



Trigger Refresher

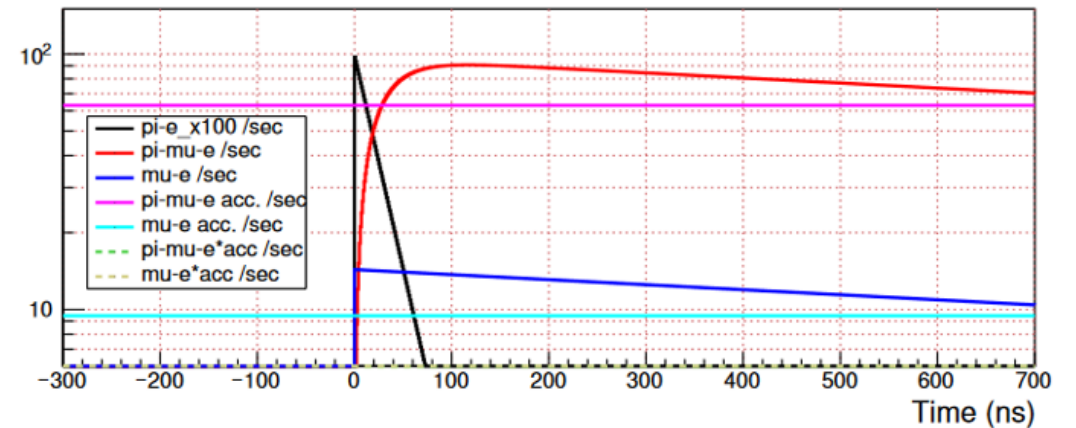
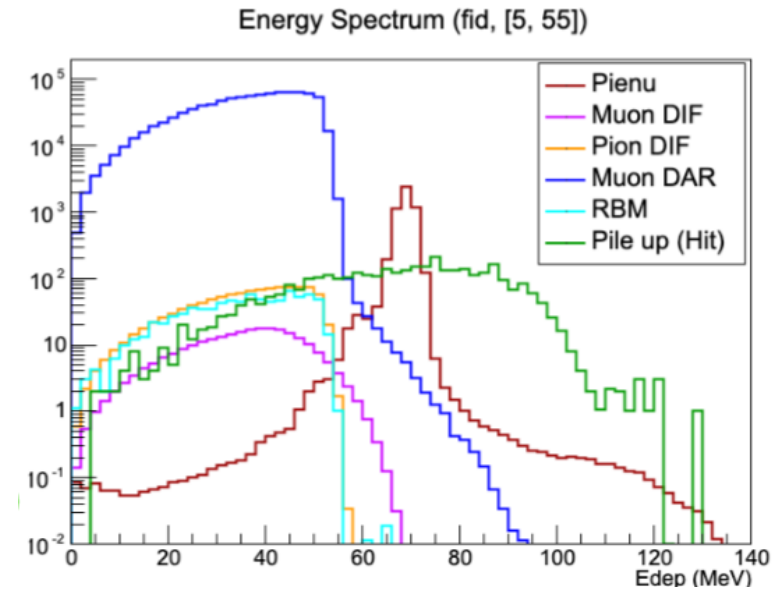
Peter Kammel

More a discussion starter than presentation

Recap: Main physics triggers

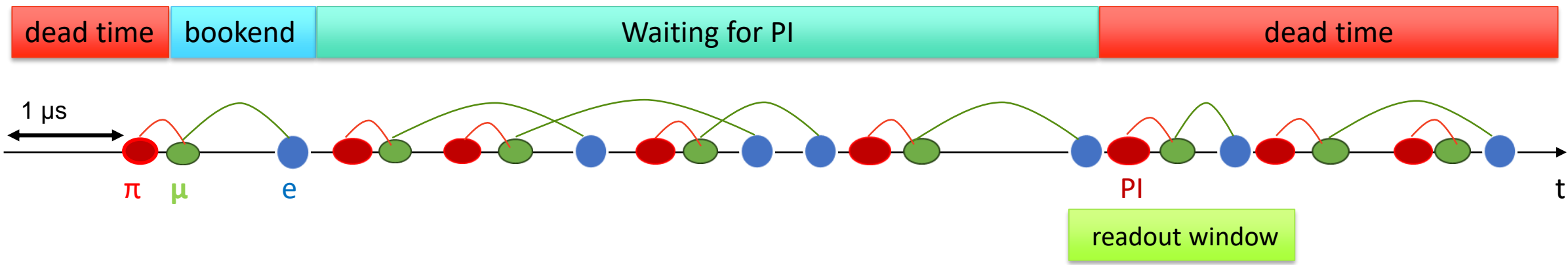
Triggers (unchanged since proposal)

- **PI**
This is a minimum bias trigger, prescaled by $k \sim 1000$
- **CaloH** N_{HE}
Selection of high energy ($E_h \gtrsim 50$ MeV) events detected by the CALO within a time range $TR = [-300, 700]$ ns relative to PI
- **TRACK** N_{LE}
All events with TRACKER hit within time range TR relative to PI, prescaled by $k \sim 50$
- **PROMPT** Tail
Selected prompt events with a TRACKER hit in time range $[-5, 40]$ ns relative to PI
- **Additional?**



Data Stream and Trigger

$R_{\pi} = 300 \text{ kHz}$ next neighbor $T_{\pi} = 3 \mu\text{s}$
 $R_{\text{trig}} = 10 \text{ kHz}$ next neighbor $T_{\text{trig}} = 100 \mu\text{s}$ **deadtime < 10% T**



Rates and statistics

Triggers

– PI

This is a minimum bias trigger, prescaled by $k \sim 1000$. ATAR in, no out in last sensors.

– CaloH N_{HE}

Selection of high energy ($E_h \gtrsim 50$ MeV) events detected by the CALO within a time range $TR = [-300, 700]$ ns relative to PI

– TRACK N_{LE}

All events with TRACKER hit within time range TR relative to PI, prescaled by $k \sim 50$

– PROMPT Tail

Selected prompt events with a TRACKER hit in time range $[-5, 40]$ ns relative to PI

– Additional?

triggers	prescale	range TR(ns)	rate (kHz)	CALO			ATAR digitizer			ATAR high thres	
				ΔT (ns)	chan	MB/s	ΔT (ns)	chan	MB/s	chan	MB/s
PI	1000	-300,700	0.3	200	1000	120	30	66	2.4	20	0.012
CaloH	1	-300,700	0.1	200	1000	40	30	66	0.8	20	0.004
TRACK	50	-300,700	3.4	200	1000	1360	30	66	27	20	0.014
PROMPT	1	[-5,40]	5	200	1000	2000	30	66	40	20	0.2

– Limitations

- PROMPT combined with the 10-20 kHz readout limitation of ATAR electronics is bottleneck to increase time range.
Either faster digitizer or ATAR based selection of time slices.

– Assumptions

- CALO calculates E_{tot} within 200 ns
 $0.3 \text{ MHz} \cdot 0.2 \mu\text{s} = 15\%$, continuous not really DT
- ATAR 5-10 kHz, limited by digitization 200us, can be improved.
- CALO: $2\text{B} \cdot 200\text{samples/island} \cdot 1000\text{islands} = 400\text{kB}/\text{trigger}$
- ATAR: $4\text{B} \cdot 30\text{ns} \cdot 66\text{strips} = 8 \text{ kB}$ x2-3? due to cross talk

– Todo

- Update with MC multiplicities and rates
- Detailed discussion of ATAR HD-Soc deadtime, probably estimate somewhat pessimistic, clarify
- Fit studies to determine optimal TR

Discussion topics

Triggers

– PI

This is a minimum bias trigger, prescaled by $k \sim 1000$

– CaloH N_{HE}

Selection of high energy ($E_h \gtrsim 50$ MeV) events detected by the CALO within a time range $TR = [-300, 700]$ ns relative to PI

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– Additional

continuously record π , μ signals with high threshold discriminator on ATAR

– Why use TRACKER and no CALO trigger

- Hard to trigger on low CALO signal?
- But we should certainly trigger on OR between TRACK and CALO

– Can we enrich PROMPT

- Not required, as I don't expect prescaling

– However, can we enrich PROMPT for long window fit?

- Extend to 2us, depending on digitizer and sampling rate
- Enrich or prescale?

– Can we continuously record π , μ signals with high threshold discriminator on ATAR, reduced time resolution

- Not with HD-Soc, but we could develop discriminator, splitter ASIC
- Needs study on justification

– Can we trigger on ATAR

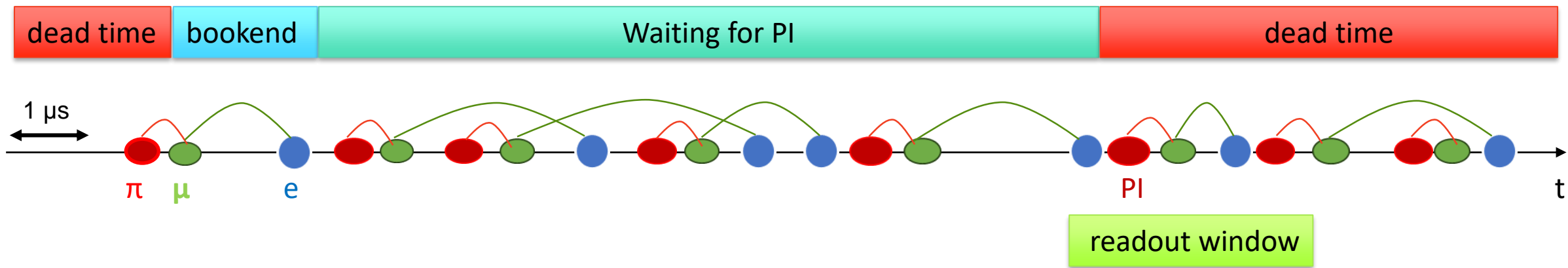
- Xin worried about e which don't make it out of ATAR. With current digitizer we cannot trigger on ATAR. My hope is that min. bias will allow such studies

– Are we losing 30% of events

- Because we trigger only once per 1us, with 30% muon PU
- Incorrect thinking, not $R_{\pi} * 0.3$, but $R_{trig} * 0.3 \sim 3\text{kHz}$ losses

Backup

$R_{\pi} = 300 \text{ MHz}$ next neighbor $T_{\pi} = 3 \mu\text{s}$
 $R_{\text{trig}} = 10 \text{ kHz}$ next neighbor $T_{\text{trig}} = 100 \mu\text{s}$ **deadtime < 10% T**



- current version HDSoc 64 channels (status, does it exist already?)
- full readout rate < 1 kHz, few ms scale
- but only 2 us for 32 sample digitization. Thus 1 channel should be read out in $64 \times 2 \mu\text{s} = 128 \mu\text{s}$.
- the residual bottle neck from transfer at 500 MB/s. Readout of all channels in 1ms would be $64 \times 12 \text{ bits} \times 2048 \times 1000 \times 1 \text{e-}6 = 1500 \text{ MB/s}$.
- dynamic range: 0.4-2V. A little bit more if pulses with cut off peaks are acceptable.
- analog bandwidth 0.8 GHz or 0.6? Some Nalu documents quote 0.6. If your sampling rate is only 1 GHz, you would have to reduce the input BW to below 0.5 GHz to avoid Nyquist.