Muon reconstruction at Level-2

Rome muon trigger group & Boston Muon Consortium

- Level-2 muon trigger (μFAST + bmc_trig)
  - stand-alone μ trigger using RPC + MDT
- Level-2 combined muon + track trigger
  - fast algorithm combines tracks from SCT trigger and μFAST

- Present performance + rates calculation as in HLT TP

Stand-alone Level-2 muon trigger

- Two algorithms: mFAST (Rome $|\eta|<1.$) and BMC_TRIG (Boston $|\eta|<2$).
- Two algorithms are similar
- μFAST reconstruction done in three steps:

- pattern recognition using RPC to define roads in the MDT stations; a contiguity algorithm removes background hits from muon track.

- track-segment fit; a straight-line track is fitted using selected hits in each muon station. The drift-time measurement is used with a linear r-t relation. The intercept of this trajectory with the plane in the middle of the muon station defines a “superpoint”. This procedure provides one superpoint per muon station and the related sagitta.

μFAST and bmc_trig

- momentum reconstruction; a linear function relates observed sagitta with the muon momentum at vertex. This relation is described by a LUT where the two parameters are given as a function of the eta and phi, for a given muon charge.

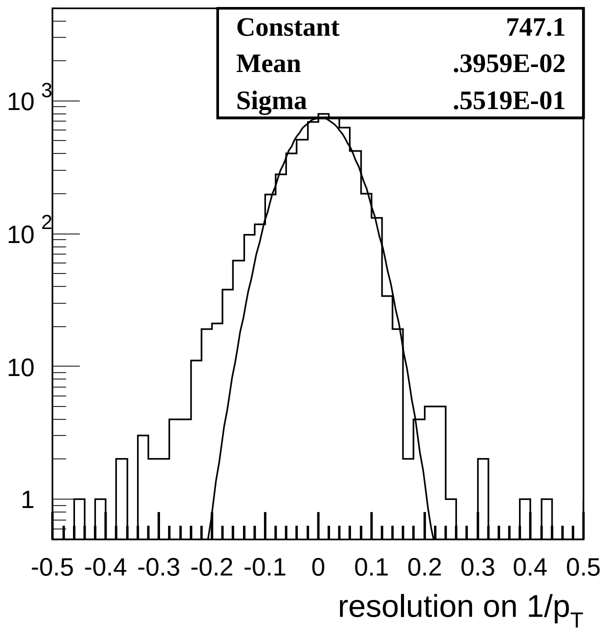
- The output of the algorithm is the muon pT at vertex, the η and ϕ coordinates and the track direction at the Inner MDT station.
- The main differences of the BMC_TRIG algorithm are:

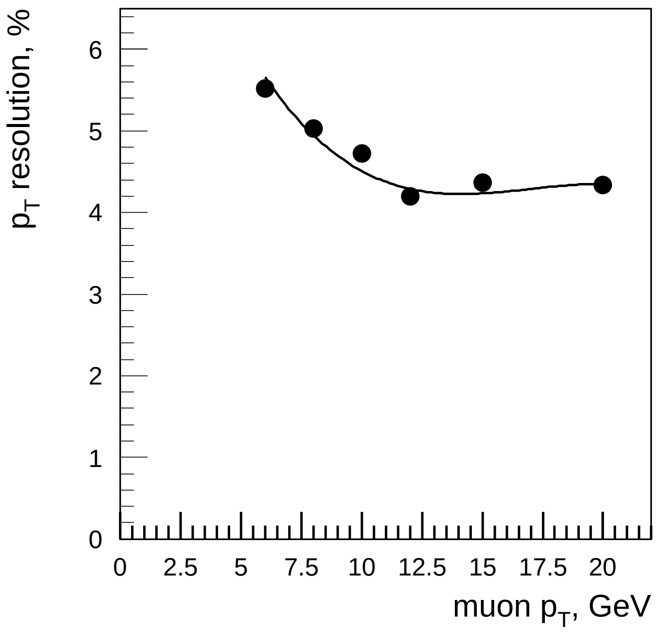
- no contiguity algorithm is applied; the best track-segment is selected in each MDT station after the local fit procedure;
- two superpoints are defined in each MDT station, one per multilayer;
- the radius of curvature of the track is studied at the place of the sagitta

Level-2 performance

- p_T resolution:

  - similar for both algorithms (|η|<1)



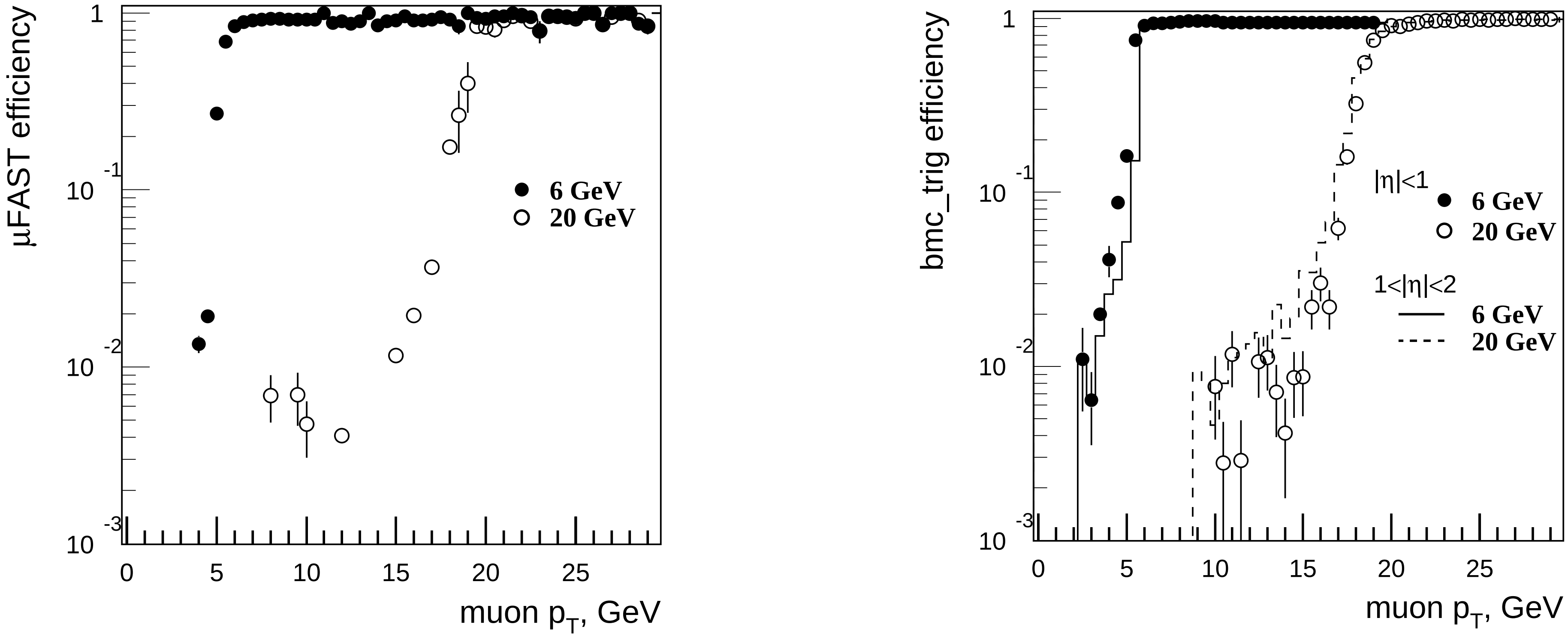


- simulated (nominal) background not seen to degrade performance (some effect at hi-lumi, high-p_T for 10x background)

- at low-p_T, resolution is close to that from offline

Level-2 performance

- Efficiency:



- high statistics at low-p_T provide precise rate estimate, since rate is dominated by low-p_T tail

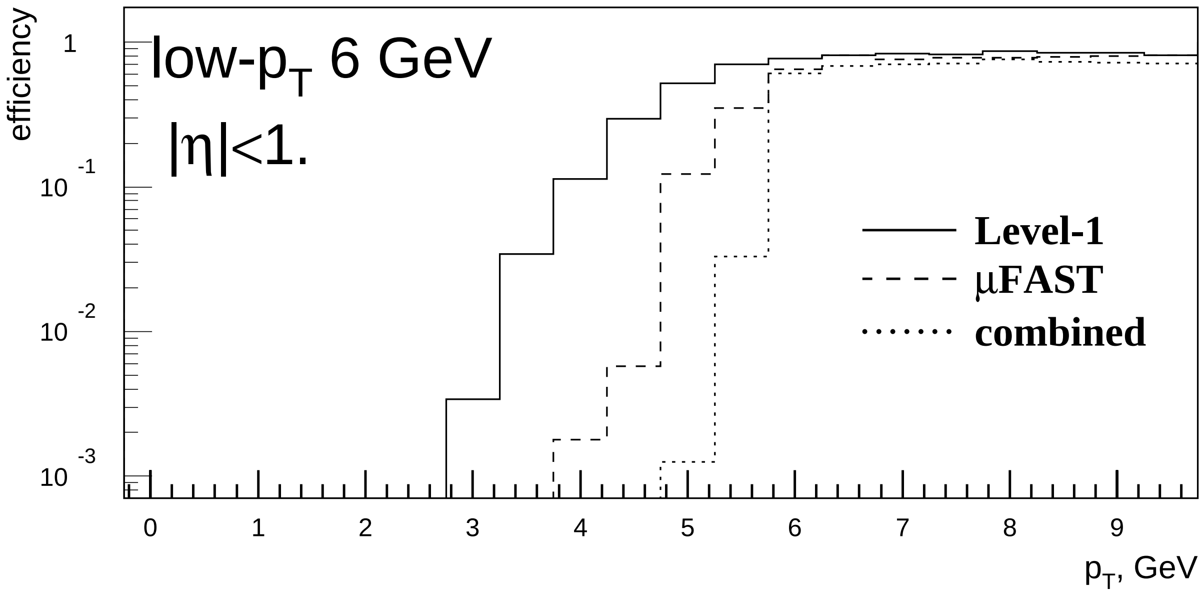
Combined algorithm

- Combine features from Level-2 muon algorithm (μFAST - $|\eta|<1$), with those form SCT algorithm:

  - use simple linear extrapolations + analytic corrections in η and z to make matches

  - reject K/π decays using p_T matching

  - improve threshold sharpness using SCT - e.g. consider efficiency curve:



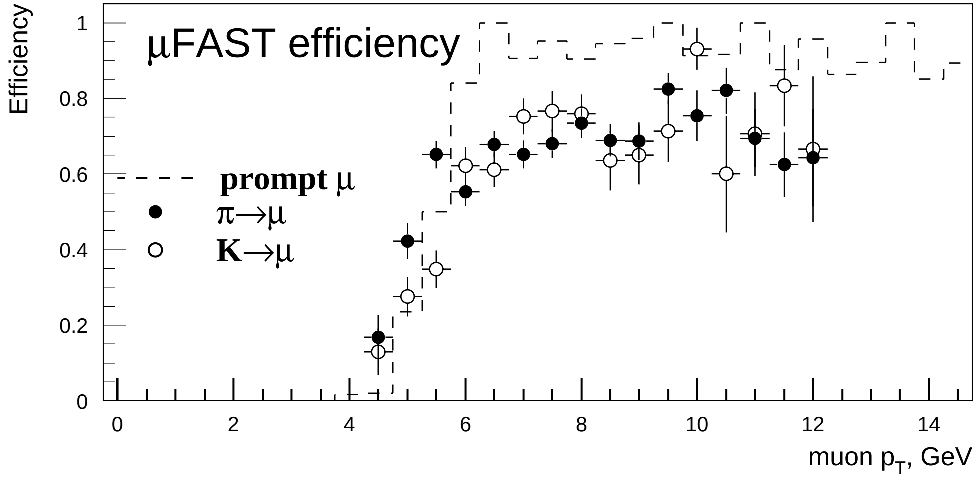
Combined performance

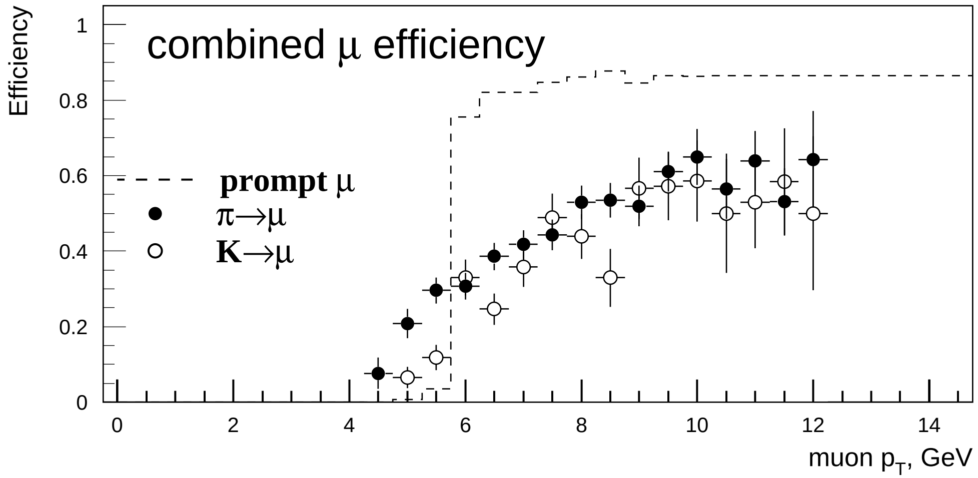
- Efficiency

  - substantial K/π rejection

  - good prompt μ efficiency

  - algorithm is fast (23 μs/RoI)





Rates at Level-2, kHz

- low-p_T, 6 GeV

	Level-1 ($|\eta|<1$)	μFAST ($|\eta|<1$)	bmc_trig ($1<|\eta|<2$)	combined ($|\eta|<1$)
K/π decays	7.9	3.1	1.8	0.98
b decays	1.7	1.0	0.9	0.73
c decays	1.0	0.5	0.5	0.37
Total	10.6	4.6	3.3	2.08

-high-p_T, 20 GeV

K/π decays	1.1[a]	0.06	0.07	-
b decays	0.8	0.09	0.11	-
c decays	0.4	0.04	0.04	-
W decays	0.06	0.04	0.05	-
Total	2.4	0.23	0.27	

Summary

a. Studies still in progress.

- Algorithms now exist for stand-alone muon triggers in almost all η range, and for $|\eta|<1$ for combined reconstruction
- Stand-alone trigger reduces rates by ~2 at low-pT, and ~10 at high-pT.
- Fast combined reconstruction suppresses K/π decays by further factor ~2