Track-Finder Issues

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Parity Violation in CSC Geometry

Efficiency Studies of DT/CSC Overlap Region

Sagitta Measurement in Track-Finder

CSC Redundancy Studies

CSC Geometry Problem

- 60° Trigger sector boundaries do not line up between stations
  - 20° chambers are bisected in some stations
- Nominal solution requires sector boundaries at φ = 15°, 75°, 135°, … to match *as well as possible* with barrel sectors
  - MB1 rotated +5° with respect to these boundaries
  - MB2 rotated -2°, MB3 rotated +2°
- Proposed changes:
  - Rotate ME3/1 by 10° in the +Z endcap
  - Rotate ME2/1 by 10° in the -Z endcap
- Implies each endcap is different
- ME1 and all 10° chambers are aligned properly. ME4?

Other Dependencies on Trigger Sectors

- Endcap RPCs
  - Chambers should be aligned with CSC sector boundaries for clean match between CSC and RPC muons
  - They aren't aligned in TDR drawings (ME1/2), but then we don't have a real design yet. Thus, make it a requirement.

- Calorimeter
  - Association of muons with CAL quiet regions can be performed at L1
  - Quiet regions extend 20° (possibly 40°) in φ, but starting from φ=0°
  - However, match is done by comparing φ from the Track-Finder to the appropriate CAL region. Thus, it doesn't really depend on CSC sector geometry—only that φ is determined properly

- Alignment System ???

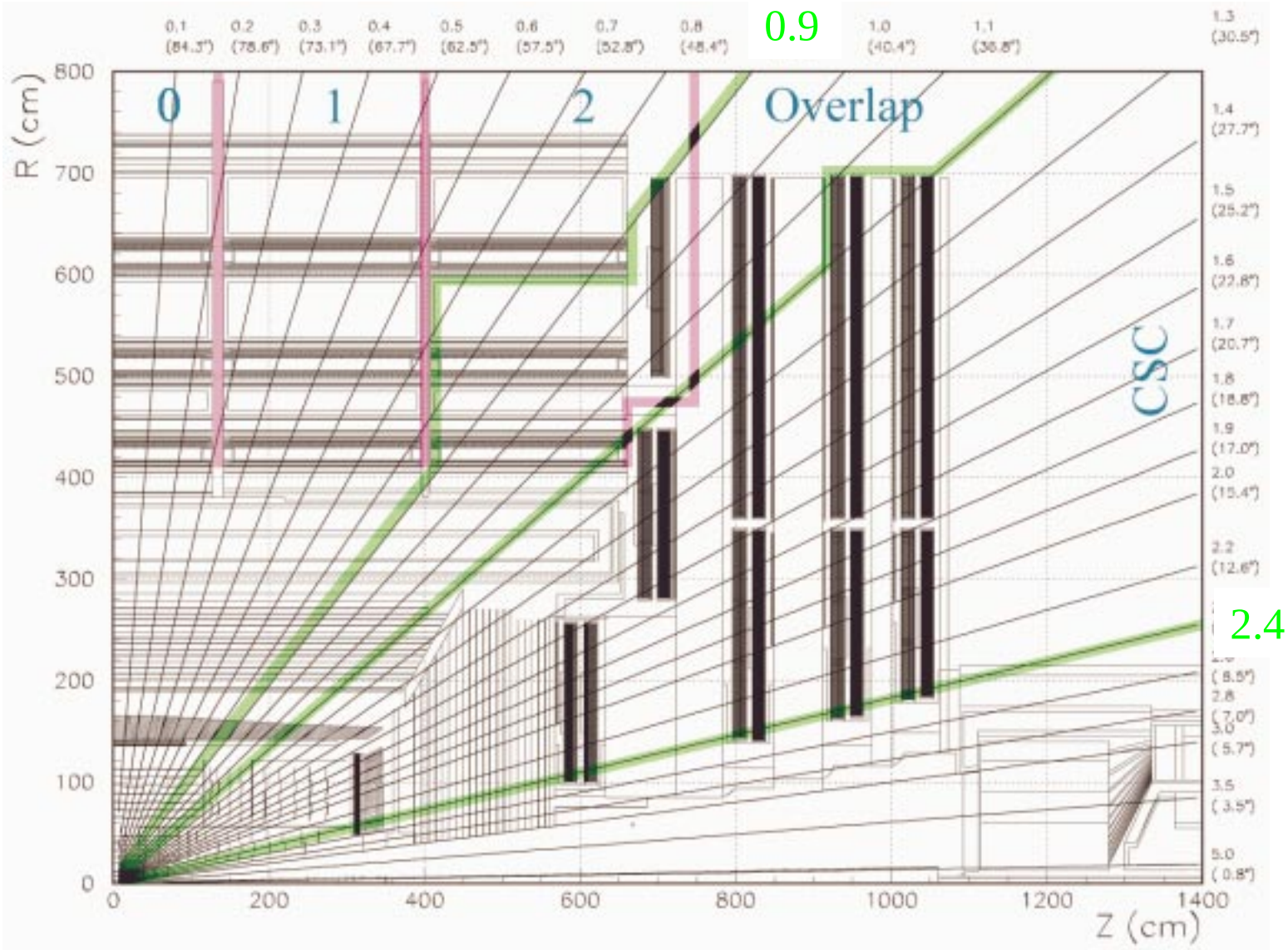
Trigger Efficiency Study in Overlap Region

- Question: What is the increase in acceptance when overlapping ME1/3?

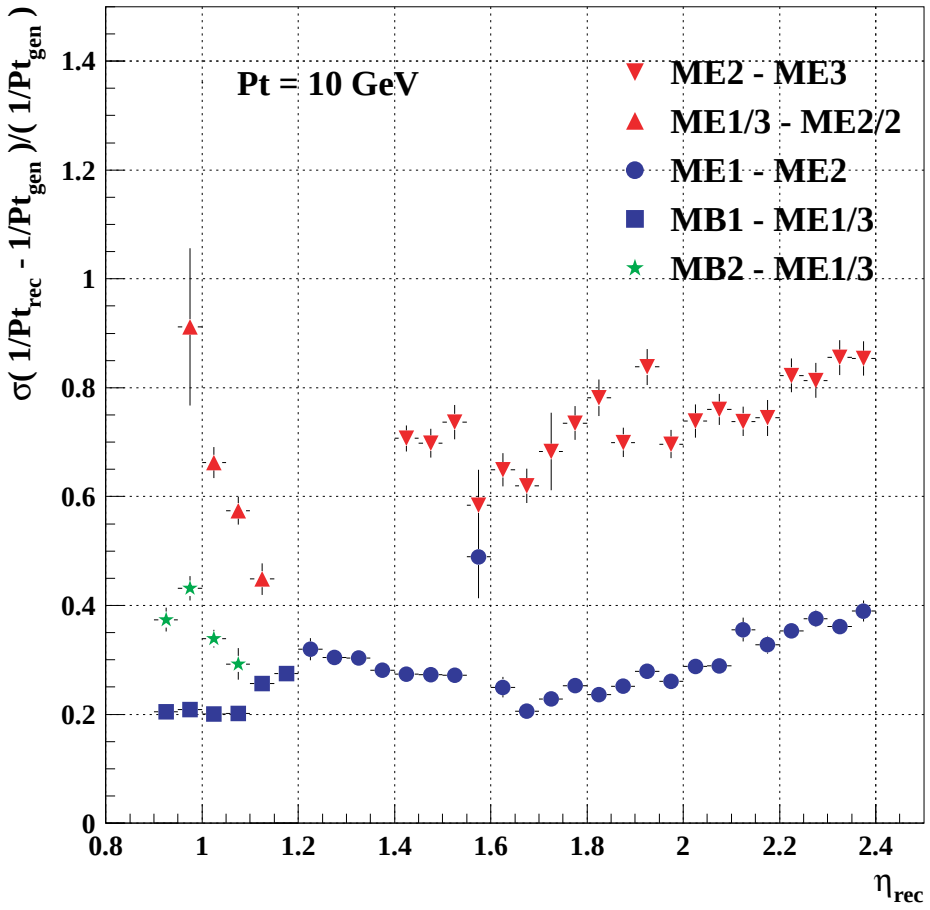
- Facts:
  - Overlap region covers $0.9 < |\eta| < 1.2$
  - ME1/3 presently has only 75% coverage in φ
  - Trigger resolution using only ME1/3 and ME2/2 is not sufficient to reduce single muon trigger rate in overlap region
  - MB1 and MB2 have only 87% coverage in φ
  - MB1 and MB2 will suffer inefficiency from fringe B-fields in overlap region

- Study:
  - Find efficiency for 2 or more stations to fire in overlap region
  - Require one hit in MB1 or MB2 for sagitta measurement
    - Rate reduction is questionable without MB1 at full luminosity, though, because P_T resolution is 40%

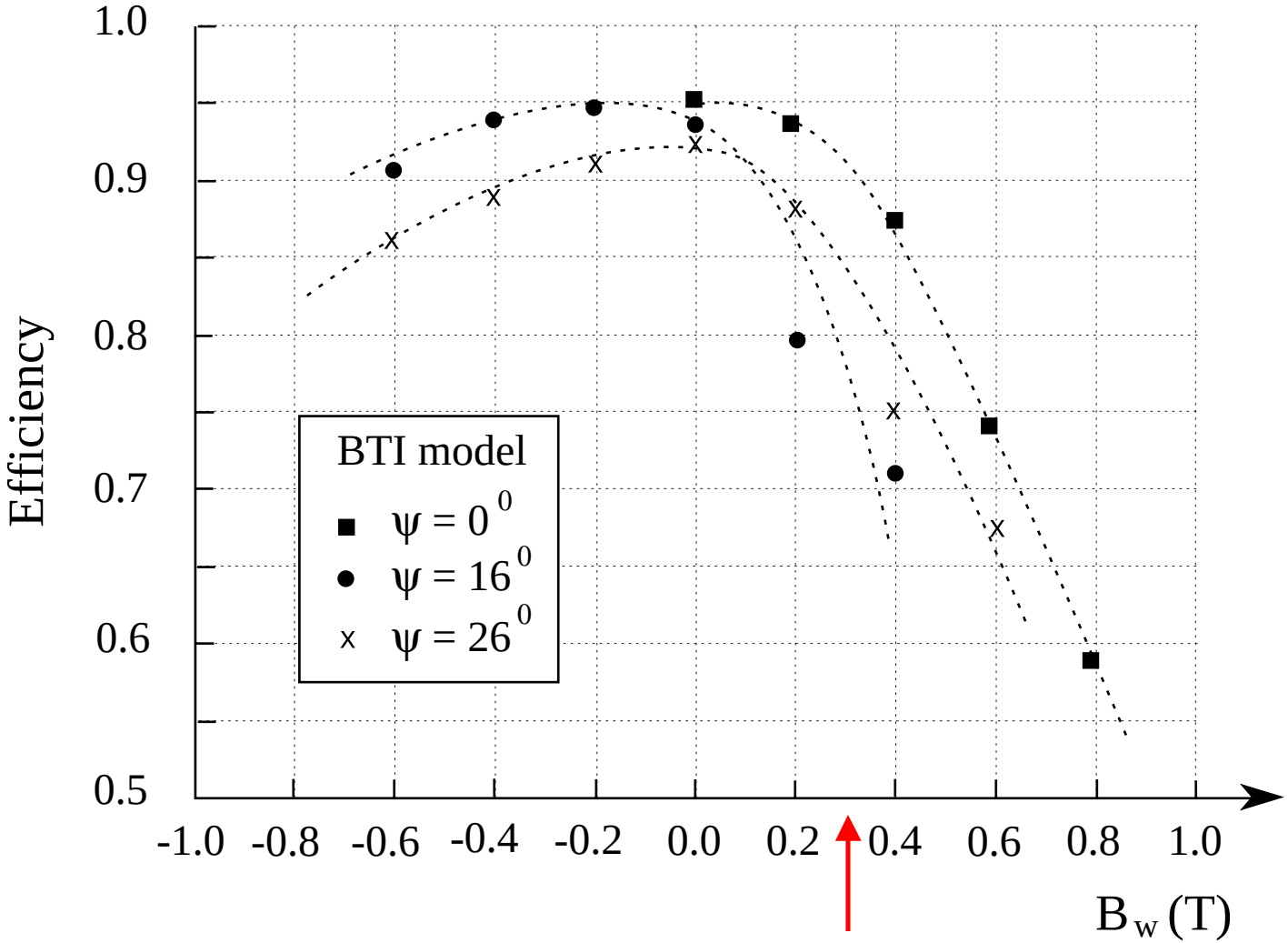
Trigger Regions in η

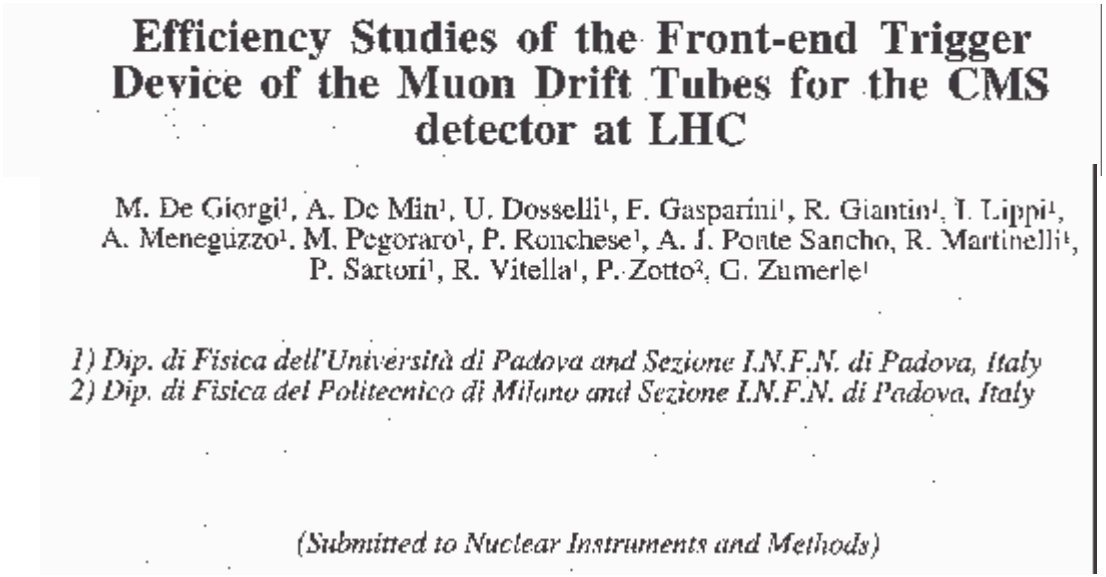


Trigger Resolution



BTI Efficiency in Fringe Field





Efficiency Studies of the Front-end Trigger Device of the Muon Drift Tubes for the CMS detector at LHC

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(Submitted to Nuclear Instruments and Methods)

"Looking at the obtained results we see that the effect is negligible for a field with components $B_n < 0.5T$ and B_w or $B_v < 0.2$ T. The CMS region where the magnetic field exceeds these values is only the far corner of the first muon station. Since this region is fully covered by the forward chambers we do not expect any trigger loss."

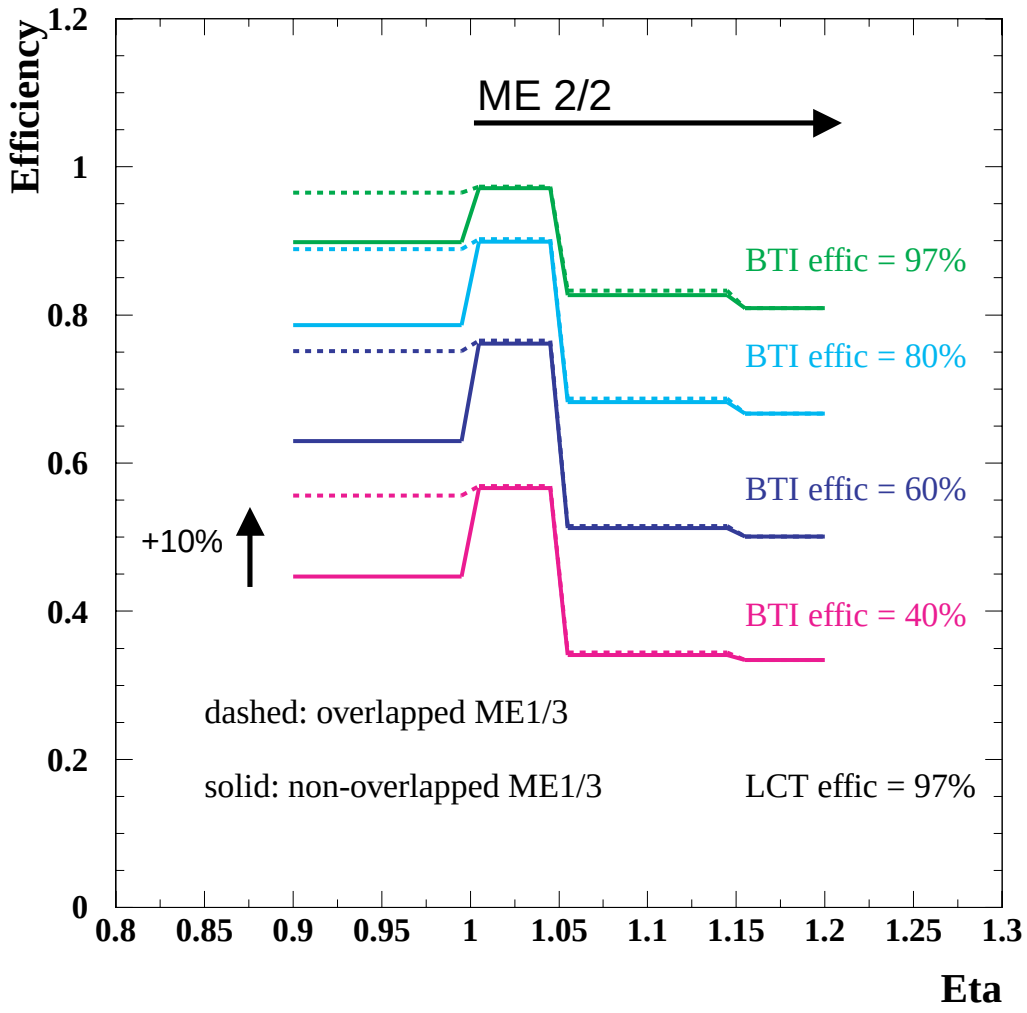
Inputs to Study

- Acceptance in φ for MB1 or MB2 is 87%
- Acceptance in φ for ME1/3 is 75% (or 100%)
- Acceptance in φ for ME2/2 is 100%

- Trigger efficiency for MB1 or MB2 is varied: 97%, 80%, 60%, 40%
- Trigger efficiency for ME1/3 or ME2/2 is varied: 97%, 80%, 60%

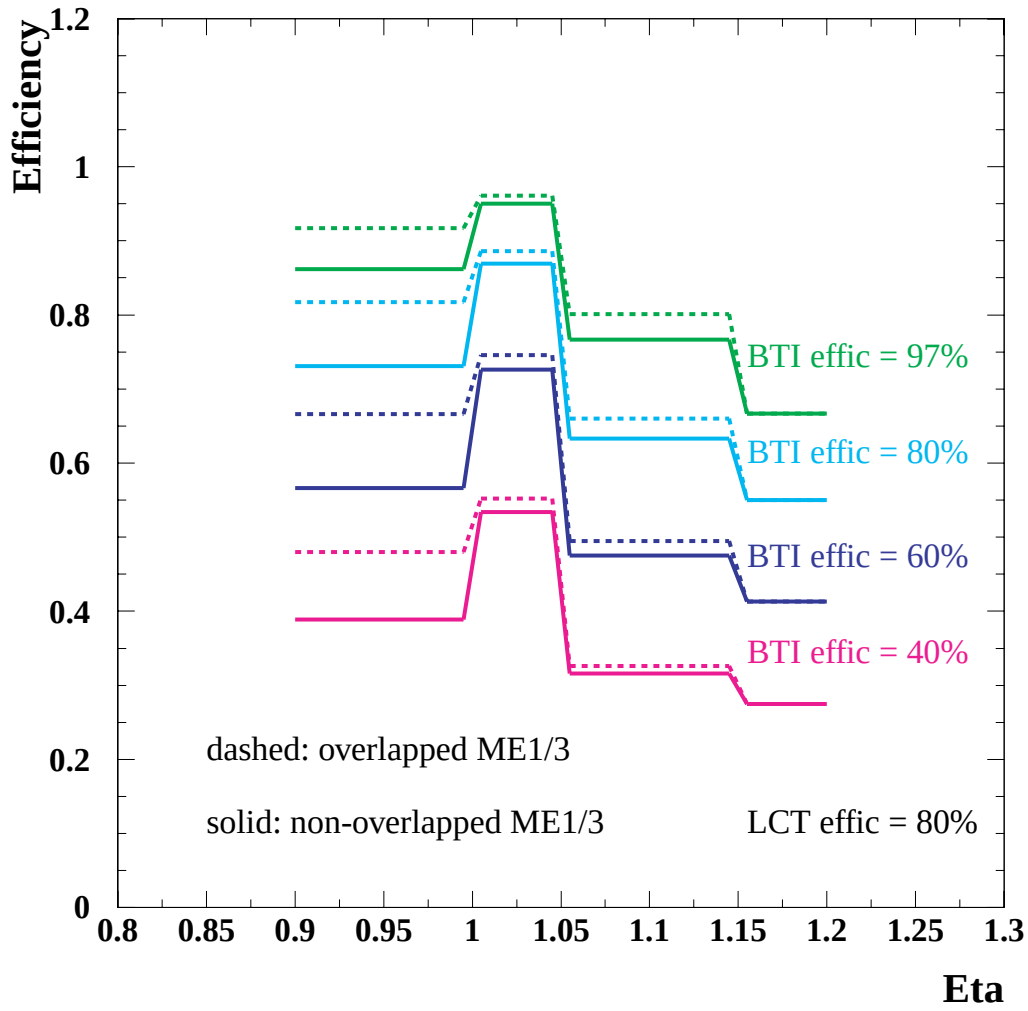
- Coverage in η is studied in 4 regions:
  - 0.9 < η < 1.0 – MB1, MB2, ME1/3
  - 1.0 < η < 1.05 – MB1, MB2, ME1/3, ME2/2
  - 1.05 < η < 1.15 – MB1, ME1/3, ME2/2
  - 1.15 < η < 1.2 – MB1, ME2/2

Efficiency of Overlap Region, Case 1

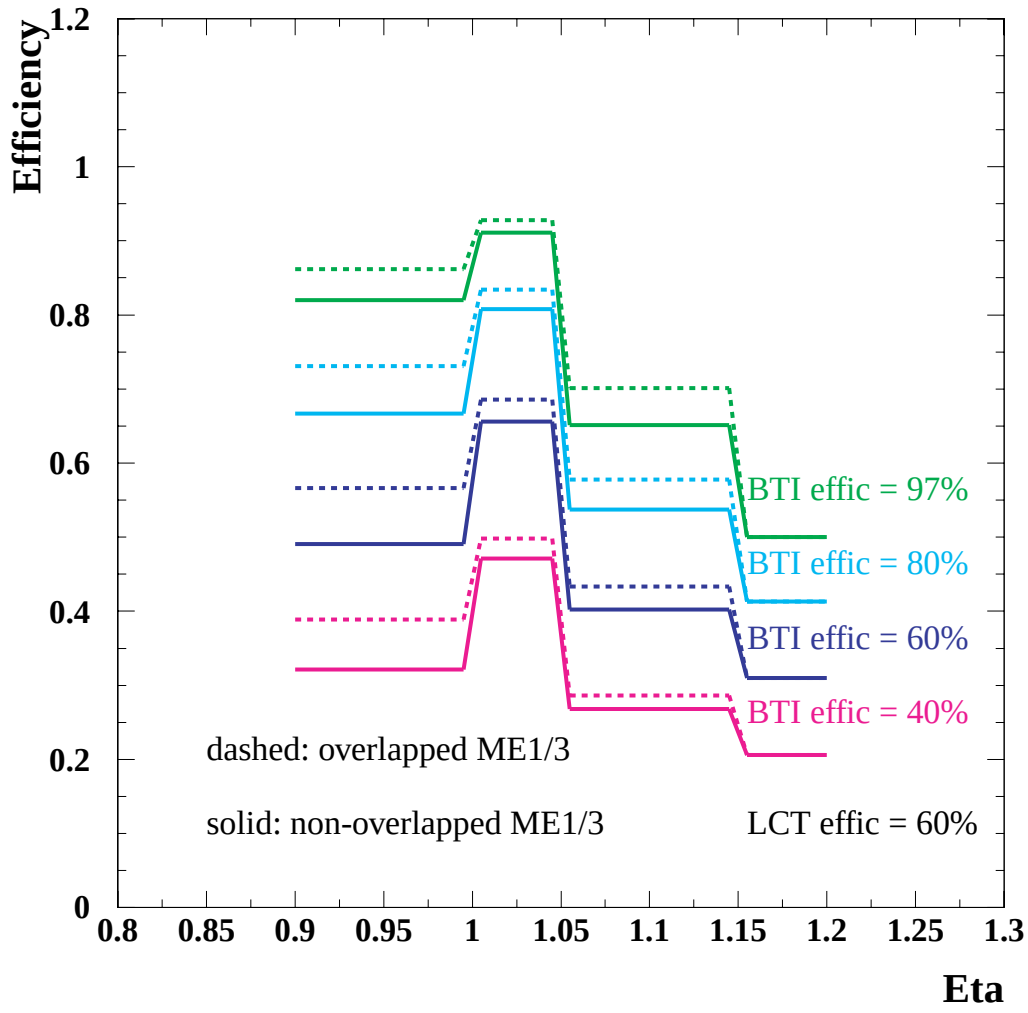


4% increase in acceptance overall

Efficiency of Overlap Region, Case 2



Efficiency of Overlap Region, Case 3



Summary of Overlap Efficiency

- Largest effect of overlapping ME1/3 occurs for $0.9 < \eta < 1.0$
  - 12% increase in acceptance (6% if MB1 hit is required)
  - Caused by lack of ME2/2 coverage
- Minimal effect elsewhere
  - A hit in either ME1/3 or ME2/2 has high efficiency
- Overall effect of overlapping ME1/3:
  - Increase in acceptance for overlap region is 4% (2% if MB1 hit is required)
  - Approximately independent of BTI and LCT efficiencies

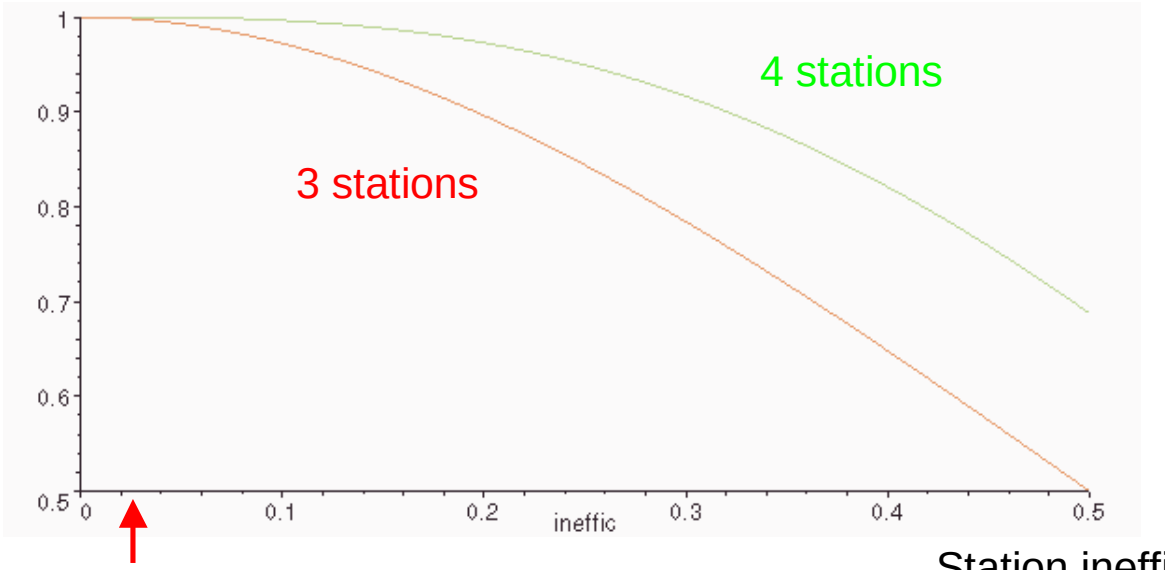
Sagitta Measurement in CSC Trigger

- Estimated trigger resolution of CSC Track-Finder using only $\Delta\varphi$ measured between ME1 and ME2, 3, or 4 is about 30% for P_T
- This is barely sufficient to reduce single muon rate below 1 kHz per unit rapidity for any trigger threshold at full luminosity
- Must go beyond simple scheme of Vienna Track-Finder:
  - Require 3 station sagitta measurement to improve resolution to 20% or better
  - Would provide a safety factor of at least 100 in rate
- Little redundancy in CSC system which has only 3 stations, however

CSC Redundancy Studies

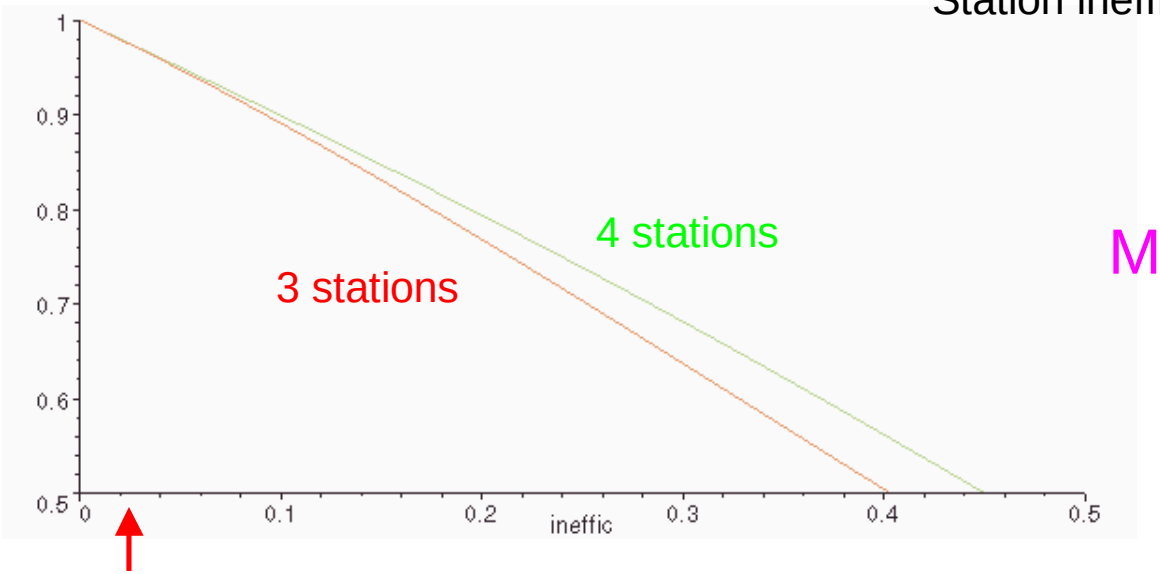
- Study efficiency for 2 or more stations to fire in CSC system as function of hit inefficiency (default scheme)
- Study efficiency for 3 or more stations to fire in CSC system as function of hit inefficiency (sagitta measurement scheme)
- Study for 3 and 4 stations
- Require a hit in ME1 for sufficient P_T resolution

2-Station Efficiency



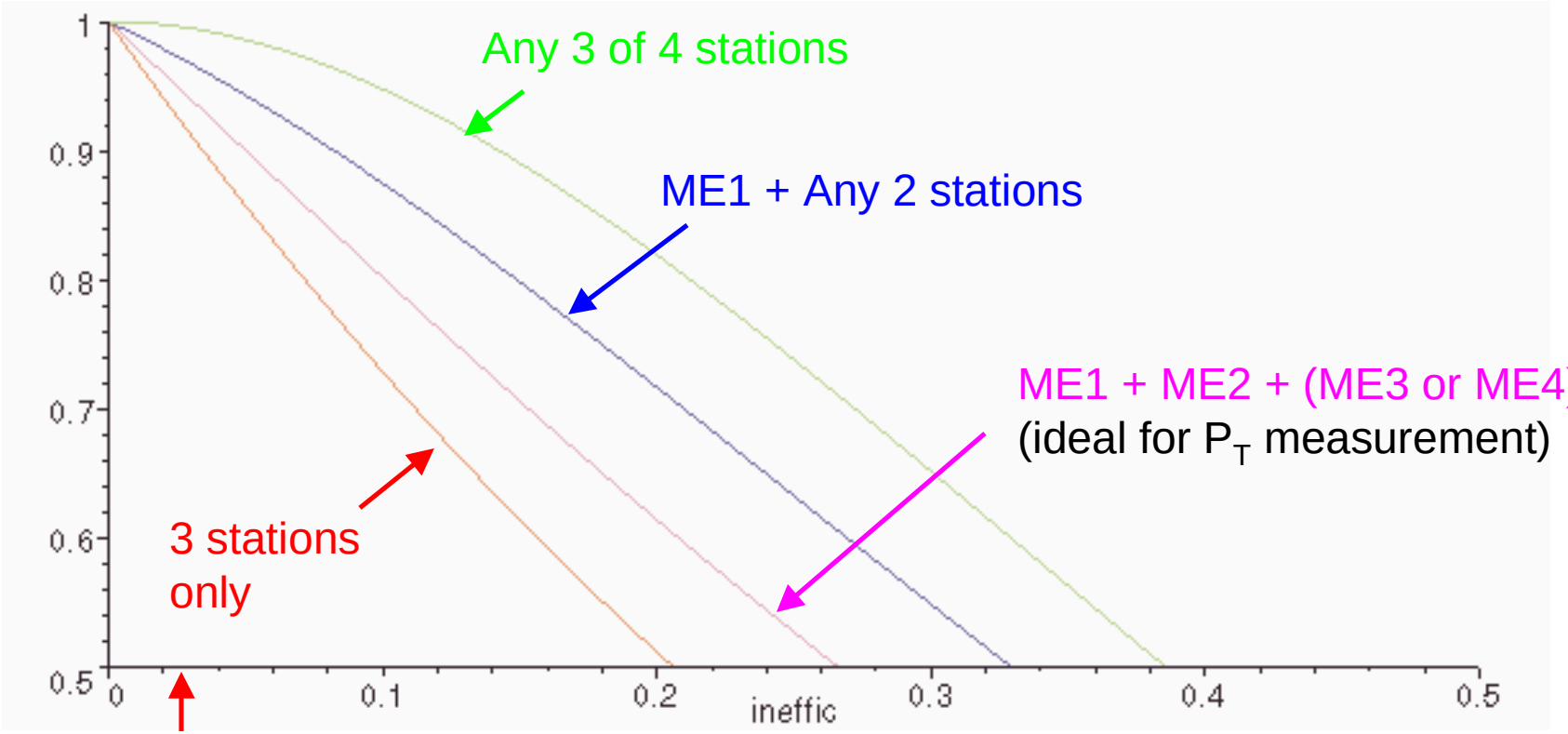
Any Two

Station inefficiency



ME1 + Any

3-Station Efficiency



Comments

- Largest increase in acceptance occurs for $0.9 < |\eta| < 1.0$ when overlapping ME1/3 (0.2 units of rapidity)
- This should be weighed against a similar increase in the 3-station efficiency for $1.2 < |\eta| < 2.4$ if ME4 is recovered (2.4 units of rapidity)
- 3 stations may be necessary for a sagitta measurement to reduce the trigger rate
  - This will require some design work to determine feasibility
- Offline determination of LCT efficiency may benefit from 4 stations, if 3 stations are required to trigger (similar to a study of residuals)