RE22/PANDA DIRC

Prototype Test at PS/T9

Jul 25 – Aug 15, 2018

Wed 25 Jul	Thu 26 Jul	Fri 27 Jul	Sat 28 Jul	Sun 29 Jul	Mon 30 Jul	Tue 31 Jul	Wed 1 Aug	Thu 2 Aug	Fri 3 Aug	Sat 4 Aug	Sun 5 Aug	Mon 30 Jul	Tue 31 Jul	Wed 1 Aug	Thu 2 Aug	Fri 3 Aug	Sat 4 Aug	Sun 5 Aug	Mon 6 Aug	Tue 7 Aug	Wed 8 Aug	Thu 9 Aug	Fri 10 Aug	Sat 11 Aug	Sun 12 Aug	Mon 13 Aug	Tue 14 Aug
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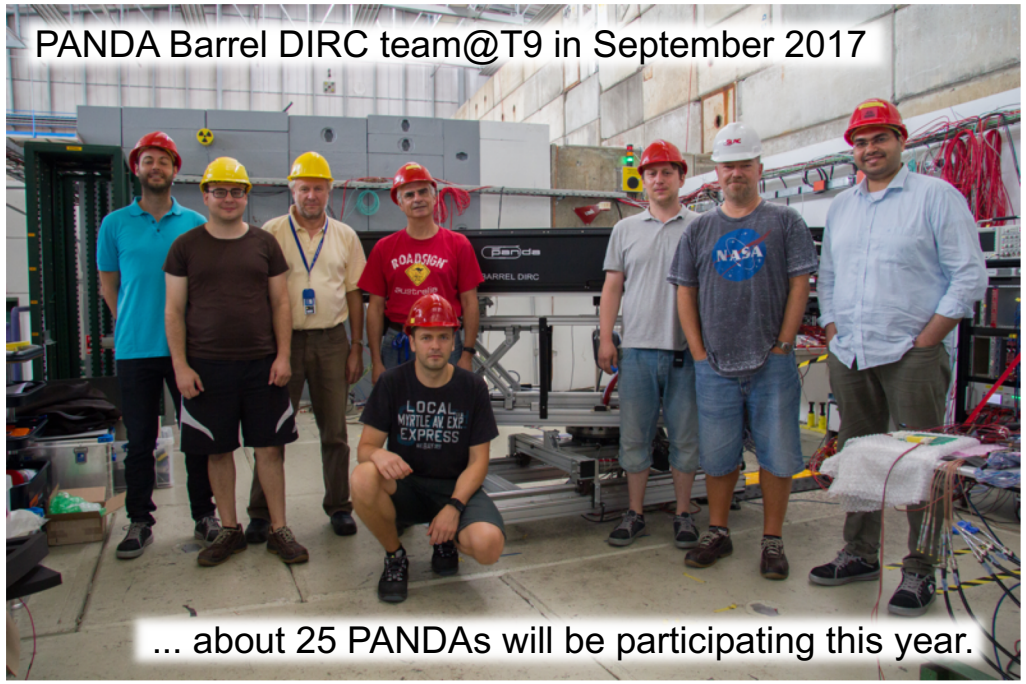
EA-Irrad												F. Ravotti															
RE22 PANDA					J. Schwiening							J. Schwiening															
ALICE ITS					P. Martinengo							P. Martinengo															
P349												D. Grzonka							P349								
nTOF												E. Chiaveri															

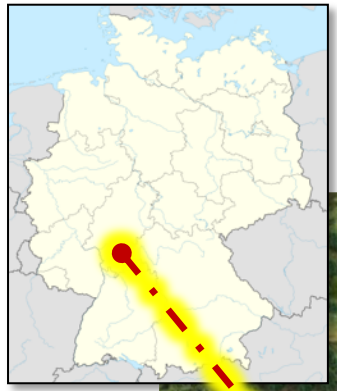


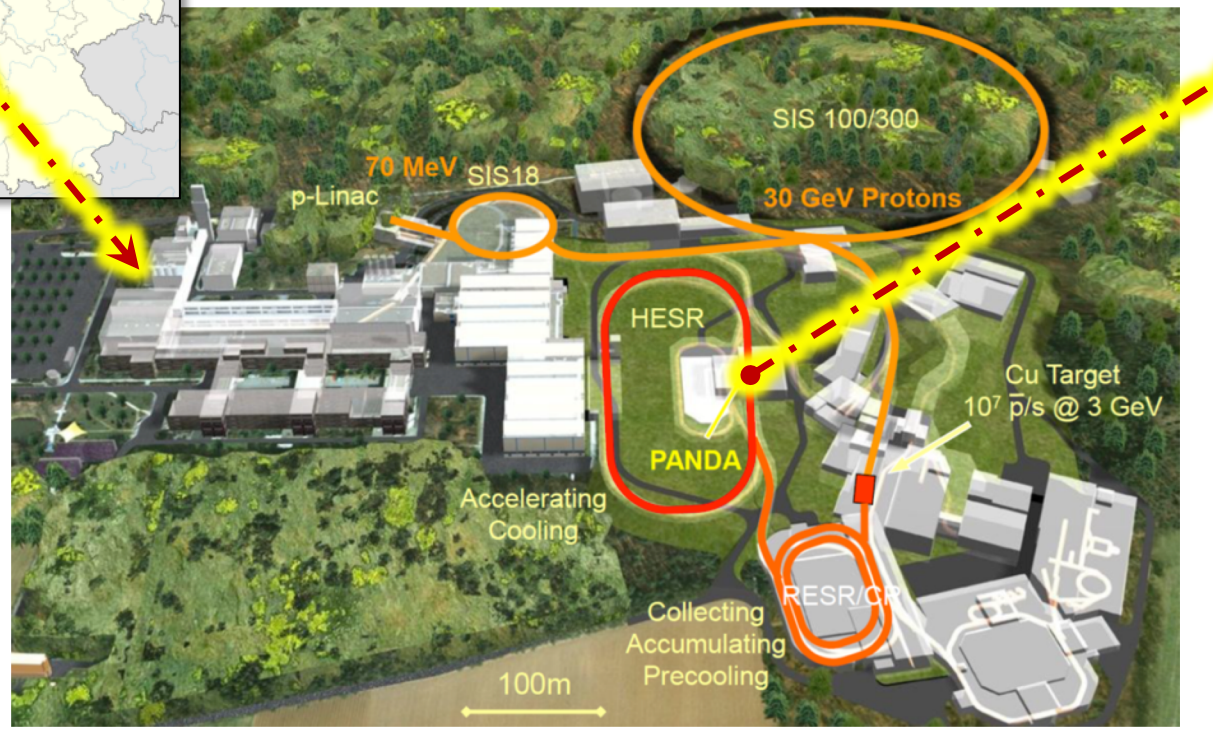
THE PANDA EXPERIMENT AT FAIR

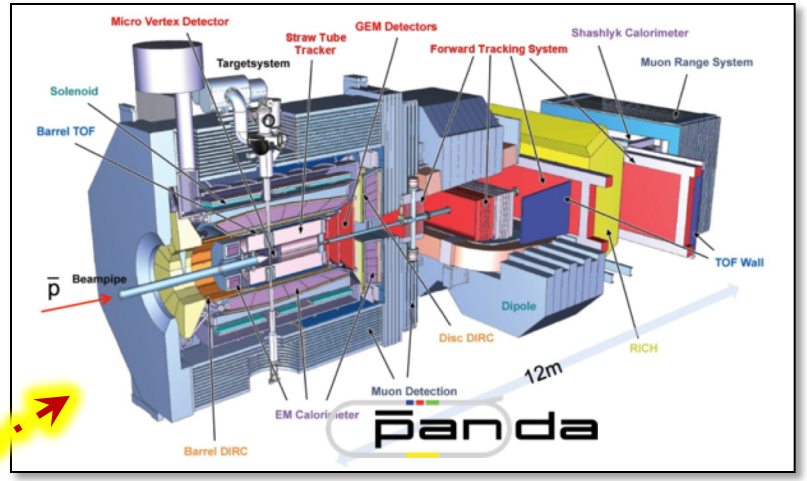
FAIR

Facility for Antiproton and Ion Research at GSI near Darmstadt, Germany

- FAIR Accelerator Complex
- PANDA Experiment
- DIRC Detectors







PANDA Collaboration:

460+ scientists from

75+ institutions in 19 countries.

PANDA schedule:

installation in 2022/23,

commissioning with protons in 2024,

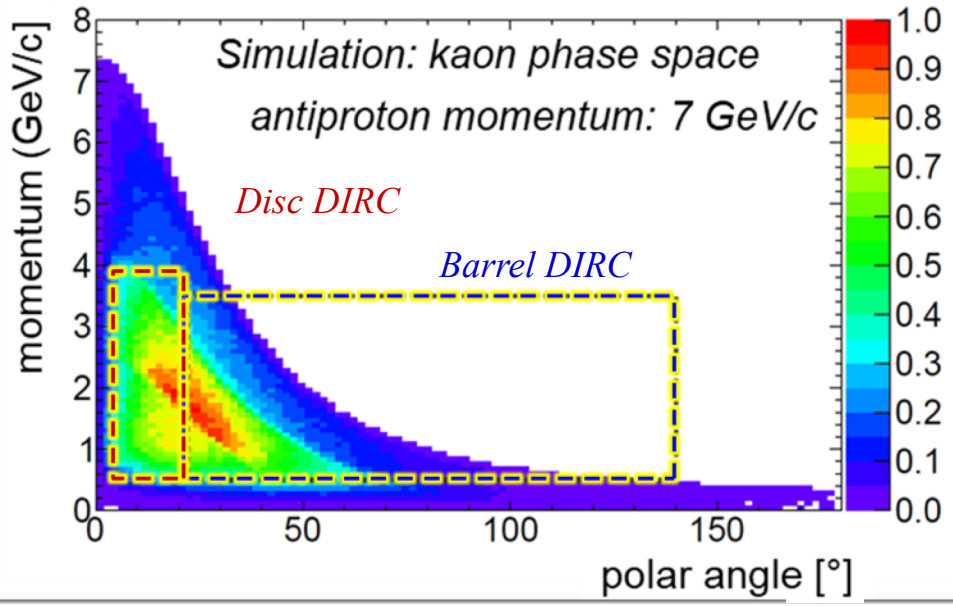
physics with antiprotons soon after.

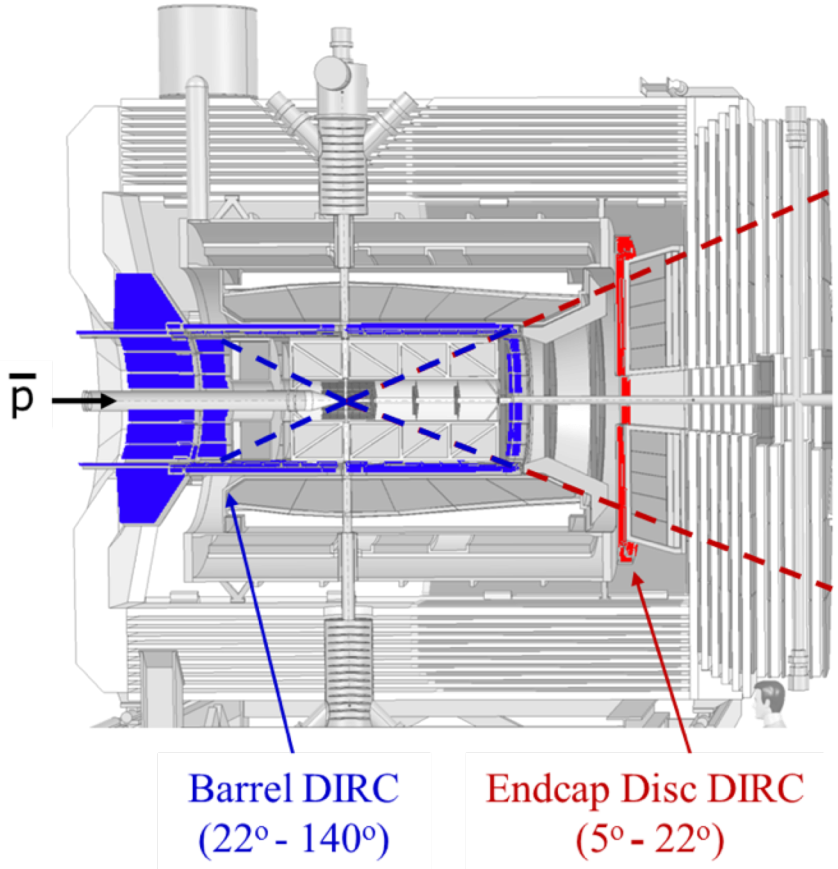
GSI

PANDA: two DIRC detectors for hadronic PID

- **Barrel DIRC** *(Detection of Internally Reflected Cherenkov light)*
  First DIRC with lens focusing.
  Goal: 3 s.d. π/K separation up to 3.5 GeV/c

- **Endcap Disc DIRC**
  First DIRC for detector endcap region.
  Goal: 3 s.d. π/K separation up to 4 GeV/c





Required PID performance perfect match to DIRC coverage

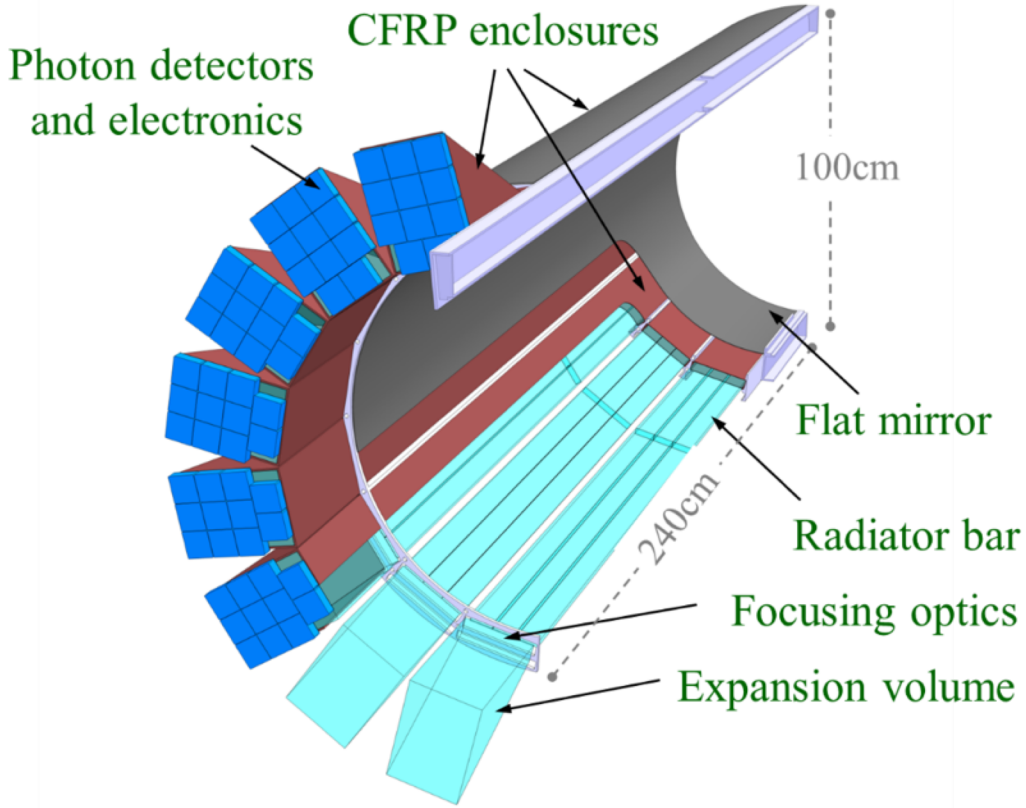
→ BaBar DIRC achieved 3 s.d. π/K sep. up to 4 GeV/c

BARREL DIRC: FINAL DESIGN

For more detail, see PANDA Barrel DIRC TDR, arXiv:1710.00684

Compact fused silica prisms, 3 bars per bar box, 3-layer spherical lenses.

- 48 radiator bars (16 sectors), synthetic fused silica,
  17mm (T) × 53mm (W) × 2400mm (L).
- Focusing optics: 3-layer spherical lens
- Compact expansion volume:
  30cm-deep solid fused silica prisms
  ~11,000 channels of lifetime-enhanced MCP-PMTs
- Fast FPGA-based photon detection.
  ~100ps per photon timing resolution
- Expected performance (simulation and particle beams):
  better than 3 s.d. π/K separation for entire acceptance.



Conservative design – similar to proven BABAR DIRC, validated in particle beams in 2015-2017.

Excellent performance, robust, little sensitivity to backgrounds and timing deterioration.

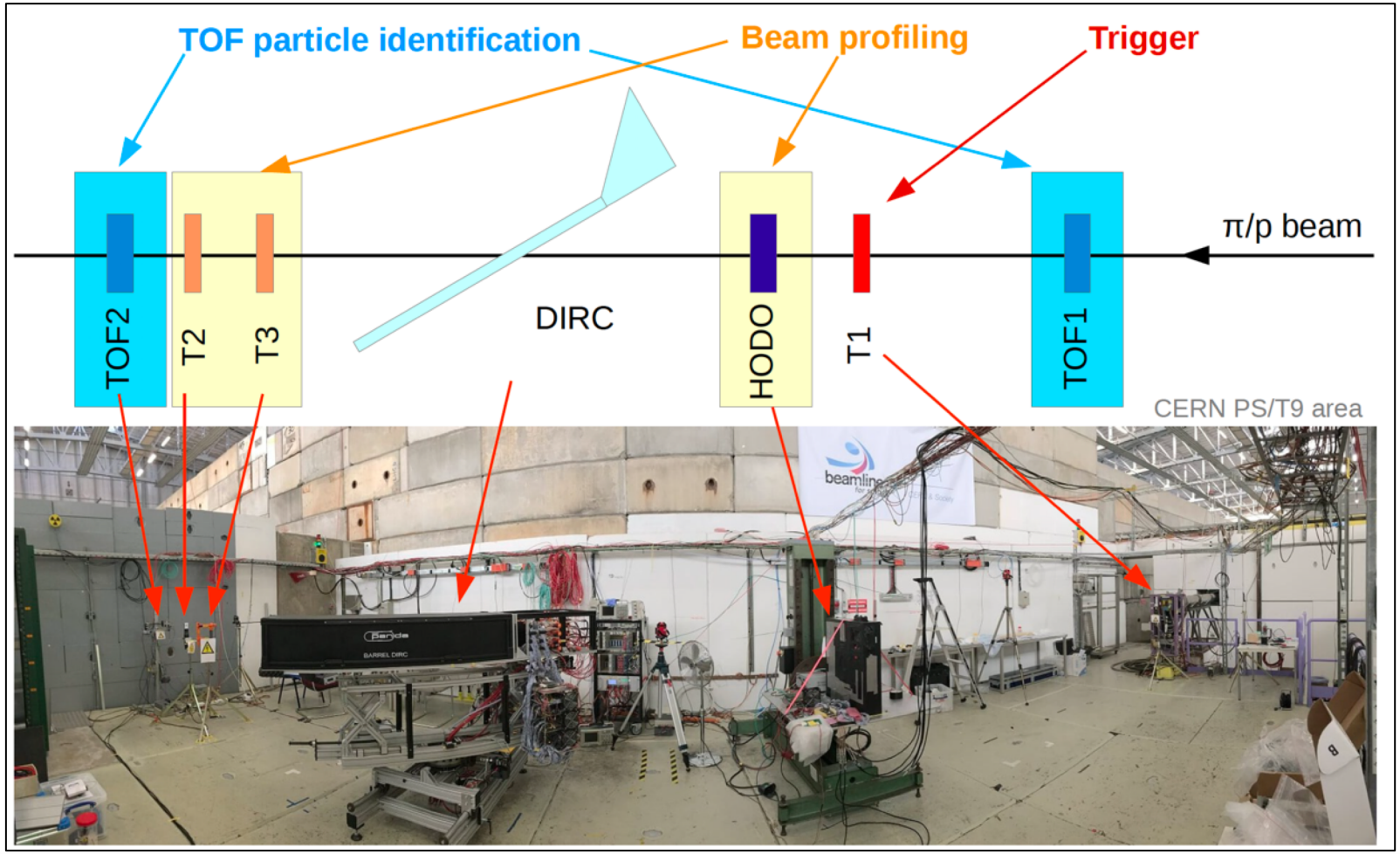
Design completed, moving to construction phase (call for tender this summer).

2017 BARREL DIRC TESTBEAM IN T9

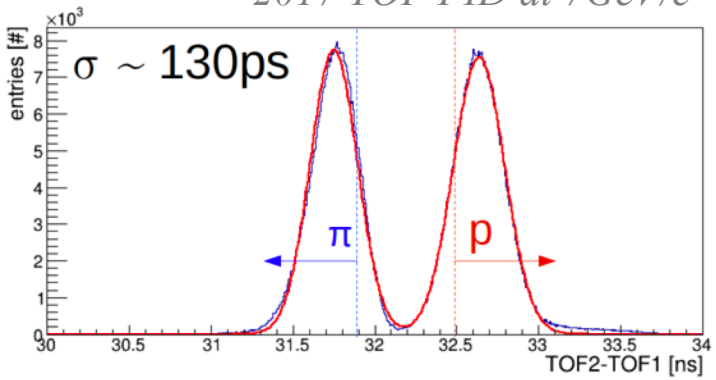
T9 beamline: mixed hadrons (mostly π and p), available momentum range 1.5-10 GeV/c

Most measurements at 7 GeV/c – π/p Cherenkov angle difference (8.1 mrad) approx. same as π/K at 3.5 GeV/c (8.5 mrad).

Scintillators for trigger (T1-3) and beam spot selection in combination with fiber hodoscope.



2017 TOF PID at 7GeV/c



Time-of-flight system

Two TOF stations, ~28m distance

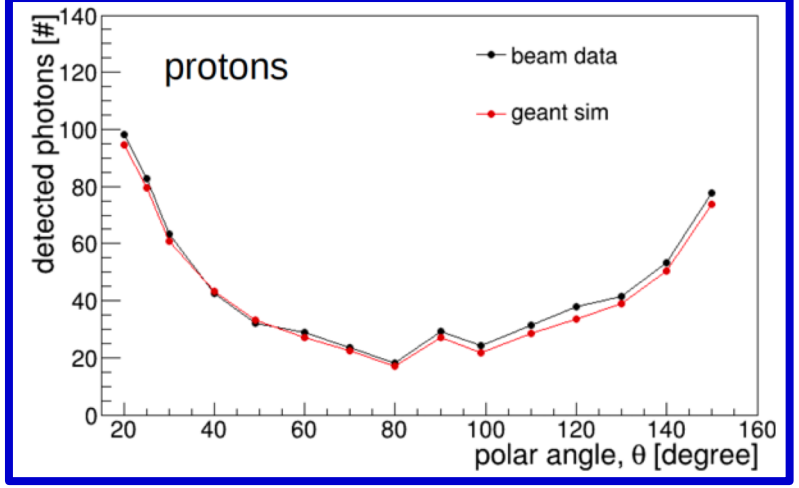
Clean tag for pions and protons up to 10 GeV/c.

2017 Barrel DIRC Highlights

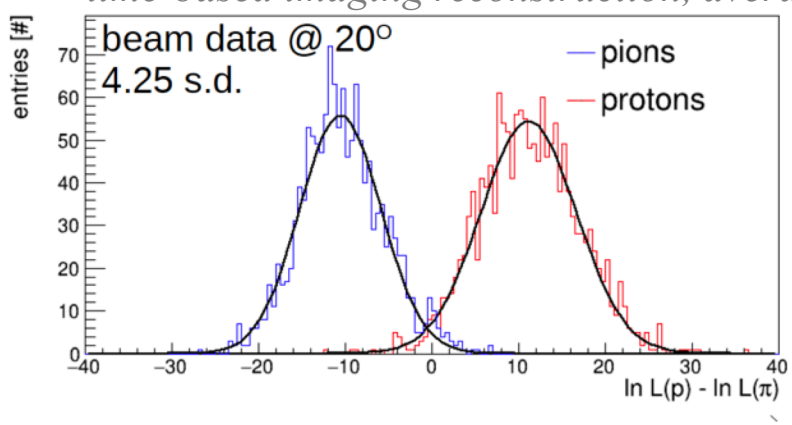
Photon yield, single photon angular resolution, π/p separation

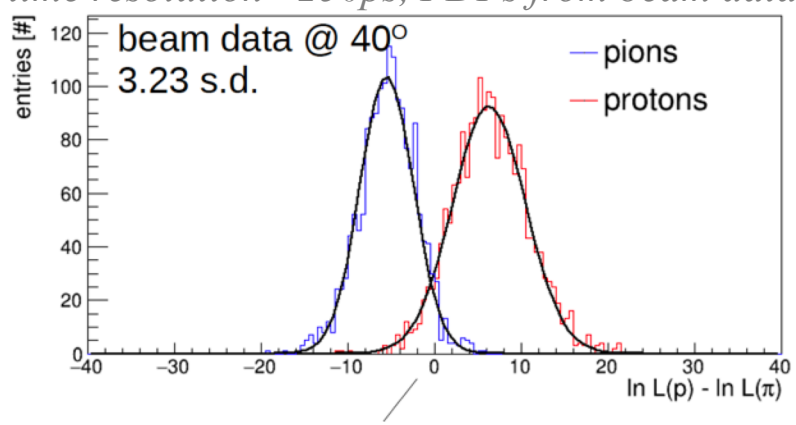
at 7 GeV/c (equivalent of 3.5 GeV/c π/K).

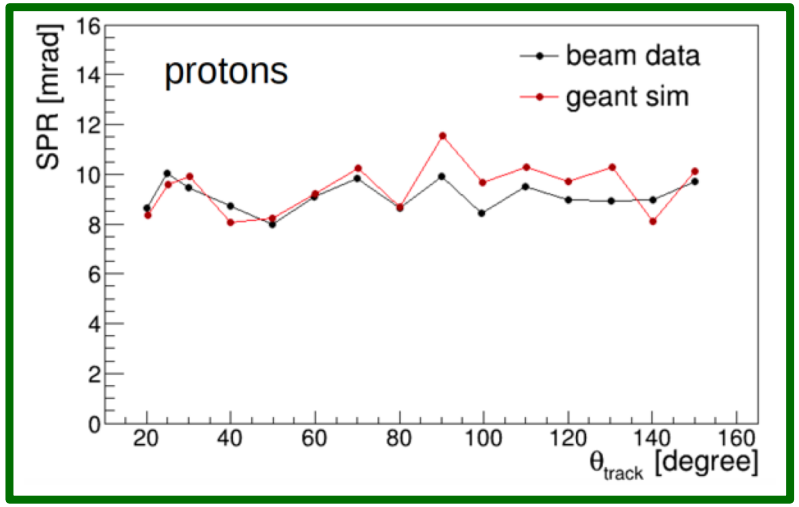
Calibration of data still ongoing
All results still preliminary



time-based imaging reconstruction, average time resolution ~250ps, PDFs from beam data







Simulation describes beam data well.

PID performance exceeds PANDA requirements,

validates the design (both geometric/spatial and time-based reco).

Result extrapolates to 6.6 s.d. π/K at 3.5 GeV/c, 22 deg for fully equipped PANDA Barrel DIRC (simulation with 100 ps timing).

Endcap Disc DIRC (EDD) Design

Cherenkov effect-based PID

3σ π/K-separation up to 4 GeV/c

2 mrad Cherenkov angle resolution

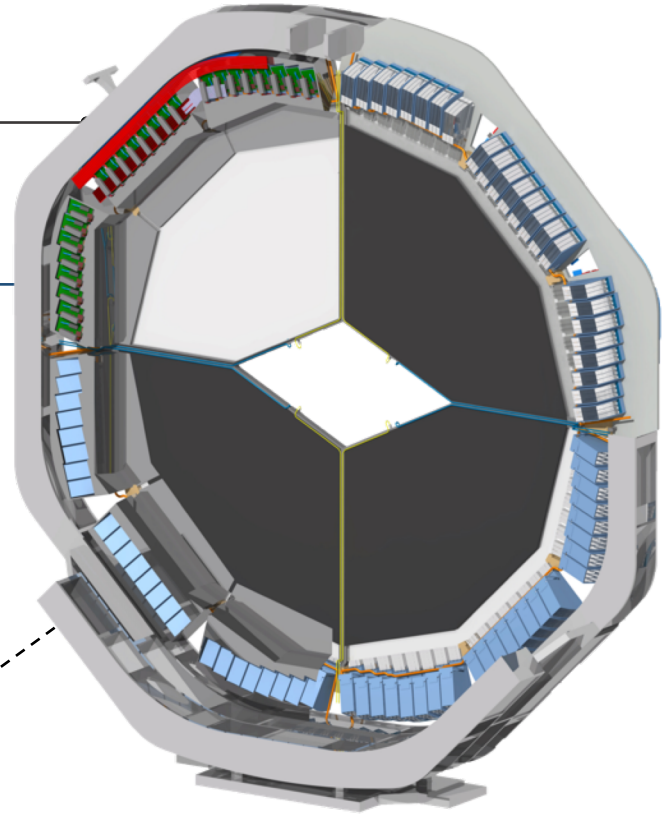
4 independent Quadrants

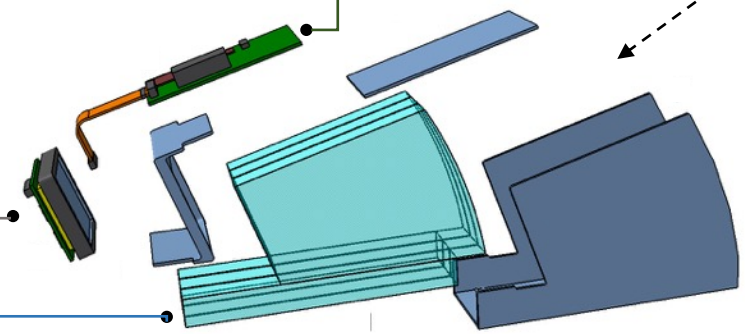
optics made of synthetic fused silica

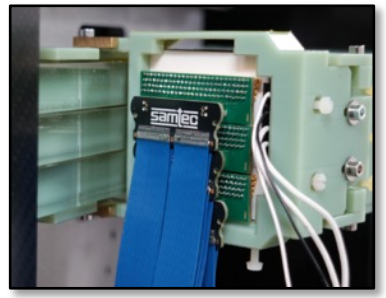
focusing elements convert angle to position information

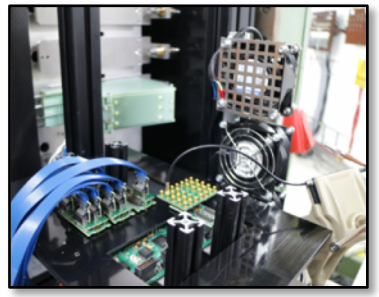
2-inch MCP-PMT readout with a pitch of 0.5 mm

ASIC based readout









Quadrant plate dimension:

20mm thickness

1056mm outer radius

Sensors: 96 MCP-PMTs

with very fine segmentation

TOFPET ASIC readout

~30k channels

TDR completed

Beam tests at CERN in 2015 (T9) and at DESY in 2016 validated basic performance parameters.

Looking for direct pi/K separation power measurement this year.

T9 2018 TESTBEAM LAYOUT

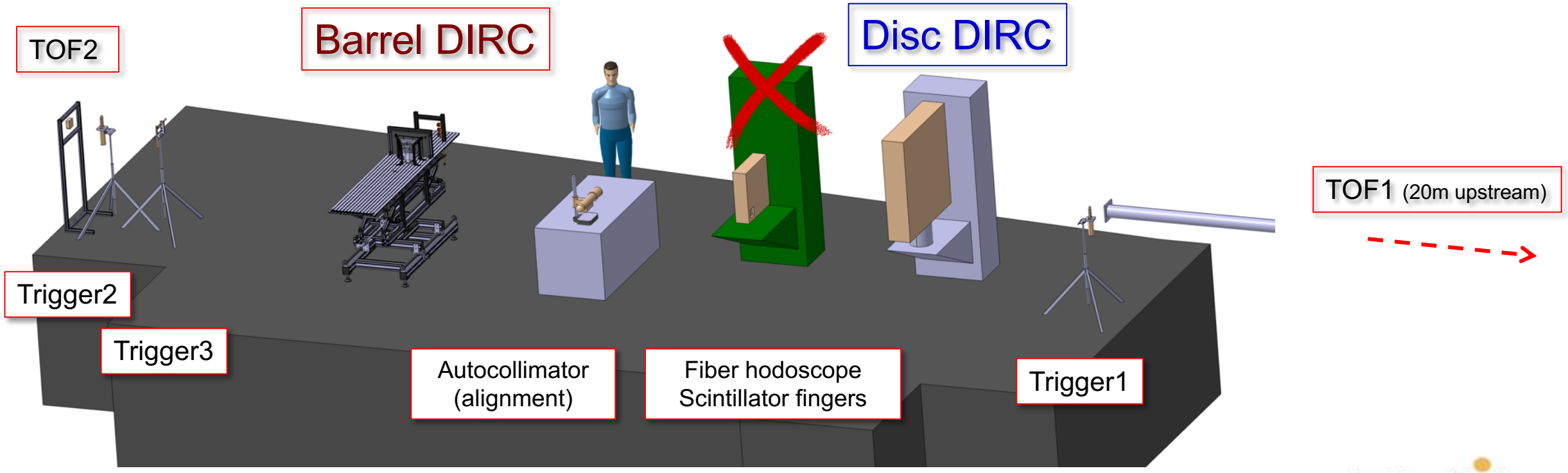
Setup more complex in 2018 than in past years: Barrel DIRC and Endcap Disc DIRC prototypes

Goal for this beam test: evaluate performance of advanced/near-final configuration

Barrel DIRC: collect high-statistics data sets for most challenging kaon phase space region, test cost-saving sensor coverage.

Disc DIRC: validation of PID performance of latest design, direct measurement of π/p separation power.

Tests of Scintillating Tile (SciTil) prototype (time-of-flight barrel for PANDA, SiPM as sensors, TOFPET readout).



PANDA/RE22 REQUESTS

Status, plans, requests:

- Team arrived on Monday, started setting up in T9 on Wednesday.
- Safety inspection scheduled for Friday, 14:00, hope to take first beam data before the weekend.

- Need high statistics pions and protons, primarily at 7 GeV/c, few runs at lower/higher momentum.
- Can our fellow East Area users agree to the use of the hadron-rich target (head 3)?

- Our measurement is statistics-limited, planning 24 hour/day data taking.
- We received 2-3 (sometimes 4) spills/SC in 2015 and 2016, even more in 2017, was essential to obtain high-precision results.
- Is it possible to get at least 2 spills/SC this year, and could we get 3 spills/SC when an extra spill is available?