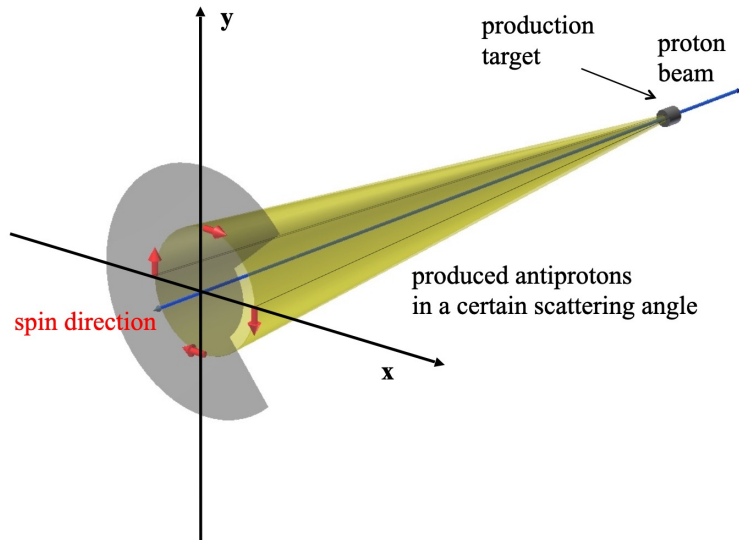


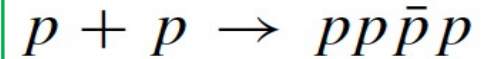
Commissioning of the DOGMA DAQ for the P371 Experiment

Huagen Xu

- Can antiprotons be polarized during production?



Antiproton production reaction:

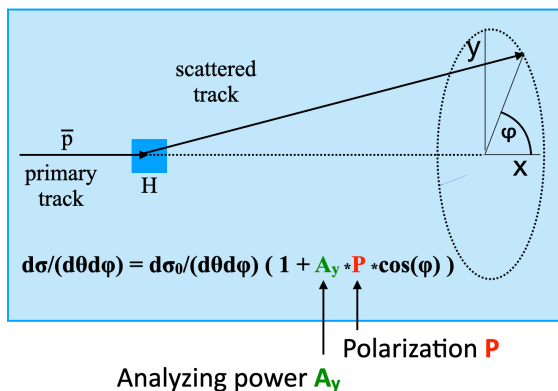


Possible origin of transverse polarization (at non-zero angles):

- Spin-orbit coupling
- Interference of spin-dependent amplitudes

**Cut out one side in the horizontal angular distribution
=> Preparation of a polarized beam**

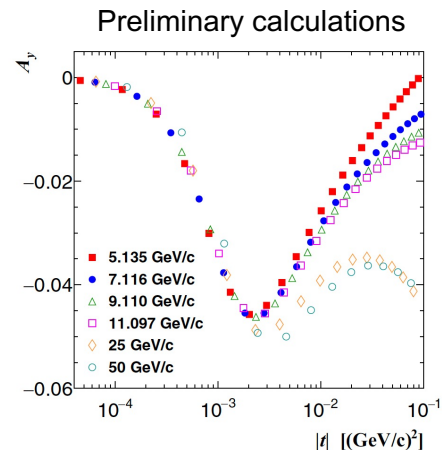
- Left-right asymmetry of elastic $\bar{p}p$ scattering at known analyzing power



Measurement of the asymmetry:

$$\epsilon = \frac{N_L - N_R}{N_L + N_R} = A_y(\theta) P \cos \phi$$

of elastic $\bar{p}p$ scattering
at known analyzing power

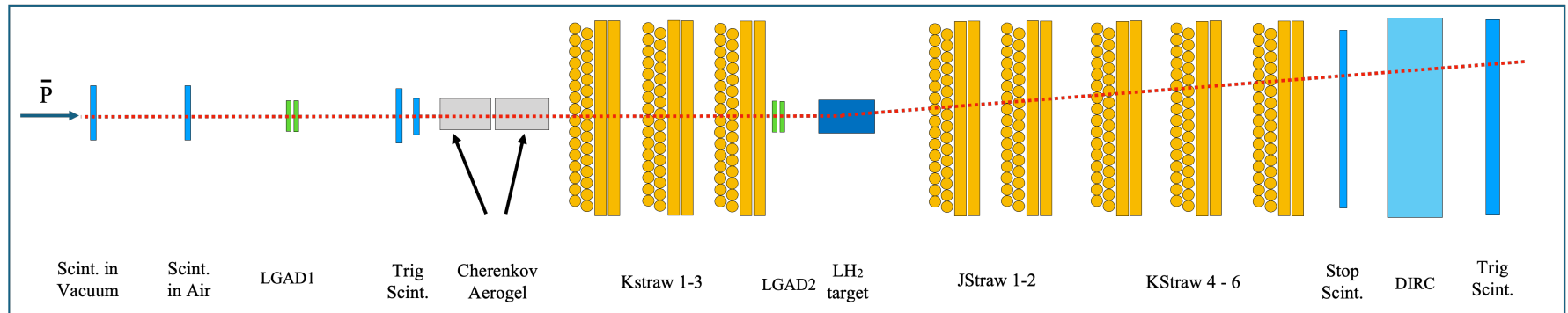


Coulomb Nuclear Interference
(CNI) region: $A_y = 4.5\%$

Ref: EPJC_2026_86:390

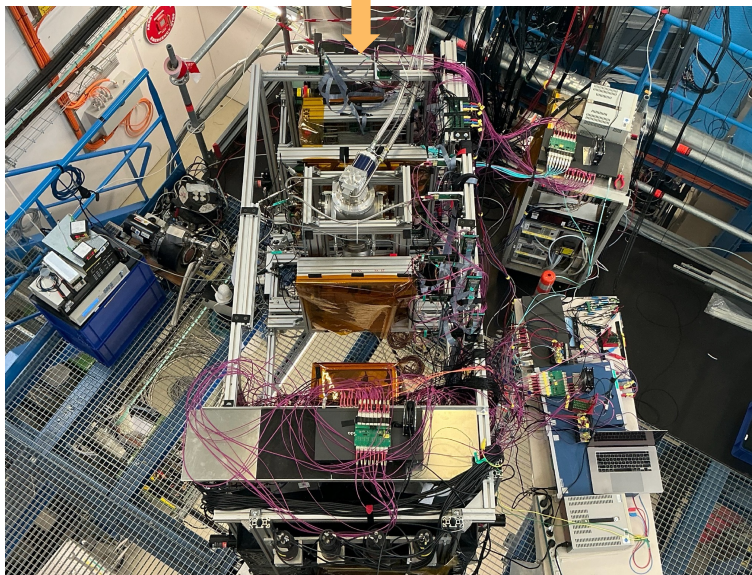
P371 Detector Concept

- Antiproton-proton elastic scattering at ~ 10 mrad and 3.5 GeV/c
- Angular distribution of scattered antiprotons
- Identification of antiprotons from the beam particles

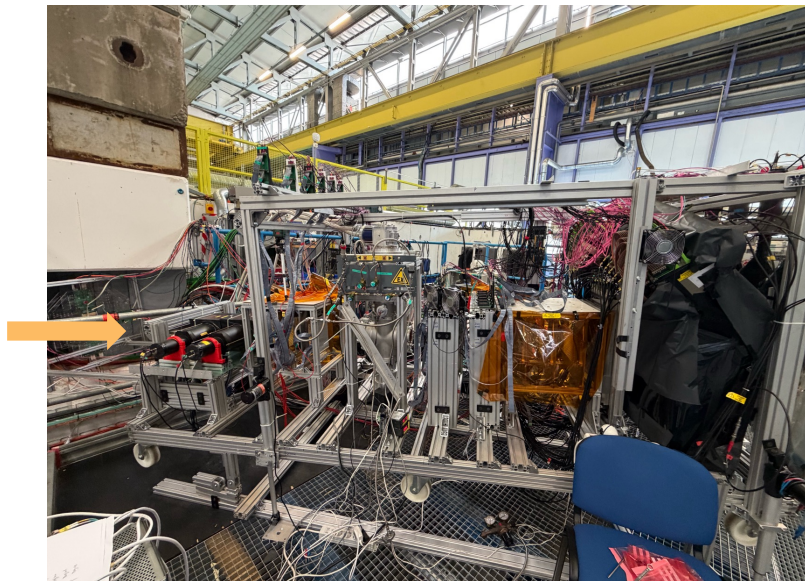


Experiment Setup at T11

- Beam test setup at the CERN PS east area T11 beam line



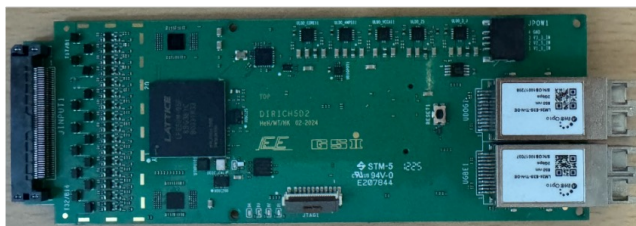
Top view



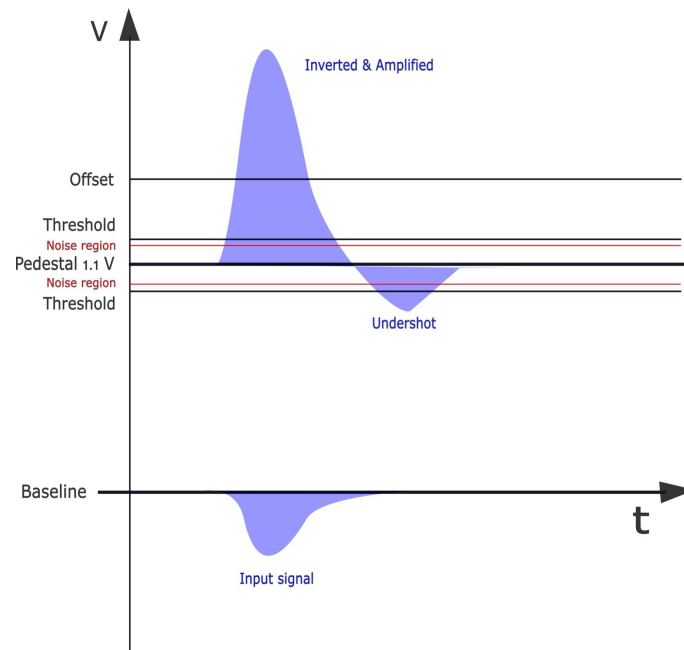
Side view

- Detector signals
 - Plastic scintillator with PMT readout
 - Cherenkov with PMT readout
 - LGAD timing detectors
 - DIRC with PMT readout
 - Straw tubes detector with PASTTREC
- Signal channels: ~ 1800
- Beam intensity: $\sim 1e6$ /s
- Trigger (external): $< 20k$ /s
- DOGMA DAQ
(M. Traxler, GSI EE, for the DOGMA Coll.)
 - Scalable parallel boards
 - Detector-specific input adaptors
 - Common timing and trigger handling
 - Online monitoring

- DOGMA/DiRICH(HW)
 - 32 Channels (both polarities)
 - Input down to 500 μV signals @50 Ω
 - Adjustable Gain and thresh
 - TDC precision: ~ 12 ps (RMS)
 - Optical data links
 - 1 Gbps /10 Gbps link options



10 x 4 cm²



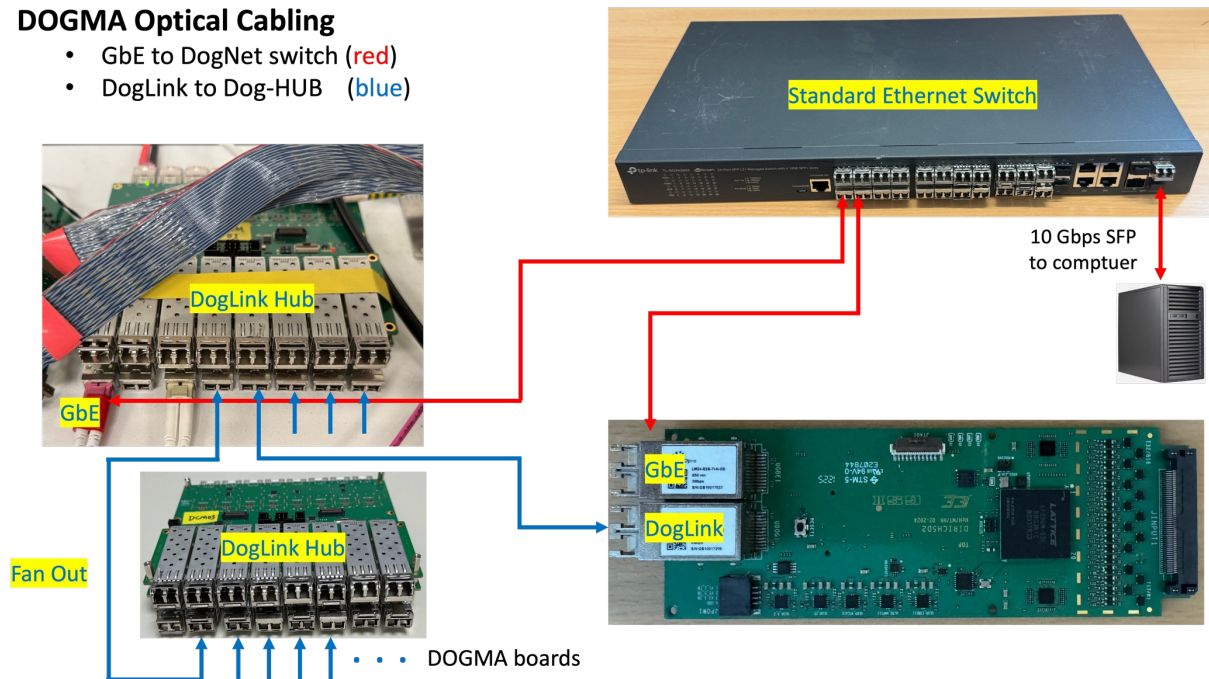
Schematic working principle

DOGMA Scalable Architecture

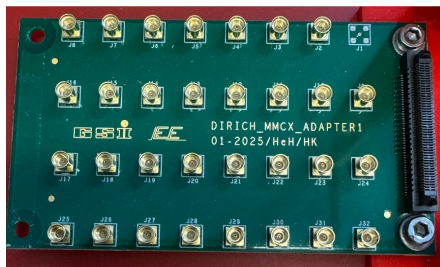
- Scalable DOGMA readout
- Standard ethernet switches
- No intrinsic limit of bandwidth for the data flow

DOGMA Optical Cabling

- GbE to DogNet switch (red)
- DogLink to Dog-HUB (blue)



DOGMA Adapters



MMCX
adapter



34 pin IDC
connector
adapter



Digital
Input



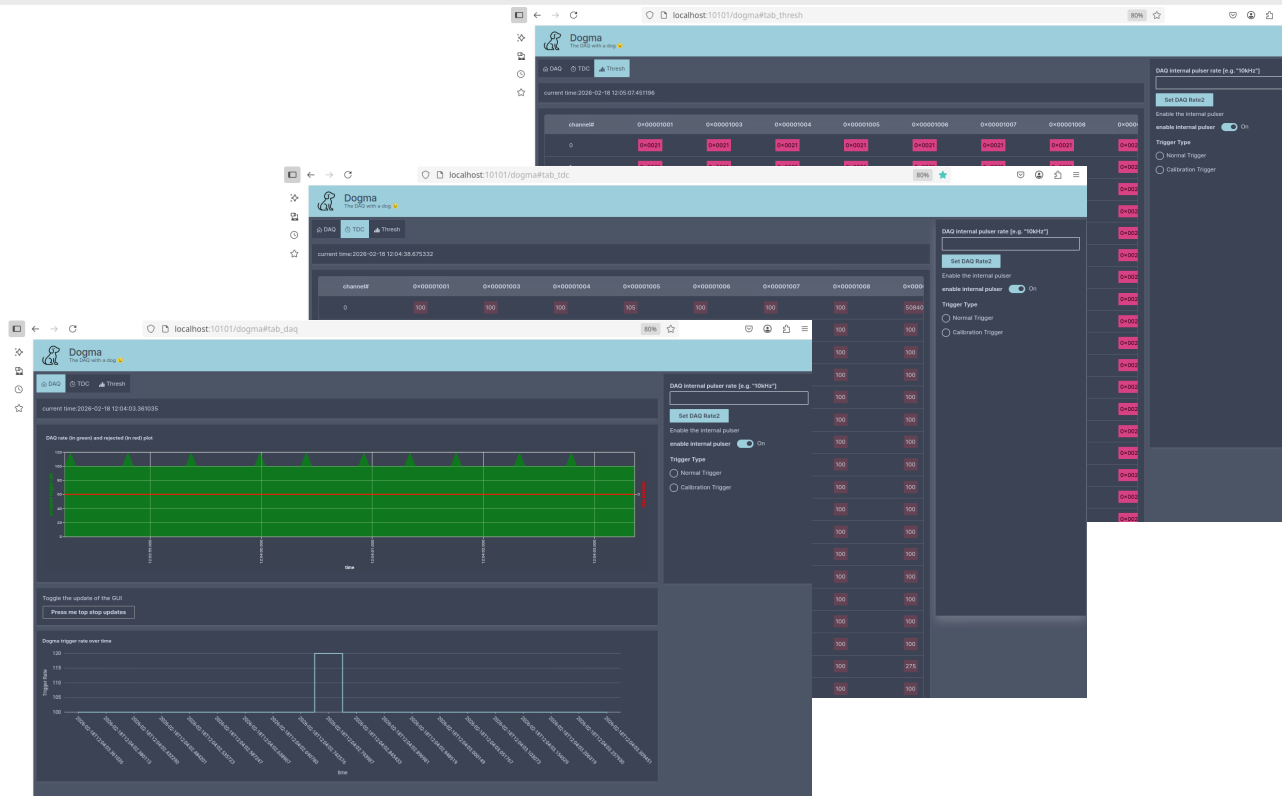
LVDS
Input

Detector-specific adapters for analog and LVDS signals

Mapping, timing and online checks



- Thresh tab
- Hit-rate tab
- Trigger-rate tab

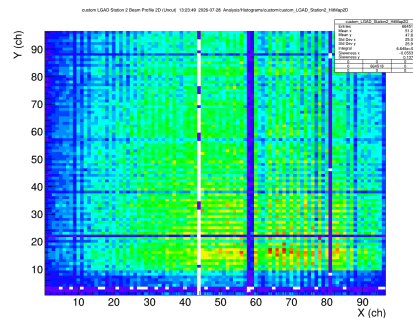


DOGMA Data Taking and Monitoring (Beam Profiles)



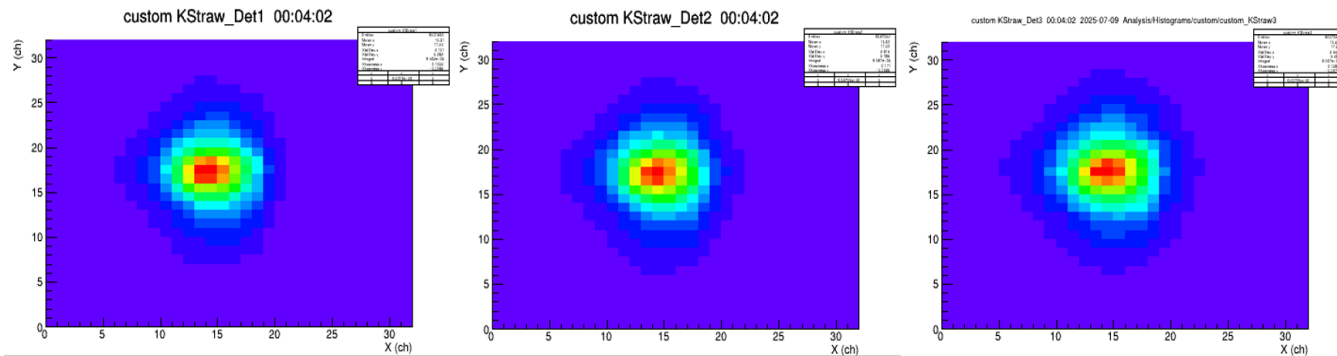
- DABC package for data taking
- Go4 package for online analysis
 - ROOT for histogramming and checks

LGAD



2 x 2 cm

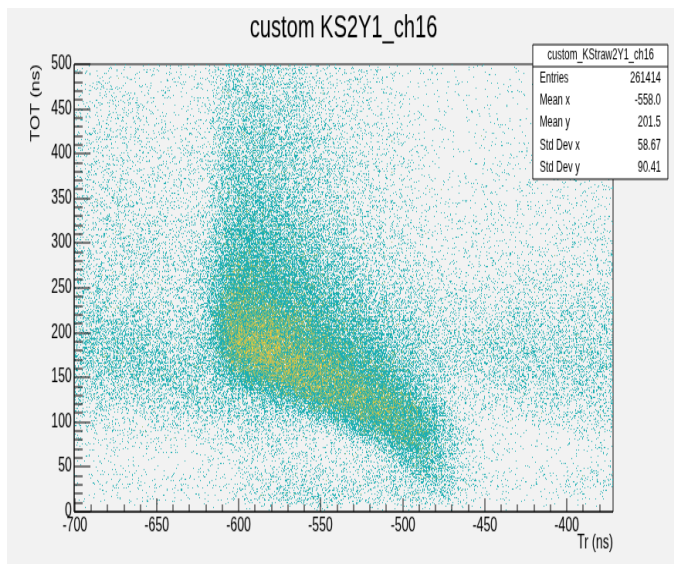
Straw tube detector



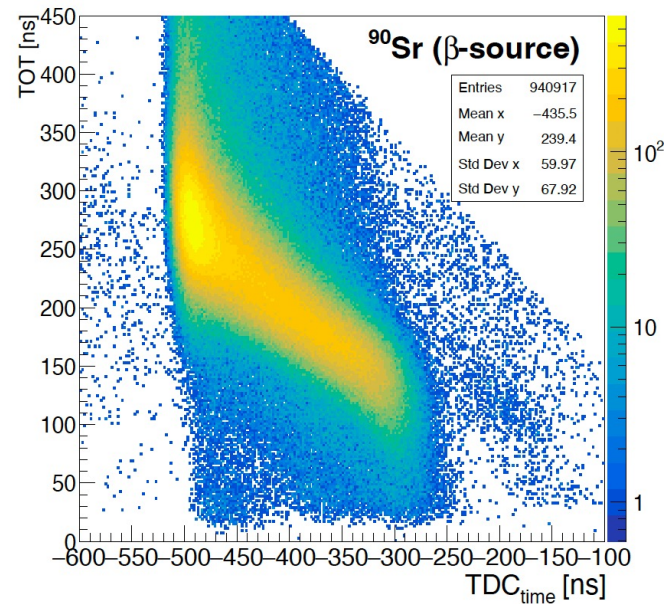
32 ch per layer
(~16.5 cm)

- Straw readout via Pasttrec digital output (alternative Dogma with TDC only)

Beam data: one straw

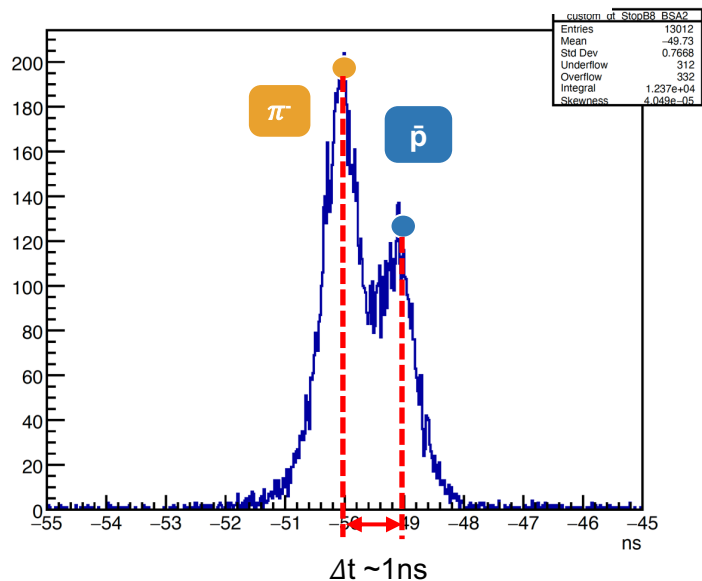


Reference: one straw

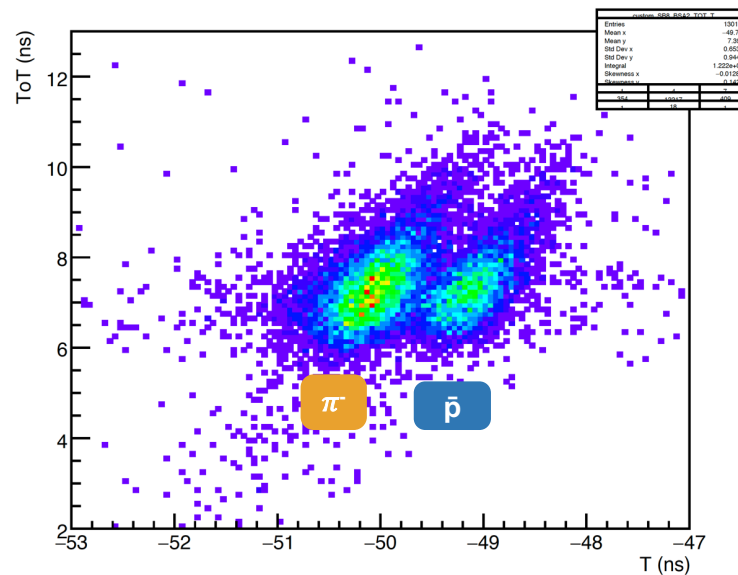


- Flight distance ~ 8.5 m, at 3.5 GeV/c

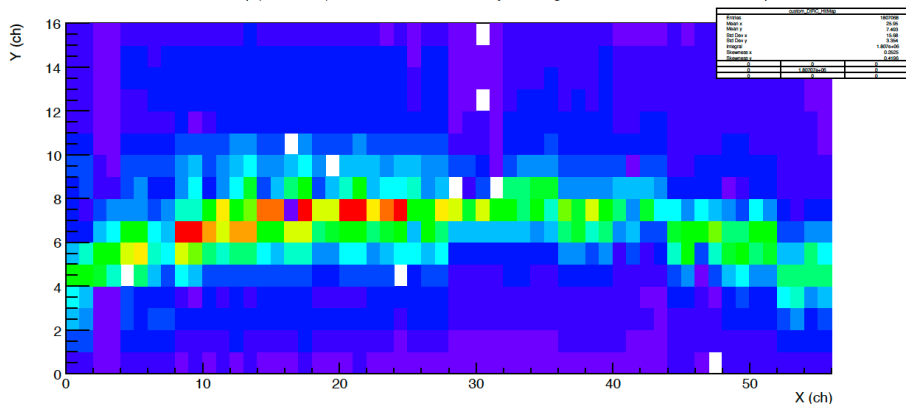
ToF Spectrum



ToT vs ToF



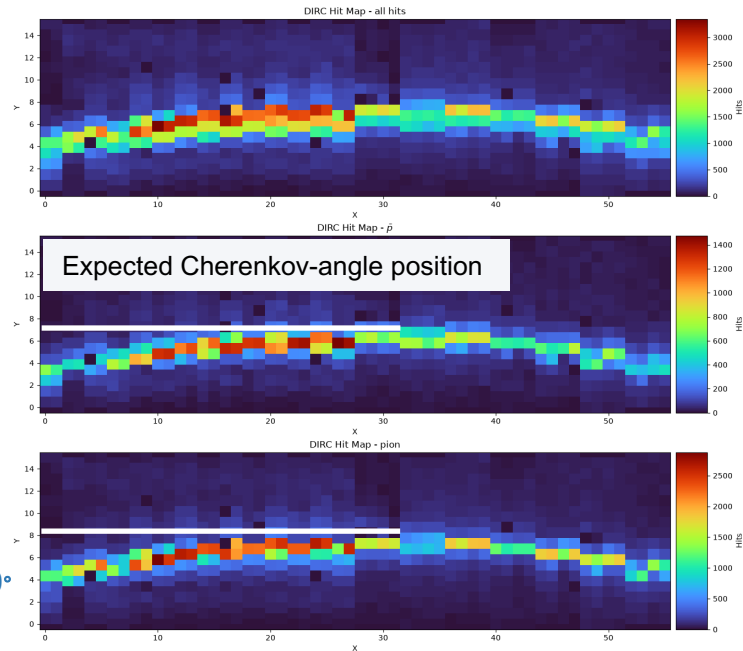
All Channels of DIRC



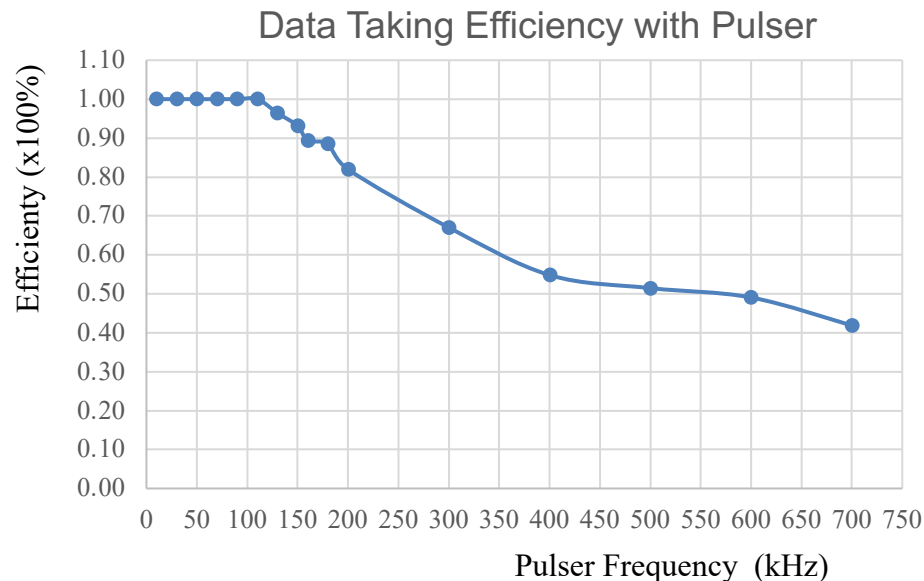
All hits
 $p = 3.5 \text{ GeV/c}$

**ToF-tagged
 $\bar{p}$ candidates
 $\theta_c(\bar{p}) = 45.99^\circ$**

ToF-tagged Pions
 $\theta_C (\pi^-) = 47.80^\circ$



- ~1800 Channels (~63 DOGMAs)
- Stable operation over 8 weeks
- Data flow with a common trigger
 - ~70 MB/s @ 14 kHz trigger rate
- Analog and LVDS signal integration



Pulser:

- Trise: 2.5ns, Tfall: 10ns,
- Twidth: 15 ns, Amp: 150mV

- Successfully commissioned DOGMA in the P371 beam test
- Stable operation with 63 boards over eight weeks
- Validated a common DOGMA timing readout for variable detectors

Thanks for your attention!

- p : 24 GeV/c** **$\bar{p}$: 3.5 GeV/c**

