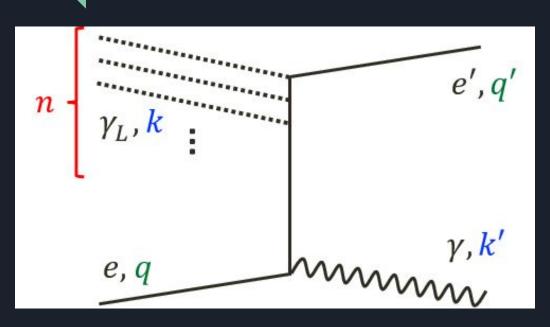
### aCSPMA mid-term thesis report

a Cherenkov Silicon PhotoMultiplier Array PCB (aCSPMA) MSc thesis

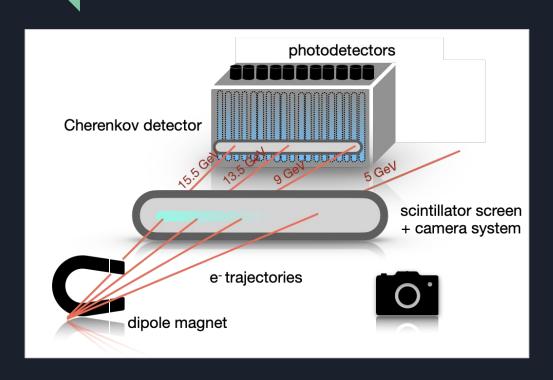
Daniel Klein
DESY, FH-FTX-SLB-LUXE
2nd October 2025

# The LUXE experiment



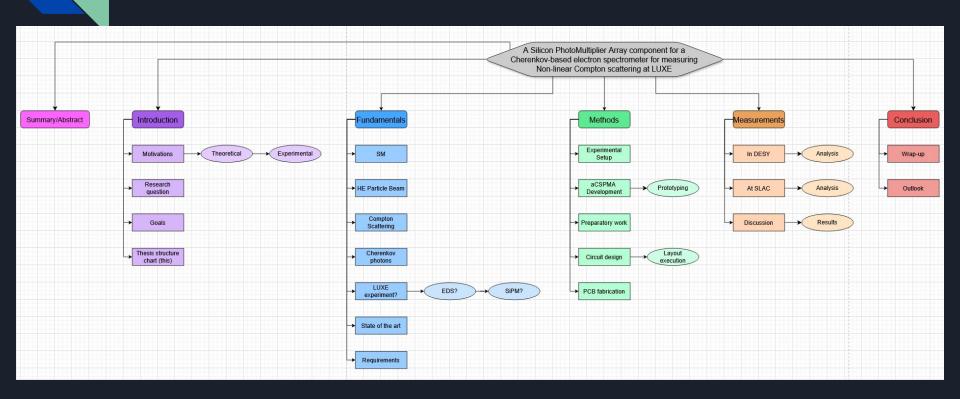
- Laser Und XFEL
   Experiment (LUXE) at DESY
   & SLAC
- Goal: Study Strong-field QED through Nonlinear Compton Scattering (NLCS)
- Relativistic electrons interacting with strong-field laser pulses

#### Premise of thesis

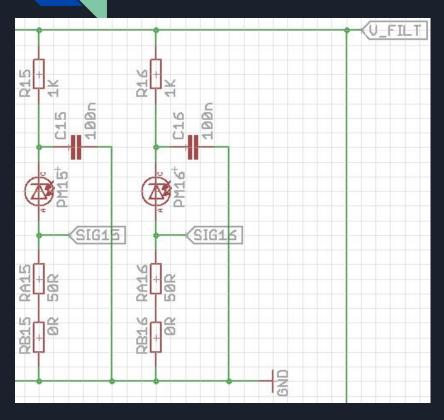


- Measure NLCS electrons by their Cherenkov emissions in a straw detector
- Precisely retrieve energy and temporal resolution for scattered electrons

#### Updated thesis structure chart

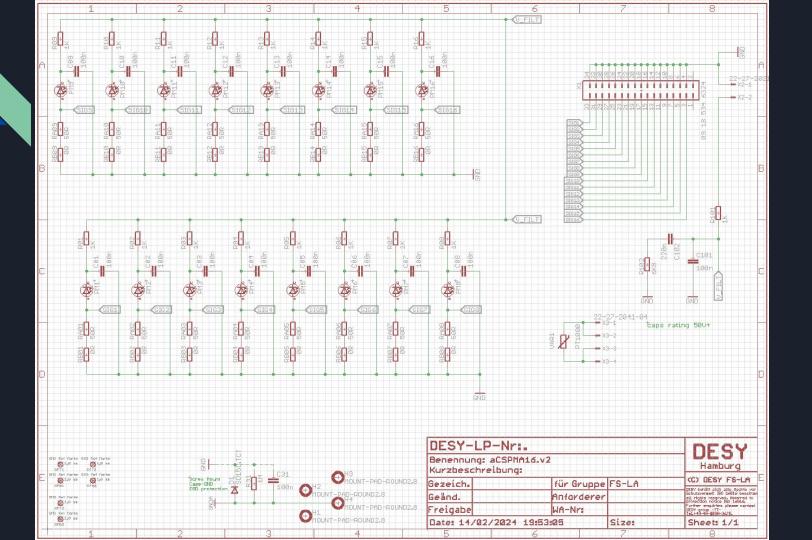


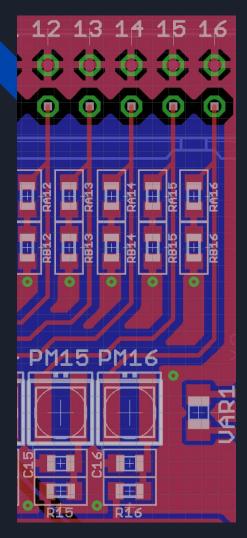
# Work performed



- Design of a semi-modular carrier-PCB for 16 SiPM sensors
  - Schematic drawn and Layout done in EAGLE 6.6
- Ordered components and printing of bare PCBs
- Manual assembly and soldering
- Lab testing/measurements at DESY
  - At SLAC by colleague

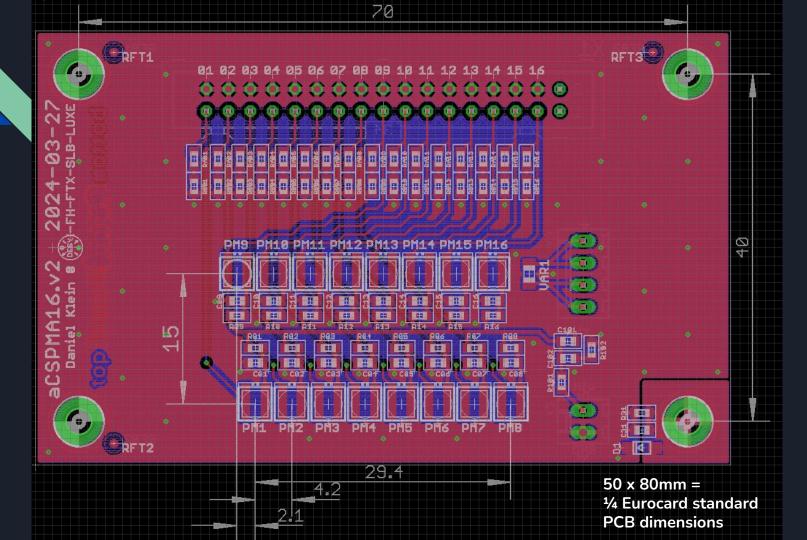
# Full electrical Schematic

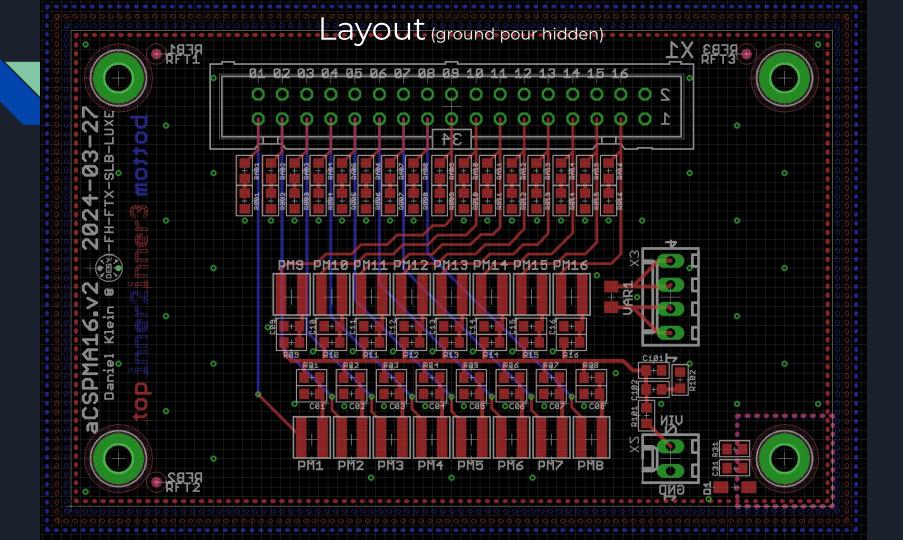




## Methods

- Circuit design: biasing topology, passive filters
- Layout optimization for low noise and impedance matching
- Geometry choices coordinated with straws assembly
- RC filters calculation and pre-testing

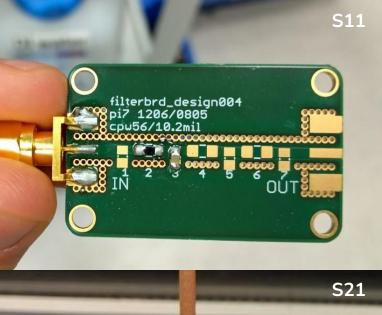


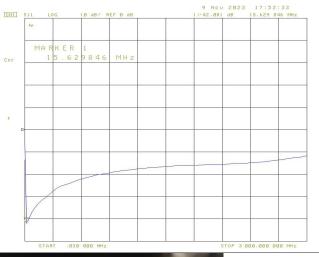




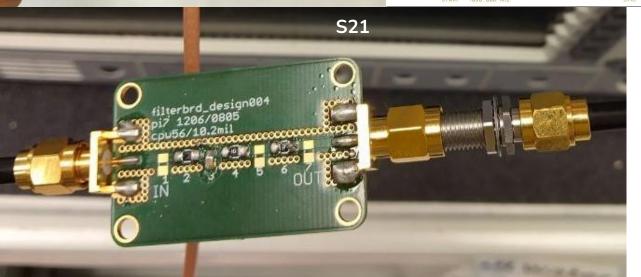
#### Measurements

- Pre-design: passive RC filter spectral response curves.
- Testing of the first two partial and fully-assembled boards:
  - Scope-based inspection of (powered-on) dark noise.
  - Channel and cross-channel (leakage) responses to dummy (LED) light pulses.
- With the two units integrated into EDS (by colleague):
  - Beam measurements at ARES (DESY)
  - Beam measurements at E320 (SLAC)

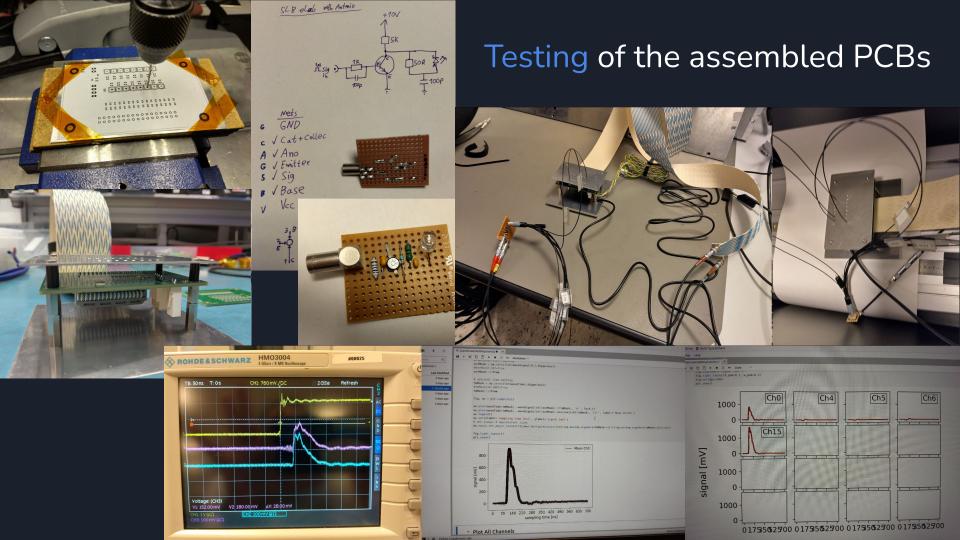




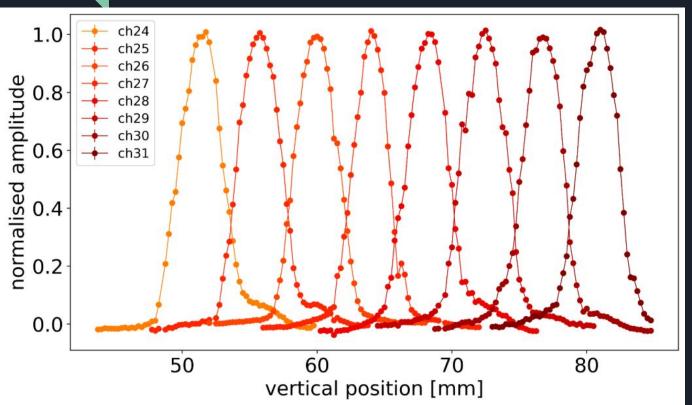
RC filters spectral response







#### Beam measurements



SiPM signals of channels 24 to 31, when the detector was scanned through a stationary 10GeV, 1.6nC (10<sup>10</sup>e<sup>-</sup>) gaussian beam of FACET-II at SLAC.

Each data point is an average over 50 measured events.

# Summary and Outlook

- Hardware successfully prototyped and tested
- Detector integrated into E320-SLAC
- Next steps: extended beam tests, final documentation, LUXE-DESY 2026(?)
- On track to complete MSc thesis write-up "lab report" of all the above - within 6 months

#### Thanks

Advising profs: Jenny List, Gudrid Moortgat-Pick

LUXE: Antonios Athanassiadis, Stefan Schmitt, Ivo Schulthess

FS-LA colleague: Uwe Große-Wortmann



# End of presentation