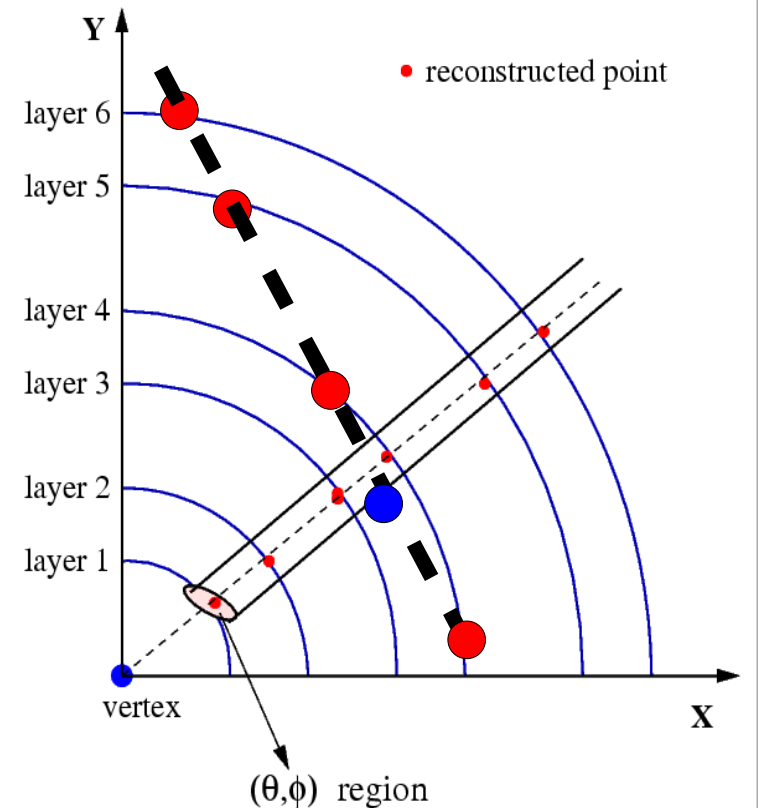# *ITS tracking for cosmics*

A. Dainese (INFN Legnaro)

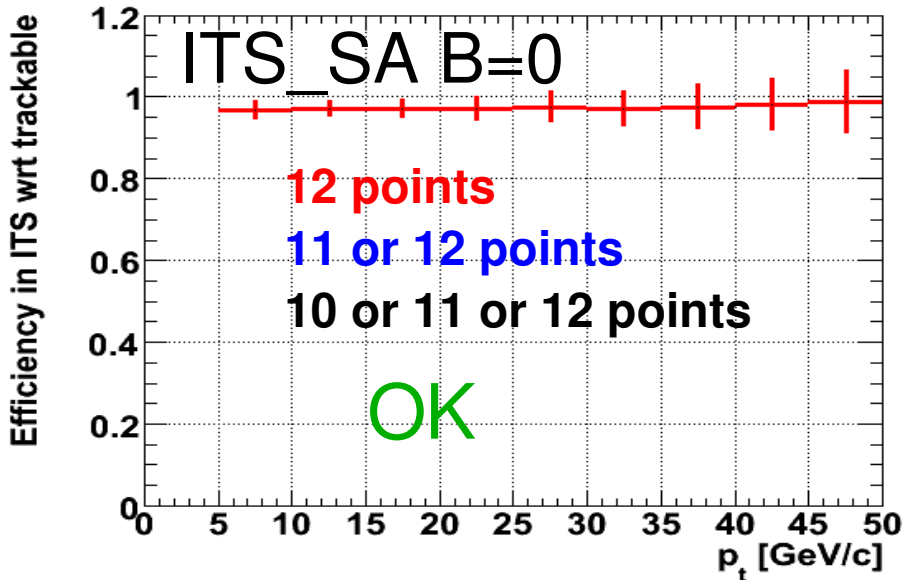# *Stand-alone tracking in ITS*

- Crucial at the beginning, when TPC may not be calibrated and will not be aligned with the ITS

- Cluster grouping (AliITStrackerSA)

- Track fit with KF from AliITStrackerMI

- Adapted for cosmics reco:

  - tracks not pointing to beam pipe

  - tracks cross only outer layers

- Procedure:

  - loop on layers (j) from 0 (SPD1) to 4 (SSD1)   **NEW FEATURE**

    - enabled via AliReconstruction::SetOption("ITS","cosmics")

  - starts from "fake" vertex and layer j, goes outward

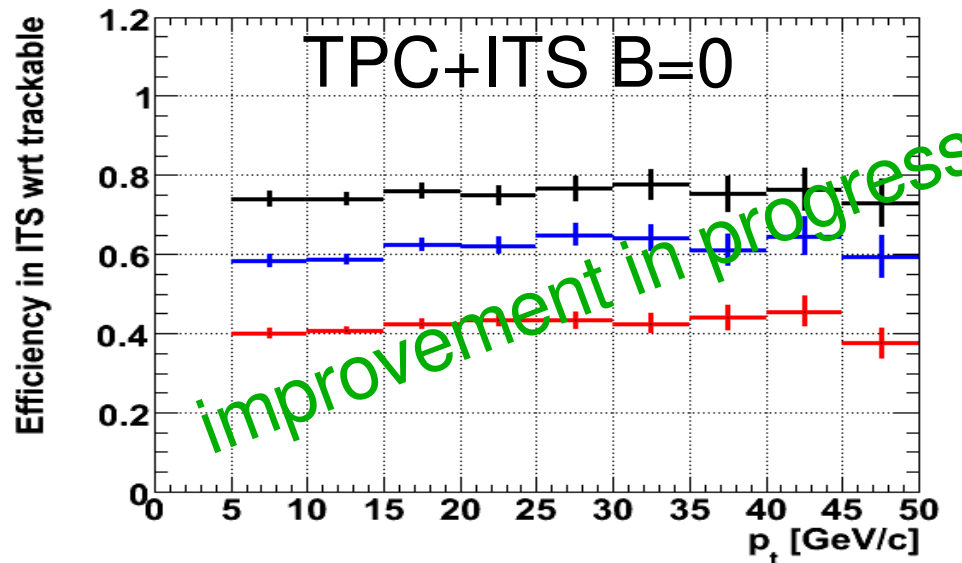 - will find 2 tracks per cosmic muon (not merged at tracking level)

Efficiencies: ITS_SA vs TPC+ITS
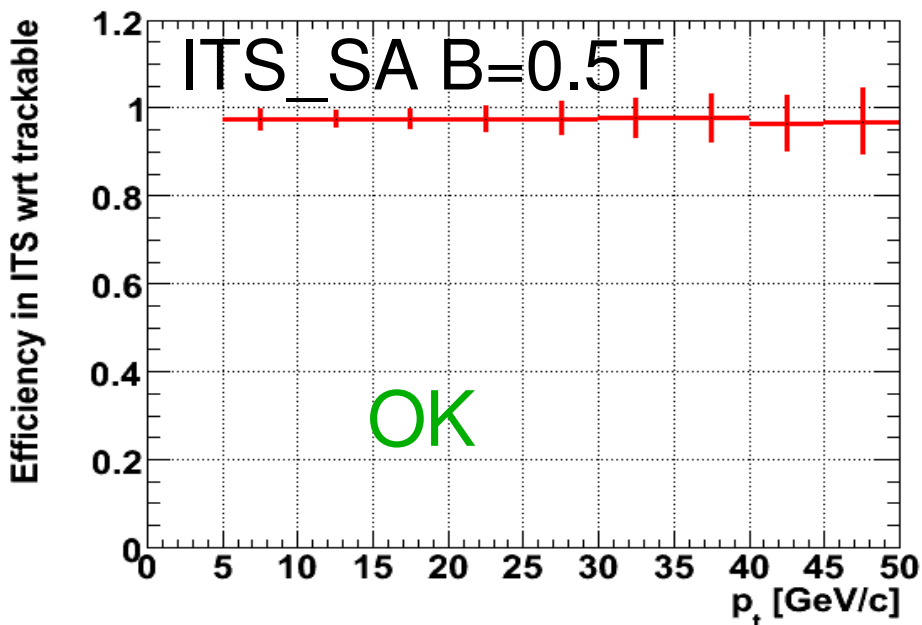
cosmics that cross all 6 layers and produce 12 clusters

Efficiencies: ITS_SA (B=0)
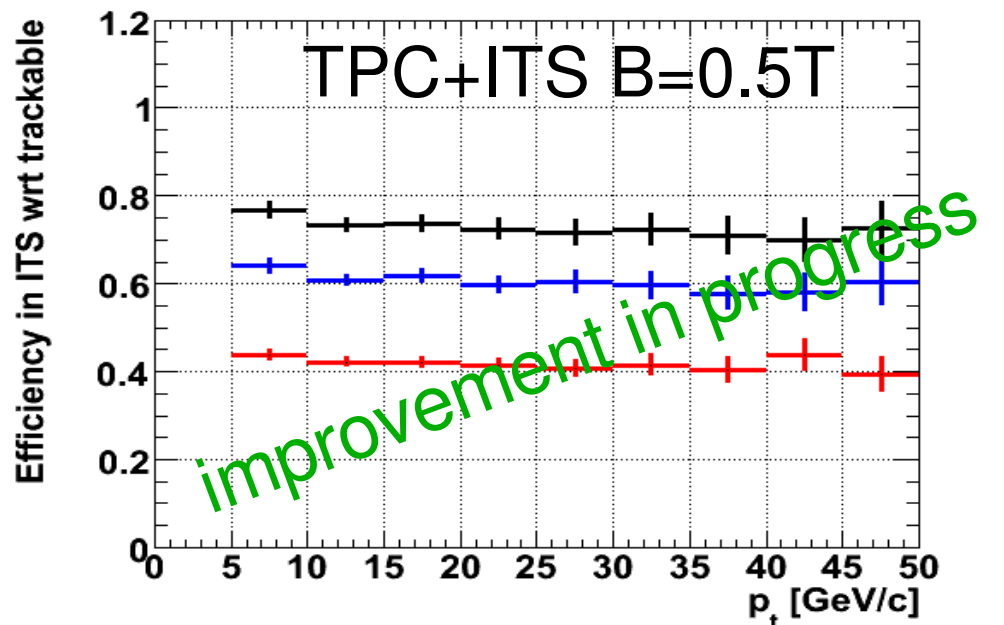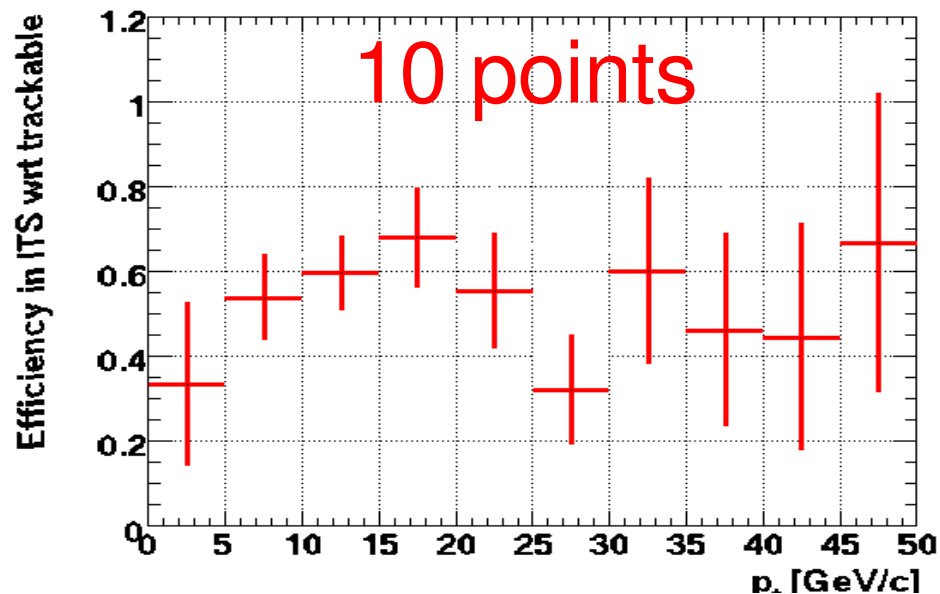
cosmics that do not cross all ITS layers

inward & outward tracks

10 points

inward & outward tracks

8 points

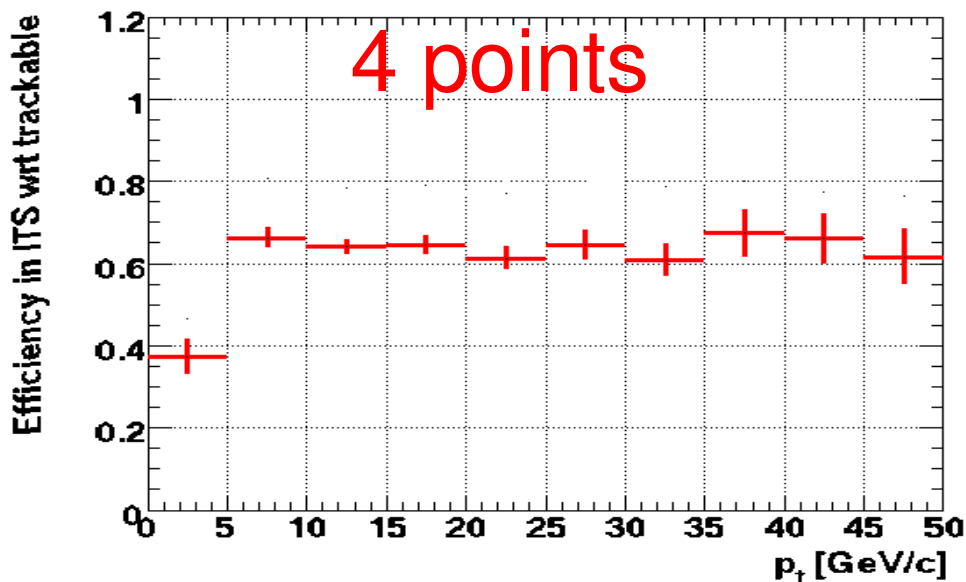inward & outward tracks

6 points

inward & outward tracks

4 points

Realistic misalignment: Motivation

- Up to now ITS misaligned only at the level of its 2198 sensitive volumes and by "small" amounts

    – acceptable for the "residual" misalignment (what remains after realignment)

    – not realistic for the "full" (initial) misalignment

	SPD (r = 4 & 7 cm)	SDD (r = 14 & 24 cm)	SSD (r = 39 & 44 cm)
nom. resolutions $x_{loc} \times z_{loc}$ [μm^2]	12 × 120	38 × 20	20 × 830
full mis. (shifts) $x_{loc} \times y_{loc} \times z_{loc}$ [μm^3]	20 × 20 × 20	45 × 45 × 45	30 × 30 × 100
residual mis. (shifts) $x_{loc} \times y_{loc} \times z_{loc}$ [μm^3]	10 × 10 × 20	20 × 20 × 20	15 × 15 × 100
rotations (mrad) around $x_{loc}, y_{loc}, z_{loc}$	0.3	0.3	0.3

Towards a realistic misalignment

1) Misalignment should follow hierarchy of hardware structure; each level should be misaligned

- e.g. for SPD:

    barrel/half-barrel/sector/half-stave/ladder

    (up to now only ladder misaligned)

2) Magnitude of misalignments should be realistic

- input from hardware people

3) Misalignments at the same hierarchical level should be correlated (still to be done)

MakeITSRealisticMisAlign.C

- Macro prepared with Ludovic, along the lines of MakeITSresMisAlign.C
  - input from Domenico, Massimo, Bjorn, Alberto, Raffaele, Adriano, Sandra, Marcello, Enrico ...

- Macro and helper class AliITSMisalignMaker committed in ITS

- Hierarchic misalignment required changes to the ITS geometry (introduction of new alignable volumes)

Realistic misalignment: numbers

- ITS (as a whole): numbers to be decided (~ mm)

- SPD barrel (w.r.t. ITS)

  - x, y, z: Gauss 3σ = 1 mm

  - ψ, θ, ϕ: Gauss, so as to have shifts with 3σ = 500 μm at the extremes

- SPD half-barrels (w.r.t. barrel)

  - x, y, z: Gauss 3σ = 200 μm

- SPD sectors (w.r.t. half-barrel)
  - ψ, θ, ϕ: Gauss, so as to have shifts with 3σ = 100 μm at the extremes
  - local x (~glob rϕ), y (glob r), z (glob z): Uniform [-Δ,Δ], Δ = 50, 100, 100 μm

  - ψ, θ, ϕ: ...

- SPD half-staves (w.r.t. sector)

  - local x, y, z: Uniform [-Δ,Δ], Δ = 20, 100, 20 μm

  - local ψ, θ, ϕ: ...

- SPD modules (w.r.t. half-stave)

  - local x, y, z: Gauss 3σ = 10, 50, 10 μm

  - local ψ, θ, ϕ:

Realistic misalignment: numbers

- SDD layers (w.r.t. ITS) - ?

- SDD ladders (w.r.t. layer) - Torino

    - local x, y, z: Gauss 3σ = 5, 5, 5 μm

    - local ψ, θ, ϕ: 0

- SDD modules (w.r.t. ladder) - Torino

    - local x, y, z: Gauss 3σ = 45, 45, 105 μm

    - local ψ, θ, ϕ: 0

- SSD layers (w.r.t. ITS) - ?

- SSD ladders (w.r.t. layer) - Trieste

    - local x, y, z: Gauss 3σ = 5, 5, 5 μm (tbc)

    - local ψ, θ, ϕ: 0 (tbc)

- SSD modules (w.r.t. ladder) - Trieste

    - local x, y, z: Gauss 3σ = 50, 50, 50 μm (tbc)

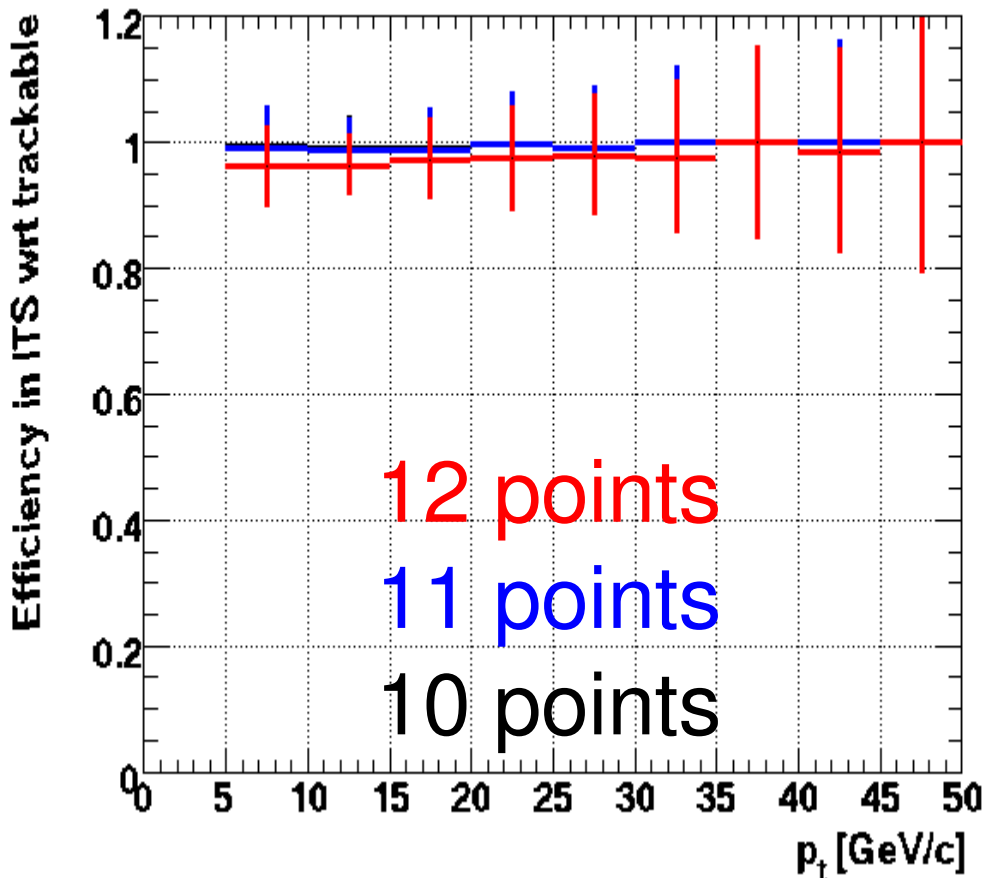   - local ψ, θ, ϕ: 0 (tbc)

Efficiency: ITS_SA (B=0) with realistic ITS misalignment

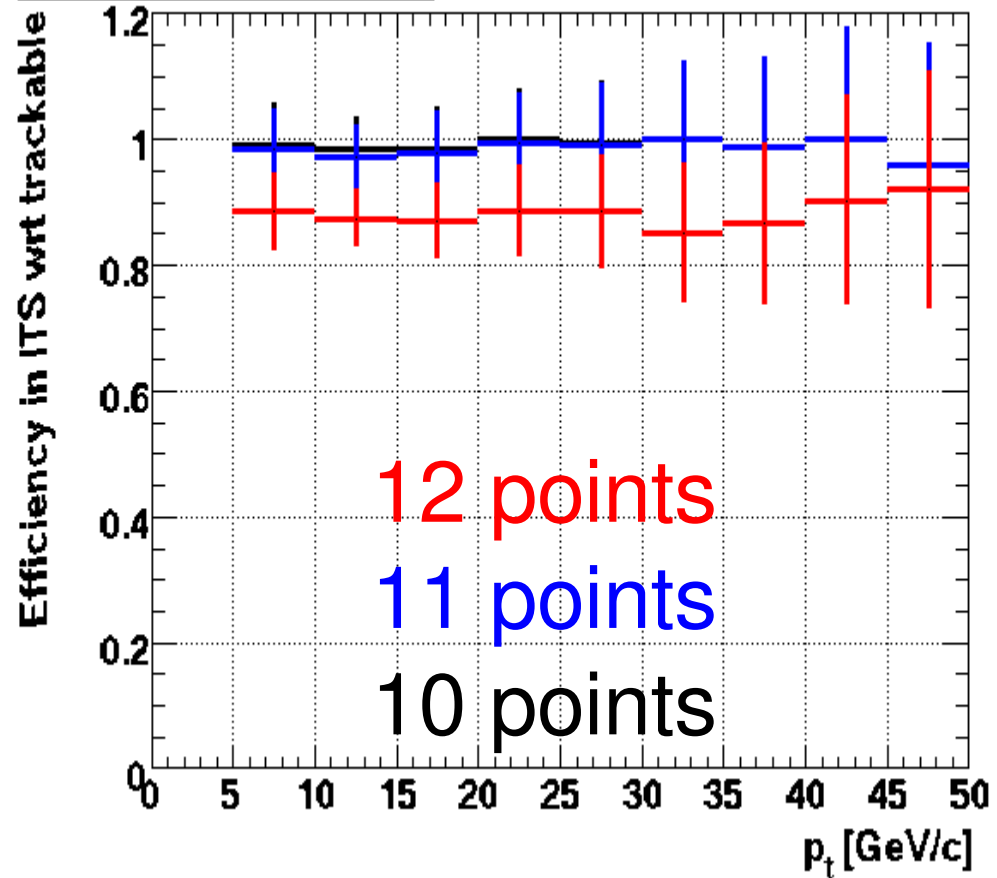cosmics that cross all 6 layers and produce 12 clusters

null misalignment

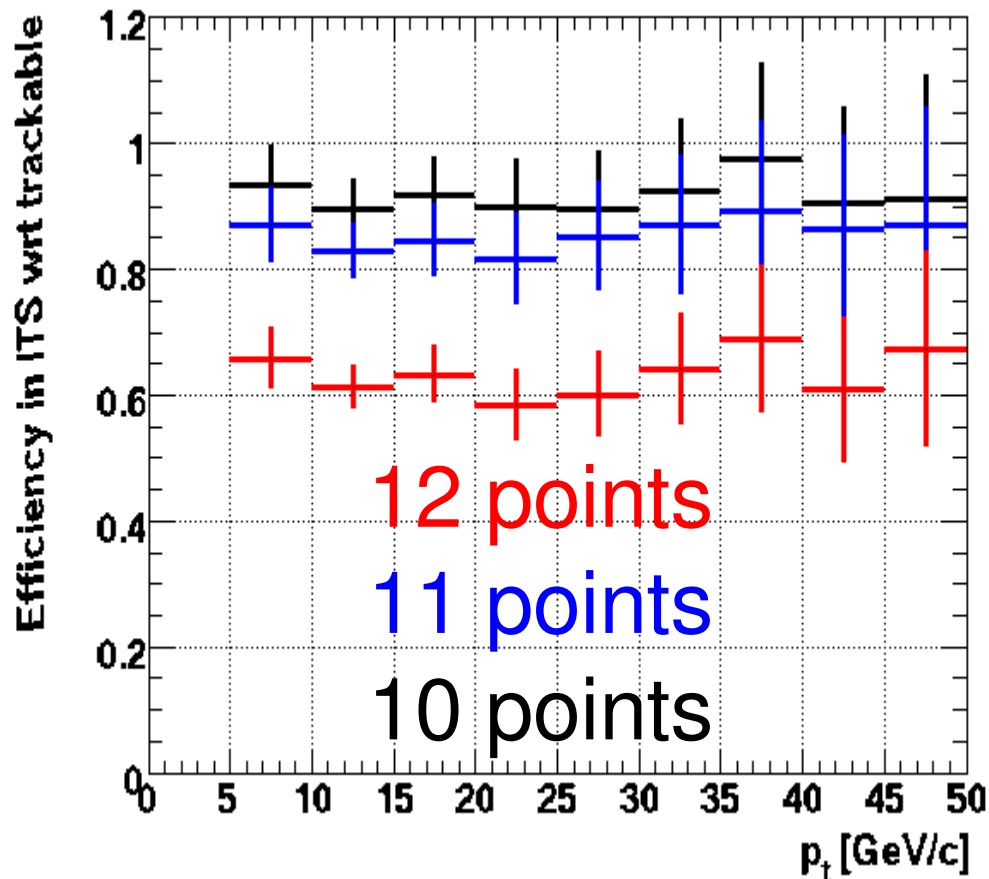## realistic misalignment

Efficiency: TPC+ITS (B=0) with realistic ITS misalignment

cosmics that cross all 6 layers and produce 12 clusters

null misalignment   realistic misalignment
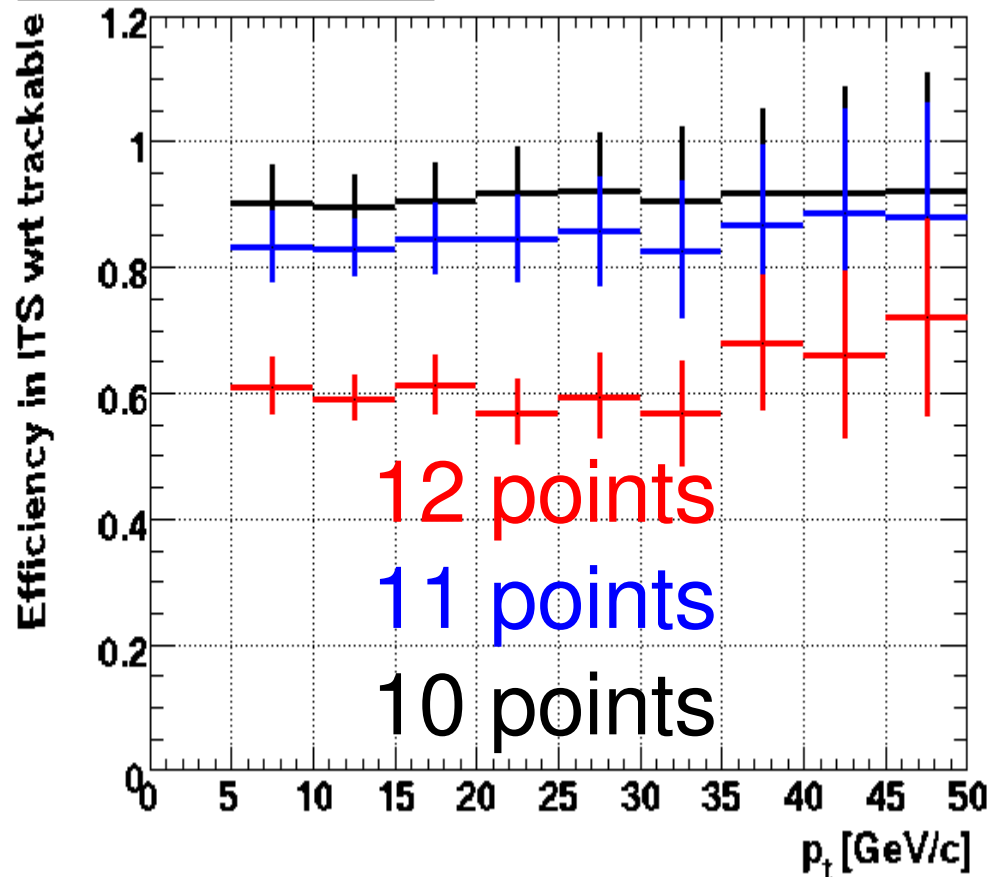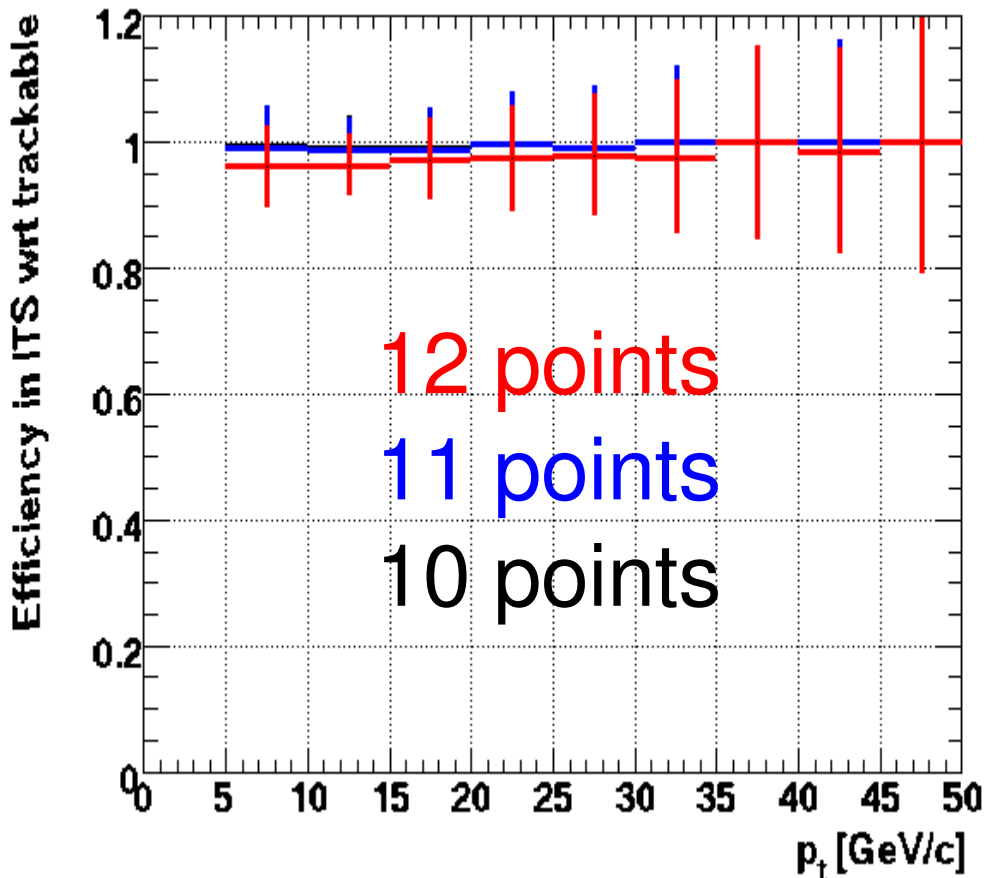
Extreme ITS misalignment

- Goal: push misalignment till the efficiency drops

- Then, find a way to recover it: special set of loose cuts for the tracking

- Use same macro and parameters ranges (σ), but sample values only between 2σ and 3σ

- Example: SPD half-staves

Efficiency: ITS_SA (B=0) with "extreme" ITS misalignment
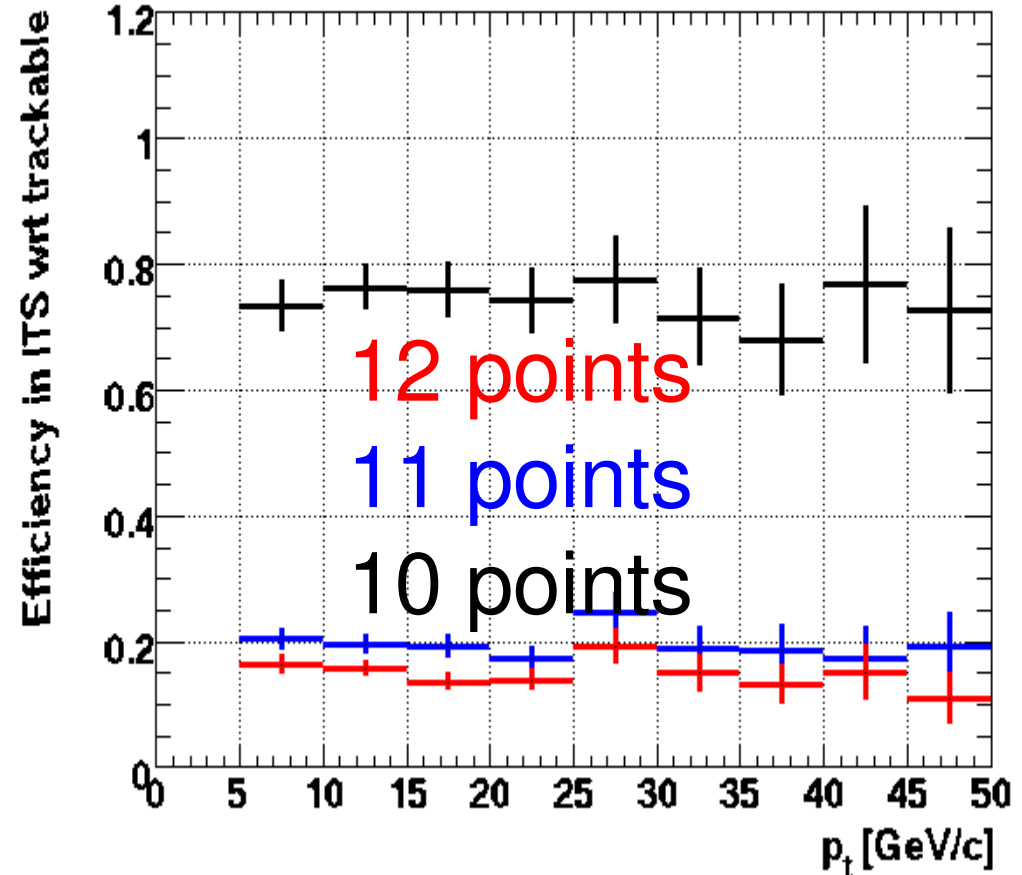
cosmics that cross all 6 layers and produce 12 clusters

Summary

- ITS-peripheral cosmics needed for alignment

- AliITSVertexerCosmics and AliITStrackerSA adapted to reconstruct also cosmics that cross only outer ITS layers

- Code for realistic ITS misalignment is on CVS

  – hierarchical misalignments

  – realistic numbers from hardware experts

  – can be modified to apply correlated misalignments

- (Surprinsingly) small effect on tracking efficiency: ~10% loss of points on SPD1

  – larger loss for "extreme" scenario

    - need to find set of cuts for tracking to recover efficiency even in this case