MFT and Global Muon Definitions

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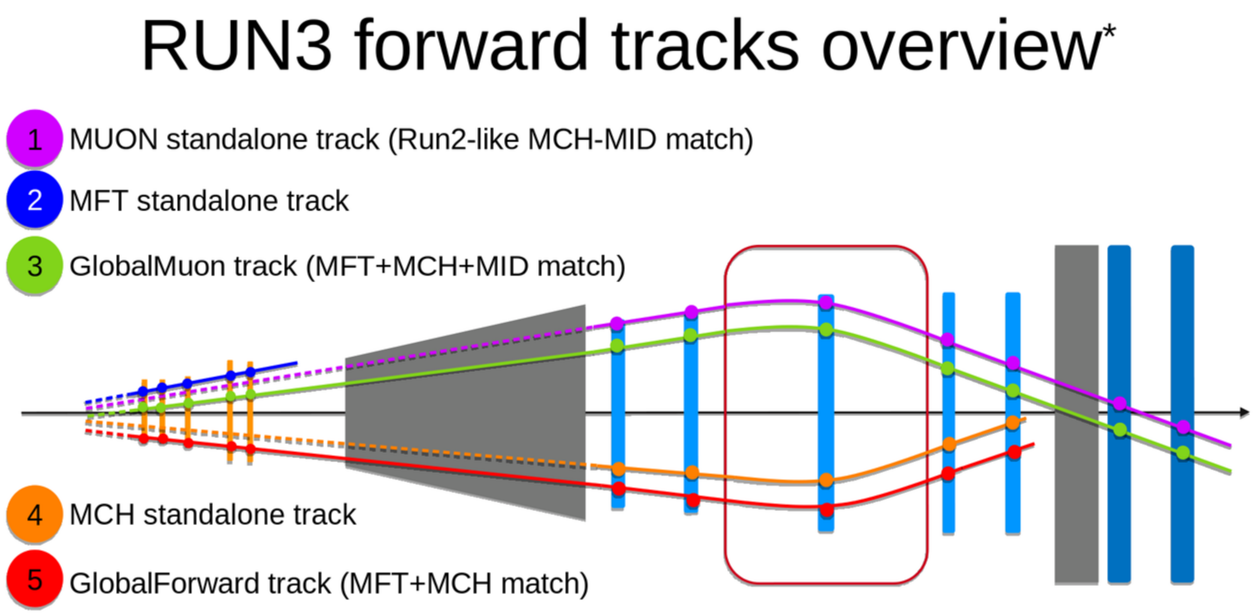
Live version at +MFT and Global Muon Definitions

Glossary



Track types:

- MUON Standalone track: Run2-like MCH-MID Match
- MFT Standalone track (aka MFT reconstructed track): A combination of clusters resulting in a track with fitted parameters and covariance matrix
- GM Track: Global Muon Track is a combination of a MuonStandalone and a MFT Track

Classification:

- Trackable: a track fulfilling the minium requirements of the reconstruction criteria
- True track: Reconstructed track with correct MC labels
- Fake track: Reconstructedtrack with incorrect MC label

- Generated particle: A generated particle with a trajectory within the detector acceptance.

MFT Standalone

- $N^{MFT}_{Trackable}$ → Number of MFT trackables. Tracks with clusters in at least 4 MFT disks; reference is MC.
- N^{MFT}_{Rec} → Number of Reconstructed MFT tracks. (MC and Real data)
  - $N^{MFT}_{Rec} = N^{MFT}_{True} + N^{MFT}_{Fake}$
- N^{MFT}_{True} → Number of Reconstructed MFT tracks with correct MC labels (> 80% of clusters from same MC label).
  - $N^{MFT}_{True} = \epsilon^{MFT}_{True} * N^{MFT}_{Trackable}$
- N^{MFT}_{Fake} -> Number of Reconstructed MFT tracks with incorrect MC label (< 80% of clusters from same MC label)
  - $N^{MFT}_{Fake} = \overline{\epsilon}^{MFT}_{Fake} * N^{MFT}_{Trackable}$
- N^{MFT}_{Gen} → Number of particles generated within the MFT acceptance. (Attention to generation parameters, specific usages).

Assessment

Should be expressed as a function of pseudo-rapidity, vertex position (and p_t if compatible with the MFT momentum resolution, probably not)

- $A^{MFT} = N^{MFT}_{Trackable}/N^{MFT}_{Gen}$ → MFT Acceptance
- $\epsilon^{MFT} = N^{MFT}_{Rec}/N^{MFT}_{Trackable}$ → MFT tracking efficiency
  - $\epsilon^{MFT} = \epsilon^{MFT}_{True} + \overline{\epsilon}^{MFT}_{Fake}$
- $\epsilon_{MFT} * A_{MFT} = N^{MFT}_{Rec}/N^{MFT}_{Gen}$
- Purity of MFT tracks: $P_{MFT} = N^{MFT}_{True}/N^{MFT}_{Rec}$
  - Alternative for special circunstances: divide by the number of MFT trackables for some analysis?

MUON/MCH

MCH→ MCH+MID

- $N^{MCH+MID}_{Trackable}$ → Number of MCH trackables with MID match.

- 1 cluster on each of the first 3 stations + 3 chambers fired in the last 2 stations, after the dipole + MID match.
- $N^{MCH}_{Trackable}$
- N^{MCH}_{Rec} → Number of Reconstructed MCH tracks.
- N^{MCH}_{True} → Number of Reconstructed MCH tracks with correct MC labels
  - Two methods to propagate labels: 1) from digits; 2) from cluster positions
  - More than 50% of clusters associated to the same MC particle. At least one on each side of the dipole.
- N^{MFT}_{Fake} → Number of Reconstructed MCH tracks with incorrect MC label

Global Muon Tracking

GM Track→ Global Muon Track

- $N^{GM}_{Trackable}$ → Number of trackable GM Tracks. MC Tracks that are trackable by both MCH and MFT.
- $N^{GM}_{Pairable}$ → Number of pairable global muon tracks: tracks that have been correctly reconstructed by both MFT and MCH and comes from the same generated track (the MC track is part of both N^{MCH}_{True} and the MFT track is part of N^{MFT}_{True},)
  - Preferable quantity to use on performance assessments of the matching algorithm, namely the efficiency (not the purity); filters detector effects: efficiency, acceptance, and standalone tracking.
- N^{GM}_{Rec} → Number of reconstructed global muon tracks.
  - $N^{GM}_{Rec} = N^{GM}_{True} + N^{GM}_{Fake}$
- N^{GM}_{True}→ Number of GM tracks with correct MCH-MFT pair association. I.E. MCH and MFT have true and identical MC labels. $N^{GM}_{True} \leq N^{GM}_{Pairable}$
  - $N^{GM}_{true} = \epsilon^{GM}_{true} * N^{GM}_{Pairable}$
- N^{GM}_{Fake}→ Number of GM tracks with wrong MCH-MFT pair association. I.E. MCH and MFT have true but different MC labels.
  - $N^{GM}_{fake} = \bar{\epsilon}^{GM}_{fake} * N^{GM}_{Pairable}$
- N^{GM}_{Close}→ Number of GM tracks with the true MFT associated track in the search window. Merely indicates if the true MFT associated track was tested, regardless of being selected as the best pair.

- $N^{MCH}_{Dangling}$→Number of MCH tracks not associated to any MFT track; no corresponding GM track

Assessment definitions

At what rate MCH tracks are converted to GM Track ?

- Pairing efficiency.

$$\epsilon^{GM}_{pairing} = \frac{N^{GM}_{Rec}}{N^{GM}_{Pairable}}$$

- $\epsilon^{GM}_{true} = \frac{N^{GM}_{True}}{N^{GM}_{Pairable}}$→ True pairing efficiency. From 0 to 1
- $\overline{\epsilon}^{GM}_{Fake} = \frac{N^{GM}_{Fake}}{N^{GM}_{Pairable}}$→ Fake pairing efficiency. From 0 to ?
- $\epsilon^{GM}_{pairing} = \epsilon^{GM}_{True} + \overline{\epsilon}^{GM}_{Fake}$
- TODO: Decompose this from the efficiencies and acceptance of each detector.

- Alternative pairing efficiency: no acceptance consideration. Relevant for data size and reconstruction monitoring (QC)
    - $\epsilon^{MCH/MFT}_{pairing} = \frac{N^{GM}_{Rec}}{N^{MCH}_{Rec}}$

How often the correct MFT associate track is selected for a MCH track?

- Adopting purity to indicate how clean is a sample of GlobalMuonTracks.
    - To replace in macros and presentations: Correct match ratio → purity

- $P^{GM}_{pairing} = \frac{N^{GM}_{True}}{N^{GM}_{Rec}}$→ Global pairing purity. From 0 to 1
- $P^{GM}_{pairing} = \frac{\epsilon^{GM}_{true}}{\epsilon^{GM}_{true} + \overline{\epsilon}^{GM}_{fake}}$
- Split in contributions of pairing purity and true pairing efficiency

How to evaluate the effect of MCH-MFT pair candidate cuts?

$$\epsilon_{close} = \frac{N^{GM}_{Close}}{N^{GM}_{Pairable}}$$

- Closing matching efficiency. This number saturates at 1 by testing all possible candidates.