Prospects of D^0 TSSA Measurements With DSSD

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Possible Inner Tracker Configurations

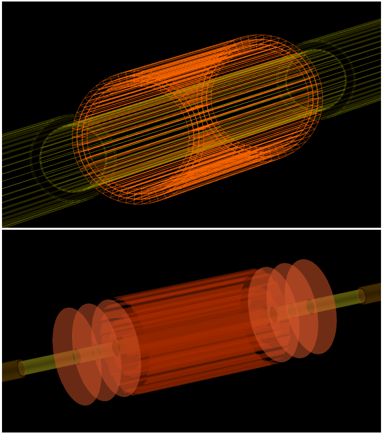


Figure 1: MicroMegas (above) and DSSD (below) TDR configurations

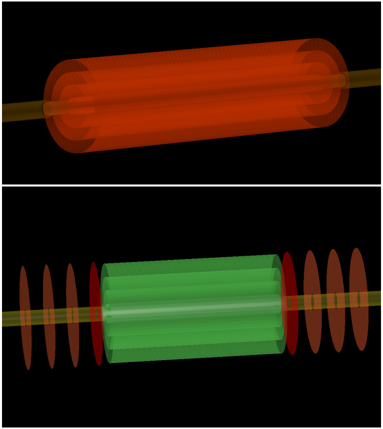


Figure 2: MAPS : TDR (above) and 'wishlist' (below) configurations

Studies So Far

- Studied expected secondary vertex resolution of all four possible SVD configurations
- Expected D^0 and D^+ TSSA statistical uncertainties with MAPS based SVD (ideal PID and realistic PID)
- Studied difference between TDR configuration and 'wishlist' configuration of MAPS SVD
- Looked at the case with no SVD at all
- Detailed analysis note available at : https://indico.jinr.ru/event/4594/ (it will be updated as I perform more simulations) - *SPD now stores analysis notes on Indico*
- It is probably more likely we might end up with DSSD as SVD (or in the worse case scenario, keep the same MicroMegas in stage II)
- We'll look into what we can expect with DSSD TDR configurations

Simulation Details

- Pythia8 + SpdRoot
- Signal : Open-charm process : $D^0 \to \pi^+ K^-$ forced
- Background : Minimum Bias : elastic not included
- Event vertex Z : Gaussian profile with $\sigma_z = 30$ cm
- KFParticle to reconstruct secondary vertex (D^0) from daughter particle candidate pairs
- 5 million signal (open-charm) events and 50 million background (min-bias) events were generated for this study

Reconstructed D^0 Properties : 1

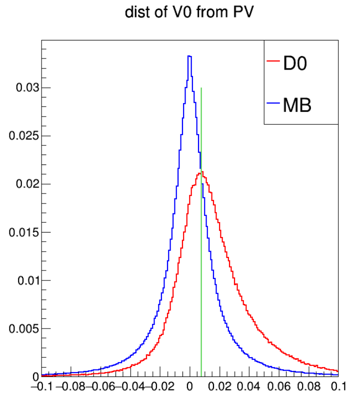


Figure 3: Decay length (left) and decay length divided by its uncertainty (notice how tight this cut is - retains a small fraction of sig but reduces bkg significantly)

Before Cuts

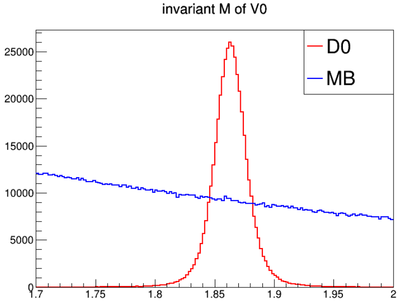


Figure 4: Reconstructed from simulations

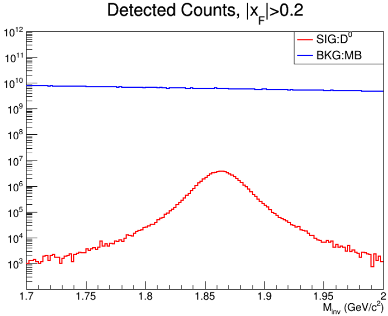


Figure 5: Projected for 1 year of data

After Cuts

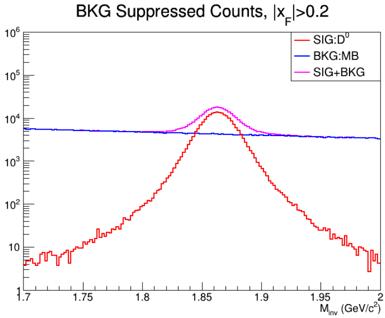


Figure 6: Projected for 1 year

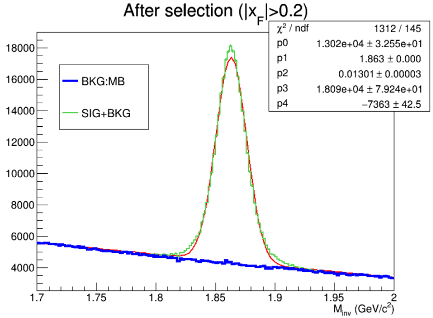


Figure 7: Projected for 1 year : signal from fit (Gaussian + linear)

Statistical Uncertainties : DSSD and MAPS

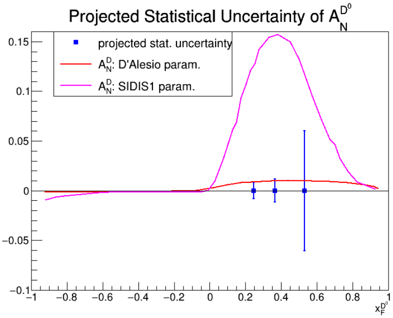


Figure 8: DSSD SVD

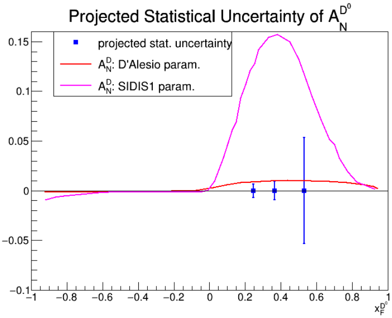


Figure 9: MAPS SVD

Similar performances : DSSD $15 - 20$ % worse

Comparison of DSSD to MAPS

Statistical uncertainties : MAPS and DSSD

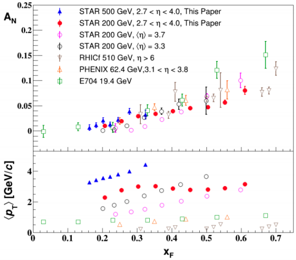
- x_F (0.2 - 0.3) : 0.00676, 0.00808
- x_F (0.3 - 0.5) : 0.00938, 0.01173
- x_F (0.5 - 1.0) : 0.05325, 0.06031

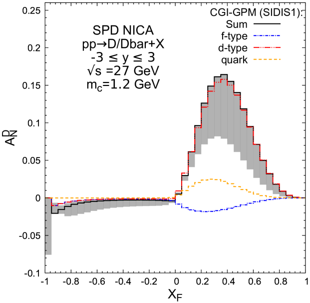
Cut efficiencies : MAPS and DSSD

- signal : 0.00825, 0.00368 (we retain less than a per cent)
- background : $5.92x10^{-6}$, $7.02x10^{-7}$

MAPS in fact allowed for even tighter cut ($L/\delta L > 4$) and therefore, better background suppression, but DSSD did not (with limited simulation statistics), comparison used ($L/\delta L > 3.5$) for both

A Side Note About x_F Range





- We have been quoting $x_F \sim 0.2$ as when A_N is expected to be relevant, but that is an after effect of looking at old pion A_N i.e. left top plot
- Our Samara colleagues tell us for D mesons, appreciable A_N probably starts at just +ve x_F i.e. left bottom plot

Comparison of Different x_F Ranges

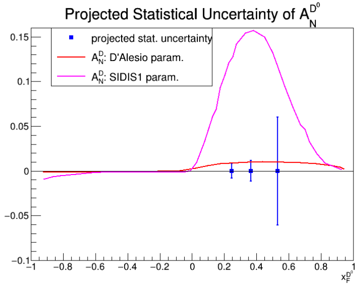


Figure 10: x_F range : 0.2 - 1.0

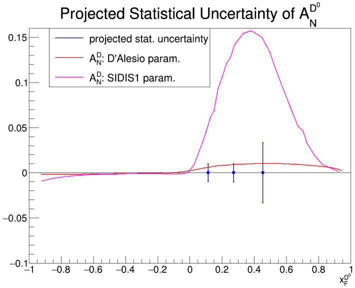


Figure 11: x_F range : 0.02 - 1.0

Left : x_F range : 0.2 - 1.0 : bins : 0.2-0.3, 0.3-0.5, 0.5-1.0
Right : x_F range : 0.02 - 1.0 : bins : 0.02-0.2, 0.2-0.4, 0.4-1.0

Summary

- DSSD TDR config performs slightly worse than MAPS TDR config $(15-20\%)$
- MAPS based SVD has better resolution, it can allow for even tighter cuts and therefore better background suprpession based on decay length and its uncertainties
- A MAPS based SVD similar to DSSD geometry (shorter barrel and with end-caps) may perform better
- May be we should start binning x_F even less than 0.2 for charmed mesons transverse single spin asymmetries (TSSA)

Thank You