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Subject: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [David Pohl](#) on Thu, 18 Nov 2010 10:48:27 GMT

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Hallo everybody,

at the moment I do some tracking tests with the Lhe package.

The parameters are:

- tracking detectors: MVD+TPC+GEM
- 1 pion per event
- theta=60, phi=0..360
- ideal track finder
- kalman task after helix prefit with pion particle hypothesis
- current PndRoot version: trunk, revision 10322
- only primary tracks are taken into account

for momenta down to 200MeV/c everything works great; but for a momentum of  $pt = 100\text{MeV}/c$  even the simple helix prefit is better.

You can see that in the following plots:

works fine:

strange:

So I would like to ask the people who have more experience with tracking what the reason is or could be.

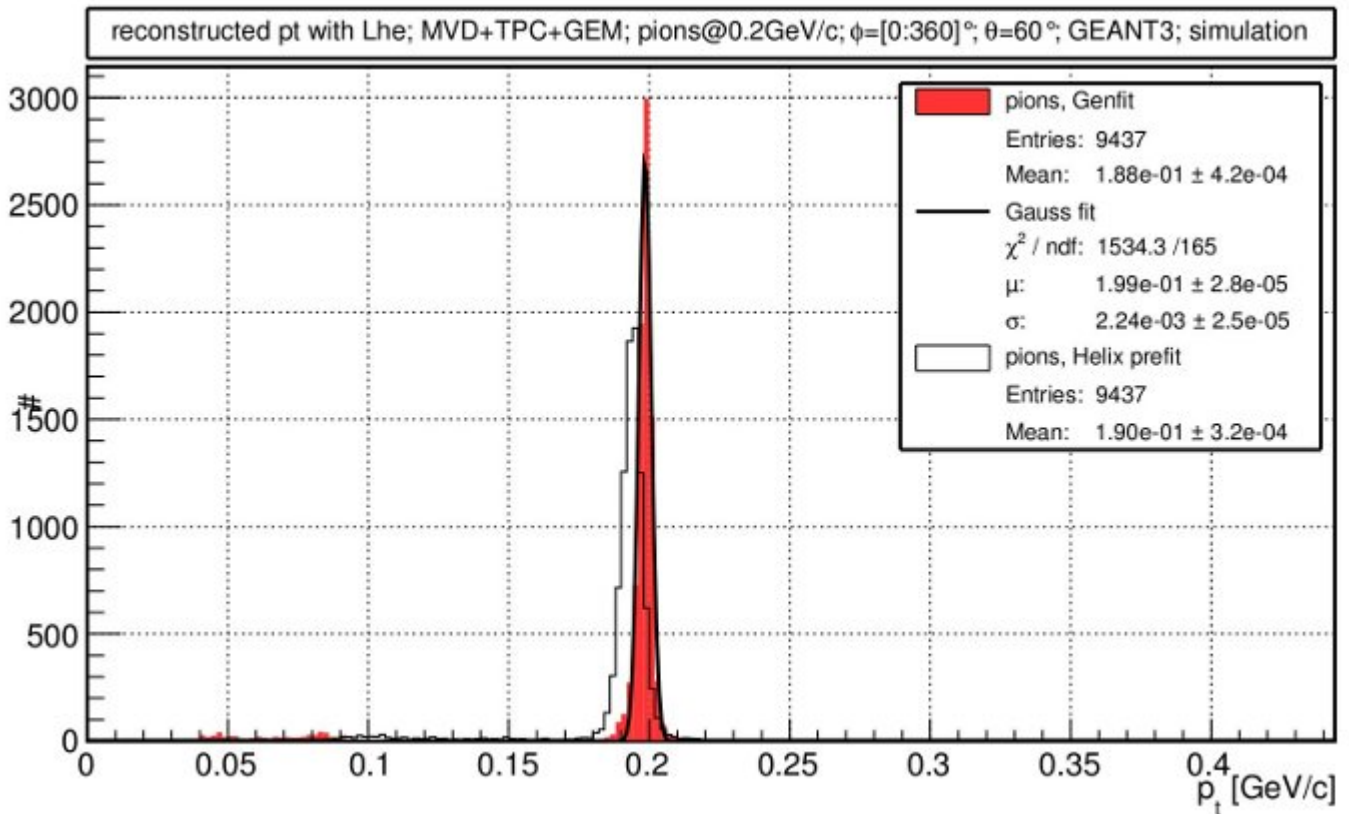
greetings

David

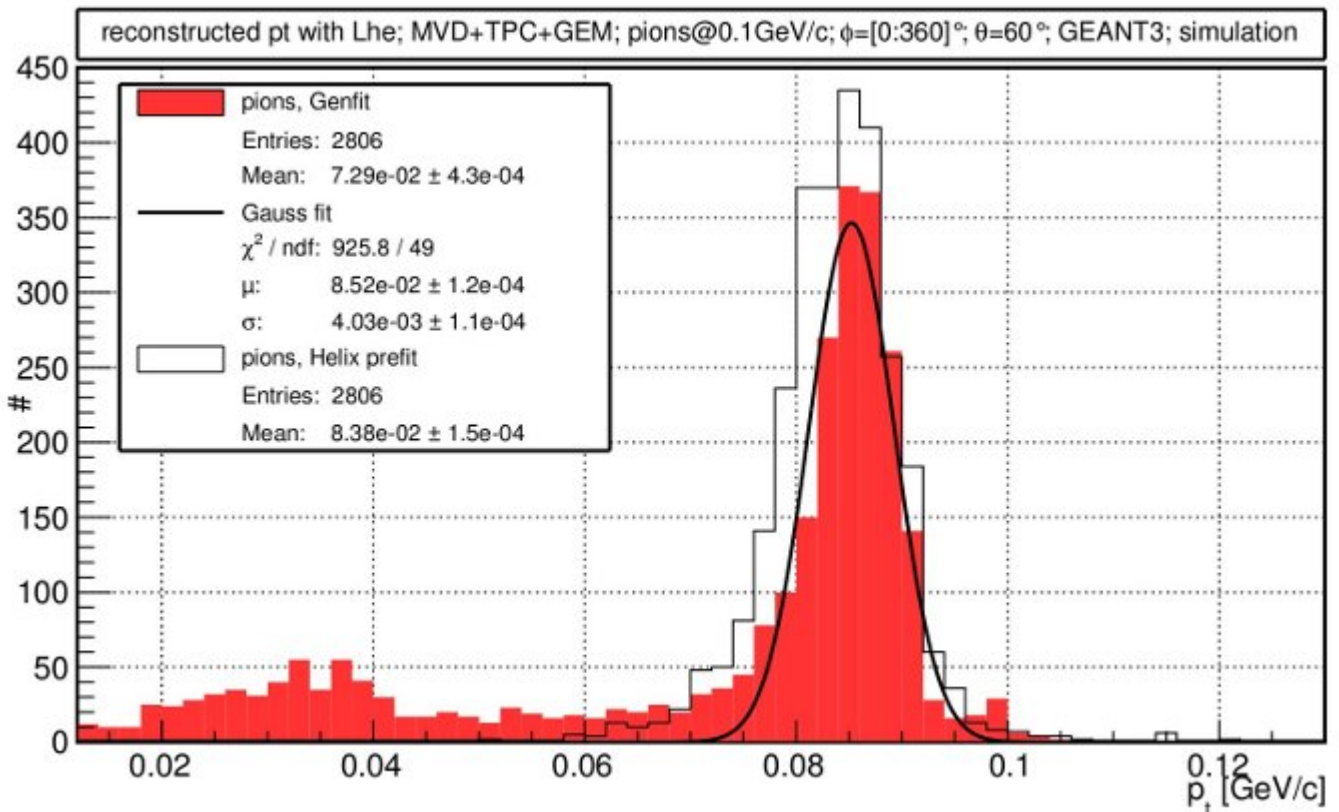
### File Attachments

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1) [pt\\_reco\\_tpc\\_200.jpg](#), downloaded 711 times



2) [pt\\_reco\\_tpc\\_100.jpg](#), downloaded 637 times



Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
 Posted by [Felix Boehmer](#) on Thu, 18 Nov 2010 11:08:17 GMT

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Hi David,

which TrackRepresentation are you using - GEANE or the RKTrackRep?

Regards

Felix

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Stefano Spataro](#) on Thu, 18 Nov 2010 11:33:52 GMT

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Answering to Fekix, GeaneTrackRep is the standard track representation in panda in the RecoKalmanTask. It would be nice that somebody would test intensively also RKTrackRep, to compare it with GeaneTrackRep, before putting it as standard.

Answering to David... no idea.

Could it be that "bad" errors play an important role for low momentum particles? I know only that errors are not properly tuned (if you check  $\chi^2/\text{ndf}$  distribution, this is not peaked at 1), at least in TPC combined mode.

I leave the world to kalman experts...

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Jens Sören Lange](#) on Thu, 18 Nov 2010 12:53:52 GMT

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Hi David,

first question: can you check, which SVD geometry are you using? with cables etc.? (so maybe it even becomes worse).

Then, as a possible explanation:

The TPC is split into 2 parts, left and right, by the target beam pipe. At  $p_T \leq 100$  MeV, tracks are so curved, that, if they are in one part of the TPC, they can also enter the other part, and produce there a 2nd, short track (for higher  $p_T$  this is impossible). Can you maybe check that? (e.g. number of hits per fitted track should be small).

Soeren

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Stefano Spataro](#) on Thu, 18 Nov 2010 13:51:46 GMT

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Jens Soeren Lange wrote on Thu, 18 November 2010 13:53Hi David,

first question: can you check, which SVD geometry are you using? with cables etc.? (so maybe it even becomes worse).

Then, as a possible explanation:

The TPC is split into 2 parts, left and right, by the target beam pipe. At  $p_T \leq 100$  MeV, tracks are so curved, that, if they are in one part of the TPC, they can also enter the other part, and produce there a 2nd, short track (for higher  $p_T$  this is impossible). Can you maybe check that? (e.g. number of hits per fitted track should be small).

Soeren

But then I cannot understand why the helix fit seems better...

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**Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!**

Posted by [Jens Sören Lange](#) on Thu, 18 Nov 2010 14:11:18 GMT

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Yeah, so, "helix fit is better" means, that "no energy loss correction at all is better than energy loss correction in genfit", but only for  $p_T=100$  MeV. I really don't know. Maybe at  $\theta=60^\circ$  particles the path length in the MVD material is so extended that they are losing almost all their energy (helix phase is short so maybe passing a few times through material).

In addition,  $p_T=100$  MeV is already in the highly rising Bethe-Bloch part, so maybe the  $dE/dx$  correction (which the Kalman is trying to do) is not correct. The error is large.

Anyway, you can see that tracking efficiency from  $p_T=200$  GeV/c to  $p_T=100$  GeV/c drops by factor  $\sim 2$  ( $\sim 9000 \rightarrow \sim 3000$ ) so I think it is also another effect, maybe short tracks.

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**Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!**

Posted by [Lia Lavezzi](#) on Thu, 18 Nov 2010 15:25:23 GMT

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Hi David,

did you cut on the PndTrack flag that says whether the Kalman was ok or not, before filling the histograms?

You should check that the PndTrack that comes from the Kalman procedure (LheGenTrack) has not a flag < 0 (the function is GetFlag()). If it is < 0 it means that either the Kalman calculation failed or the NDF are 0 or the adapter failed, in a word something has gone wrong.

Cheers,

Lia.

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [David Pohl](#) on Thu, 18 Nov 2010 16:00:25 GMT

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Sorry for the late reply. Thursday is "meeting" day

@Jens: I think you mean the MVD geometry? It's the new one:

Mvd-2.1\_AddDisks\_FullVersion. The track efficiency is not that worse. I simulated only 3e3 events for the 100MeV/c and 1e4 events for the 200MeV/c case. I forgot to say that.

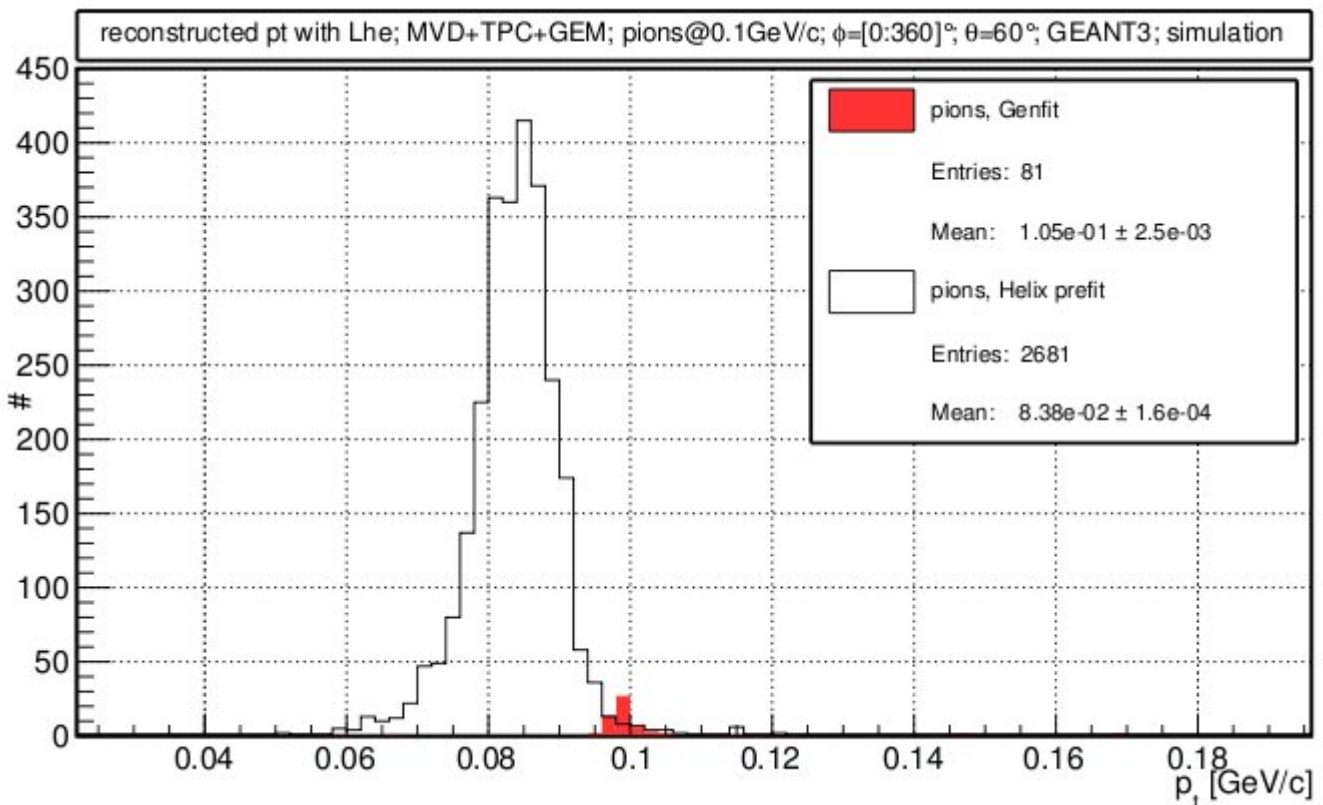
@Lia: That was the right hint I think. I have not checked if an error occurred. With the check one can see, that the Kalman failed:

greetings

David

### File Attachments

1) [Kalman\\_fails.jpg](#), downloaded 513 times



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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Lia Lavezzi](#) on Thu, 18 Nov 2010 16:05:23 GMT

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Can you please post a plot of the flag values? ...just to understand which kind of error occurs...

Thanks,

Lia.

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Lia Lavezzi](#) on Fri, 19 Nov 2010 15:22:08 GMT

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Hi David and all others,

I made some tests and I really think the problem is the cut in GeaneTrackRep for low momentum particles: though your starting momentum is not too low (the limit is 100 MeV/c of total momentum), the particle loses energy and often falls in that exception at a certain point.

Since the cut was put there when GEANE was unstable, but now several fixes have been added, I think we could get rid of it.

I uploaded a version of GeaneTrackRep with that cut commented out, so that, if we see that it still crashes, it will be easily restored.

I tried a run without that cut and everything worked fine. Now the Kalman filter is better than the Helix, so I am confident that we can keep GeaneTrackRep without the cut.

Can you please update your GenfitTools and retry to run the events to confirm/deny my results?

Have a nice week end,  
Lia.

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### File Attachments

1) [momtransv.ps](#), downloaded 261 times

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [David Pohl](#) on Sat, 20 Nov 2010 13:25:52 GMT

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Hi Lia and everybody,

very nice. I can confirm your results. For a simulation with 1e3 primary pions@100MeV/c pt from vertex (0,0,0)

I have 2627 tracks in the output.

By the way the track reconstruction (1e3 events,ideal track finding, helix fit, Genfit) took 35min. on a 3GHz core.

329 have a PndTrack Flag < 0. 204 have -1 and 125 have -2.

Have a nice weekend, too.

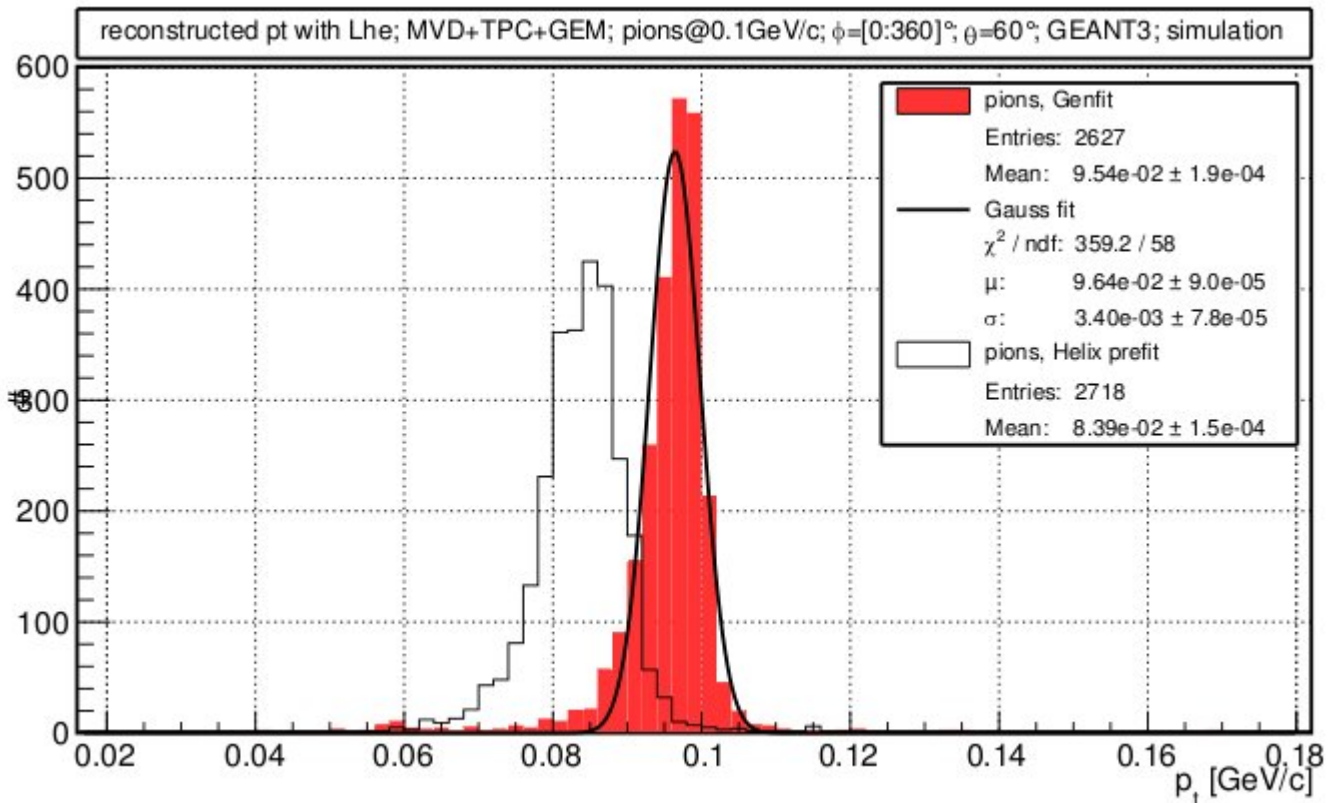
greetings  
David

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### File Attachments

1) [pt\\_reco\\_tpc\\_100.jpg](#), downloaded 491 times

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [Lia Lavezzi](#) on Mon, 22 Nov 2010 12:47:02 GMT

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Hi David,

good that it works, but I don't understand a thing on efficiencies... how many events did you simulate?

I got 990 entries in the histogram (~850 if you want the integral of the peak region) out of 1000 single track events (pion, theta 60 deg, random phi, 0.1 GeV/c pt, LHE ideal and Kalman with pion hypo).

Lia.

Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [David Pohl](#) on Mon, 22 Nov 2010 17:00:09 GMT

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Hi Lia,

I tried to understand why my reconstruction efficiency is about 87,5% instead of your 99%. From a reconstruction with the params mentioned in my first post I have for:

1000 events:

- 48 with no Kalman track: I think this is due to the minimum hits required for a track

- 62 with failed Kalman filter: flag < 0
- 2 events omitted where I was not able to find the MC track from the reco track

How do you check if the reconstructed track is the primary MC track? So far as I know one cannot take the `getMcTrackId()` function of the track candidate class? Or does this work by now?

I loop over the Lhe Tracks. Then over the Lhe Hits, take one MVD reco hit and check if this hit belongs to the primary MC track.

Do you use the new MVD geometry?

greetings  
David

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
Posted by [Stefano Spataro](#) on Mon, 22 Nov 2010 17:27:52 GMT  
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I suppose David is using the "real" track finder, therefore he has a lower efficiency. If he uses `PndLheTrackFinderIdeal`, he should have the same efficiency of Lia (almost 100%).

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
Posted by [David Pohl](#) on Mon, 22 Nov 2010 17:45:26 GMT  
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No I use the ideal track finder. When you sum up the events without a track (4,8%) and the events with a failed Kalman fit (6,2%) (I mentioned this numbers in the message before) then I wonder how one can achieve 99% track reconstruction efficiency.

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
Posted by [Lia Lavezzi](#) on Mon, 22 Nov 2010 18:30:46 GMT  
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Sorry, I was counting all the tracks, not only primary ones!

Now I filled the histo only with primary tracks and I have 880 entries (88%), so we are fine

For the track association to the MC track, you can use the `PndTrackID`:

```
// genfit track
PndTrack *gtrk = (PndTrack*) gentrackarray->At(itrk);
// corresponding helix track
PndTrack *litrk = (PndTrack*) recotrackarray->At(gtrk->GetRefIndex());
// with corresponding track ID
PndTrackID *litrkID = (PndTrackID*) recotrackidarray->At(gtrk->GetRefIndex());
```



```
// from it you can get the MC track ID:  
int mcTrackID = ltrkID->GetTrackID();  
Cheers,  
Lia.
```

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
Posted by [David Pohl](#) on Mon, 22 Nov 2010 19:56:15 GMT  
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Hi Everybody,

I found some cases where the helix prefit is still better than the kalman fit. Again I used the same parameters but different particles.

Kaons (efficiency loss, background):

Protons (efficiency loss, worse result):

The flags for the failed Kalman fits are in both cases:

90%: -1

10%: -2

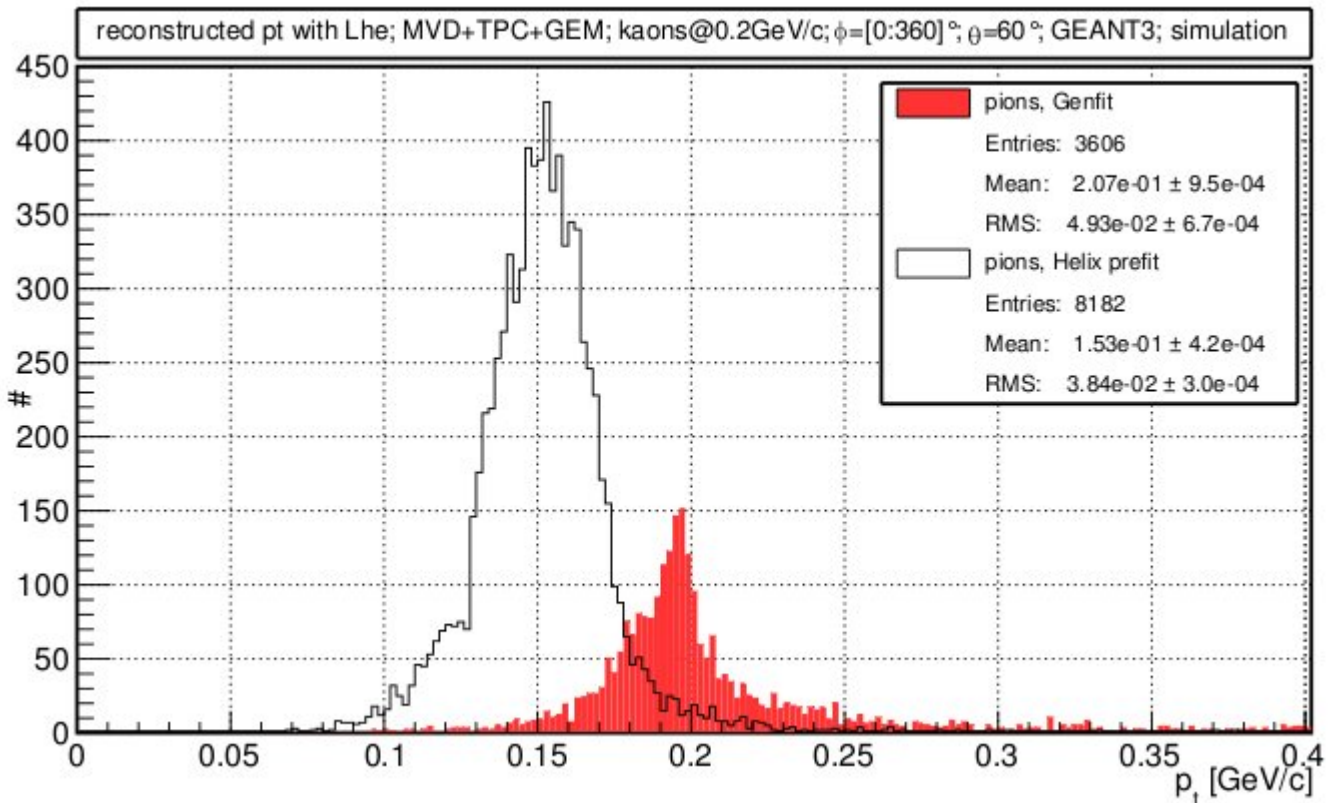
@Lia: thank you for the short tutorial

greetings,  
David

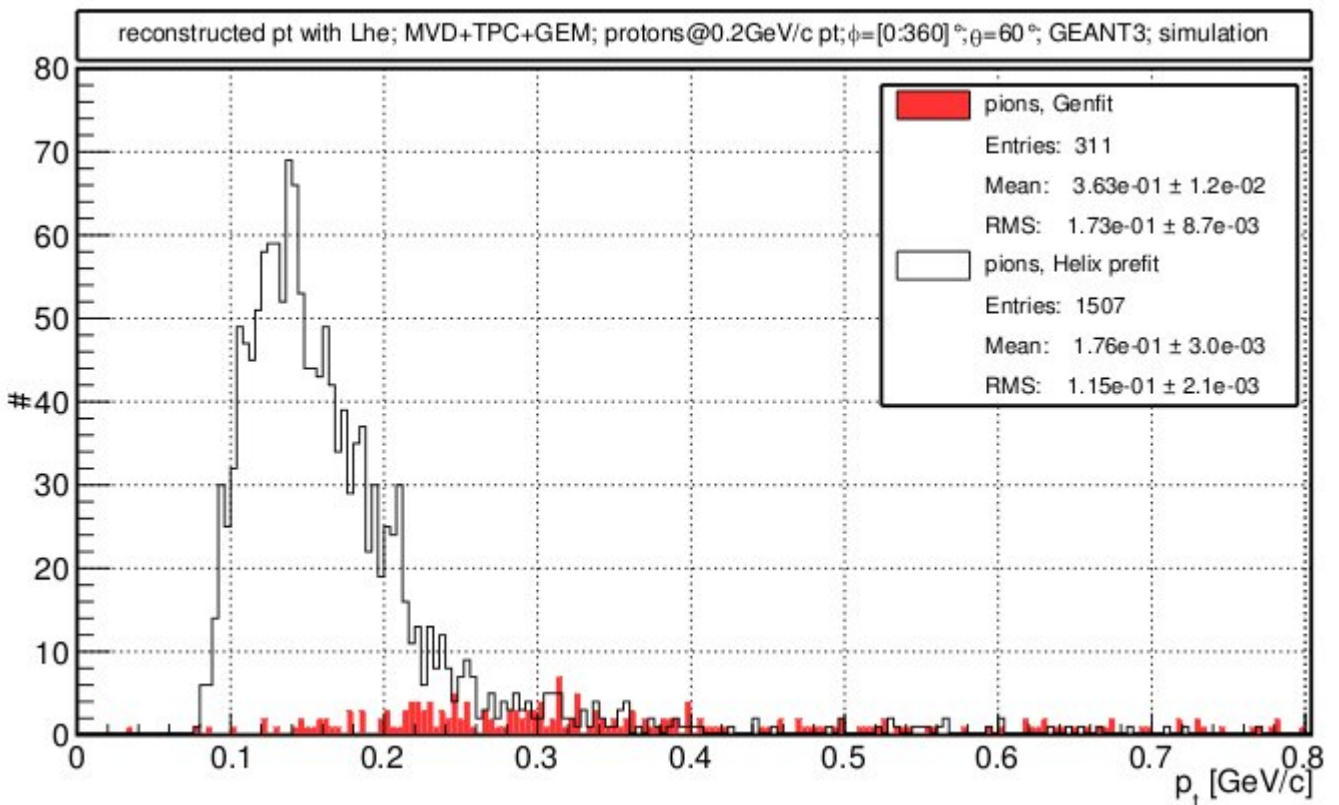
### File Attachments

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1) [pt\\_reco\\_tpc\\_200\\_kaons.jpg](#), downloaded 444 times



2) [pt\\_reco\\_tpc\\_200\\_protons.jpg](#), downloaded 404 times



Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!  
 Posted by [Stefano Spataro](#) on Mon, 22 Nov 2010 21:26:11 GMT  
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Hi,  
unfortunately this is a normal behaviour. This comes from the fact that you are using by default "muon" hypothesis for the kalman, because you do not know exactly the pid of the particle.

You could run in your run\_reco the PndRecoMultiKalmanTask instead of the PndRecoKalmantask, to run the 5 pid hypothesis, and then compare the results.

Or you could set in your PndRecoKalmanTask the flag SetParticleHypo(Int\_t h) in order to use the correct particle hypothesis.

I hope this helps a bit.

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Subject: Re: GENFIT for transverse momenta < 200 GeV/c strange?!

Posted by [David Pohl](#) on Mon, 22 Nov 2010 21:38:51 GMT

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Hi Stefano,

I already used the correct particle hypothesis. All simulation parameters are mentioned in the first message. I just used kaons and protons instead of pions and changed the particle hypothesis accordingly.

greetings,  
David