



Istituto Nazionale di Fisica Nucleare



New time calculation algorithm for TOF-Wall

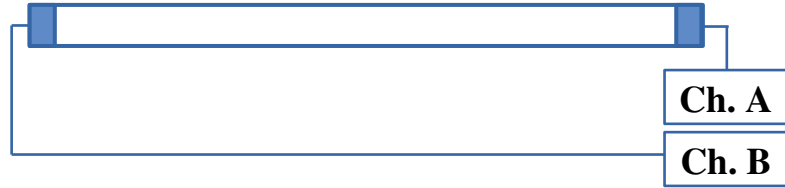
R. Zarrella (w/ the advice of Mauro!)

FOOT physics meeting

06/10/2021

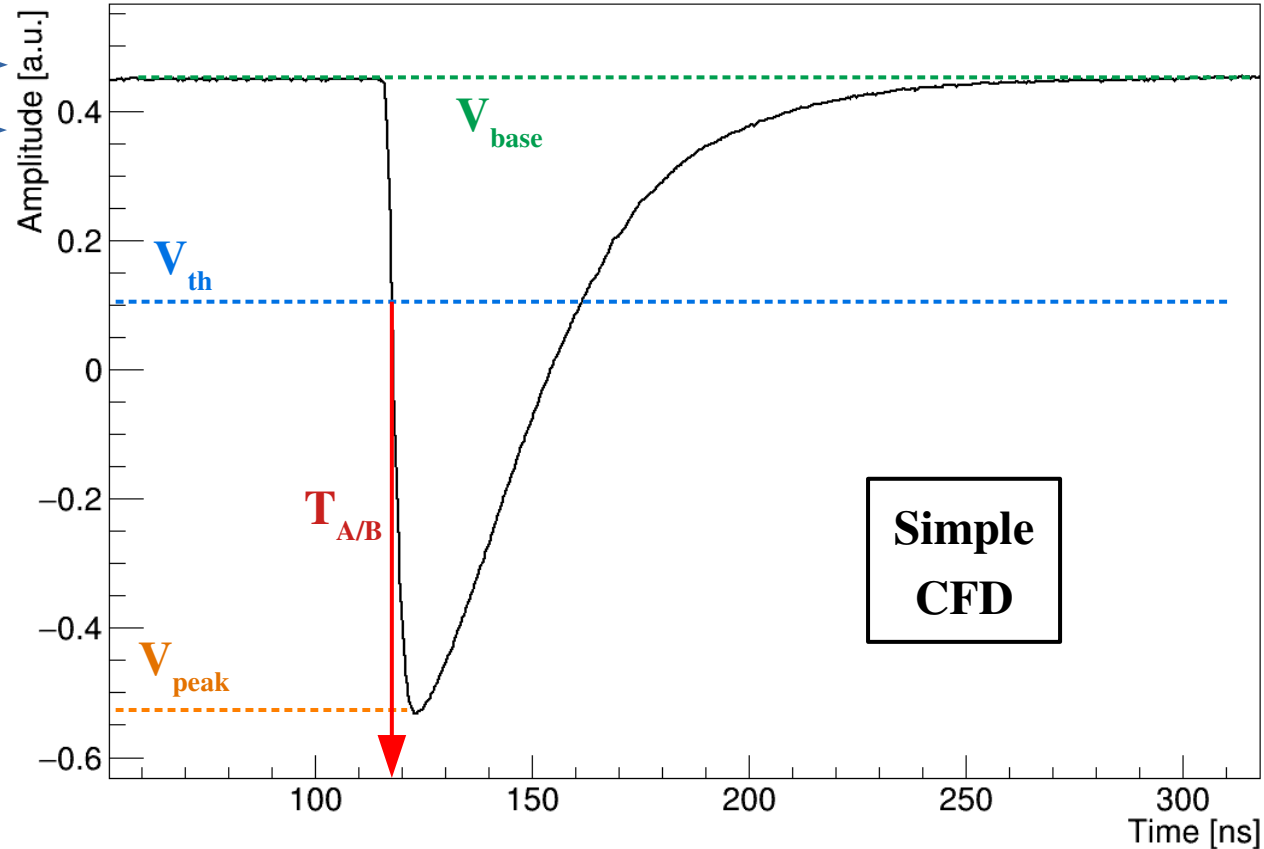


Time calculation in the TW



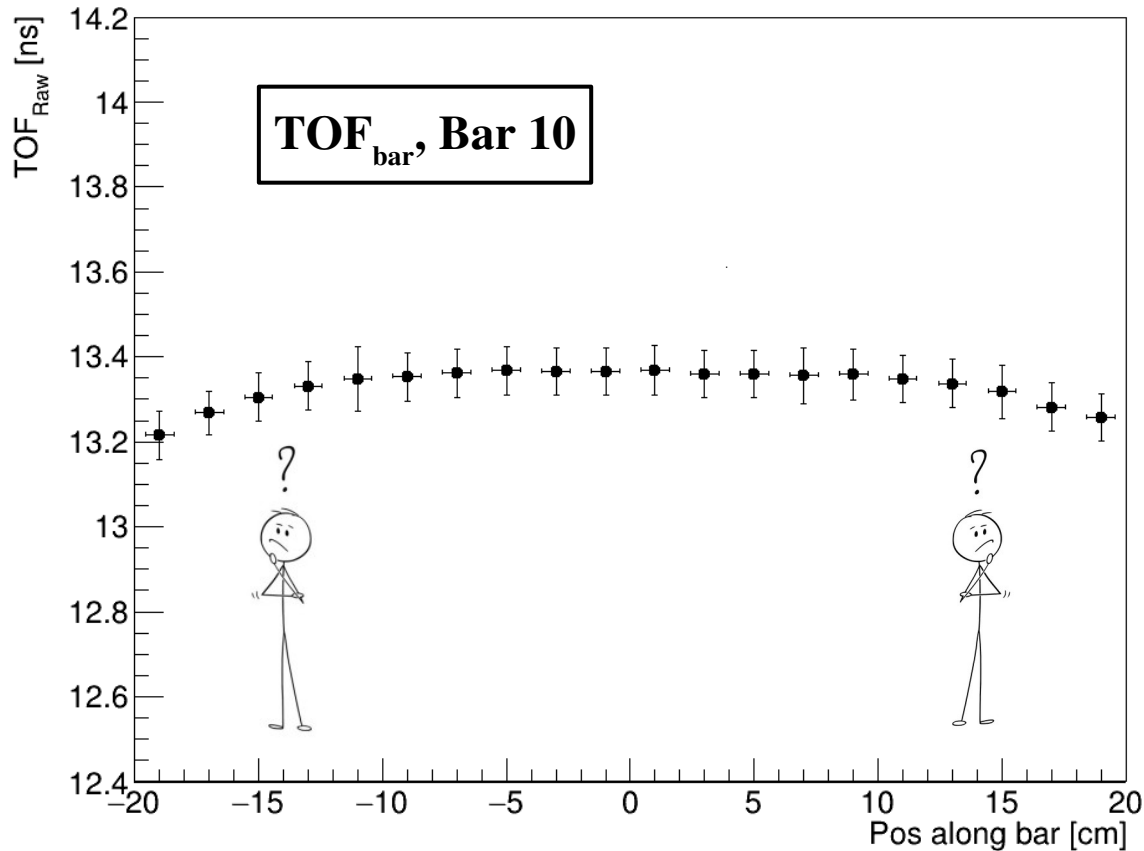
- CFD ($f_{CFD}=0.3$) applied to both channels (A/B) of each bar
- Simple CFD for SC and TW

✓ Very good performances
✗ Some strange behavior still under investigation





Unsolved problems – TOF vs Position



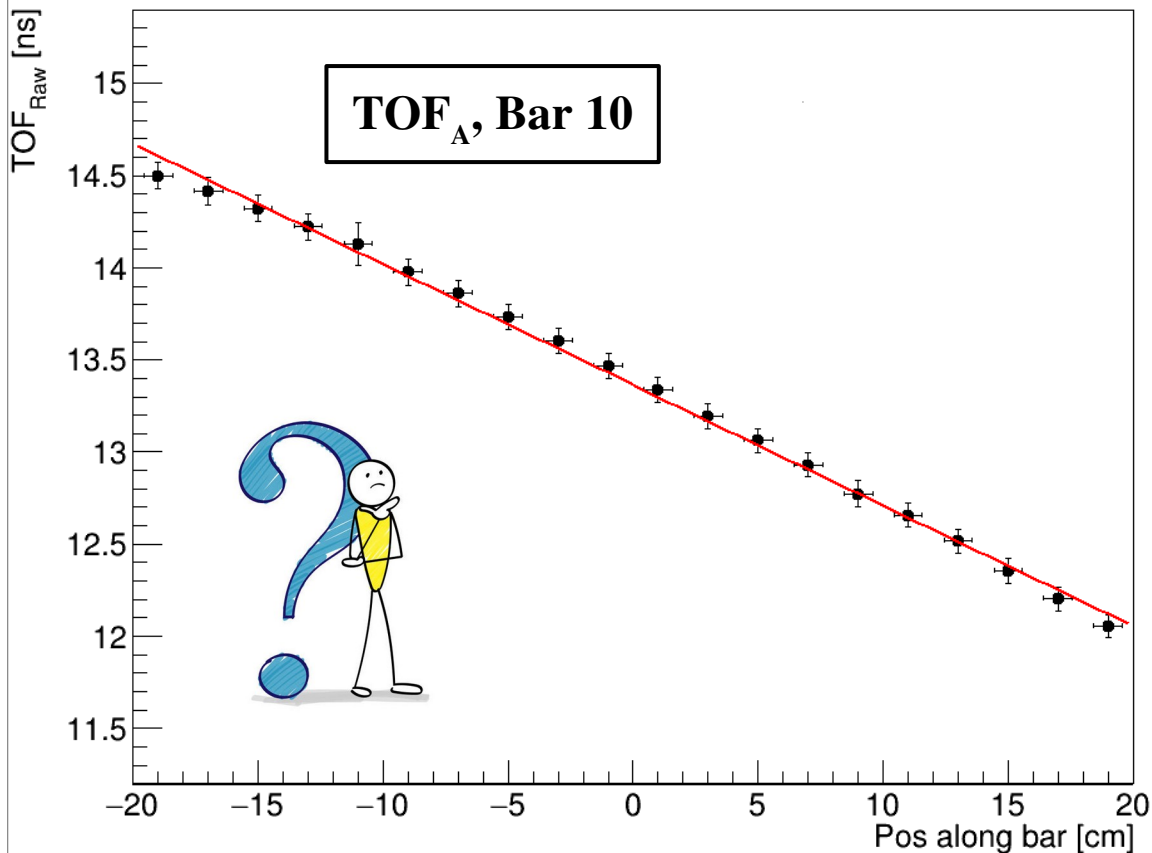
$$TOF_{bar} = \frac{T_A + T_B}{2} - T_{SC}$$

If we look @ a single bar:

- very good resolution
- TOF is never constant → possible accuracy issue
- variations up to 150-200 ps from side to center



Unsolved problems – single channel TOF



$$TOF_{A/B} = T_{A/B} - T_{SC}$$

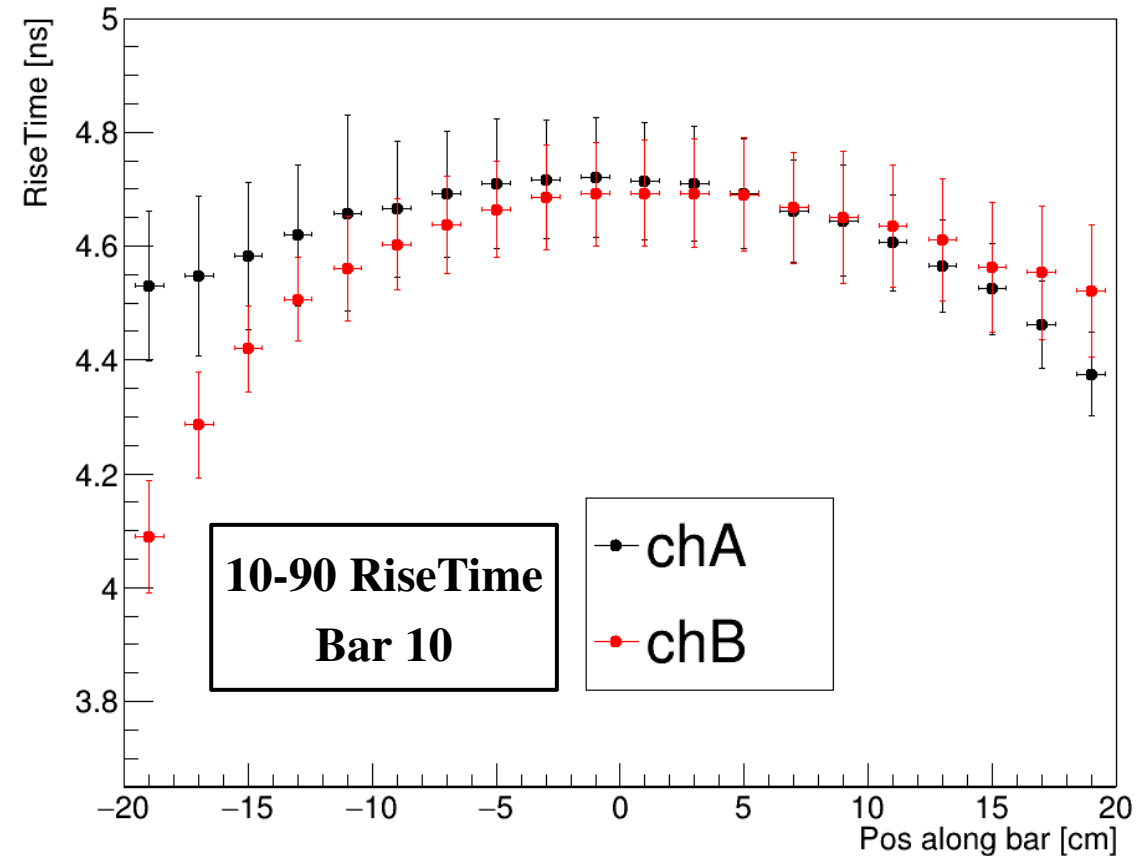
TOF along bar using only one channel:

- Again, resolution is very good
- Noticeably not linear!

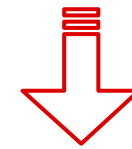
So... What is actually happening?



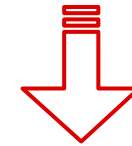
Signal rise times



CFD is accurate only if signal rise time is constant



Not really...



Lower RT → CFD time decreases
Higher RT → CFD time increases



New Timing algorithm

Decrease dependency on RT

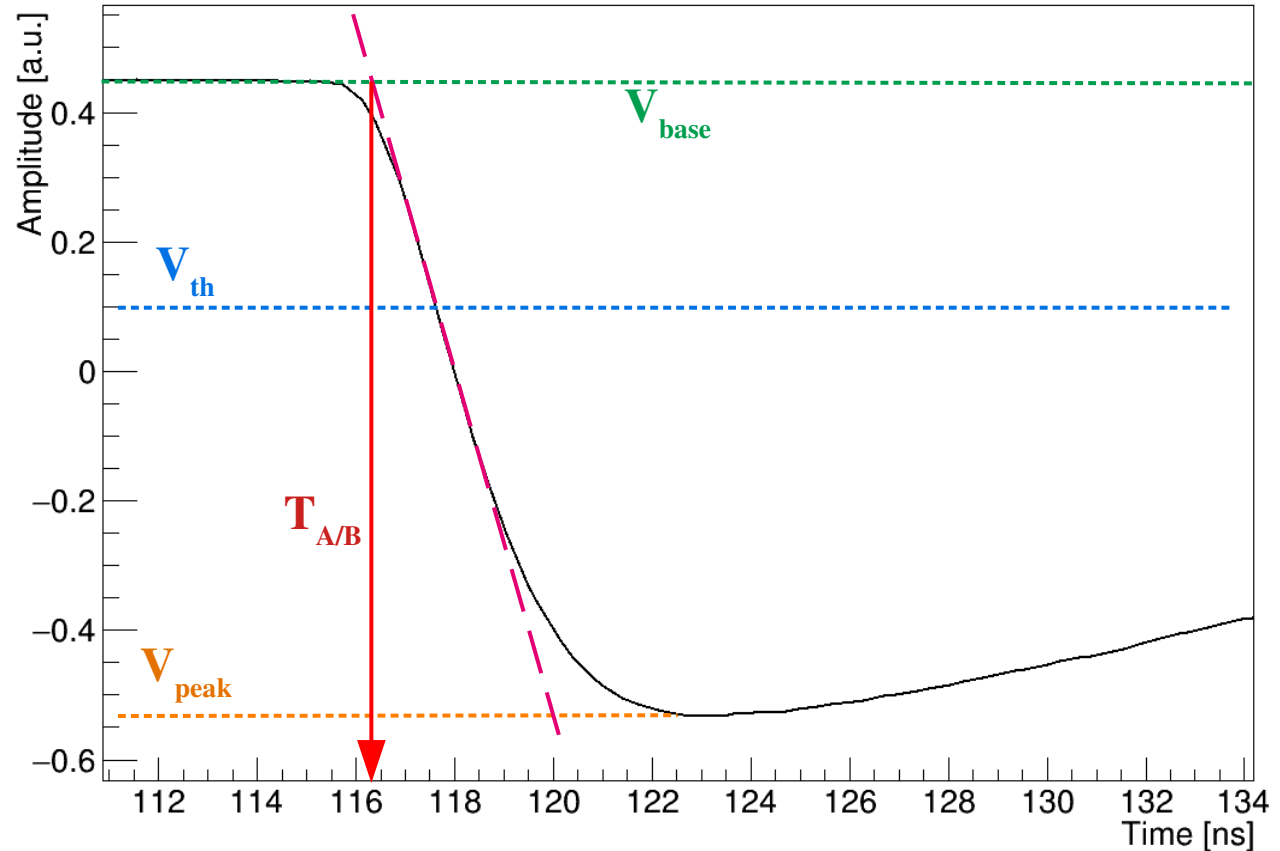


Try to retrieve signal start time:

- 1) Get to CFD threshold
- 2) Calculate tangent
- 3) Extrapolate to baseline → **Time**

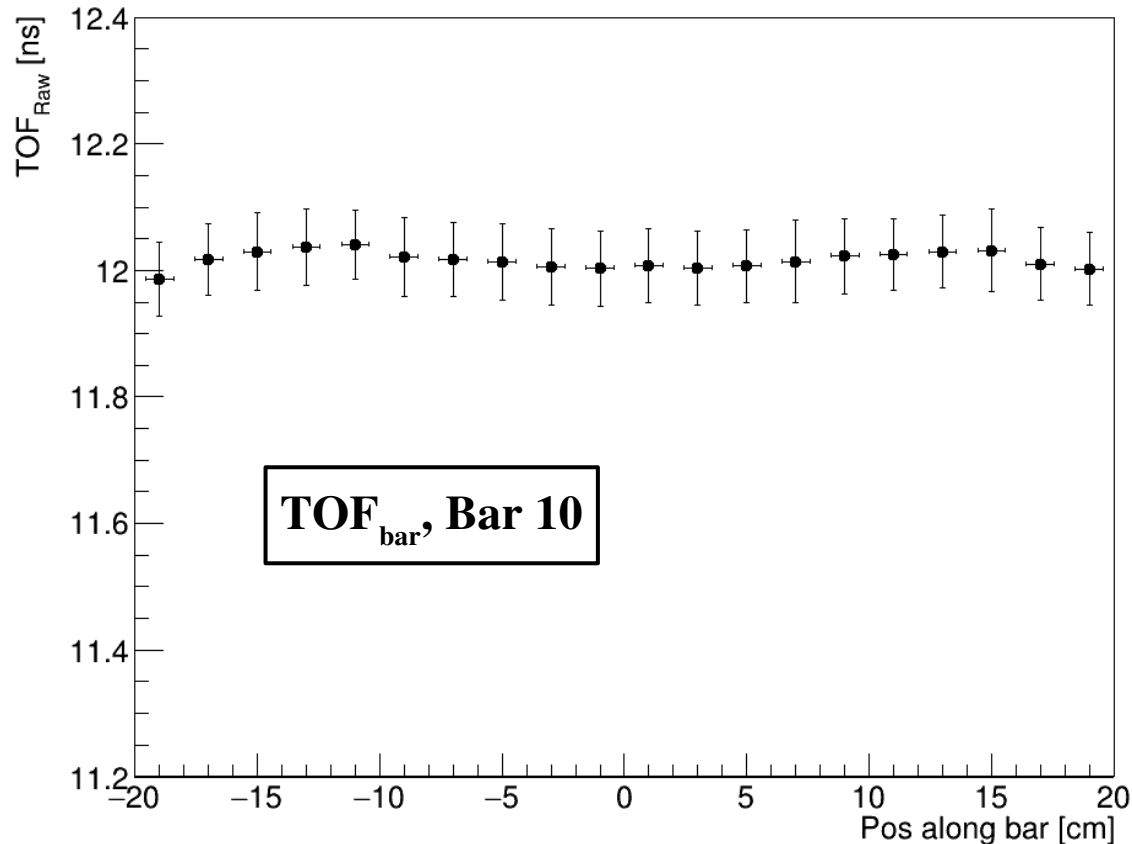
Mixed approach:

- Old CFD for SC
- New CFD for TW





Preliminary results – TOF vs Position



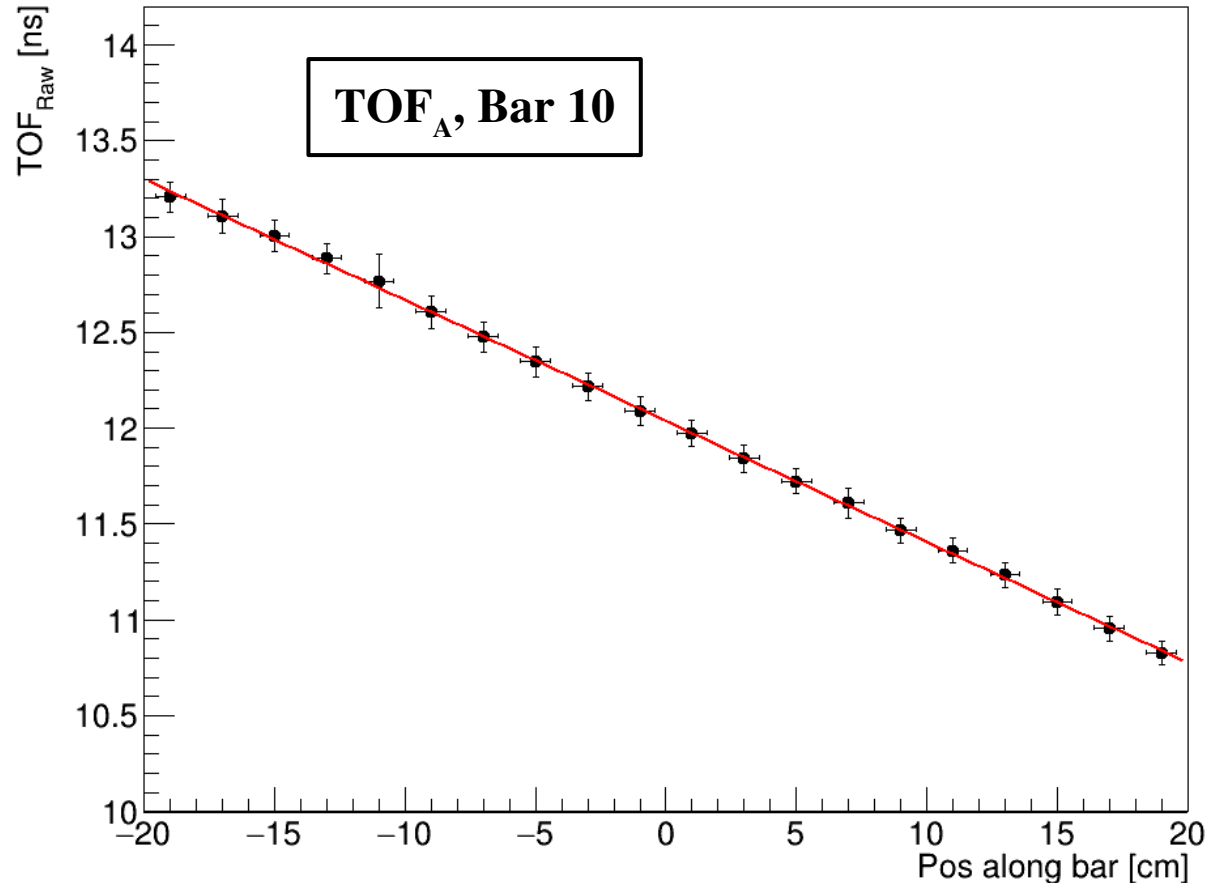
$$TOF_{bar} = \frac{T_A + T_B}{2} - T_{SC}$$

TOF along bar is much more constant!

- ✓ variability up to 50-80 ps w/ hit position
- ✓ less dependent on RT of signals
- ⚠ trend along bar is systematic
→ to be studied in more depth



Preliminary results – single channel TOF



$$TOF_{A/B} = T_{A/B} - T_{SC}$$

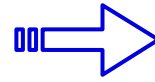
Single channel TOF is finally linear!!

- ✓ Very good for position calculation w/ ΔT_{AB}
- ✦ Slight worsening of TW single channel resolution, *but...*

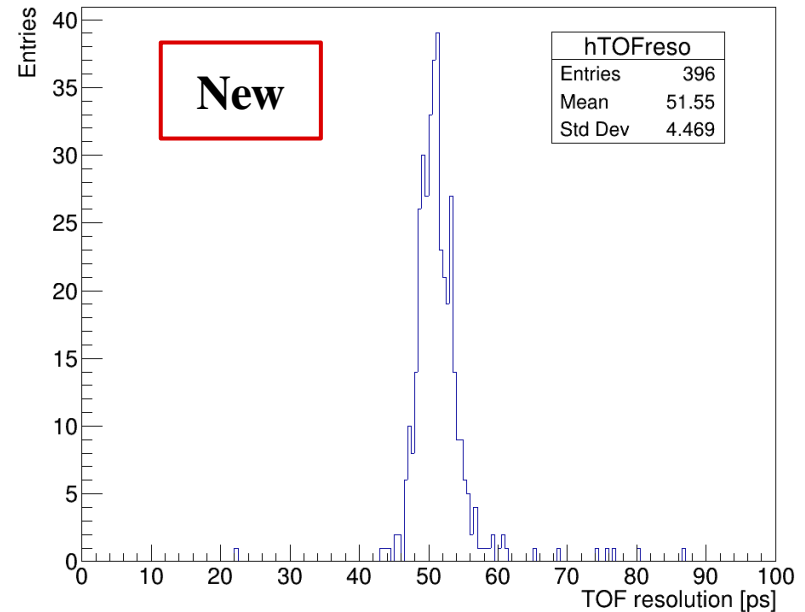
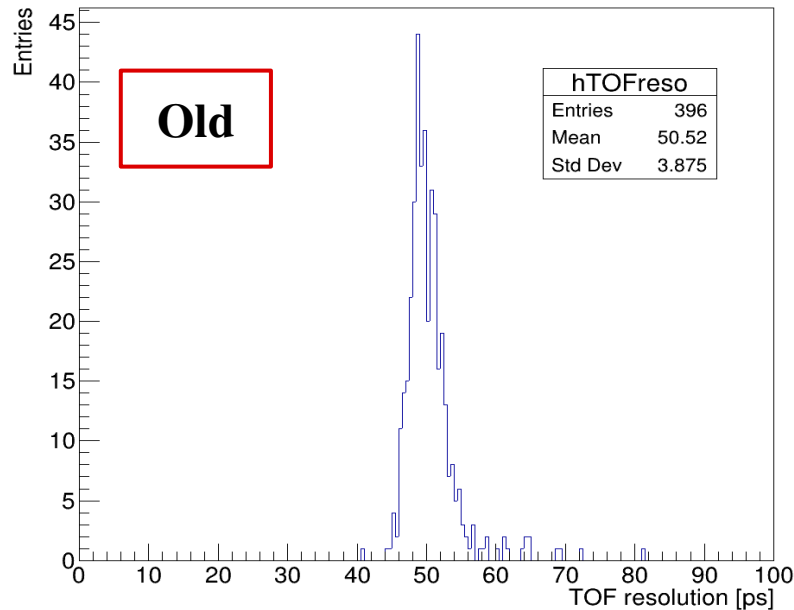


Preliminary results – TOF resolution

Final TOF resolution



$$\sigma \left(\frac{TOF_F + TOF_R}{2} \right)$$



Worsening is very mild in final TOF measurements! → resolution ~ 50 ps in the whole TW!

Conclusions



New TOF calculation approach tested:

- Retrieved timing linearity w/ hit position along TW bars (rise time effects lowered)
- Slight worsening of the resolution → mixed approach!
- Resolution in final TOF measurements compatible w/ old approach

To do list:

- 1) Understand trend of raw TOF w/ hit position
- 2) Check position resolution
- 3) Decide if this method presents a good trade-off (linearity/resolution)



This work is very preliminary, any suggestion is welcome!

In the meantime...

TOF-Wall calibration:

- **Position:** X-Y from ΔT_{AB} → algorithm ready
- **TOF** → algorithm ready
- **Energy** → ongoing, almost ready



Need to agree on TOF calculation!

Trigger:

- First efficiency results available before CNAO

Neutrons:

- Analysis started in stand-alone framework
- New master student!



Thank you for your attention

