KOALA@CaveC: A precision experiment for elastic proton-proton scattering and beyond

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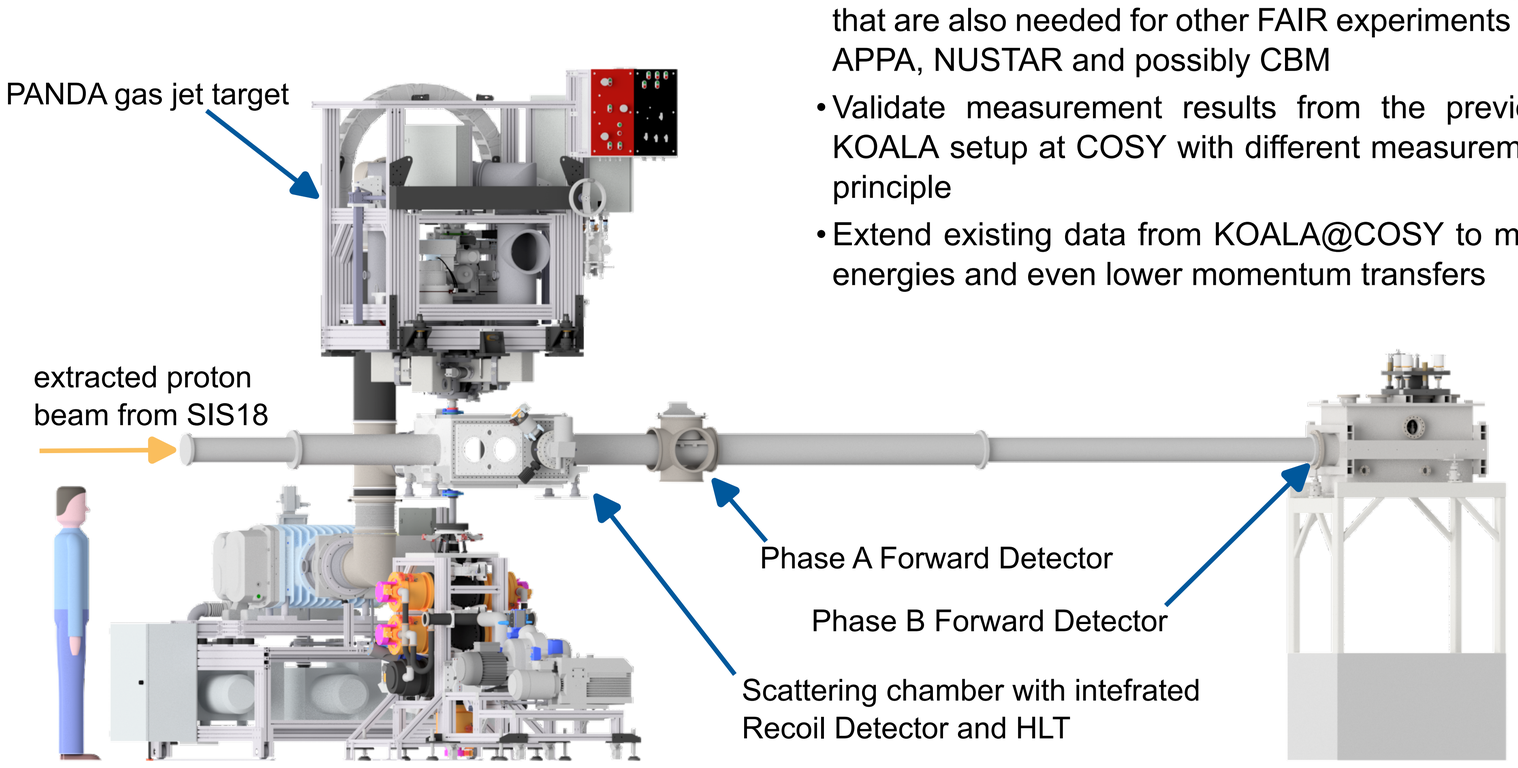
KOALA@CaveC Setup

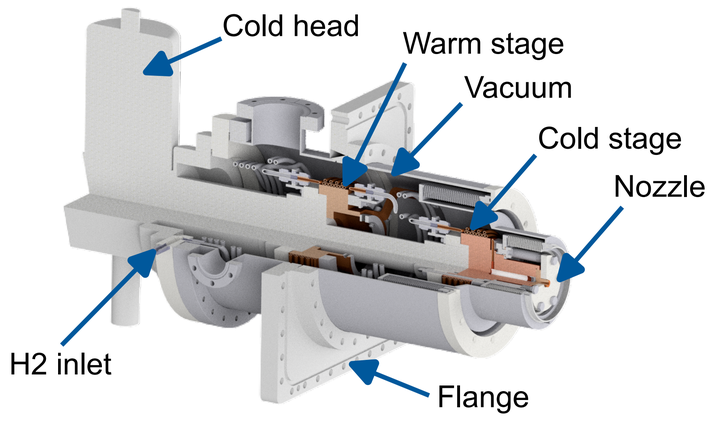


Scientific Goals

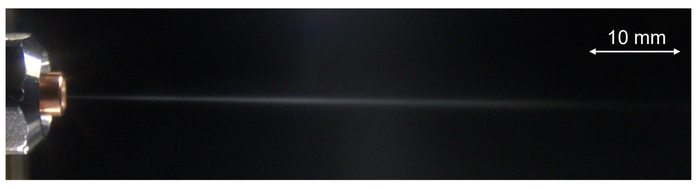
- Provide an ideal test environment for new jet targets that are also needed for other FAIR experiments like APPA, NUSTAR and possibly CBM
- Validate measurement results from the previous KOALA setup at COSY with different measurement principle
- Extend existing data from KOALA@COSY to more energies and even lower momentum transfers

Targets

- Features two different targets: the jet target developed for PANDA (vertical beam) and a compact High Luminosity Target (horizontal beam)
- Innovative jet nozzles are developed, which can provide cluster-jets, collimated filament-like cluster beams, and frozen filament beams
- One major objective is to measure the residual gas distribution inside the scattering chamber



High Luminosity Target (HLT).



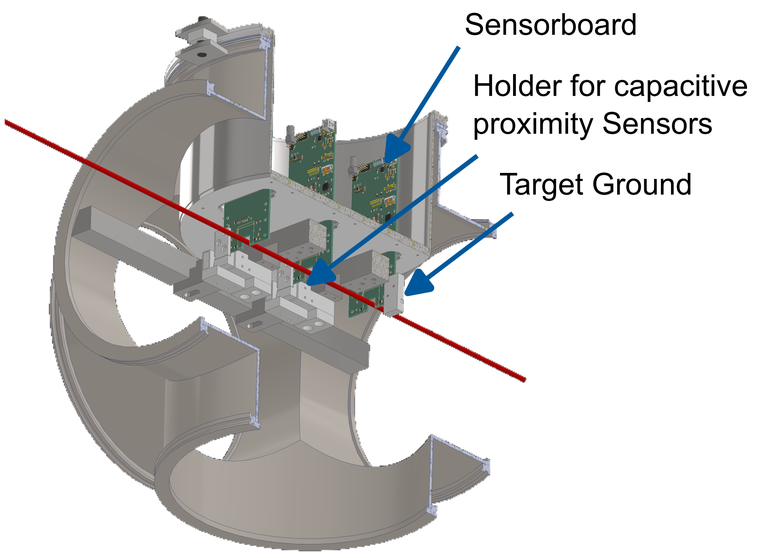
Target Beam of the HLT.

Forward Detector

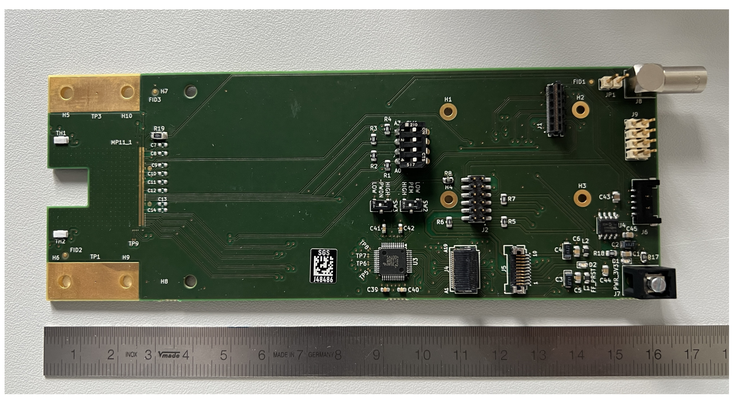
Both variants are tracking detectors with low material budget employing HV-MAPS operated in vacuum.

Phase A / Commissioning planned mid 2027

- Minimalist tracking detector, originally designed as a beam position detector, employing three layers of a single HV-MAPS (MuPix11)
- HV-MAPS are directly glued onto sensorboards that are glued into a vacuum flange



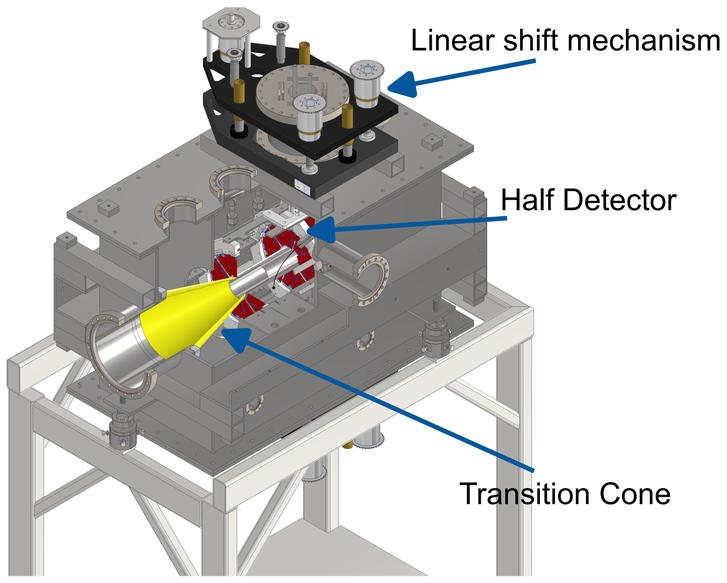
Sliced view from below of the Phase A Forward Detector featuring a cutout at the dedicated sensor position.



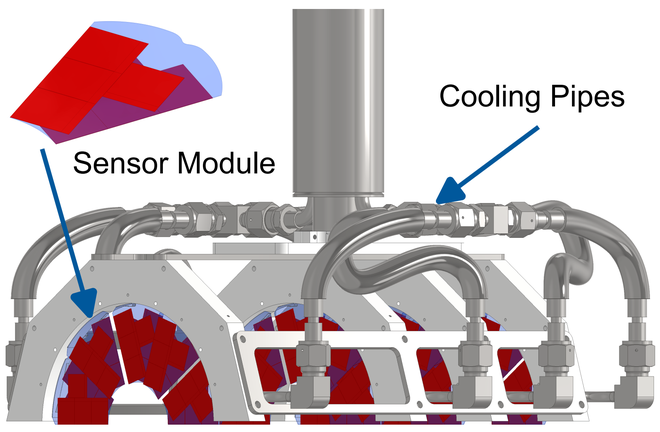
Sensorboard foreseen for the Phase A Forward Detector featuring a cutout at the dedicated sensor position.

Phase B / Commissioning planned late 2029

- Tracking detector equipped with four layers of HV-MAPS (successor of MuPix11) covering the full 360° angular range along the beam axis
- Two, from the beam pipe retractable, half detectors hold 40 modules with a total 320 sensors



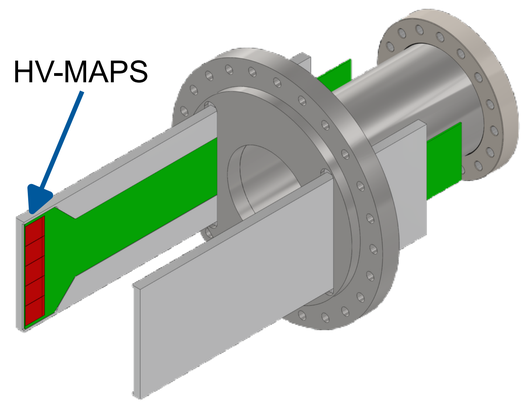
Sliced view of the Phase B Forward Detector.



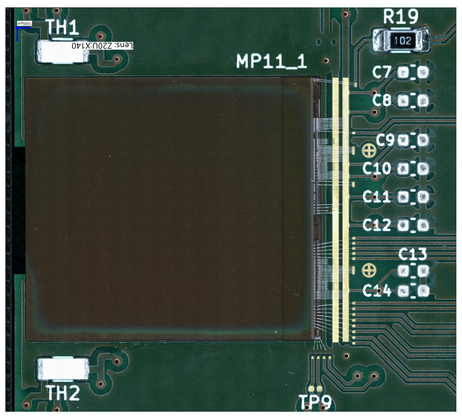
Half-Detector of the Phase B Forward Detector; inset: sensor module with HV-MAPS glued on each side.

Recoil Detector

- HV-MAPS will be placed approximately 65 mm away from the IP inside the KOALA scattering chamber
- Based on the same principle as the Phase A Forward Detector
- Used for background suppression through the coincident events in Forward and Recoil Detector



Two elongated sensorboards are glued into an aluminum support structure for mechanical stability and improved heat dissipation.



MuPix11 with ~ (20 x 23) mm² outline thinned down to 70 µm

Bonded MuPix11 sensor glued onto a sensorboard.