

L1 Muon Trigger-Rate for Run-2

~ EI/FI, Tile, Hot RoI mask ~

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Muon Trigger Signature Meeting**

Introduction

- We require two different coincidence schemes in Run-2

- BW & EI/FI
- BW & TileCal

◆ $1.0 < |\eta| < 1.3$

BW & { **EIL4** || **Tile** }

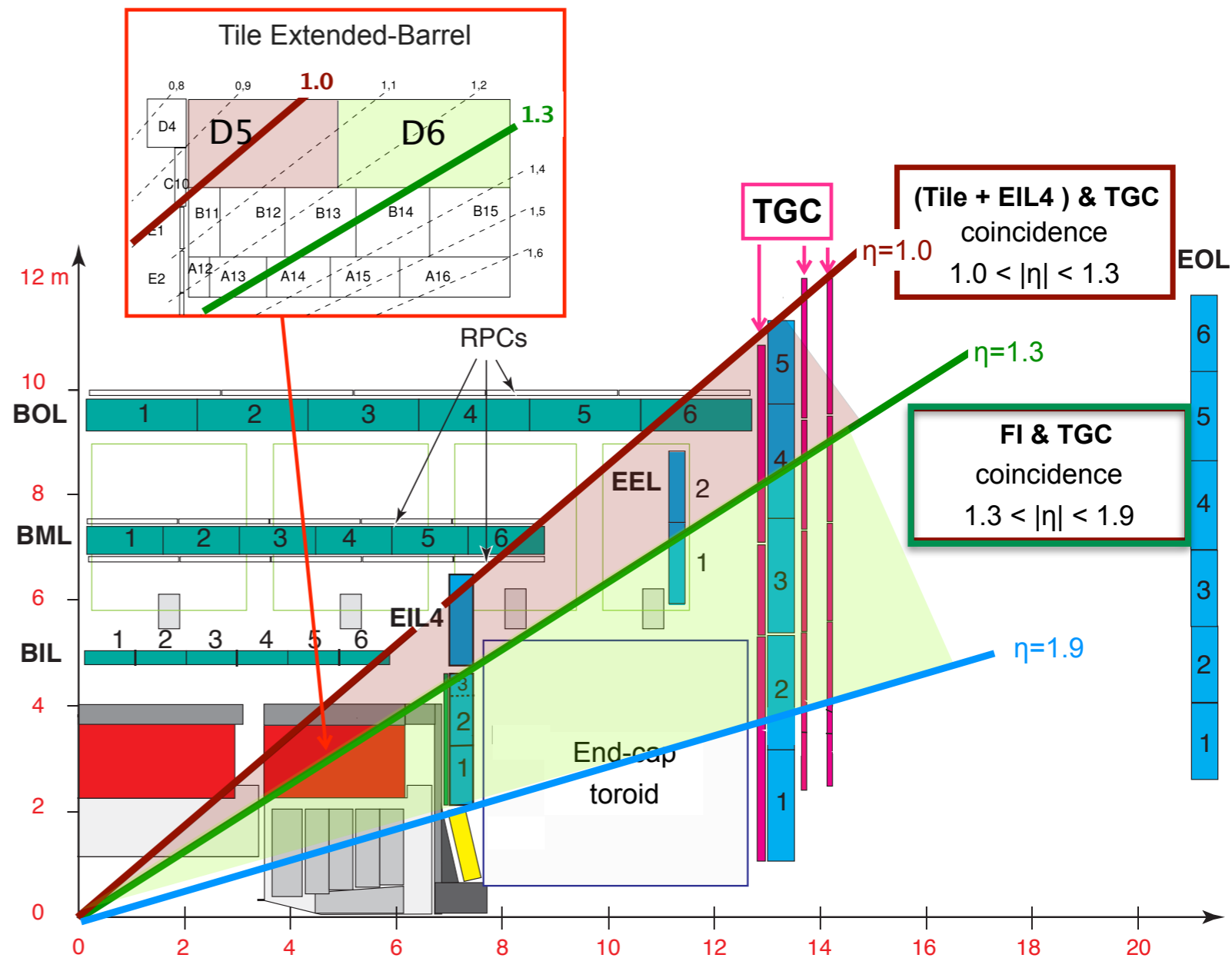
◆ $1.3 < |\eta| < 1.9$

BW & **FI**

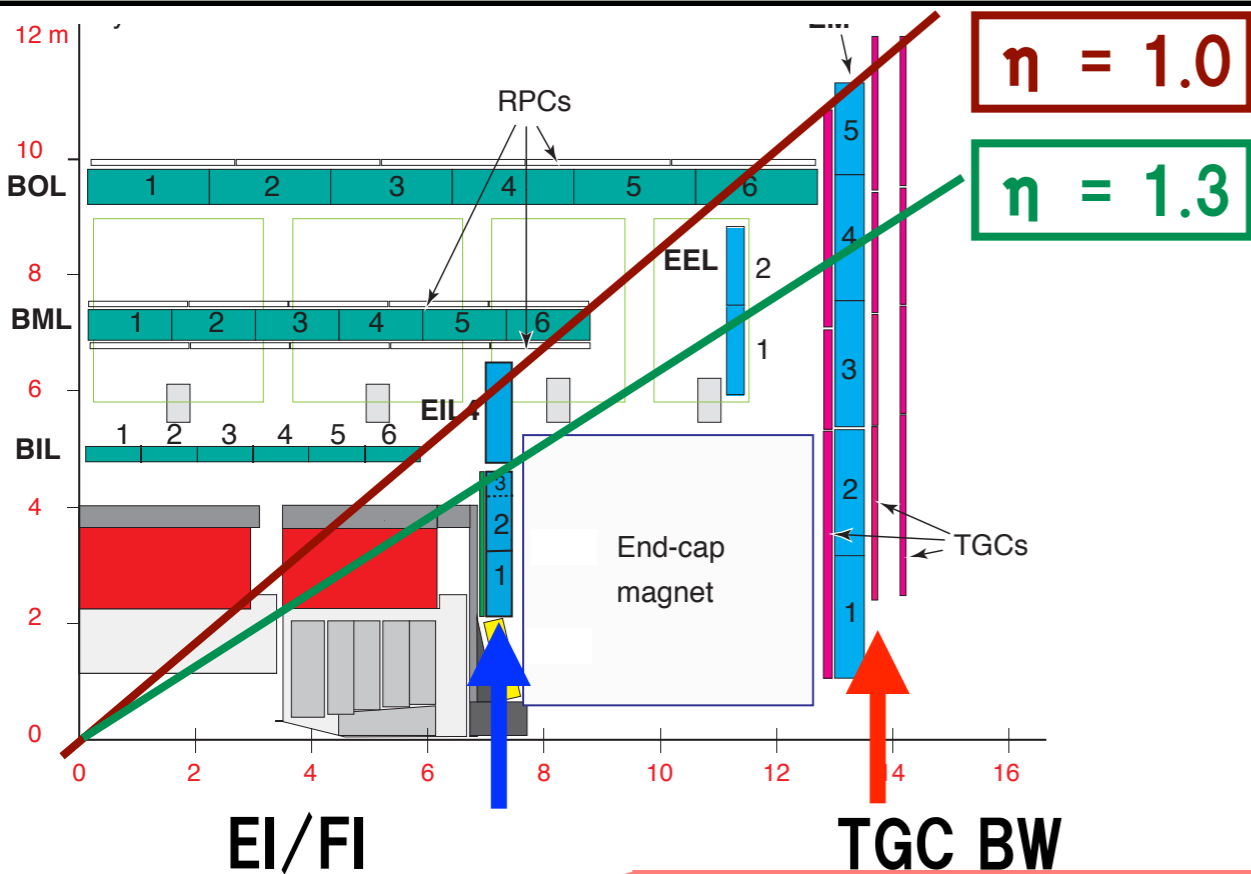
- Hot RoI:

the region with the integrated magnetic field which is too small to discriminate low p_T muons

to be masked

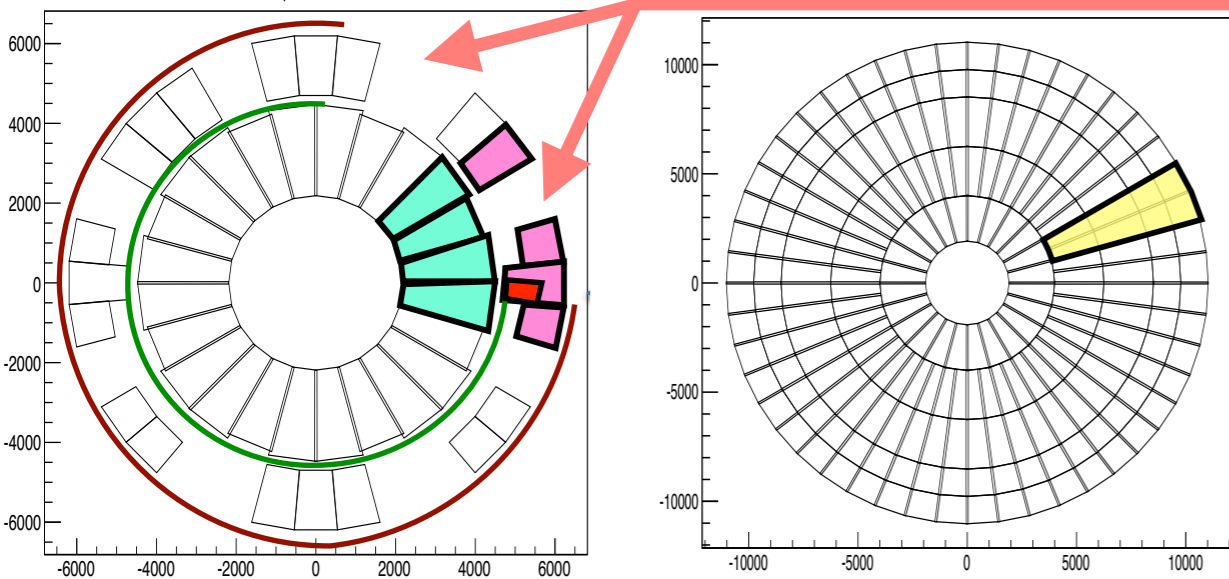


BW & EI/FI



• New Coincidence Window

- ◆ updated from TDAQ-TDR w/ optimization in MC using muon hits with more realistic p_T distribution
- ◆ applied and validated in TrigT1TGC : emulation for all the trigger function

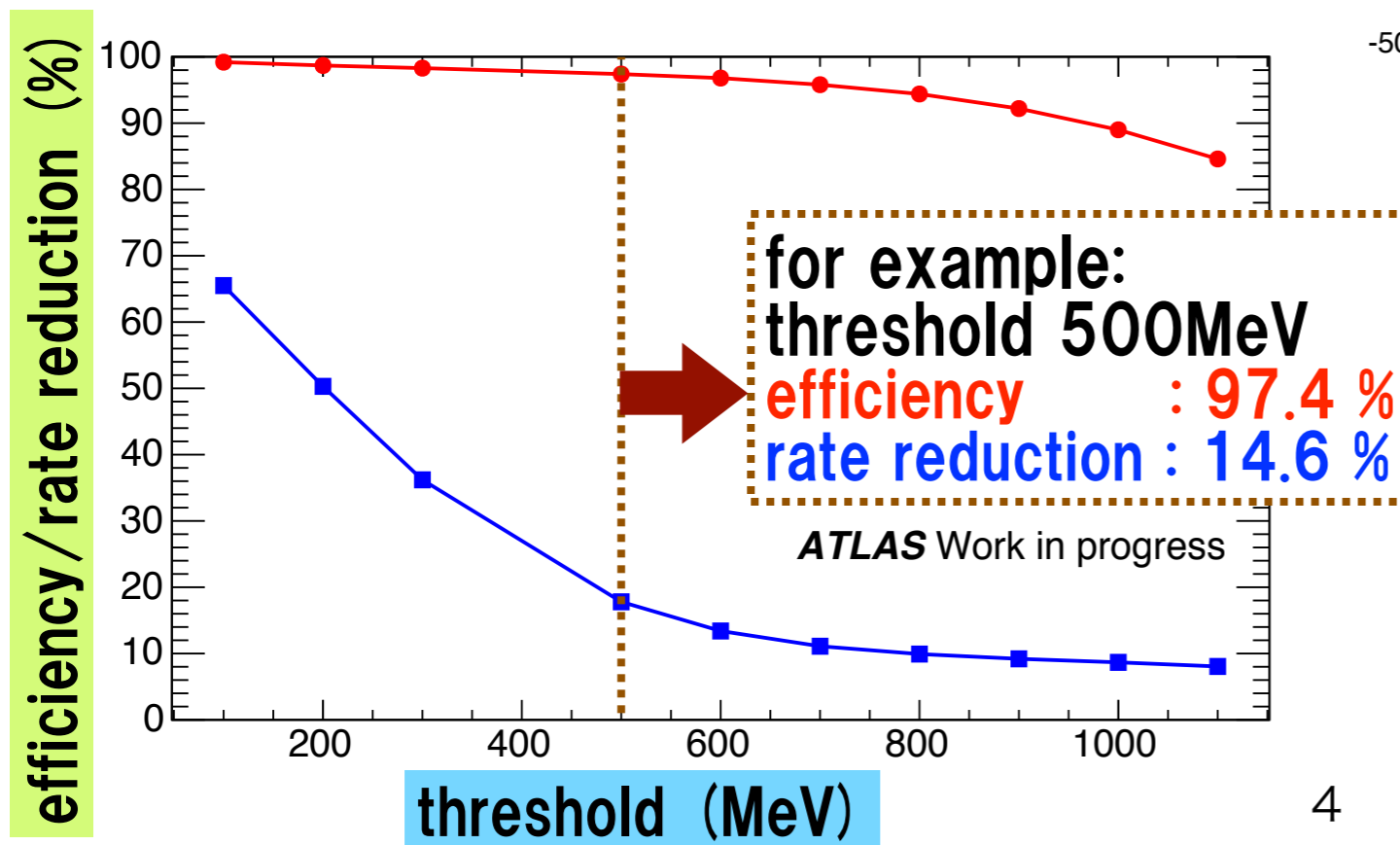
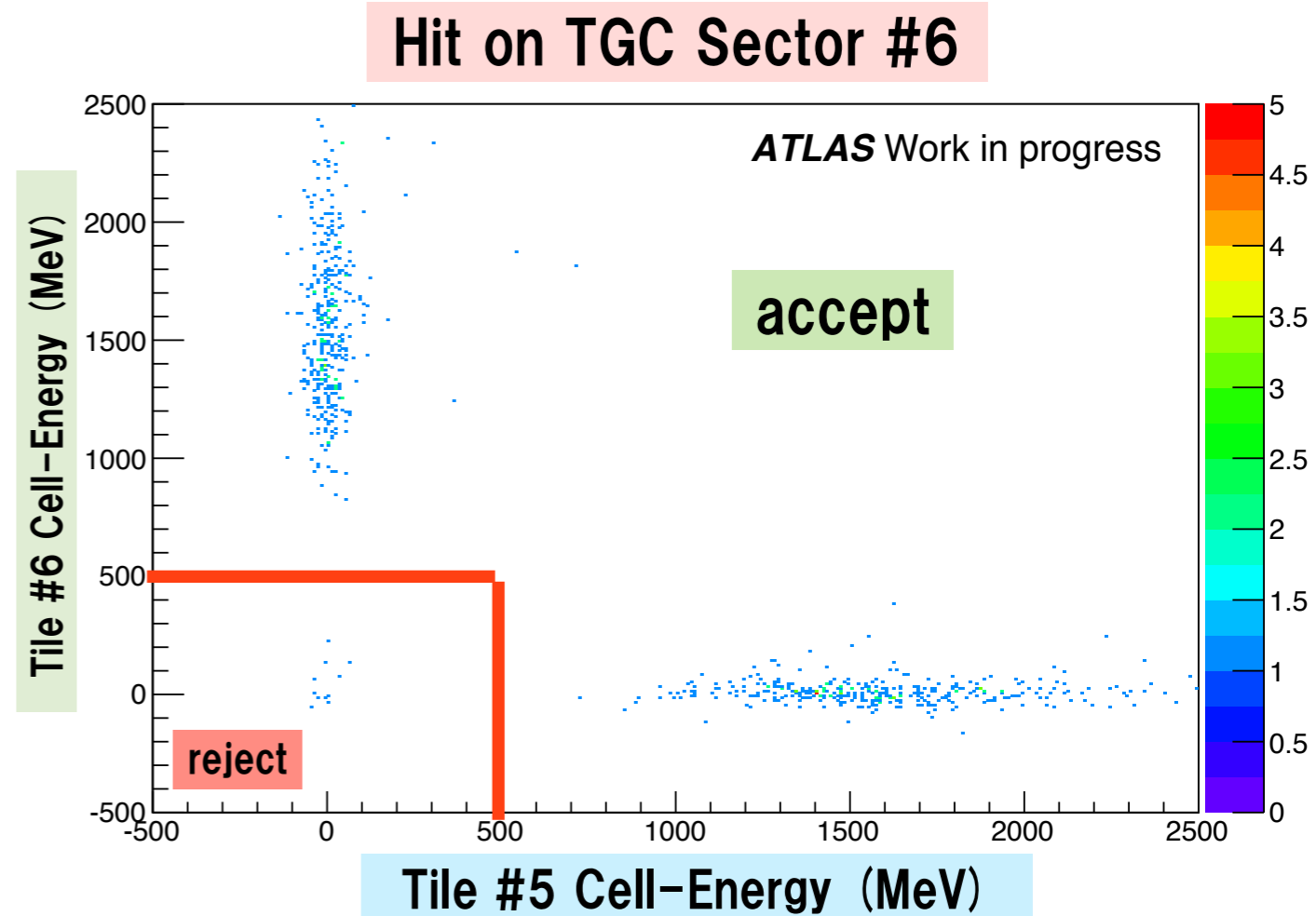
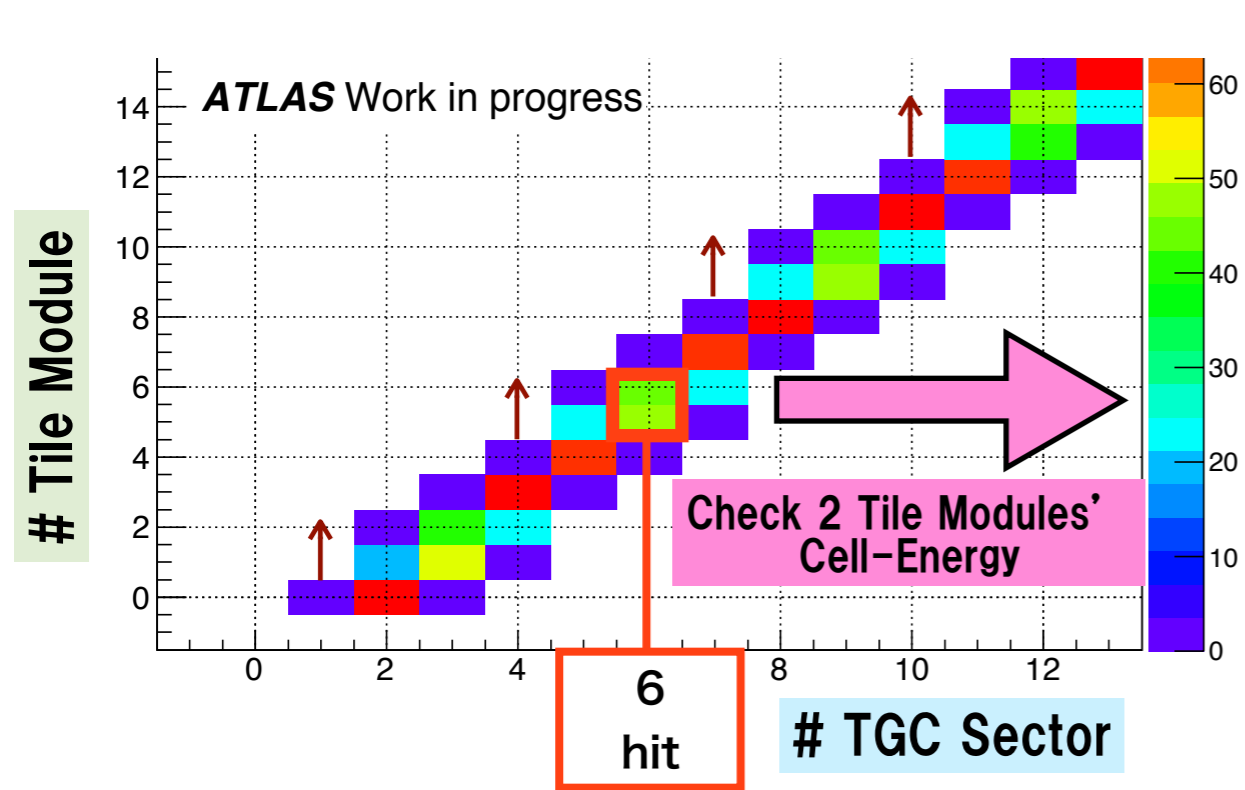


• Some regions are not by EIL4

- ♣ TileCal D-cells : Full phi coverage

➔ **Coincidence, BW & Tile**

BW & Tile



use hits in TileCal modules for the coincidence with corresponding TGC Sectors

- ❖ TileCal & BW coincidence is implemented in TrigT1TGC
- ➔ validation ongoing

Operation modes

- **Operation modes in $1.0 < |\eta| < 1.3$**

1. TileCal-only mode : not to use EIL4 hit information
2. Exclusive-OR mode : to use the TileCal signals only for the regions not covered by EIL4




- **Efficiency/Reduction:**

only slightly better in the Exclusive-OR mode


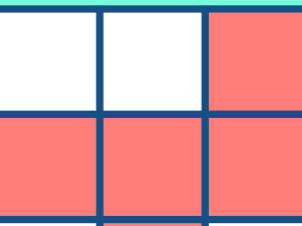
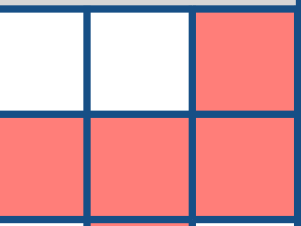

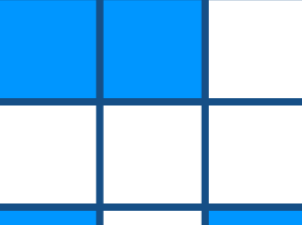
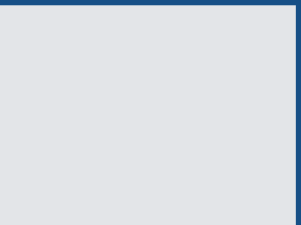
- **Cost in FPGA :**

much easier with TileCal-only mode

➔ **decided to adopt TileCal-only mode**

	: RoIs (SSC)
	: EIL4
	: TileCal

threshold 500MeV

	TileCal-only	Exclusive-OR	EIL4 only
EIL4			
Tile			
efficiency (%)	97.4	97.8	99.5
rate reduction (%)	14.6	12.5	60.7

installed in Run-2

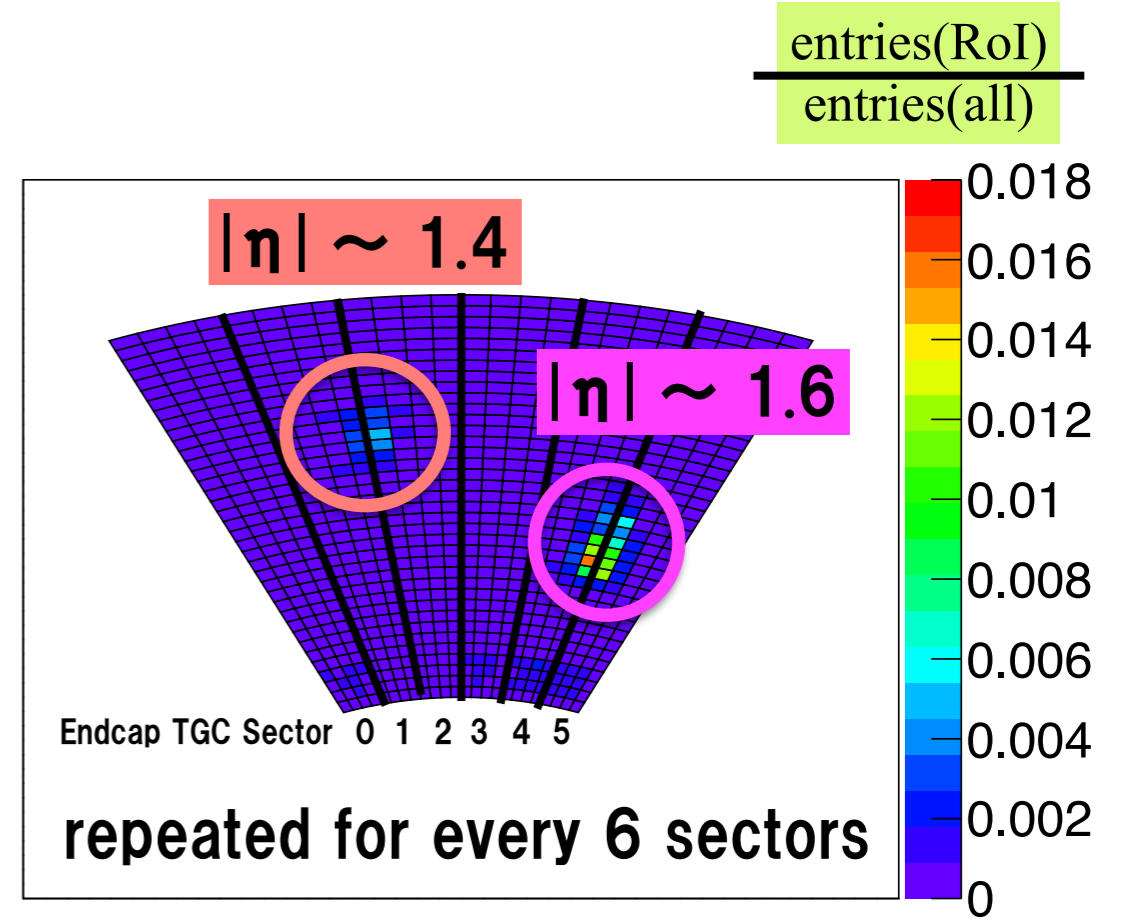
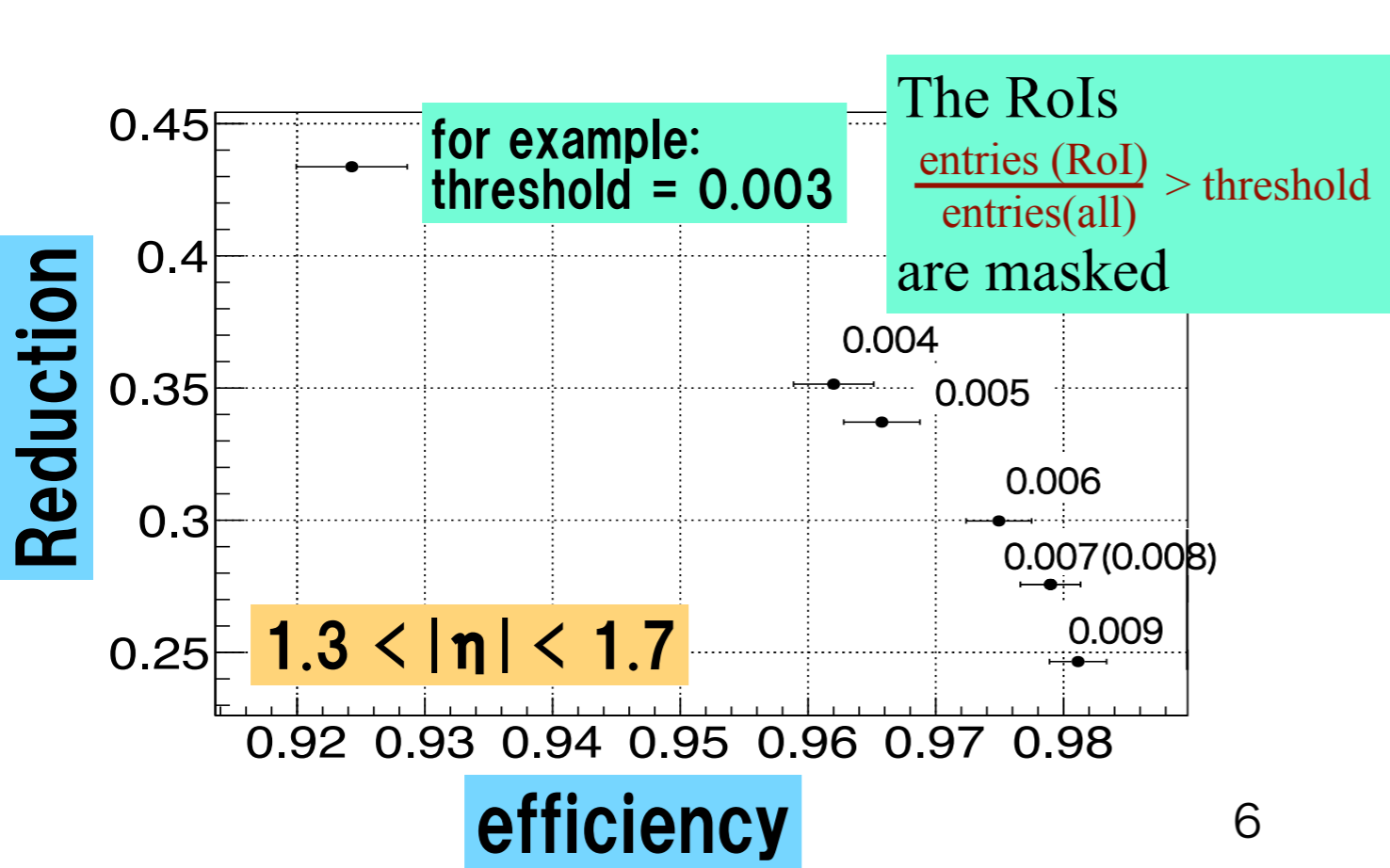
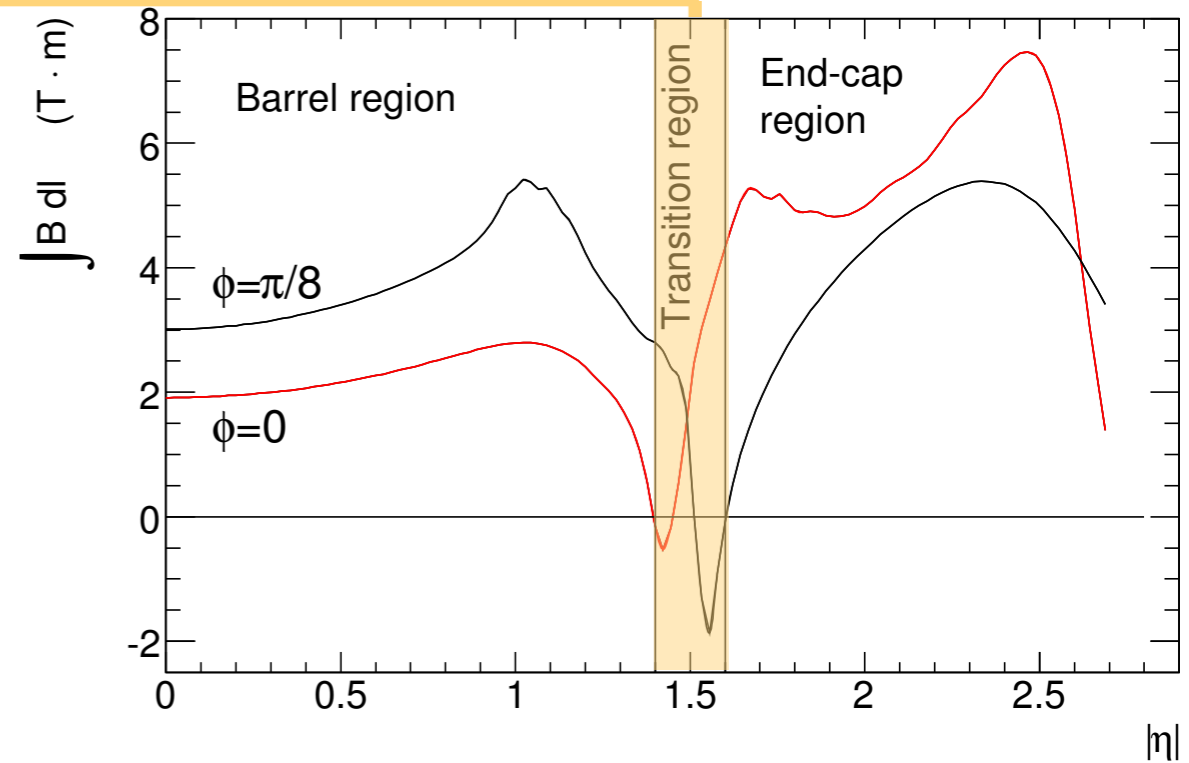
Hot RoI mask

- **Transition region**

- ❖ the region with the integrated magnetic field which is too small to discriminate low p_T muons

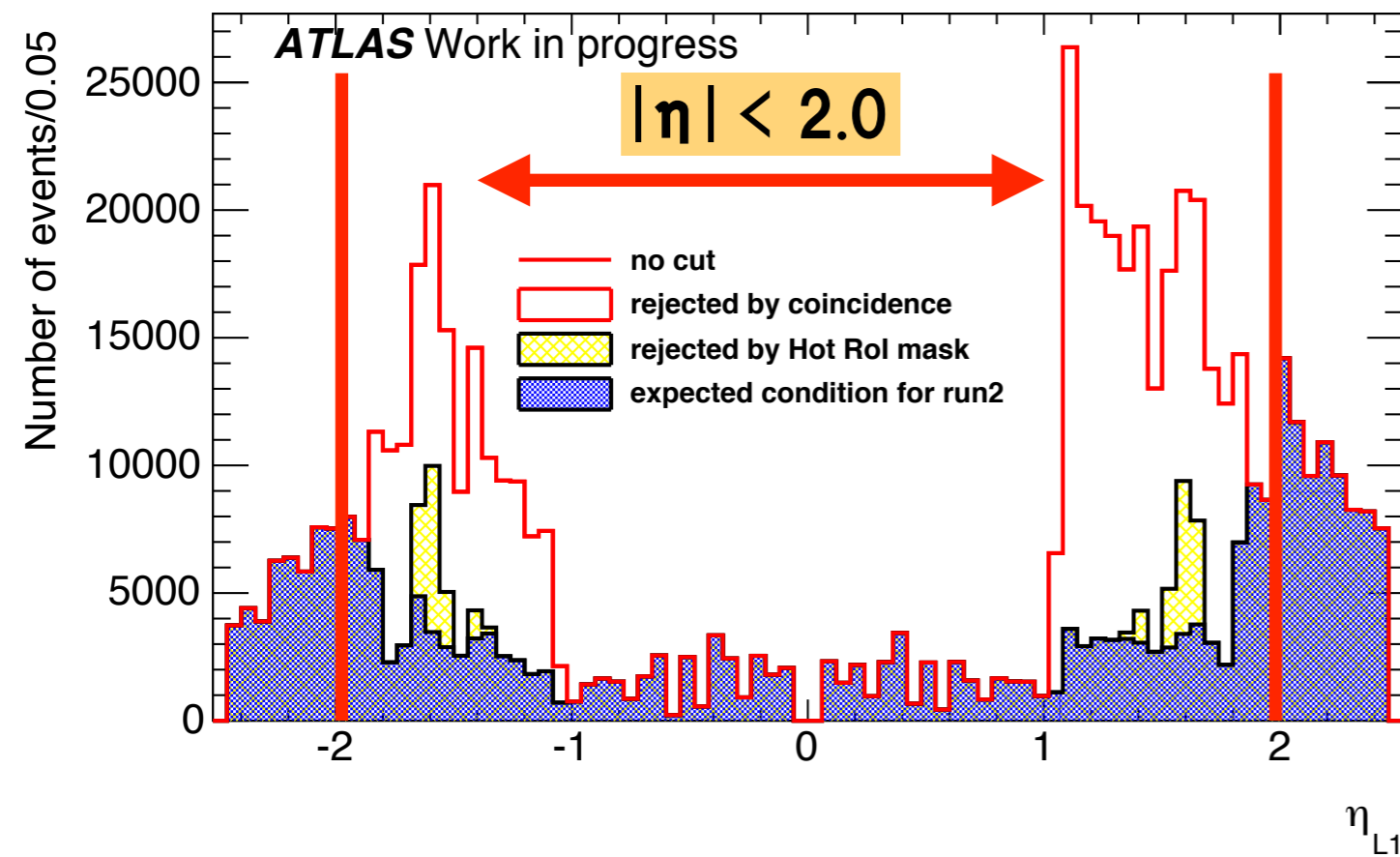
- **RoI mask**

- ❖ higher trigger rate with the low p_T muons (in those particular regions)
 - ➔ to be masked



Results

$2.0 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$



	rate reduction (%)	efficiency (%)	Trigger Rate (kHz)
no cut	100.0	100.0	34
FI + Tile (Tile only)	53.4	98.1	21
Hot Rol mask	48.9	97.4	19
$ \eta < 2.0$	29.8	84.5	12

eta region cut might be applied if the luminosity gets too high
e.g. 3×10^{34}

efficiency vs. p_T

- Definition of the “efficiency” in this slides:

ratio of muons from IP, accepted with the additional coincidence

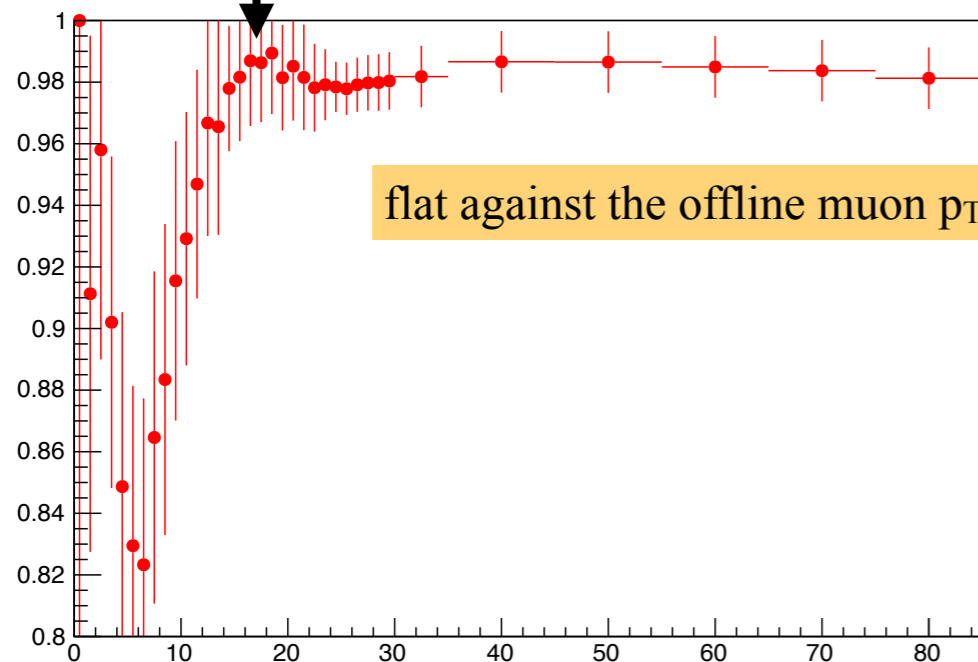
- ◆ absolute muon trigger efficiency can be calculated with the Tag&Probe method and the “efficiency” above multiplying “efficiency” and efficiency computed from Tag&Probe

EI/FI Coincidence Window
is optimized for 20GeV/c

$$1.0 < |\eta| < 1.9$$

“efficiency”

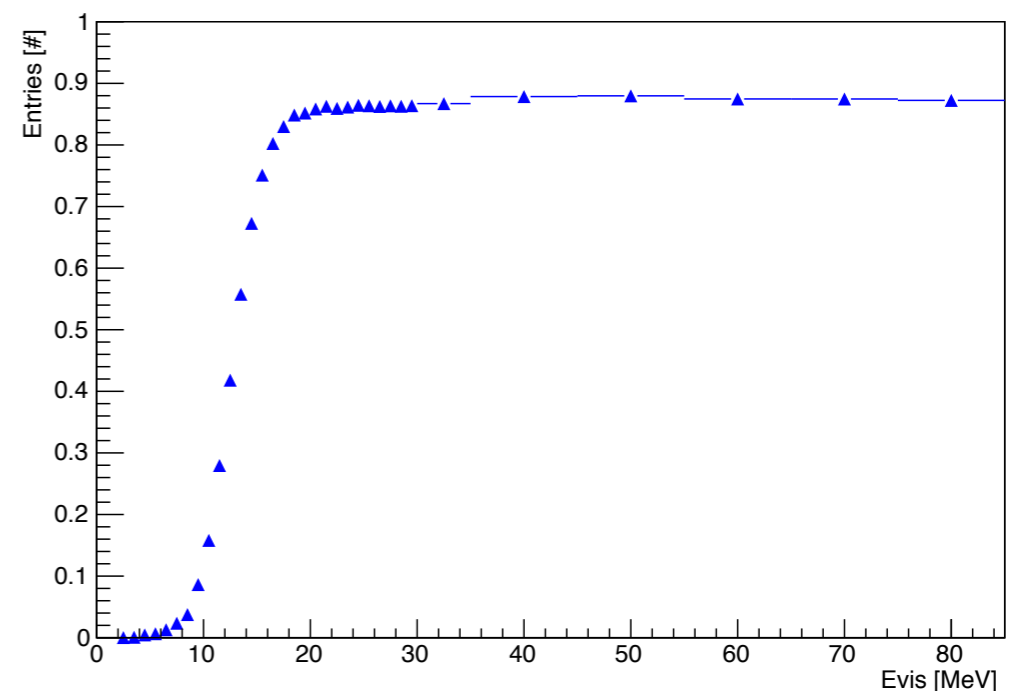
efficiency (%)



offline p_T (GeV/c)

absolute efficiency
(“efficiency” \times efficiency from Tag&Probe)

efficiency (%)

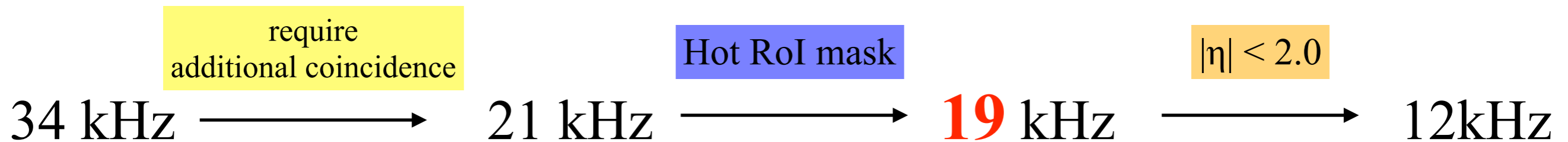


offline p_T (GeV/c)

Conclusions

- Re-estimation of Muon trigger rate in Run-2
 - ❖ EI/FI Coincidence Window optimized
 - ❖ TileCal coincidence implemented
 - ❖ Hot RoI mask applied
- Result
 - ❖ total additional efficiency (loss) : 97% (3%)
 - ❖ trigger rate reduction : $\sim 50\%$

Run-2 ($2 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$)



We can control L1_MU20 rate within the allocated bandwidth ($\sim 20 \text{ kHz}$) in a reasonable efficiency with the new end-cap coincidence scheme