

Global Muon Trigger Update

A 3D cutaway rendering of the ATLAS muon detector, showing the complex arrangement of muon chambers and support structures. The detector is composed of several layers of muon chambers, each with a different color (red, yellow, blue, purple) and a grid-like structure. The chambers are arranged in a cylindrical shape around the central beam pipe.

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1) CERN / EP

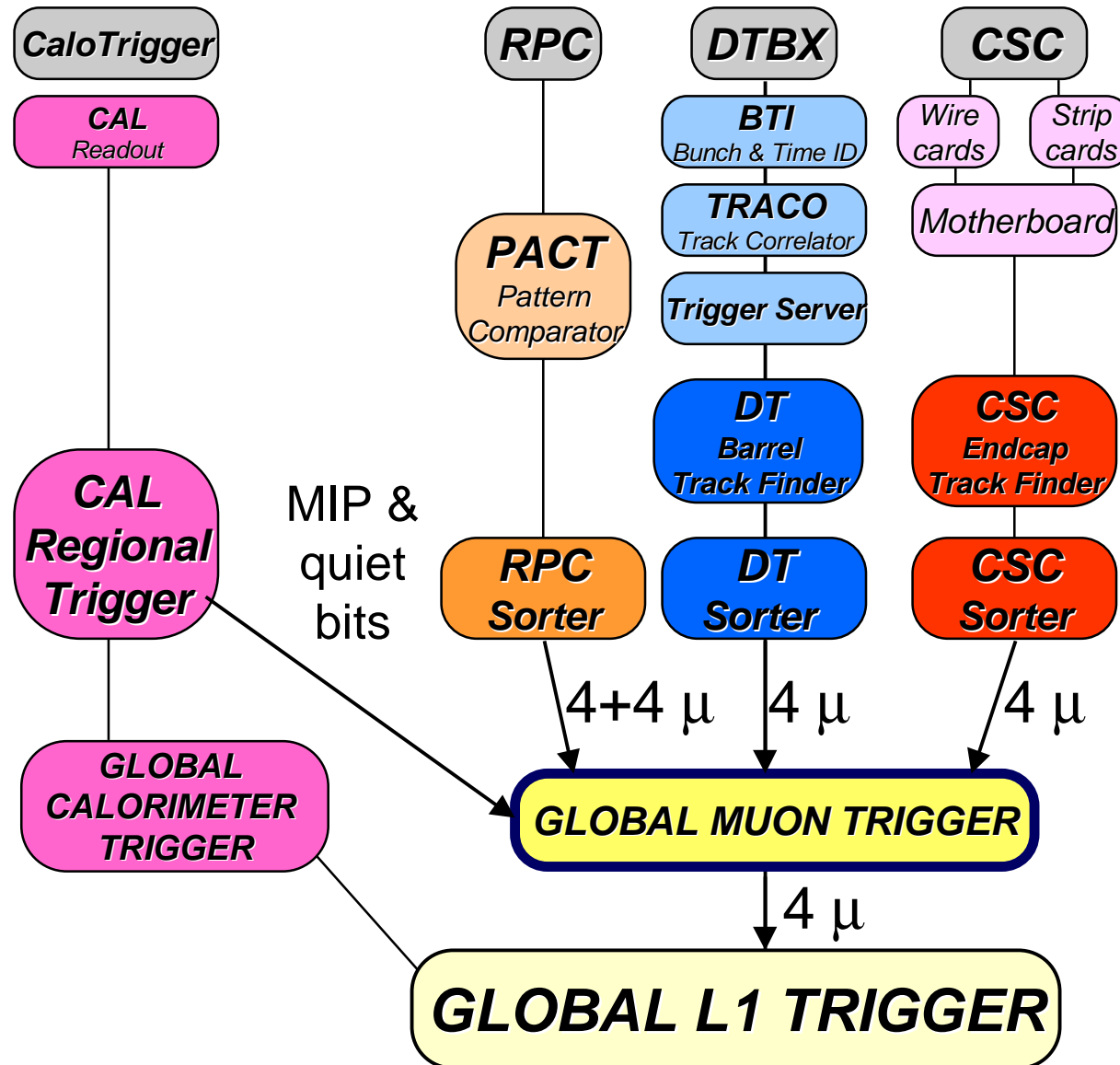
2) HEPHY Vienna

3) CERN / EP (on leave from HEPHY Vienna)

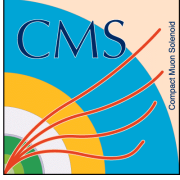
LHCC Review, March 6th, 2000



CMS Muon Trigger System



Global Muon Trigger



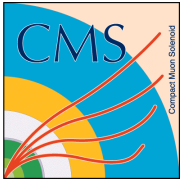
Goals of GMT



- Make use of the Complementarity of RPC and DT/CSC Trigger
- Increase Efficiency
- *Reduce Ghosts*

Strategy

- Attempt to match RPC and DT/CSC candidates
- If match found, forward better muon
- If unmatched RPC muon
 - always forward (low ghost rate) (for $|\eta| < 2.1$)
- If unmatched DT/CSC muon,
 - only forward if high quality (for $|\eta| < 2.1$)
 - always forward (for $|\eta| > 2.1$)

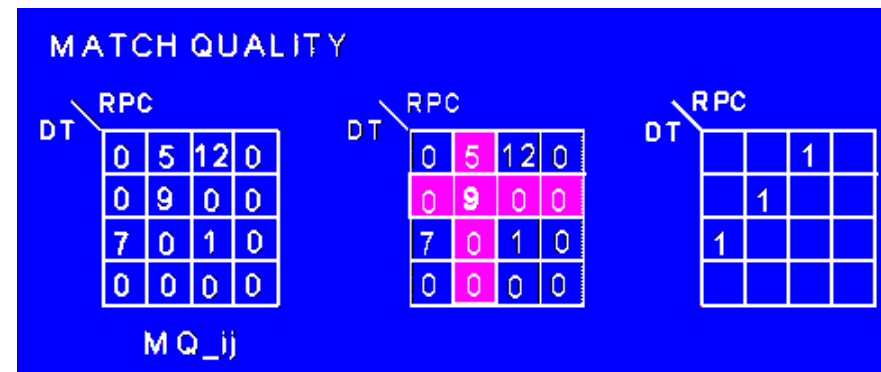


Muon Matching



- Calculate match quality function based on proximity in space ($\Delta\eta$ and $\Delta\phi$)

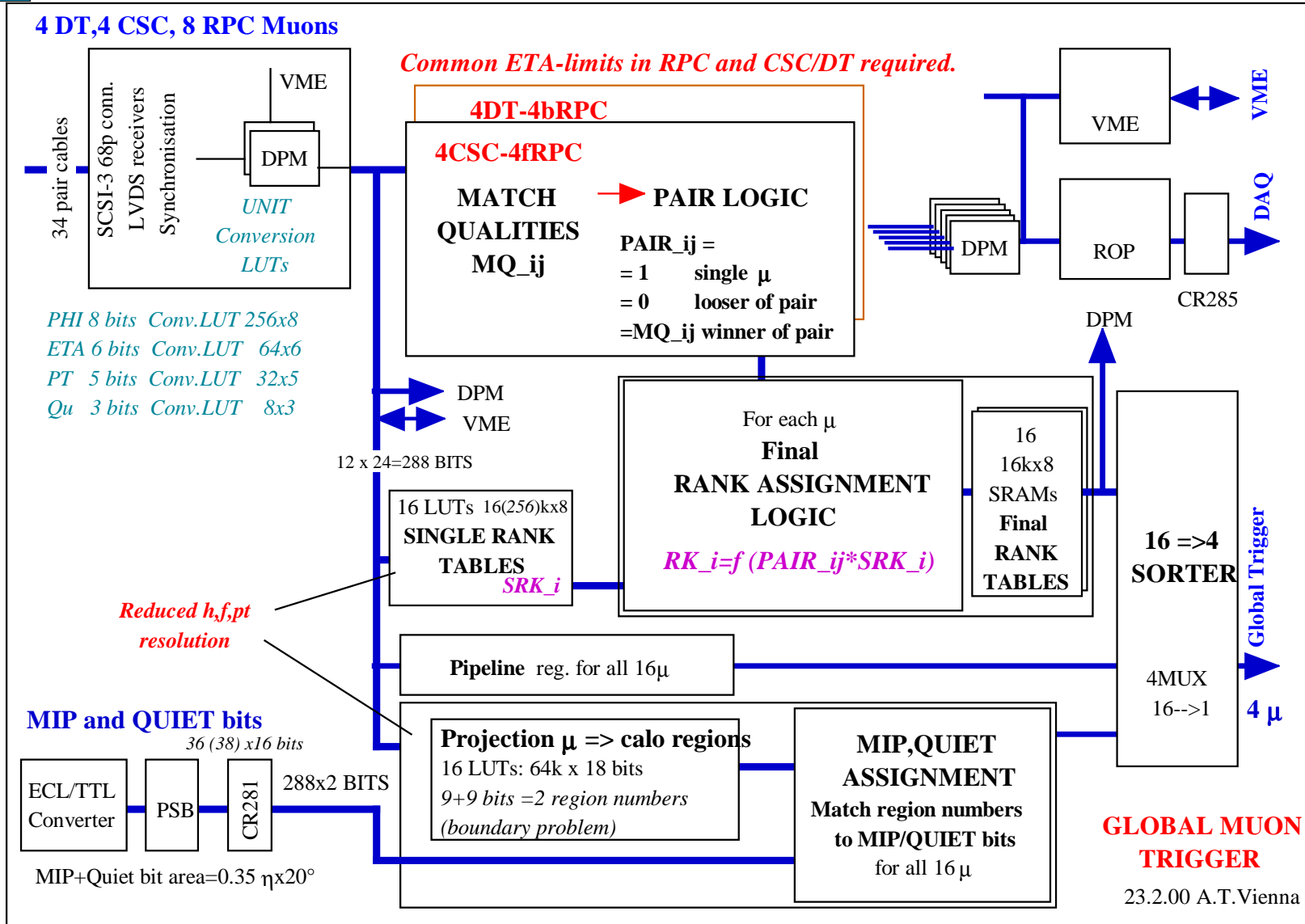
$$match_quality \propto \frac{1}{\sqrt{w_A \cdot (\Delta\eta)^2 + w_B \cdot (\Delta\phi)^2}}$$



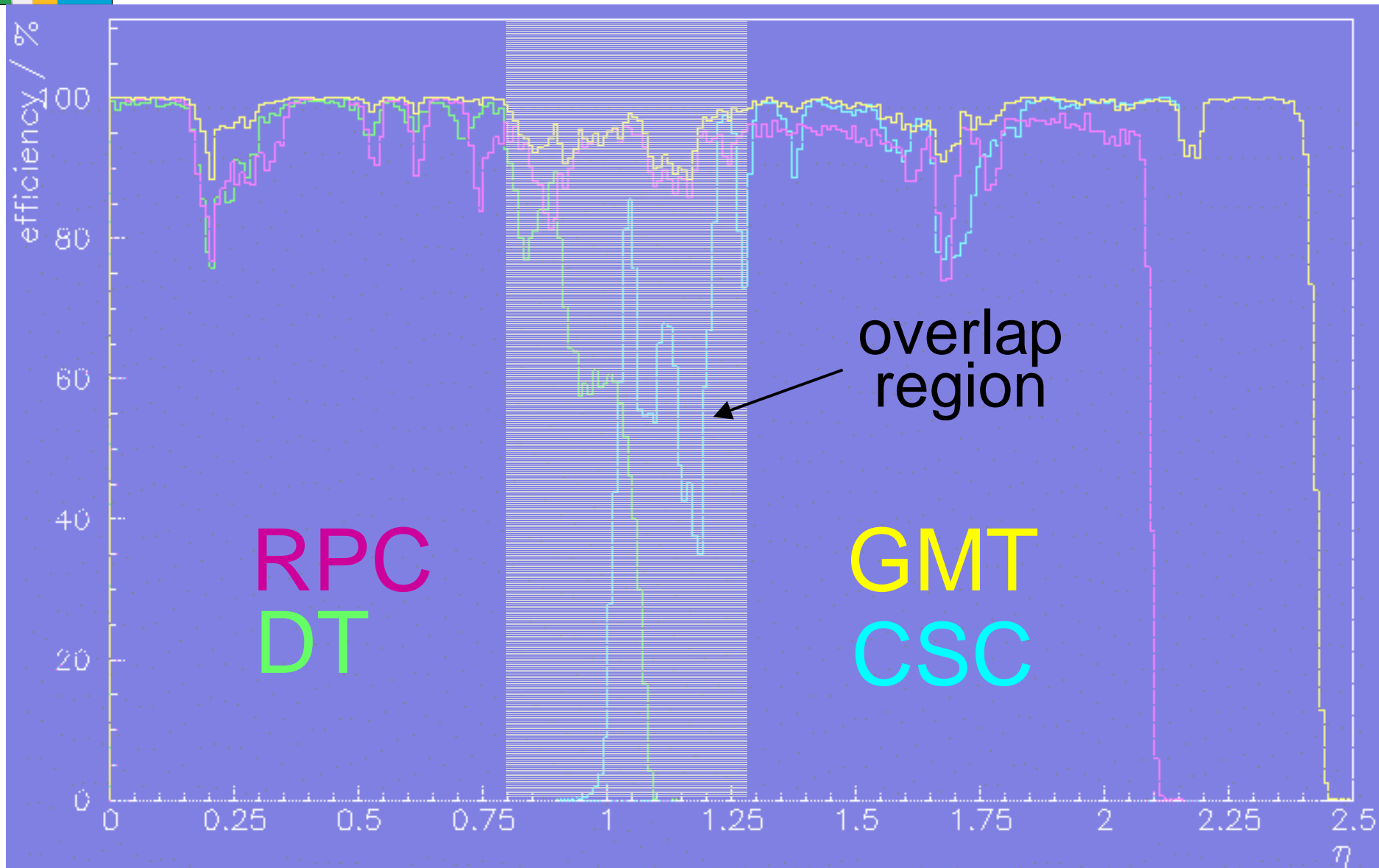
- Find maximum in row and column
- Assign PAIR-Quality
 - winner of match ... match quality > 1
 - looser of match ... 0
 - unmatched muon ... 1
- In parallel calculate Single Rank based on P_T , Quality, η , ϕ
- Compute final RANK
 - Final RANK = PAIR-Quality * Single Rank
- Sort by RANK and send 4 best muons to Global Trigger
Global Muon Trigger



GMT Hardware



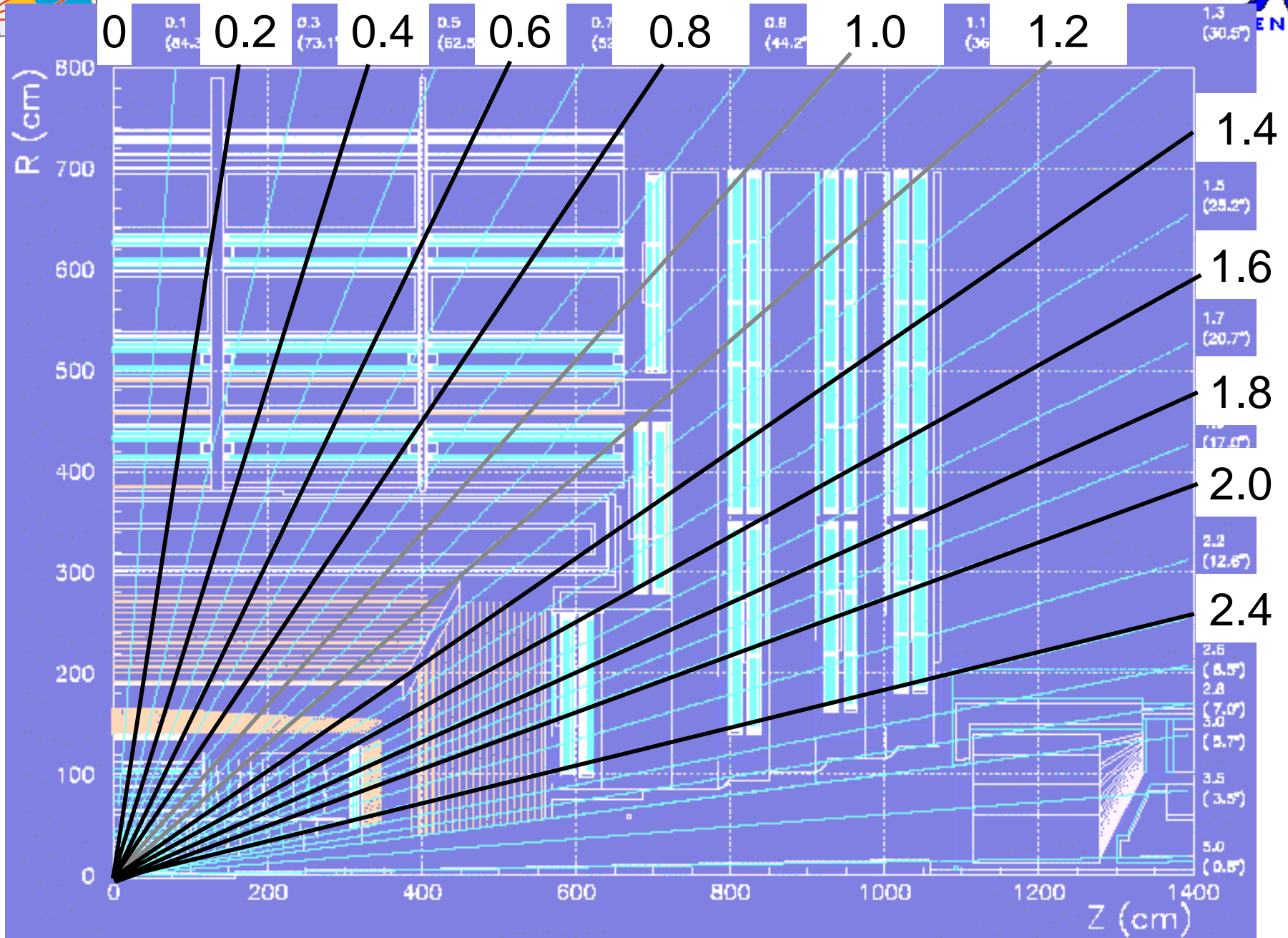
Efficiency vs. η (with barrel)



Global Muon Trigger



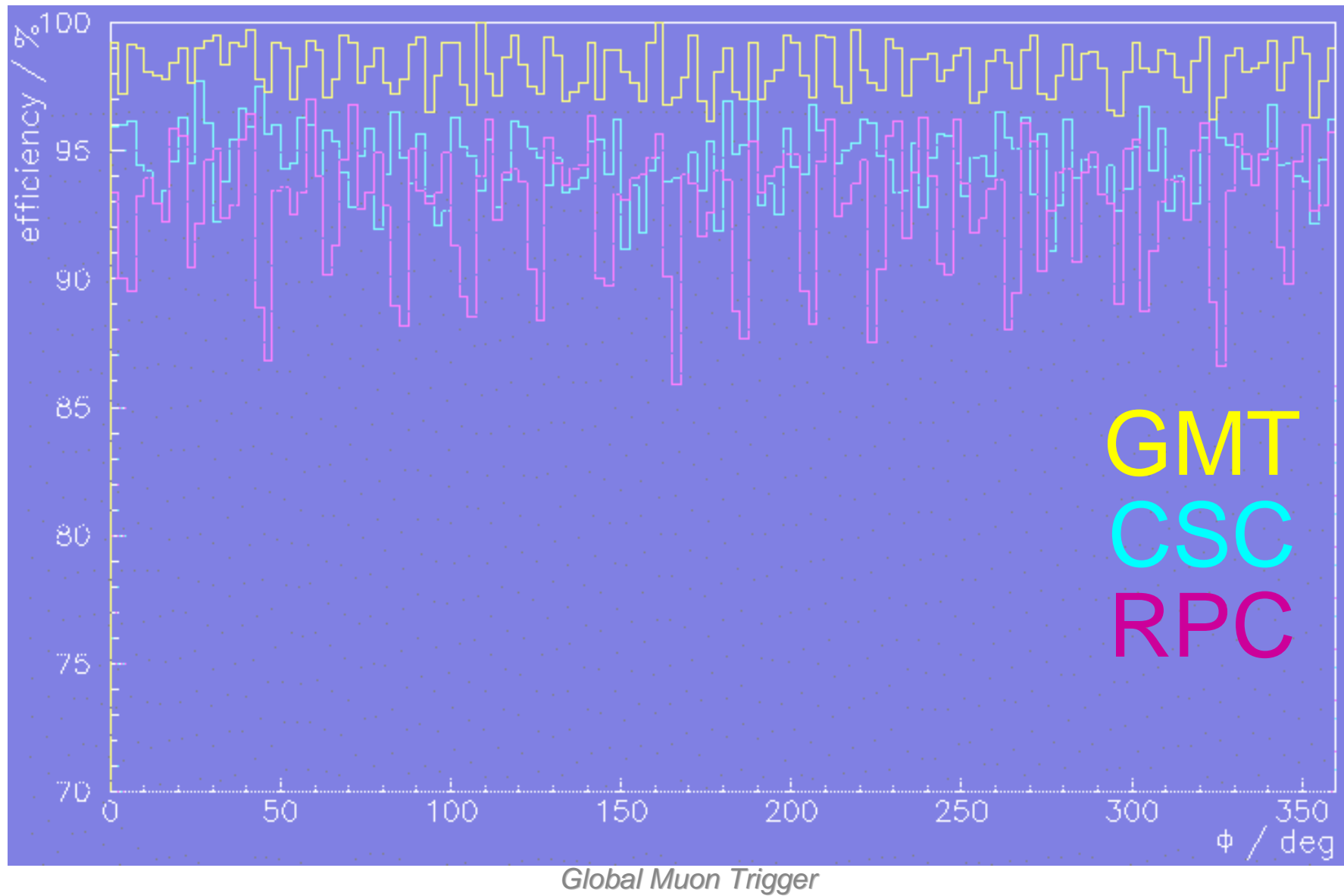
CMS longitudinal view





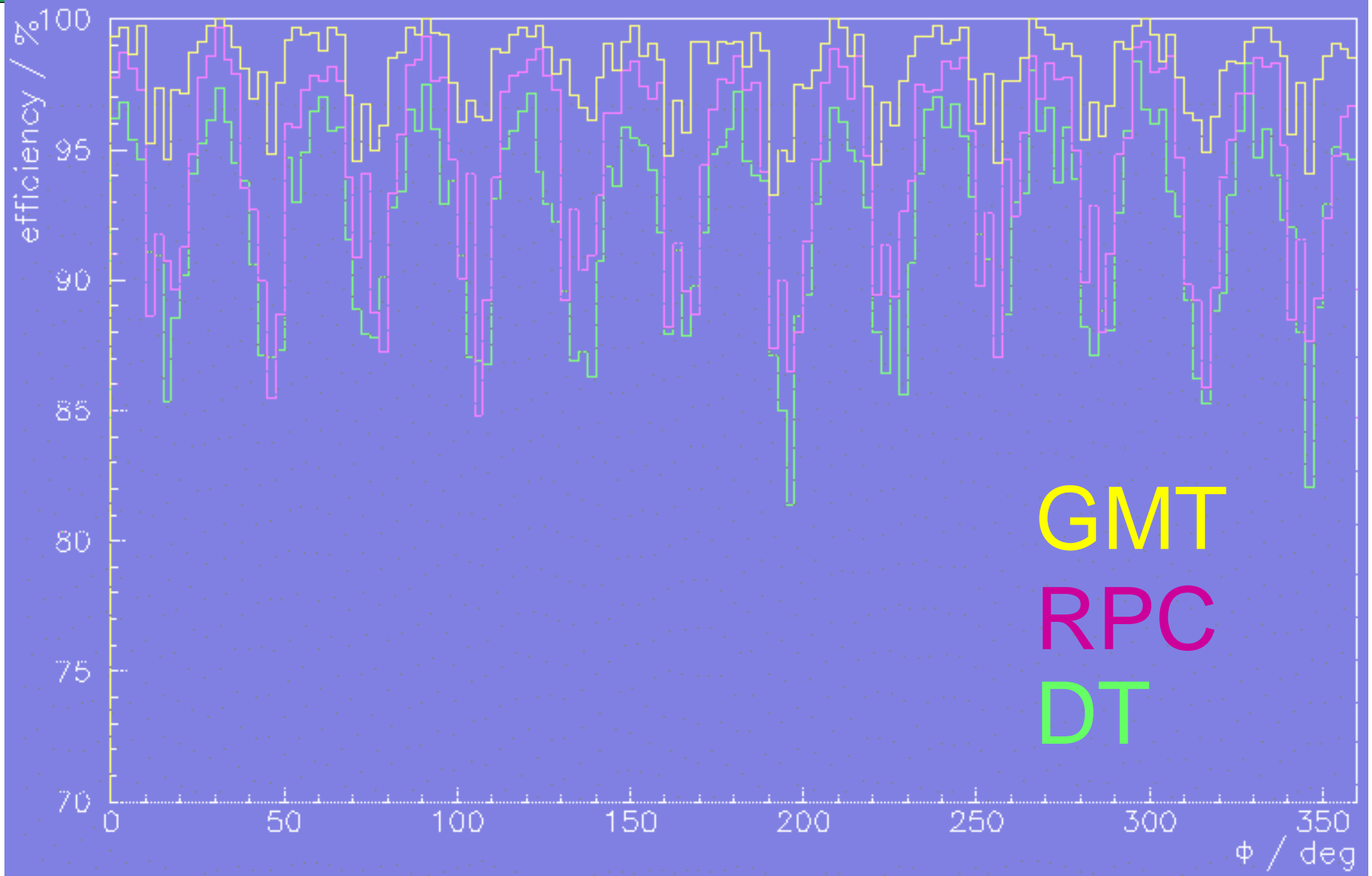
Efficiency vs. ϕ

$1.2 < \eta < 2.1$





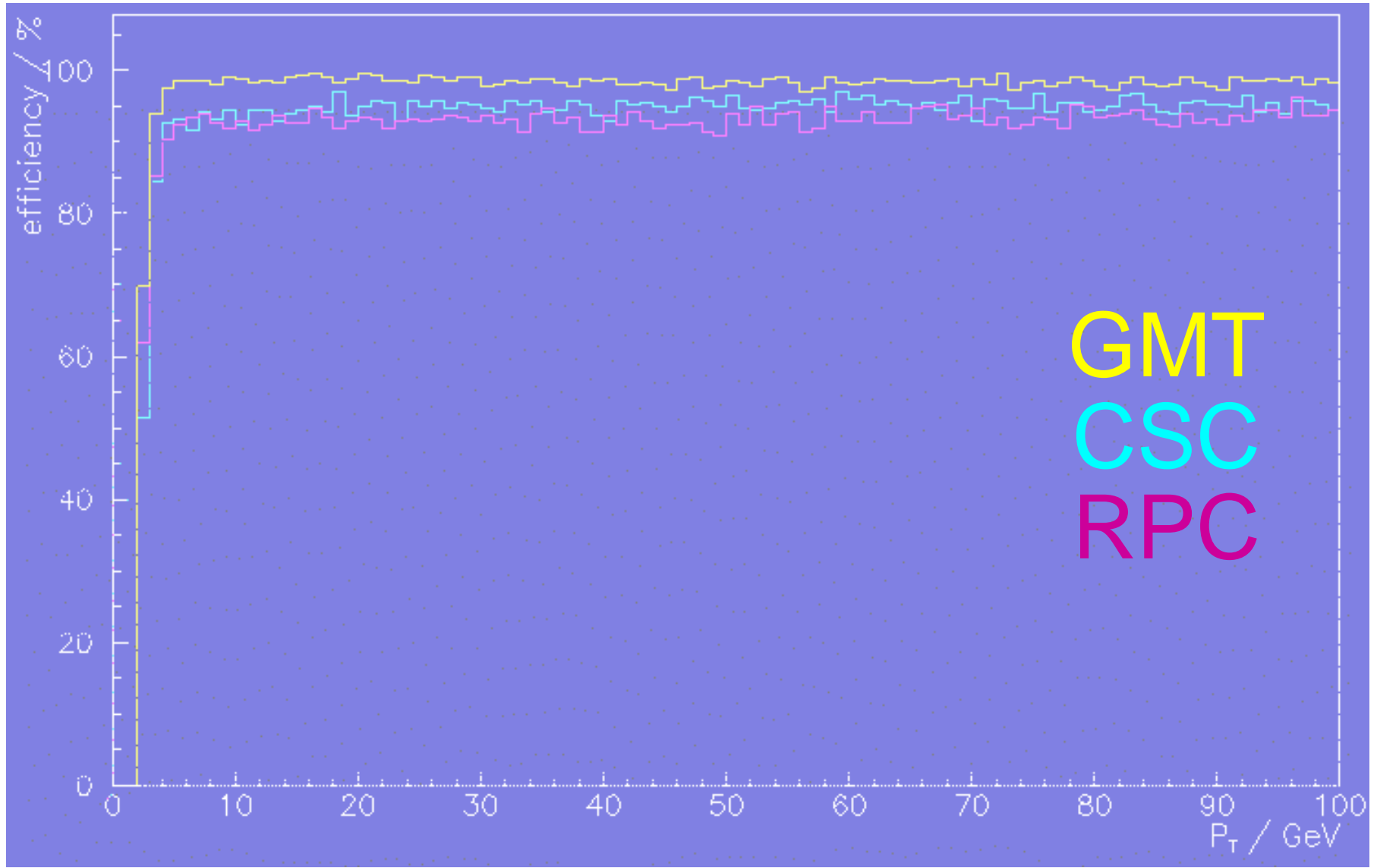
Efficiency vs. ϕ - barrel $0 < \eta < 1$



Global Muon Trigger



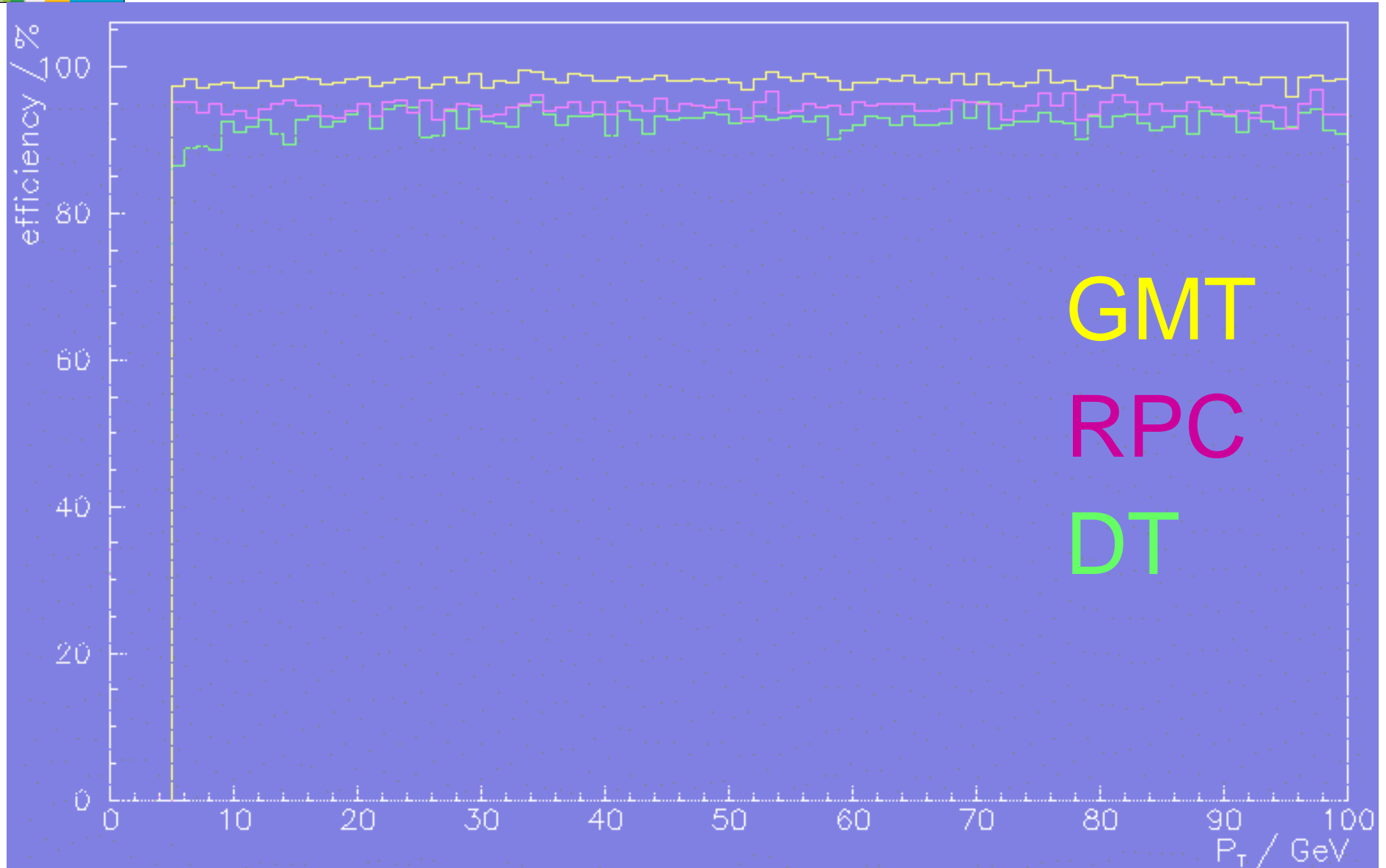
Efficiency vs. P_T $1.2 < \eta < 2.1$



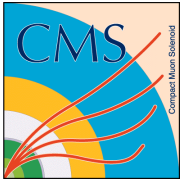
Global Muon Trigger



Efficiency vs. P_T barrel $0 < \eta < 1$



Global Muon Trigger



Efficiencies (single muons)

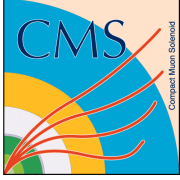


- **Endcap** $1.2 < |\eta| < 2.1$

| | no muon found | one muon found | two muons found |
|------------|--------------------------------------|---------------------------------------|--------------------------------------|
| RPC | $7.07 \pm 0.12 \%$ | $92.88 \pm 0.56 \%$ | $0.05 \pm 0.01 \%$ |
| CSC | $5.37 \pm 0.10 \%$ | $93.76 \pm 0.57 \%$ | $0.87 \pm 0.04 \%$ |
| GMT | $1.76 \pm 0.06 \%$ | $97.83 \pm 0.58 \%$ | $0.41 \pm 0.03 \%$ |

- **Barrel** $0 < |\eta| < 0.8$

| | no muon found | one muon found | two muons found |
|------------|--------------------------------------|---------------------------------------|--------------------------------------|
| RPC | $4.49 \pm 0.10 \%$ | $95.49 \pm 0.61 \%$ | $0.02 \pm 0.01 \%$ |
| DT | $6.08 \pm 0.11 \%$ | $93.70 \pm 0.60 \%$ | $0.22 \pm 0.02 \%$ |
| GMT | $1.04 \pm 0.05 \%$ | $98.78 \pm 0.70 \%$ | $0.18 \pm 0.02 \%$ |



Conclusion

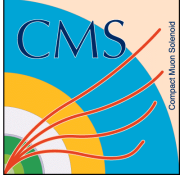


☺ **GMT improves efficiency**

☺ **GMT reduces ghosts**

- **Next Steps**

- finish Study of Overlap region
 - (different schemes under investigation)
- Move to ORCA, simulate whole detector
- Decide on final GMT design
- Build Prototype



Plans for 2000 and milestones



- **Simulation / Hardware**
 - **Dec99** baseline version of overlap region in DT track finder ✓
 - **Feb00** PSB6U input module+VME9U crate+Backplane6U ✓
 - **May00** Optimized version of overlap region in DT track finder
 - **Oct00** Detailed study of GMT for whole detector including different schemes for overlap handling
 - **Oct00** Final decision on solution for overlap region and preliminary hardware design
 - **Nov00** final conceptual GMT design ... Milestone D434
 - **Nov03** Global Muon Trigger available ... Milestone D437