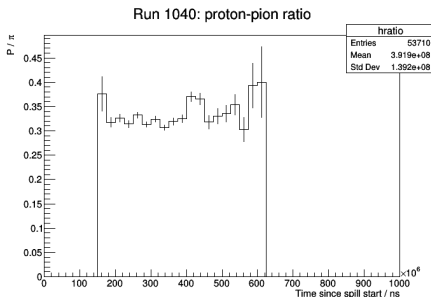# Dead time correction

Seb Jones

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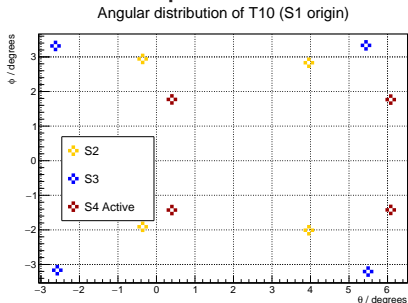
April 9, 2019

## $S3$ dead time correction – recap

- Currently, we are not sure of UToF ($S1$, $S2$, $S3$) deadtime – measurements of proton & MIP flux are incorrect
- Proton/MIP ratio is fairly constant across spill (see right) – ratio plots should be ok
- Would like to find a way to correct the absolute $S3$ flux plots



Run 1040: proton-pion ratio

| hratio | |
|---|---|
| Entries | 53710 |
| Mean | 3.919e+08 |
| Std Dev | 1.392e+08 |

# A possible solution – recap



Angular distribution of T10 (S1 origin)

- Given previous slide, $S3$ fluxes should be correct up to a factor
- Need a signal present in UToF & DToF (negligible deadtime) data
- Use $S1 + S2$ coincidences
  - Were fed directly into DToF TDC – no $S4$ hit required and no UToF deadtime
  - Also have these in UToF data, in coincidence with $S3$ hits
  - $S2$ completely shadowed by $S3$ – no geometric effects (see above)

# Results – recap

- Here are number of $S1 + S2$ coincidences recorded in each filesystem for each number of blocks
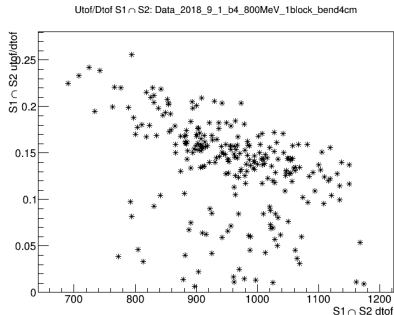
| N. blocks | DToF | UToF | Ratio |
|:---------:|-----:|-----:|:-----:|
| 0 | 97,722 | 9,268 | 0.0948 |
| 1 | 259,579 | 36,707 | 0.1414 |
| 2 | 417,054 | 63,495 | 0.1522 |
| 3 | 396,519 | 64,264 | 0.1621 |
| 4 | 11,461,429 | 1,037,454 | 0.0905 |

- People were concerned about ratio for 4 block data, doesn't fit pattern.
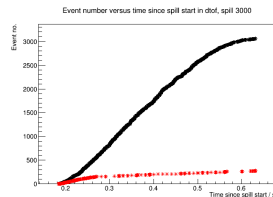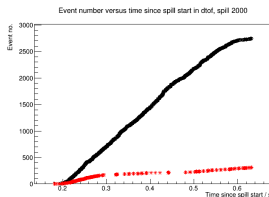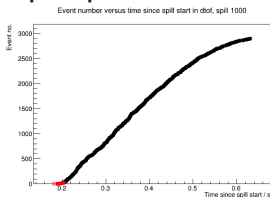
# Spill profiles – 1 block data
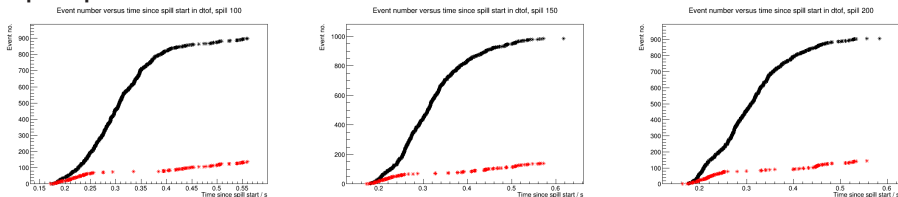






- Above are spills from 1 block data used in table previously
- Red is utof data, Black is dtof data
- Utof appears to cut out about 0.25s after spill start
- Right is utof/dtof against dtof – apparent negative correlation

Utof/Dtof S1 ∩ S2: Data_2018_9_1_b4_800MeV_1block_bend4cm

‡UCL

# Spill profiles – 4 block data



Event number versus time since spill start in dtof, spill 1000



Event number versus time since spill start in dtof, spill 2000



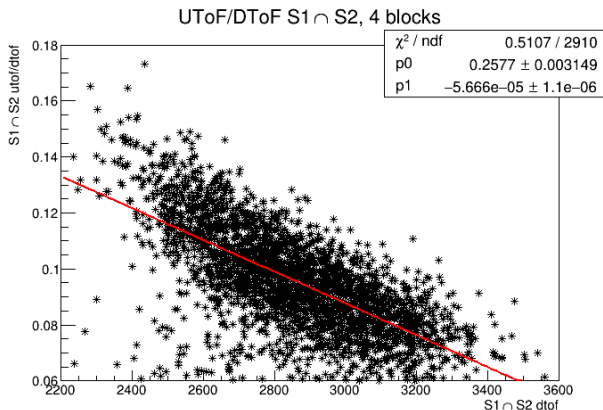Event number versus time since spill start in dtof, spill 3000

- Above are spills from 4 block data used in table
- Red is utof, Black is dtof
- Utof appears to cut out $\sim 0.25$s after spill start
- Right is utof/dtof against dtof
- Think situations like LH plot produce spills with low utof/dtof values



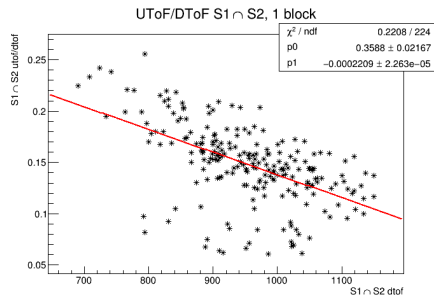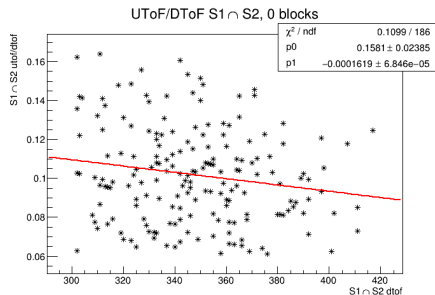Utof/Dtof S1∩S2: Data_2018_9_1_b8_800MeV_4block_bend4cm
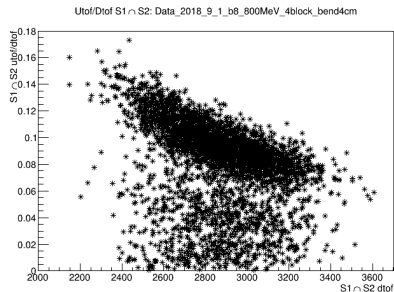
# Relation between number of DToF & UToF $S1 \cap S2$ hits

- For each run, make a cut at $y = \frac{UToF}{DToF} = 0.06$ and plot straight line through points
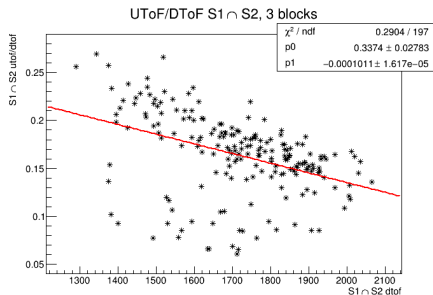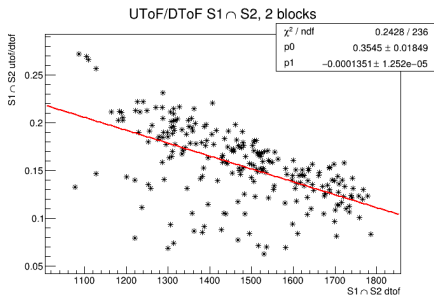


UToF/DToF $S1 \cap S2$, 4 blocks

| | | |
|---|---|---|
| $\chi^2$ / ndf | 0.5107 / 2910 | |
| p0 | $0.2577 \pm 0.003149$ | |
| p1 | $-5.666e{-}05 \pm 1.1e{-}06$ | |

# Relation between number of DToF & UToF $S1 \cap S2$ hits



Little discernible correlation for 0 block case (above left) – use average ratio over run to perform scaling

▲UCL

# Relation between number of DToF & UToF $S1 \cap S2$ hits
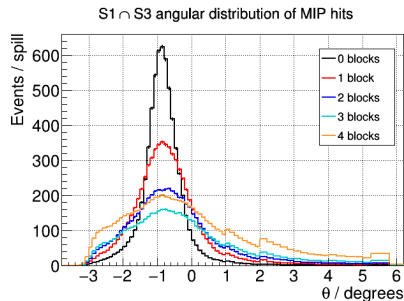
$^{\underline{\mathbb{m}}}$UCL

# Correction process

- For each spill:
    - Count number of $S1 \cap S2$ hits as recorded in DToF
    - Calculate weight from the fitted line on previous slides
    - Weight events recorded in UToF data by 1 over this factor

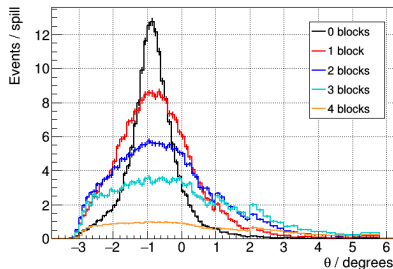# Comparisons with old plots – MIP distribution
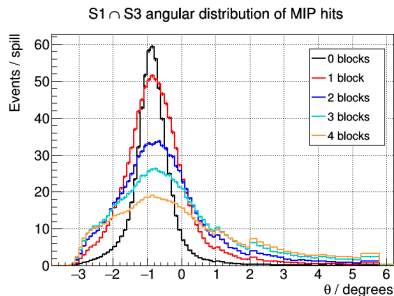


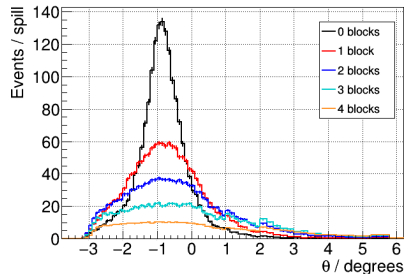Without dead time correction

With dead time correction

$^\triangle$UCL

# Comparisons with old plots – Proton distribution
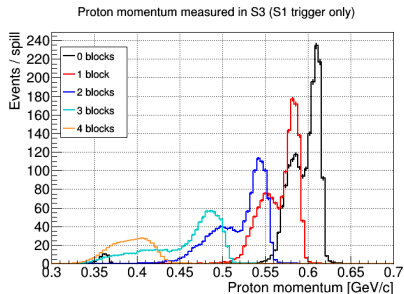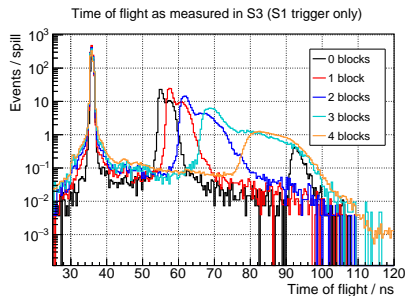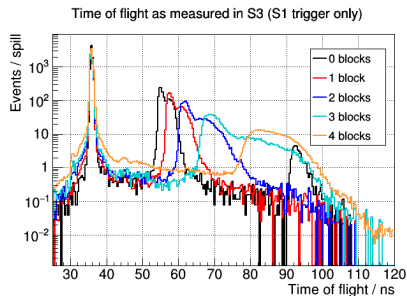


Without dead time correction

With dead time correction

# Comparisons with old plots – Proton momentum



Without dead time correction



With dead time correction

# Comparisons with old plots – Proton momentum



Without dead time correction



With dead time correction