Plan for next months

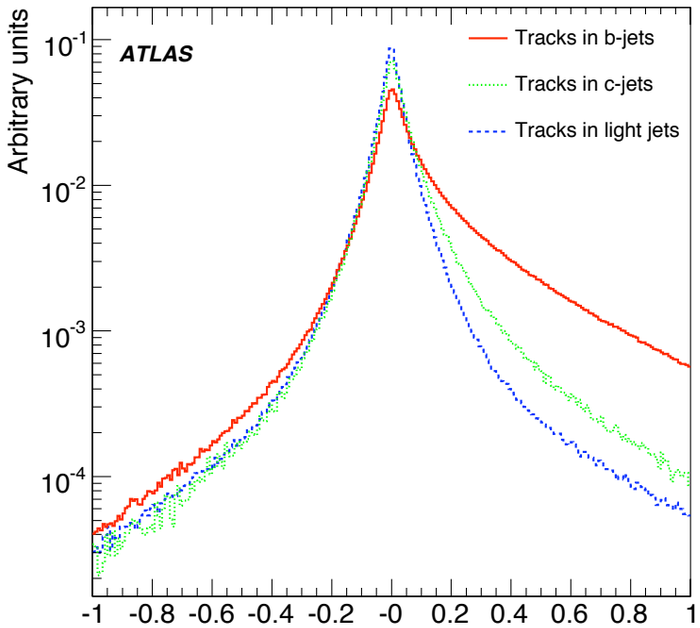
Simone

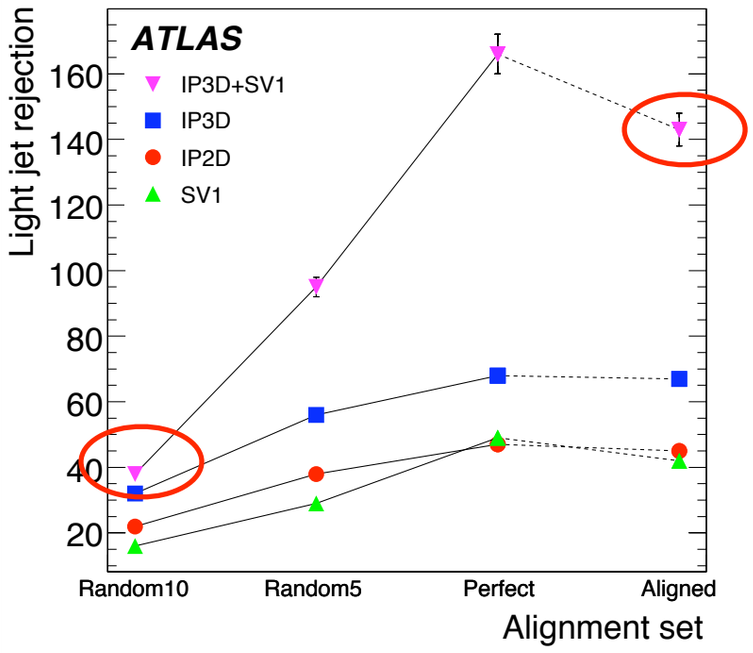
General schema

* motivation
* b-tagging
* tracking performance
* top physics
* service work

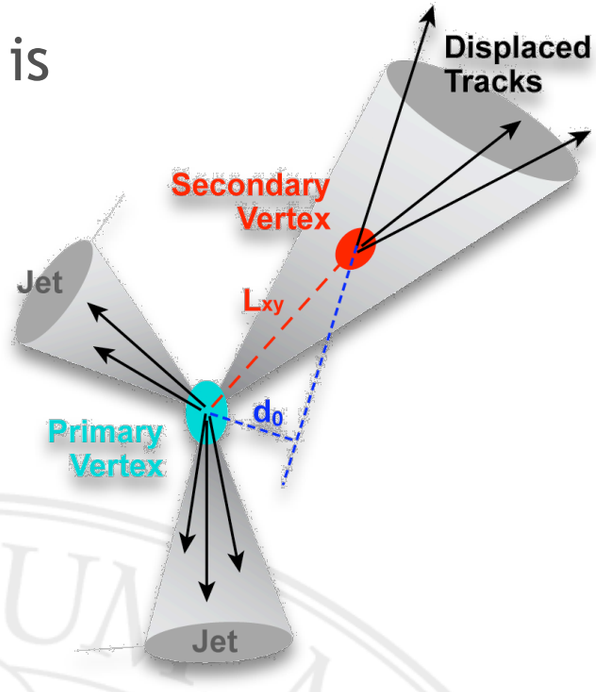
Tracking system and *b*-tagging

Motivation





- Typical task involving the tracking system is the tagging of short-living particles
  - track impact parameter (d_0) measurement
  - secondary vertex reconstruction
- *b*-tagging applies to discriminate hadrons containing *b* quark
  - interesting in the case of top quark event selection
    - ×12 improvement in S/B ratio for top pair event selection
  - heavily influenced by tracking performance
    - ÷3.5 degradation in light jets rejection if ~10 μm misalignments



Events with one muon

Sample	default	*W* const.	*W* const. + 1 b-tag	*W* const. + 2 b-tag
$t\bar{t}$	3274	1606	403	280
hadronic $t\bar{t}$	35	17	5	2
W+jets	1052	319	11	0.0
single top	227	99	19	10
$Z \rightarrow ll$ +jets	84	23	0.5	0.0
$W\, b\bar{b}$	64	19	5	2
$W\, c\bar{c}$	26	9	0.1	0.0
$W\, W$	7	3	0.0	0.0
$W\, Z$	7	3	0.0	0.0
$Z\, Z$	0.7	0.3	0.0	0.0
Signal	3274	1606	403	280
Background	1497	495	42	14
S/B	2.2	3.2	9.6	20.1

The ATLAS collaboration. Expected Performance of the ATLAS Experiment - Detector, Trigger and Physics. CERN-OPEN-2008-020.

b-tagging I

- Two main ingredients in b-tagging:
  - vertex reconstruction
  - impact parameter resolution
- JetProb will be used on first data to "tag" jets:
  - probability that each track in the jet originates from primary vertex is computed:

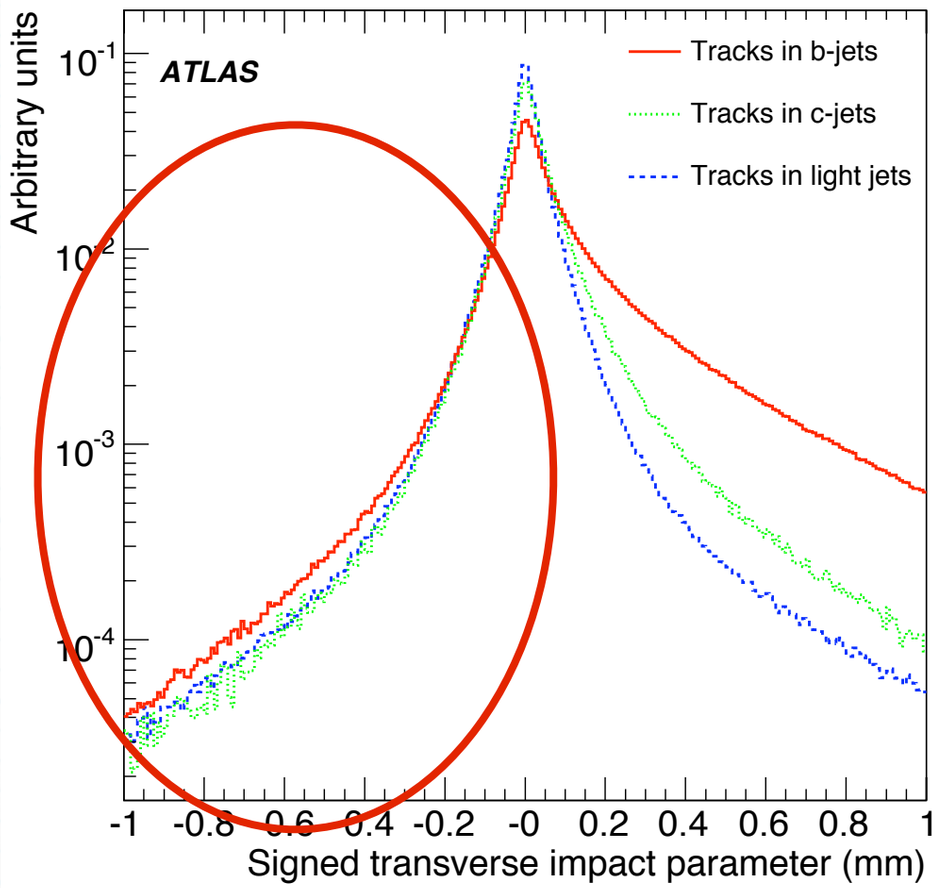
$$\mathcal{P}_i = \int_{-\infty}^{-|d_0/\sigma(d_0)|} \mathcal{R}(x)\mathrm{d}x$$

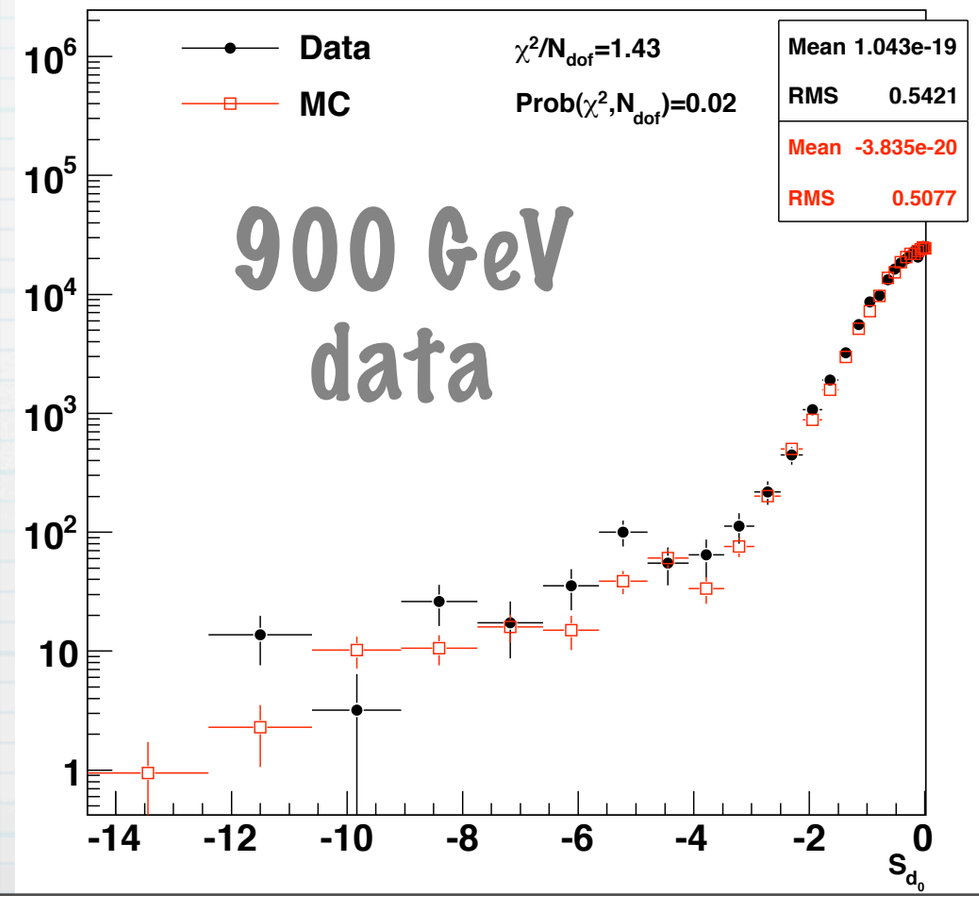
Resolution function for prompt tracks

  - the probability for all tracks in a jet is combined

b-tagging II

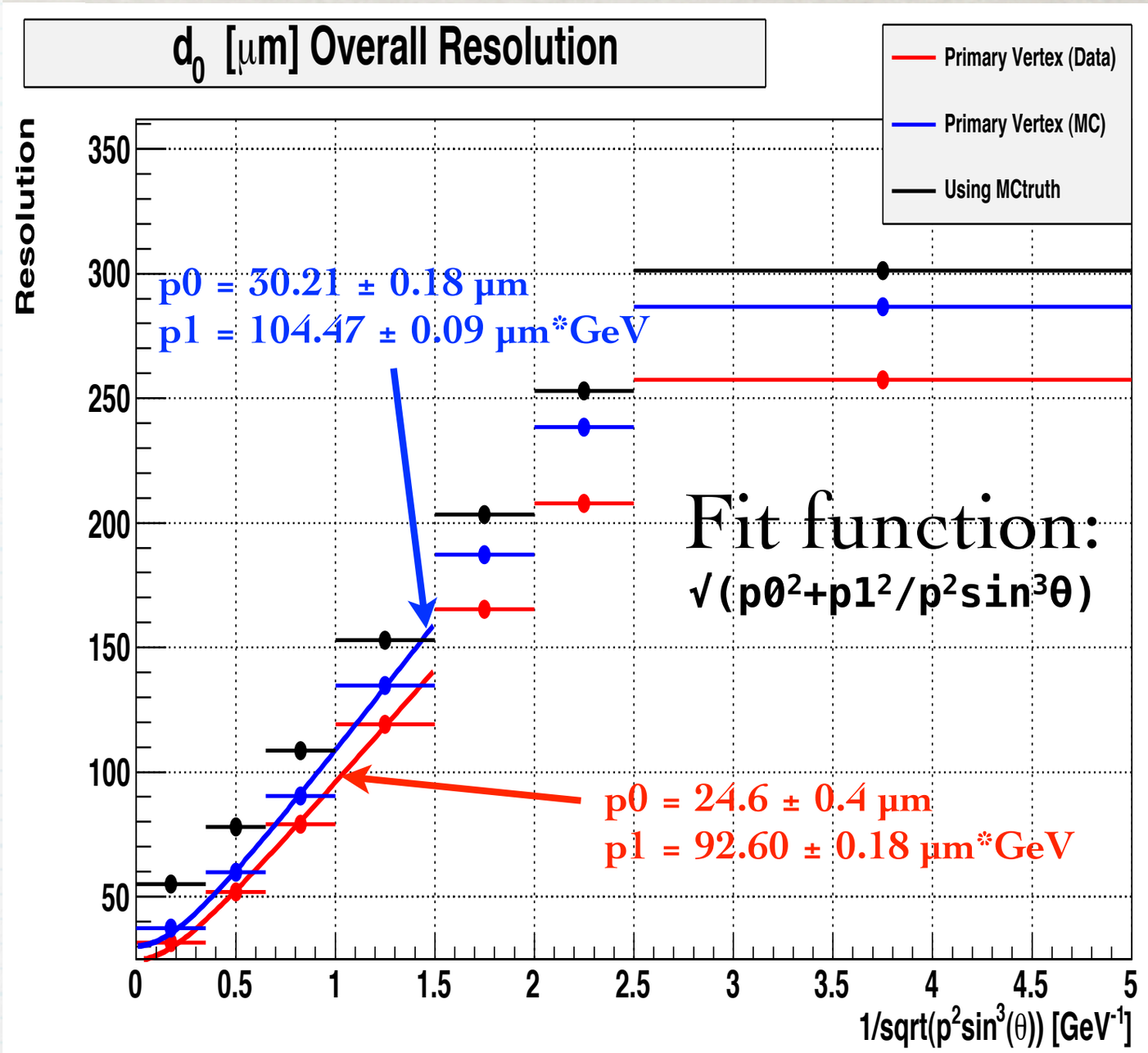
- The resolution function $\mathscr{R}$ is computed from the impact parameter distribution:
  - should select "b-tagging quality" tracks
  - use negative side of distribution to only measure spatial resolution (i.e not particle life-time contribution)
  - if MC reproduces data, additional checks are possible:
    - is the d_0 distribution really symmetric?





Tracking performance I

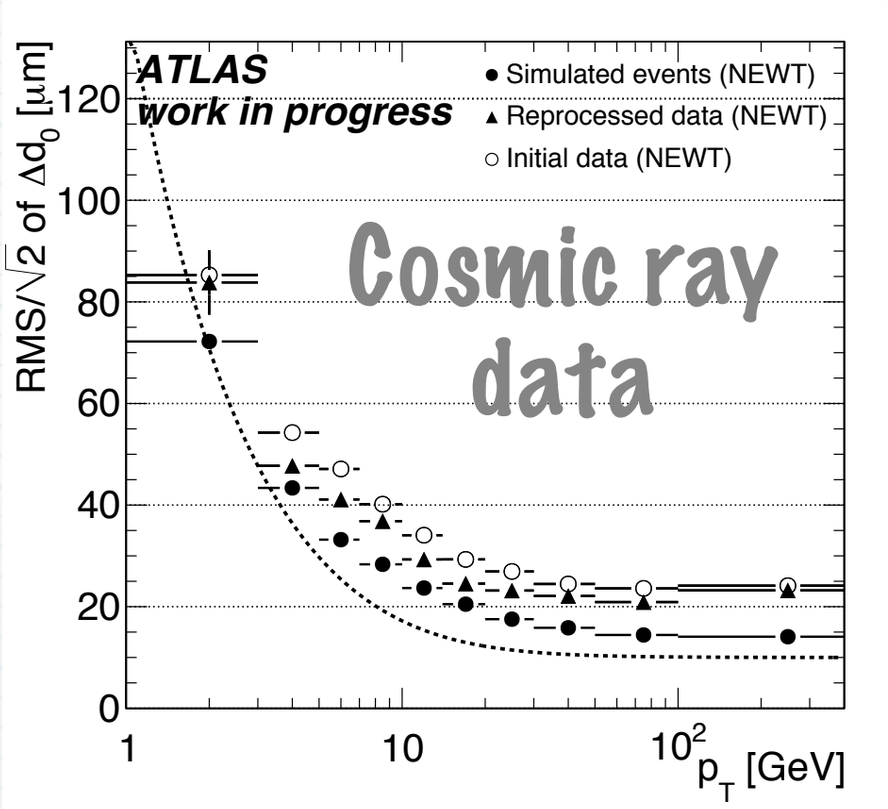
- Impact parameter resolution:
  - multiple scattering of particles due to tracking detector material
  - silicon detector resolution (i.e. number of hits + single hit resolution)
  - alignment of detector modules
  - resolution of primary vertex
    - InSitu Performance should provide this information

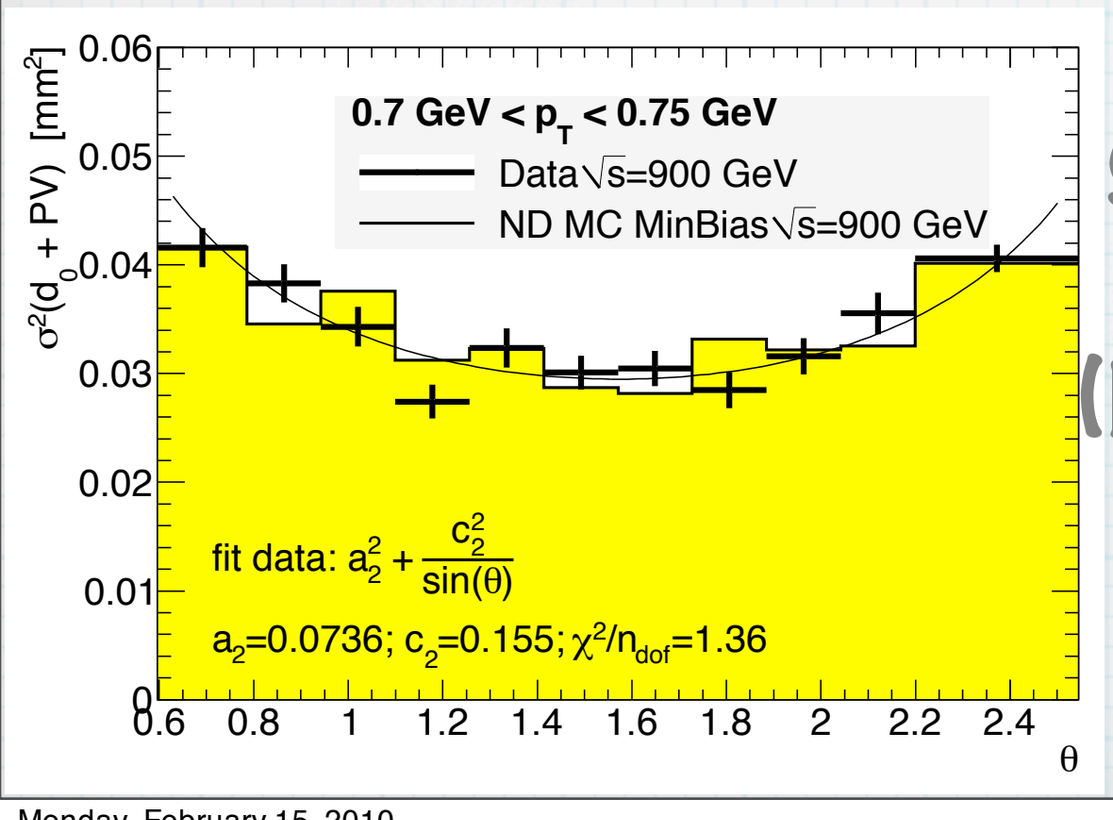


$$\sigma(d_0) = p0 \oplus \frac{p1}{p_T \sin\theta}$$

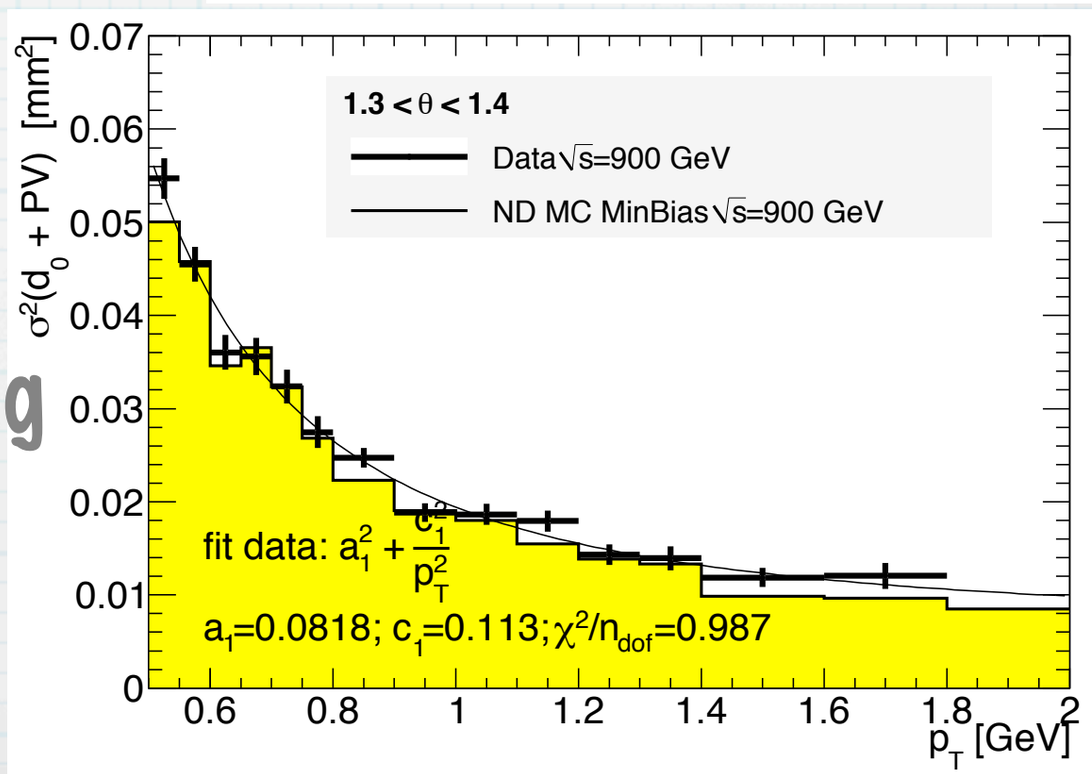
Tracking performance II

* Multiple scattering effect:
  * $\sigma(d0) = a \oplus b/(p_T \sin\Theta)$
  * $\sigma(d0) = a' \oplus b'/\sin\Theta$
  * $\sigma(d0) = a'' \oplus b''/p_T$
* If correct: $a=a'=a''$ and $b/(p_T \sin\Theta) = b'/\sin\Theta = b''/p_T$





900 GeV data (b-tagging group)



Tracking performance III

- Study d0 resolution as a function of:
  - track transverse momentum
  - track pseudo-rapidity
  - number of silicon hits
- Contribute to the "b-tagging quality" definition for tracks

top physics

- Collaboration started with Udine + Genova + Bologna to be able to re-discover top in 2010 data
  - weekly meeting to monitor progresses
  - Common analysis tools
    (or different but cross-checked tools)
    - TopReconstruction framework?
  - "My" assignment is to implement b-tagging in the commissioning analysis
    - even 1 leptons + MET + 2 jets + 2 (jets with "tracks with big impact parameter") can be enough to have a candidate top pair event

top physics and b-tagging I

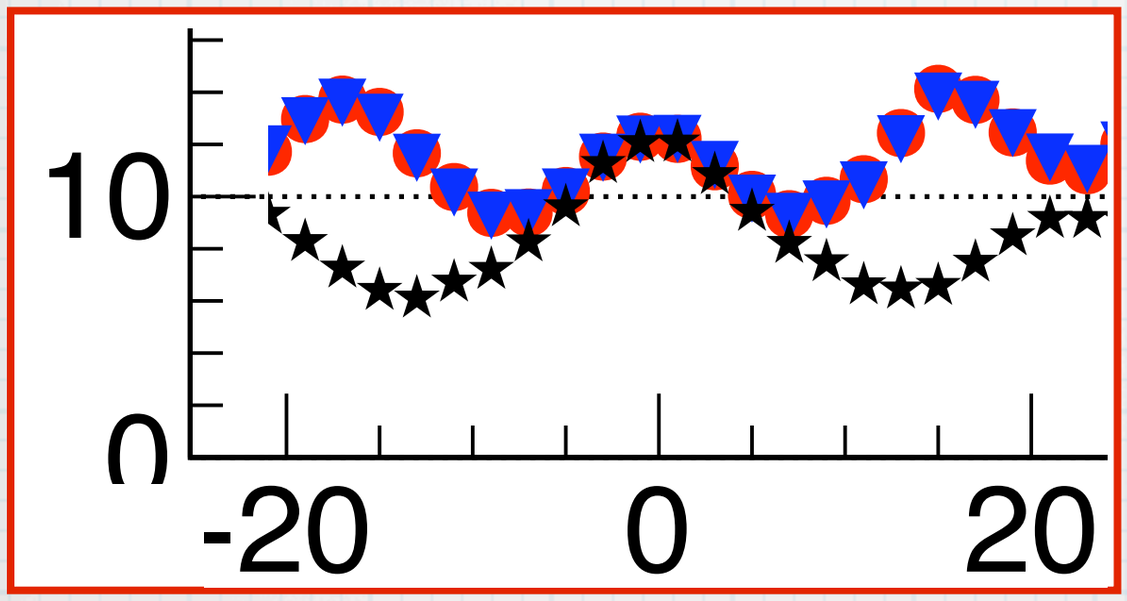
- top pairs decays:
  - leptonic (2 lep + MET + 2 b-jets)
  - semi-leptonic (1 lep + MET + 2 b-jets + 2 jets)
  - hadronic (2 b-jets + 4 jets)
- main background is W + jets (small b-jet presence)
  - estimated from Z+jets sample
- estimate b-tagging efficiency & rejection + b-jet content of signal and background with minimal use of simulation

top physics and b-tagging II

- Several samples:
  - top & W+jets (SIGNAL)
  - Z+1jet
  - Z+2jet
  - Z+3jets
  - .... according to CM energy
- 2 "global" variables:
  - b-tagging efficiency
  - b-tagging fake rate
- 1 "per sample" variable: b jet fraction
- For each sample 2 (1) observable:
  - N_{1b} fraction of events with one tagged jet
  - N_{2b} number of events with two tagged jets
- At the beginning:
  - b-jet fraction from MC, measure fake rate (and efficiency)

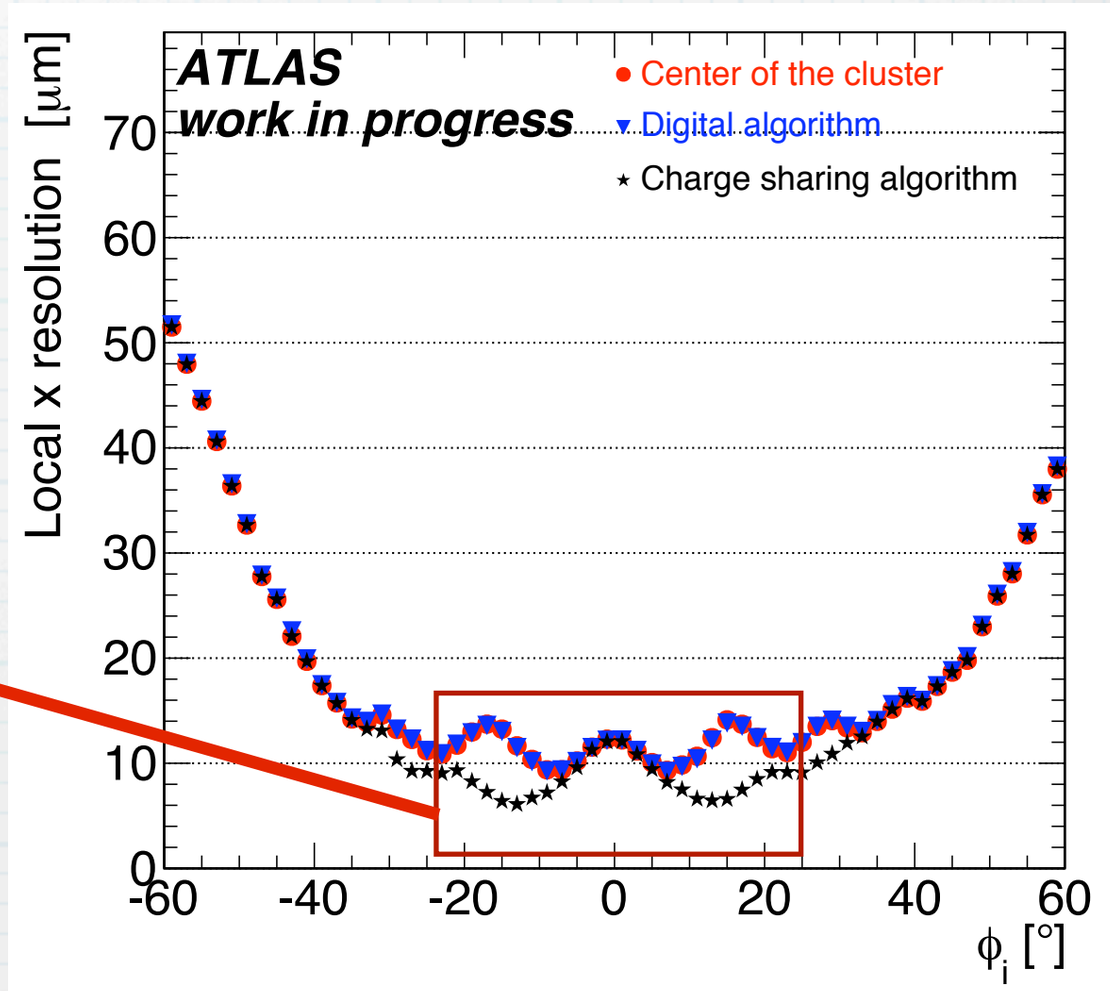
Service work I

- Try to put effort in projects that are valuable for the physics and performance analysis:
  - Implement the official D3PD for tracking group
  - Finalize the Pixel 36h calibration loop
    - charge sharing to improve pixel detector resolution



Before Charge sharing

After Charge sharing



Service work II

- Implement the official D3PD for tracking performance group
  - "D3PD" is the flat Ntuple format used in (most of) the physics analysis
    - every analysis has its own dumper for track properties in D3PD
    - track performance group is using TrkValidation Ntuple
      - it does not take advantage from global D3PD framework
  - Track performance group wants to:
    - switch to D3PD for its studies:
      - some links (i.e. TrackParticle --> Track, TrackParticle --> Vertex) not easy in TrkValidation Ntuple
    - provide a global tool for ATLAS to deal with track properties in D3PDs