D* Hadron Correlations in pPb Collisions at 5.02 TeV

Sonia Rajput[1], Sandro Bejelogrilic [2]

1. University of Jammu, India
2. Utrect University, Netherland

Outline

- Motivation
- Introduction
- D* reconstruction
- Hadron Selection
- D*–hadron $\Delta\phi - \Delta\eta$ correlations in pPb data at 5.02 TeV
- Summary & Outlook

Motivation: Heavy Quarks as Probe of QGP

- p+p data:

  ⟶ baseline of heavy ion measurements

  ⟶ test of pQCD calculation: mc ~ 1.3 GeV, mb ~ 4.8 GeV >> T_c , Λ_{QCD} → less affected than light quarks

- Due to their large mass heavy quarks are primarily produced by gluon fusion in early stage of collision.

  ⟶production rates calculable by pQCD (M. Gyulassy and Z. Lin, PRC 51, 2177 (1995)

- Heavy ion data:

  - they travel through the created medium interacting with its constituents

    Studying energy loss of heavy quarks

    ⟶independent way to extract properties of the medium.

Motivation for Analysis

- Study Heavy Flavor pair production and the charm fragmentation in pPb collisions at 5.02 TeV

- Estimate the fraction of hadrons that are coming from Heavy Flavor in the near and away side peak

- Correlations are done with:
  - Charged Hadrons
  - Charged Kaons
  - Reconstructed K^0s

Introduction

- The reconstructed D* is used as "trigger" to look for azimuthal correlations with hadrons.

- Data samples used : 78 M events.
  - LHC13b pass2
  - LHC13c pass1

- D* mesons selected within 2 sigmas

- Background estimated from D0 side bands (4-8 sigmas)

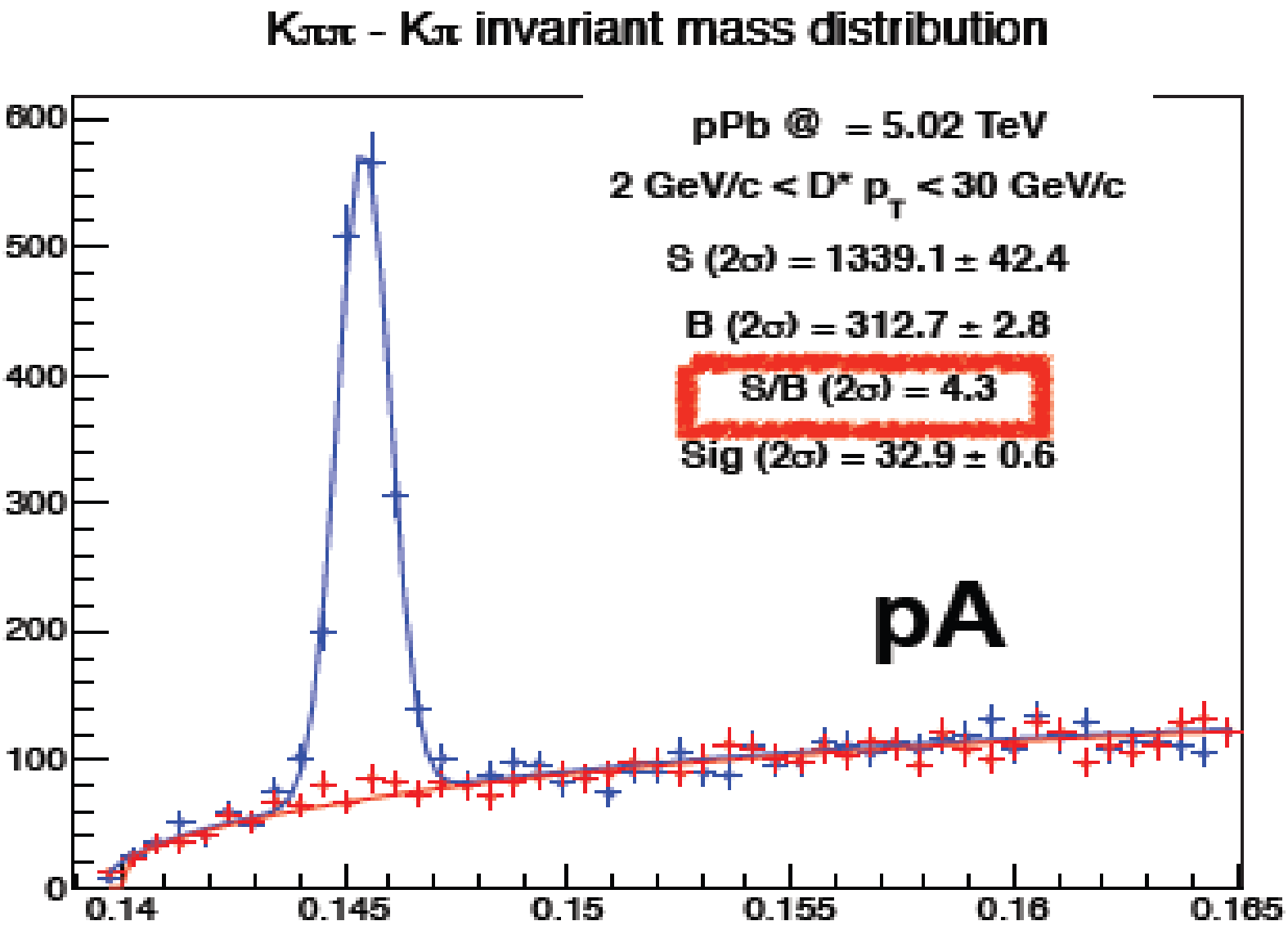
Analysis Strategy

- D* reconstructed using invariant mass method
- Azimuthal angular correlation between D* and charged hadrons
- Identify background of $\Delta\phi$ distribution using side-bands

D* Reconstruction

- $D^{*\pm}$ reconstructed in its hadronic decay channel: $D^{*\pm} \longrightarrow D^0 (k\pi)\pi^{\pm}$
- Reconstruction based on D^0 secondary vertex identification
- Combinatorial background reduced with topological selections and particle identification.

Invariant mass spectrum for D* meson



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D* - charged hadron correlations

•Steps:

1. Select D^* (Mass region ($\mu \pm 2\sigma$)) & obtain $\Delta\Phi$ by other hadrons.

1. Background removing is done by SIDE BAND TECHINIQUE (taking background from side bands of D^* spectra).

SIDE BAND TECHNIQUE

- Side Band Technique provides functionality to do Sideband Subtraction quickly and easily.
- For Invariant Mass spectra we define background in three parts in terms of sigma.
- For left side we define -8σ to -4σ and we call it left side band.
- For middle (where we have signal+bkg) we define the range -2σ to+ 2σ
- For right side we define the range +4σ to +8σ and call it right side band.

- $WB_L + WB_R - B_0 = 0$
- Where W is the scaling factor $W = B_0/(B_L + B_R)$

Now using this side band technique we will remove background and identify signal

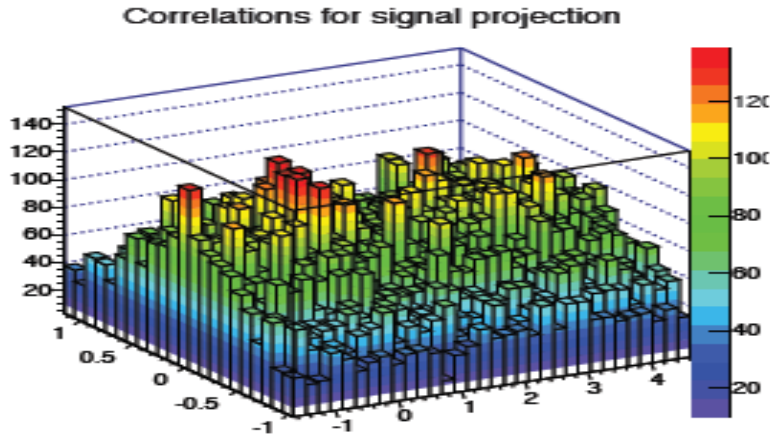
How to use SB Technique

- Obtain D*- Hadron Correlation in
- S1. $\pm 2\sigma$ region (S+B)
- S2. $-(8\sigma - 4\sigma)$ Left Side Band (B)
- S3. $+(4\sigma - 8\sigma)$ Right Side Band (B)
- S4. Add background from Left + Right with scaling.
- S5. Subtract S4 from S1.

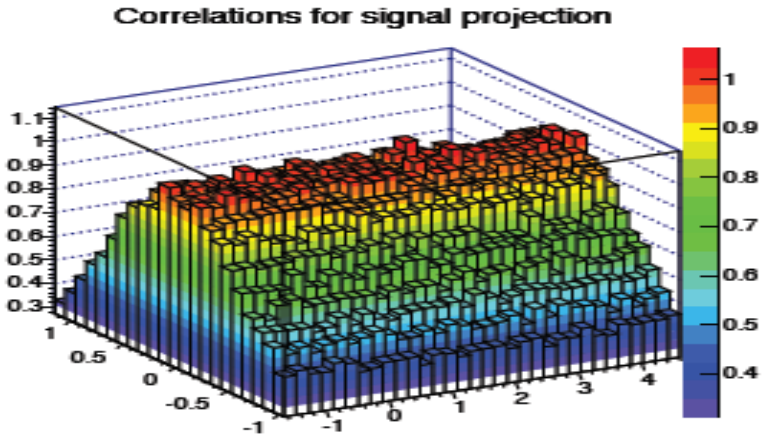
Hadron Selection

- Hadrons : AOD Tracks with :
  - TPC refit
  - ITS refit
  - Min 80 TPC clusters
  - Min 2 hits in ITS
  - pT > 0.3 GeV/c
  - SPD::kAny

Correlations D* pt Integrated , Assoc. pt> 0.3 GeV/c

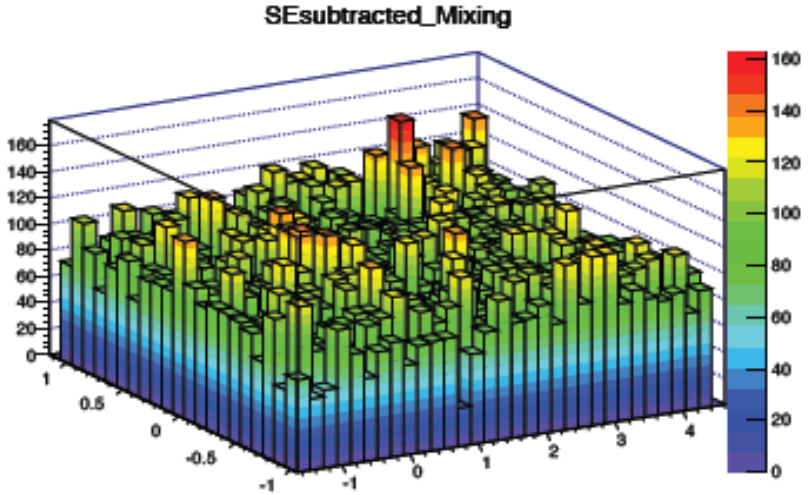


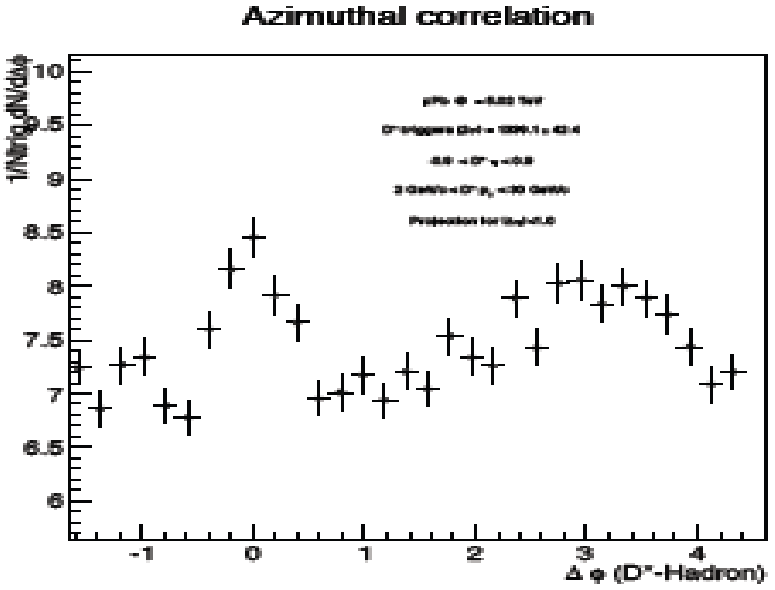
Single Event



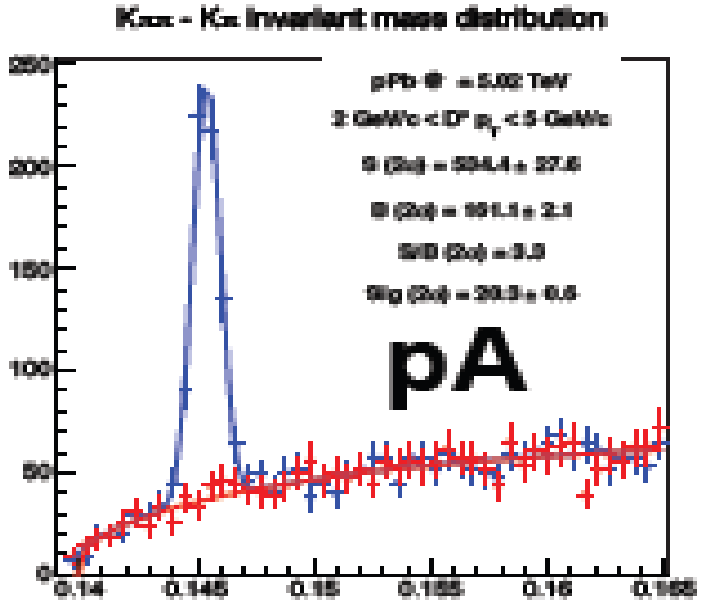
Mixed Event

After correction

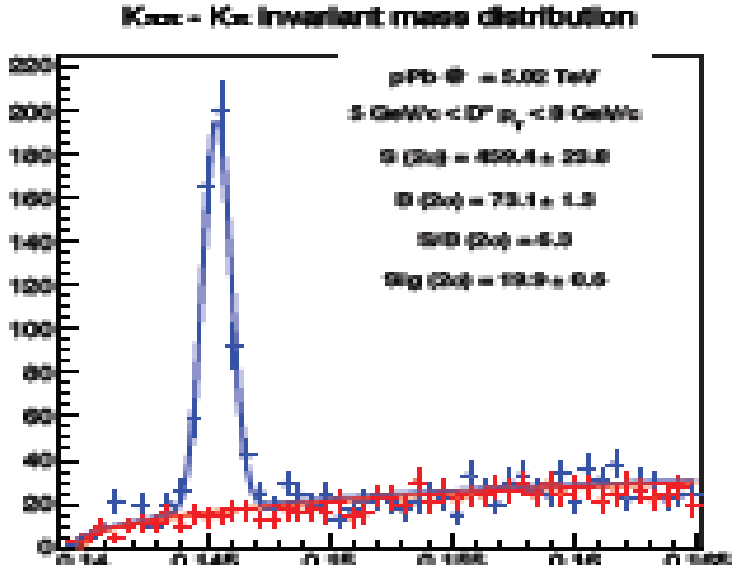




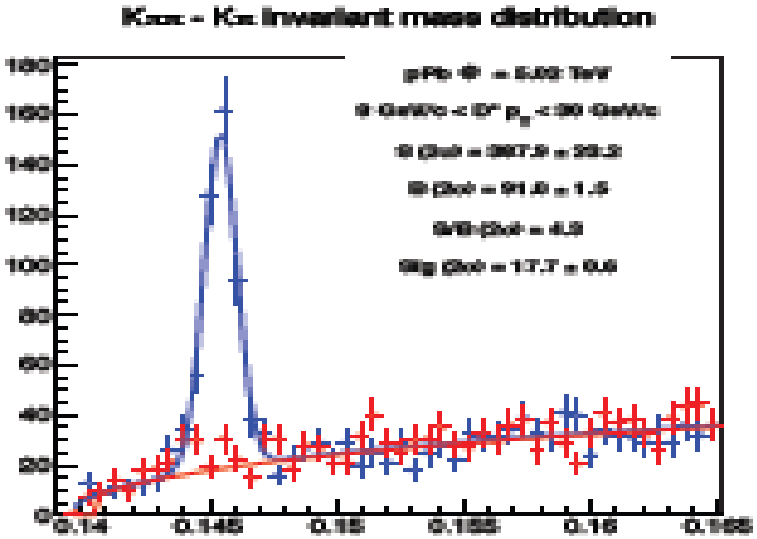
D* RECONSTRUCTED FOR DIFFERENT pt BINS



2 – 5 GeV/c

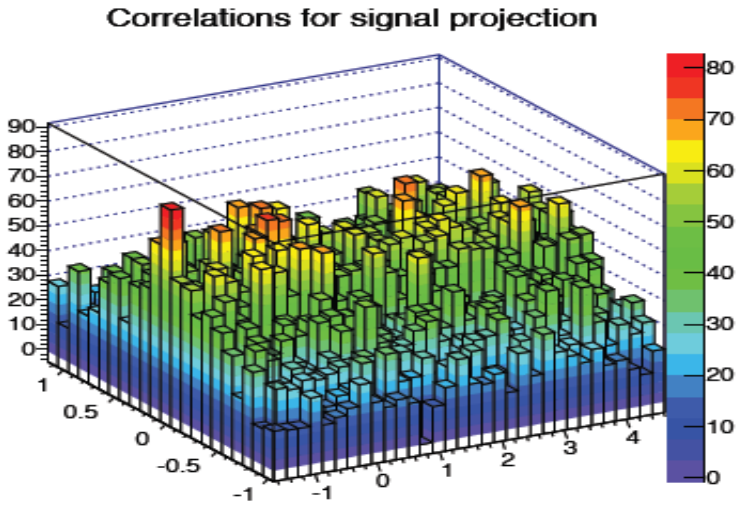


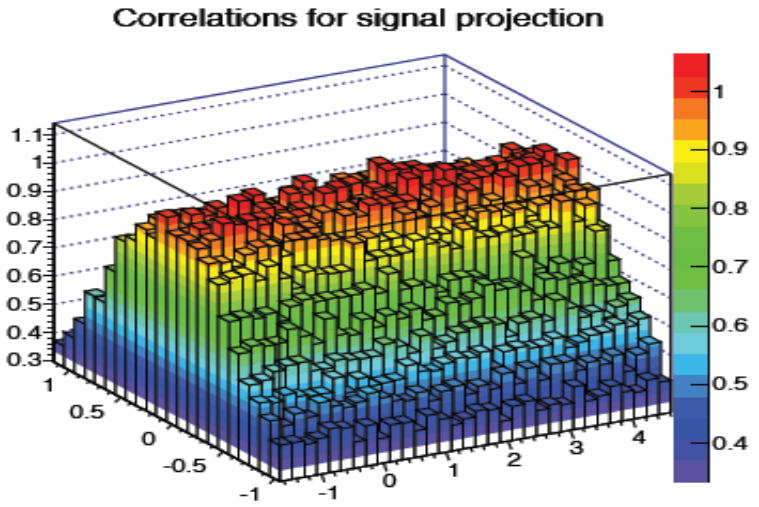
5– 8GeV/c



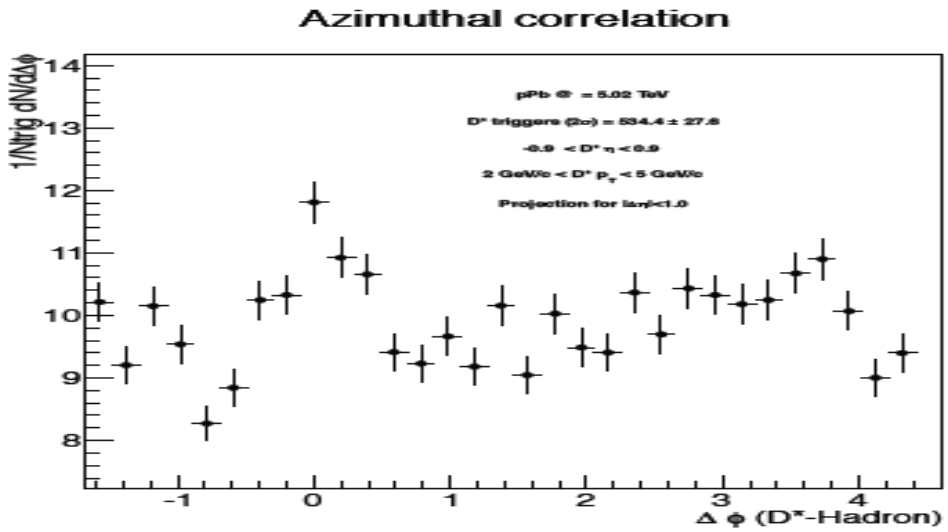
8 – 30 GeV/c

D* Hadron Correlations :2GeV/c< pt <5GeV/c , Assoc. pt> 0.3 GeV/c

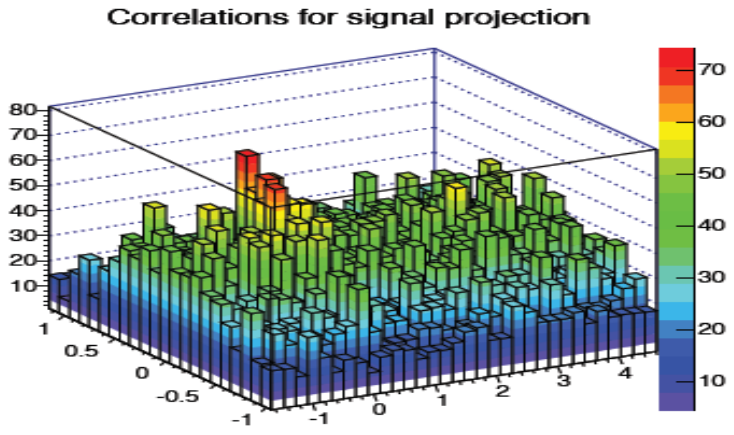


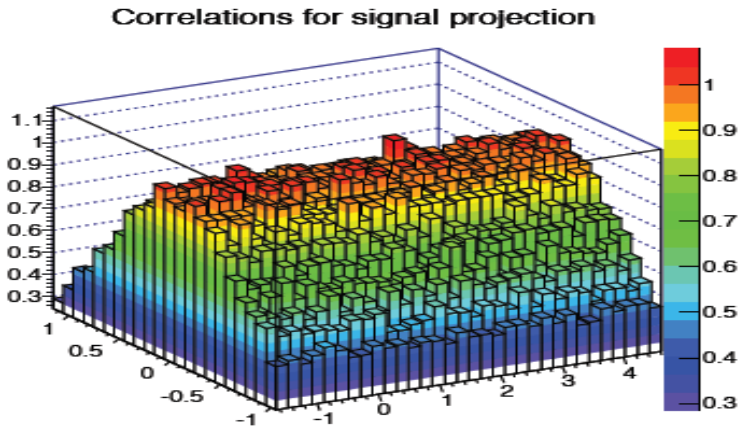


Single Event **Mixed Event**



D* Hadron Correlations : 5GeV/c< D* pt <8GeV/c , Assoc. pt> 0.3GeV/c





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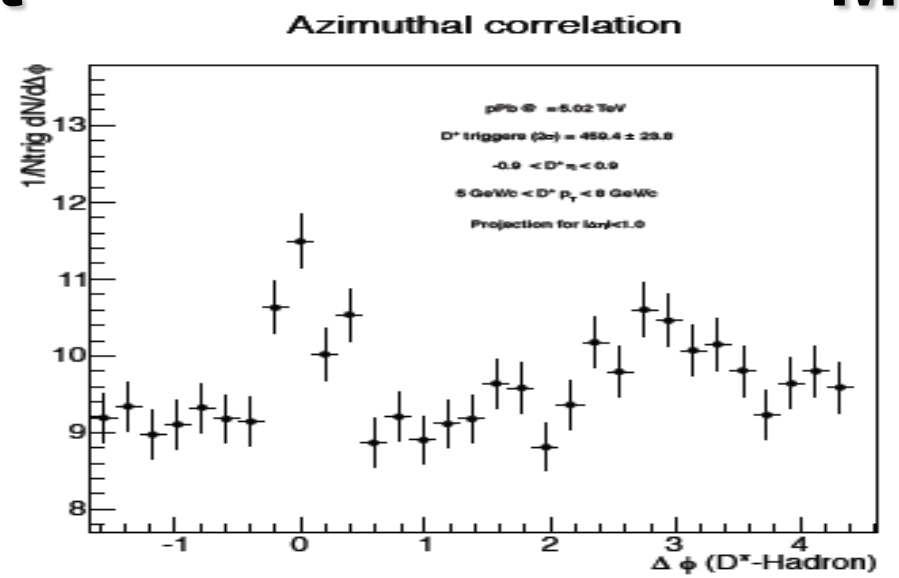
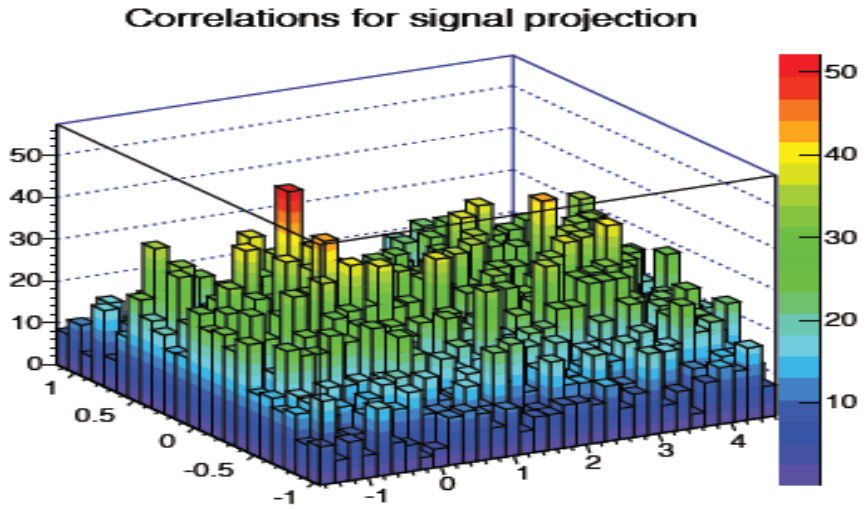


D* Hadron Correlations :

8GeV/c< D* pt <30GeV/c , Assoc. pt> 0.3 GeV/c



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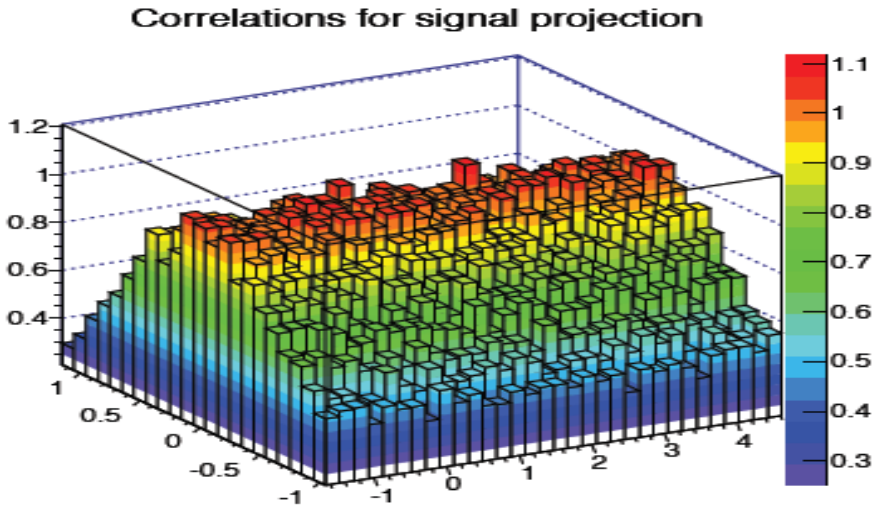
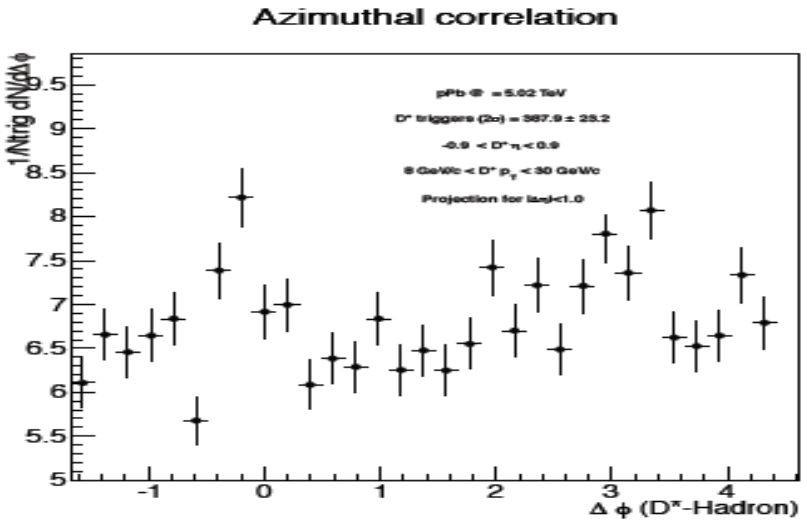


Mixed Event



Summary & Outlook

- **D*-hadron correlations in the available pPb data sample**

- **78 M events available at the moment (LHC13b pass2 & LHC13c pass1)**

- **Correlations are clearly visible for D* p_T integrated**

- **Correlations are also shown for D* p_T bins :2-5, 5-8, 8-30**

- **Extraction of the relevant correlation parameters to be done after applying necessary corrections plus cut optimization for D* selection**

THANKS.....

Backup slides

Extraction of Heavy Flavor Signal

- **Electron:** measuring first inclusive electrons:

- **Background subtracted method**: using background cocktail composed of electron sources measured at PHENIX: **photonic** and **non-photonic** sources:
  - → Conversion of photons from hadron decays in material
  - → Dalitz decays of light mesons ($\pi 0$, η, ω, η', ϕ)
  - → Ke3 : $K^{\pm}$ → π^0 $e^{\pm}$ ν_e
  - → vector meson decays: ρ, ω, ϕ → e^+ e^-
  - → heavy quarkonia decay
- **Converter subtract method:** adds material of known thickness around beam pipe, measures conversion electrons by extra yield produced. Used at lower p_T.

Both cocktail and converter methods agree

- **Muon:** measuring first inclusive muons:
- **Background subtracted method**: backround removed trough hadronic cocktail subtraction. Backgrounds include:
  - decay muons: resulting from light hadron decay.
  - Punchtrough hadrons: hadrons that are not absorbed in steel absorber, look identical to muons.