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Central Muon Upgrade Cosmic Cap Side Wall Gap Counters

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1 Holes in the Cosmic Cap Coverage

The Cosmic Cap counters [1, 2] are a crucial part of the upgraded DØ central muon trigger. We anticipate that the high-p_T muon trigger in the region $|\eta| < 1$ will require a hit in these scintillation counters which are located outide of the muon toroid. Therefore, in order to maximize the geometrical acceptance of the trigger, it is important to avoid having gaps in the coverage.

We have been studying the Cosmic Cap detector in order to identify and fix holes in the coverage by adding new scintillation counters. The top of the central muon detector is well-covered having no holes and only small cracks between detectors. The bottom is very difficult to cover because of platform supports; we have Cosmic Bottom counters in the places that we have WAMUS coverage. We are not trying to address problems with the bottom in this note. The East and West sides are well-covered except for a region at the lower edge spanning $|\eta| < 1$. Here, there is a gap in the coverage of the C-Layer Octant-7 and Octant-4 WAMUS PDT's. These are only 165" long where full C-Layer coverage demands 218" long PDT's. There is a corresponding gap in the Cosmic Cap coverage. This gap could be fixed by adding counters.

The azimuthal size of the gap is 5.4 (times two), spanning $\phi = -30.6$ to -36.0 degrees and $\phi = 210.6$ to 216.0 degrees. The gap spans the length of the central region, including the CF WAMUS Ring on the EF magnet.

2 Gap Filling Counters

We propose the "Cosmic Cap Side Wall Gap Counters" to fill in the acceptance. The 8 counters which fill each gap (East and West side gaps) would be 35" wide. Six will be of length 49"; two will be of length 67". The length of the 49" counters corresponds to the 1/2 the width of the WAMUS PDT's on which the scintillation counters would be mounted. The length of the 67" counters is the full width of the corresponding WAMUS PDT's. Sixteen counters (plus two spares) are needed in total. The design will be similar to the CF Bottom C-layer and EF Bottom B-Layer counters. In short, Bicron 404a scintillator with Bicron BCF-91a waveshifter fiber in deep, vertical grooves. The counters will be read out with two 1.5" EMI PMT's into presently spare front-end electronics channels.

The new counters will be mounted between the B-Layer PDT's and the WAMUS truss frame. Presently the WAMUS B-Layer chambers are to too close to the truss to allow space for the scintillator; luckily, it appears that there is extra space between the PDT's and the magnet coils. The PDT's could be moved closer to the coils freeing space between the PDT's and the truss frame[3]. The height of the counter and the PMT cover will be about 1 3/4". This will exceed the gap between the truss frame and the PDT, even if the PDT's are moved closer to the magnet. The PMT cover will have a slightly modified design compared to previous (EFB and CFC) designs.

Counters of this size can be shoehorned into position. But installation of the counters is made easier by any of several possible minor modifications to the truss. Shortening of the 4"-high plate along the floor (it looks like a kick plate) could provide some space. The diagonal-running box beams could be removed for counter installation. They would be returned and bolted in place after the counters are installed. This wouldn't create any mechanical difficulties for the truss [4].

We chose the 1.5" EMI PMT's because counters with a 35" width require 23-27 grooves (times two) with 6 fibers per groove. The diameter of each bundle of fibers exceeds the active area of the 1" MELZ PMT but not the 1.5" EMI PMT. We plan to obtain the PMT's and bases from the supply at MSU.

The principal cost is in the scintillator and fiber. In total the cost would amount to approximately $15,000.

3 Alternatives

An alternative is to replace the 6 center-most PDT's (217, 227, 237, 214, 224, and 234) with 228" spares from the old EF WAMUS C-layer. However, these new PDT's would then occupy the same space as the East-West platform supports when the detector was closed, or the PDT's would have to be mounted 6" further from the central truss. If that were to be done, access to the electronics under the platform would be restricted to a passage less than five feet high and the detector could not be opened as far in the collision hall. Having done all that, we would still have the same angular gap in the scintillation counter coverage. We would then add scintillator coverage to the C-Layer, not to the B-layer.

We don't think this alternative is as good for the reasons mentioned. We think it is better to simply add scintillator coverage to the B-Layer. We think the trigger will be nearly as good, despite the lack of WAMUS C-Layer coverage, because it will have a coincidence of the CFT, $A-\phi$, and Cosmic Cap counters.

Another alternative is to use three 100" long counters instead of six 49" long counters on each side. We prefer the shorter counters for two reasons: 1) the shorter counters are easier to install and 2) the shorter counters have a higher light yield. We are concerned that the the number of photoelectrons expected from the long counters might be too small in the corners. We prefer to have a minimum of 20 photons.

4 Summary

We propose the "Cosmic Cap Side Wall Gap Counters" to fill in holes in the Cosmic Cap acceptance. Two regions corresponding to an azimuthal angle of 5.4 degrees, spanning the length of the central muon system, are presently not covered by the Cosmic Cap. Adding 16 new counters to fill these gaps would allow the muon trigger to use a coincidence of the CFT, $A-\phi$, and Cosmic Cap counters uniformly on the top and sides of the detector.

References

[1] B. Baldin *et al.*, "Design of the Central Muon System" to be made into a DØ Note (March 24, 1997).

[2] J.M. Butler *et al.*, "The DØ Muon System Upgrade", DØ Note 2780 (1996).

[3] Del Miller, private communication.

[4] Herm Streede, private communication.