Subject: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Wed, 16 Jan 2008 18:03:18 GMT
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Hello all,

I'm studying the possibility of excited hyperon states decay reconstruction using Straw Tracker. I found a strange behavior while reconstructing particles of different charge:
1) polar angle (theta) is not reconstructed for large amount of events;
2) theta for negatively charged particles reconstructed significantly better than for the positively charged ones.

Just for check and to be sure it is not an error in my code, I generated kaons with BoxGenerator using fixed 1.0 GeV/c momentum, fixed 20 degrees polar angle and free azimuth angle (range from 0 to 360).

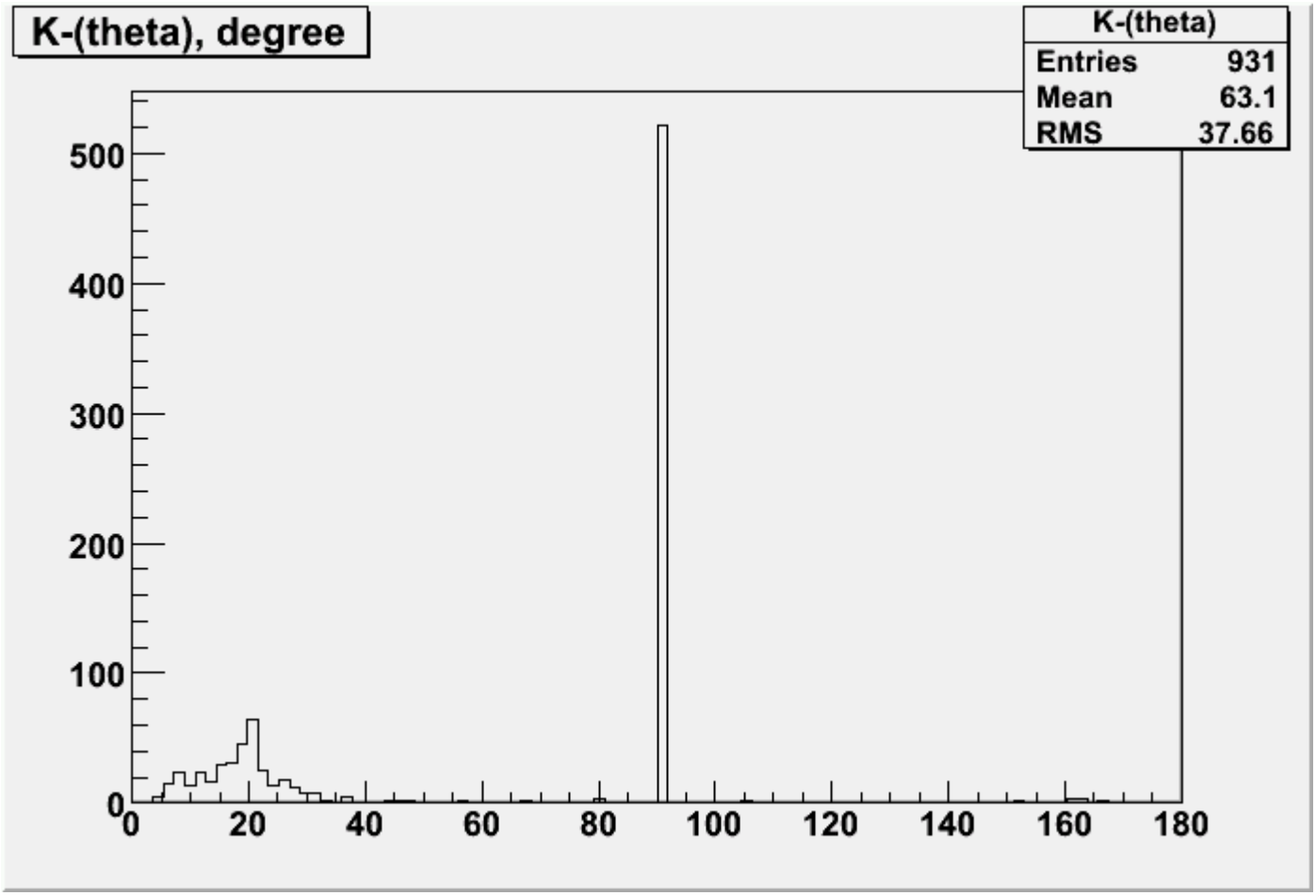
Results are in the attachments. As you can see, there are a lot of events with unknown polar angle (i.e. 90 degrees, it is just default angle in the reconstruction software). Nevertheless in the k- distribution one can see a peak about 20 degrees, but in the k+ distribution there is only some noise present alongside particles with unidentified angles.

So the question is: is this a bug or I'm doing something wrong?
How this can be fixed? I can see no reason why positively charged particles should be identified worse than negative ones.

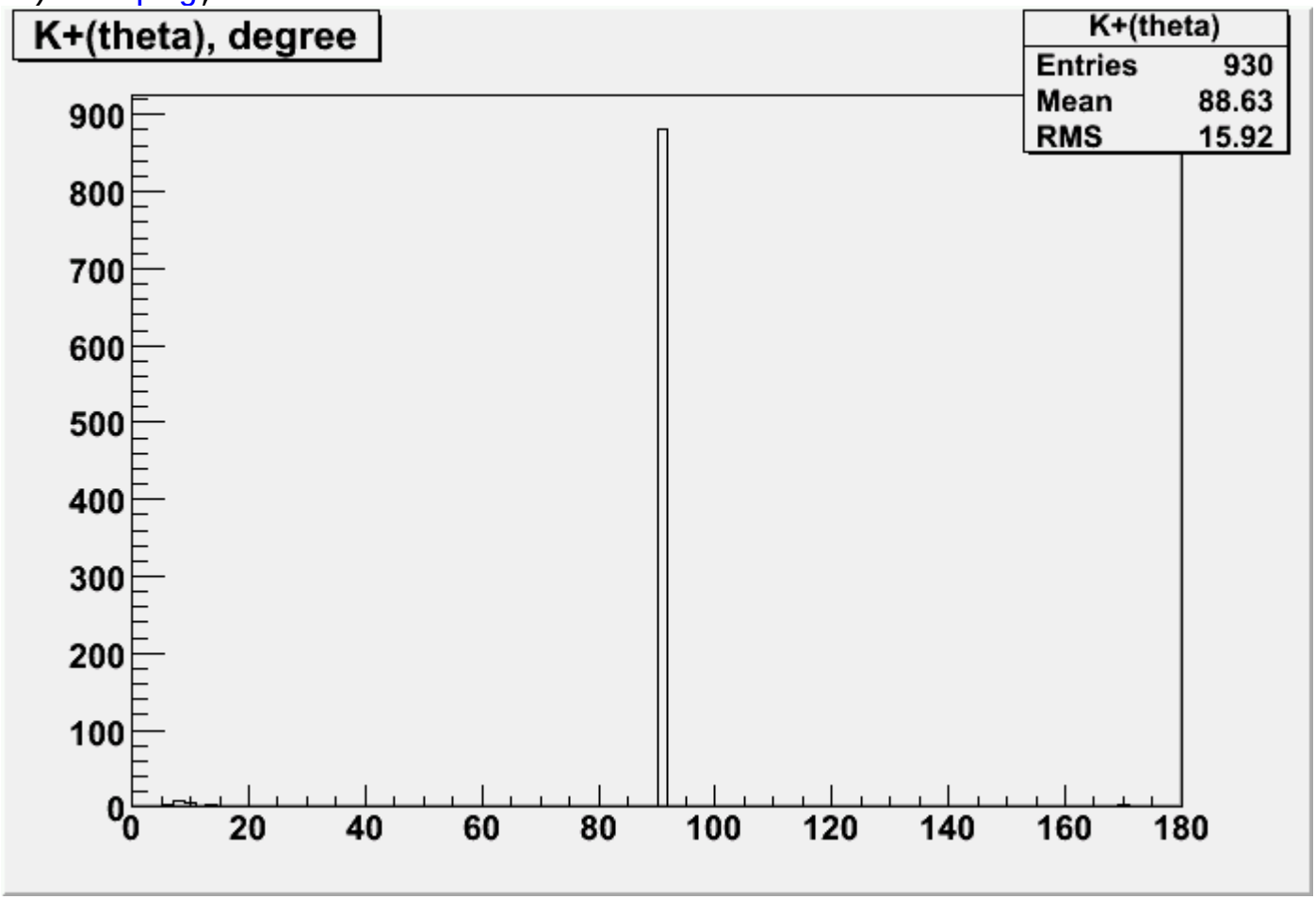
For simulation and reconstruction standard marco from pandaroot/macro/stt was used (run.C, rundigi.C and runreco.C)

File Attachments

1) k-.png, downloaded 1385 times



2) k+.png, downloaded 1407 times



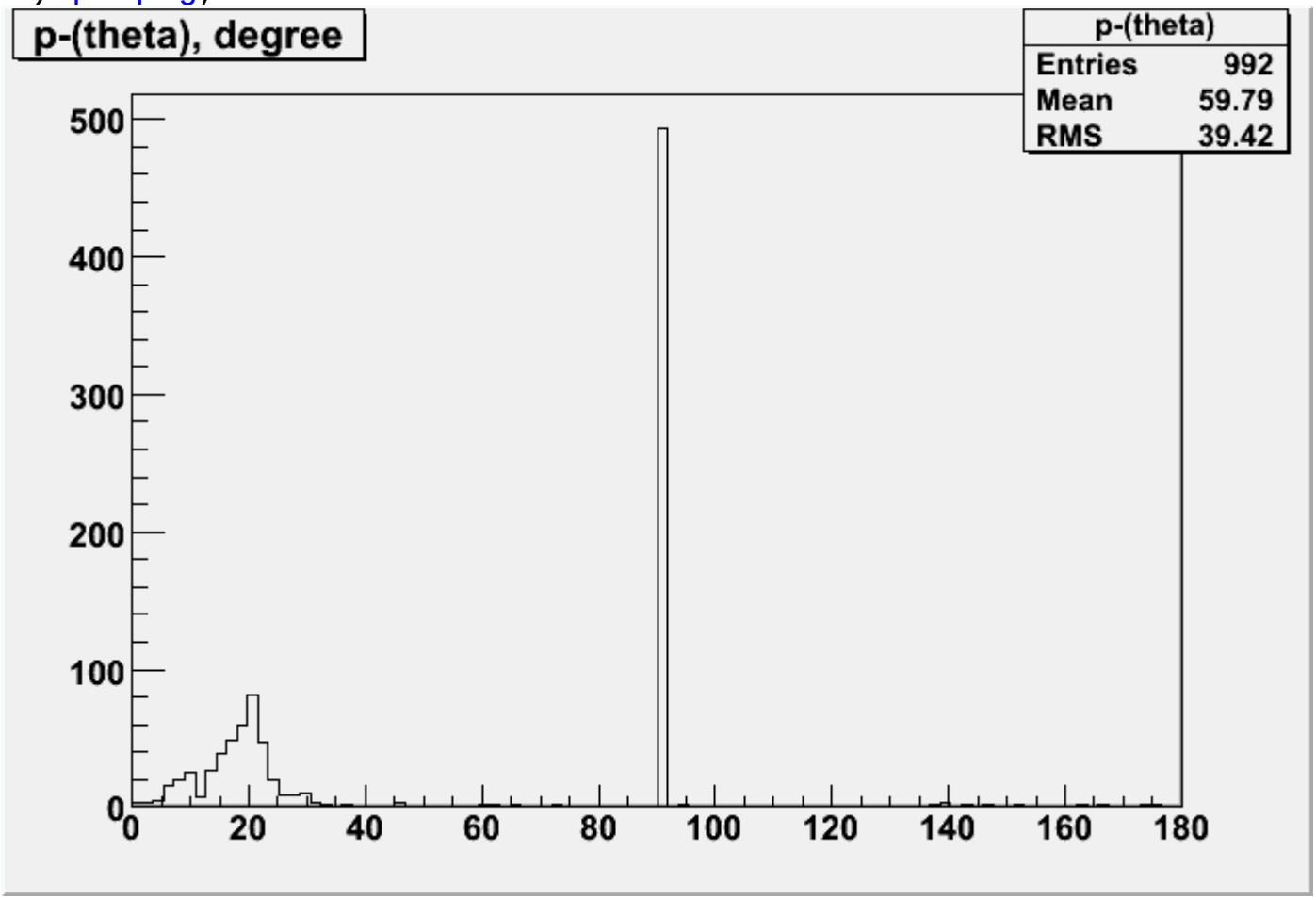
Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Thu, 17 Jan 2008 12:14:05 GMT
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I have just performed the same test for protons and result is similar:
polar angle for negatively charged particles (antiprotons) is reconstructed just for approximately 50% of events. And it is not reconstructed at all for positively charged particles (protons), only small noise is present.

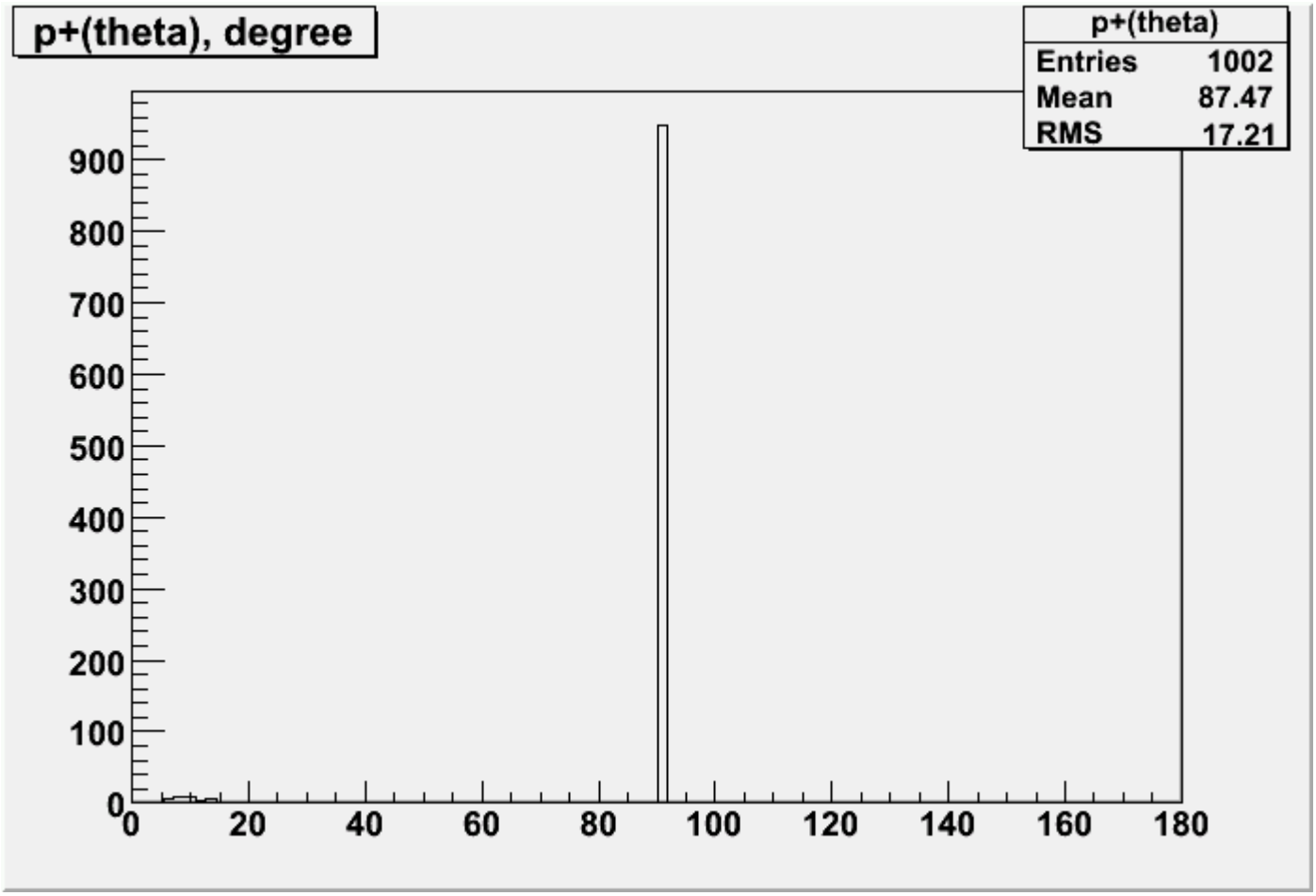
Corresponding plots are attached.

File Attachments

1) p-.png, downloaded 1308 times



2) p+.png, downloaded 1224 times



Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by StefanoSpataro on Thu, 17 Jan 2008 12:17:14 GMT
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Have you tried with higher theta angles, such as 60°?
Maybe the tracking at 20° is a bit problematic... but I am just trying to guess.

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Thu, 17 Jan 2008 14:23:11 GMT
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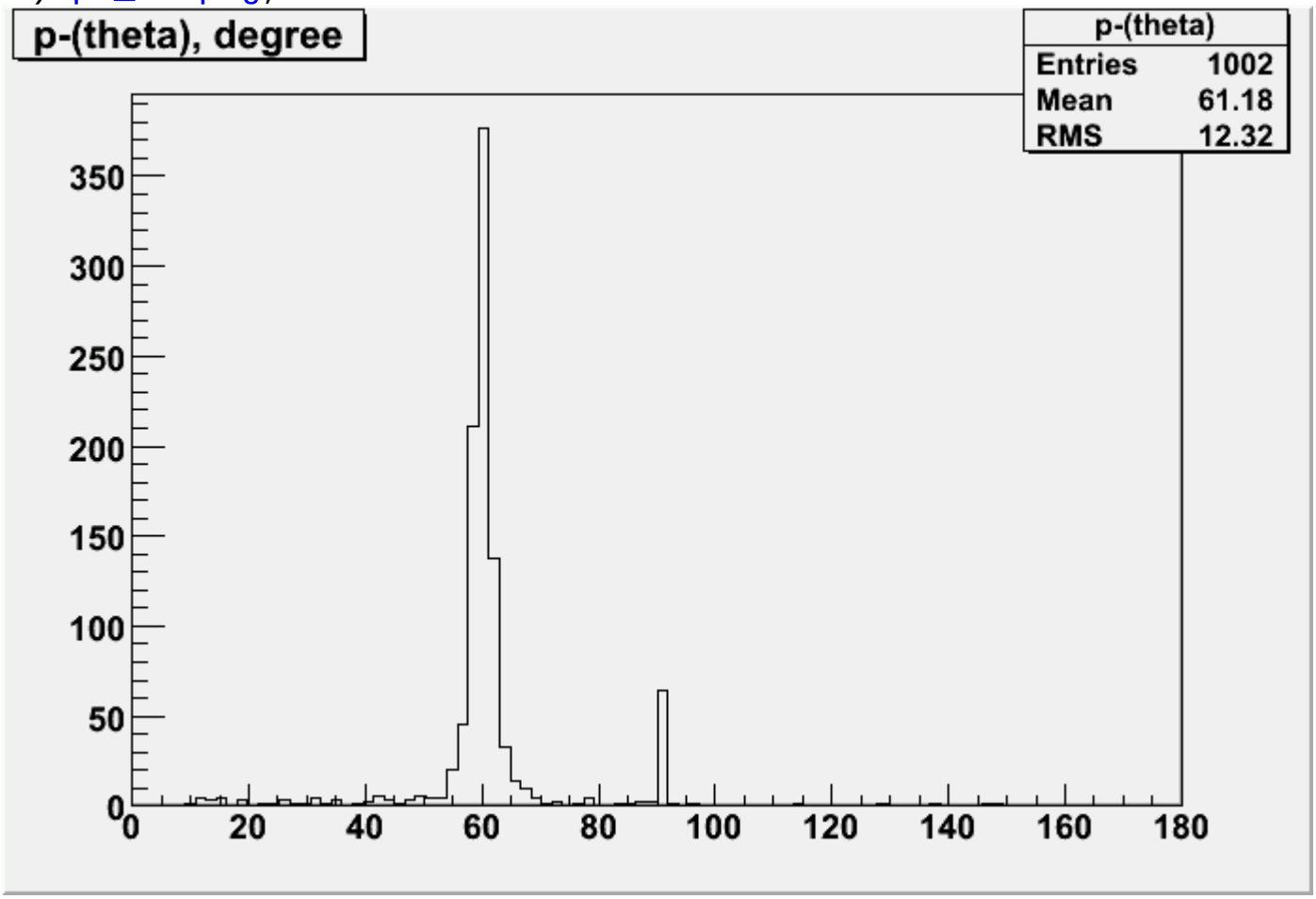
Stefano Spataro wrote on Thu, 17 January 2008 13:17Have you tried with higher theta angles, such as 60°?
Maybe the tracking at 20° is a bit problematic... but I am just trying to guess.
Hi Stefano, thank you for reply.
I tried with 60 degree and here is the result:
for antiprotons identification is much better. But protons are still not identified at all.

Here are the pictures.

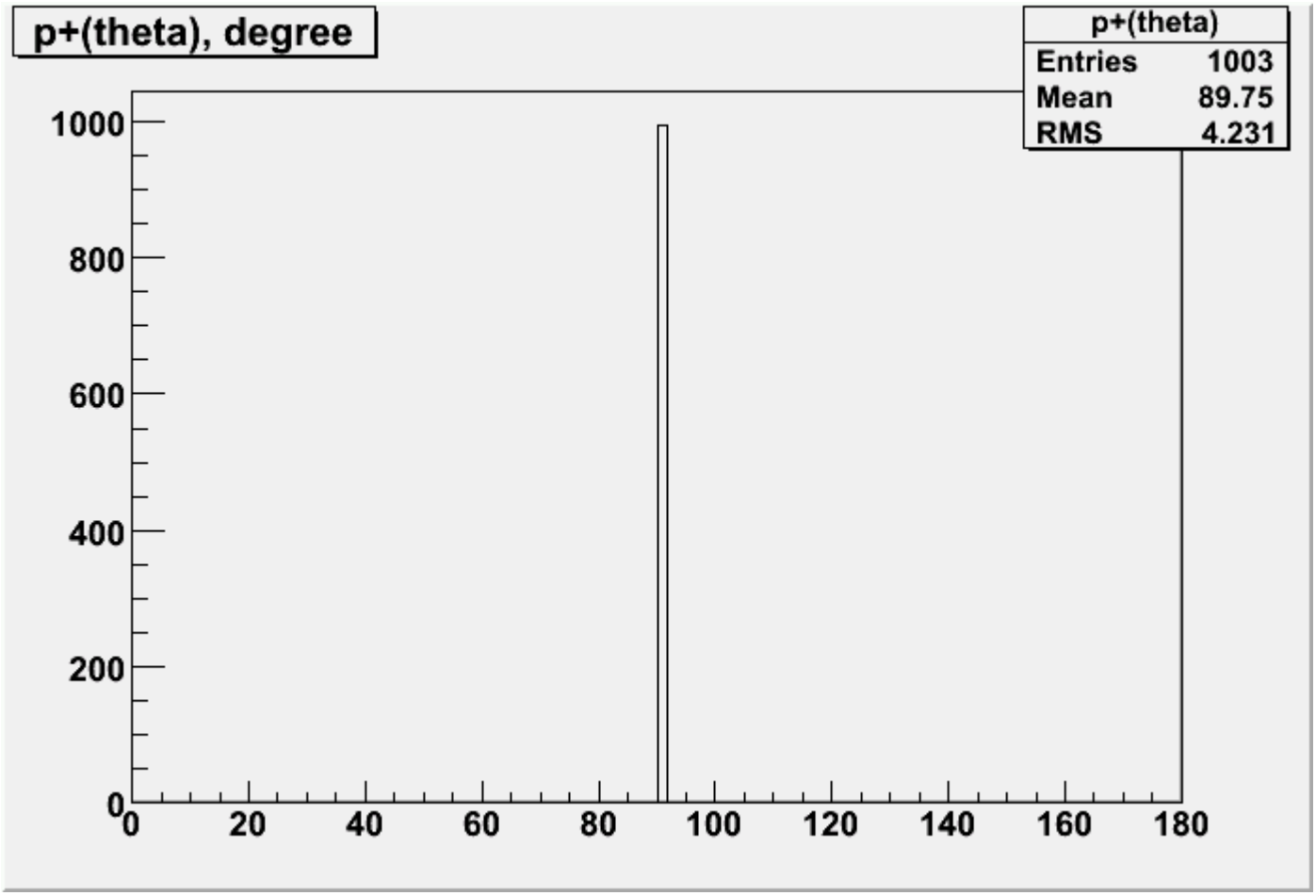
P.S. In the real simulation I will deal with low polar angles due to conservation laws. As far as I know, 15 degree is already acceptable for the Straw Tracker.

File Attachments

1) p-_60.png, downloaded 1317 times



2) p+_60.png, downloaded 1220 times



Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Pablo Genova on Thu, 17 Jan 2008 14:50:44 GMT
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Dear Andrew,

what you see is really surprising.
I remember that, in the past, we had problems with the charge sign, but they were fixed!!
Did you check if, at least, the modulus of the momentum is reconstructed properly (for the positive particles)?
By the way how do you calculate the reco theta starting from the reconstructed momentum?
I guess you have to do some calculations to back propagate it at the vertex, right?
Your results suggest a bug in the zed reconstruction procedure,
I'll have a look into the problem and let you know.

Regards, Pablo

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Thu, 17 Jan 2008 16:19:45 GMT

Dear Pablo,

first of all to avoid uncertainties I should mention that I use rather new SVN revision 1993 of pandaroot.

Quote:
Did you check if, at least, the modulus of the momentum is reconstructed properly (for the positive particles)?

No, moreover I'm wondering how can reconstruct full momentum using STT only, afaik it is possible to reconstruct only transverse momentum using the Straw Tracker. And I have not done it yet, below I'll describe why.

Quote:
By the way how do you calculate the reco theta starting from the reconstructed momentum?
I guess you have to do some calculations to back propagate it at the vertex, right?

I haven't performed any calculations on my own, I just used existing code in the following way. I used a macro macro/stt/runreco.C which calls PndSttHelixTrackFitter in order to fit the tracks. And then I used values from output of this macro.

At this point I got a lot a problems while trying to understand what the fit parameters means. They are stored at the CbmTrackParam class, but the description of the fields fX, fY, fZ, fTx, fTy, fQp in this class documentation completely differs from their real meanings used in HelixFitter. I got a completely crazy results until I looked in the PndSttHelixTrackFitter source code (stt/PndSttHelixTrackFitter.[cxx|h]).

From that source code and its comments it figured out, in particular, that fTy=tan(pi/2 - theta), so I used this value.
But I'm new to the project and Z reconstruction procedure is still not clear to me, currently I'm supposed to use already working STT track reconstruction code.

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Pablo Genova on Mon, 21 Jan 2008 14:03:33 GMT

Dear Andrew,

sorry for the late reply, I was busy with other businesses.

I also see very strange things with positive particles.
I'm trying to understand what is happening.
That problem was solved, I do not undestand why it is showing again. I will go back to previous stable versions and see what is happening.

One possibility is that in the conversion from Stt to Pnd nomenclature I made some mistake, previously I was working with the old pandaroot1 release and I did not see such effects.

I must apologize for the misleading comments. I must clean the PndSttHelixTrackFitter,

improve the comments and the documentation, but since, in the past, nobody was really using that classes, apart from the Pavia Group, I was never doing that.

I'll let you know asap, Pablo

ps: it is possible to reconstruct both transverse and total momentum. I should put a test macro for displaying such variables.

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Mon, 21 Jan 2008 14:49:42 GMT
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Dear Pablo,

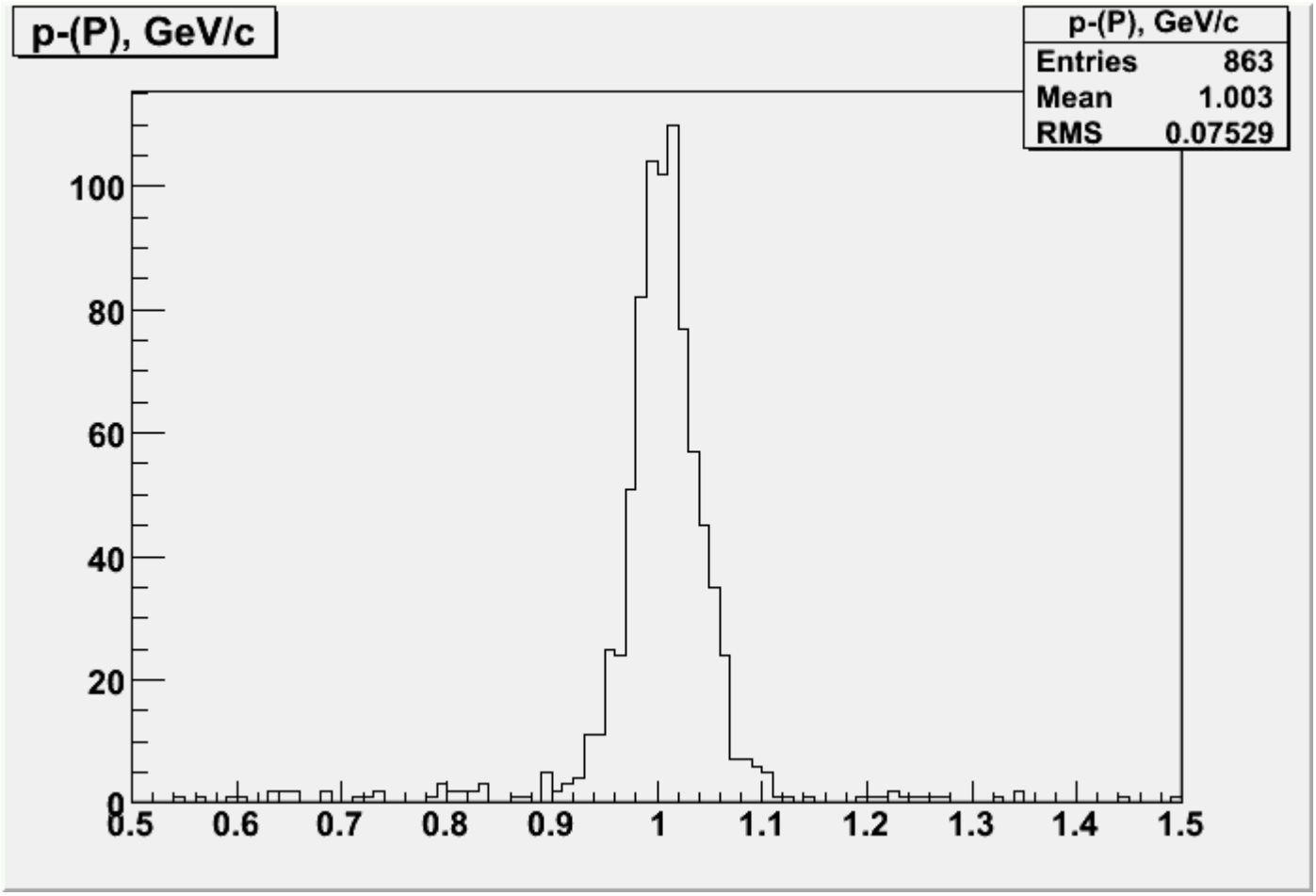
Pablo Genova wrote on Mon, 21 January 2008 15:03
ps: it is possible to reconstruct both transverse and total momentum. I should put a test macro for displaying such variables.

Yes, you are absolutely right, it is rather simple indeed.
I reconstructed the total momentum for protons and antiprotons with original momentum 1.0 GeV/C and polar angle theta 60°.

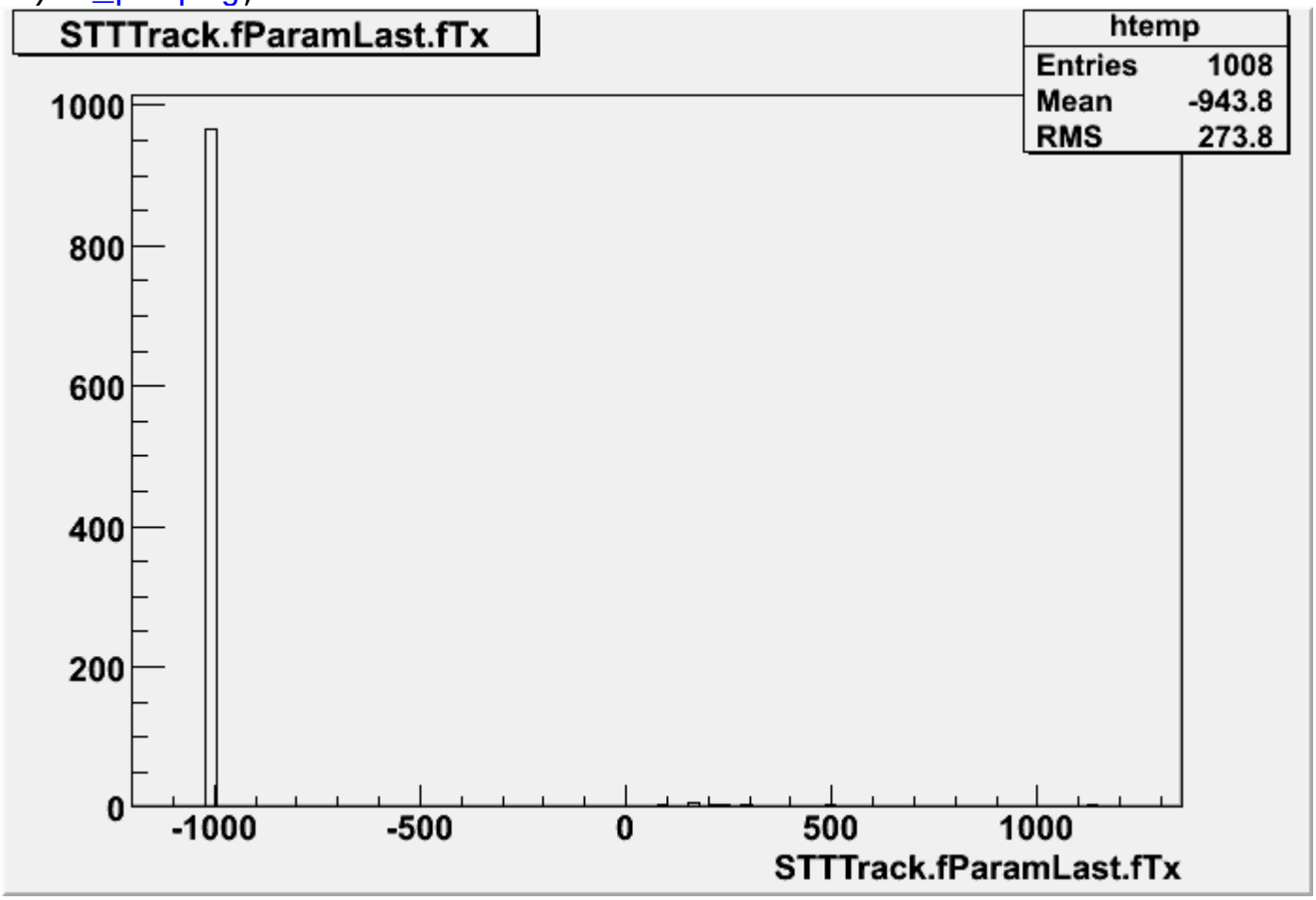
For antiprotons I used only those with 50° < theta < 70°, and momentum reconstruction is reliable in this case.
And for protons radius is not reconstructed at all. I hope, this will help.

File Attachments

1) Pabs_p-.png, downloaded 1343 times



2) R_p+.png, downloaded 1211 times



Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Pablo Genova on Mon, 21 Jan 2008 15:52:00 GMT
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I checked that with the old version it is working, but I still have to understand why with the new one is not!

For the question of the reconstruction at low theta angles, it might be that the zed procedure fails, but I think that this is is a different problem from the complete failure of the total momentum for positive tracks (the former is related to the zed reconstruction, the latter to the reconstruction of the radius of curvature, which, in our code, are done separately - first the curvature, then the zed - if the latter fails also the former fails but the vice versa in not necessairly true).

ciao, Pablo

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Pablo Genova on Wed, 23 Jan 2008 16:07:13 GMT
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Dear Andrew,

the errow was really stupid i. e. in the line 914 of PndSttHelixTrackFitter

```
 if(a<0.000001) return 0;
```

to protect the division by zero was cutting away the a<0 i. e. the positive tracks, with

```
 if(fabs(a)<0.000001) return 0;
```

it's now OK.

So try to svn-update the PndSttHelixTrackFitter and do again the reconstruction.

Other observations:

->cross check of the variables

1. fParamLast.fTx*0.006 <--------> transverse momentum

[i. e. cbmsim->Draw("(fParamLast.fTx*0.006)"]

2.fParamLast.fTx*0.006*sqrt(1+fParamLast.fTy**2)) <------> total momentum

Do you agree?

->importance of fFlag==3 parameter

when you are looking at total reco, to get the only the events with the full reconstruction succeeded do like this:

cbmsim->Draw("(fParamLast.fTx*0.006)>>h2","fFlag==3")

in this way you select the events with fFlag==3 i. e. full success of the whole reconstructed procedure.
You should not see any more the 90 degree values (algorithm failure). Of course I expect that the reconstruction is not perfect when you go to small theta angles, since you are using only the stt with lower number of hits.

It's certainly an interesting and not yet done study that of STT resolution at small theta angles, with or without MVD.

MVD + STT integration is also an interesting issue not yet tackled.

##
If you need better explanation of the variables and the fitting procedure etc etc I can send you the presentations I made in the past and Lia's Phd Thesis (which, among other things, describes in detail the algorithm).
##
I'll soon clean the code and put into the repository a better commented version of PndSttHelixTrackFitter

LET ME KNOW IF IT'S OK AND ANY QUESTION ON YOUR SIDE!!

ciao, Pablo

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Andrew Savchenko on Fri, 25 Jan 2008 16:01:17 GMT
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Dear Pablo,

sorry for a long response, but I was busy a lot these days.

Pablo Genova wrote on Wed, 23 January 2008 17:07
So try to svn-update the PndSttHelixTrackFitter and do again the reconstruction.

Yes, this works thank you very much.

Quote:
Other observations:

->cross check of the variables

1. fParamLast.fTx*0.006 <--------> transverse momentum

[i. e. cbmsim->Draw("(fParamLast.fTx*0.006)"]

2.fParamLast.fTx*0.006*sqrt(1+fParamLast.fTy**2)) <------> total momentum

Do you agree?

Yes, I do. This is mathematically equivalent to what I'm using now.

Quote:
->importance of fFlag==3 parameter

when you are looking at total reco, to get the only the events with the full reconstruction succeeded do like this:

cbmsim->Draw("(fParamLast.fTx*0.006)>>h2","fFlag==3")

in this way you select the events with fFlag==3 i. e. full success of the whole reconstructed procedure.

Yes, this helps. But not absolutely. Even with a check for (GetFlag() == 3) I still can see this false peak at 90 degrees, but it become much smaller.

Quote:
It's certainly an interesting and not yet done study that of STT resolution at small theta angles, with or without MVD.

MVD + STT integration is also an interesting issue not yet tackled.

Yeah, this should be investigated indeed, but later. Currently I will be out of work for several months due to technical reasons.

Quote:
If you need better explanation of the variables and the fitting procedure etc etc I can send you the presentations I made in the past and Lia's Phd Thesis (which, among other things, describes in detail the algorithm).

OK, this will be useful, but later

Andrew

Subject: Re: Weird STT reconstruction: efficiency depends on charge
Posted by Pablo Genova on Fri, 25 Jan 2008 16:33:22 GMT
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Dear Andew,

I'm happy that at least the main problem is fixed and you also see the results.

More work is needed to integrate STT and MVD and to test carefully the zed reconstruction procedure.

Let's keep in touch for any news, I'll keep you updated with my changes (by documenting them in the forum and in the wiki).

ciao, Pablo
