DT-TK EXTRAPOLATION ALGORITHM DEVELOPMENT

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OUTLINE

- Review of work done till May workshop
- Update since May workshop
- Outlook

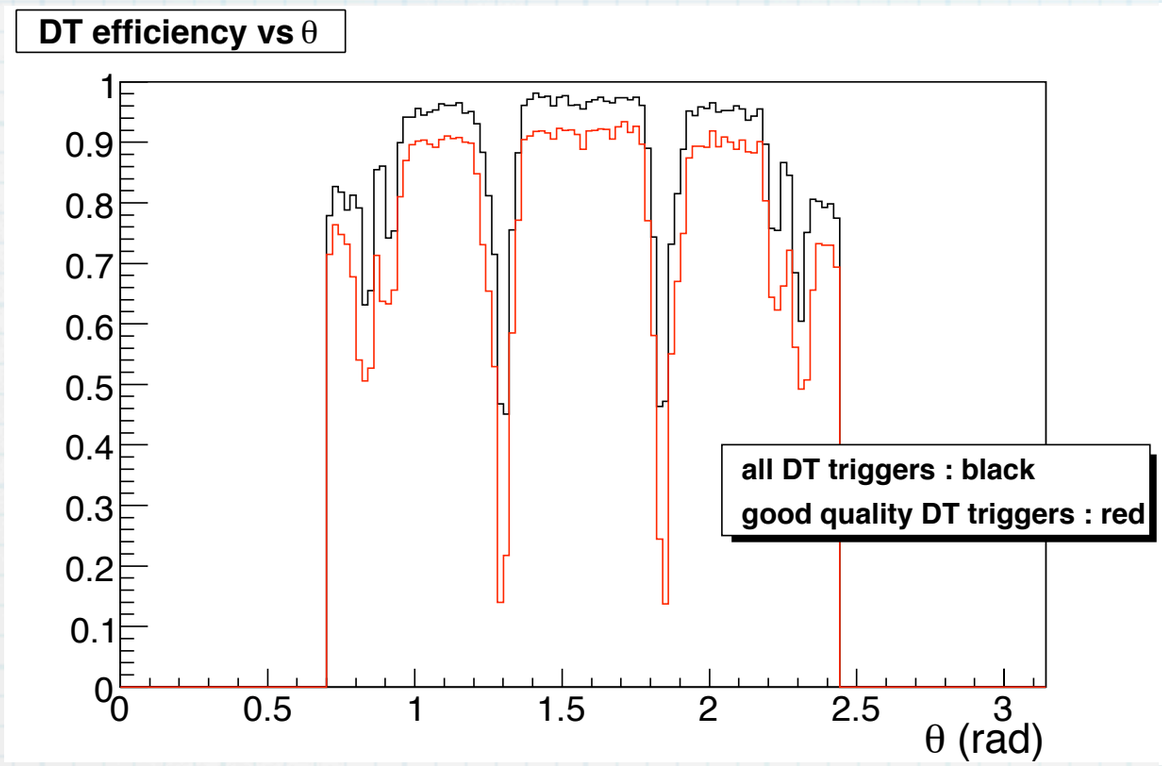
REVIEW OF WORK DONE TILL MAY WORKSHOP

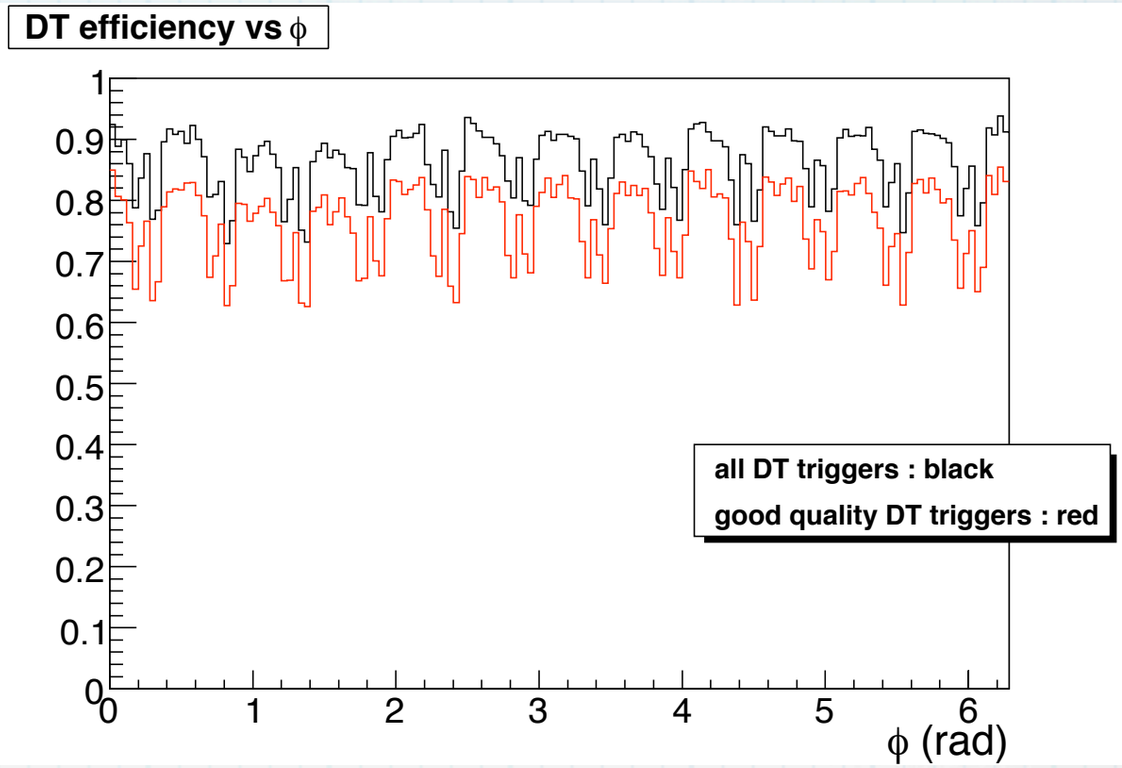
- Worked with Strawman B (CMSSW_1_8_4) using single muon samples
- Match of φ and θ in DT chambers
- Extrapolation to Strawman B layers
- Match with stubs of stacked layers

DT φ - θ MATCHING

- Associated trigger primitives within each muon station
- Decided a quality ranking
- Developed a cancellation policy for duplicates

DT φ - θ matching efficiencies



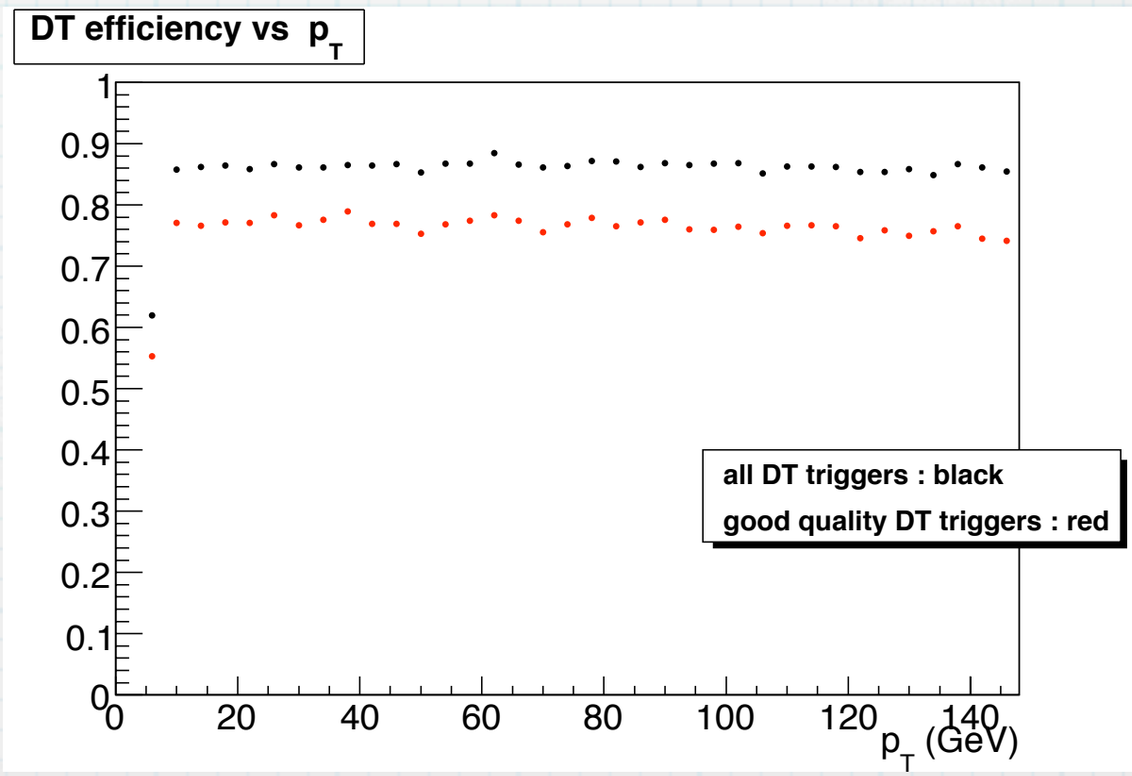


best match φ - θ efficiencies

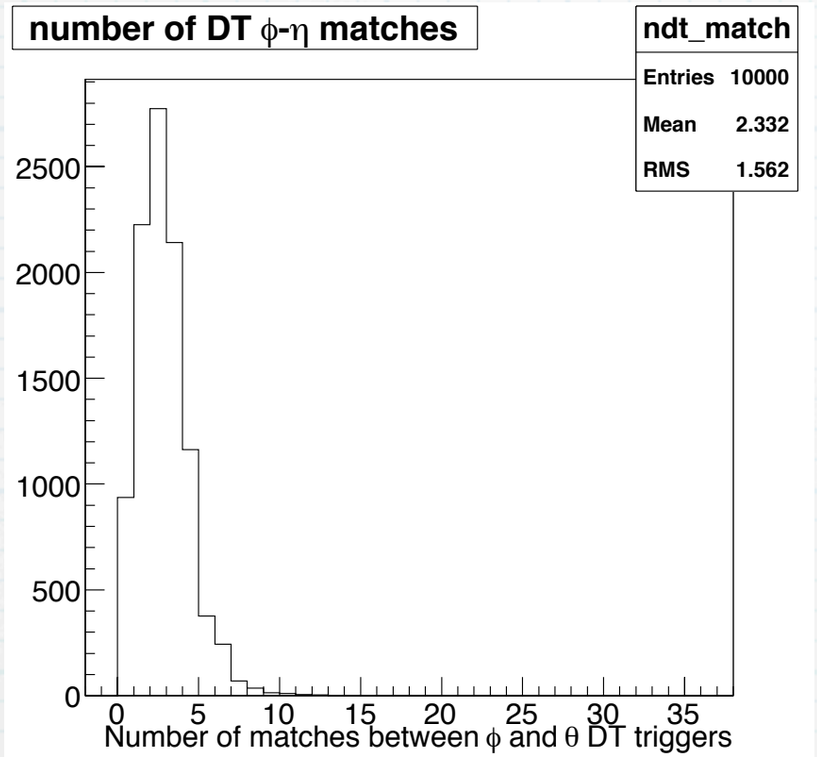
Inefficiency breakdown

* 6% only φ TPs
* negligible only θ TPS
* 4% only TPs at wrong bx
* 3% no TPs

Main efficiency loss due to cracks in θ



Multiplicities



Already many matches just with single muons

Origins:

- ghost triggers at wrong bx
- superposition of station 1 & 2
- second triggers due to mismatch or noise
- ambiguities if more than a TP in a station

Cancellation policy:

- duplicates deleted using ST1 & ST2 TPs compatibility comparison
- use of a 2D external coincidence
  - rejection of out of time ghost triggers
  - ambiguities rejection

The 2D coincidence could be used also to recover the φ only TPs (6%)

Cancellation of duplicates

Candidates are compared after extrapolation

1. Check 3 σ compatibility in position
2. Check 3 σ compatibility in bending angle
3. Reject lower quality candidates if both position and bending angle are compatible

Dimuons dead area
about 120 cm (15°) at 10 GeV
about 30 cm (4°) at 50 GeV

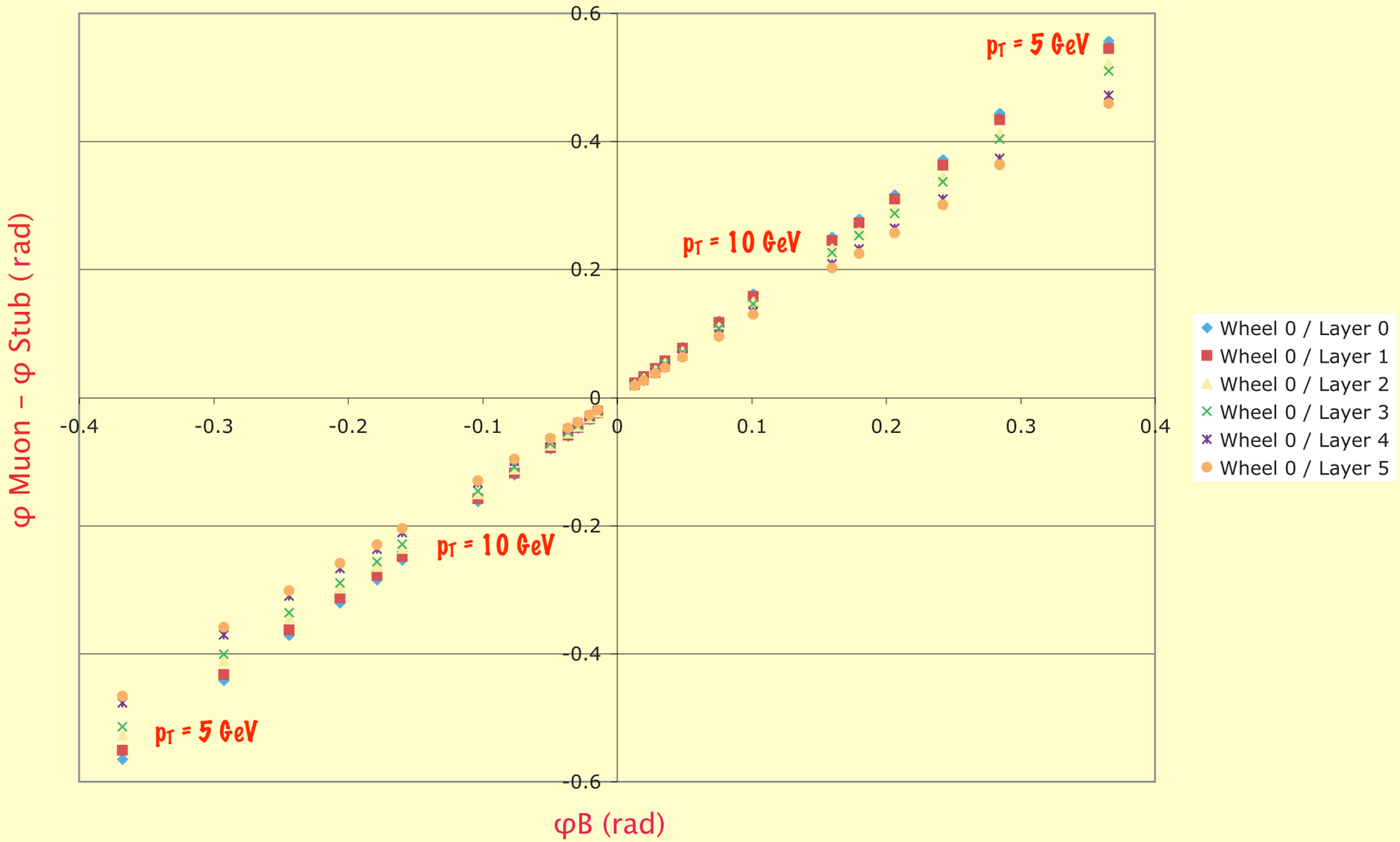
Second tracks and out of time TPs are not rejected

EXTRAPOLATION

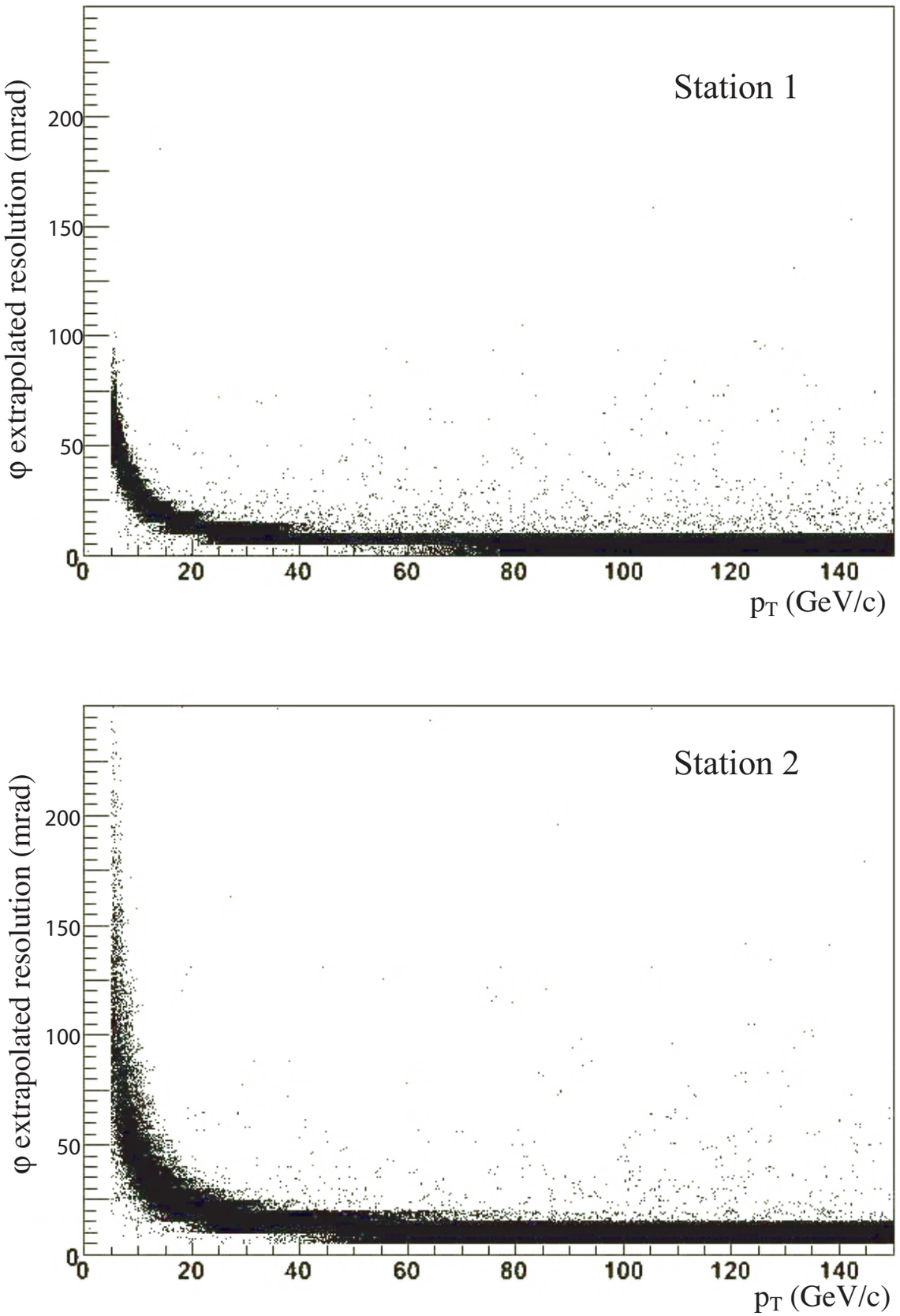
- extrapolate to tracker layers
- define the size of the search region around the extrapolated position
- create a list of tracker stubs inside the search reagion

The extrapolation done exploiting the linear relationship between the φ deviation (φ_μ -φ_{TK}) and φ_B

$$\varphi_{EXT} = \varphi_\mu - (m\varphi_B + q)$$



Line coefficients are computed by wheel/layer and digitized



φ search windows

The **resolutions** of DT Trigger Primitives are **dominated by multiple scattering**, showing a quadratic dependence on momentum

The size of the search window is given by error propagation on the extrapolation function

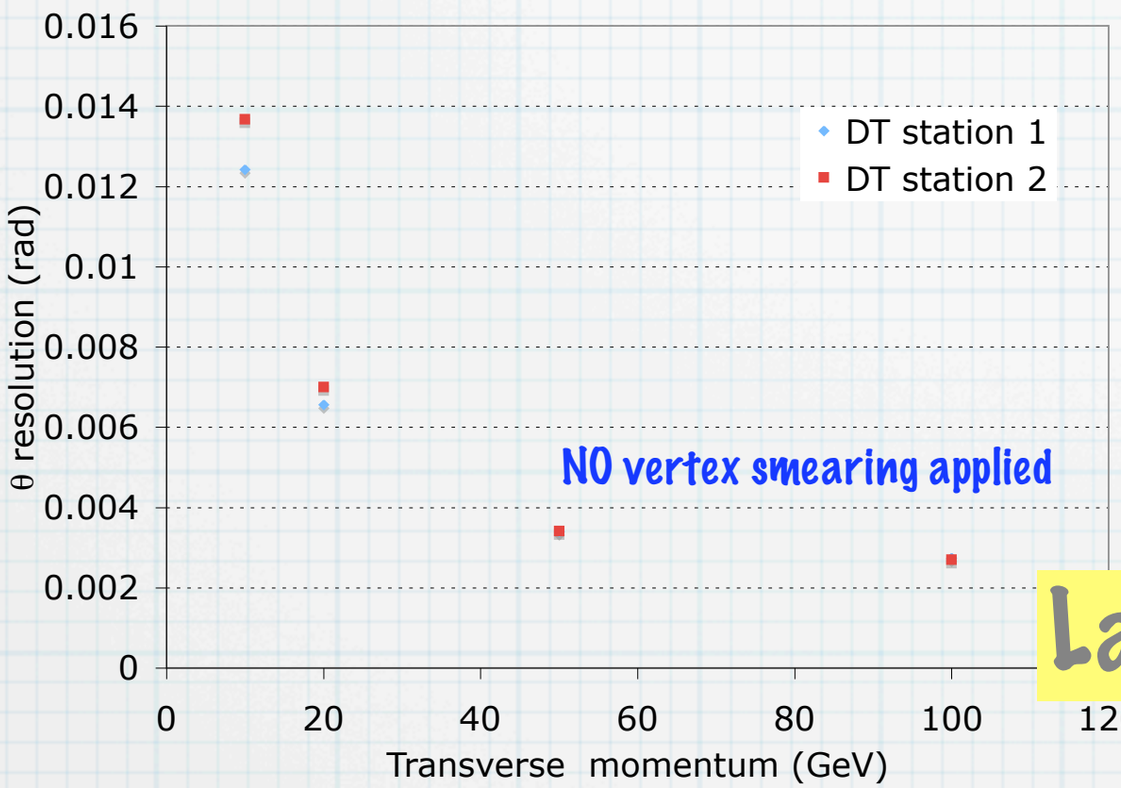
$$\sigma_{extr} = \sqrt{\sigma_{\varphi}^2 + m^2 \sigma_{\varphi_B}^2}$$

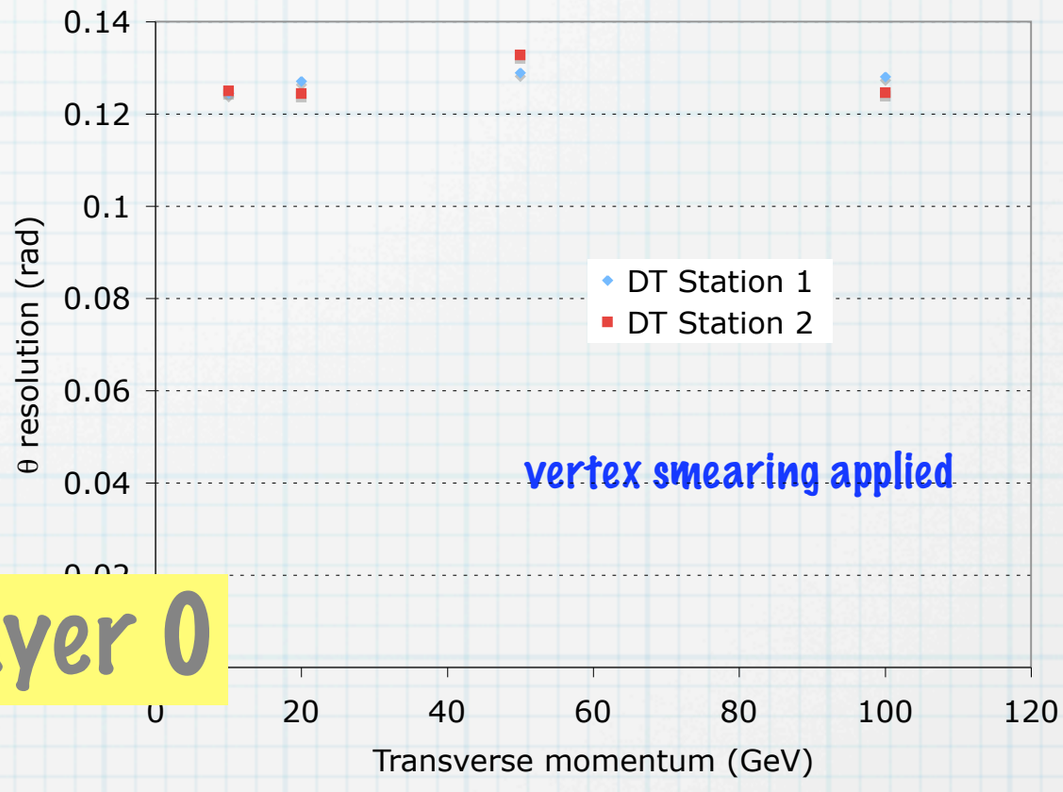
for a cut at 3 σ and Station 1

at 100 GeV ~ ±15 mrad

at 10 GeV ~ ±90 mrad

No extrapolation is needed in θ





Layer 0

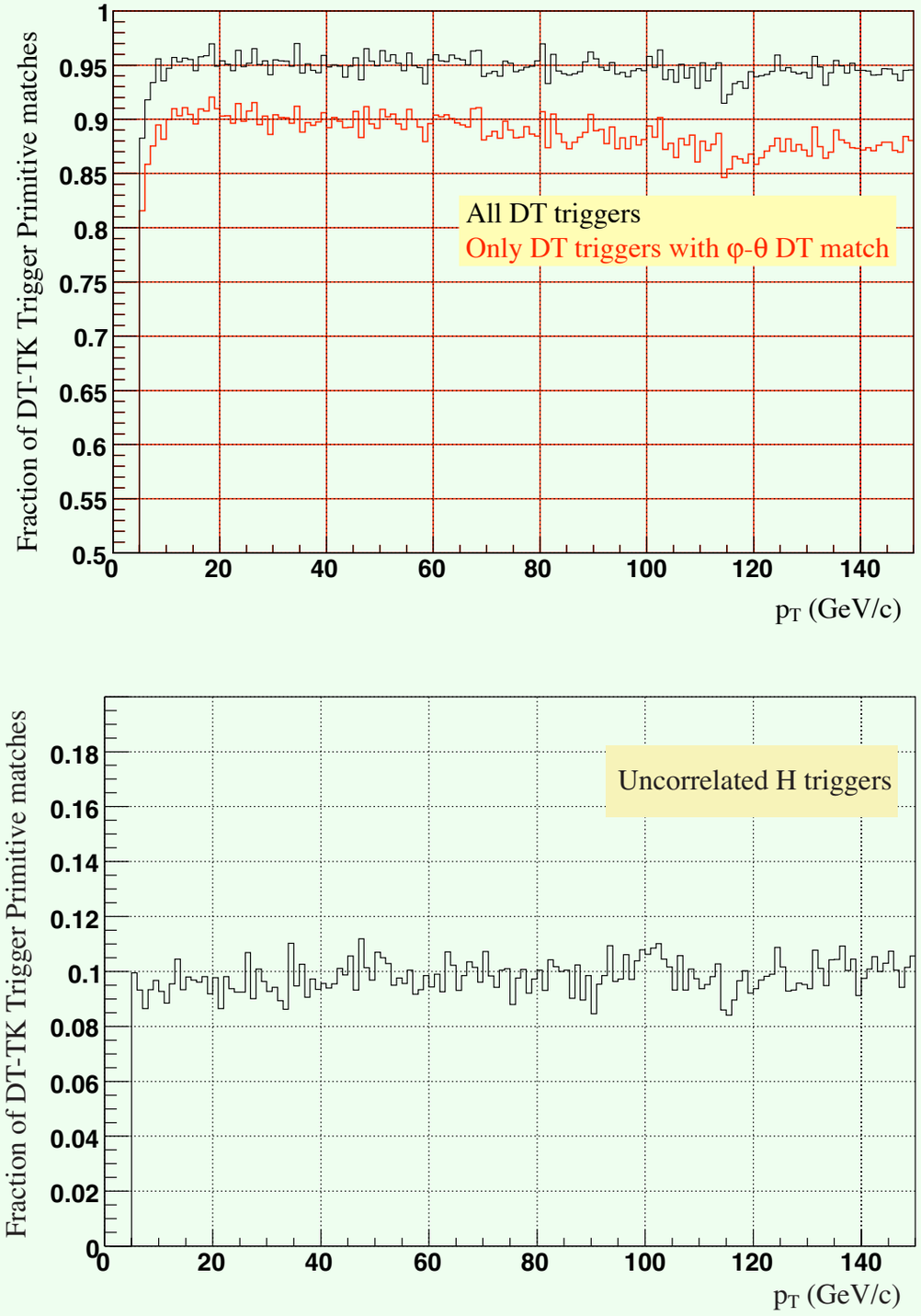
Resolution dominated by the uncertainty on z-vertex position of the collision

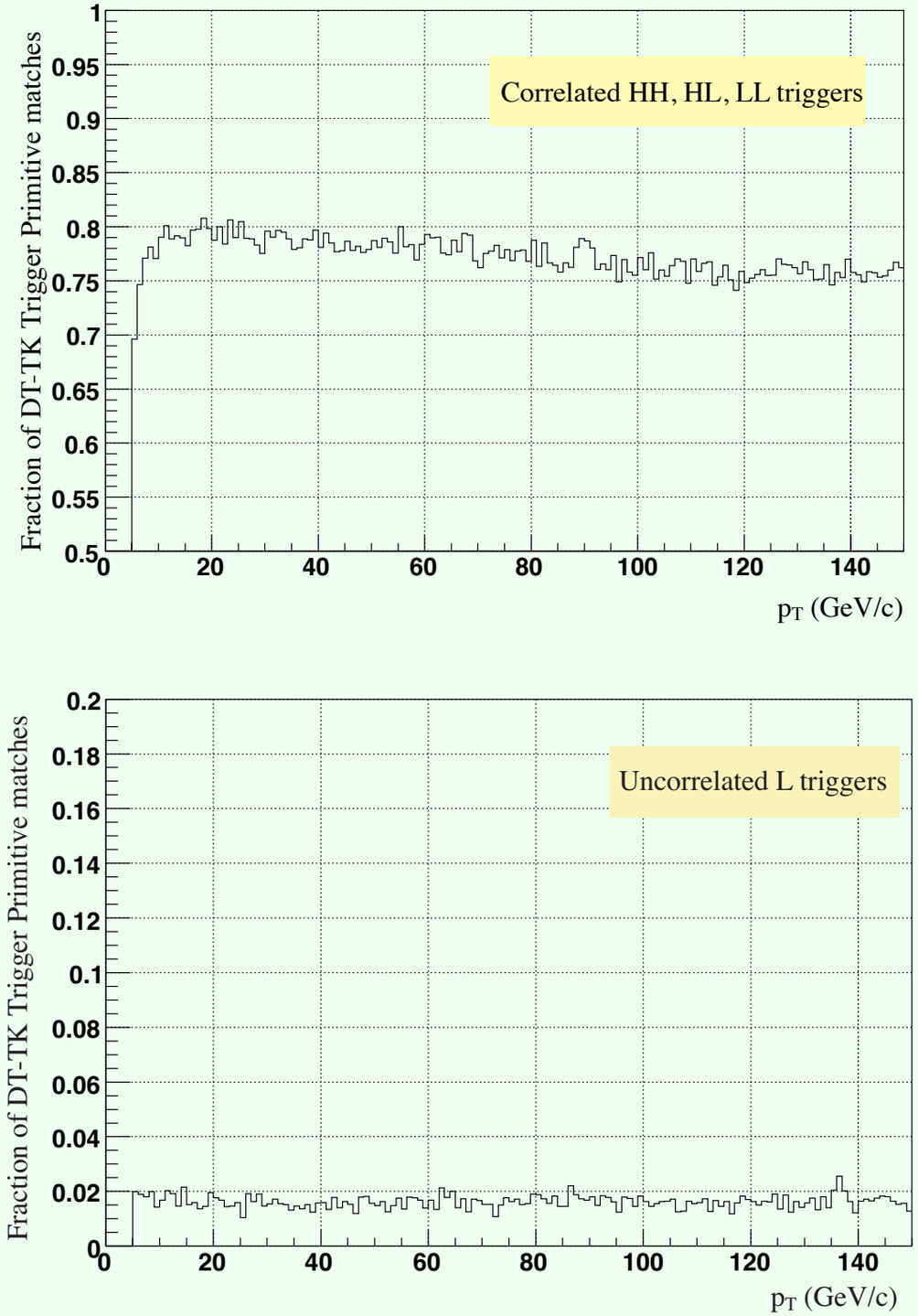
Size of matching window is

- independent of momentum
- dependent on tracker layer
- slightly dependent on barrel wheel

at r = 35 cm size is ± 300 mrad
at r = 55 cm size is ± 180 mrad
at r = 100 cm size is ± 90 mrad

DT -Tracker matching efficiencies

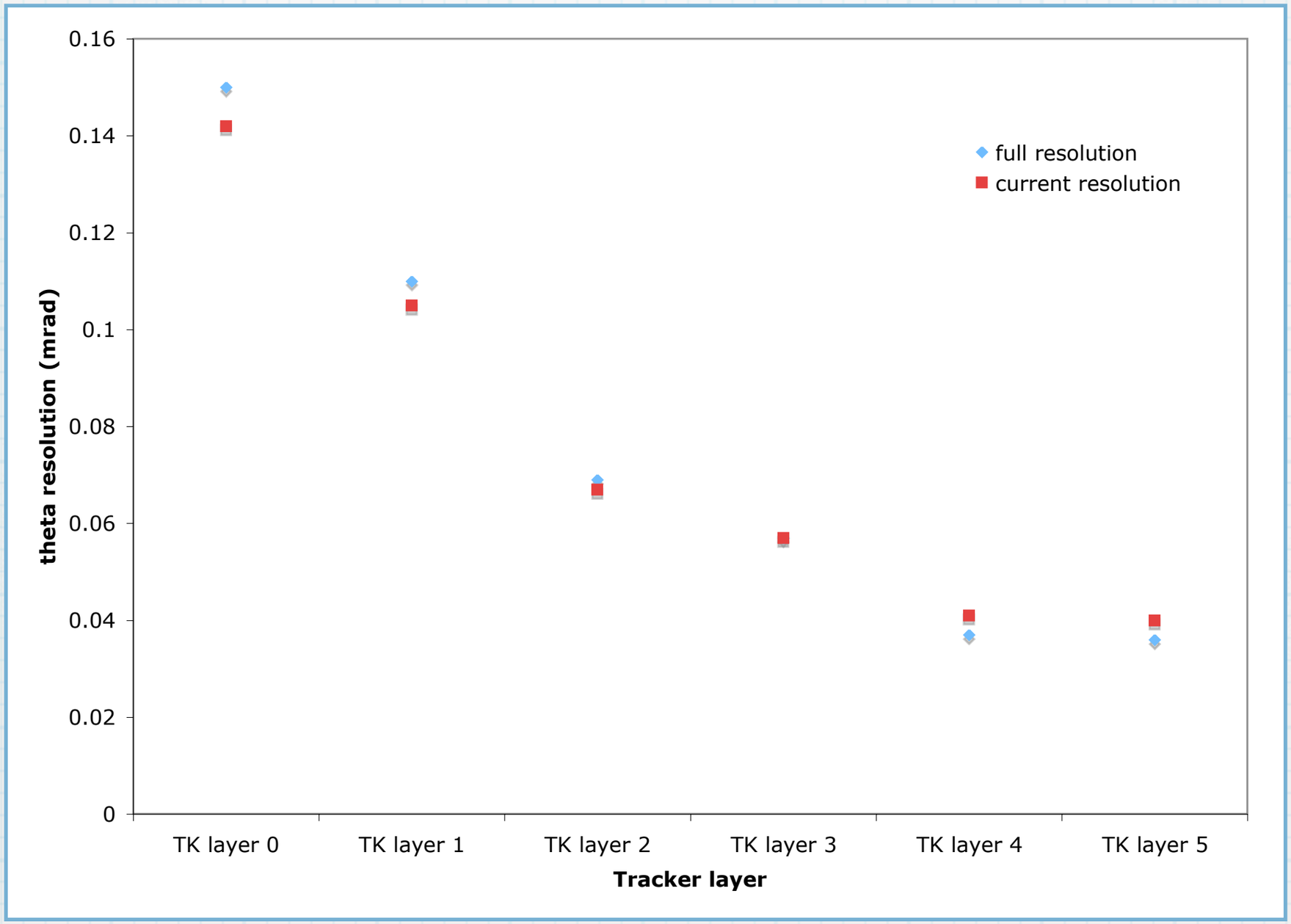




PROGRESS SINCE MAY WORKSHOP

- Studies with lower theta resolution
- First results on muon momentum measurement using matched stubs
- Upgrade to CMSSW_2_2_6
- Software for Strawman B released
- Transition to Long Barrel almost completed

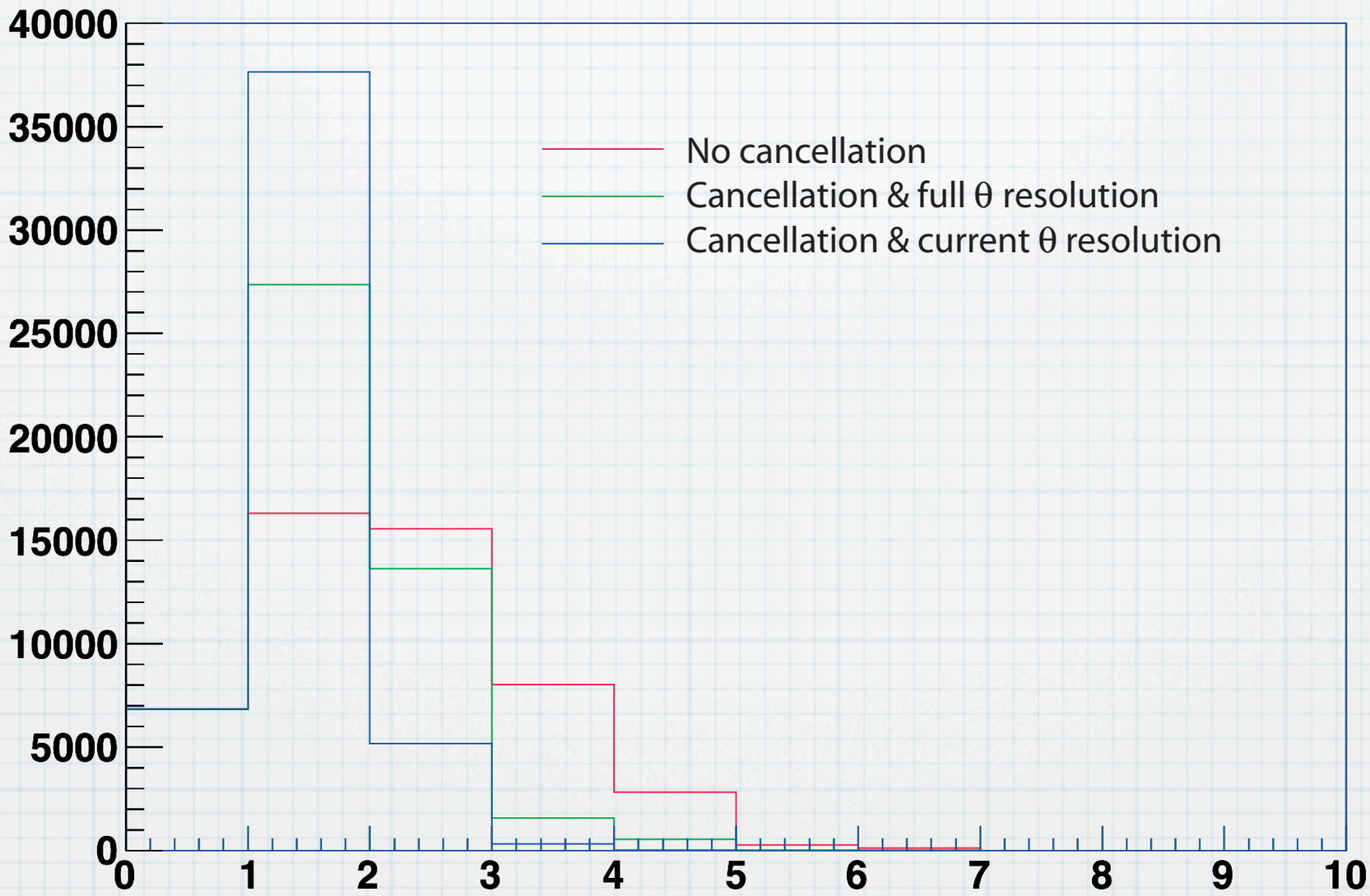
TPs in θ projection are currently OR-ed every 8 devices
Resolution worsens from ~1.5 mrad to ~ 40 mrad



Matching window size still dominated by z-vertex uncertainity

Worse resolution brings large benefit to duplicates reduction

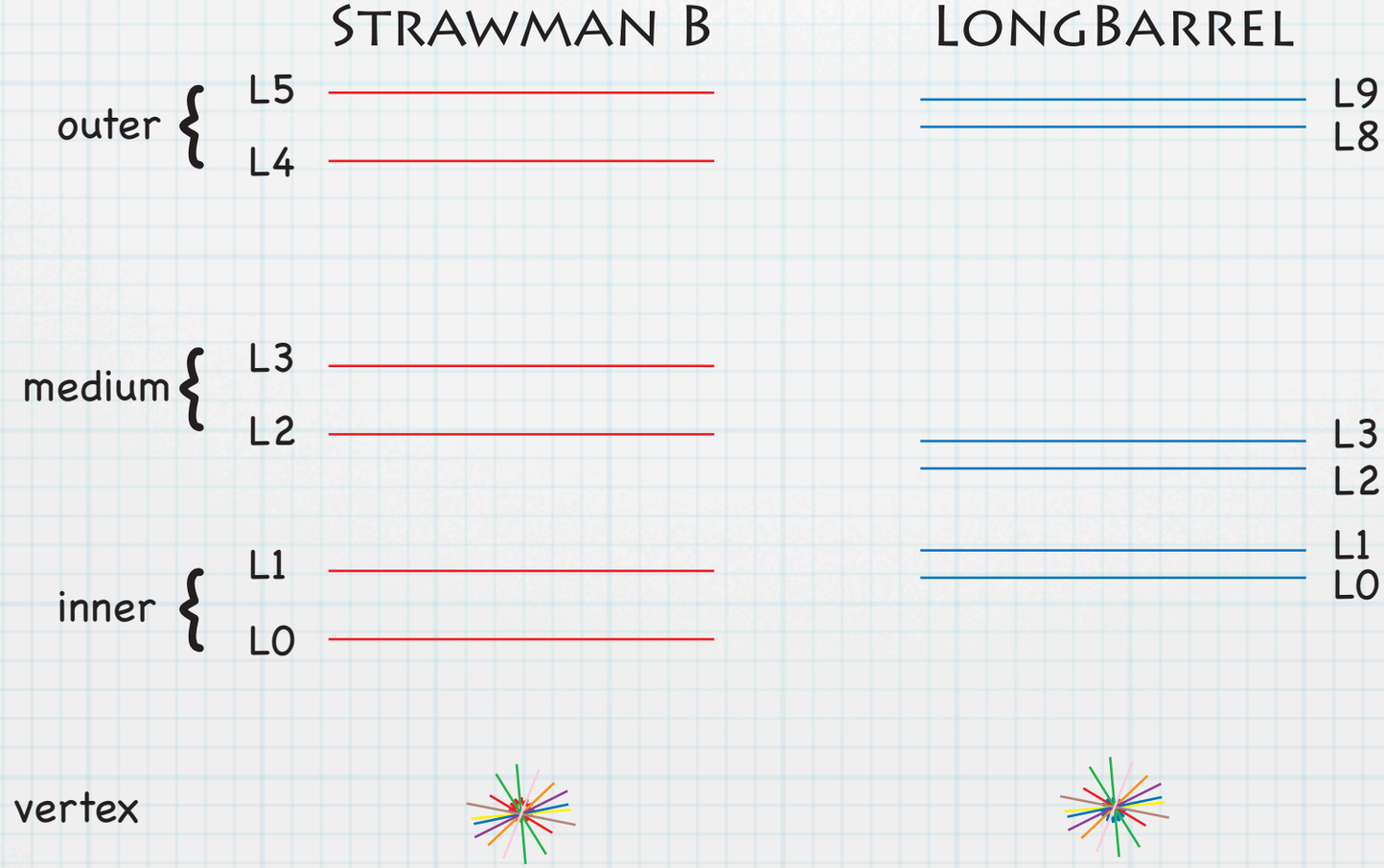
θ TPs may even not be needed if a 2D detector is added



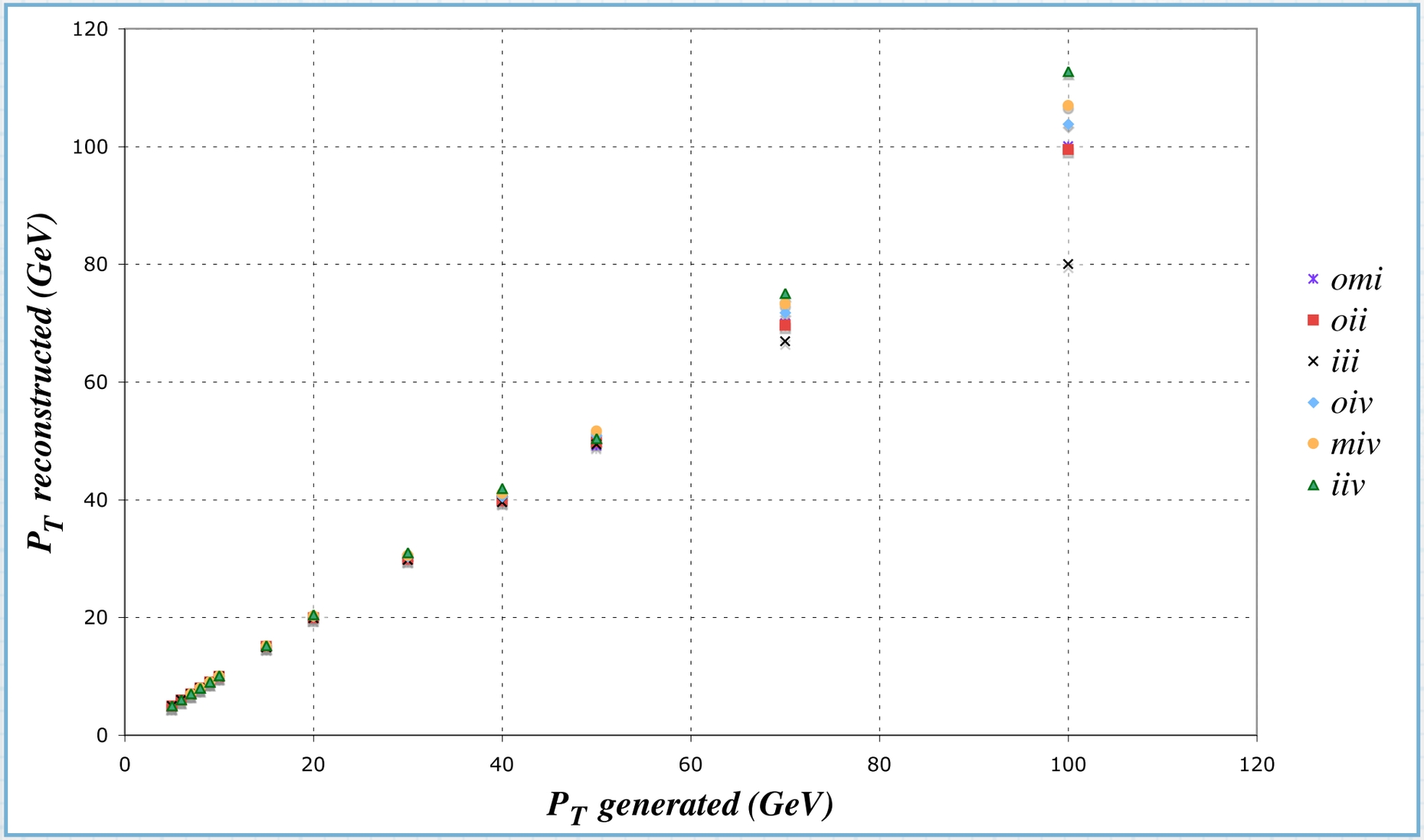
Number of φ – θ DT matched candidates per muon

Use matched stubs to estimate muon momentum

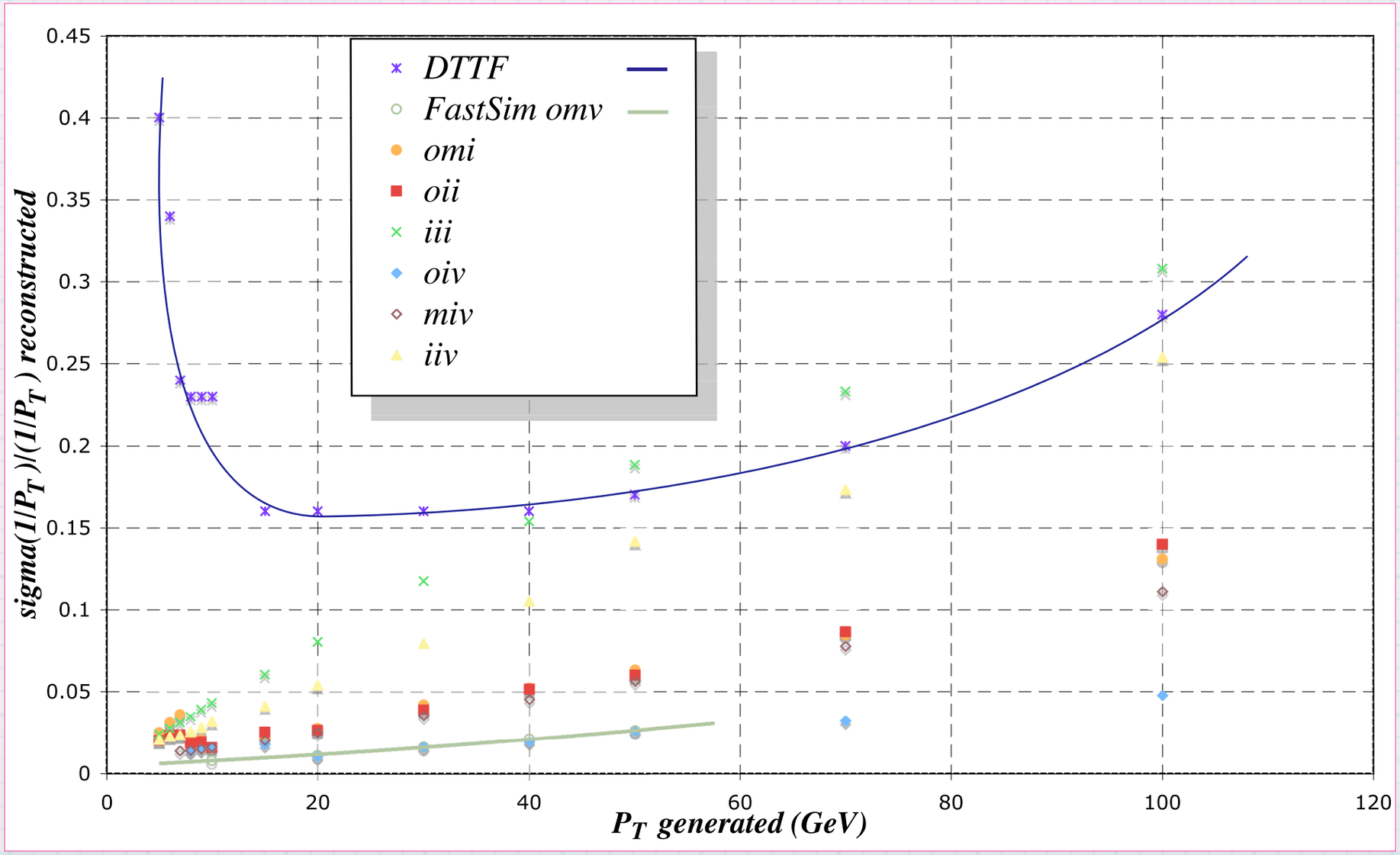
- Choose always stub closer to DT extrapolation
- Several choices compared
- Still using Strawman B



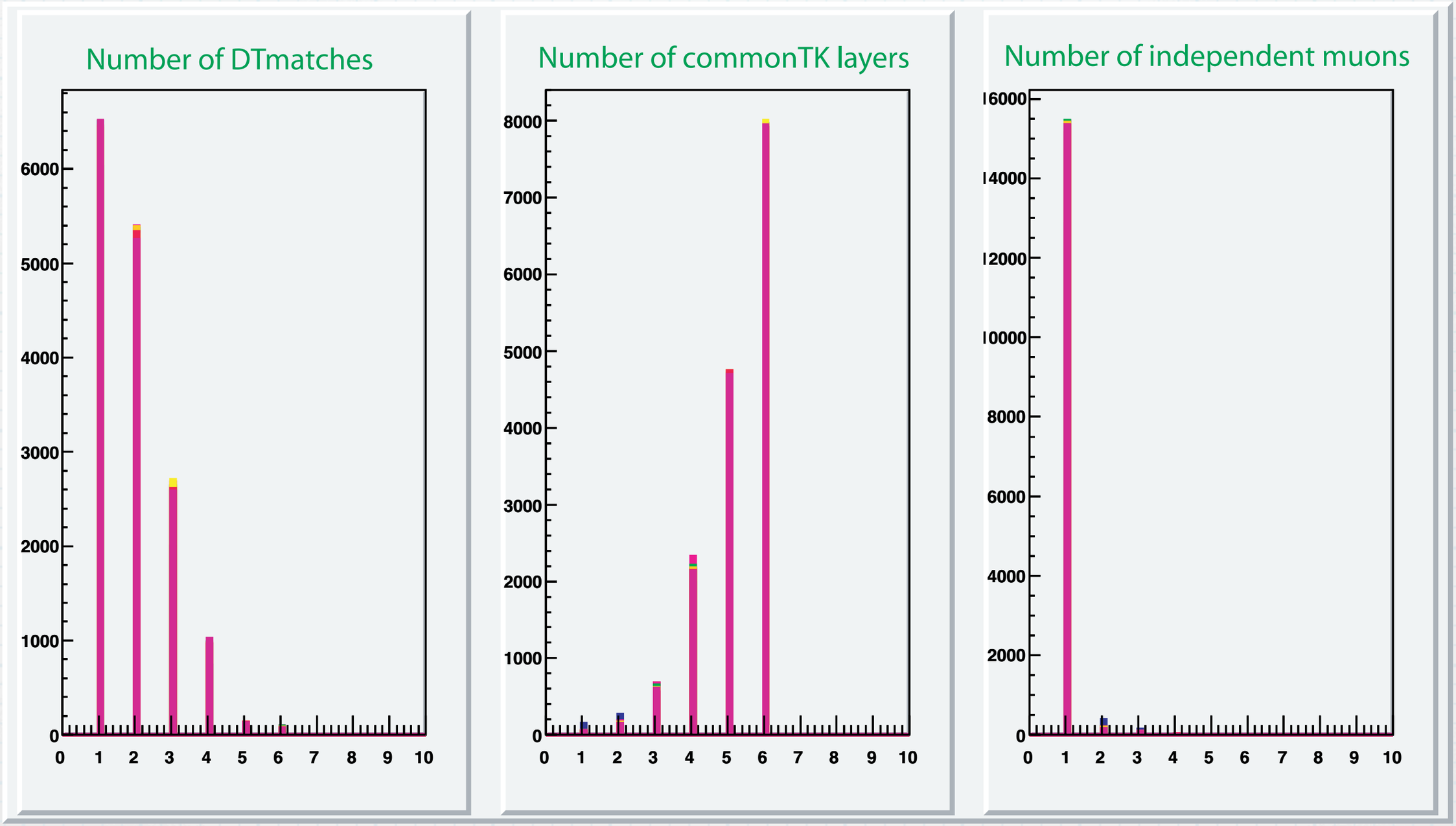
- Vertex inclusion systematically overestimates momentum
- Small lever arm underestimates momentum



- Large dependence on lever arm
  - ✳ innermost and outermost points position are driving result
  - ✳ middle point position almost negligible
- Vertex constraint really strong
  - ✳ should we dare to impose it? Caution needed with long lived particles ...
- Even small lever arm useful to improve resolution at low P_T
- Early FastSim results confirmed



First attempt to define a combined DT-TK muon
All muons with $\geq$ 3 common stubs



OUTLOOK

- Optimize cancellation algorithms
- Include new 2D detector
- Study combined DT-Tracker P_T calculation
- Start working with pile-up events