WP 5.6 / Giessen

Work Package 5: SCT - Joint technology development around SCT and future lepton colliders

Task 5.6: Development and design of a Particle Identification system for the SCT detector

Contributions from JLU Giessen

Michael Düren, Avetik Hayrapetyan, Mustafa Schmidt, et al.

IInd Physics Institute, Univ. Giessen

CREMLINplus Kick-off Workshop, Feb. 19-20, 2020

Task 5.6:
Development and design of a Particle Identification system for the SCT detector

Description in proposal:

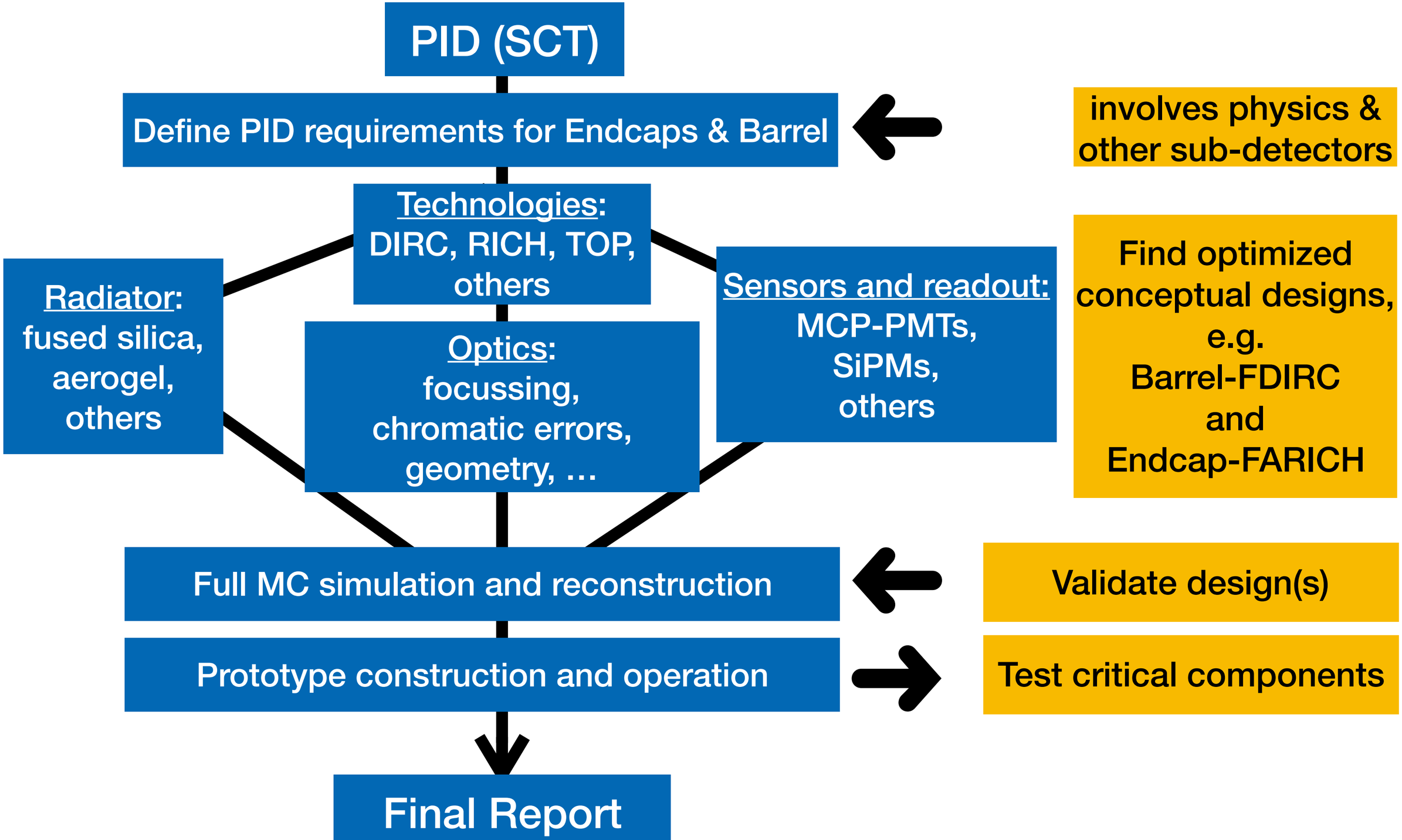
The particle identification system is a key system of the SCT detector. Particle identification (PID) systems based on Cherenkov detectors are widely used in HEP experiments to discriminate between charged long-living particles. Today the most promising types of Cherenkov detectors for the identification of particles with about 1 to 10 GeV/c momentum are based on the ring imaging technique using quartz or aerogel radiators and focusing designs. Notable representatives of such kind of detectors are the FDIRC (Focusing Detection of the Internally Reflected Cherenkov light) and the FARICH (Focusing Aerogel Ring Imaging Cherenkov detector) designs. Registration of single Cherenkov photons with a position resolution of about 1 mm is needed in these detectors. Excellent resolution of photon arrival time (about 100 ps) and low dead time are also required for improving PID and suppressing the high rate of background hits that are typical in modern experiments. Also, the ageing of photon sensors with high counting rate and radiation damage can be an issue.

The multipurpose detector to be built should have PID subdetectors in the front and back endcaps and in the barrel region. The experience of several research groups will be combined to come up with proposals for the optimum PID system for the SCT project with respect to performance and cost. Detector prototypes are going to be constructed and tested to verify the performance of these novel detector concepts and their readout systems.

Deliverable D5.4

Status report on R&D work on particle identification system for the SCT detector **(M24)**

Work Flow for Deliverable D5.6: R&D on PID for SCT



Expected topics and outcome on Feb. 20:

Where and when will you carry out your WP-specific kick-off:

- 2020 WP5 kick-off Workshop to be defined ??
- Sept. 2021 DIRC conference in Giessen + SCT Workshop??

Which is the WP-specific work plan, means: which will be the direct next steps after project kick-off:

- study again and redefine PID requirements for Barrel and Endcap: minimum requirements and requirements for best physics outcome (separation power for pion, kaon, muon; timing resolution, multiplicities, rates, etc.)

Which are the tasks in your WP, and which partner will have; which task and role, e.g. devise Task-leaders

- to be defined (before the meeting) ??
- Giessen: SCT-DIRC development (Monte Carlo, Reconstruction, Prototyping, Tests)

Point out WP-specific timeline for 1st year M1-M12

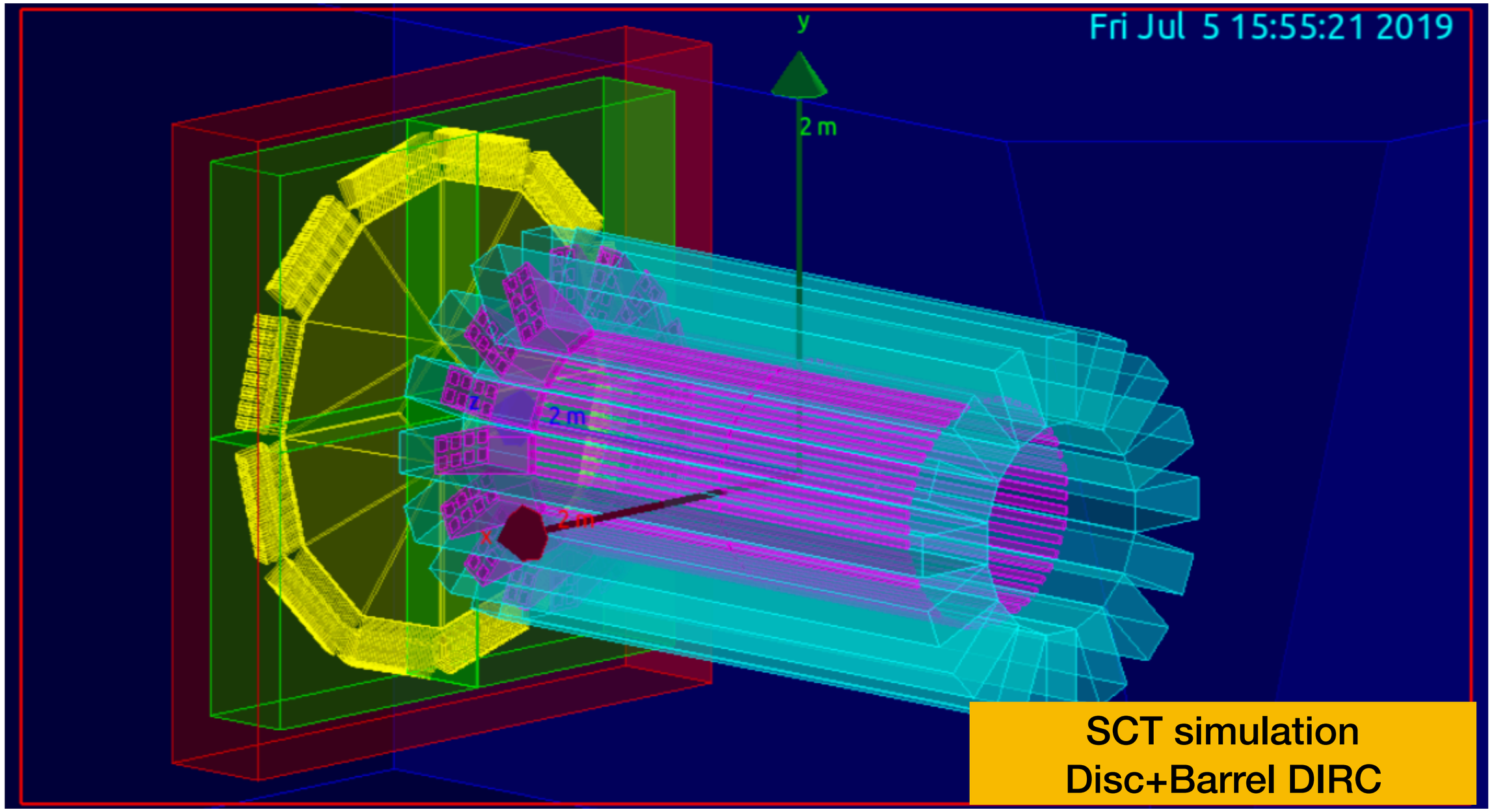
- Conceptual design studies, define hardware to be tested, Monte Carlo preparation ??

Which contributions by technical WPs to ensure proper interaction with WP8 TNA and WP9 TRAIN: overview planned contributions (e.g. training measures,..) M1-M12

- colleagues from BINP coming to Giessen to work together on design or Monte Carlo implementation??
- use test facilities at BINP or at Giessen cosmics station??

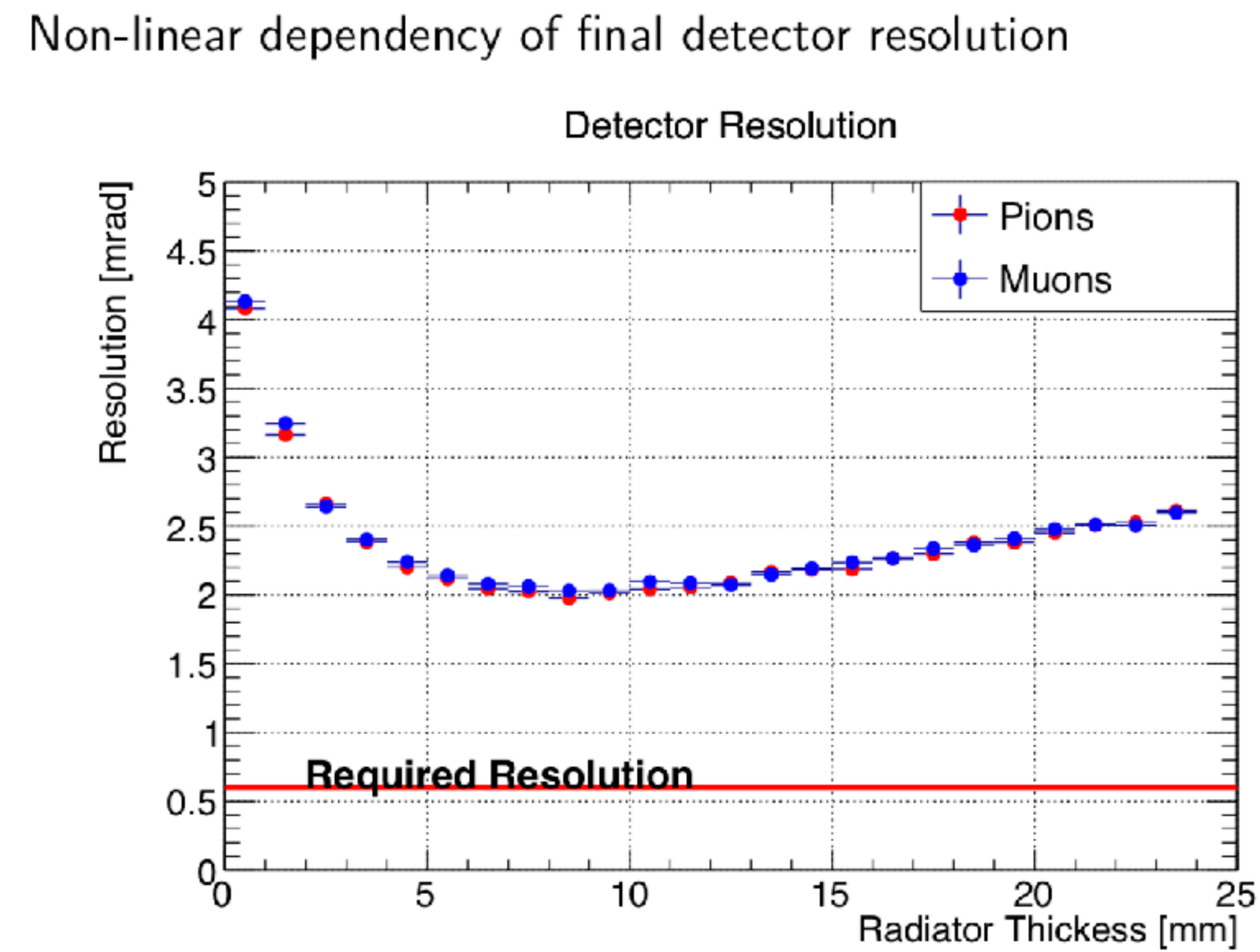
Activities in Giessen (Mustafa Schmidt):

Monte Carlo implementation of first versions of Barrel DIRC and Endcap DIRCs in SCT



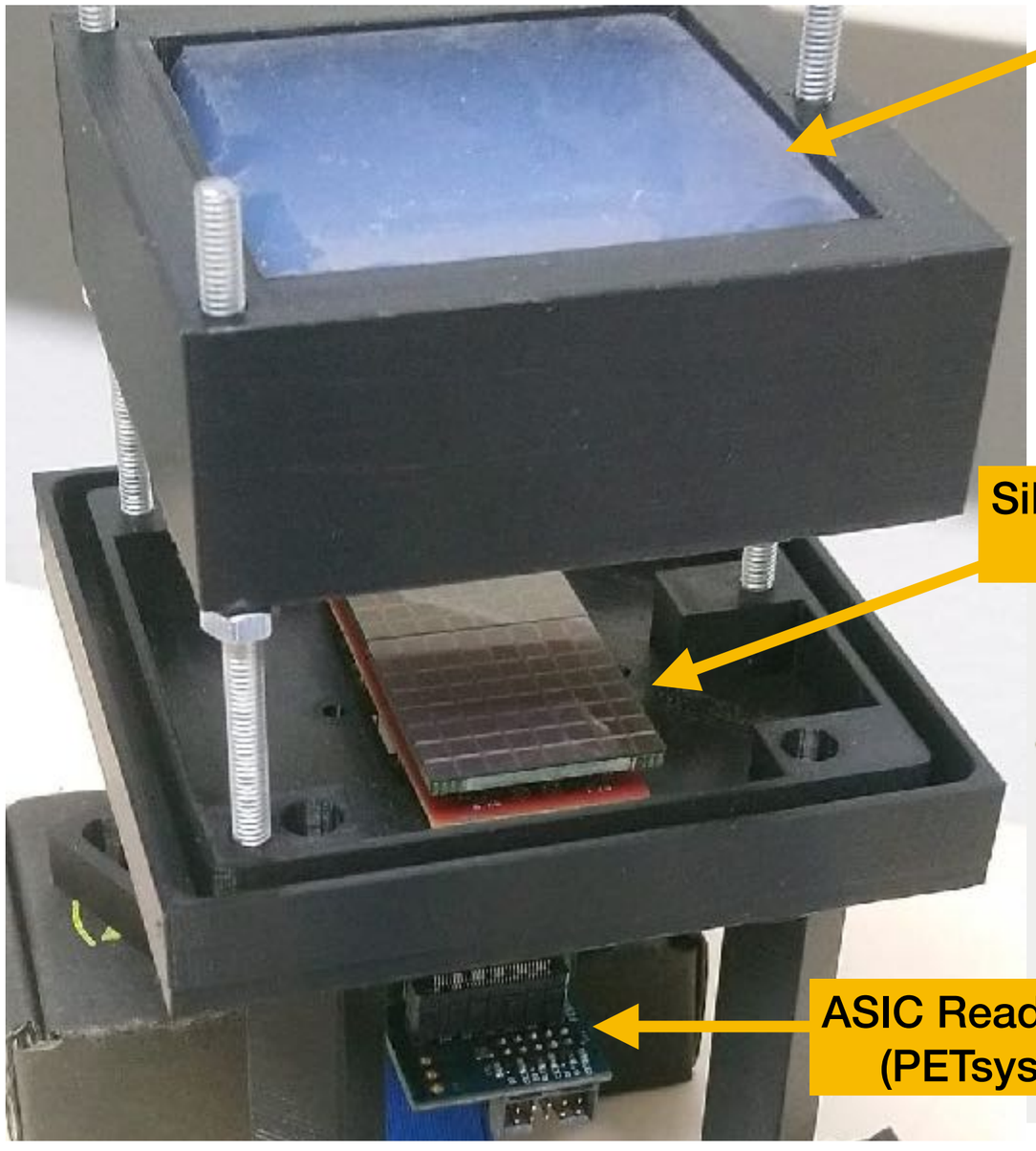
Activities in Giessen (Mustafa Schmidt):

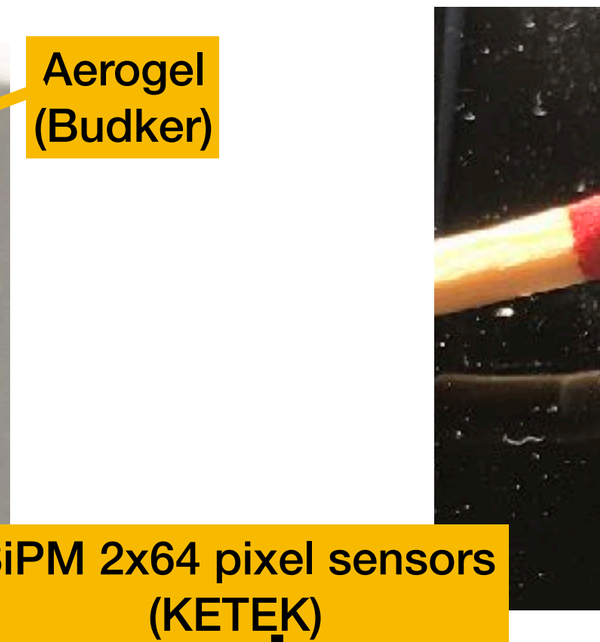
Conceptual studies for performance optimization

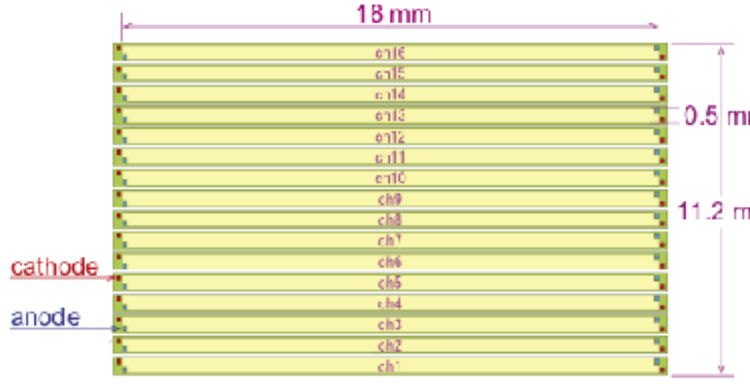


Activities in Giessen (Avetik Hayrapetyan):

Studies with SiPMs and Cherenkov radiators (Aerogel, fused Silica)

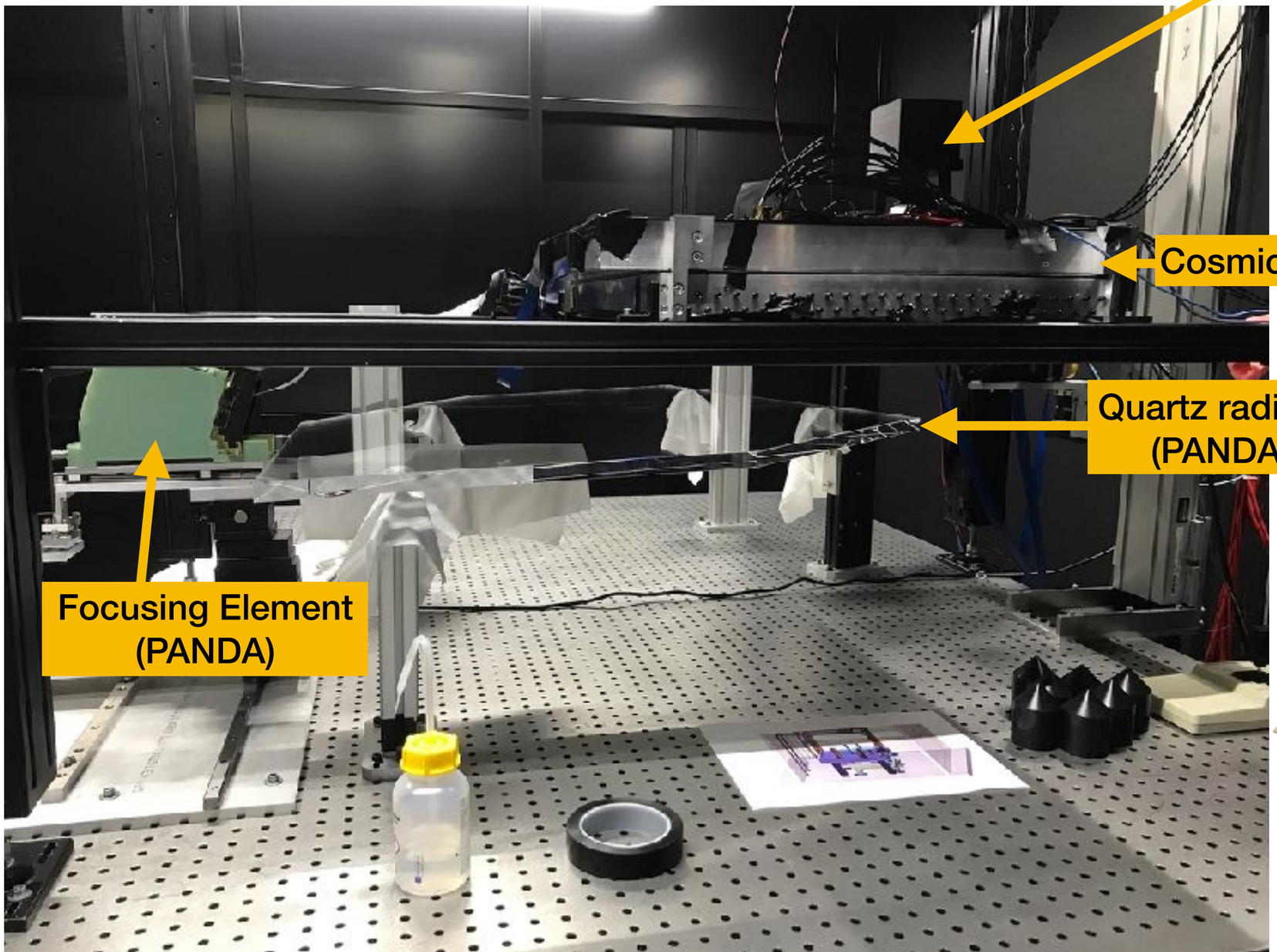






SCT activities in Giessen:

Giessen Cosmics Station:
A test stand for Cherenkov detectors



SCT activities in Giessen:

Giessen Cosmics Station:
A test stand for Cherenkov detectors

Cosmic Muons:
p > 700 MeV/c

Fixed Cherenkov angles:
fused Silica: $\theta_C = 46.4°$
Aerogel: $\theta_C = 17\text{-}19°$

Acceptance:
Rate ~ 14 000/day
Angular range = 6°-23°
Size = 50x50 cm²

Resolution:
Spatial: $\sigma_x = 8.4$ mm, $\sigma_y = 4.6$ mm
Angular: $\sigma_\theta =$ 3.8 mrad
Time: $\sigma_t = 0.55$ ns