Subject: PANDA ToF Task Force Questions
Posted by Lars Schmitt on Fri, 26 Jun 2009 14:32:46 GMT
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Dear colleagues,

In Turin it was decided that we collect a number of questions leading to a decision on the barrel Time-of-Flight detector of PANDA. The aim is to work on these in questions in a task force to find as many answers as possible until the next Collaboration Meeting in September.

In this forum we want to discuss until July 8th what these questions should be. As a starting point I put here the topics raised already at the Technical Board in March:

Detector Requirements
- Minimum time resolution, path length, detector resolution
- Required separation power
- Evaluation of relative timing

Implications on PANDA
- Interaction with EMC
- Minimum material budget, realistic material budget with r/o cables etc

Physics Impact
- Momentum window
- Rejection levels
- Improved global PID
- Channels requiring ToF

Criteria for ToF decision
- Physics case
- Control on conversions
- Budget/groups

Stan Belostotski agreed to coordinate the effort with my help.
We will compile the questions collected here to give them to the various groups to work on them.

Best regards,

Lars

Subject: Re: PANDA ToF Task Force Questions
Posted by Klaus Föhl on Tue, 07 Jul 2009 15:58:24 GMT
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Dear colleagues, dear Lars, dear Stan,

Here in Giessen we are interested in the reactions p-bar p going to gamma gamma and also p-bar p going to gamma pi0. It is the inverse reaction to (virtual) gamma gamma going to p-bar

p which has been measured at Belle and also cross channel to Compton scattering.

Our current simulations show that from the statistics and background we are close to the feasibility limit in PANDA. Any further material upstream of the EMC acts as a pre-shower component and degrades the EMC performance.

Hence we suggest to include these two physics channels into the simulation programme for the RPC ToF detector assessment.

Best regards from Giessen

Klaus (Föhl)

Subject: Re: PANDA ToF Task Force Questions
Posted by Vladimir Vikhrov on Wed, 08 Jul 2009 11:49:33 GMT
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Dear colleague,

concerning the implication of barrel TOF on PANDA EMC i would propose to make a plot - radiation length of all sub-detectors (MVD, STT/TPC, barrel TOF, barrel DIRC) until EMC versus polar angle. The similar plot was already done for beam & target pipes and MVD (look for example Rene Jakel report on collab. meeting 11.12.2007). Barrel TOF could be included in 3 options:

1) RPC (X/X0 ~6% as declared, but overlapping and realistic material budget should be taken into account)
2) Scintillator TOF with constant thickness in Z (let it be 4 cm)
3) so called "tapered" scintillator, with ~constant X/X0 versus Z

During the last collab. meeting Bertram Kopf presented the result of his MC simulation for the second option. He didn't found strong theta dependence in losses of efficiency of pi0 reconstruction and S/B ratio (pp. 10&11 of his report). This is what i would like to understand. For the particles coming from the interaction point (it is true for the gammas from pi0 decay) radiation length depends on polar angle - if at theta=90deg barrel TOF has a X/X0=10% then at 30deg it will be 20% (two times!) and at 20deg will be 29%. But we see 2% drop in efficiency loss at 20deg only. If somebody understand this?
I think we need to continue our MC simulation to understand how barrel TOF material can affect on EMC versus polar angle.

Best regards from St.Petersburg,
Vladimir

Subject: Re: PANDA ToF Task Force Questions
Posted by Bertram Kopf on Tue, 14 Jul 2009 10:32:44 GMT
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Dear Vladimir and all others,

sorry for the late reply to your posting. During last week I was out of office and even not online. But here - with a delay of few days - are some answers to your questions/ideas.

vikhrov wrote on Wed, 08 July 2009 13:49
concerning the implication of barrel TOF on PANDA EMC i would propose to make a plot - radiation length of all sub-detectors (MVD, STT/TPC, barrel TOF, barrel DIRC) until EMC versus polar angle. The similar plot was already done for beam & target pipes and MVD (look for example Rene Jakel report on collab. meeting 11.12.2007).

You can find below the X0 plot for the geometry which we have used for our TOF simulation studies. The barrel ToF is not included here (see also EmcTDR and Physics Book):

vikhrov wrote on Wed, 08 July 2009 13:49
Barrel TOF could be included in 3 options:

1) RPC (X/X0 ~6% as declared, but overlapping and realistic material budget should be taken into account)
2) Scintillator TOF with constant thickness in Z (let it be 4 cm)
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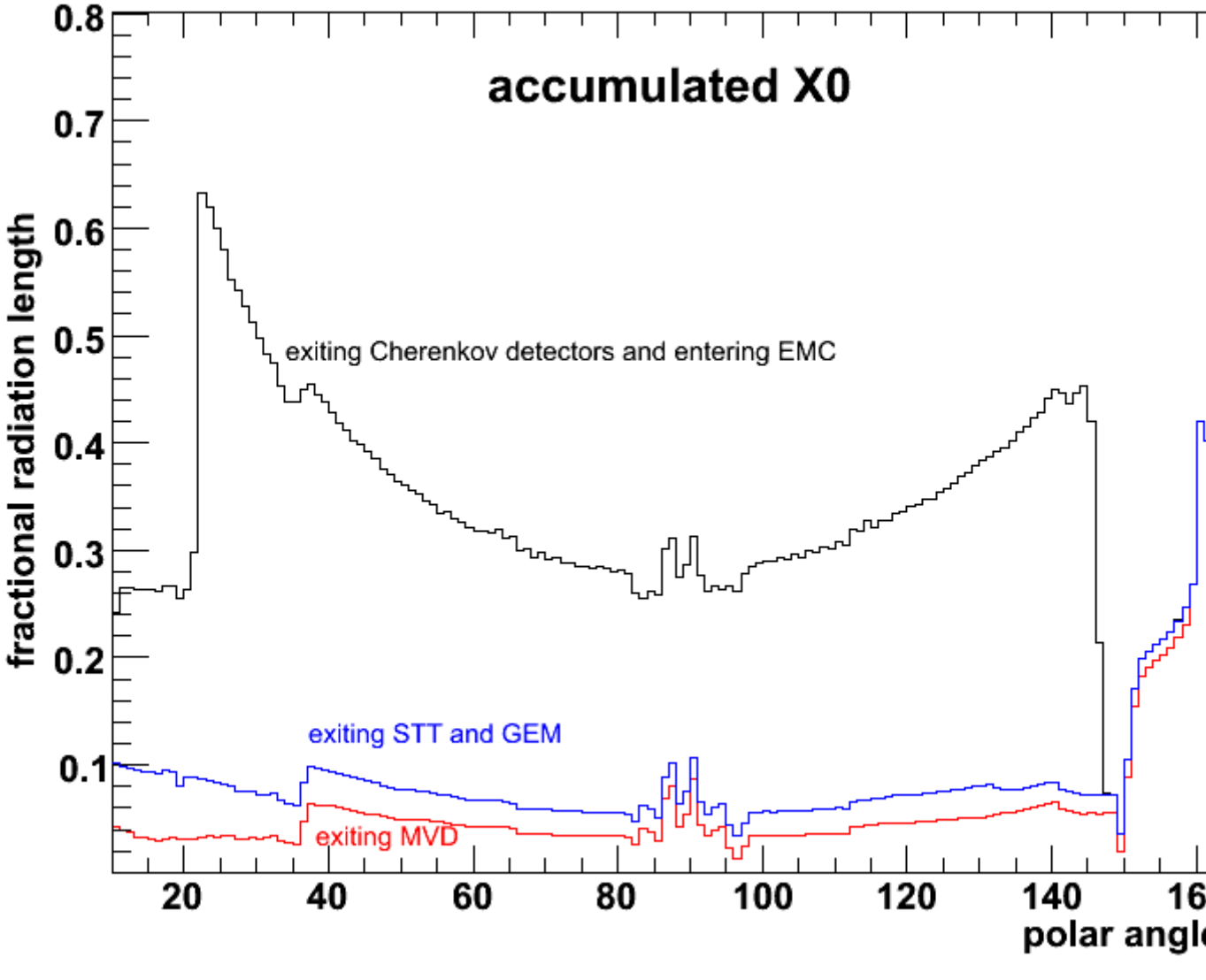
I think we need to continue our MC simulation to understand how barrel TOF material can affect on EMC versus polar angle.

You are right! One can see just a slight theta dependence. The reason I think is that these plots are the average efficiency and S/B ratio over the hole pi0-momentum range (between 10MeV/c and ~1.6 GeV/c) and that the cos(theta) angle of the pi0 is plotted on the x-axis. As you know, the pi0 decays into two photons with a specific (minimum) opening angle.The plot at (this is just a web-link since it seams to be not possible to upload more than 1 file here):
http://www.ep1.rub.de/~bertram/plot14.png
shows the momentum dependency of the opening angle. That means that the the direction of the two photons can be strongly different to the pi0 direction.

Best regards,
Bertram.

File Attachments

1) X0.png, downloaded 941 times



Subject: Re: PANDA ToF Task Force Questions
Posted by Bertram Kopf on Tue, 14 Jul 2009 12:03:56 GMT
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Dear Klaus,

Klaus Föhl wrote on Tue, 07 July 2009 17:58
Here in Giessen we are interested in the reactions p-bar p going to gamma gamma and also p-bar p going to gamma pi0. It is the inverse reaction to (virtual) gamma gamma going to p-bar p which has been measured at Belle and also cross channel to Compton scattering.

Our current simulations show that from the statistics and background we are close to the feasibility limit in PANDA. Any further material upstream of the EMC acts as a pre-shower component and degrades the EMC performance.

Hence we suggest to include these two physics channels into the simulation programme for the RPC ToF detector assessment.

those studies have been done and already presented at the last Collab. Meeting for the gamma gamma channel. You can find the results on page 12 and 13 of my presentation in the TB session.

Best regards,
Bertram.

Subject: Re: PANDA ToF Task Force Questions
Posted by Bertram Kopf on Tue, 14 Jul 2009 13:41:09 GMT
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Dear Vladimir,
I would like to continue our private discussion about the tapered option (two weeks ago) here in the forum so that all others can also follow and contribute to this topic. As you mentioned, the tapered option has the big advantage that the material budget is almost independent of theta with up to 3 time less effective material budget for the forward angles (around 20 degree). This - of course - would have a lot of advantages for the photon reconstruction efficiency.
On the other hand I have some doubts that one can achieve the required time resolution of about 100ps. The time resolution depends on the number of optical photons reaching the readout devices at the end of the ToF bars. Due to the fact that the photons propagate through tapered bars where the slice plane becomes smaller I guess that the loss of photons is much bigger compared to non tapered bars. This effect is simply caused by Liouville's theorem. Am I right?
Therefore I would propose to firstly find out which time resolution is feasible to achieve with this geometry before one starts with more detailed simulations. What do you think? Does it make sense?

Best regards,
Bertram.

Subject: Re: PANDA ToF Task Force Questions
Posted by Klaus Föhl on Wed, 15 Jul 2009 15:21:40 GMT
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Dear Bertram,

Bertram Kopf wrote on Tue, 14 July 2009 14:03

Klaus Föhl wrote on Tue, 07 July 2009 17:58
Here in Giessen we are interested in the reactions p-bar p going to gamma gamma and also p-bar p going to gamma pi0. It is the inverse reaction to (virtual) gamma gamma going to p-bar p which has been measured at Belle and also cross channel to Compton scattering.

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Our interest also involves gamma pi0, and in the context of signal and background channels I have been explained that pi0 pi0 is also an important channel. The simulations that you showed in Torino, are they based on the PandaROOT framework?

From talking to our student Irina Brodski I understand that these neutral channels are pushing PANDA performance. We in Giessen need to have full simulations to be able to assess the performance influence of an added RPC and only on this basis give our vote at decision time.

Talking within our group, I understand that Irina is still faced with some quirks in the EMC geometry. On the other hand, having such events simulated would suit Irina as she could analyse these for her Diplomarbeit.

Regards

Klaus

Subject: Re: PANDA ToF Task Force Questions
Posted by Bertram Kopf on Wed, 15 Jul 2009 15:55:21 GMT
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Dear Klaus,

Klaus Föhl wrote on Wed, 15 July 2009 17:21
Our interest also involves gamma pi0, and in the context of signal and background channels I have been explained that pi0 pi0 is also an important channel. The simulations that you showed in Torino, are they based on the PandaROOT framework?

the results from Torino are based on the full simulation with the old BaBar-like software. We have also studied the gamma pi0 channel w/ and w/o the Barrel ToF. I didn't show these results there because the efficiency loss and the decrease of the signal to background ratio originated by the Barrel ToF are similar in comparison to the results of the gamma gamma channel.

Best regards,
Bertram.
