Mini-Workshop on muon track matching

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Status of L2 muon trigger

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- Generalities;
- local Pattern recognition;
- seed generation;
- algorithm description;
- performances;
- missing item.

Reconstruction algorithm :

- Seed generation: either external (L1 input) or internal (local patter recognition);
- Steering: to find which recHits are compatible with the given seed and to “grow” a trajectory;
- Fit: use all compatible recHit to get best parameter for the track;

So far only tracking detector (DT and CSC) are used.

To reduce combinatorial, the algorithm is hierarchical, i.e. it first performs a local pattern recognition inside a chamber, then use it for the global one.

The algorithm is fully based on CommonDet interface, and uses a lot of its functionality.

Local Pattern Recognition (segments):

- Barrel:
  - reconstructs ϕ super-layer hits;
  - clusterize them (linear fit);
  - ipso for z super-layer;
  - associate the two projection to build a 3D segment(s);
  - re-reconstruct RecHits to apply impact angle correction on time to distance relationship, and refit segment;
- Endcap:
  - reconstruct 3D RecHits;
  - associate them with linear fit, only one hit for each layer;

Seed:

The seed can be internally generated (i.e. by muon code) or provided as an external input (L1 trigger from Global Muon Trigger (GMT)).

- internal seed: from local pattern recognition “segment” (see after)
  - global: muons are looked for everywhere;
  - state vector from segment;
  - Pt assigned with parameterisation of pt vs phi dependence, with or without vertex constrain (barrel) or helix trajectory hypothesis (endcap)

Seed:

- external: for L2 use output from L1 GMT;
  - local: reconstruct muon only where L1 found something;
  - pt assigned with 90% pt-scale!
  - state vector at station 2;
  - $\sigma_{1/pt} \sim 15\%$ barrel $\div \sim 29\%$ endcap ;
  - $\sigma(x, y, dx/dz, dy/dz)$ chamber dimension;

Track finding:

- extrap L1 seed to virtual inner surface;
- go outward and find compatible chamber, via CommonDet navigation tools;
- reconstruct RecHits (segments) in compatible chamber;
- update (Kalman) the trajectory with compatible RecHits;
- filtering is loose: the idea is simply to collect compatible RecHits and improve the state vector definition given by L1;
- true filtering is apply after;
- propagator is geane.

Filering:

- Once we have collected all RecHit going outward, we apply “true” filtering going inward;
- now apply a reasonable cut on χ^2 increment to reject bad hits;
- hits used are 3d segment for barrel and 3d hits for Endcap;
- in Endcap we use segment to reduce combinatorial;
- trajectory is updated, and the “best” measurement is the innermost;
- trajectory is not smoothed.

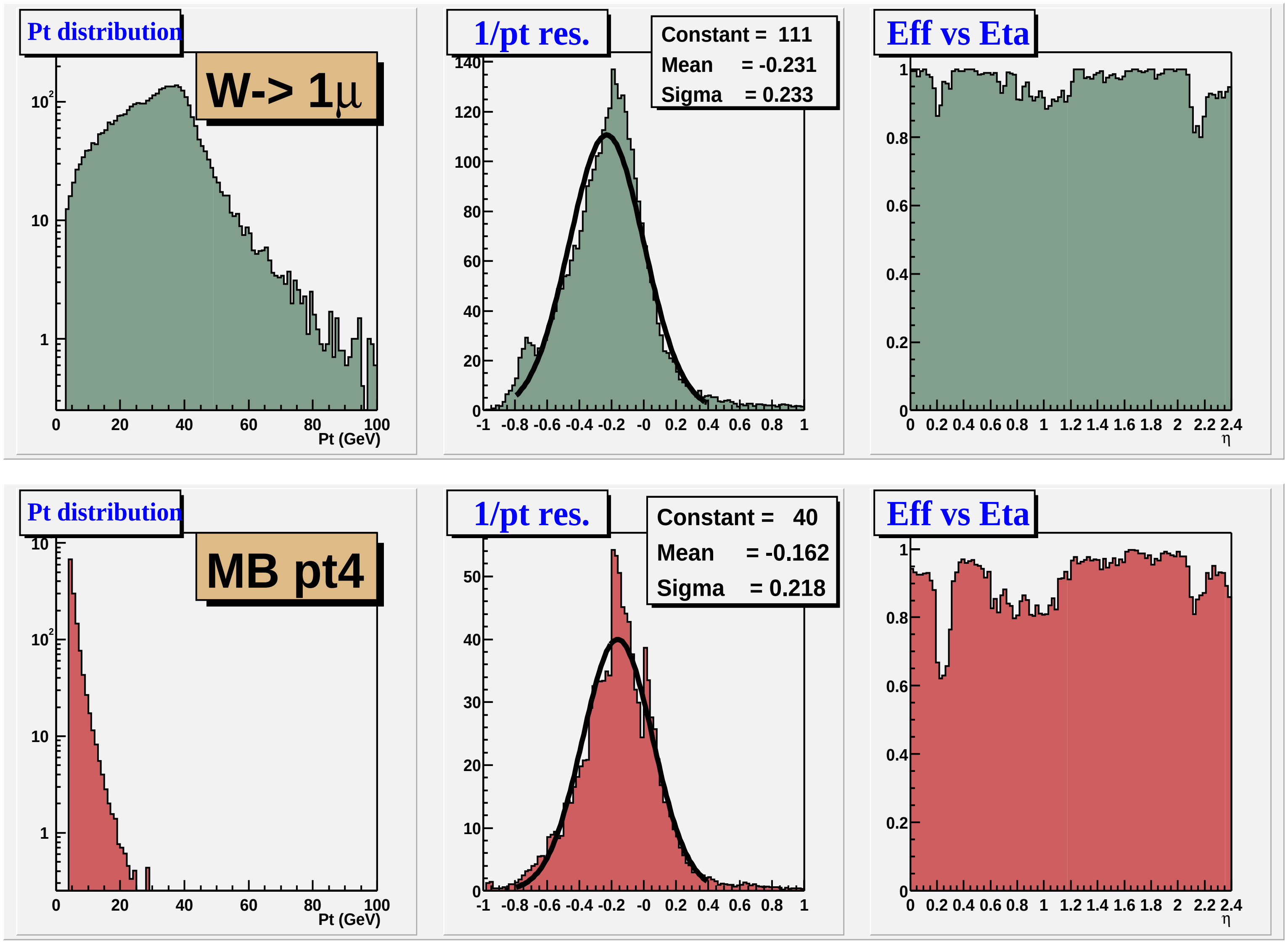
Vertex fitting:

1. We have state vector at innermost station;
2. Get state vector at point of closest approach to IP, extrapolating (geane);
3. Try to fit the trajectory with IP, and update state vector;

L2 muon is:

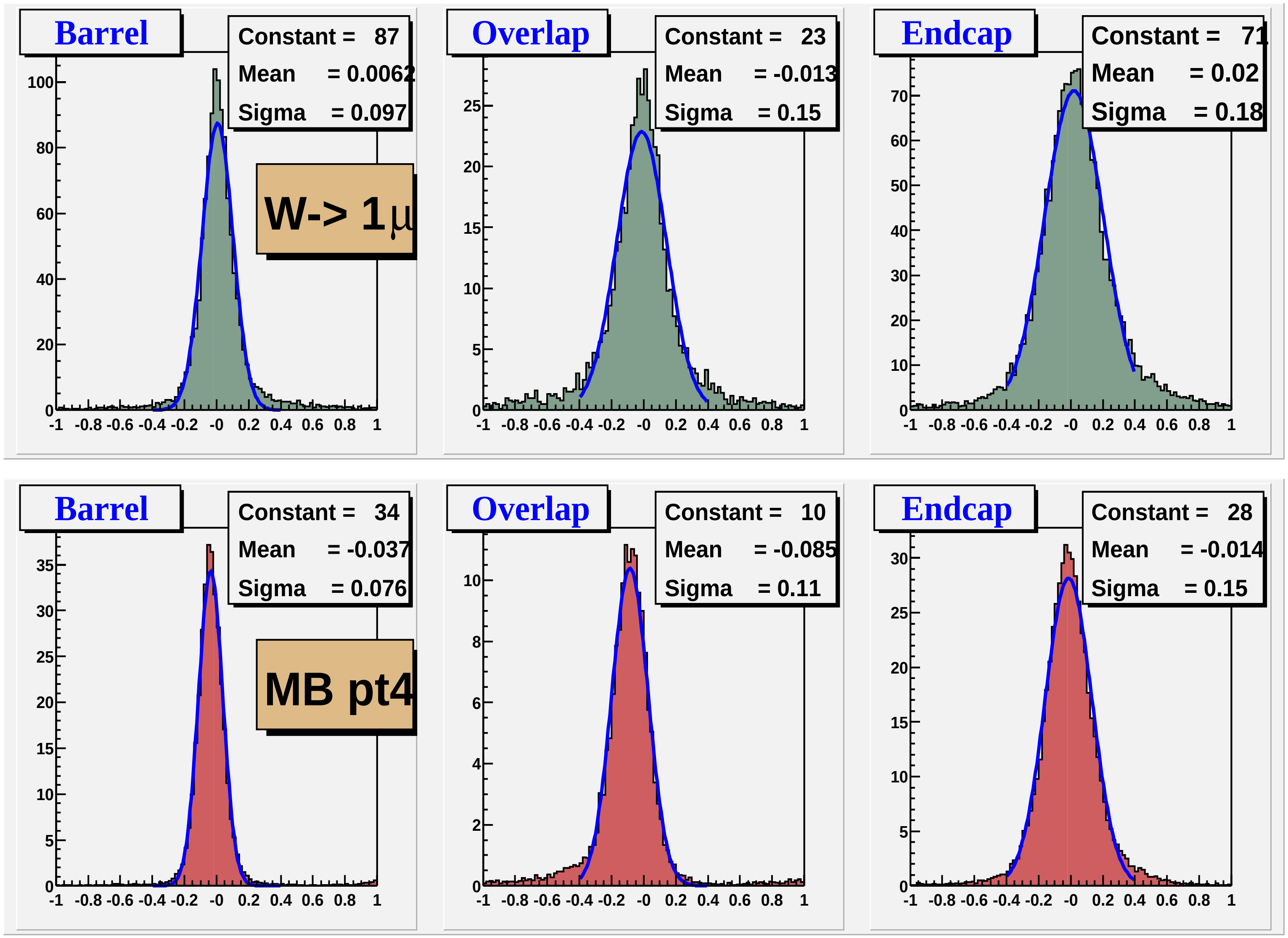
- 3) if successful;
- it 3) fails L2 muon is 2);
- if 2) fails is 1).

L1 seed:

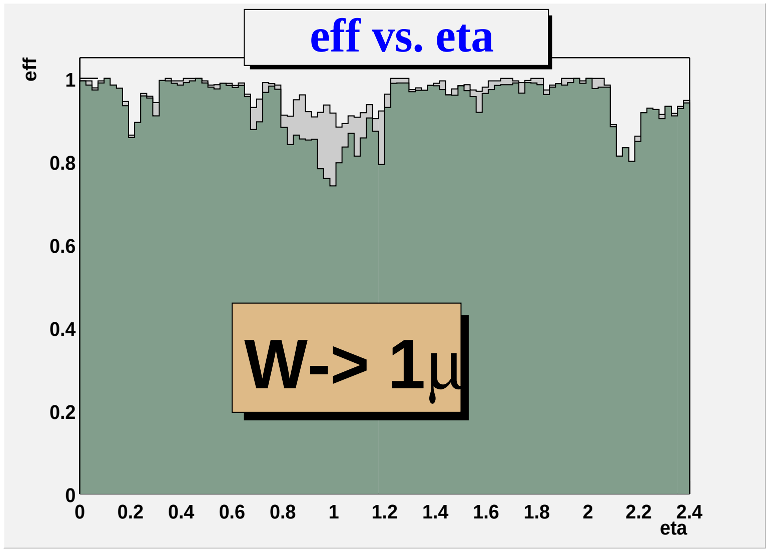


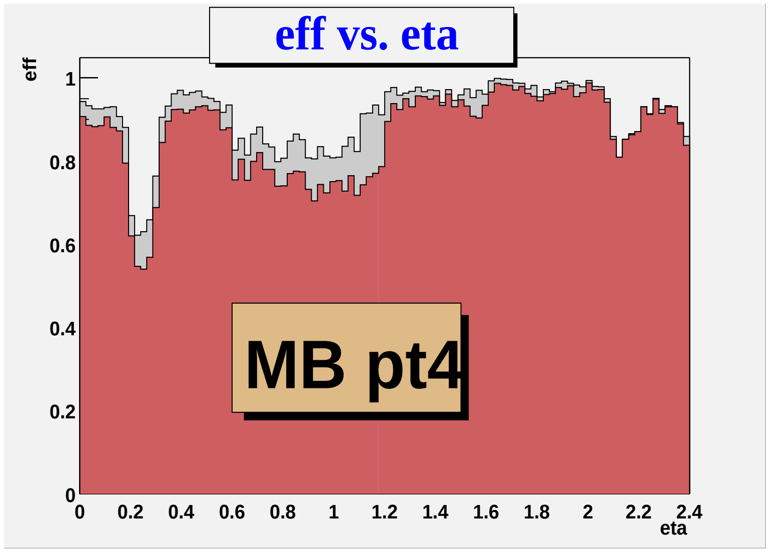
Pt distribution
W-> 1μ
Pt (GeV)
1/pt res.
Constant = 111
Mean = -0.231
Sigma = 0.233
Eff vs Eta
η
Pt distribution
MB pt4
Pt (GeV)
1/pt res.
Constant = 40
Mean = -0.162
Sigma = 0.218
Eff vs Eta
η

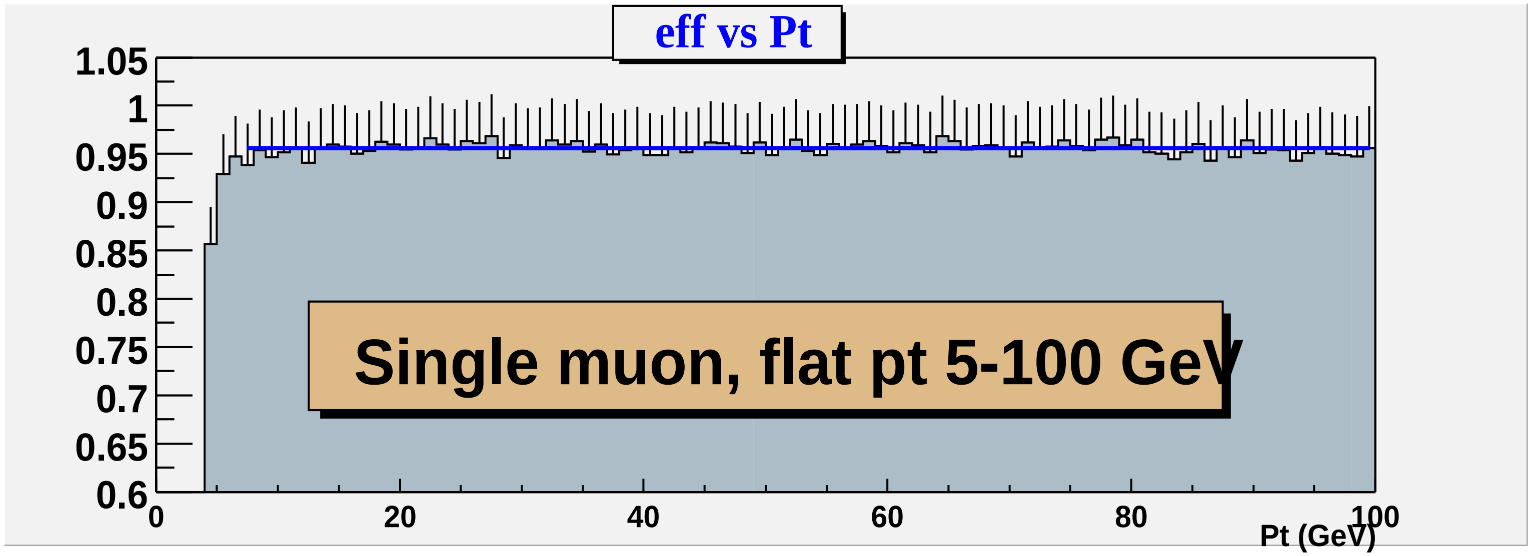
L2 $1/p_t$ resolution:



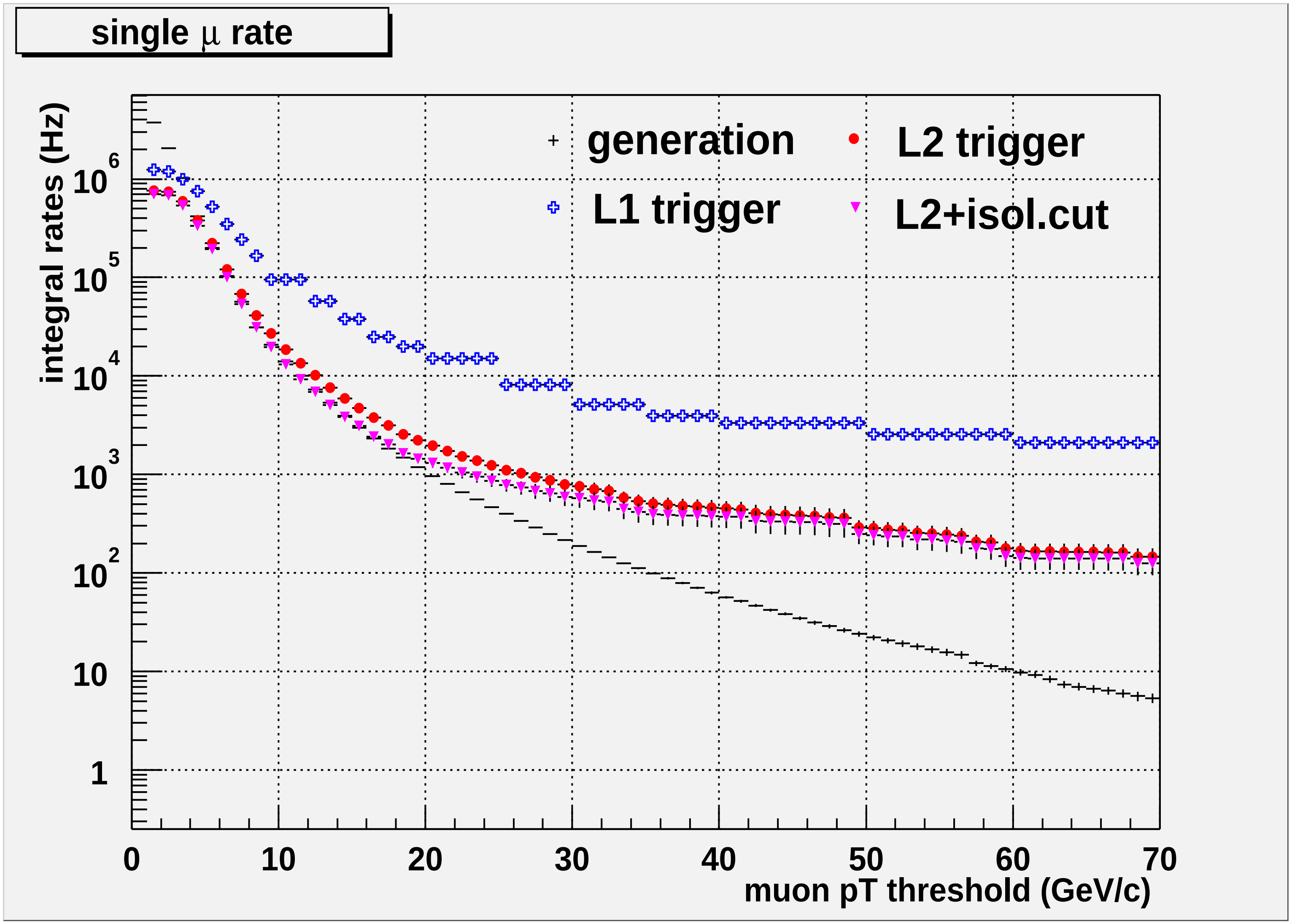
Efficiency:


eff vs. eta
eff
1
0.8
0.6
0.4
0.2
0
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4
eta
W-> 1μ


eff vs. eta
eff
1
0.8
0.6
0.4
0.2
0
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4
eta
MB pt4


eff vs Pt
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0 20 40 60 80 100
Pt (GeV)
Single muon, flat pt 5-100 GeV

Rate reduction on MB single muon events:



Open issue:

- Efficiency: we have important eff holes in the overlap region, where the RPC help L1. Could we use RPC as well? How?
- Non prompt muons (coming from pi/kaon decays): so far we can't do much to reject them at L2. That's an issue that must be addressed at L3?
- Overlapping station: some of the barrel chamber and quite all Endcap chamber (of a given station) have a (small) region where they overlap. So far we use one of the two. we have to use both (if present).
- What if a segment is not built but some hits are present? Should we try and use them?