

RPC trigger for the transition region

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on behalf of the RPC upgrade group

ATLAS Italia Upgrade

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Fake muon triggers in barrel-endcap transition region

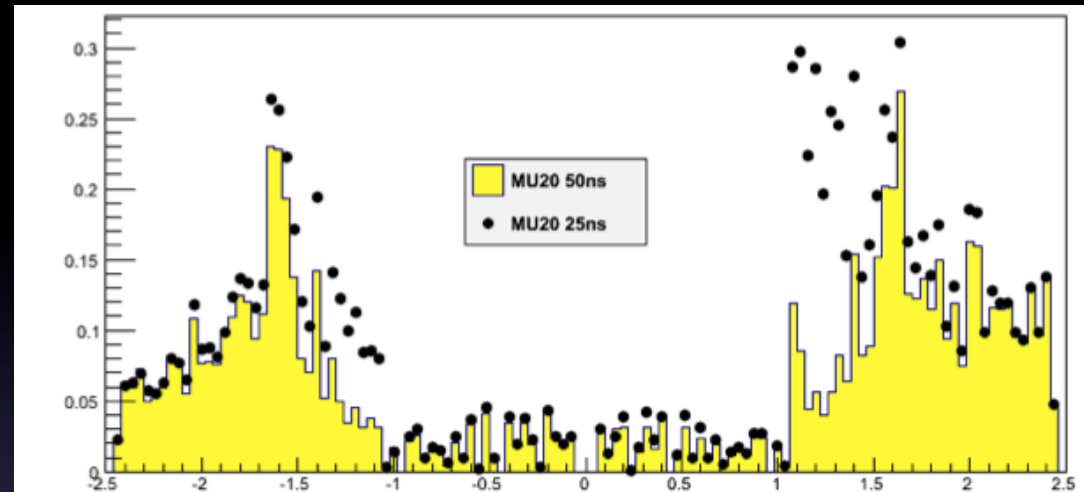
K.Nagano

High fake trigger rate in $1.0 < |\eta| < 1.3$ region

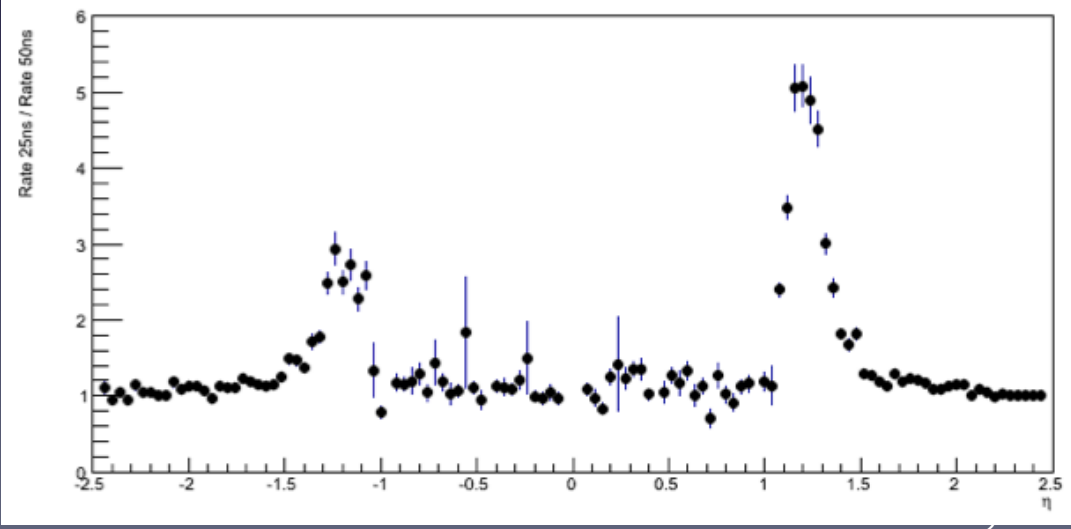
Large contamination with 25ns bunch spacing

Consistent with late arrival proton hypothesis

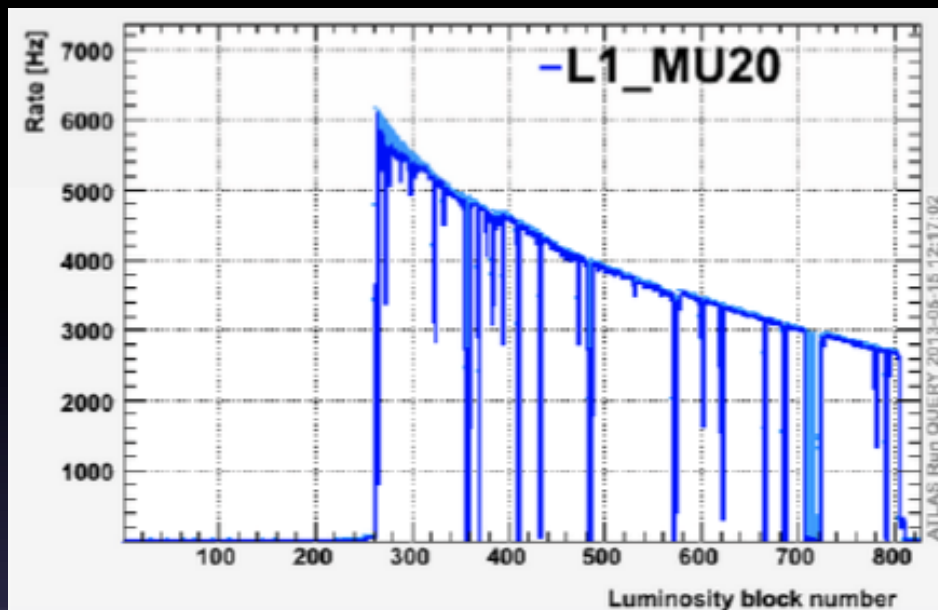
Poor coverage in barrel-endcap transition region, not reached by NSW



L1_MU20: rate 25ns / rate 50ns



L1_MU20: rate extrapolation



$L1_MU20 = 6 \text{ kHz} @ L = 0.7 \times 10^{34}$

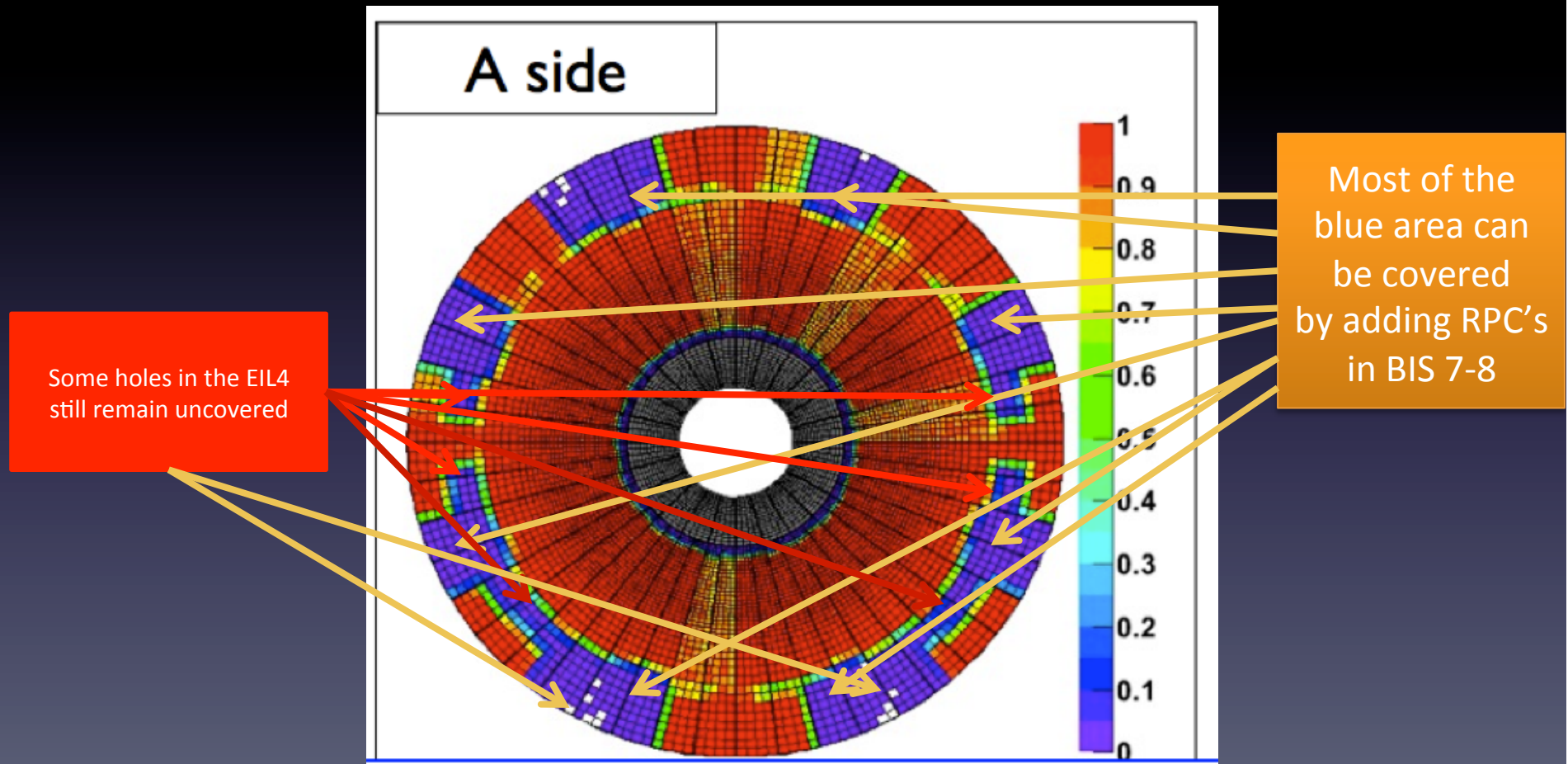


$6 \text{ kHz} \times [3.0/0.7] \times 1.4 \times 1.6 = 57.6 \text{ kHz}$
 $@ L = 3 \times 10^{34}, 25 \text{ ns}, 13 \text{ TeV}$

The rate must be reduced!
 $57.6 \text{ kHz} \times 44\% = 25 \text{ kHz}$

L1 Item	Offline pT	Predicted Rate/kHz
EM28H	33	28.0
EM50	60	8.6
2EM15H	2x20	8.8
MU20	25	25.6
2MU11	2x13	4.3
EM15H_MU10	20,12	2.0
2EM8H_MU10	2x12,12	0.9
EM8H_2MU6	12,2x8	0.6
TAU60	150	10.2
2TAU30_TAU40	100,80	9.4
2TAU15l_3J15	2x40,50(jet)	8.7
2TAU15l_EM15H_3J15	40,20,50(jet)	4.9
TAU15l_MU10	40,15	4.6
TAU20l_XE40_3J15	50,90,50(jet)	1.3
J100	250	4.9
4J20	Nx60	1.6
J75_XE40	200,150	4.7
XE60	190	1.2
Others	Topo?	~5
Totals		90.0

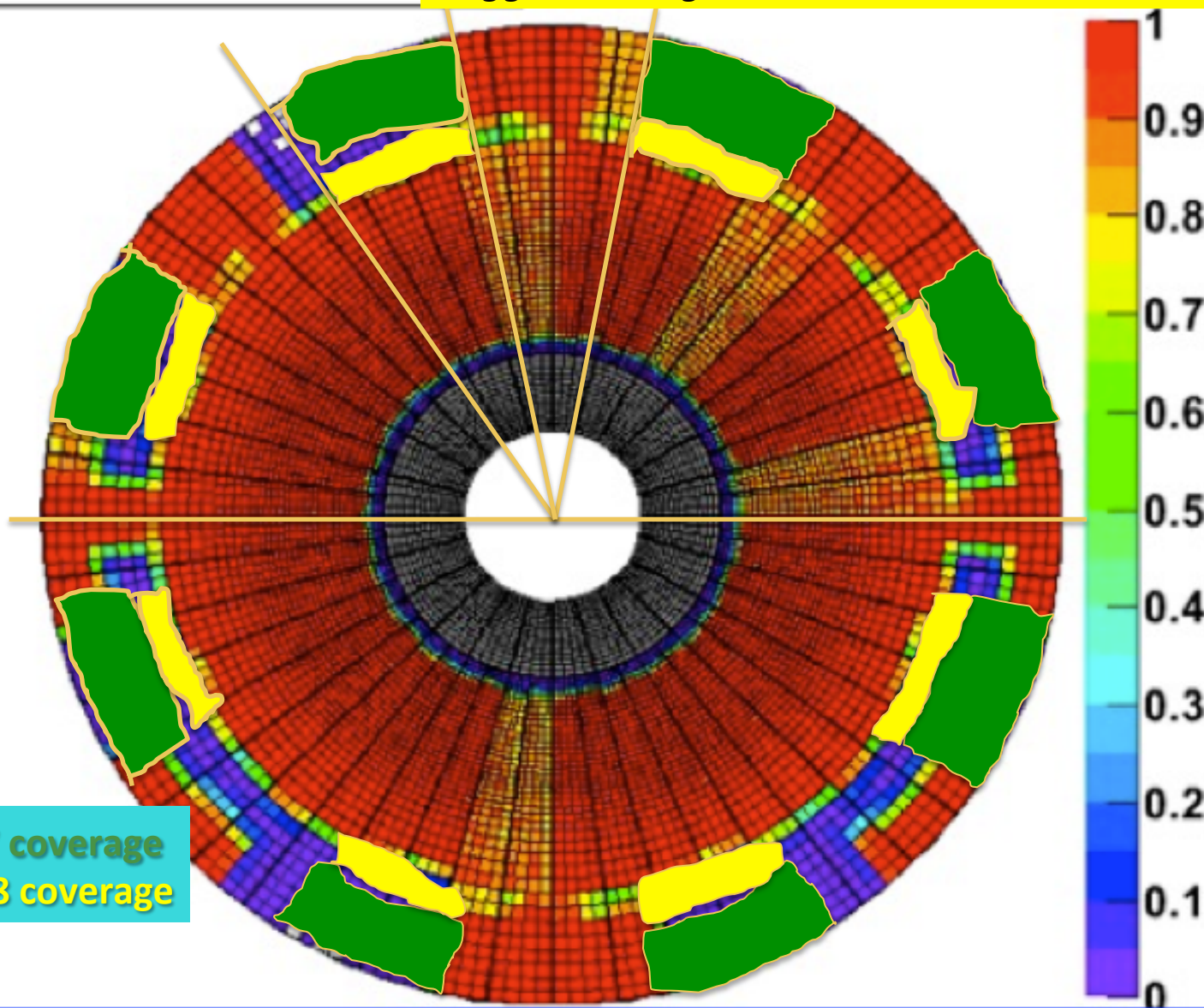
Big-Wheel Rol map: coverage upstream the endcap toroid



MUON EndCap Big Wheel

A side

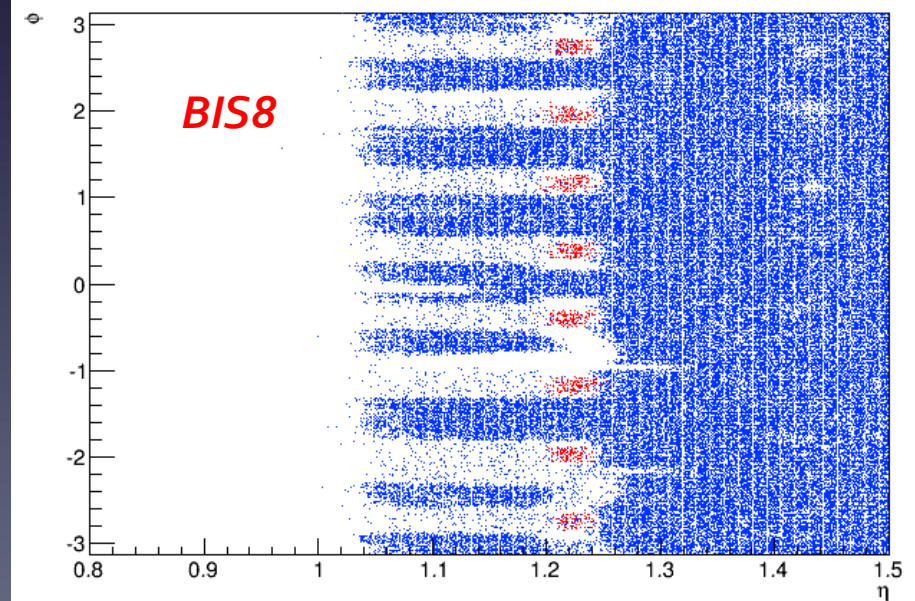
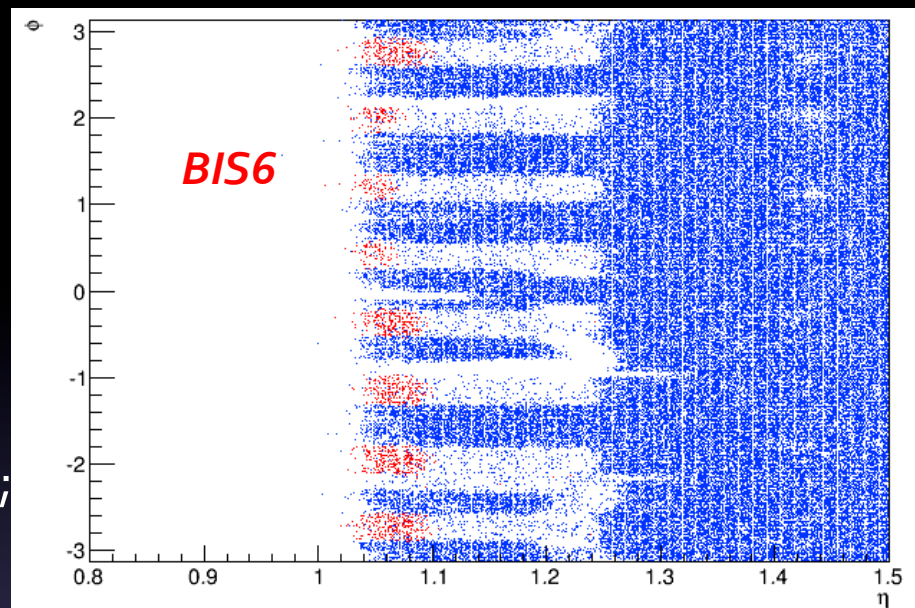
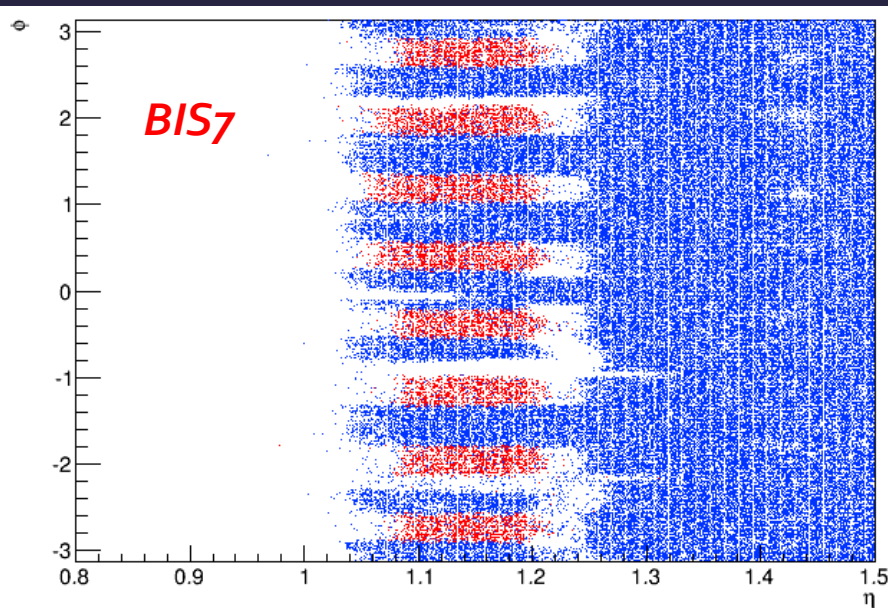
Trigger coverage with outer and inner stations



Green: BIS7 coverage
Yellow: BIS8 coverage

Geometrical Coverage (with MDTs)

- 50ns physics_Muons stream
- Reconstructed muons $p_t > 20$ GeV
- η - ϕ of reconstructed muons (staco) associated to EC triggers:
 - **Blue**: MDT segment on EI chambers;
 - **Red**: MDT segment on BIS6-7-8



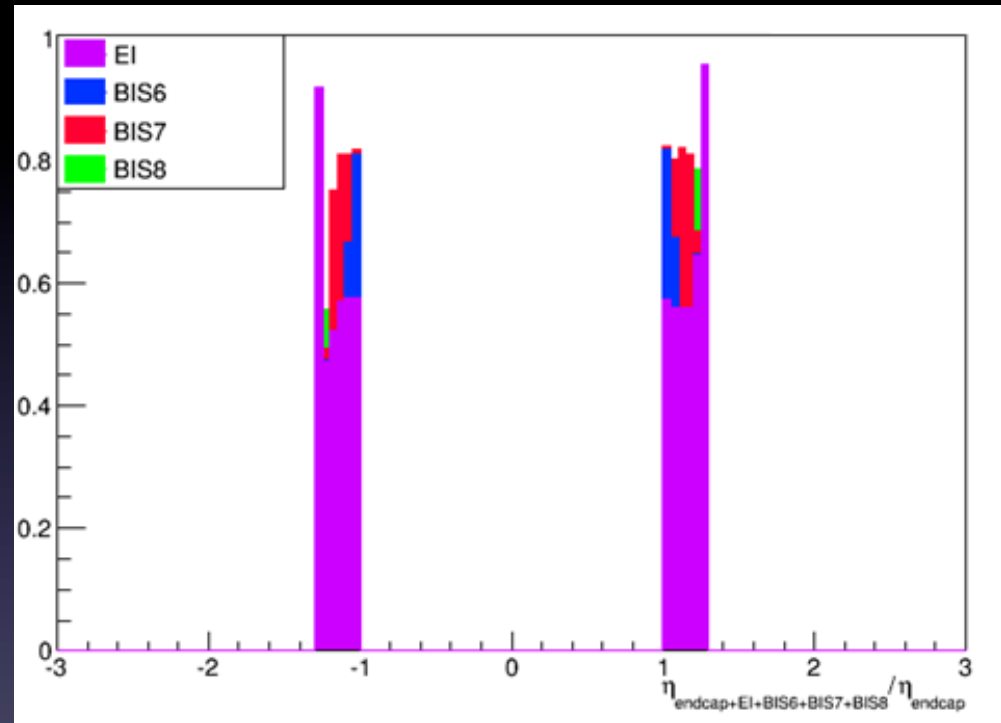
Evaluation with 2012 data

Evaluation made with some simple requests:

- Trigger L1_MU20
- Reconstructed muons:
 - $p_T > 20 \text{ GeV}$
 - $\Delta R(\text{ROI}, \text{MuReco}) < 0.1$
- MDT segment in **BIS6-7-8** or **EI (containing holes)**:
 - Mboy segment (tight cuts, pointing to IP)
 - The sector must be compatible with ϕ of MuReco
 - $\Delta\eta(\text{seg}, \text{ROI}) < 0.05$

Efficiency

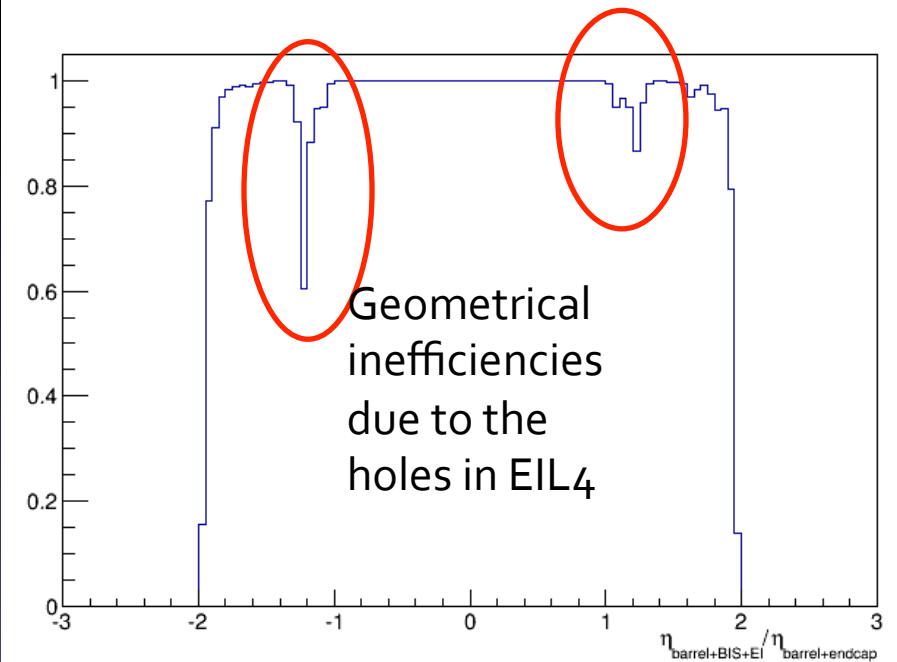
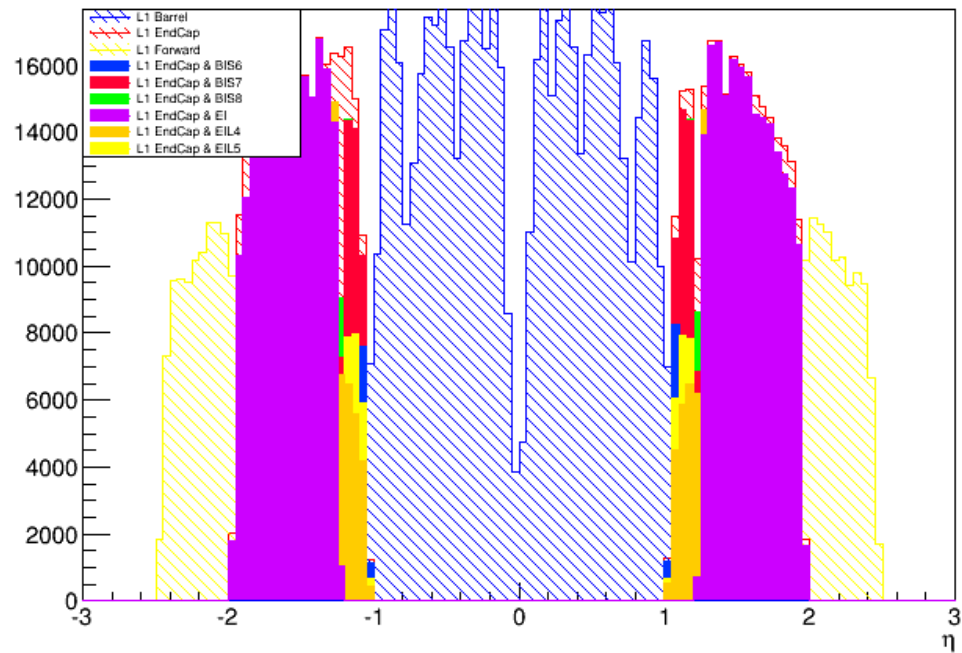
- The surviving fraction of reconstructed muons in $1.0 < |\eta| < 1.3$ asking one segment in EI is 63.7%
- The surviving fraction of reconstructed muons in $1.0 < |\eta| < 1.3$ asking one segment in EI or BIS6-7-8 is 80.3%



$$\text{Efficiency(EI)} = \frac{N_{\text{MuonReco}}(\text{EndCap} \ \& \ 1.0 < |\eta| < 1.3 \ \& \ \text{EI})}{N_{\text{MuonReco}}(\text{EndCap} \ \& \ 1.0 < |\eta| < 1.3)}$$

Efficiency

Based on 50ns physics_Muons stream (L1_MU20)

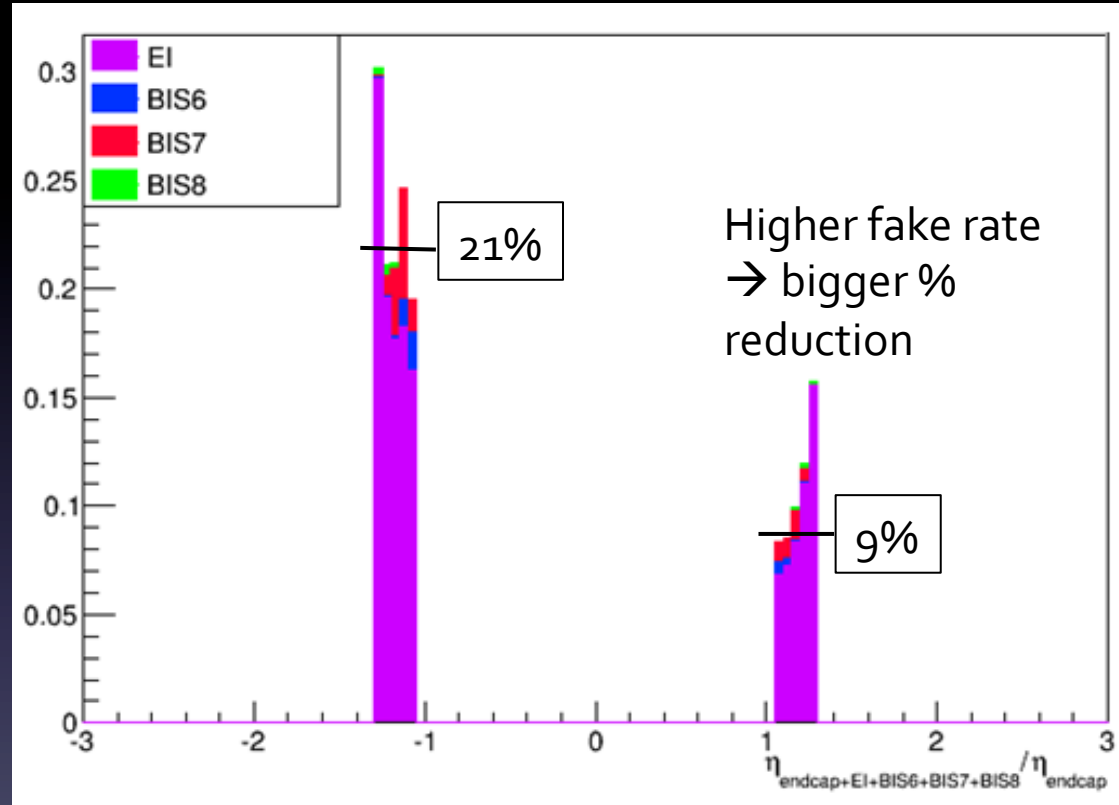


$$\text{Efficiency} = \frac{N_{\text{MuonReco}}(\text{Barrel} \parallel \text{EndCap} \& (\text{BIS6} \parallel \text{BIS7} \parallel \text{BIS8} \parallel \text{EI}))}{N_{\text{MuonReco}}(\text{EndCap} \parallel \text{Barrel})}$$

Raw rate Reduction

The surviving fraction of ROI in $1.0 < |\eta| < 1.3$ asking one segment in EI or BIS6-7-8 is 14.2%

No η or ϕ cut applied



$$\text{Rate Reduction (BIS7)} = \frac{N_{\text{ROI}}(\text{EndCap} \ \& \ 1.0 < |\eta| < 1.3 \ \& \ \text{BIS7})}{N_{\text{ROI}}(\text{EndCap} \ \& \ 1.0 < |\eta| < 1.3)}$$

Chambers and surface

◆ From the parameter book

BIS7: $1.7 * 1.1 = 1.87\text{m}^2$

BIS8: $0.9 * 0.5 = 0.45\text{m}^2$

But what is really needed is to cover the holes:

- about 1200 mm in eta are needed
- hopefully 1560mm in phi are sufficient (avoid mechanical complications with the MDTs)
- lateral overlap with the EIL4 to be checked
- extended BIS8 to be checked

◆ 8 of each type per side

→ total 16 BIS8 + 16 BIS7

→ Total chamber surface 37 m^2

Project overview

PERFORMANCE ESTIMATED TROUGH MDT SEGMENTS WITH 2012 DATA

- Fake muons rejection factor of **7** (down to about **14%**) by means of broad coincidence before applying geometrical cuts only
- **Further** reduction of **40%** matching the End Cap ROIs in Eta only
- Overall rate suppression factor **~11** (down to about **9%**) by now
- EI+BIS6-7-8 MDT chambers increase the coverage (**~80%**).

COLLABORATION (starting up)

- Bologna (simulation; production layout; DCS)
- Roma2 (front-end-electronics and gas volume design)
- MPI (mechanics, integration, station assembly and test)
- Contact with Roma1 for the trigger electronics integration
- UMICH, USTC proposal for the readout system

CORE COST ESTIMATE (for the BIS)

- 16 x (3-layer detector + strip panels + supports) = 120 kE
- 6k front-end-electronics channels = 75 kE
- Cabling and services = 50 kE
- Trigger: we aim to be compatible with the same PAD being designed for the NSW

Next steps

Comparison to Tile Cal proposal

- Tile ready for Phase 0; lower cost; not providing granularity for the EC ROI
- RPC ready for Phase 1 and designed for Phase 2; provides high granularity and timing; about 3x cost
- Pile-up effects not yet estimated in either of the two proposals

Still needed:

- Cover all the items of the project
- Collaborate with the endcap muon community to define the trigger details (if project approved, the EC SL will have an input allocated for RPC-BIS)
- Complete the cost estimate of the full project
- Define the sharing of the core costs $\leftrightarrow$ Interact with funding agencies

At short term:

- Build and install a prototype in stable data acquisition in the next p-p runs
- Prepare the module-0 for the 2015 winter shutdown

Review meeting in ATLAS: 18/09