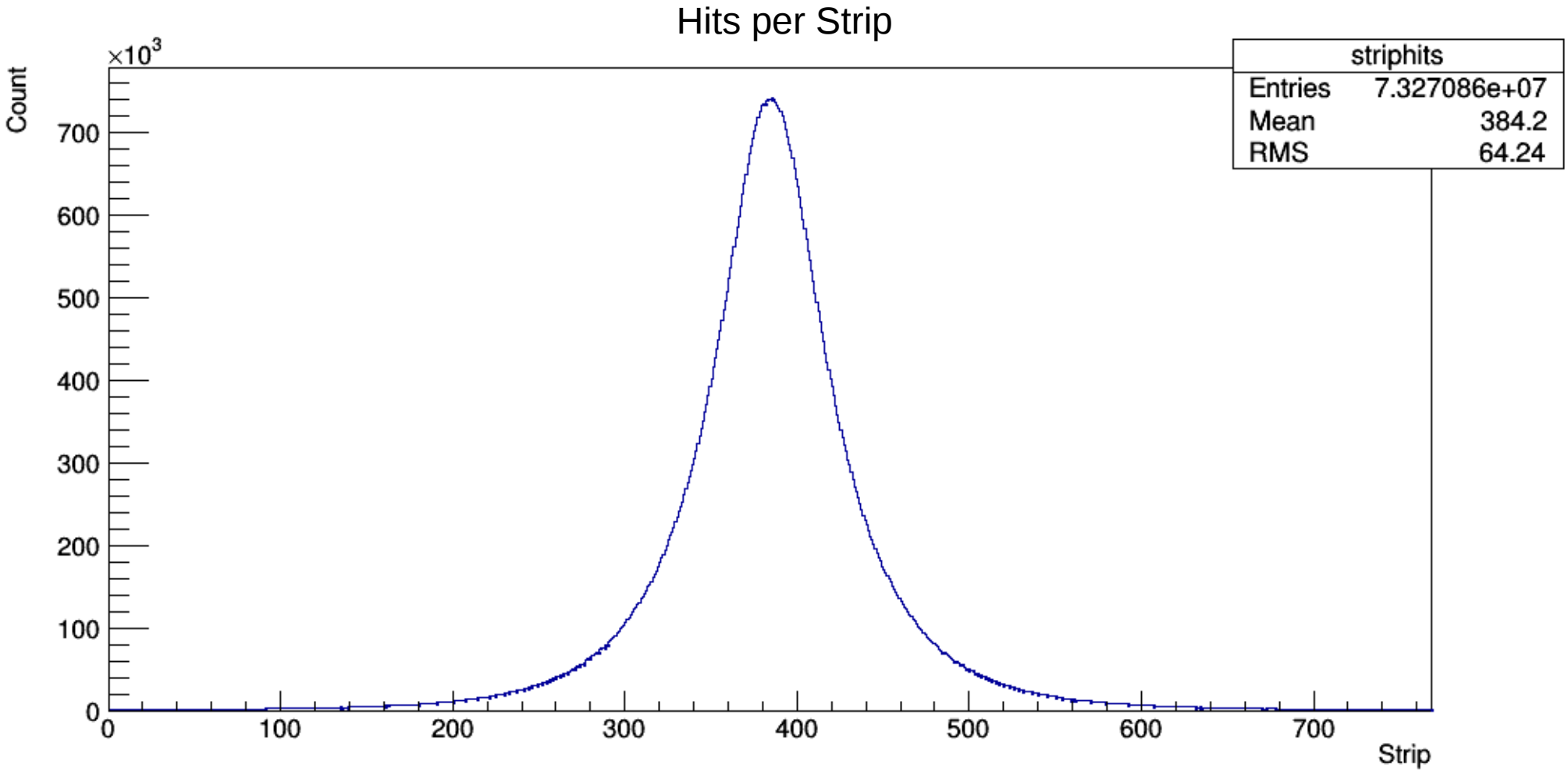
$\bar{x}_{\text{left}} = 382.5$ strips

$\bar{x}_{\text{right}} = 384.2$ strips

$$\Delta \bar{x}_{\max} = 74.4 \pm 0.5\,\mu\text{m}$$

$$P_e = \frac{\Delta \bar{x}}{P_\gamma \cdot 74.4\,\mu\text{m}}$$

Geant4 Simulation

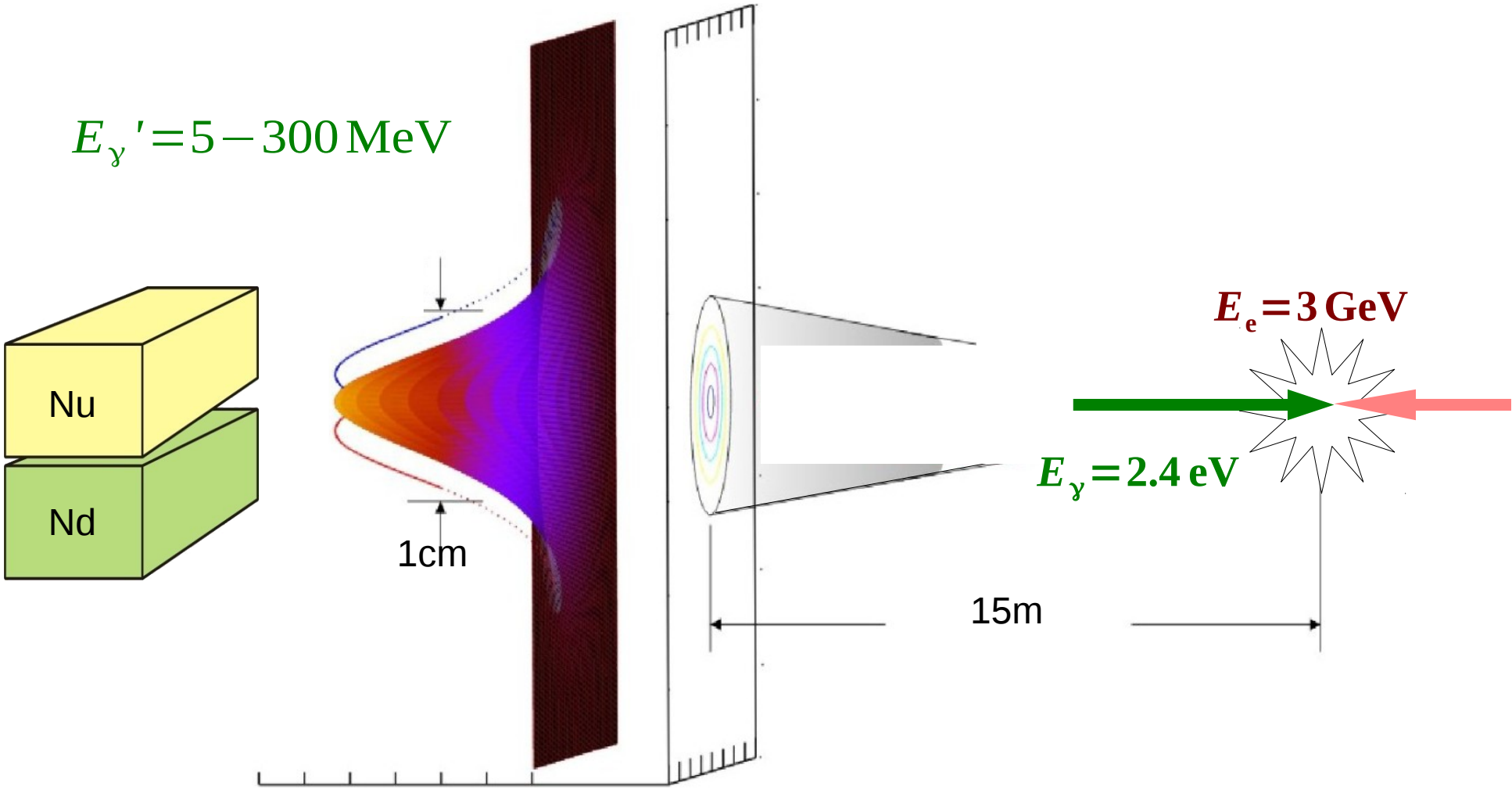


$$\Delta \bar{x}_{\max} = \Delta \bar{x}_{\max}\left(\boldsymbol{E}, \sout{twiss}\right)$$

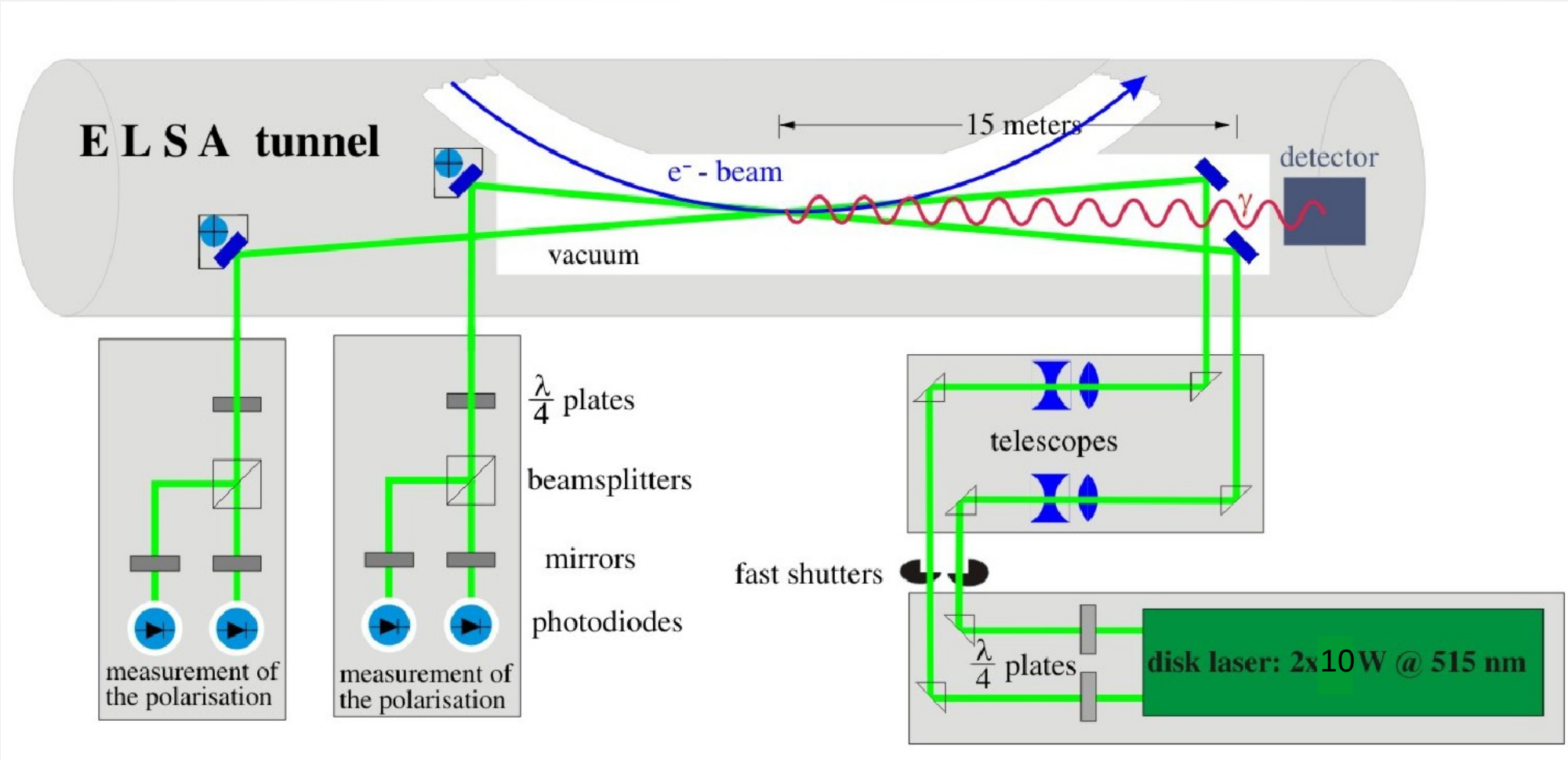
$$P_e = \frac{\Delta \bar{x}}{P_\gamma \cdot 74.4\,\mu\mathrm{m}}$$

Calibrated with Sokolov-Ternov effect

Compton-Scattering

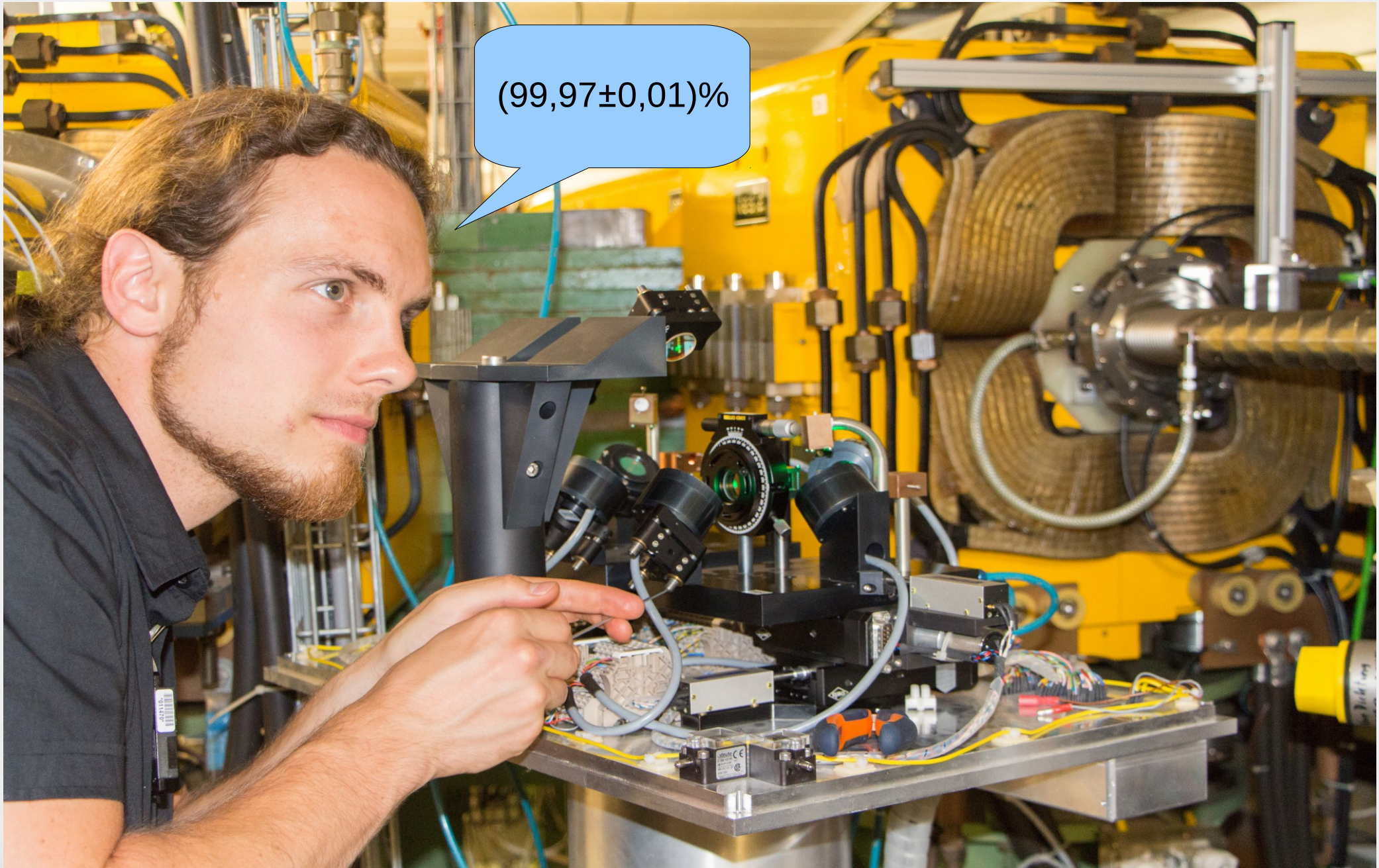


Compton System Components



$$P_e = \frac{\Delta \bar{x}}{P_\gamma \cdot 74.4\,\mu\mathrm{m}}$$

Laser Beam Polarization and Position



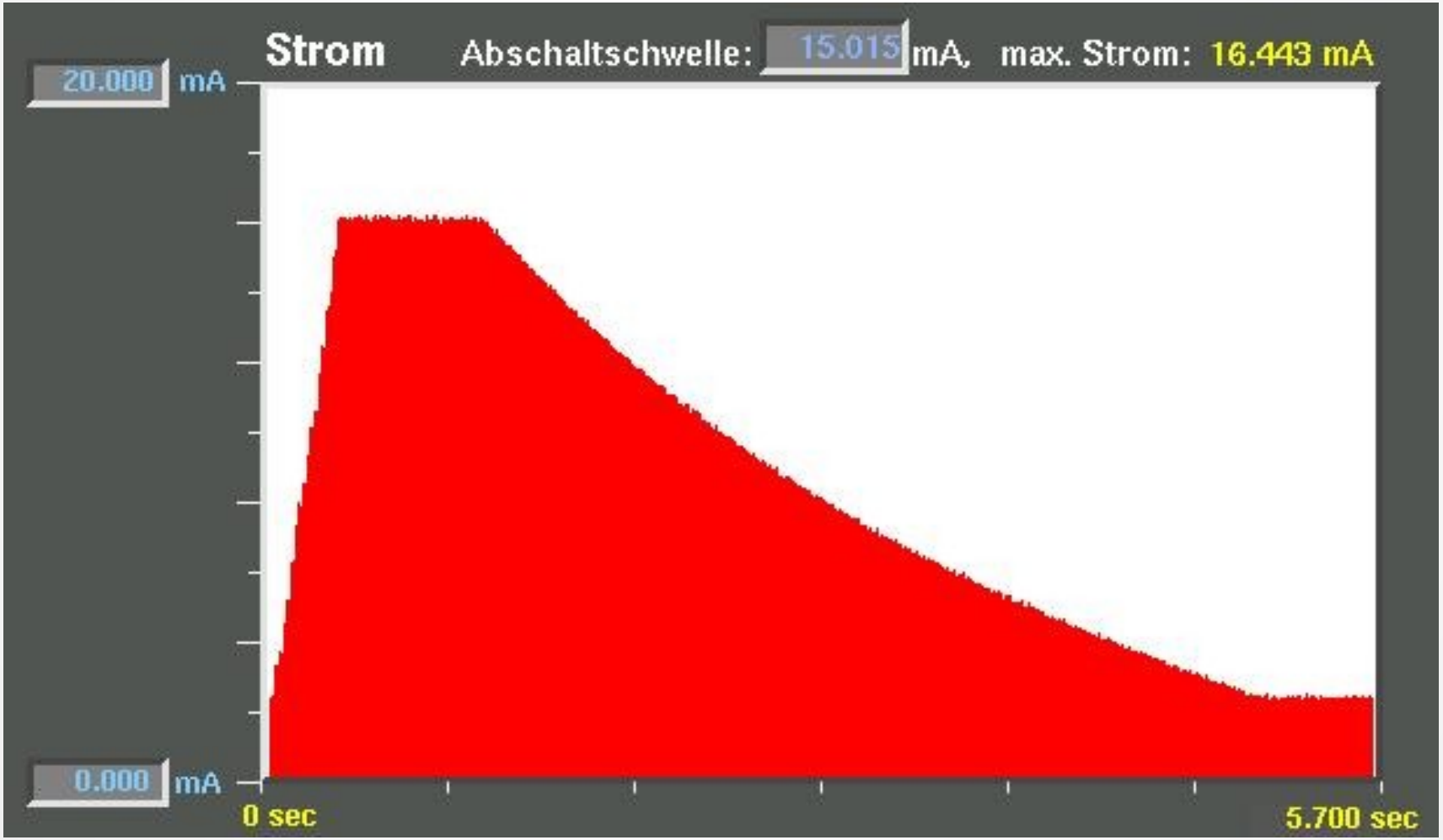
Laser and Beamline

Detector System Considerations

- 50μm pitch
- 768 strips
- Rate acceptance of 1 MHz

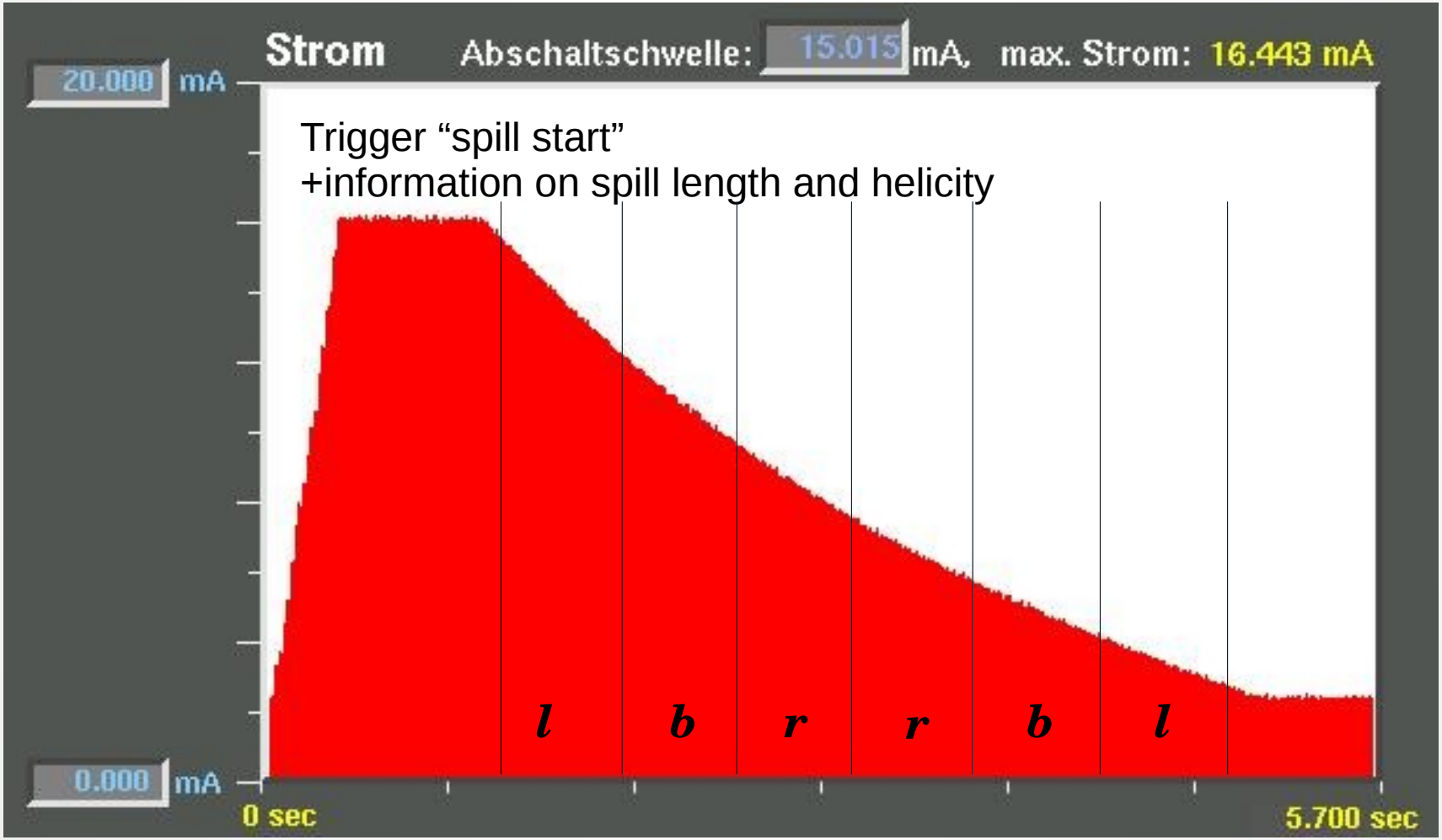
Detector System Considerations

Current vs time in **“Booster Mode”:**



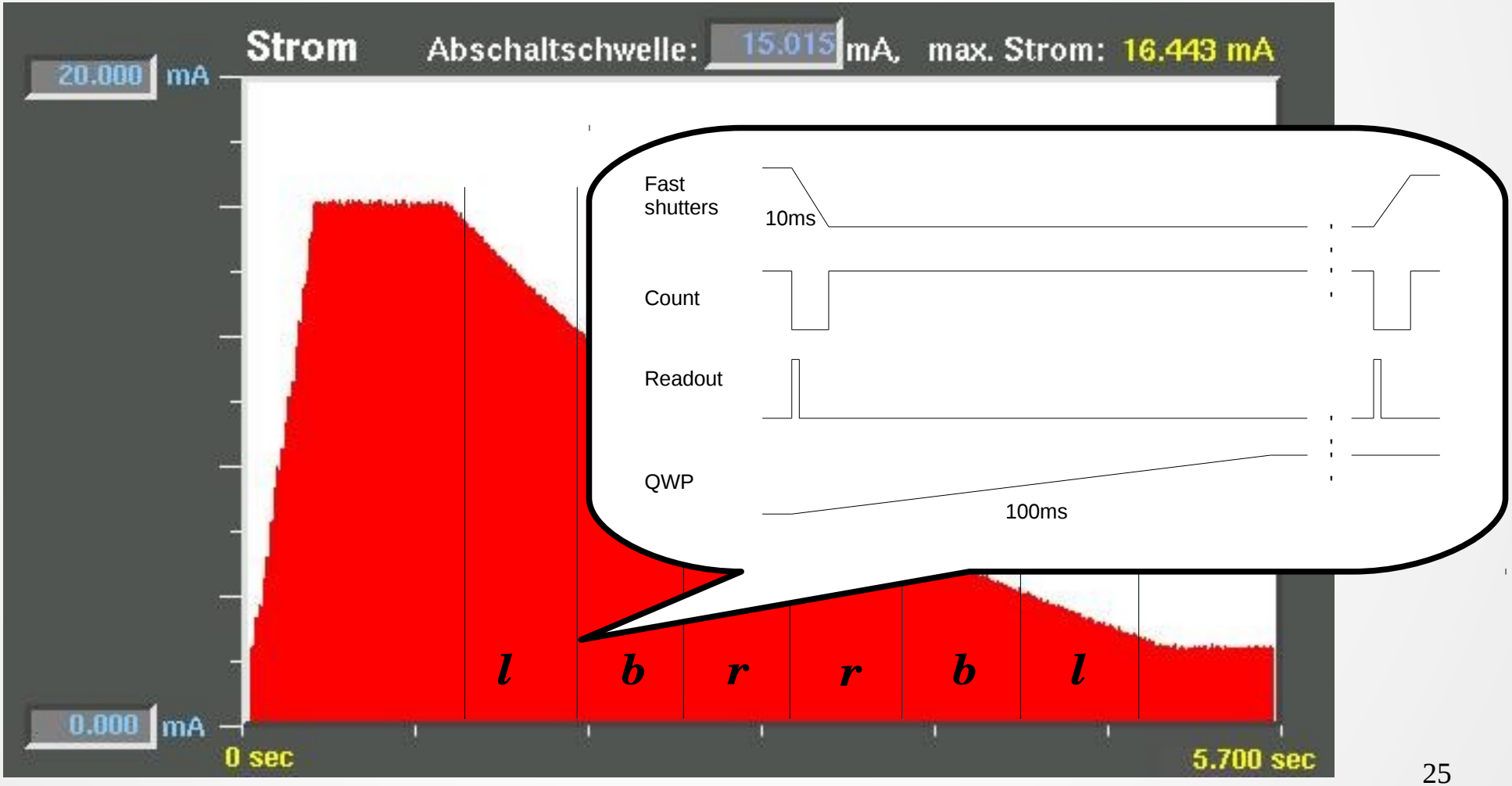
Detector System Considerations

Current vs time in **“Booster Mode”:**



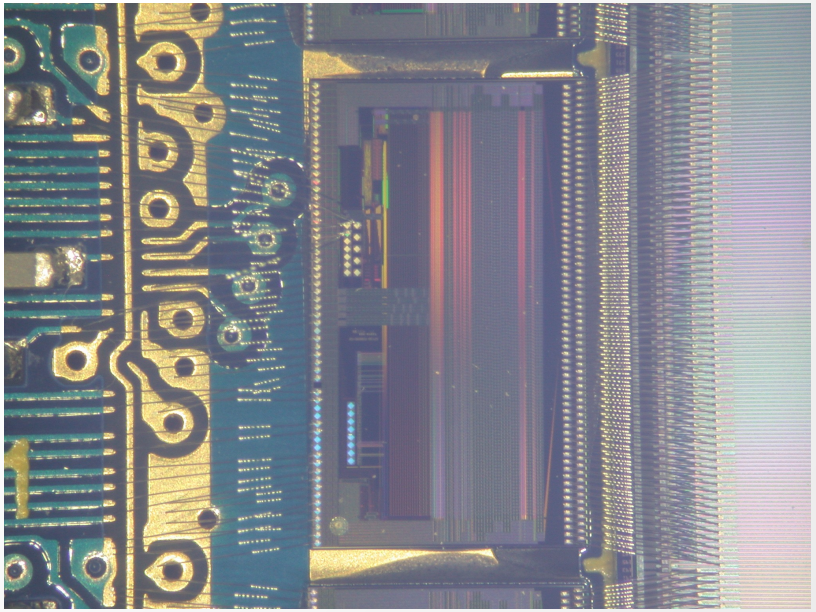
Detector System Considerations

Current vs time in **“Booster Mode”:**

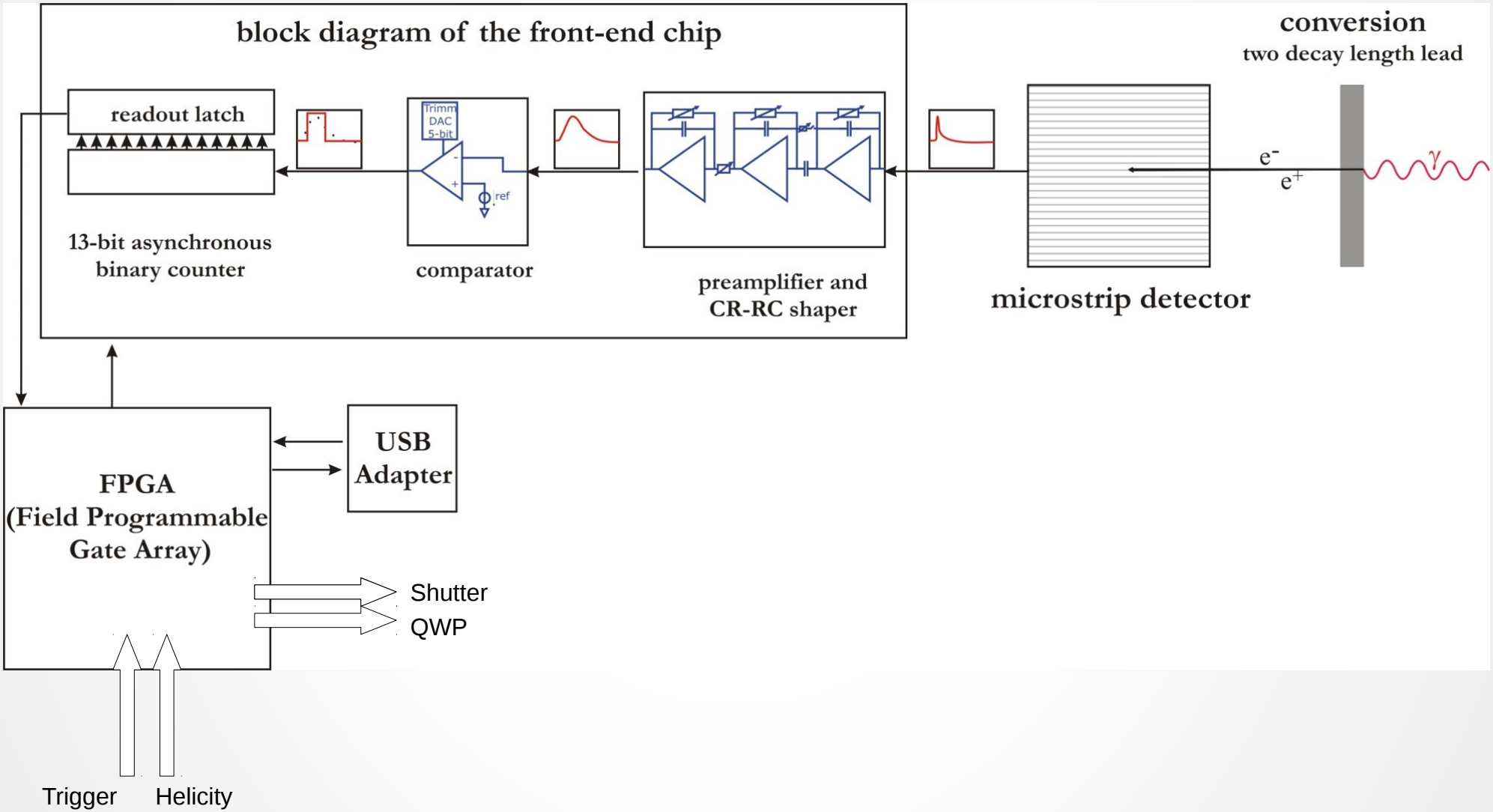


Detector System Considerations

- Minimum of 650 strips
- Rate acceptance of 1 MHz
- FPGA controlled Counting Detector Chips (ASICS)
- TTL output for
  - Fast (10ms) shutters for background measurement
  - Quarter-wave-plates
- TTL input for
  - Spill start
  - Helicity information
  - Veto if current stays below a threshold value



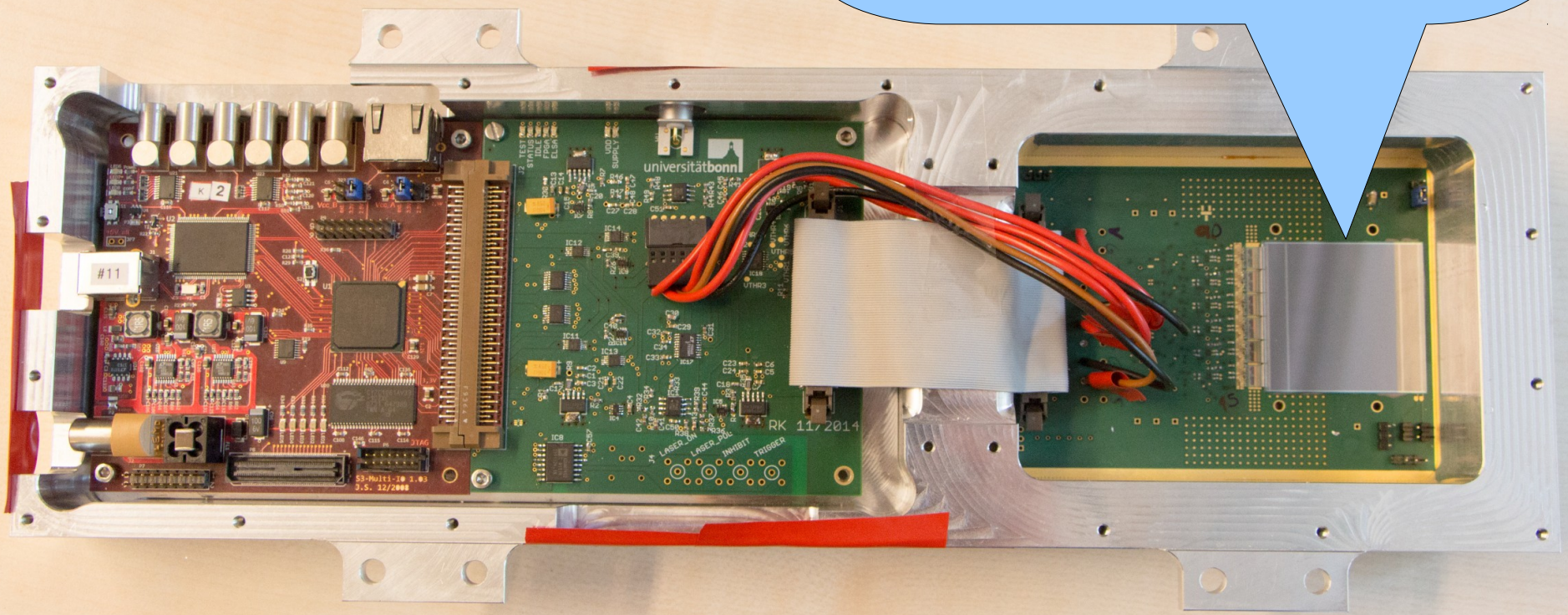
Detector System



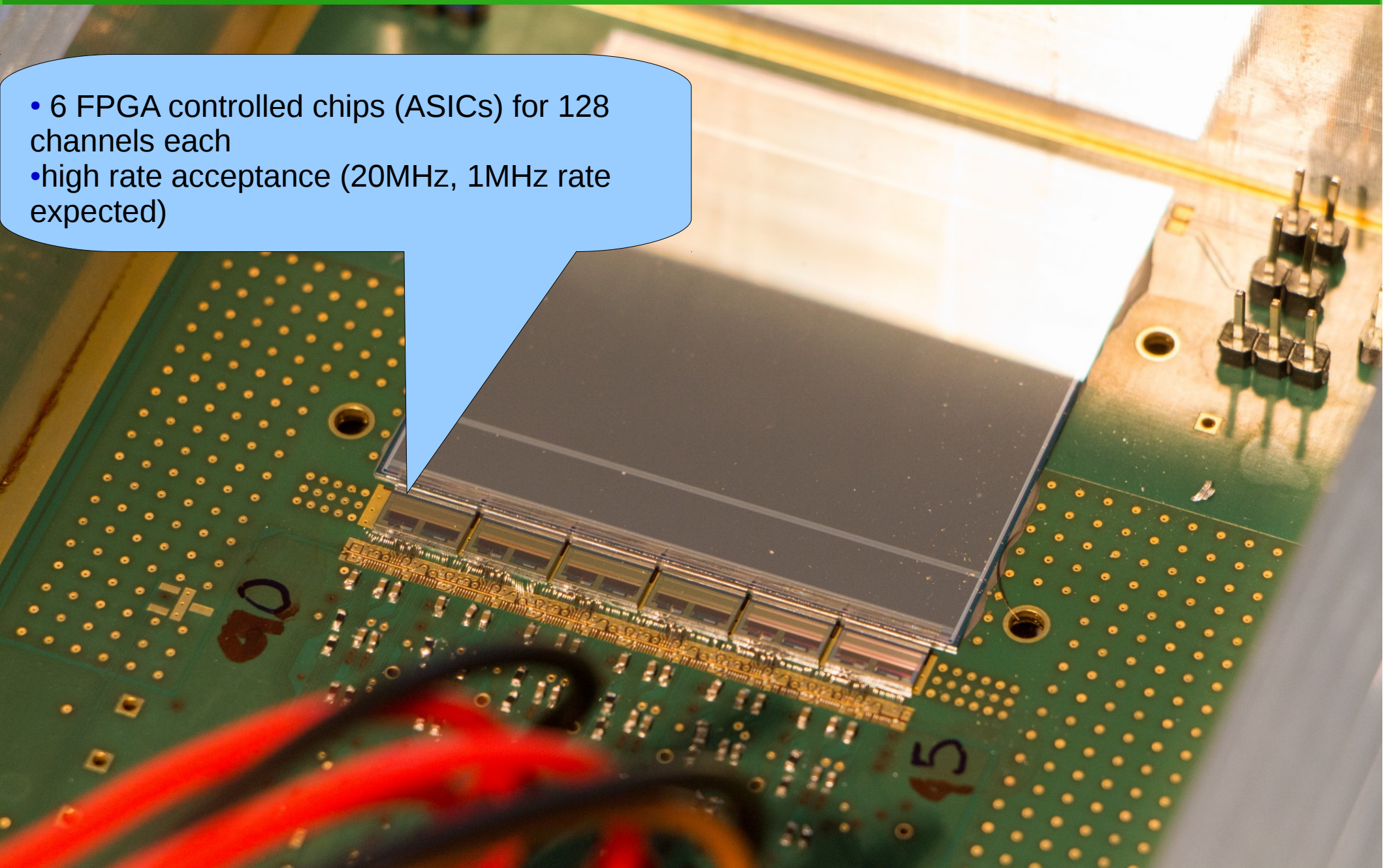
Detector System

Detector board

- Si, double sided and AC coupled
- 41,3mm x 40mm
- 768 strips with 50µm pitch
- Thickness: 300 µm

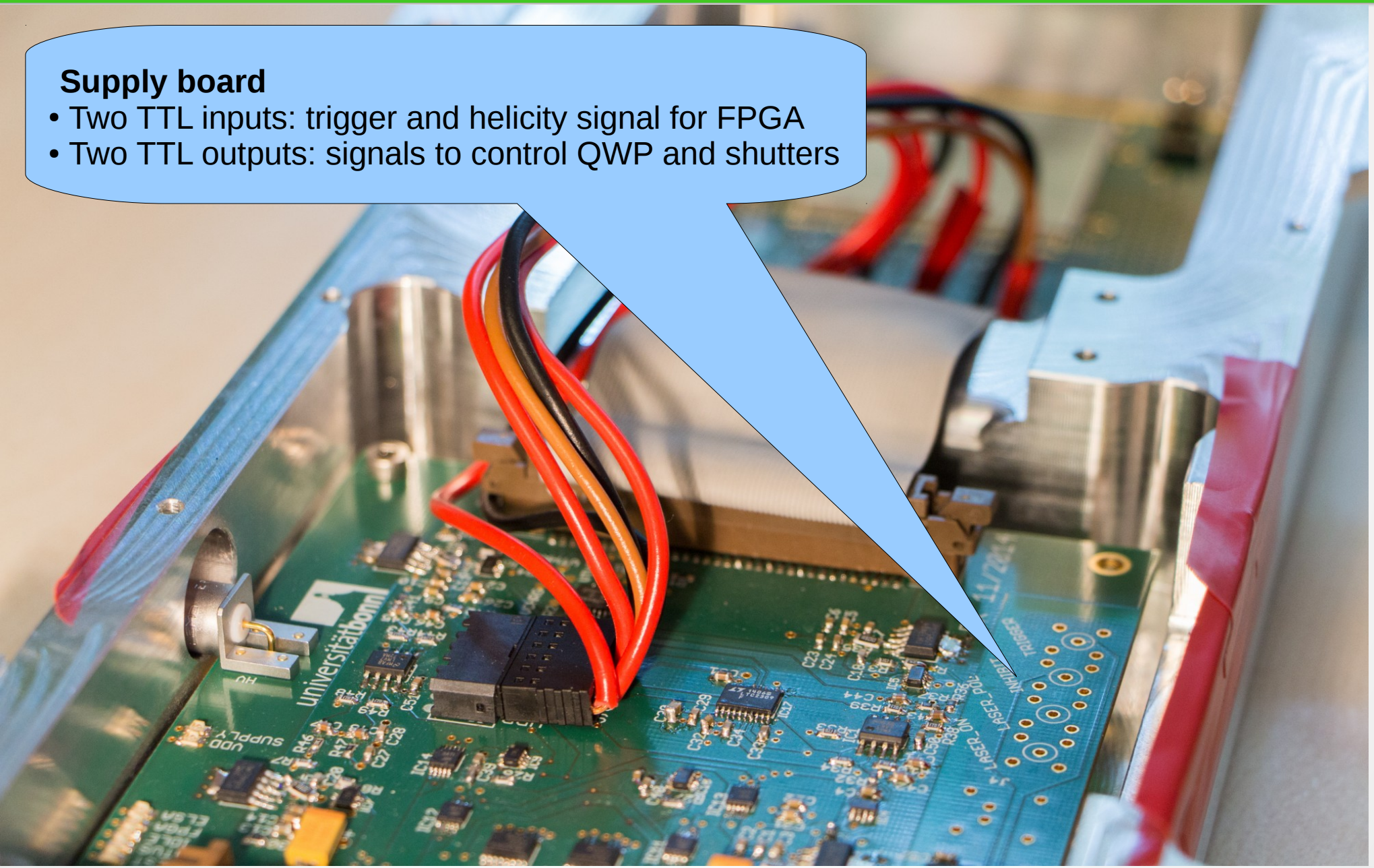


Detector System

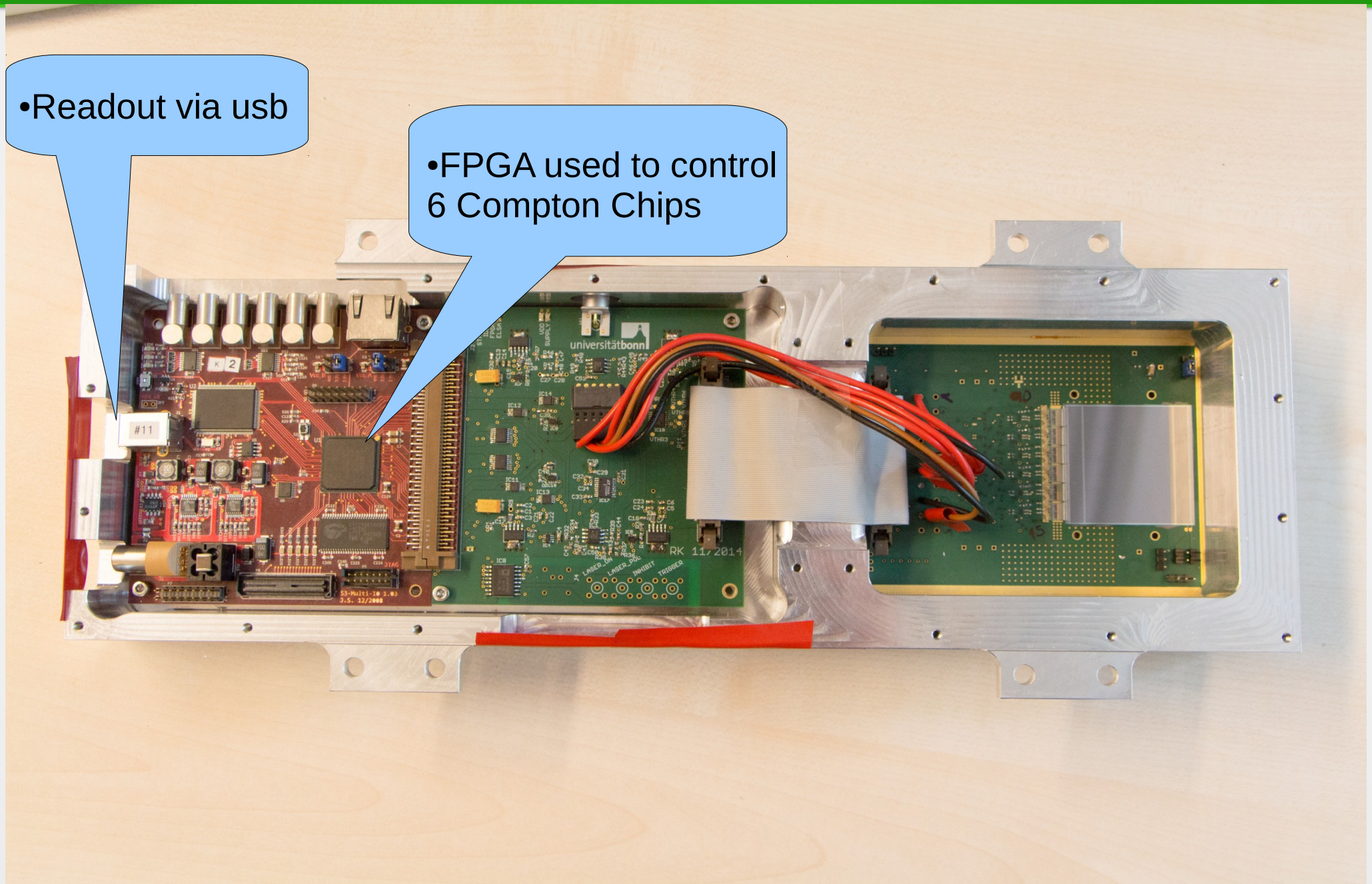


- 6 FPGA controlled chips (ASICs) for 128 channels each
- high rate acceptance (20MHz, 1MHz rate expected)

Detector System

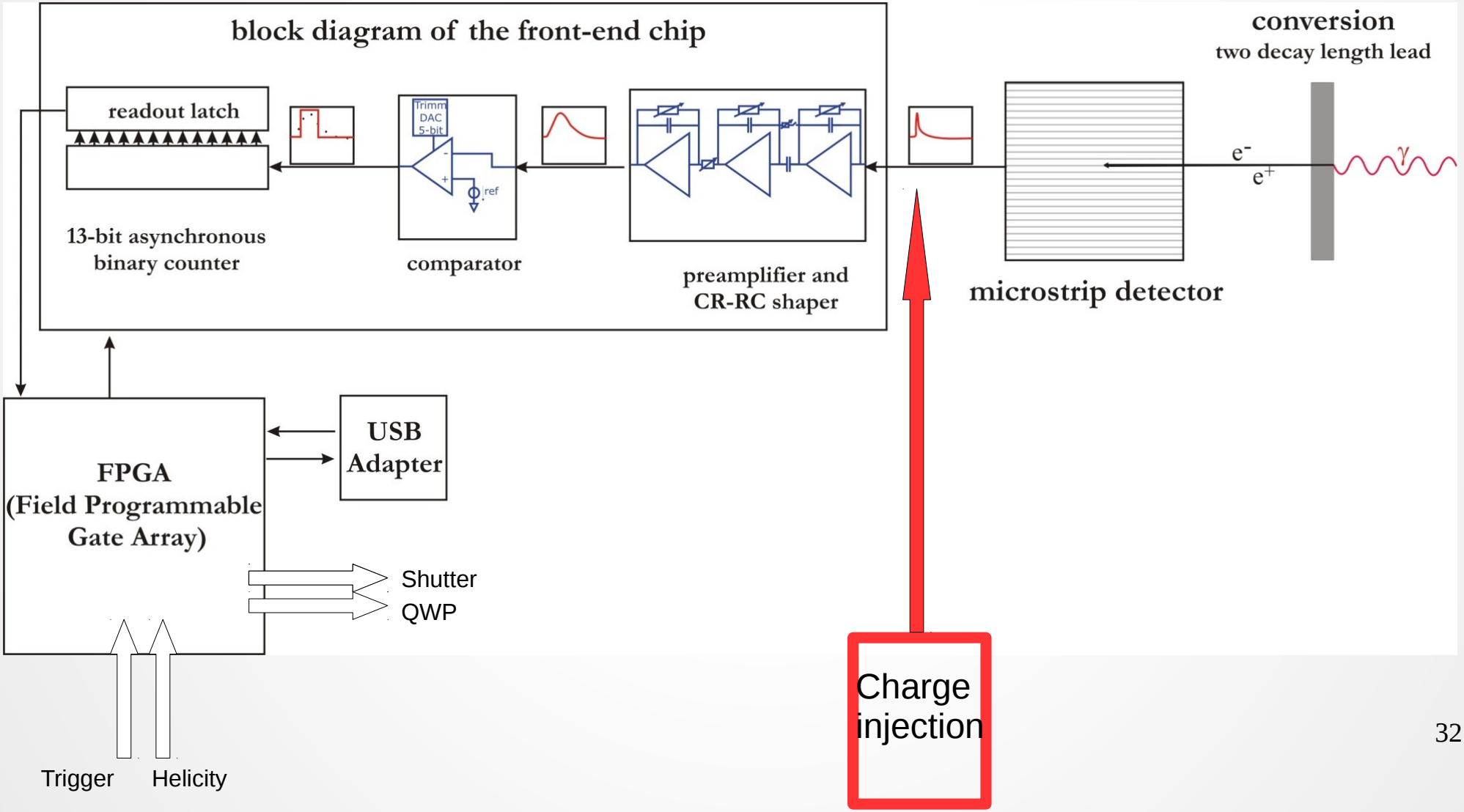


Detector System

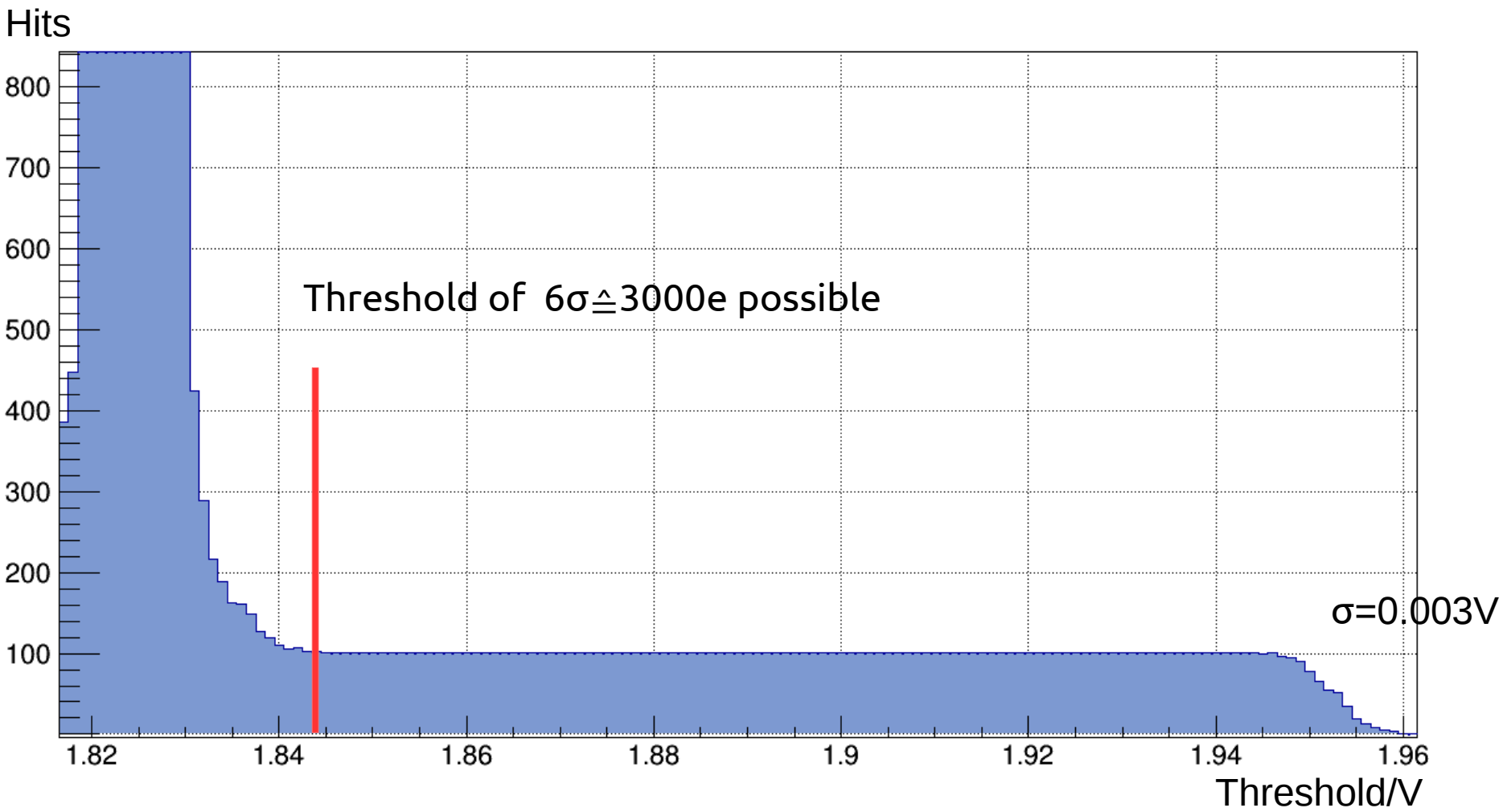


Detector Tests

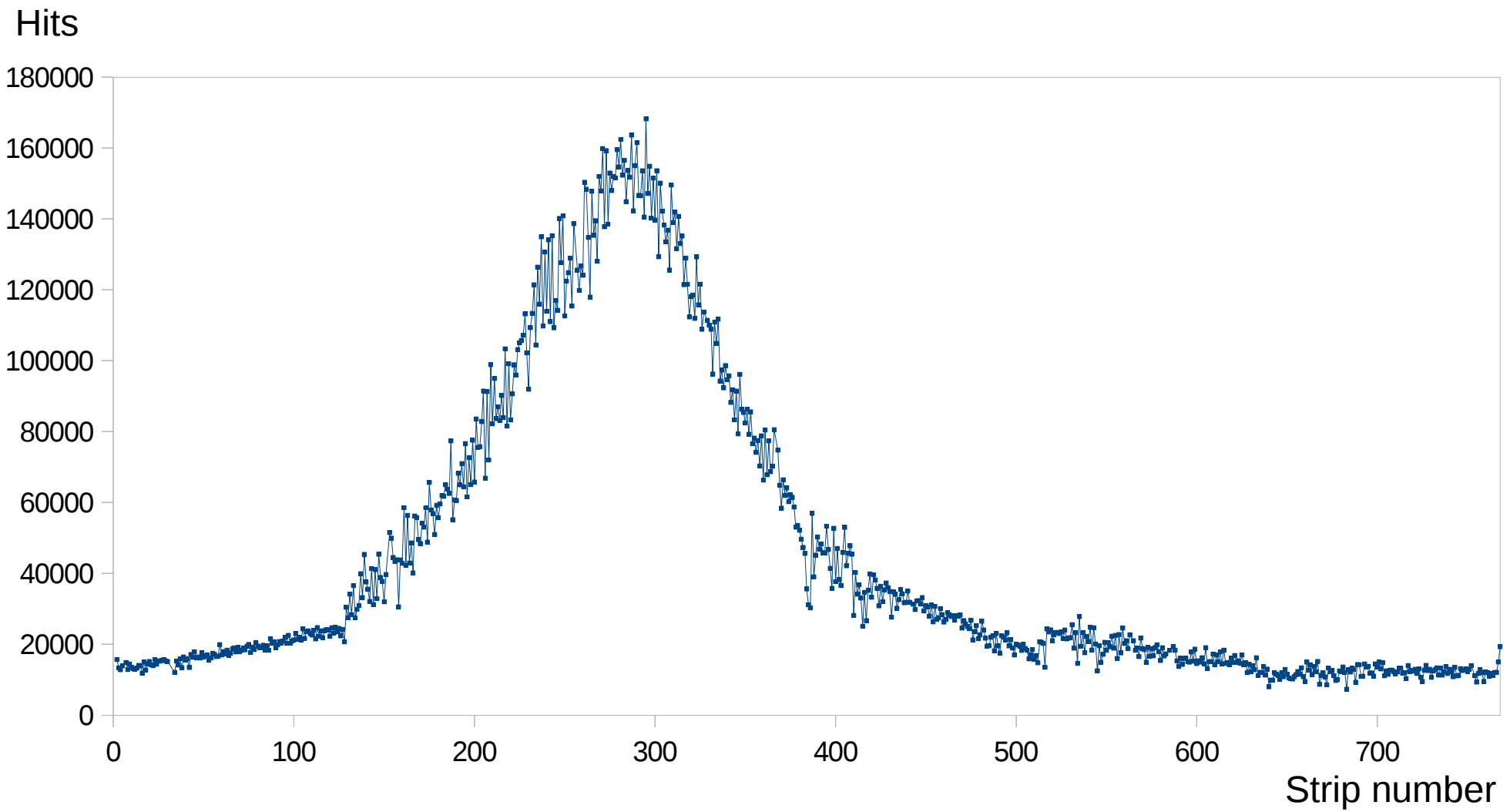
·MIP will generate 24 000 electron-hole pairs in 300µm silicon (MPV)
·Charge injection of 100 x 24 000 electrons for a threshold scan:



Detector Tests



Background Measurement with Test Beam



Expected Measuring Time

- Earlier tries:
  - Detector with 100µm pitch
  - Laser power 7W
  - High background due to bad vacuum

90 minutes

Expected Measuring Time

- Improvements:
  - Detector with 50µm pitch
  - Laser power 20W
  - IGP for better vacuum

5 minutes

Thank you for your attention!