From: George Lolos <George.Lolos@uregina.ca>
Subject: **Re: MC stuff**
Date: June 6, 2007 5:33:01 PM GMT-06:00
To: Matthew Shepherd <mashephe@indiana.edu>
Cc: Zisis Papandreou <zisis@uregina.ca>, Blake Leverington <leverinb@uregina.ca>, Alex Dzierba <dzierba@indiana.edu>, "George J. Lolos" <George.Lolos@uregina.ca>

Hi Matt:

I agree with you that the beam spot size and Moliere radius are not contributing to the timing spread in proportion to their values. However, I am not so sure that it does not contribute to the same degree that you propose.

Indeed, the "jitter" of the beam spot size on an event-by-event basis contributes to the sigma of the timing difference TDC(N)-TDC (S) but preserves the equivalent invariant length of the BCAL in the [TDC(N)+TDC(S)]/2 histogram. So, on an event-by-event analysis the beam spot size does not contribute to the timing resolution in the sum but it does for the difference, which represents hit location.

Now, for the shower cone and for a single event, in order to preserve the event-by-event sequence, light that exceeds the threshold will cross the TDC of the PMT closest to it earlier than the other and the same goes in reverse for the other side of the cone for the other PMT. So, the TDC(N)-TDC(S) will reflect some spread due to non-symmetry of the cone and variations of thresholds but will not reflect the extend of the shower physical size. This I agree with you. However, the sum is a different case because, in the same logic, the sum will result in a "diffusion" of the "invariant timing length" of the BCAL since now you will not get the same length because within the same event you get a spread due to size. So, it looks to me that in the sum the Moliere radius will contribute to the timing spread and - if all else were equal (perfect cylinder and exact same thresholds) - the difference in path length the photons would have to travel to their closest PMT's would be around 7 cm. Such a number would clearly over-correct because of variations that tend to fuse the origins of the photons that exceeded the thresholds of the discriminators. How much now one needs to correct is an open question. One way of telling would have been in the case of a really pencil beam to eliminate the beam spread, but...So, the point is that sums and differences of TDC's reflect different sensitivities to beam spot and Moliere radius.

My two bits,

George

Matthew Shepherd wrote:

> Hi guys,
>
> I think the Moliere radius issue is quite different from the beam spot. The beam spot effectively describes the transverse "jitter" of single photons hitting the BCAL, while the Moliere radius describes the width of a single shower.
>
> Imagine the shower forms like a cylinder. Changing the Moliere radius changes the radius of this cylinder. Increasing the beam spot size increases the random motion or placement of this cylinder on the BCAL. If the timing is determined strictly by photons on the leading edge of the pulse (those coming from the surface of cylinder closest to the PMT) then the actual Moliere radius itself should have no impact on the timing resolution. Beam spot will affect things because it introduces a a jitter in the distance from the PMT to the shower cylinder.
>
> Of course the shower isn't a perfect cylinder and there will be variations in the radius of charged particles that produce the timing pulse. My instinct is that these variations though are on a smaller scale than the Moliere radius itself. I think unfolding the Moliere radius in the same style as the beamspot is unfolded will result in a bettter-than-actual timing resolution. Perhaps there is some way to get a feel for the shower size jitter from simulation.
>
> Cheers,
>
> Matt
>
> On Jun 6, 2007, at 4:54 PM, Zisis Papandreou wrote:

Hi folks:

Blake and I have had some discussions on the unfolding of all effects from the timing resolution for the t_diff. The two main effects are the Moliere expansion and the beam spot size with the 18mm radius.

1. Moliere radius for our BCAL is R_m=3.58cm 90% of the shower is in a cylinder of radius R_m and 99% in a cylinder of radius 3.5R_m. The profile is shown in that 500MeV electron NIM paper I sent last week (N. Akchurin et al) in Figure 5. We can parametrize the shape and use it analytically to unfold it from the timing resolution, or we can run some simulations on the mixed Pb-SciFi geometry with the effective Z, A, and rho.

2. The beam spot size is info is on the WIki, courtesy of Matt:
http://www.jlab.org/Hall-D/software/wiki/index.php?title=Hall- B_Collimators_and_Flux&redirect=no

Anything else to account for?

For Blake only:

3. hydra10 is up and running again.

4. Reminder: please send me the PDF from your presentation to the group for posting on P3I.

Cheers, Zisis...

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