CPT week - PRS Muon reports

CERN 26 April 2001

Status report on Lvl-2 and Lvl-3 muon selection

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- ◇ L2 status;
- ◇ Progress on isolation studies at L2;
- ◇ Plan for L2;
- ◇ L3 status;

L2 strategy:

- ◇ get L1 Global Muon Trigger results;
- ◇ use these GMT μ's as seed for regional reconstruction: regional means that the reconstruction is performed only in a region of Muon system
- ◇ the seed is defined on a internal (virtual) surface, and the filtering (Kalman) is done outward, with loose criteria, to collect compatible hits in Muon chamber;
- ◇ the hits collected are 3D segment in barrel and 3d points belonging to segments in endcap: RPC are not used;
- ◇ when all hits are collected, the filtering is done inward and tighter cut is applied;

◇ most updated trajectory is defined at the innermost station;

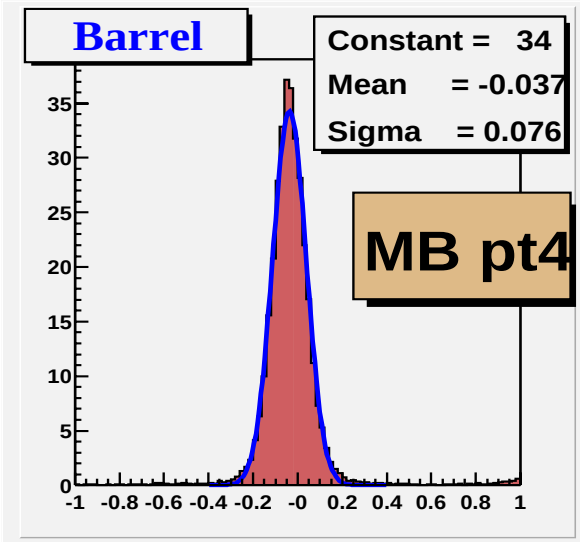
◇ we extrapolate the trajectory to the point of closest approach to IP;

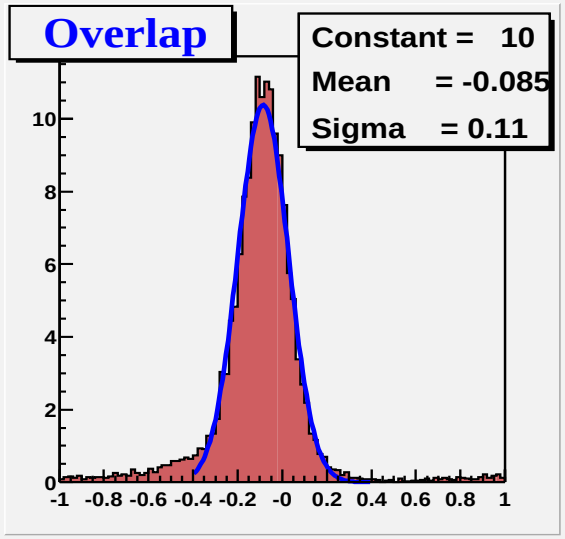
◇ use IP constrain;

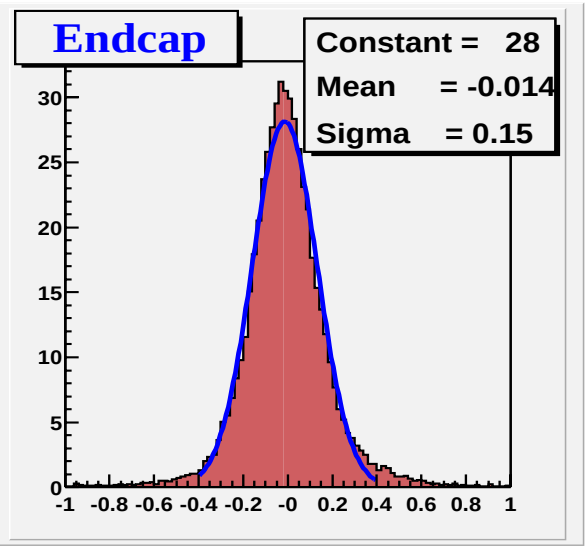
L2 muon is:

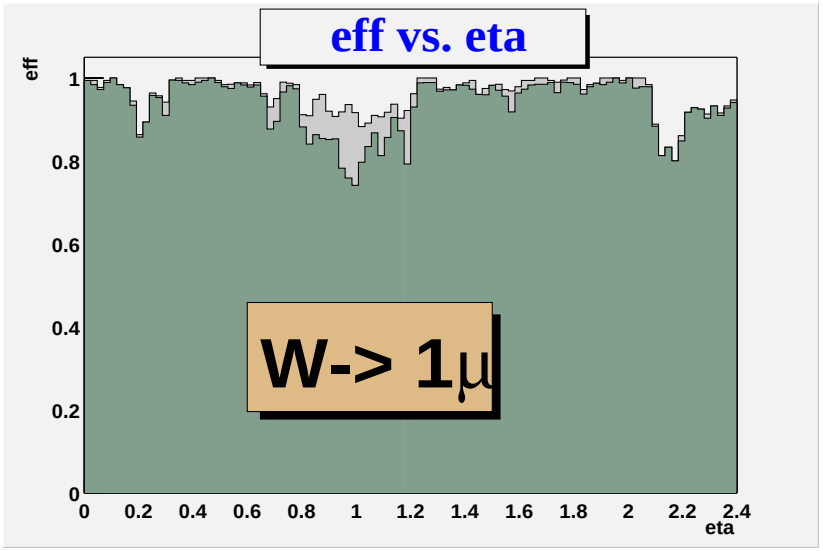
- vtx constrain if successful;
- vtx extrapolation otherwise;
- innermost muon station state otherwise.

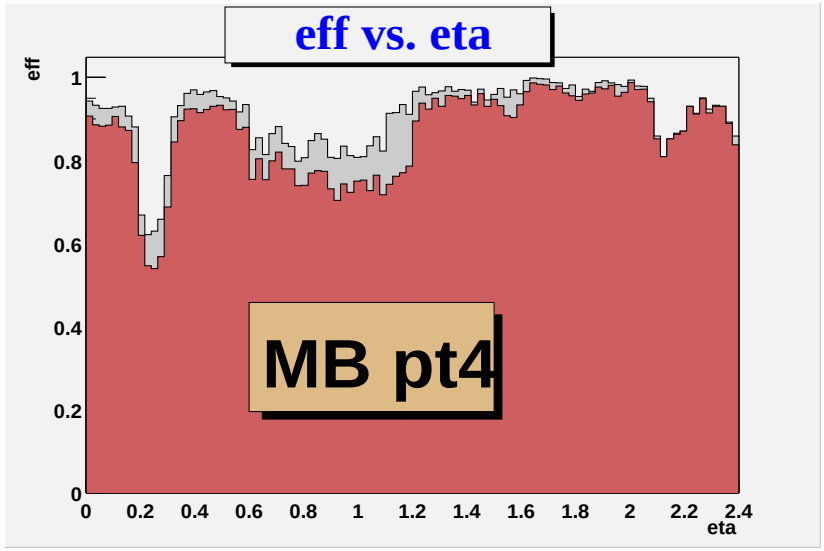
L2 performances:



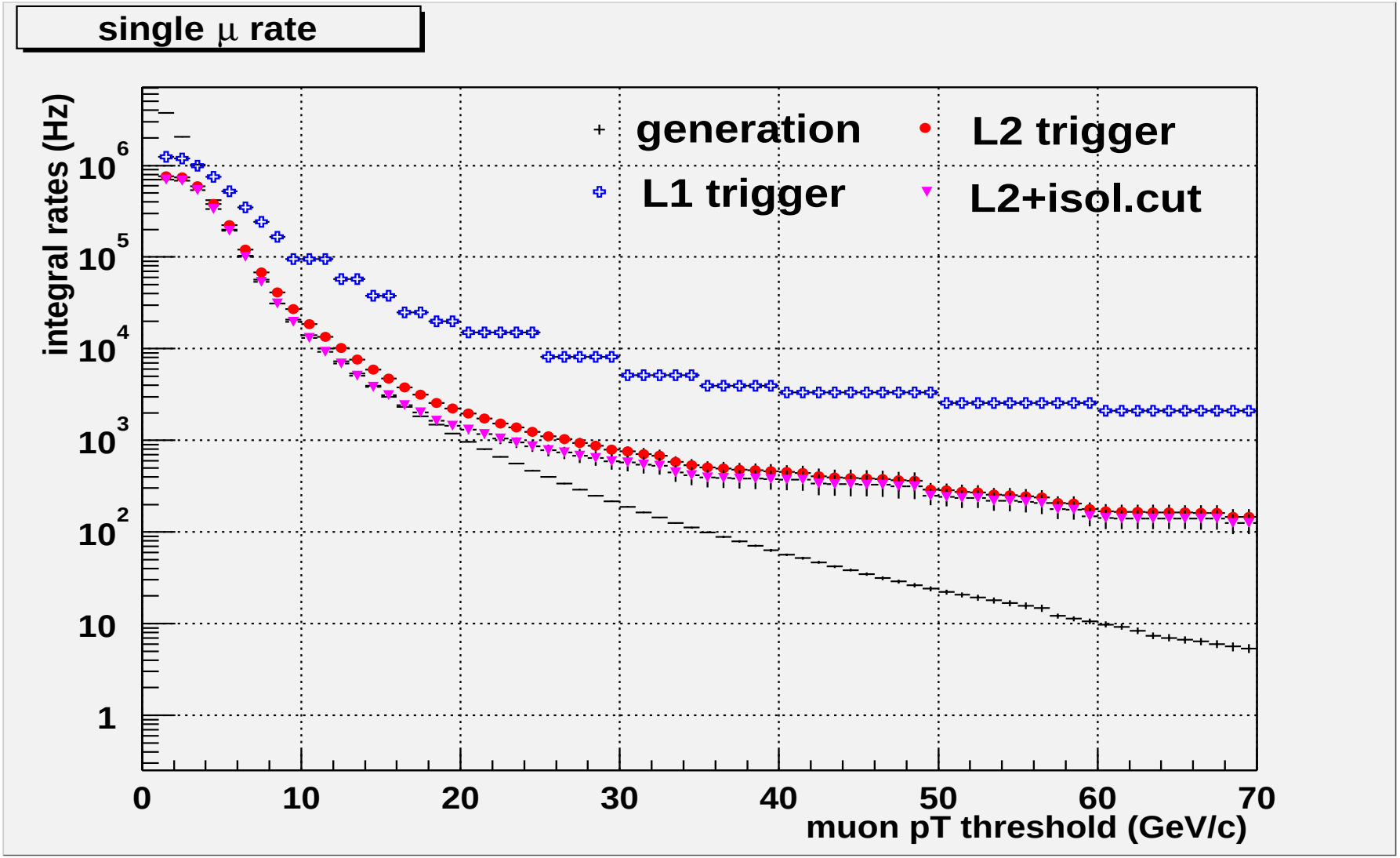








L2 performances:



L2 isolation:

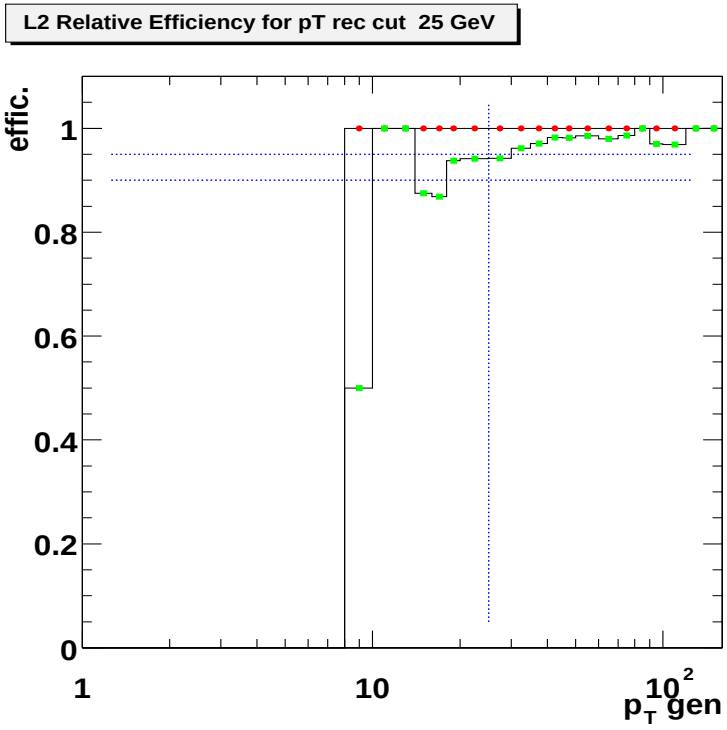
- Extrap Muon tracks to calorimetry;
- find most energetic (ECAL+HCAL) tower around it;
- construct some kind of cone of calo tower around impact point;
- get E_T/p_t^{rec} for this cone, E_T threshold 0.5GeV;
- set efficiency for $W \rightarrow \mu$ dataset to 0.97 and look for rejection on MB events.

Isolation performances:

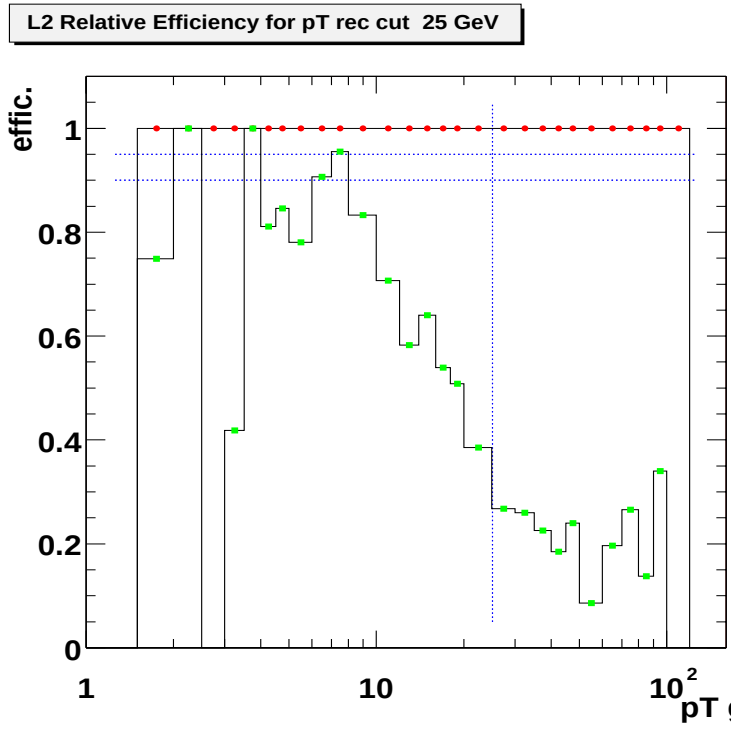
$\Delta R = \sqrt{\Delta\phi^2 + \Delta\eta^2} \leq 0.2$ w/o central tower, trigger threshold 25GeV

Works fine for high p_T muons, does not affect low p_T muons

ϵ (W$\rightarrow 1\mu$, $p_T^{gen}(\mu) > 20$GeV)$\sim 97\%$



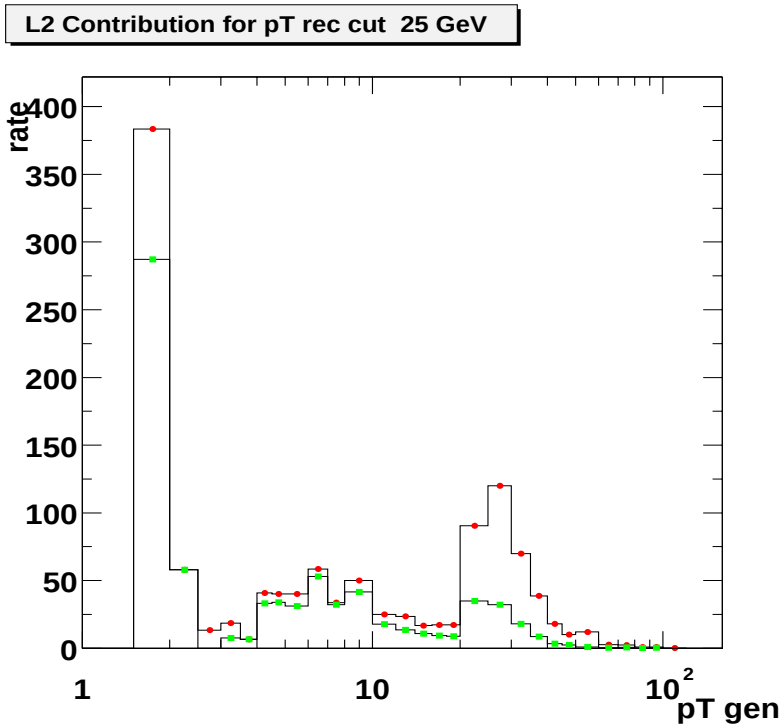
ϵ (MB$\rightarrow 1\mu$, $p_T^{gen}(\mu) > 20$GeV)~ 0.28

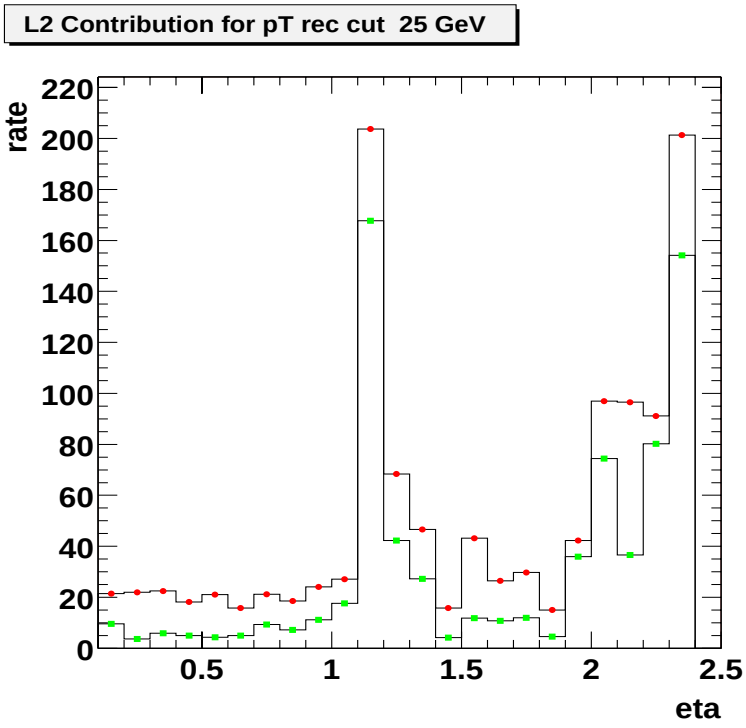


L2 Rate: where it come from?

But most contibution from rate comes from low pt muon, mostly on overlap and very forward region

MB, contribution to L2 and L2+isol vs p_t and η

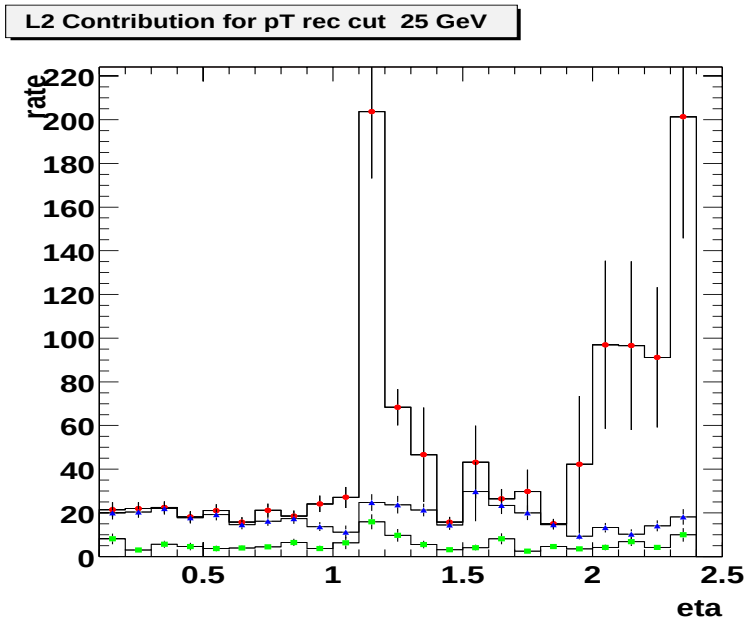




Quality critera to reject bad tracks

Even with a naif approach, appling cut based on tracks parameters (η, p_T, ...) in most problematic regions (overlap and very forward), it's possible to reduce the contribution of low p_T.

MB, contribution to L2, L2+naif Quality cut L2+quality+isol vs η



ϵ (W$\longrightarrow 1\mu$, $p_T^{gen}(\mu) > 20$GeV)$\sim 90\%$

ϵ (MB$\longrightarrow 1\mu$, $p_T^{gen}(\mu) > 20$GeV)~ 0.22

Open problem

Most critical region is the overlap, not only for efficency drop, but also for non gaussian tail in pt resolution which give large feed through;

A possible solution for efficency is to include RPC hits in the recostruction.

Work is in progress to adapt RPC code to CommonDet interface, then it should be easy to include these hits into muon tracking.

Having more hits could also improve pt resolution, despite poor spatial resolution of RPC. Need to study the effect of RPC noise hits.

Detailed study of tracking in overlap to find possible improvement.

Study of track quality criteria to reject poorly reconstructed tracks (may also include a “fit” to calo mip signal)

L3 status

- get muon trajectory as fitted by muon system;
- propagate to outer tracker surface (or pixel);
- define start tracker layer, build a seed here and start tracker reconstruction;
- go back to Muon system and include in the track also muon hits.

Most of the work can be done re-using code from tracker & CommonDet, muon group should provide:

⋆ external seed generation; *(done)*

⋆ navigation from tracker to muon; *(first version done)*

⋆ propagation tool; *(done)*

⋆ interface to existing track finders (CM, GTF, ...); *(done)*

A new package is now in ORCA: MuonReco

- CommonNavigation: tools to navigate between tracker and muon system;
- MuonAnalysis: ntuple maker, user collection, . . . ;
- MuonIsolation;
- MuonReconstruction: seeded reconstruction, tracker matching, . . . ;
- MuonUtilities;
- SeedGenerator(?);

A first version committed (HEAD), tested with ORCA_4_5_1, release within next ORCA version.

Seed generator

- ◇ Starting point: Trajectory at outer tracker surface;
- ◇ find all compatible tracker layers by propagating w/o errors using `GtfPropagator`;
- ◇ sort layers by (radius, z);
- ◇ define start layer and direction (outside-in or inside-out);
- ◇ get measurement at start layer, continue to next if none found;
- ◇ create trajectory seed.

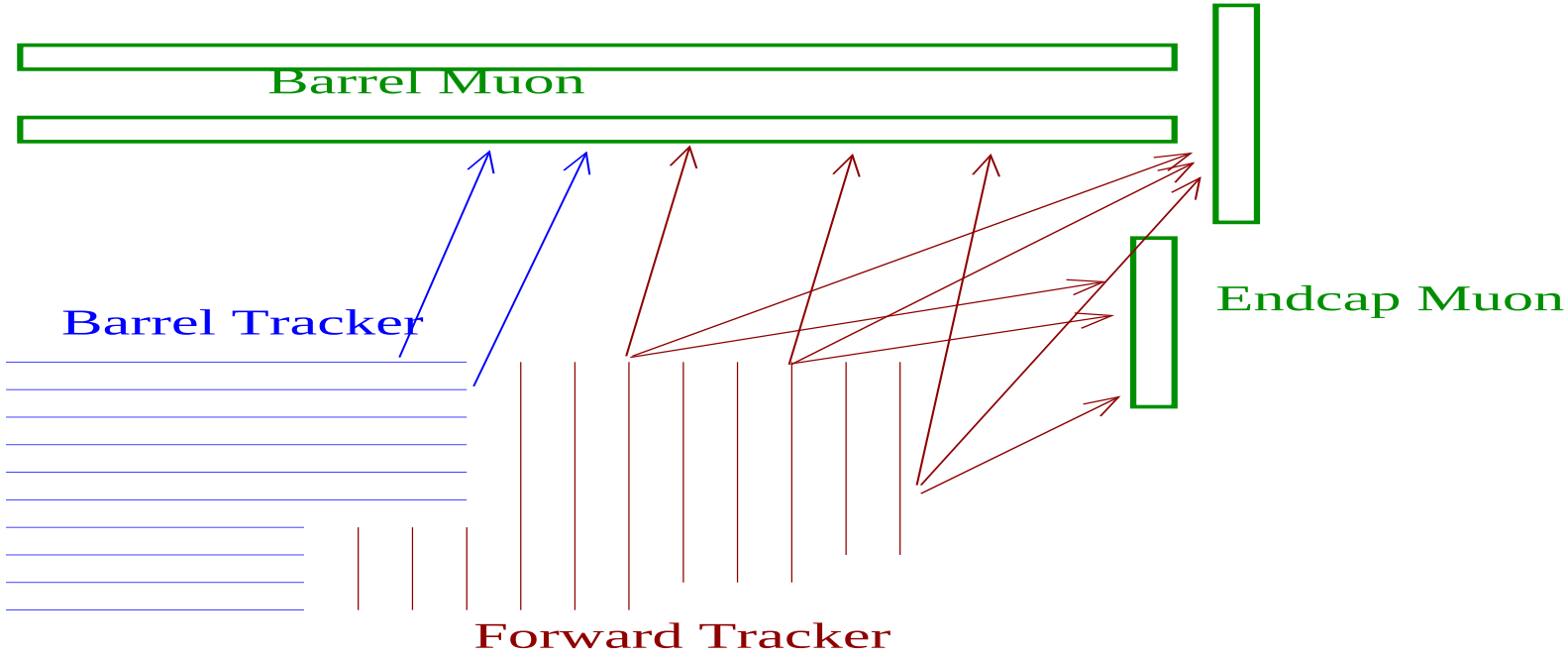
Different for CM interface.

Navigation

Navigation between tracker and muon system is defined in class

`MuonTkNavigationSchool`

It's based on tracker SimpleNavigationSchool, but in addition the first muon DetLayer is linked to the outer tracker layers;



Propagation

`SmartPropagator` *is a* `Propagator`, and it acts as a a wrapper to two concrete Propagator to propagate FreeTrajectoryState inside or outside tracker volume.

◇ The default algorithm are: **GtfPropagator** for Tracker, and **Geane** outside,

◇ other choices can be defined in the constructor,

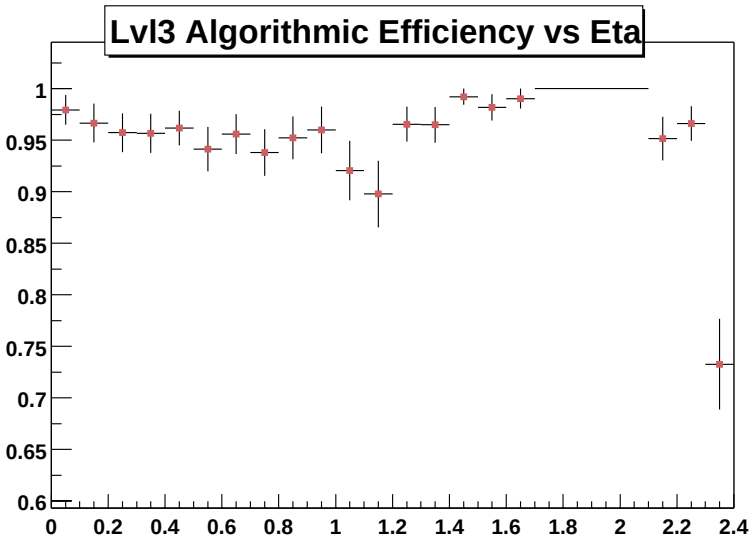
◇ the user interface is that of Propagator:

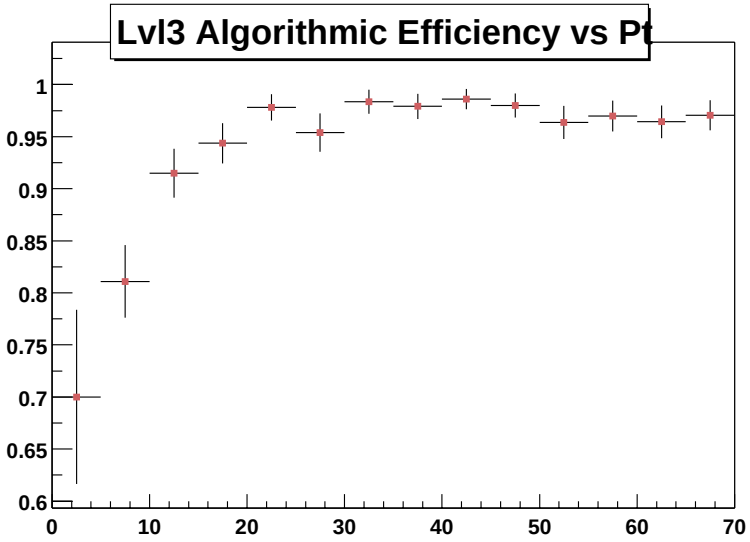
◇ whenever a propagate method is invoked, the SmartPropagator check if initial and final position are inside tracker and uses *tracker propagator* otherwise uses *outer propagator*

Interface to existing track finders

- Connection with GTF implemented and tested: two option *outside-in, inside-out*, also with extension to muon system;
- Connection with CM implemented and tested;

Some results from CM seeded by L2:





Summary

- ⋆ L2 is still to be studied and optimized, it's not a defined tool!!
- ⋆ In particular a better tracking in overlap region is needed;
- ⋆ Isolation studies show the possibilities to gain a factor ~ 2.5 on high p_T MB muon;
- ⋆ Basic tool for L3 are becoming available.