

Event determination (t_0) and sorting based on TOF counters

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On behalf of the Panda SciTil group

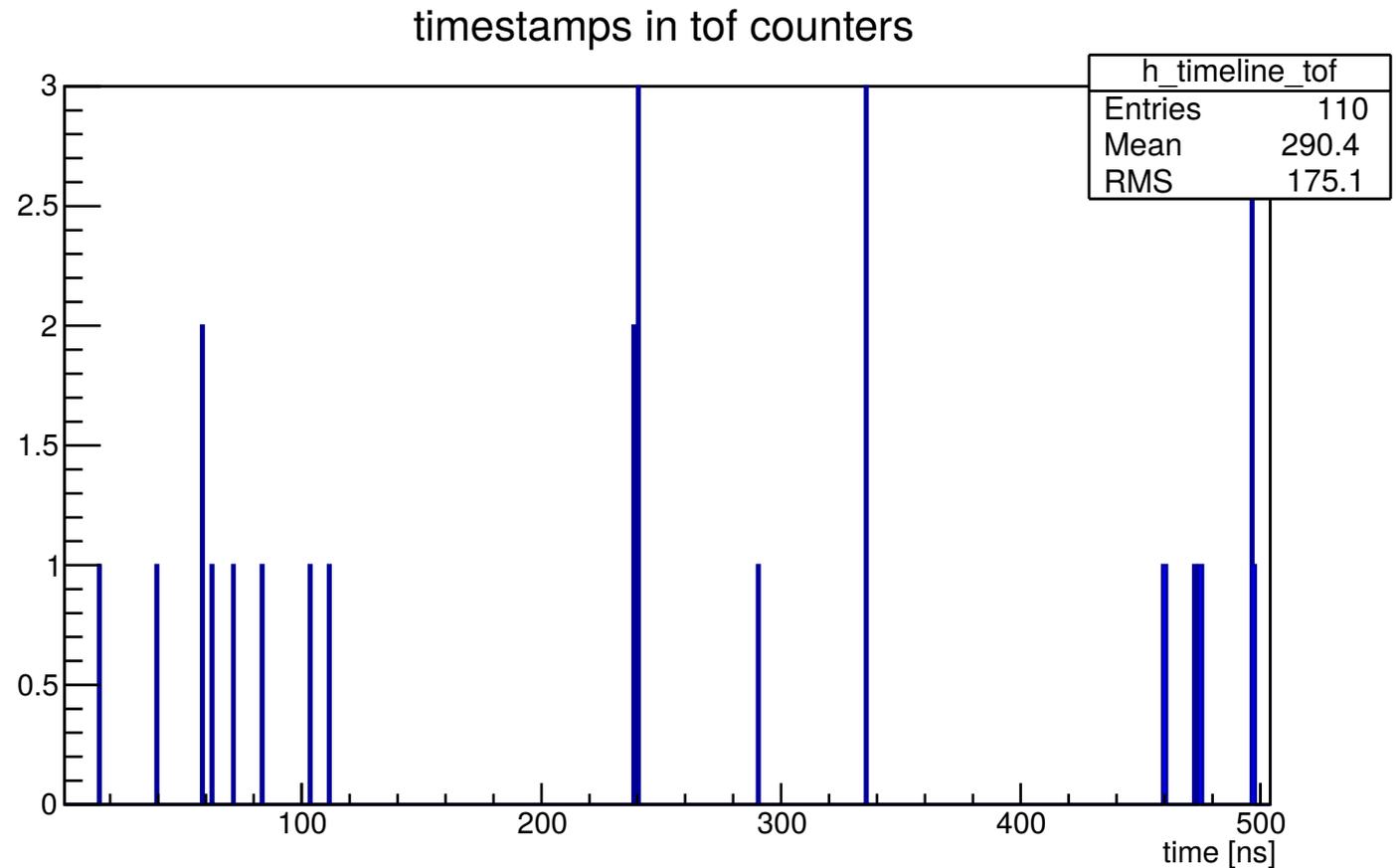
GSI, 6.12.2016

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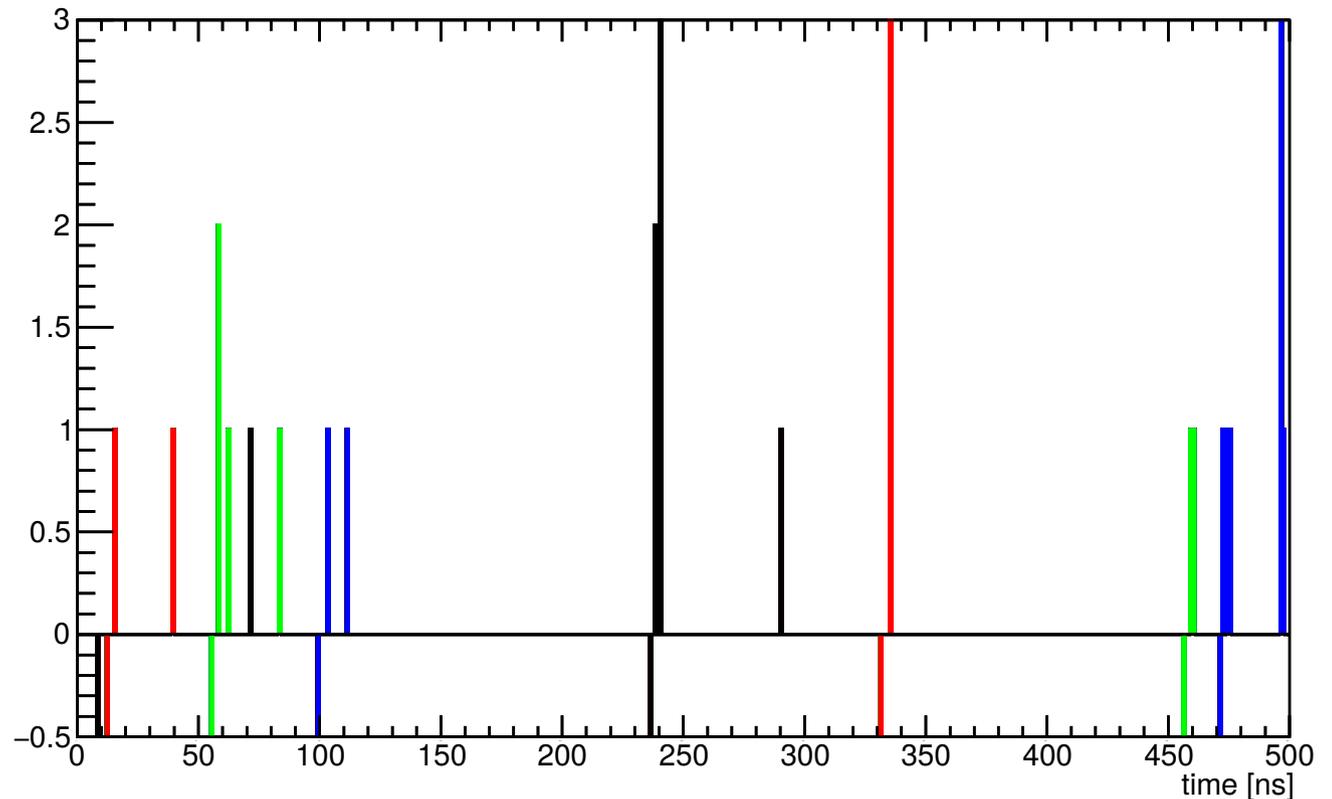
- Time based simulation
 - DPM generator
 - 20 MHz average event rate

- ~ 10 events
 - Events not clearly separated
 - Events may mixed



- Offset due to time-of-flight
 - ~2ns for SciTil
 - ~26 ns for FTOF
- Long event width
 - Late arriving particles
 - > 50 ns
- => Event Mixing

time stamps in Tof counters



- Timestamps detected in TOF counters at an event rate of 20 MHz. On the negative y-axis the MC event time is indicated.

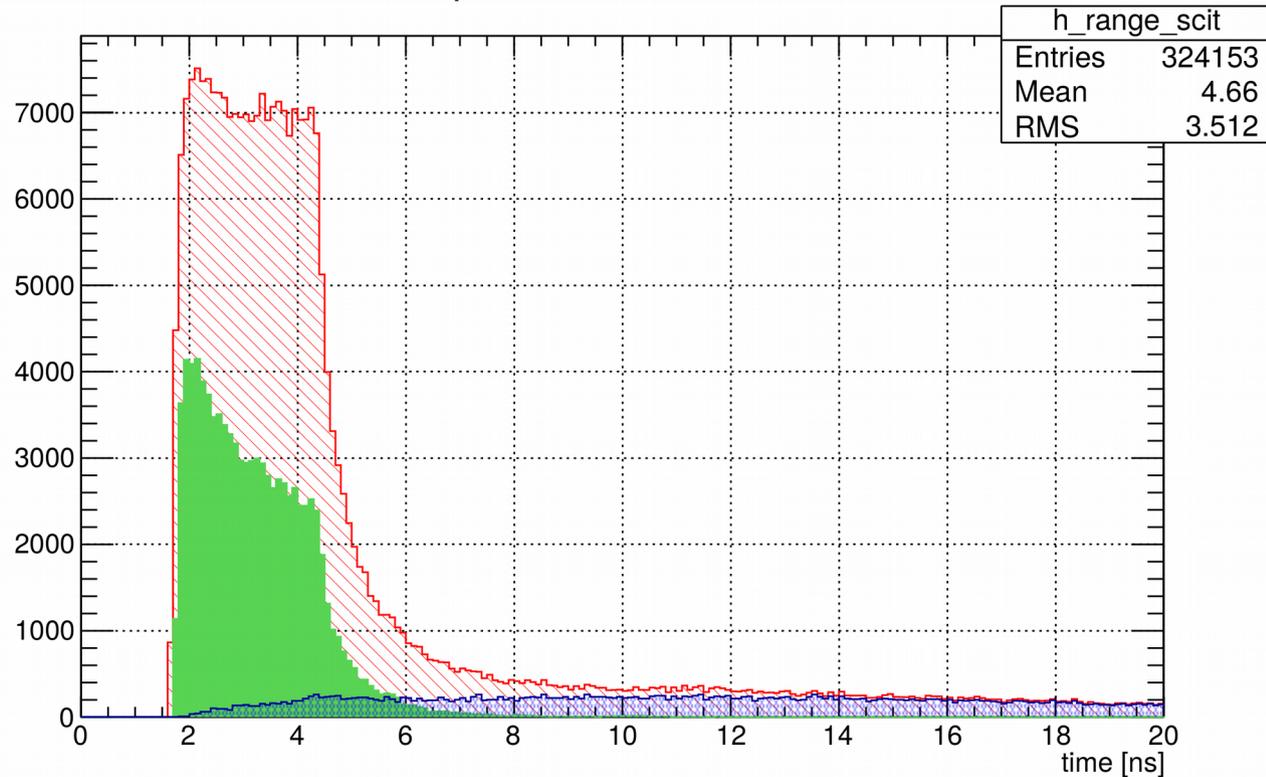
All timestamps from a single event have the same colour. Consecutive events are iteratively coloured in black, red, green and blue.

Event structure (event based)

Sources of late arriving /indirect

- Neutrons
 - Most prominent
- Backscattered Photons
- Backscattered Hadrons
- Slow/late/multiple decays

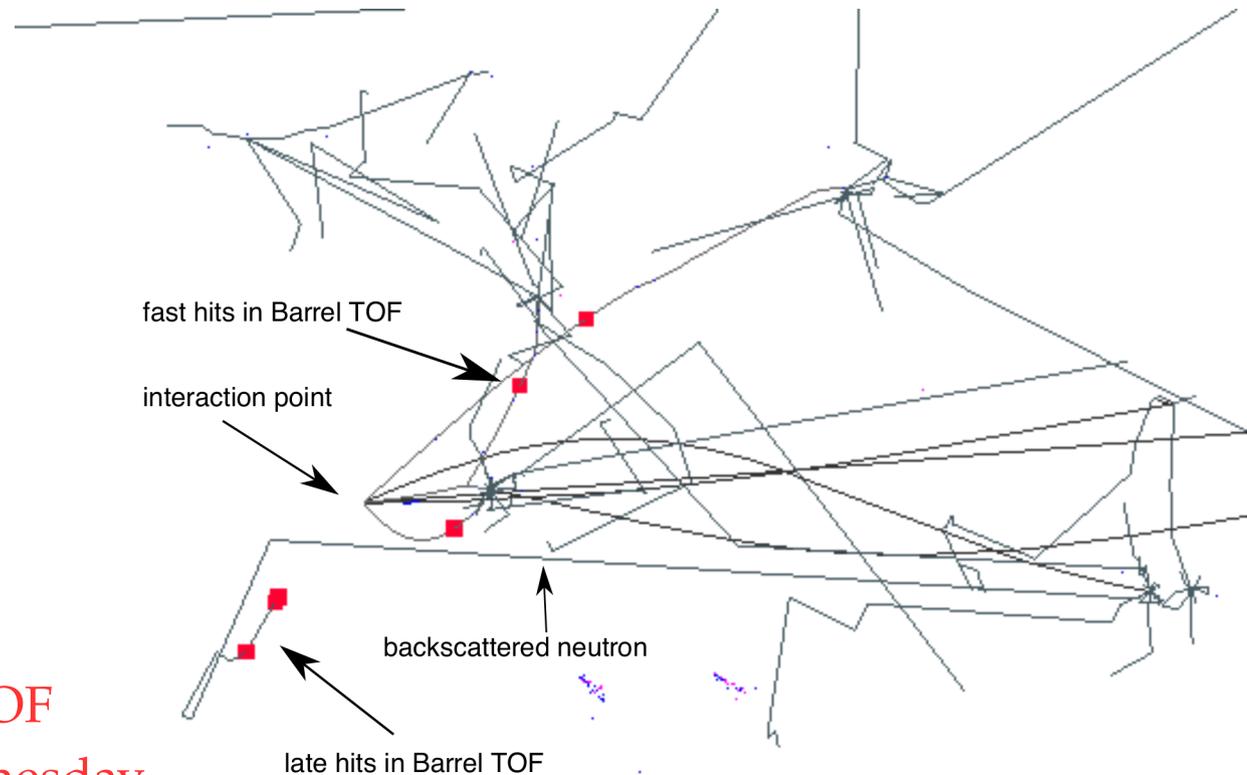
timestamp distribution in Barrel TOF



- Timestamp distribution in SciTil for all hits (red), primary particles (green) and hits initiated by neutrons (blue)

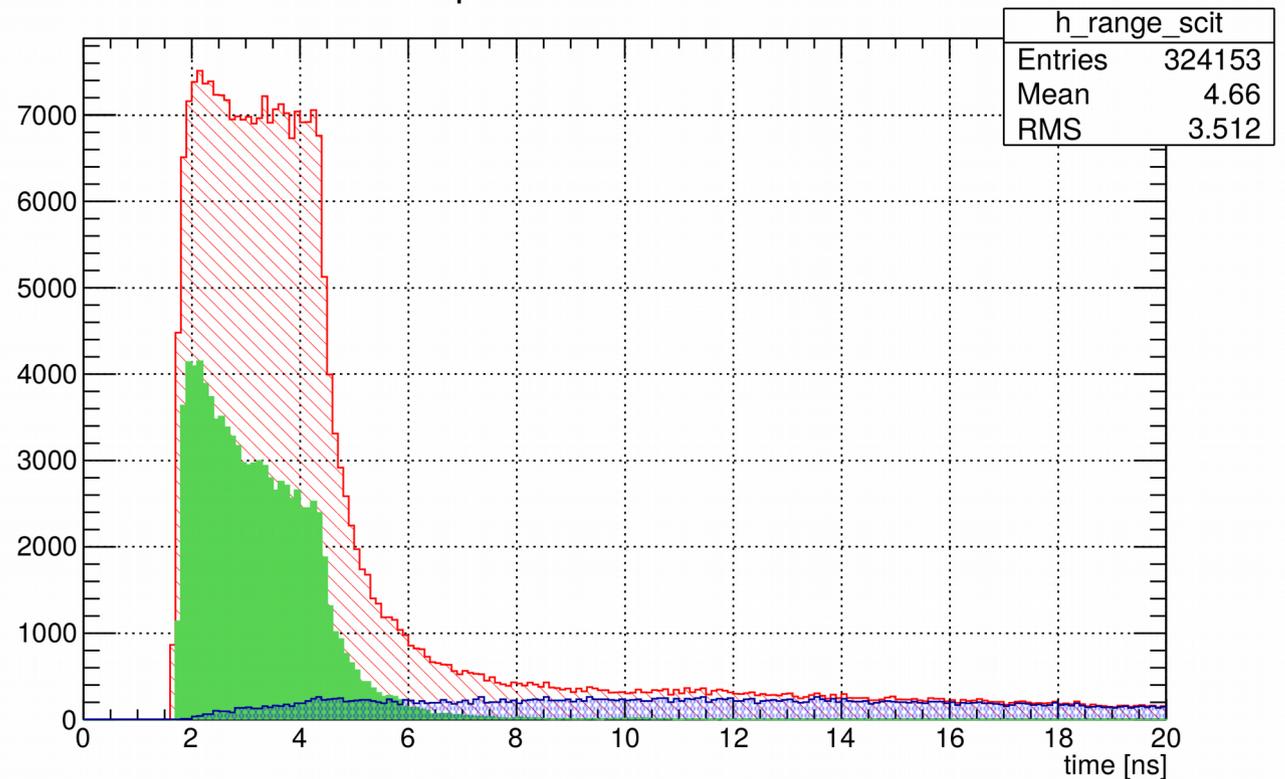
Sources of late arriving /indirect

- Neutrons
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- **More on this topic in the TOF
Pid / SciTil session on wednesday**



- Direct particles:
(also secondaries)
 - $\text{TOF}_{\min} = 1.66 \text{ ns}$
 - $v=c, \vartheta = 90^\circ$
 - $\text{TOF}_{\max} = 8.6 \text{ ns}$ (16.6 ns)
 - $P_t = 300 \text{ MeV}/c$ (150 MeV/c)
 - $\Delta t = 7 \text{ ns}$ (15 ns)
- Indirect particles/secondaries
 - $\text{Tof} > 15 \text{ ns}$
 - Propably hard to reconstruct
 - Provide no additional information

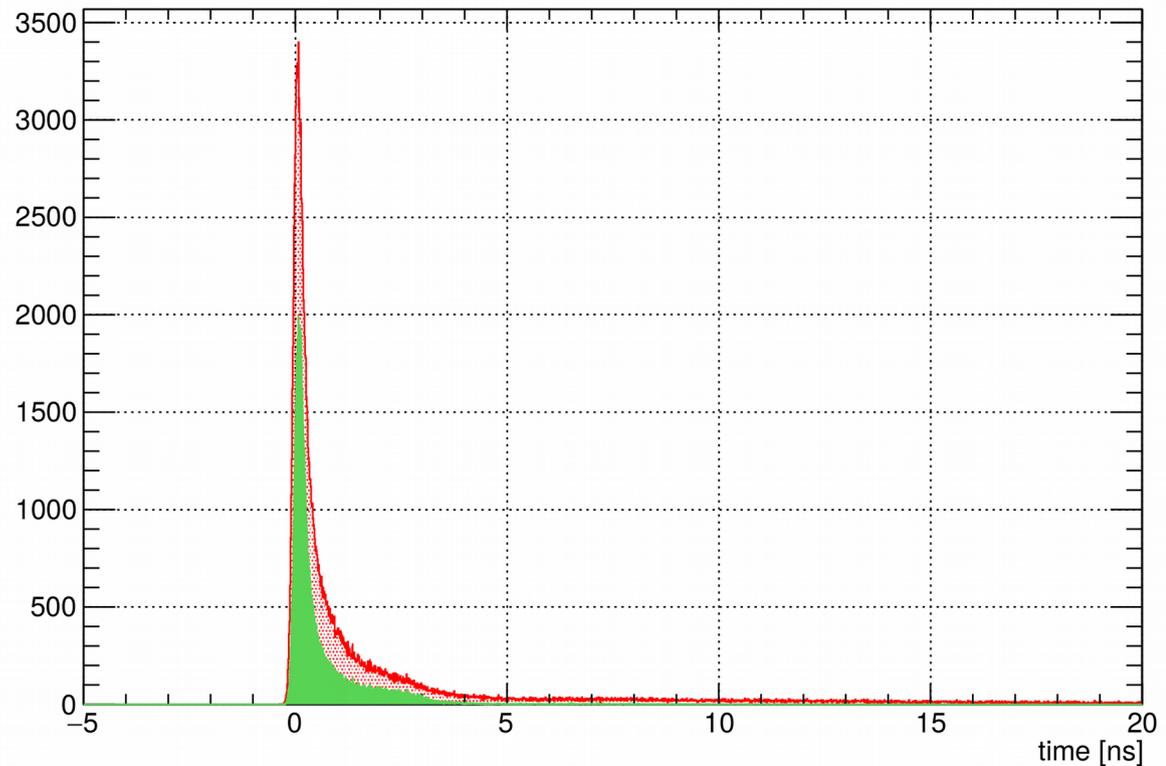
timestamp distribution in Barrel TOF



- Reduce the Offset and width

- No tracking information!
- Speed of light correction
 - Track length: straight line
 - $v = c$

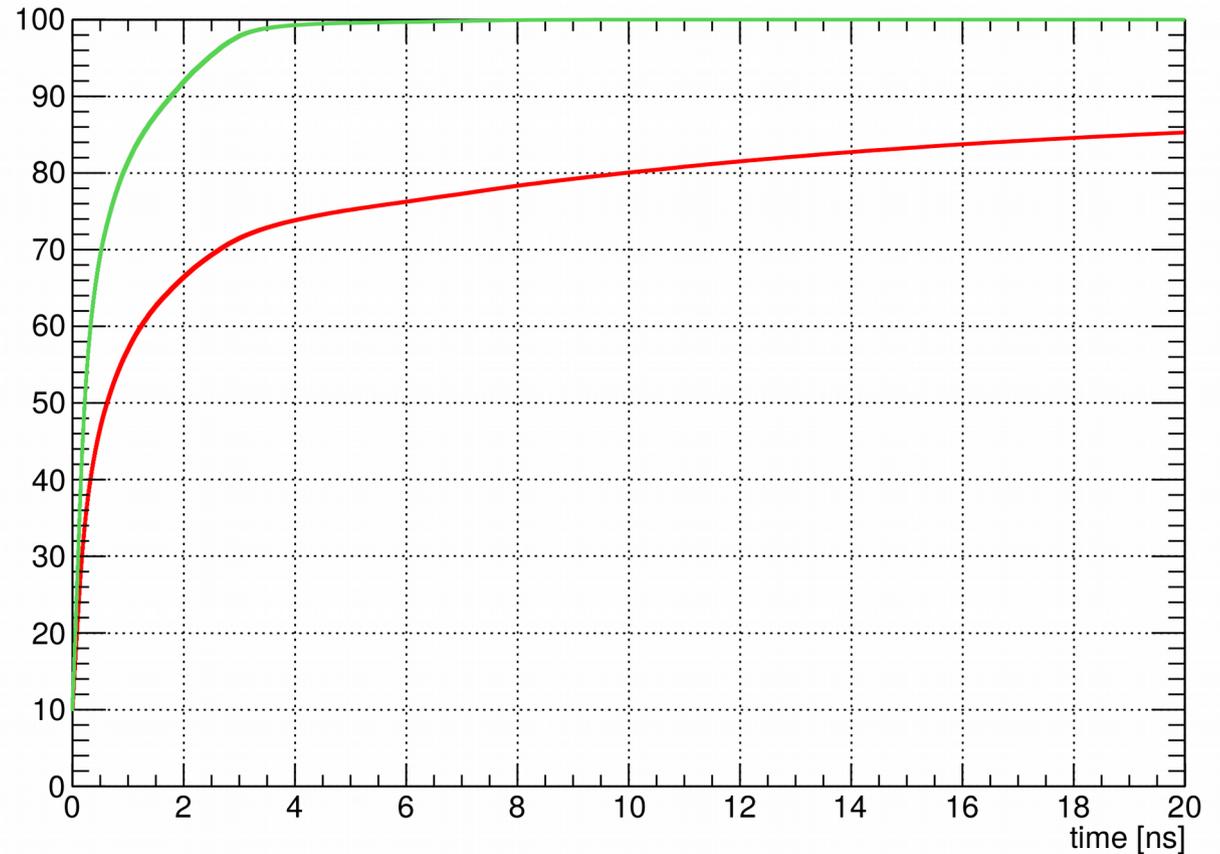
corrected timestamps in Barrel TOF



- Timestamp distribution in SciTil after applying the speed-of-light correction for all hits (red) and primary particles (green)

integral of corrected timestamps in Barrel TOF

- Direct particles (primaries)
 - 4 ns --> > 99%
- Total
 - 1 ns --> 60%
 - 2 ns --> 70 %
 - 4 ns --> >75%
- “Core Event width”
 - $t_{\text{Core}} = 4 \text{ ns}$



- Integrated timestamp distribution in SciTil after applying the speed-of-light correction for all hits (red) and primary particles (green)

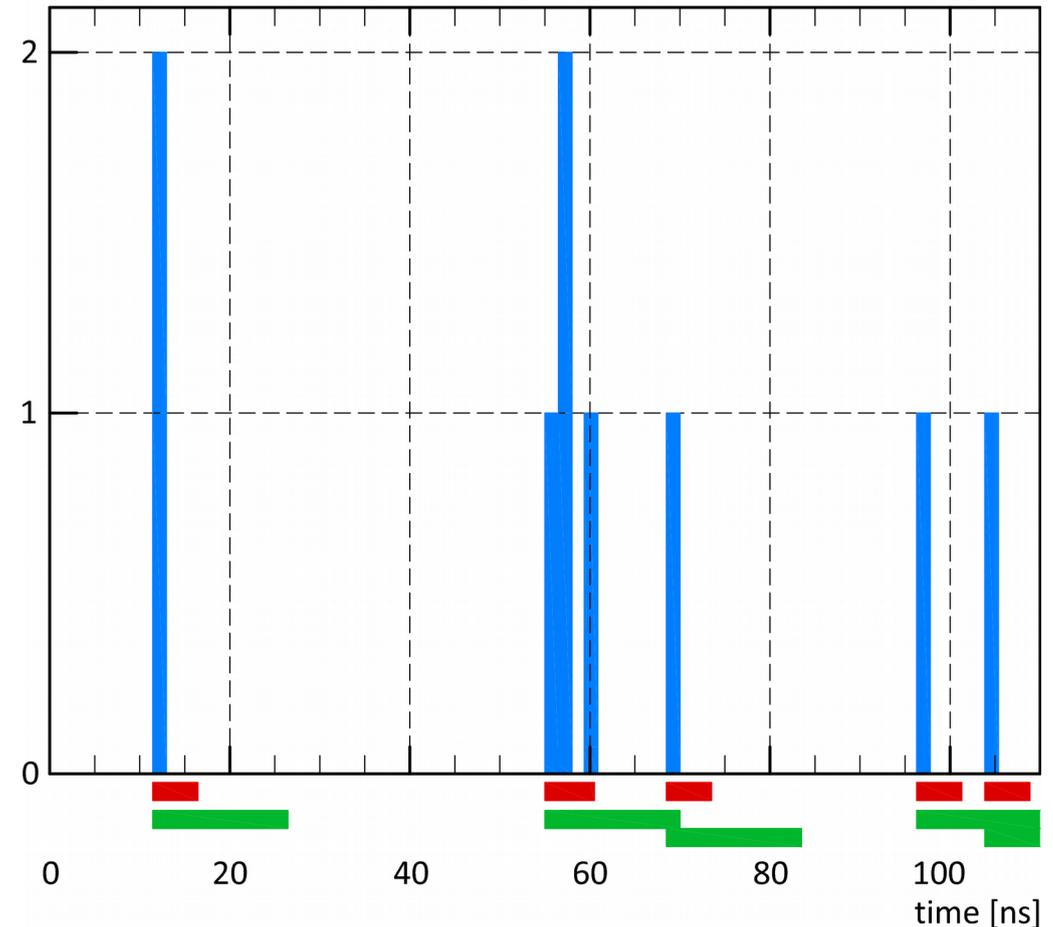
Make it short:

- One can show the same behavior for the FTOF
 - Speed-of-light correction
 - 4 ns => >99% of primaries
 - 4 ns => >75% of secondaries
- “Core Event time”
 - $t_{\text{Core}} = 4 \text{ ns}$

Basic algorithm

- Due to the low particle multiplicity per event every timestamp can potentially be the trigger for an event. After a trigger has been accepted, there is a dead-time of 4 ns (red) where no other trigger is accepted. All timestamps after a trigger and within a window of 15 ns are assumed to belong to a single event (green). These event time windows potentially overlap to ensure the completeness of the data.

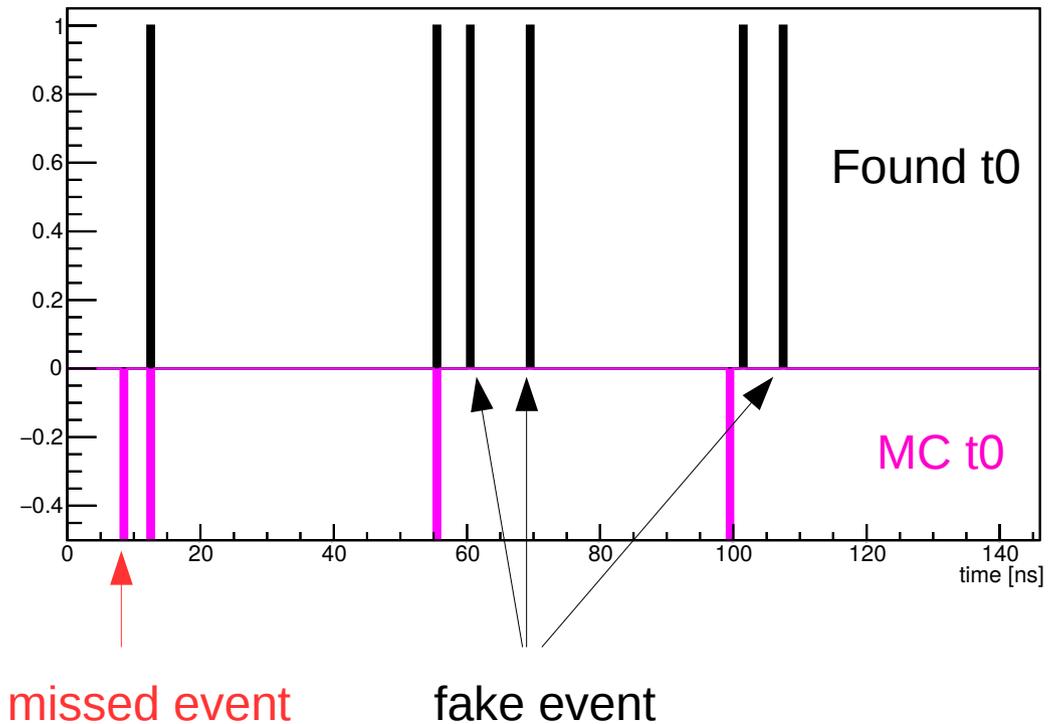
Event Determination Algorithm



- “Timebased” timestamps in the TOF counters after applying the speed-of-light correction

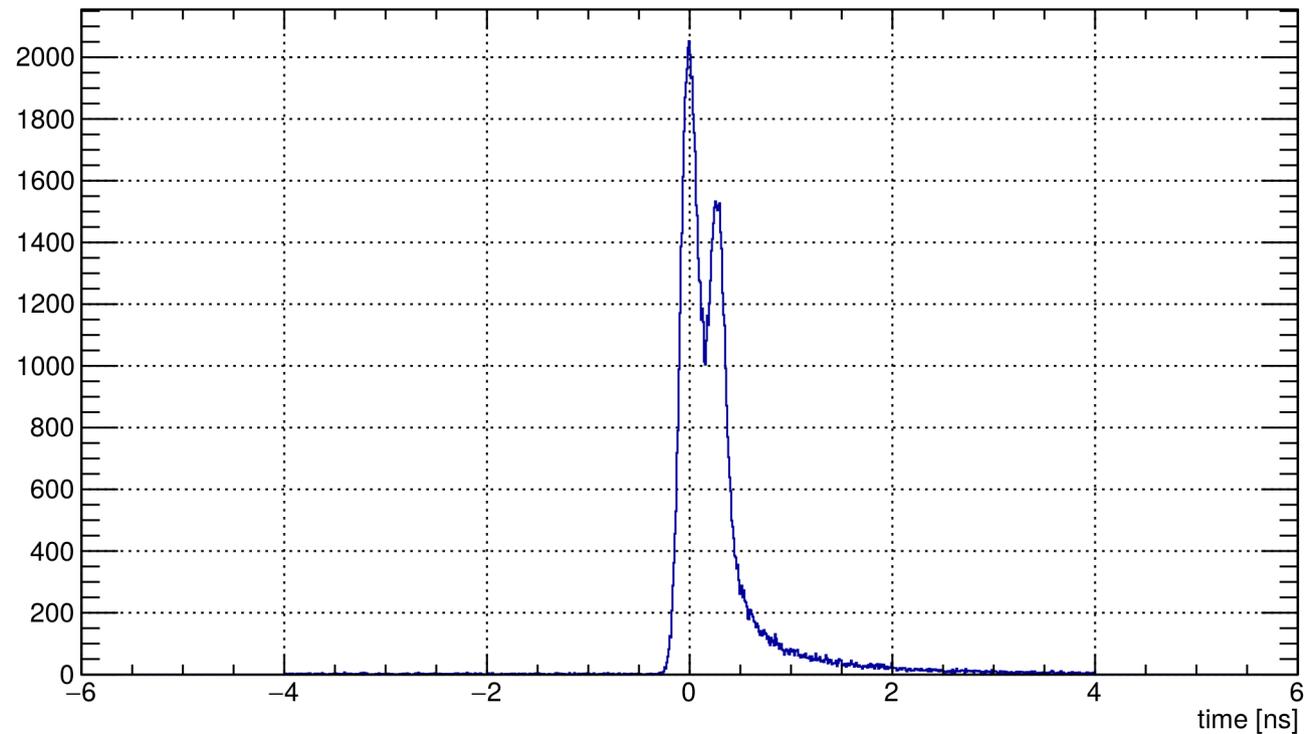
Results

Event rate	2 MHz	20 MHz	20 MHz w. fake reduction
Correctly identified	93% (>99)	89 % (96)	83%
misidentified	80%	66%	29%
Event included in previous package	0.5%	4%	4%
Missed events	6.5%	7%	12%



- 2 MHz
- T0 determination
 - $\sigma < 1$ ns
- Double peak structure
 - Slightly different timestamp distribution of Barrel TOF and FTOF

t0 distribution for correctly identified events



Outlook

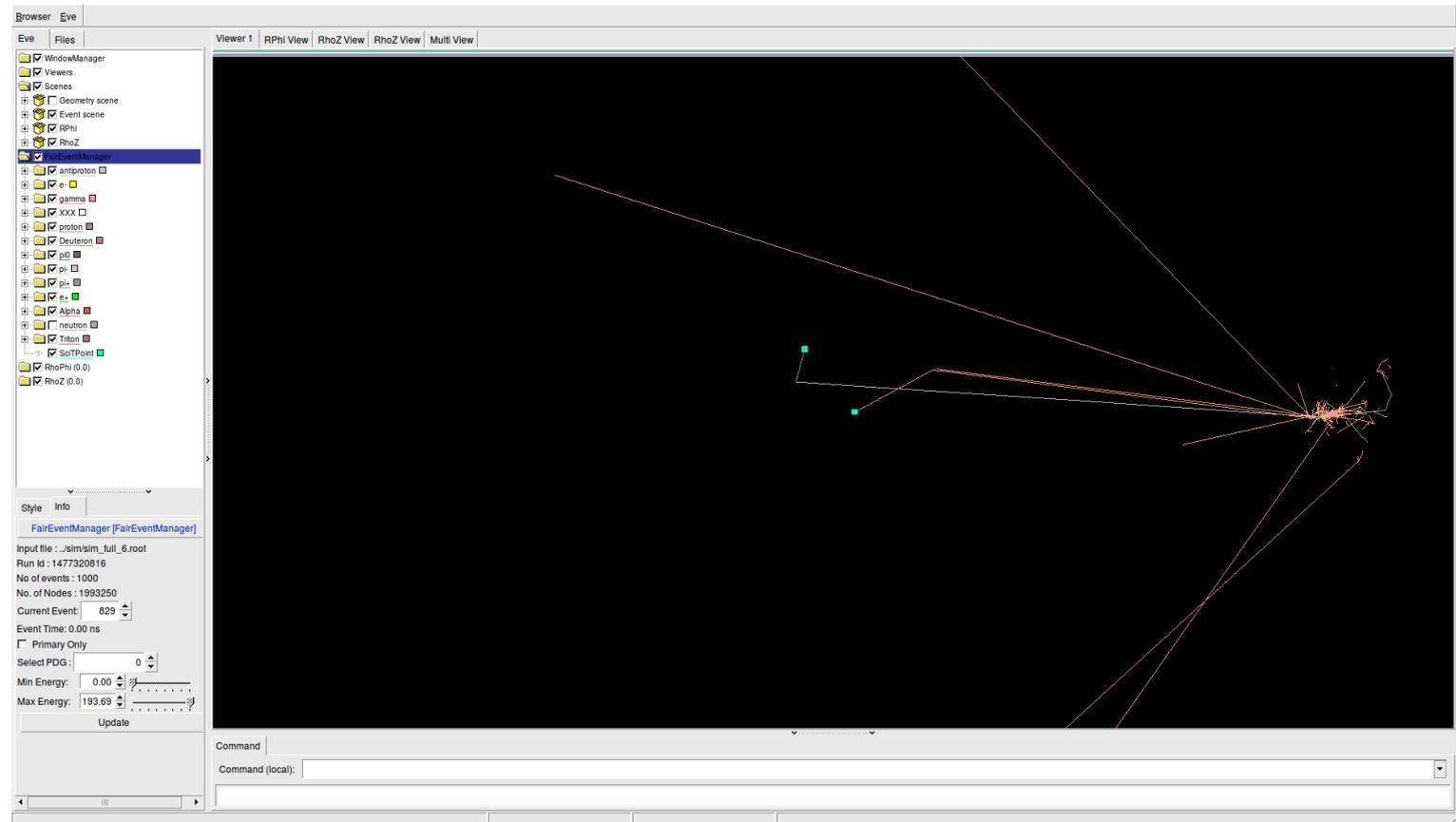
- Improve cut parameters
 - Core event width
 - Event package time window
- Include more sub detector information
 - Enhance determination rate (“neutral events”)
 - enhance fake event reduction ?

Thank you for your attention

Indirect/late Particles

Sources of late arriving particles/timestamps

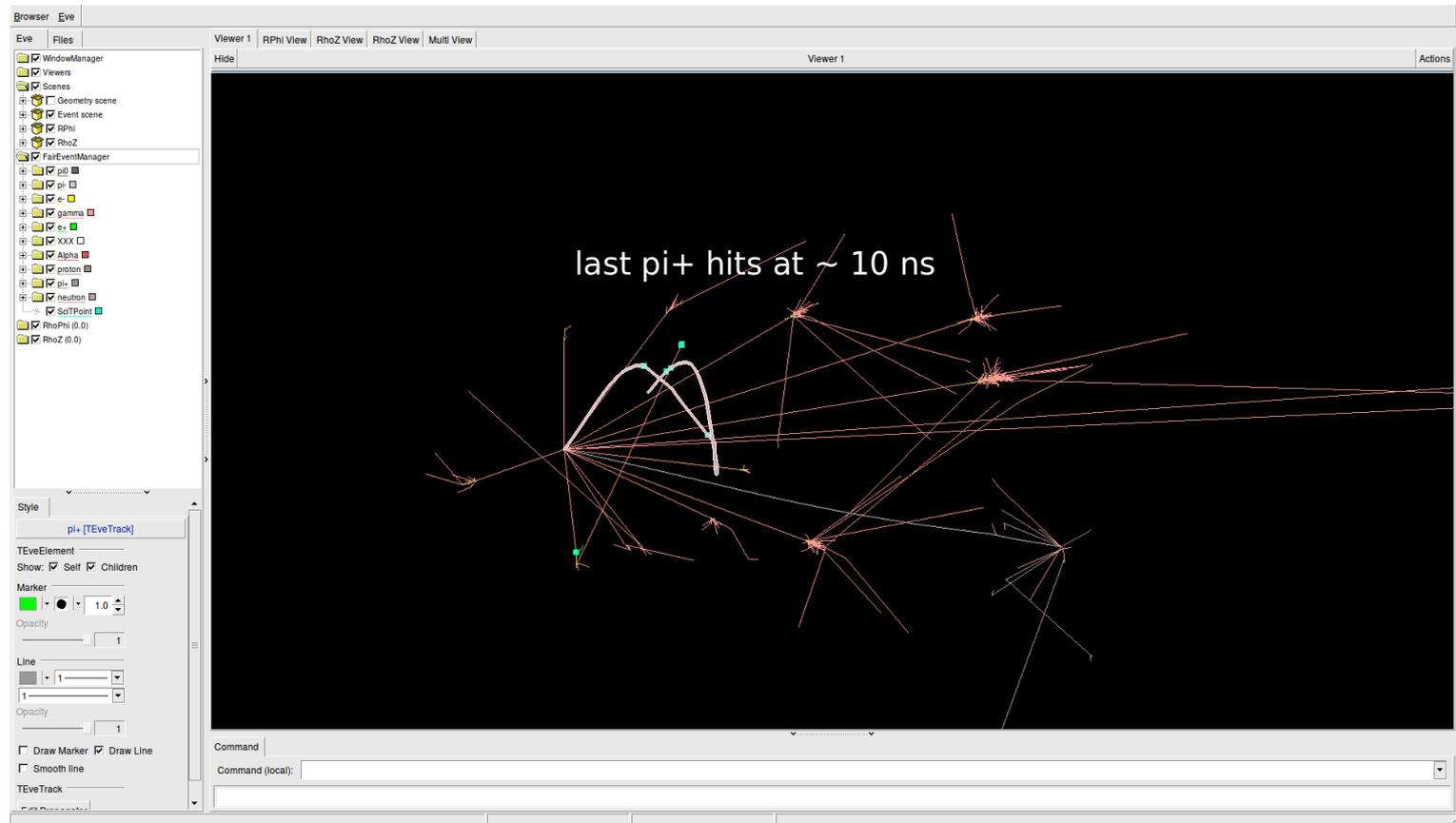
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