TRG Summary
2022/12/2
T.Koga

Overall goal during LS1

-Summary of TRG discussions

-Goal during LS1

- -TOPTRG: make TOPTRG ready for operation just after LS1
- -KLMTRG: implement tracking logic for cosmic BG reduction
- -ECLTRG: UT3->UT4, calibration improvement, future high BG study
- -CDCTRG: reduce CDCTRG rate ~50%
- -GRL,GDL: UT3->UT4
- -injection veto: try new injection veto scheme
- -TRG/HLT: reduce L1 rate ~half, increase HLT limit up to 20kHz
- -physics: optimize and priotise trigger menu
- -(upgrade at LS2 and beyond) ← covered by morning slide

TOPTRG

-Goal during LS1:

-TOPTRG to be ready for operation with CDC-TOP matching

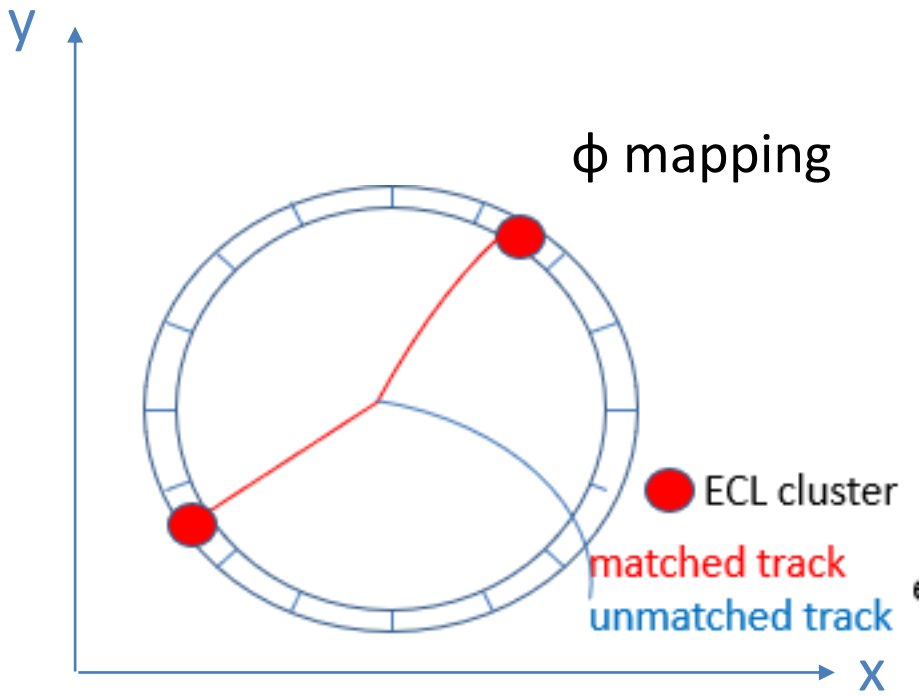
-Tasks:

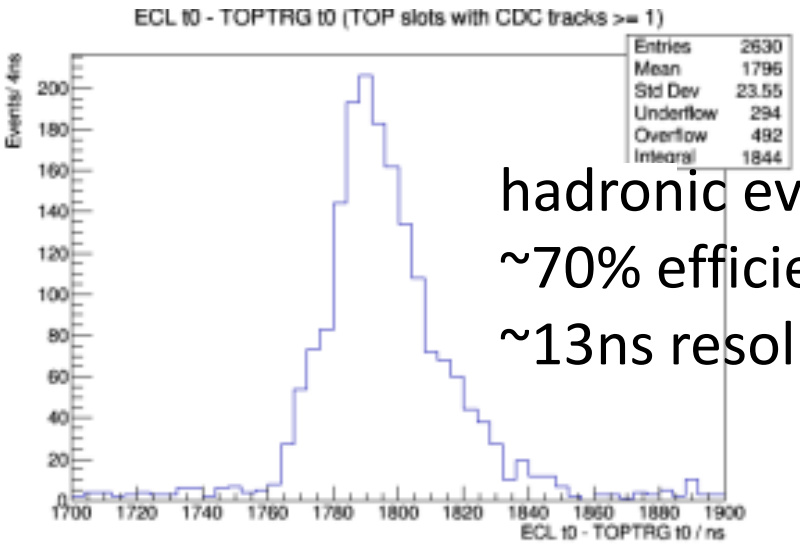
-Design and performance check: done

-TOPTRG transition to UT4 and commissioning: on-going

-GRL FW modification and commissioning: next

-TOPTRG SLC implementation





hadronic event

~70% efficiency

~13ns resolution

ECLTRG timing – TOPTRG timing (ns)

KLMTRG

-Goal during LS1:

-improve core logic to reconstruct track

-all KLMTRG expert may leave BelleII in this half year.

New comer needed to keep operation.

-Tasks:

-design of core logic with simulation: done

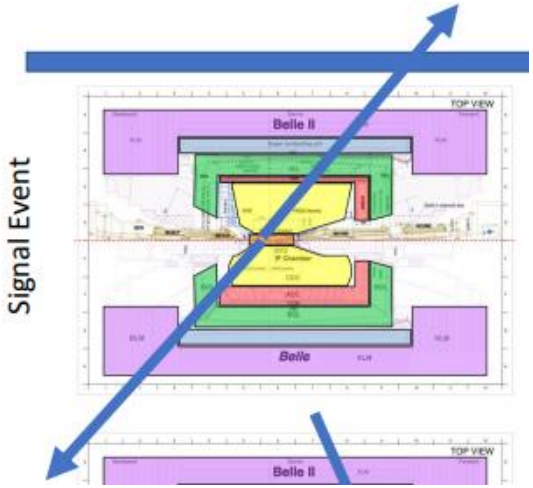
-implementation of firmware: done

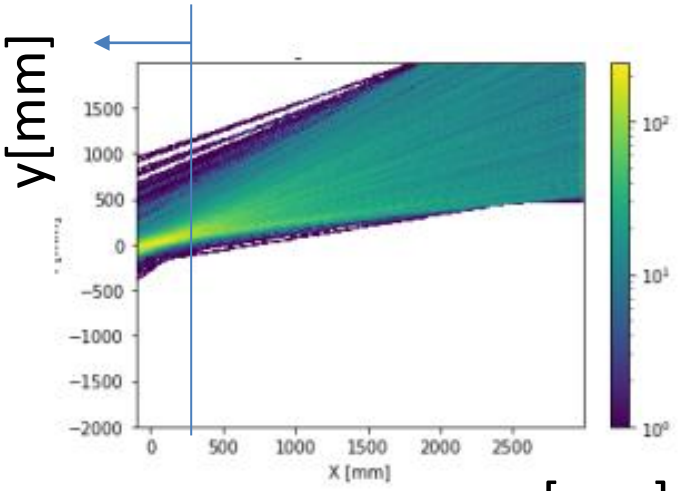
-commissioning with cosmic: next

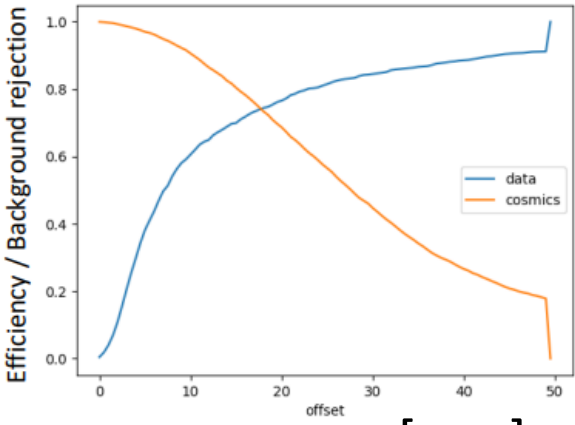
-optimization of track selection criteria and output to GRL/GDL: next

-Signal efficiency

-BG rejection rate







ECLTRG

-Stable operation and performance during 2022ab.

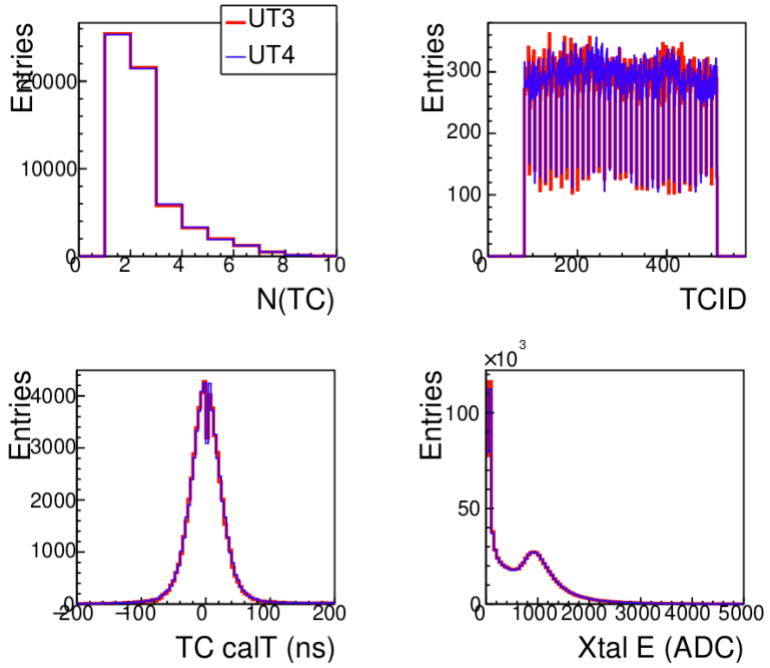
-Tasks during LS1:

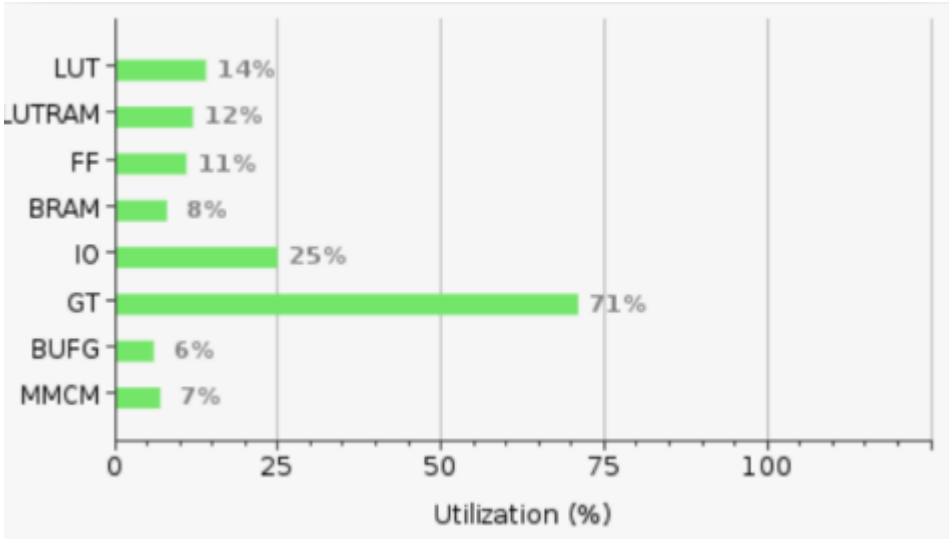
- -Transition of ETM from UT3 to UT4: on-going
- -Performance study for high luminosity and background: next
- -Trigger logic optimization for Bhabha veto etc.: on-going
- -calibration: on-going
- -Event timing with multiple TC: next (maybe low priority)
- -Software update: next
- -Online luminosity monitor discussion and development by ECLTRG: next

ECLTRG ETM: UT3->UT4

-Status: Migration of ETM to UT4 is still in progress
  -timing violation issue were solved
  -Strange ecl trg data in cosmic run with clustering logic

-Plan:
  -continue commissioning with stability check
  -higher optical transceiver speed to reduce latency





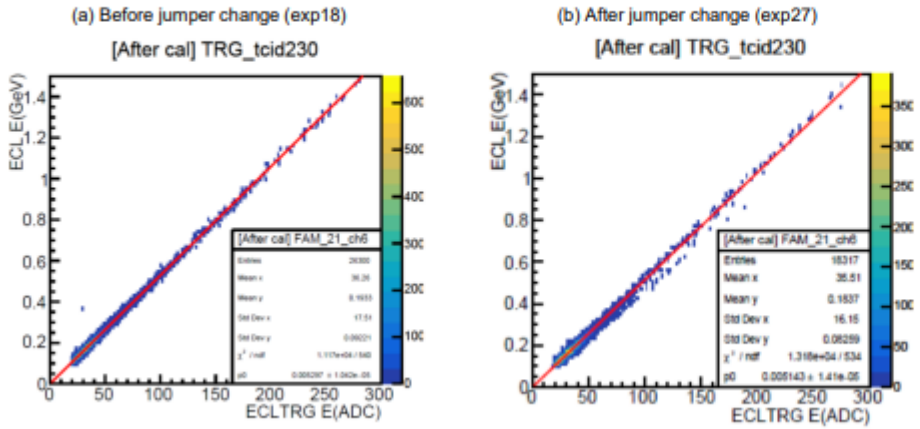
ECLTRG: calibration

-Status: Test to change jumper configuration for better energy resolution
-confirm jumper change works well with expected gain with 3 channels

-Plan:
-check consistency with beam/global cosmic/local cosmic data: on-going
-decision to change jumper setting of more channels: next

$$Gain = \frac{1 + \frac{470}{2500\left(1 - \frac{Att}{63}\right) + 240}}{1 + \frac{470}{240}}$$

2D plot "zoom-in" [300ADC : 1.5 GeV] with changed chs



Cell ID 4514 (TCID 230)	Gain (float)	Coefficient
Before	1.0877	63
After	0.6045	54

3

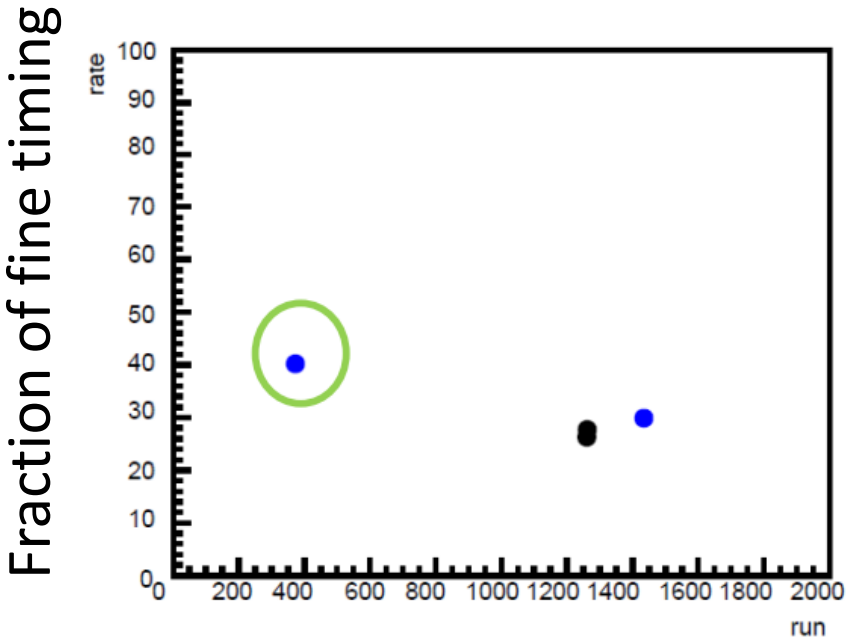
ECLTRG: DQM

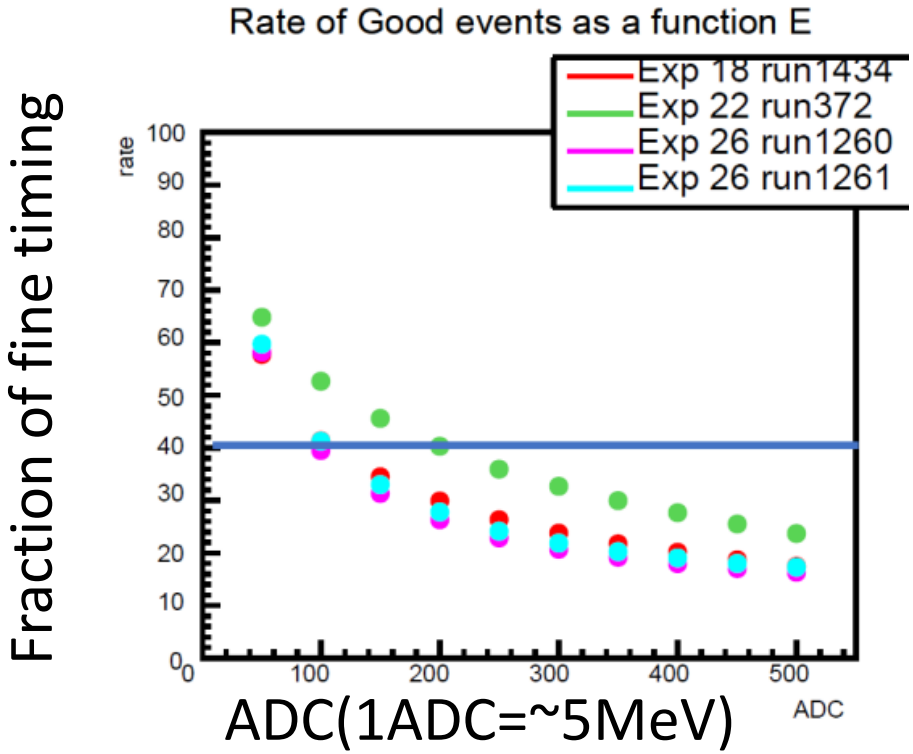
-Status:

check fraction of “fine timing” events during run for SVD 3-sampling

-Plan:

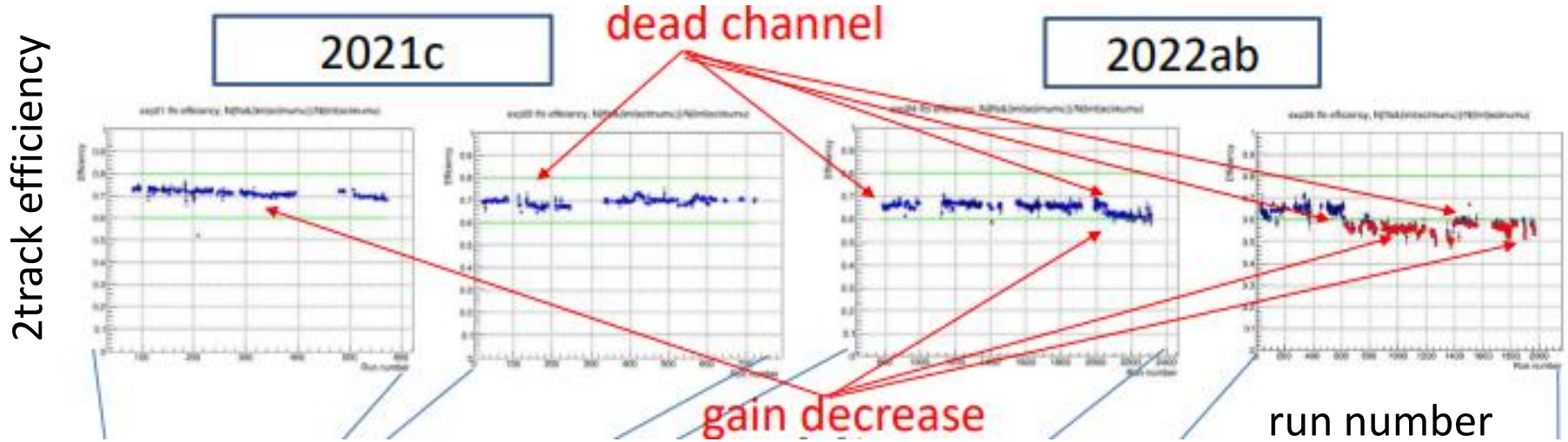
- -implement the plot to online DQM and QAM: next
- -comparison with GDL and ETM recorded data: on-going



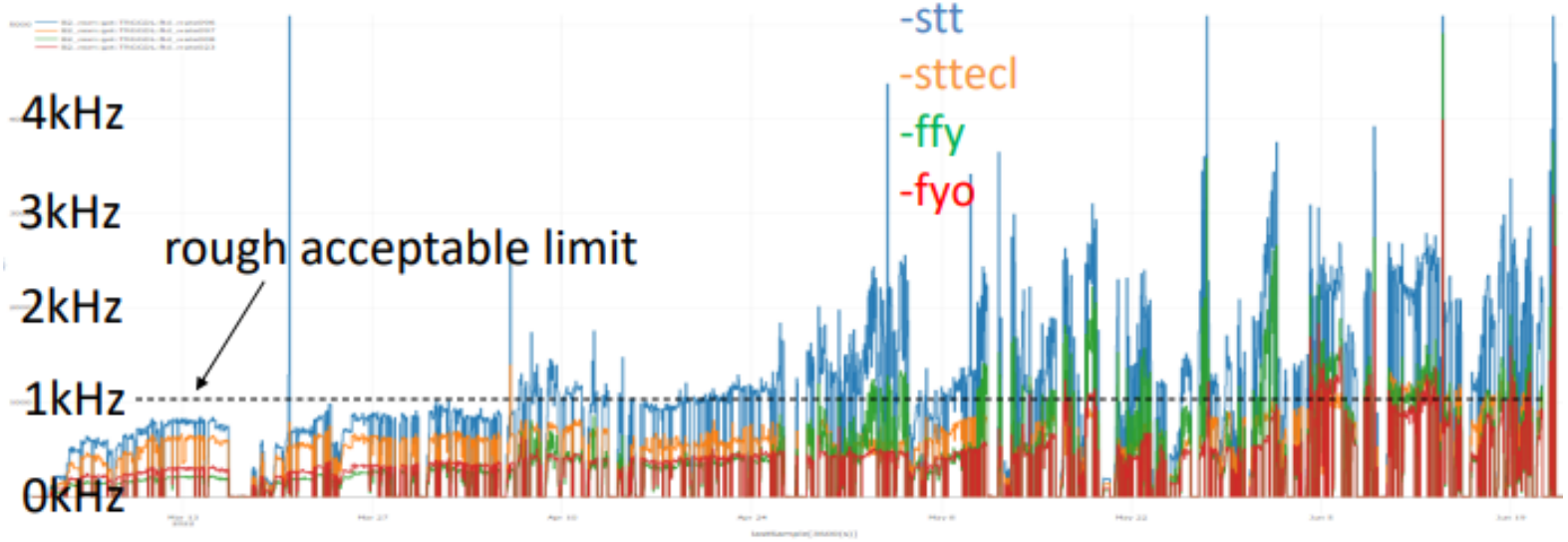


CDCTRG problem 2022ab

-CDC gain drop -> efficiency decreased significantly

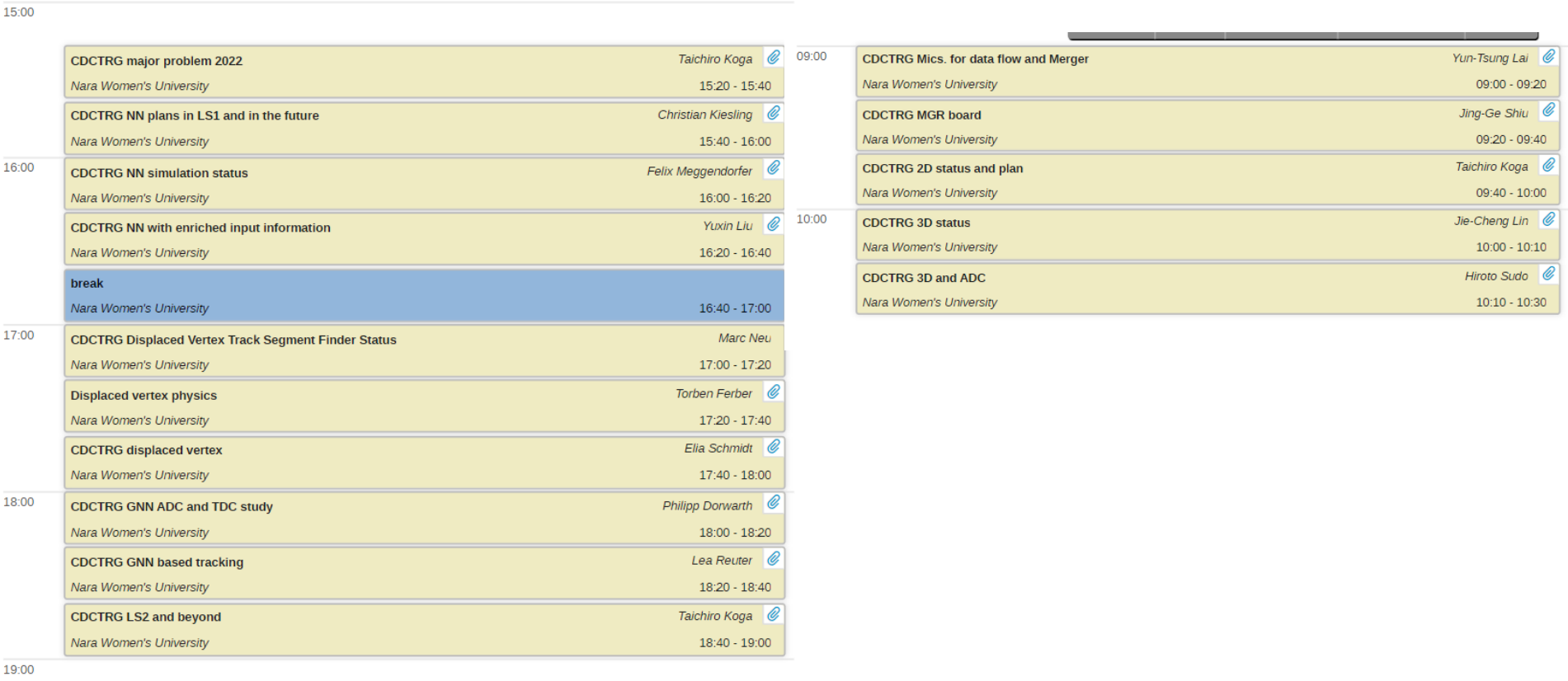


-beamBG increased -> trigger rate increased significantly



CDCTRG developments

-Too many slides and can not review one by one..



CDCTRG developments

-Too many slides and can not review one by one..

-Summary of on-going/planned activities in LS1

-In total, aiming to ~50% rate reduction (challenge!!)

module	modification	feature
CDCFE	modify crosstalk suppression send ADC to CDCTRG	cross talk reduction ×latency increase ~400ns
MGR	dead channel masking send ADC to TSF if possible, increase bandwidth	apply mask to each CDCFE ×degradate event T0 resolution 10->25ns keep eventT0
TSF	send ADC to 2D if possible, loose requirement with ADC	recover efficiency
2D	use full hit pattern for hough counting hit selection with ADC	fake track rejection noise rejection
3D/NN	Update training with newer dataset Increase #wire for fitting Implement ADC for fitting Improve LR flag decision	improve z resolution improve z resolution improve z resolution, noise rejection improve z resolution
Displaced vertex	design of logic with TSIM, performance evaluation	improve efficiency of displaced vertex

CDCTRG

-

GRL

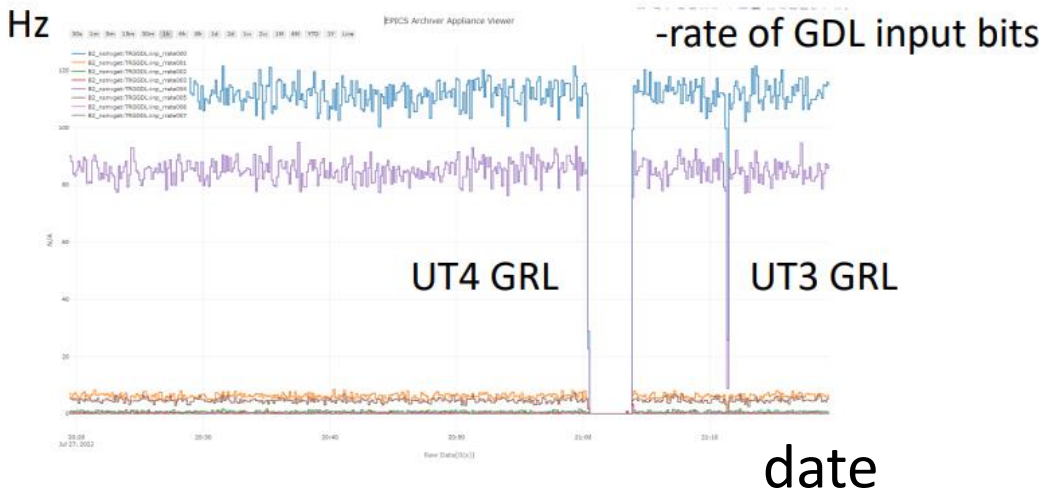
-Goal and tasks during LS1:

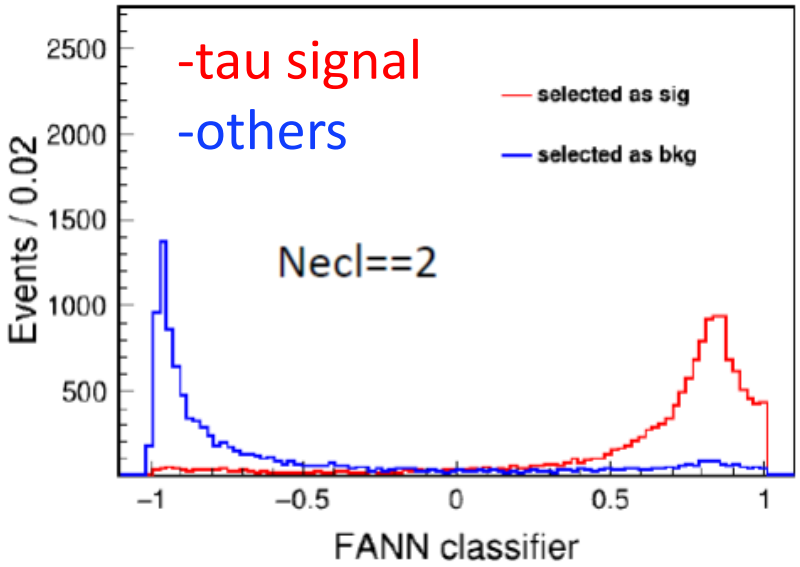
-UT3->UT4 transition: done

-speed up transceiver speed: next

-modify TOP-CDC matching logic for timing estimation: next

-implement neural net logic for final event selection: on-going





GDL

-Goal and tasks during LS1:

-UT3->UT4 transition: firmware made, test on-going

-LVDS extended board protocol: next

-modify injection veto to handle >40ms veto length: next

-software modification to generate GDL payload automatically: on-going

-Unification of GRL and GDL is under discussion.

Injection veto

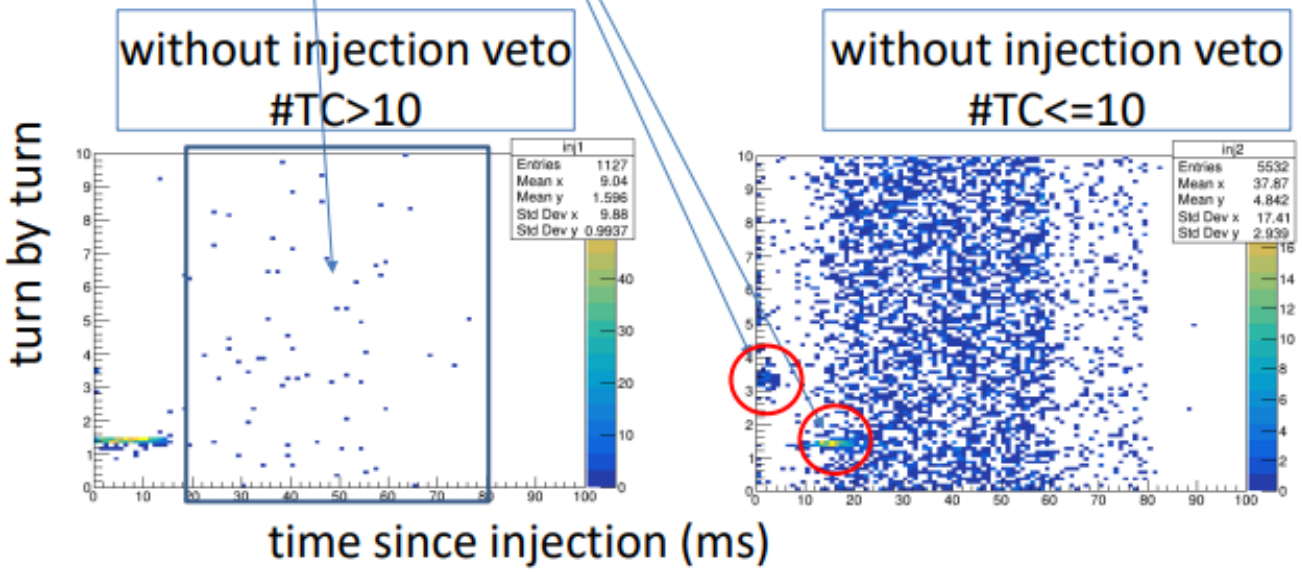
-R&D started to reduce injection veto deadtime with new veto logic:
if event occupancy (etc.) at level1 is low, take data even during veto

Analysis of no-injection veto run

-Time since injection with #TC>10 and <=10 (primary criteria for veto)

- -~1% impact for physics efficiency at maximum
- -some leakage of injection BG.
- Need to check TOP #hits if DAQ crashes or not.

-Need further study but not bad as the first trial

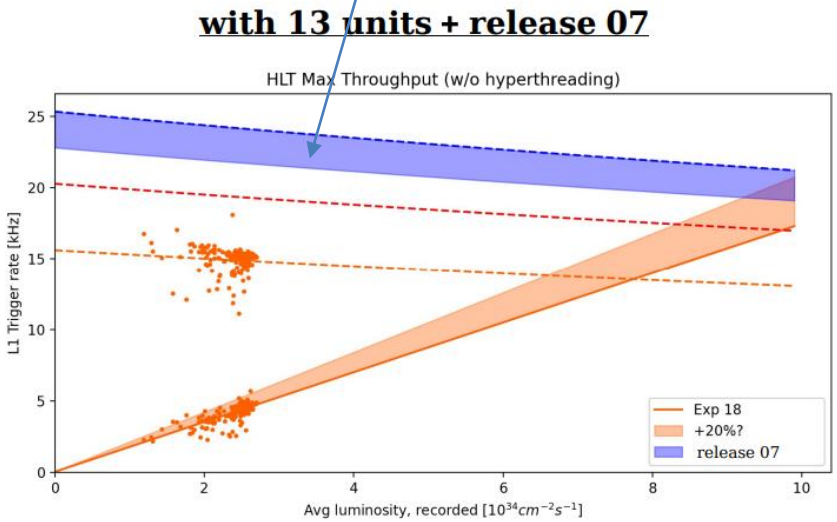


TRG/HLT

-HLT: Add ~3HLT during LS1, software optimization ->achieve 20kHz limit.
Further HLTs and optimization are needed for 30kHz achievement.

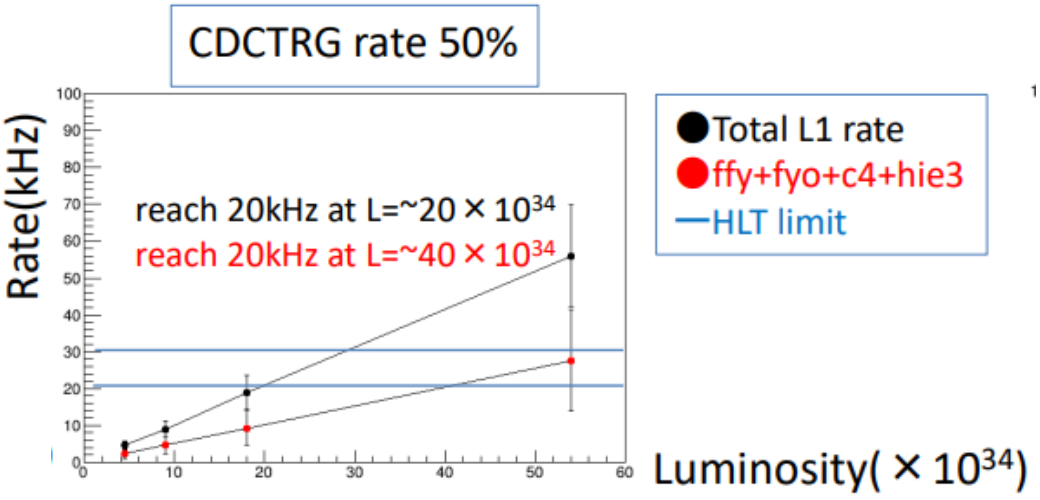
-TRG: Modify CDCTRG to reduce ~50% rate,
Priority and optimization of trigger bit menu during LS1.
Further development is needed to keep 30kHz for B physics.

L1 rate limit



~20kHz limit at L=10 × 10^{35}

L1 rate expectation



~5kHz at L=10 × 10^{35} (B physics)
~10kHz at L=10 × 10^{35} (B+low multi)

Physics: low multi

-Physics mode and needed trigger conditions are summarized
-Priority should be discussed, as well as optimization of condition

Analyses	triggers
Z' invisibile, dark Higgs	fy30, cdcklm, stt
Z'→ττ, μμ	fff/ffy, cdcklm,stt (fy30, fyo)
A' invisible (single γ)	hie, lml6, lml16 (lml1, prescaled)
A' visible without γ	stt, fyo, hie
X17/ A' visible + γ	dpee (lml,,hie, c2hie)
ALP→ γ γ (3γ final state)	hie (high mass) , ggsel (low mass)
ALP→ γ γ fusion (ee → γ γ e)	lml2, hie (stt, lml1 barrel)
Single π^0/η/η' (ee → γ γ e)	hie (stt)
μμ(γ) control sample (for invisible A' + …)	stt, beklm, cdcklm (fyo, syo)
IDM + Dark Higgs	hie (lml12, stt [stt4/5])
ππγ for HVP	hie, (ff, stt)
πππ^0γ for HVP	hie, bha3d (lml1)
Dark showers	stt, stt-ecl, hie for electrons (displaced VTX)

CDC
ECL
KLM

Triggers used now or in already planned extensions of analyses to the full dataset (and beyond)

Physics: tau

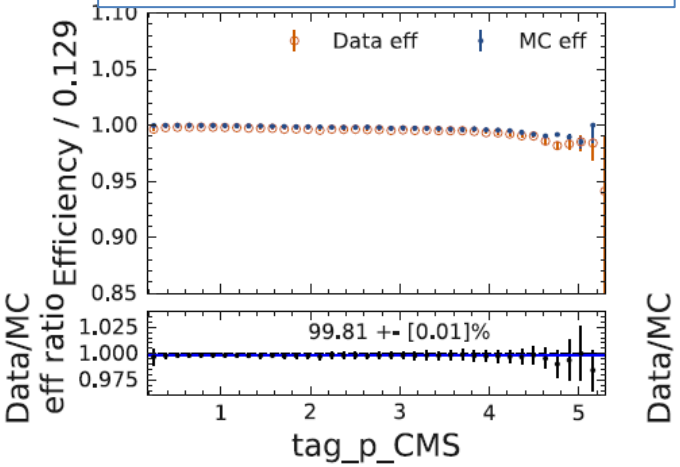
-Physics mode and needed trigger conditions are summarized
-Priority should be discussed, as well as optimization of condition

Trigger bit	Prescale (today)	Raw Rate	Physics analysis	Physics analyzer	Physics note,slide (of TRG efficiency)	Comments, priority
stt	1	🤔	τ 1x1 τ 3x1	CDC trigger for τ group	LFV_tau3mu	priority: high
fy30	1	🤔	—	—	General checks only This presentation (backup slides)	priority: low
hie, hie3	1	🤔	τ 1x1 τ 3x1	τ group	LFUV , LFV_tau3mu, LFV_tauerho, LFV_taulKS	priority: high
lml2	1	🤔	τ 1x1 τ 3x1	τ group	LFUV , LFV_tau3mu, LFV_tauerho, LFV_taulKS	priority: low
lml6	1	🤔	τ 1x1	τ group	LFUV , LFV_tau3mu, LFV_tauerho, LFV_taulKS	priority: medium

Physics: τ efficiency performance

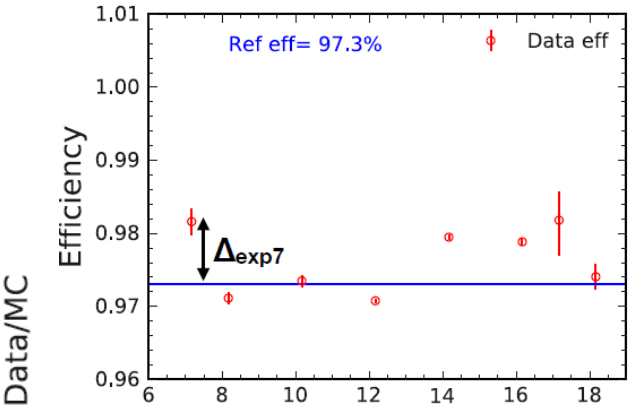
- >~90% efficiency for tau 1x1
  - -CDC:>~90% eff. with stt
  - -ECL: >~90% eff. with hie, lmlx
- -~1% level agreement of Data/MC !
  - -expected Trigger systematic is ~0.5%

ECLTRG efficiency with e



nu

ECLTRG efficiency with μ



Sys	e	μ
Data-MC	0.05	0.05
Ref trig	0.11	0.34
Exp dep	0.13	0.26
Total (%)	0.124	0.437

Physics: PID with two photon

-New trigger is requested to keep p>2GeV tracks without prescale
-After checking rate, new bit will be implemented.
-CDC-ECL matching bias will be studied.

Use CDC triggers for LID efficiency in two-photon channels

- Un-prescaled triggers are necessary
  - to obtain consistent result with other channels
  - to enhance the events with high momentum
- CDC-ECL matching is probably fine: no bias on LID efficiency
  - **More dedicated study is ongoing**

Trigger	p, θ coverage	prescale
ffb, fsb	○	100 from e17 → Not use
fyb, syb Main triggers now	○	1, but X from exp??
fyb_ecl, syb_ecl	○	1 in the future?
stt	How much endcap acceptance?	1 in the future?
※ my idea fyb_low(high) Syb_low(high)	○	5(1) ?

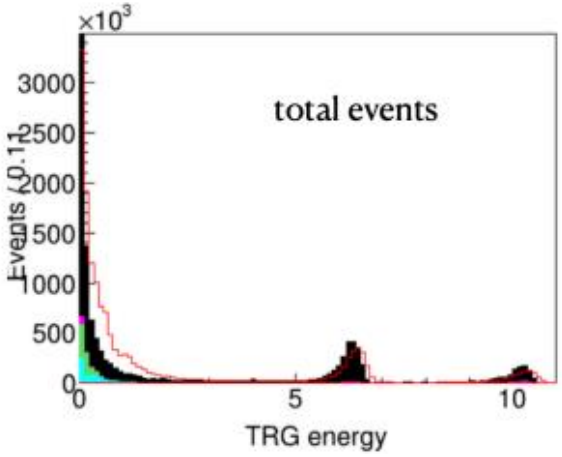
Physics: Bhabha veto

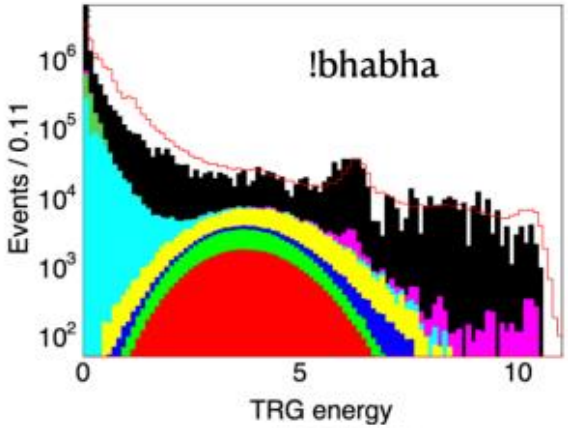
-Rate of hie is ~2kHz @ L=4.5 × 10^{34}. Need ~50% reduction.

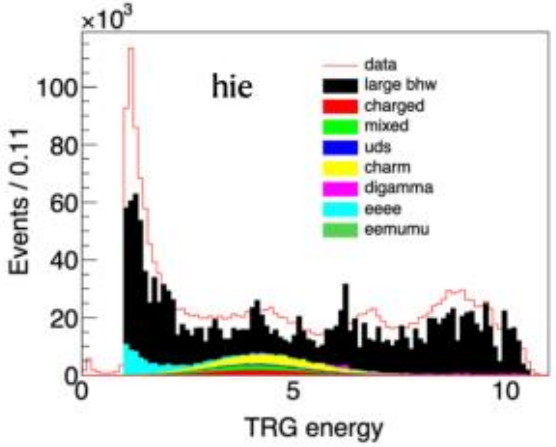
-We found it is coming from Bhabha.

-Optimization is done and ready to tighten veto at endcaps.

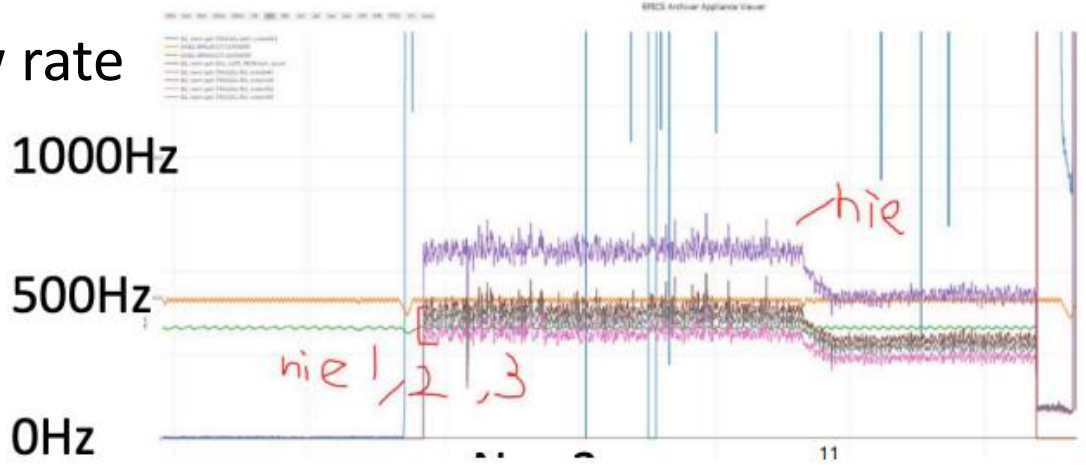
->Check Bhabha events at gaps of ECL barrel and endcap with CDC track.







Raw rate



-hie ← now

-hie1

-hie2

-hie3 ← new

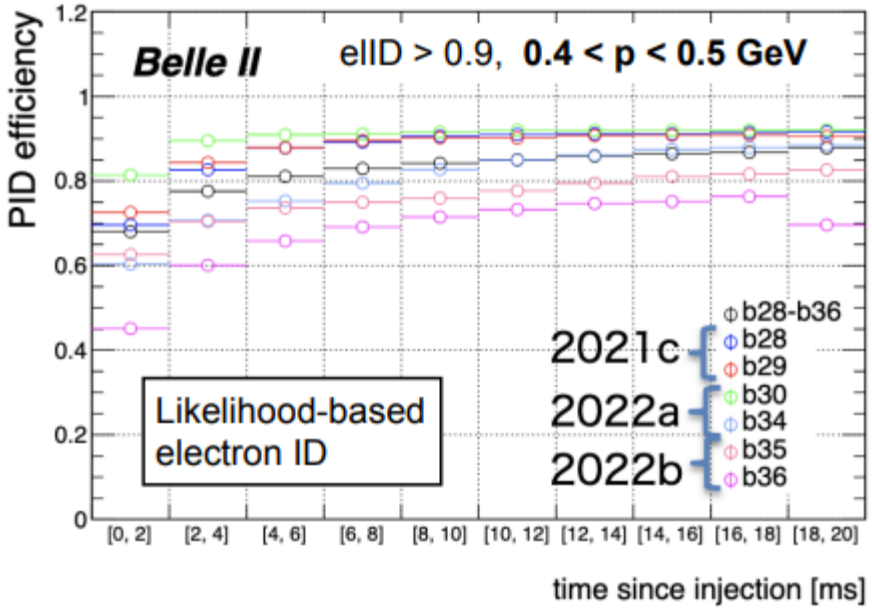
Physics performance: Injection

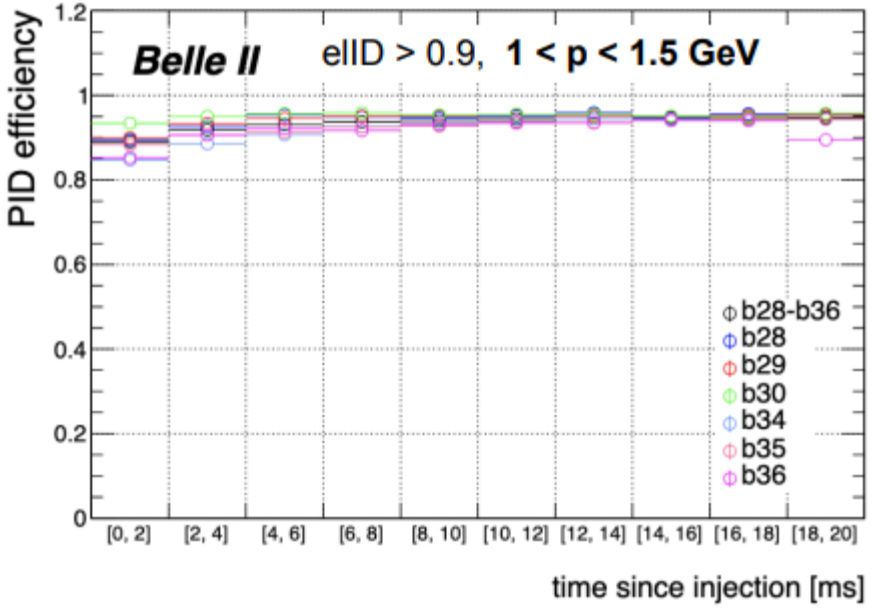
-TRG asked performance group to investigate data quality just after beam injection (slide at performance meeting)

-A lot of investigations are done and on-going.

-We discussed to shorten the veto to reduce DAQ deadtime: looks acceptable in terms of data quality but need to keep discussion.

Electron ID





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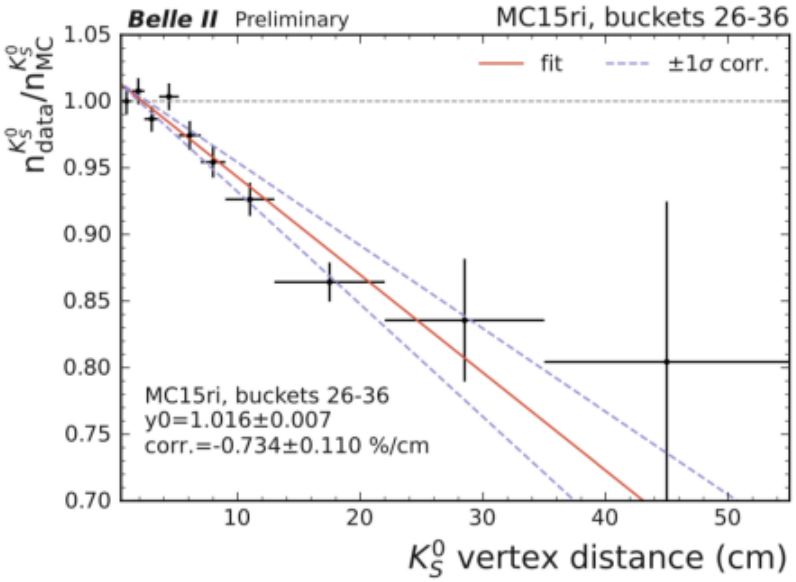
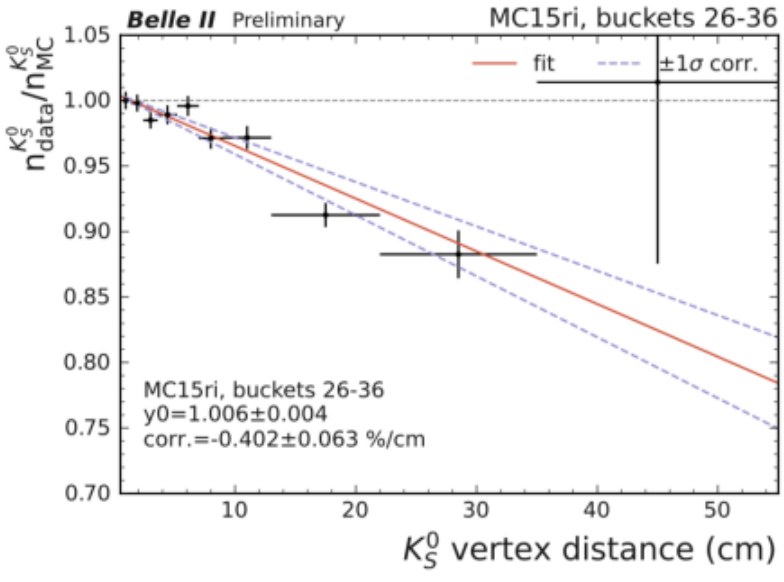
K short

Sascha Dreyer



$< 20\,ms$ after injection



$> 20\,ms$ after injection

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- -GRL,GDL: UT3->UT4
- -injection veto: try new injection veto scheme
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- -physics: optimize and priotise trigger menu
- -(upgrade at LS2 and beyond) ← covered by morning slide

backup

-

KLMTRG human resource

Manpower Status & Changes

Personnel	System(s)	Current Role	Status	Term?
C. Ketter	Scintillator	Deploying Waveform Readout	~50% FTE	Ramping to ~5% FTE in Q1 2023.
K. Nishimura	All	Coordination & Advising	<10% FTE	Current position ends 3/2023 – some (limited) availability beyond
R. Peschke	KLM TSIM KLM TRG FW	Deploying KLM TRG Straight Line Fits, Maintaining/updating KLM TSIM	~50% FTE	Position ends May 2023.
V. Shebalin	Scintillator KLM TRG FW	Mainly Maintenance, Debug	<10% FTE	TBD, potentially available through 2023.
G. Varner	All	Coordination & Advising	TBD	

- FTE values are unofficial, just rough estimates.
- Some additional contributions to TSIM from Iowa in past ~year+, significant guidance from S. Prell.
- Significant losses in manpower/knowledge already have occurred or are expected to occur soon.
- ***Most important to find new coordinators/contributors in next months while availability of existing participants is still good.***

-Sydney group may newly join to KLMTRG, CDCTRG (very welcome!!).
Keep discussion.

Operation

-Expert shift: prepare recovery GUI for CR shifter

-Automatic error detection, DQM, QAM:
add more plots and conditions.

-KLMTRG too high/low hit rate in each sector

-efficiency of all physics bits (for now, ~10bits are monitored)

-rate of all physics bits respect to bhabha

-efficiency of CDCtrack/ECLcluster/KLMsector with μμγ, with ϕ/θ mapping

-Arrangement of present messages

-all of GDL/GRL/CDCTRG VME parameters (for now, only important one)

-Latency of subtriggers on GRL