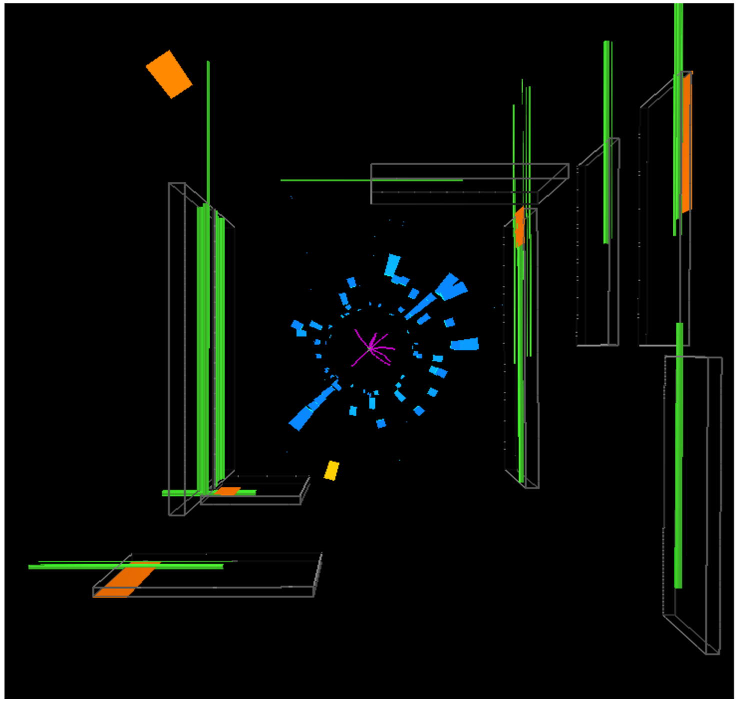
Status of the Dzero Muon Reconstruction

An overview of the status of the muon reconstruction
with the goal to underline remaining items for future developments.

- Scintillators
- PDTs
- MDTs
- Segment reconstruction
- Muon track reconstruction
- Matching with central tracks
- Muons in the calorimeter
- Hits in Thumbnail



Christophe Clément, Stockholm University, Sweden

Scintillators

1) Time of flight corrections and time resolutions

Next to latest (December 2002) corrections from Mike Eads implemented from p13
New since p13: TOF corrections applied to both scintillator times if 2 scintillator hits on segment.
Latest corrections (May 10) to be included in test head, goal p16.
In same piece of code introduce the measured σ on time, p16
Development: provide the corrections and sigmas via a RCP

2) Scintillator T0's

Forward scintillators: very stable T0s. Never used offline database.
Individual channels Tzeros in A-phi layer since Nov 27, 2003
A-phi T0 accurate and seem stable. (D.Wood, muon calibration group)
No individual T0s in C-layer because data from individual tubes not available.
Offline database not fully populated (?) and not used.

3) Scintillator pulse height

From p15 pulse height unpacked, stored and propagated to thumbnail (C.Clement, S.Doulas)

4) Two PMTs on one scintillator

From p15 if 2 PMTs on same scintillator the *average* time is propagated to the rest
of reco and to the thumbnail. To do: propagate both times to thumbnail for T0 determinations

5) Trigger gate

From p15 trigger gates are unpacked and stored in MSCHits.
To do: propagate information to segments and thumbnail.

PDTs

1) PDT T0s

T0s accurately determined by Indiana group (A. Zieminski, HaoYin), see Andrzej's talk
Online T0 up to date since run 176730 (D.Wood)
Offline database fully populated
Hack in p14.03.00 to apply t0 corrections to runs before 176730
From p14.04.00 and p15.04.00 “cleaner way” of doing it, using a RCP scheme, also useful for other constants since offline database not accessible for reprocessing.
Better coordinatation software/hardware

2) Time to distance relations

One time to distance relation implemented for each gas system (since p13) (provided by Chunhui Luo)
Change of gas a few weeks ago => new time to distance relation.
New (p14.04): RCP based system, specify sets of coefficients per gas system and per run range. To do: put new coefficients in RCP when available

3) Hit resolution

Until now the hit resolution (in drift plane) was set to 1cm.
Use a more realistic description of the hit resolution 1500µm (provided by the Indiana group)
Ongoing tests of the impact on the momentum resolution.
To do: use the measured resolutions provided by the Indiana group - Review axial error.

4) Cathod pads

Nothing was designed in D0reco to use cathod pads
To do: unpack and store in PDTHit.
Use cathod pads to measure longitudinal coordinate and use in reco.

MDTs

1) MDT Tzeros
Online database only. Very stable coefficients, no need for offline database.

2) Time to distance
Very stable coefficients, look up table in reco, no need for offline database.

3) Time of flight corrections
None implemented, not needed, should be small due to the size of the tubes, plus many different sizes.

4) Hit resolutions
Axial error: wirelength/sqrt(12), Drift plane error without scintillator hit: distance corresponding to CLOCK_RESOLUTION / 2

Review resolution when scintillator hit associated.

Estimate real hit resolution and use it?

Segments

1) B and C scintillator hits on segments

From p15 both scintillator times are stored at the segment level. (Clement)
To do: propagate the information to TMB.

2) Mixed segments

Since p13 D0reco makes mixed orientation segments: segments containing both PDT and MDT hits. (P.de Jong)
To improve overlap region performance: also allow construction of tracks from pure PDT seg + pure MDT segment (muon track reco code).

3) Segment errors and $\chi2$

Current $\chi2$ too low, should improve with more realistic hit resolutions.

4) Segment reconstruction algorithm parameters

A lot of parameters. Maximise efficiency while keeping fake rate from algorithm low and care about CPU time.
We have already done 2 passes of optimisation. (R.Ströhmer, P.de Jong, O.Peters, C.Clement)
More fine tuning still necessary in order to maximise the number of hits on segments while keeping efficiency high.
Parameters/algo might not be optimal for efficiency for pairs of very close muons. Needs study.
Worse performace for level 3 due to the necessity of keeping the CPU time low. Streamline the slow parts of the code?

5) Scintillator only segments

Make segments out of "left over" scintillator hits. Since p14 it is required that the time of the scintillators somewhat matches within a 5 sigma window. (P. de Jong)

Local Muon Tracks

1) Mixed region tracks

Mixed segments are made in the segment code which lead to an increase of efficiency in the overlap region

There is still a significant amount of efficiency to be gained by making tracks out of pure and PDT and MDT segments

2) Momentum resolution

Is significantly worse than in RunI.

Several geometry issues solved: (misalignment of the muon system by 2mrad, shift and rotation of the toroid field)

Could it be due also to unrealistic hit resolutions in reco? See Andrzej's talk.

Implement PDT hit resolution for each chamber and measure effect on resolution.

Muon Central Track Match

1) Algorithm

Since p13 Muon to Central match and Central to Muon match. (Boris Tuchming)

2) Performance and behavior

Since p13 sizable improvement in efficiency.
Review the track matching performance with latest changes (new t0s, improved hit resolutions and geometry)
Chi2 cut less efficient for higher pT muons: still there with latest updates? Understand?
Take into account the central match while choosing the best muon in a group.

Muons in the Calorimeter

1) Improve efficiency of MTC

D. Whiteson's code, two studies (L.Stutte and M.Adams) indicate efficiency close to 65%
Possible improvements: require only 3 calorimeter layers or 2 layers + IC. Preshower? Larger supercells?
Use energy threshold rather than likelihood?

2) Road method

Implement!

Thumbnail

1) Hits in thumbnail

Now implemented, contains PDT and MDT hits with times and with time? (X.P.Nguyen)
And scintillator hits with ADCs.
To do: add times separately for each tube when 2 tubes on one scintillator.
Add trigger gates.

2) Muon Quality words

Contains summary of bunch crossing number mismatch, RVS and SRQ errors (Shpakov, Clement)
Do we want to add sthg there?

3) Scintillator times on segments

Currently A scintillator time and average of B and C scintillator time stored
Store B and C separately

Conclusions

Muon reconstruction has moved forward significantly since p11 (reconstruction, central track match efficiencies,...) but:

1. Substantial gain of efficiency still possible at least in the overlap region, if the muon track reconstruction could make a mixed-region track out of a pure PDT and a pure MDT segment.

2. Further optimisation of the segment code could also probably improve efficiency,

3. Still a few basic implementations remain to be done (cathod pads in reco, scintillator times,...) still requires some significant amount of person-power.

4. Should focus on **quality of reconstruction**: implement realistic errors, resolutions, calibration constants, understand and improve momentum resolution, MTC efficiency,...

5. Monte Carlo and geometry: see Daniela Bauer's talk.