

# **Neural Track Trigger in 2022**

- Since Exp. 24 new firmware from improved network training
- Synopsis of STT resolutions for experiments in 2022
  - Successes and problems
- Plans for the rest of 2022
  - Analyse cosmic data taking recently (started, not yet finished): test some minor fixes in firmware, use of (global) event time for drift time calculation
  - Work planned for the rest of the year

## **Reminder: z-Resolution in Exp. 22**







Gaussian fits to neuro tracks associated with reco tracks from IP (|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 5.6 cm

2nd Gauss:  $\sigma = 11.5 \text{ cm} (8 \%)$ 

# Exp. 24, New Training and FW





(|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 2.8 cm

2nd Gauss:  $\sigma = 6.4 \text{ cm} (13.2 \%)$ 

Exp 24, runs 790 - 890, New FW

3000

2000

1000

0

-1

STT active, zcutTrig = 20 cm

-0.5

0

0.5

cos(theta)

1

## **Z**-Resolution for IP Tracks ("Clean" Tracks)





### z-Resolution for IP Tracks ("experts")



chIPErr2Phi

Entries

Mean

Std Dev

իրտուր

phi [deg]

100

20148

-4.834

96.16



C. Kiesling for the Neuro Group, B2GM, Trigger Parallel Session, Oct. 7, 2022

Gaussian fits to neuro tracks associated with

### **Z** z-Resolution for all z values





Exp 24, runs 790 - 890, New FW

STT active, zcutTrig = 20 cm

#### Exp 24, New FW (positive z values)





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#### Exp 24, New FW (negative z values)





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Exp. 26



Exp 26, runs 0-800 (first half)

|z| < 15 cm, STTactive

# Exp. 26, last Runs 1600-1960







Exp 26, runs 1600-end

|z| < 15 cm, STTactive

#### Exp 26 (positive z values)





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#### Exp 26 (negative z values)





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## z-resolution at IP, Exp. 26, early runs







Gaussian fits to neuro tracks associated with reco tracks from IP (|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 3.2 cm

2nd Gauss:  $\sigma = 8.9 \text{ cm} (12.1 \%)$ 

Exp 26, runs 0-800 (first half)

|z| < 15 cm, STTactive

## Zeresolution at IP, Exp. 26, runs 1600-end







Gaussian fits to neuro tracks associated with reco tracks from IP (|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 3.1 cm

2nd Gauss:  $\sigma = 7.6 \text{ cm} (17.9 \%)$ 









Gaussian fits to neuro tracks associated with reco tracks from IP (|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 2.9 cm

2nd Gauss:  $\sigma = 7.3 \text{ cm} (13.0 \%)$ 







Gaussian fits to neuro tracks associated with reco tracks from IP (|z|<1 cm, d < 1.5cm)

Central Gauss:  $\sigma$  = 2.9 cm

2nd Gauss:  $\sigma = 7.0 \text{ cm} (16.3 \%)$ 

### Comparison of STT Rates Exp. 25 / 26









- New FW, based on retrained networks using Exp. 20 data, has shown excellent performance: better data selection and more advanced training methods
- z-resolution dramatically improved compared to the previous networks: central Gaussian  $\sigma$  = 5.6 cm ->  $\sigma$  ~ 3 cm , p resolution also improved
- However, trigger rate of STT increased during the last month before the shutdown (much larger background due to attempts to increase luminosity)
- Reason: "feed-down" and especially fake tracks due to increased background (and therefore increased 2D candiadates in the neural peprocessing) have strongly increased.
- BUT: IP track resolution did not suffer under high BG conditions
- Efforts now on UT4 FW using 3D preprocessing -> Kai
  Caveat: Training of networks lacks person-power
- Development of Displaced Vertex Trigger (macro cell Hough) very promising -> Elia





## STT Bit vs STT calc has improved !







- HW/SW program for LS1 period concerning STT clearly defined
- Essential: Full concentration on new UT4 platform step by step
- Main goal is to bring the z resolution below 2 cm (simulation/training needed)
- Time scale to fulfill the new requirements seem OK (1.5 years)
- First DVT (MPI variant) could realistically be brought online for the next running period

Development for LS2 (> 2026 ....) , just for completeness

- New UT5 platform being discussed
- During LS2 CDC frontend will be replaced, providing also the digitized charge depositions on all of the CDC wires (full ADC values, not just thresholds).
- Could be very useful for suppressing background hits for advanced DVTs and further "sharpening" of the STT when design luminosity is being approached.

