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SDC
SOLENOIDAL DETECTOR NOTES

CHAMBER RESOLUTION STUDIES

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I was asked by Duncan Carlesmith to study how the momentum resolution of various fits which utilize the muon system depend on the assumed muon point resolution. In these studies, I use the chamber stations and thicknesses proposed at the ORNL SDC meeting except I assume a 60 cm thick BW1. I assume the layer structure recently proposed at the SDC meeting at the SSCL (ie 4 physical theta layers and 4 phi layers in BW1 , 4 theta layers and 2 stereo layers (mostly phi layers) in BW2, and 4 theta and 4 layers in BW3). We use a projective design for the theta layers where the coordinate is measured in a plane whose normal points back to the interaction point. Each offset doublet is modeled as a single space point with resolutions of 250, 500, and 1000 microns. The theta layers in a given chamber station are placed on the inner and outer radius in order to maximize the theta lever arm. The LoI model of the CTD and silicon is used which provides 26% fractional momentum resolution at 1 TeV.

Figure 1 gives the fractional momentum resolution as a function of Pt for a full off line fit which incorporates the beam constraint (20 microns in rphi and 5 cm in theta), the silicon, CTD and muon chambers. The solid curves are for tracks at eta = 0 and assume muon space point resolutions of 250, 500, and 1000 microns. The dashed curves are for muons produced at an extreme eta of 1.5. The dotted curve shows the fractional momentum resolution in the absence of any help from the muon system. The muon system with space errors of 250 microns gives nearly a factor 2 improvement over the resolution obtainable from the inner tracker system. Essentially 1/2 of this improvement is gone if the space point resolution is degraded to 1 mm at eta = 1.5.

Figure 2 gives the fractional momentum resolution as a function of Pt for the so called "hi luminosity" scenario specified in the LOI. This fit assumes that the CTD becomes too occupied for use in track fitting at high luminosity and hence momentum momenta are measured by the beam constraint, the silicon, and muon chambers. The solid curves are for tracks at eta = 0 and assume muon space point resolutions of 250, 500, and 1000 microns. The dashed curves are for muons produced at an extreme eta of 1.5. For the high luminosity option the muon system is crucial. Momentum resolution degrades by roughly a factor of 2 as one degrades the space point resolution from 250 microns to 1 mm at the extreme eta = 1.5.

Figure 3 gives the fractional momentum resolution as a function of Pt for an alternative high luminosity scenario not considered in the LOI. This fit assumes that all but the outer super layer of the CTD becomes too occupied for use in track fitting at high luminosity. Hence momentum momenta are measured by the beam constraint, the outer super layer of the CTD (modeled as a stub with 2 mrad angular resolution) and the muon chambers. The solid curves are for tracks at eta = 0 and assume muon space point resolutions of 250, 500, and 1000 microns. The dashed curves are for muons produced at an extreme eta of 1.5. Momentum resolution degrades by roughly a factor of 2 as one degrades the space point resolution from 250 microns to 1 mm.

Figure 4 gives the fractional momentum resolution as a function of Pt for a stand alone muon system where momenta are measured entirely via the muon toroid. This curve has both relevance for a 2nd level theta trigger and for a redundant

momentum measurement in the off line analysis. The solid curves are for tracks at eta = 0 and assume muon space point resolutions of 250, 500, and 1000 microns. The dashed curves are for muons produced at an extreme eta of 1.5. Momentum resolution degrades by roughly a factor of 4 as one degrades the space point resolution from 250 microns to 1 mm beyond Pt = 500 GeV.

Figure 5 gives the fractional momentum resolution as a function of Pt for a possible second level phi trigger which uses information from a 100 micron (r phi) beam constraint, the outer CTD stub (assumed to have 2 mrad resolution) and the phi layers of muon system. The solid curves are for tracks at eta = 0 and assume muon space point resolutions of 250, 500, and 1000 microns. The dashed curves are for muons produced at an extreme eta of 1.5. A relatively small degradation in momentum resolution exists for the second level phi as one degrades the space point resolution from 250 microns to 1 mm.

My conclusion is that an rms spacial resolution of 250 microns for a two layer offset doublet is still a desirable goal. For most applications a 500 micron rms resolution might be tolerable ; a 1 mm resolution would create a significant degradation in performance. The most stringent resolution requirements comes from the use of the muon system as a stand alone system which offers a redundant momentum measurement for the purposes of matching and other off line analyses.

FIG 1--Full:B.C + SI + CTD + MUON

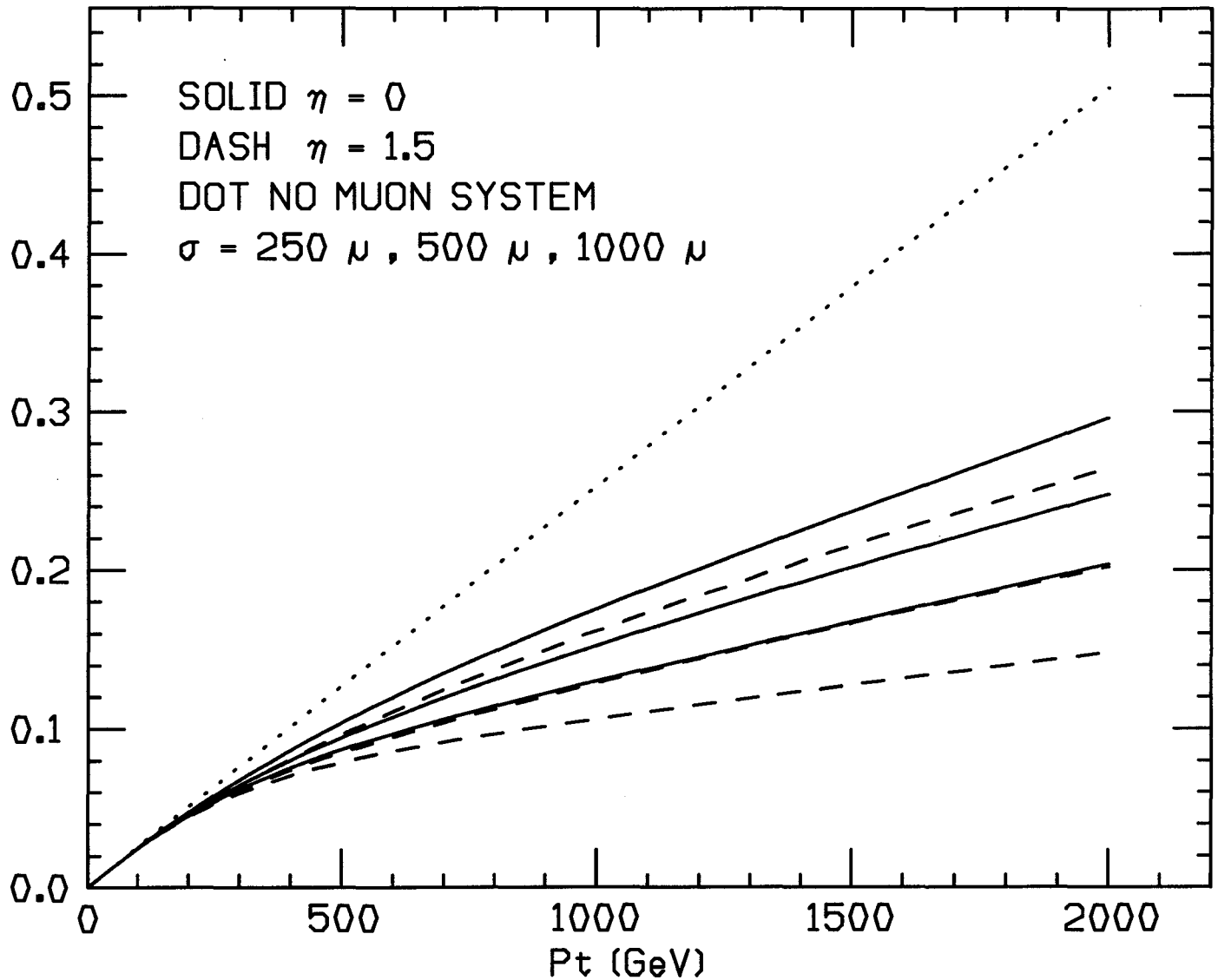

FIG 2 -- h1 lum: B.C + SI + MUON

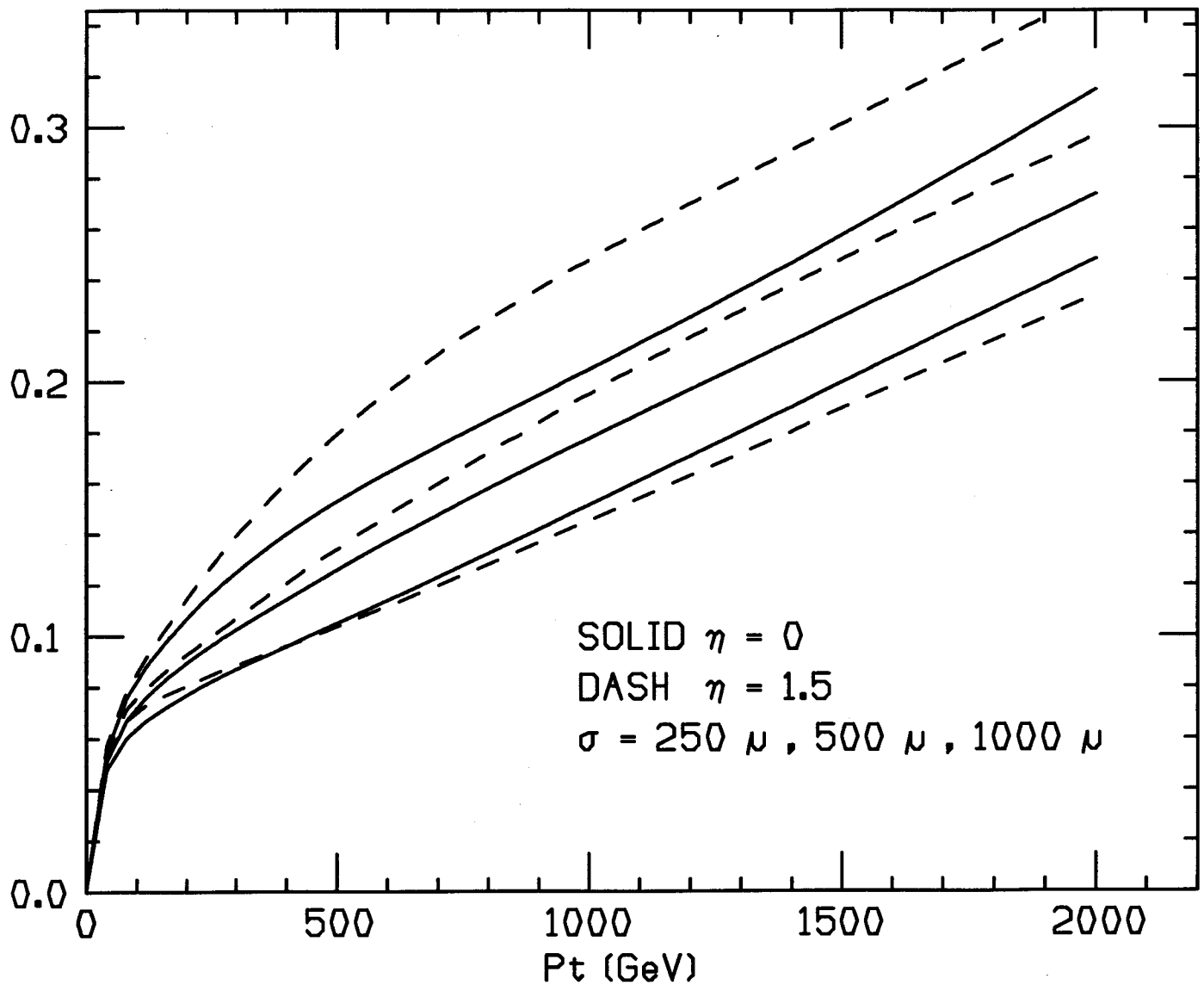

FIG 3 - h1 lum2: B.C + OUTER CTD + MUON

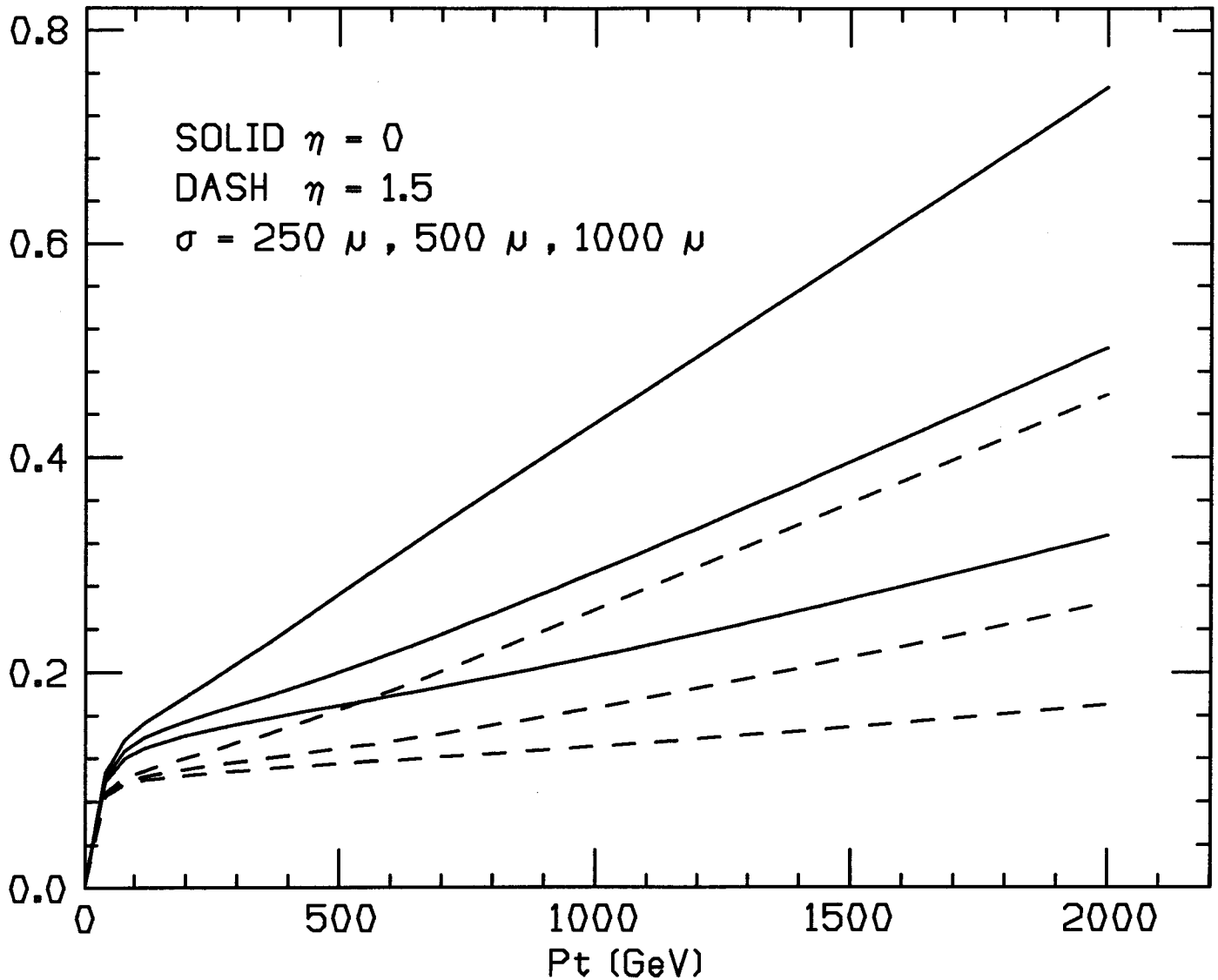

Fig 4 -- SA : MUON ONLY

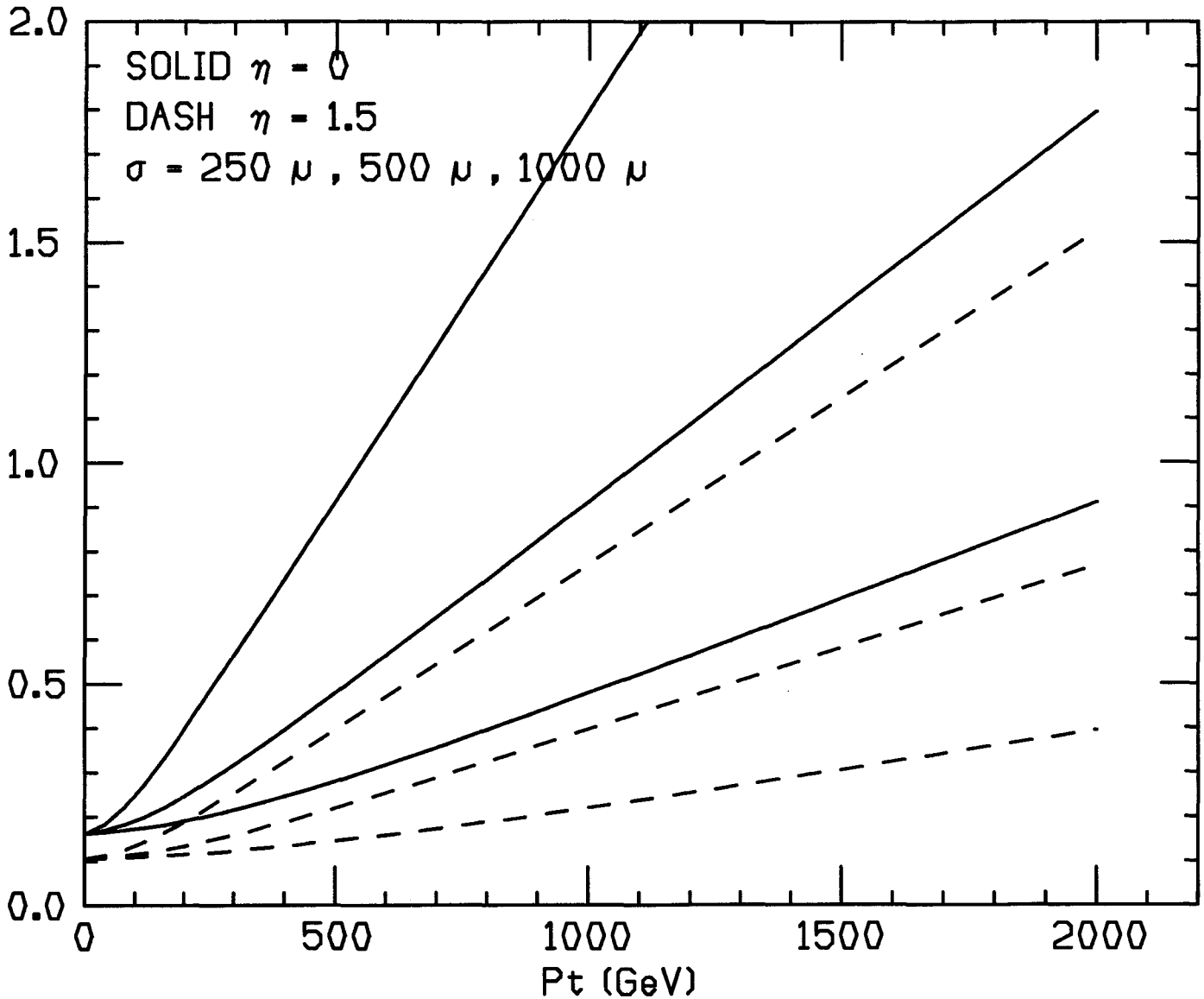
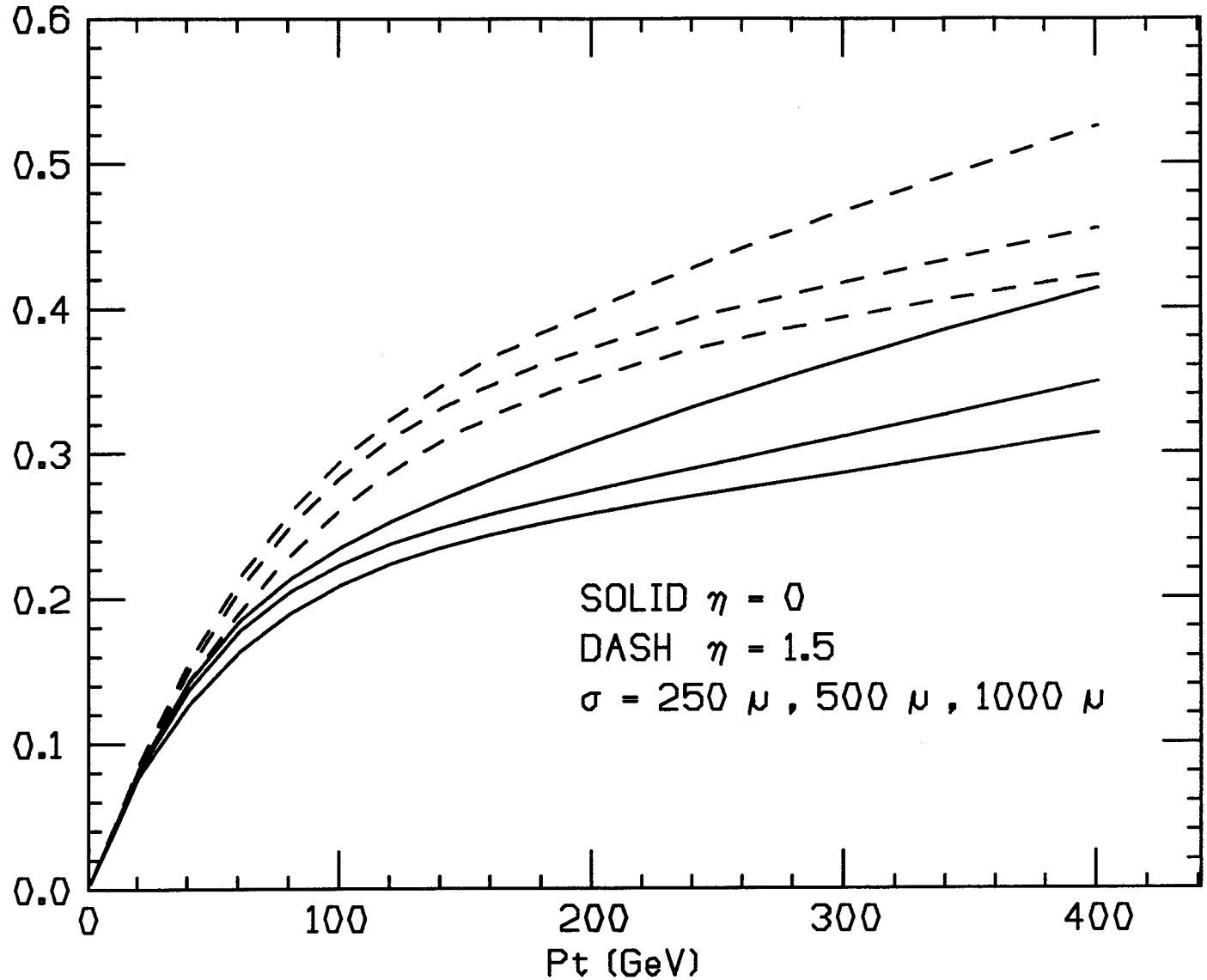
FIG 5 -- PHI TRIG : BC+OUTER CTD+MUON