Subject: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 25 Nov 2014 15:35:06 GMT
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Dear Pandaroot experts,

there is an efficiency loss of antiprotons above a lab polar angle of 20 degrees in all hyperon channels I had a look at so far. To avoid any other kind of systematics I (after advice from Stefano) generated a sample of pbar p -> Lambdabar Lambda at 1.64 GeV/c with an isotropic angular distribution of the Lambda/Lambdabar. The problem remains, as you can see in the attached figures.
th_p_pbar.pdf shows theta (lab polar angle) vs the lab momentum of the antiproton, whereas th_p_proton.pdf is the same but for the proton.
Furthermore, there is an non-negligible difference in the pi- and pi- yields: 74% for pi- while 65% for pi+.

What could be the reason for this? Interaction of the antiproton with the detector material or some artifact of the tracking?

Kindest regards,
/Karin

File Attachments
1) th_p_pbar.pdf, downloaded 752 times
2) th_p_proton.pdf, downloaded 680 times

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by StefanoSpataro on Tue, 25 Nov 2014 16:42:06 GMT
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Ehm, my suggestion was to run the "box generator" with isotropical distribution of protons and antiprotons separately, fixed momenta (i.e. 1 GeV) for a range of theta, to see if the drops occurs or not.

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 02 Dec 2014 12:25:04 GMT
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Hi again,

I ran the box generator at 1 GeV and 2 GeV, from 0 to 0 degrees in the lab angle, and at 2 GeV I first put the generator in the interaction point and then 20 cm away (in z) from the IP. One can not see any clear differences in structures, but there is a significant difference in the efficiency of protons with respect to antiprotons:

1 GeV, at IP: protons 89%, antiprotons 80%
2 GeV, at IP: protons 91%, antiprotons 82%
2 GeV, at (x,y,z) = (0,0,20): protons 69%, antiprotons 64%

In the attachment you can see the distributions theta vs p. Hopefully the file names ar self-explanatory.

It is difficult to draw any conclusions from this except that there is indeed a difference between the proton and the antiproton efficiency. Here, it however looks like it is an overall effect.

I will shortly post some more plots from Lambda Lambdabar simulations because they tell a somewhat different story.

Cheers,
/Karin

File Attachments

1) th_p_boxp_1.pdf, downloaded 564 times
2) th_p_boxp_2.pdf, downloaded 589 times
3) th_p_boxp_2_20cm.pdf, downloaded 542 times
4) th_p_boxpbar_1.pdf, downloaded 581 times
5) th_p_boxpbar_2.pdf, downloaded 562 times
6) th_p_boxpbar_2_20cm.pdf, downloaded 582 times

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 02 Dec 2014 12:34:49 GMT
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Another things: concerning the simulations of isotropic Lambda Lambdabar production at 1.64 GeV, the efficiency drop, or maybe one should say very large momentum smearing, above 20 degrees, is an effect which has appeared lately. I ran the same macros on revision 24660 and the difference between this revision and 26319 is striking. See the attach plots of theta versus p for antiprotons from isotropic pbar p -> Lambdabar Lambda. th_p_pbar_iso.pdf corresponds to revision 26319, the other is 24660.

Cheers,
/Karin

File Attachments

1) th_p_pbar_iso.pdf, downloaded 556 times
2) th_p_pbar_iso_rev24660.pdf, downloaded 539 times

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by StefanoSpataro on Tue, 02 Dec 2014 12:47:13 GMT
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Can you please provide a one-dimensional histogram with theta distribution of your primary particle, overlapping protons with antiprotons? From the 2D histogram is hard to understand what is going wrong and where.

Moreover, can you check that your antiprotons are not annihilated into some material? Maybe this could cause a loss in efficiency, since your antiproton does not exist anymore. I don't know

if this can explain a 10% loss.

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 02 Dec 2014 12:50:46 GMT
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I will produce also 1D histos.
I also suspect annihilation since it has a visible effect in other experiments. However, I am not sure how to check it, any ideas?

Cheers,
/Karin

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by StefanoSpataro on Tue, 02 Dec 2014 13:02:38 GMT
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Select an antiproton event where you do not reconstruct a primary antiproton, and use event display on it. Or you can plot the STT points coordinate to see what is happening in the central tracker.

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 02 Dec 2014 13:27:08 GMT
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Hi again,

here are the projected theta distributions for dispaced production points (suffix "20cm") and at the regular interaction point (no extra suffix).

Cheers,
/Karin

File Attachments
1) theta_p_2.pdf, downloaded 514 times
2) theta_p_2_20cm.pdf, downloaded 565 times
3) theta_pbar_2.pdf, downloaded 537 times
4) theta_pbar_2_20cm.pdf, downloaded 527 times

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by StefanoSpataro on Tue, 02 Dec 2014 13:35:15 GMT
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Are you sure you are using exactly the same macros?

From svn the major differences are in the GEM geometry and digitization, which could introduce a lower efficiency in the gem region (up to 20%).
In your monodimensional plots I do not see a large reduction of efficiency between protons and antiprotons. And nothing in particular after 20°. Or at least I cannot judge that something is going wrong.

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Tue, 02 Dec 2014 14:19:14 GMT
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From the theta vs p plot for pbar from Lambda Lambdabar I showed earlier, it looks like above 20 degrees, the antiprotons are not disappering but rather have their momenta very poorly reconstructed. Thus, in the projection, the dip in efficiency is not visible.
I will also check what happens if the production vertex is displaced in the XY-direction.

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Stefan Pflueger on Tue, 02 Dec 2014 16:37:03 GMT
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Hi Karin,

ok I first of all, you are simulating protons and pbars with the box generator in a theta angular range from 0 to 50, correct? Then it looks like you generated 10k events in each scenario (non shifted and shifted IP in z by 20cm) and calculated the efficiency number of reconstructed tracks / 10k. As a small side remark, I would like to point out that the box generator does not generate events isotropically, but merely uniform in theta and phi. This generates a peak in the forward direction (theta=0) as the box generator uniformly distributes particles in a grid in theta and phi. However in spherical coordinates the angular elements mapped from your theta and phi plane become much smaller closer to the z axis (small theta), or to be more precise by a factor of sin(theta).
Now I looked at the 2GeV pictures for both scenarios. I'm not really sure how the global panda tracking works in detail, but at low angles your efficiency seems to be rather equal for both cases. Then the inefficiency at 8 degrees moves up to about 12 degrees which could be some kind of gap between the target and forward spectrometer. Above that your efficiency eventually breaks down, which could be related to the MVD which you miss completely when shifting the IP +20cm. Afaik MVD extends to roughly 23cm. I'm not sure if target spectrometer tracks require mvd hits or something like that. But since you have different mappings of the angular regions onto your detector for both cases, I think its quite difficult to make statements...

Cheers,

Stefan

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Karin Schönning on Wed, 03 Dec 2014 14:55:45 GMT
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Hi Stefan, and thanks for your clarifications. Yes, there was a typo and you are correct that I meant 50 degrees. I wanted to, if not mimic, but at least cover the same range as i have for Lambda Lambdabar.

Further checks seems to boil down to two, possibly completely separate problems (or maybe issues rather than problems):

1. Something happened with the code during the summer which had the consequence that the reconstruction efficiency and resolution for antiprotons, not protons, becomes worse above ~20 degrees.
This can be seen in the attached files, where the black dots represent revision 24660 and the red revision 26319 (similar to the Oct2014 release in this sense as i understood from discussions with Albrecht).
Both plots show the acceptance as a function of the lab angle theta for protons (eff_24660_26319_p.pdf) and antiprotons (eff_24660_26319_pbar.pdf) from decays of Lambdas and anti-Lambdas from isotropically
generated pbar p -> Lambda Lambdabar at 1.64 GeV.

2. The reconstruction efficiency is smaller for antiprotons than for protons. This probably has a perfectly explanation - the antiproton may annihilate with detector material and escape detection. I am looking
into this to try to confirm it. In the attached plots theta_eff_p_pbar.pdf and theta_eff_p_pbar_24660.pdf, the efficiency for protons (black dots) and antiprotons (blue points) are shown as a function of
theta, for the 26319 revision (theta_eff_p_pbar.pdf) and the older 24660 revision (theta_eff_p_pbar_24660.pdf). The channel is the same as above. You can see that this effect is larger for particles going
through the target spectrometer than the forward tracker. In the late revision, there is an additional drop at ~20 degrees but also at other angles the antiproton yield is smaller. In revision 24660 the lower antiproton yield is evenly distributed in the target spectrometer.

Cheers,
/Karin

File Attachments

1) eff_24660_26319_pbar.pdf, downloaded 533 times
2) eff_24660_26319_p.pdf, downloaded 510 times
3) theta_eff_p_pbar.pdf, downloaded 523 times
4) theta_eff_p_pbar_24660.pdf, downloaded 521 times

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by Stefan Pflueger on Wed, 03 Dec 2014 16:39:34 GMT
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Hi Karin,

ah ok I see, thanks for clearing it up. Regarding:

1. Do you use an identical MC data sample (same seed etc)? I guess you do, but then also fluctuations for each bin are already quite interesting -> something central has to have

changed. Specifically the drop at 20 degrees (comes solely from the revision change if I understood correctly) is also a strange, as it seems to be more equal again at 25 degrees... Maybe some material/geometry changes or a specific detector is located at this angular range...

2. Hmm yeah looks like that this difference was always present and the effects from the changes of the different revisions are visible here... What I also found strange is that the protons have a lot larger acceptance at angles below 3 degrees for the rev 24660 as compared to 26319..

Cheers,
Stefan

Subject: Re: Efficiency reduction of antiprotons above 20 degrees
Posted by StefanoSpataro on Sat, 06 Dec 2014 16:02:22 GMT
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Dear Karin,
I would like you to comment (just to be sure) if you are using ideal tracking, if you removed out backward propagation, or if you are using standard macros. Moreover, your "old" trunk was the trunk or a version of the scrut release?

Apart from this, I checked a bit the numbers, in the meantime of the two versions the radius of the first plane of GEM was reduced from 42 cm to 38 cm. This corresponds to the region around 22° where you see the jump, then maybe it is connected to this change in the geometry. Since in the GEM region the field is not constant, maybe protons and antiprotons are deflected (in theta) diferently, and this is the reason why the hole apepars only for one kind of particle. If I am correct, this should happen also for the pions with the same momenta, maybe you can check. Or maybe simply antiprotons interact with some materials in that region and are absorbed, while protons continue, hit again some gem plane and the efficiency is still high.

In this sense, I would suggest to have a comment from the GEM experts (Radek, Dima).
