Y(nS) from Run II

- pp vs PbPb
- Centrality dependence
- Event plane dependence

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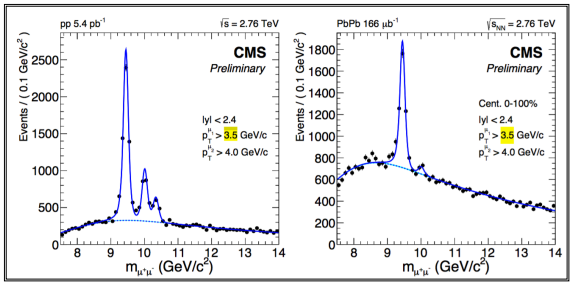
Outlook

- Y(1S), Y(2S), Y(3S) fit by single Cyrstalball functions
- Dataset
  - Onia trees from HLT_L1DoubleMu0 prompt RECO available on Jan 19th
- Muon selection
  - Soft muon cuts for both pp and PbPb, w/o HighPurity in inner track
  - Trigger object matching was not applied
  - $p_T^1 > 3.5$GeV , $p_T^2 > 4$GeV
  - Similar to (HIN-15-001)



- 2x2 kinematic bins
  - 2 p_T bins : low p_T (0-5 GeV) & high p_T (5-100 GeV)
  - 2 rapidity : mid (|y|< 1.2) & forward (1.2 < |y| <2.4)
- Fit procedure

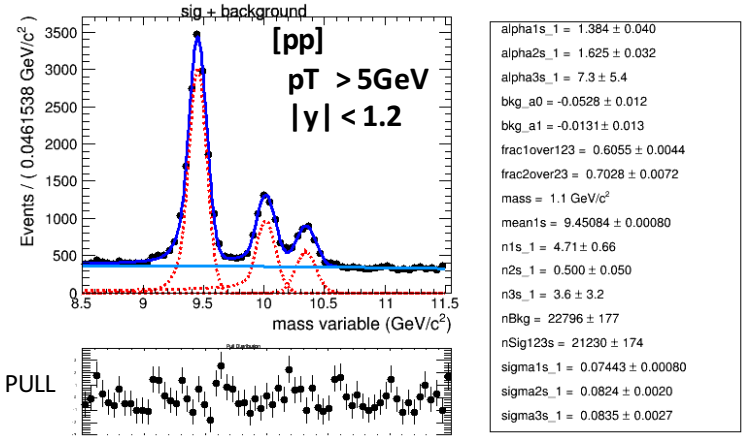
  Step 1. 2S/1S, 3S/1S mass ratios were fixed by PDG value

  Step 2. Fit pp data

  Step 3. Fixed (alpha, n, sigma) for 3 peaks

  Step 4. Fit PbPb ➔ Only # of signals and Y(1S) mass are free parameters

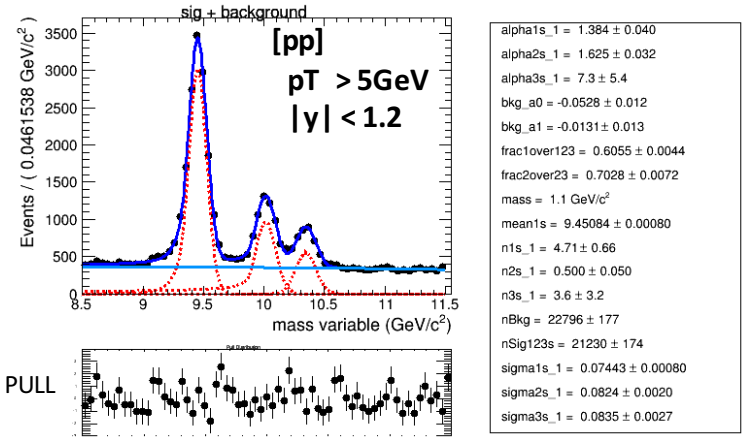
Fitting in pp (example)

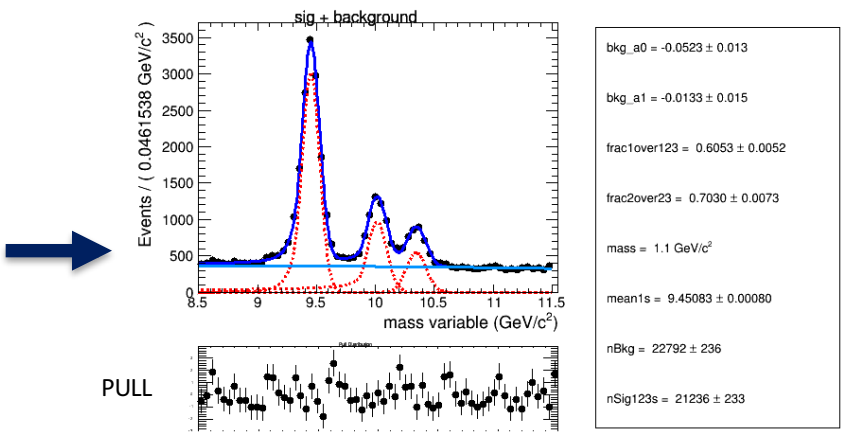


Example in high pT, mid-rapidity.
All CB parameters are flaoting.

- 3 single Crystalball (signal) + 1st ordre Chebychev polynomial (background)

Fitting in pp (example)



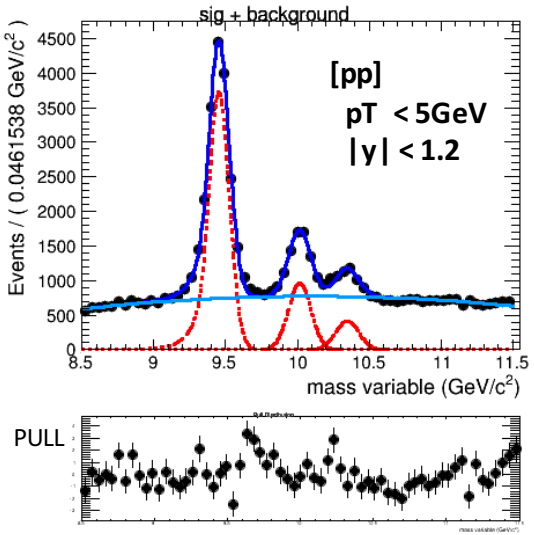


Example in high pT, mid-rapidity.
All CB parameters are flaoting.

Re-fit after fixing (α, n, σ)

- Total number of signals and the ratio (2S+3S)/(1S) was changed by very little amount by parameter fix
  ➔ (α, n, σ) values are stable, and can be used for PbPb system

Fitting in pp



bkg_a0 = 0.0326 ± 0.0084

bkg_a1 = -0.11628 ± 0.0099

frac1over123 = 0.7250 ± 0.0053

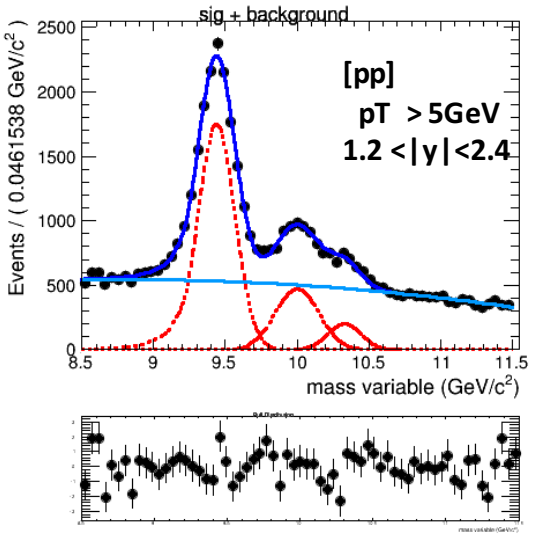
frac2over23 = 0.693 ± 0.011

mass = 1.1 GeV/c^2

mean1s = 9.45320 ± 0.00078

nBkg = 46629 ± 286

nSig123s = 21262 ± 238



bkg_a0 = -0.2273 ± 0.010

bkg_a1 = -0.0703 ± 0.015

frac1over123 = 0.7150 ± 0.0067

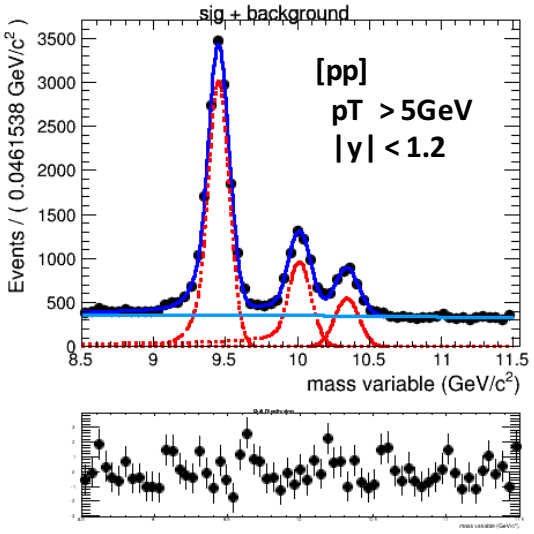
frac2over23 = 0.755 ± 0.014

mass = 1.1 GeV/c^2

mean1s = 9.4393 ± 0.0018

nBkg = 31164 ± 308

nSig123s = 17781 ± 285



bkg_a0 = -0.0523 ± 0.013

bkg_a1 = -0.0133 ± 0.015

frac1over123 = 0.6053 ± 0.0052

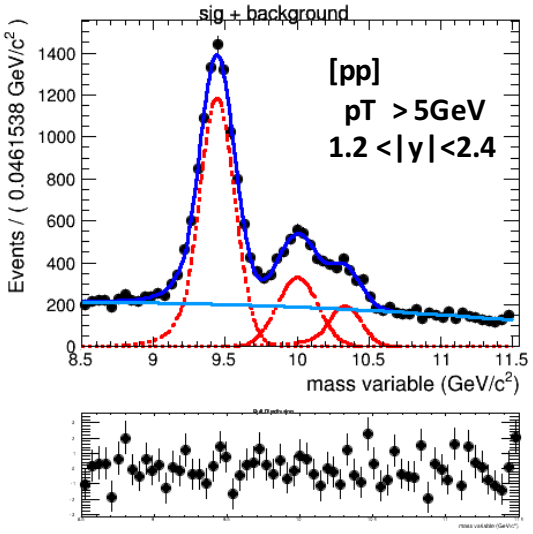
frac2over23 = 0.7030 ± 0.0073

mass = 1.1 GeV/c^2

mean1s = 9.45083 ± 0.00080

nBkg = 22792 ± 236

nSig123s = 21236 ± 233



bkg_a0 = -0.2378 ± 0.017

bkg_a1 = -0.0549 ± 0.024

frac1over123 = 0.6764 ± 0.0068

frac2over23 = 0.645 ± 0.015

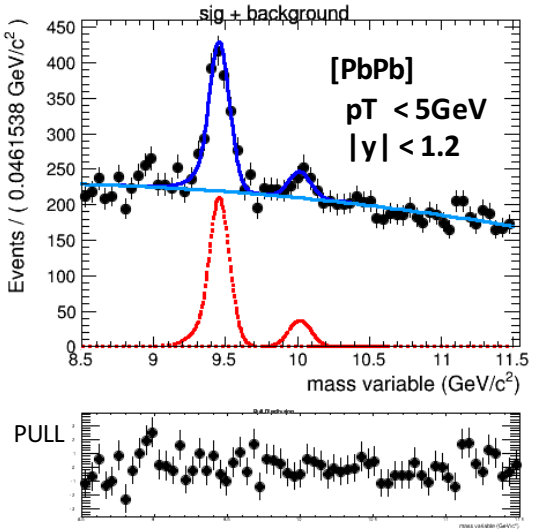
mass = 1.1 GeV/c^2

mean1s = 9.4421 ± 0.0019

nBkg = 11861 ± 196

nSig123s = 12085 ± 196

Fitting in PbPb



bkg_a0 = -0.1447 ± 0.015

bkg_a1 = -0.0261 ± 0.016

frac1over123 = 0.844 ± 0.037

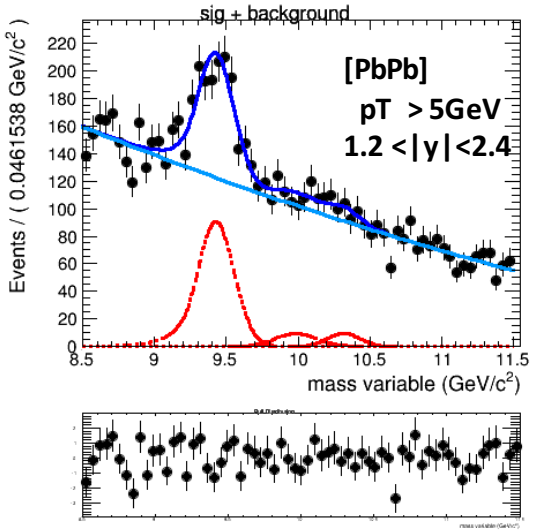
frac2over23 = 0.97 ± 0.14

mass = 11 GeV/c²

mean1s = 9.4557 ± 0.0055

nBkg = 13414 ± 134

nSig123s = 1031 ± 75



bkg_a0 = -0.4965 ± 0.021

bkg_a1 = 0.026 ± 0.028

frac1over123 = 0.828 ± 0.068

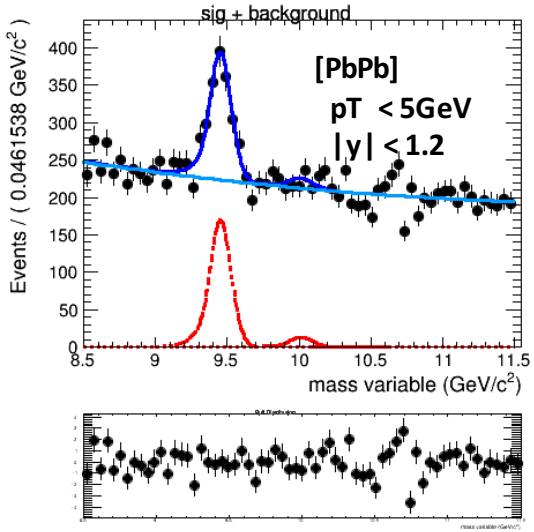
frac2over23 = 0.56 ± 0.19

mass = 11 GeV/c²

mean1s = 9.427 ± 0.013

nBkg = 6732 ± 132

nSig123s = 792 ± 107



bkg_a0 = -0.1215 ± 0.015

bkg_a1 = 0.019 ± 0.016

frac1over123 = 0.897 ± 0.069

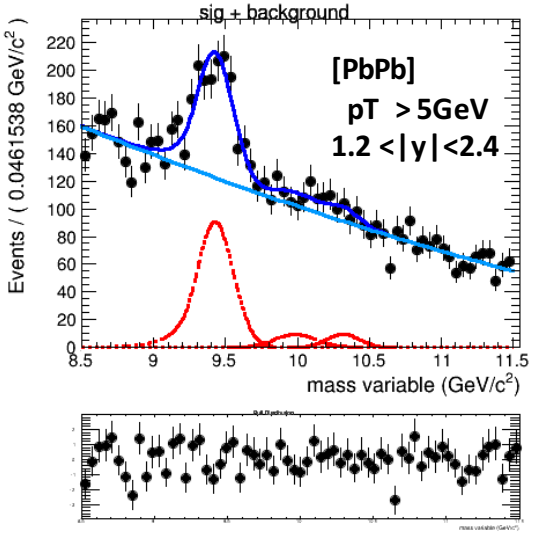
frac2over23 = 1.00 ± 0.73

mass = 11 GeV/c²

mean1s = 9.4516 ± 0.0067

nBkg = 13992 ± 145

nSig123s = 807 ± 88



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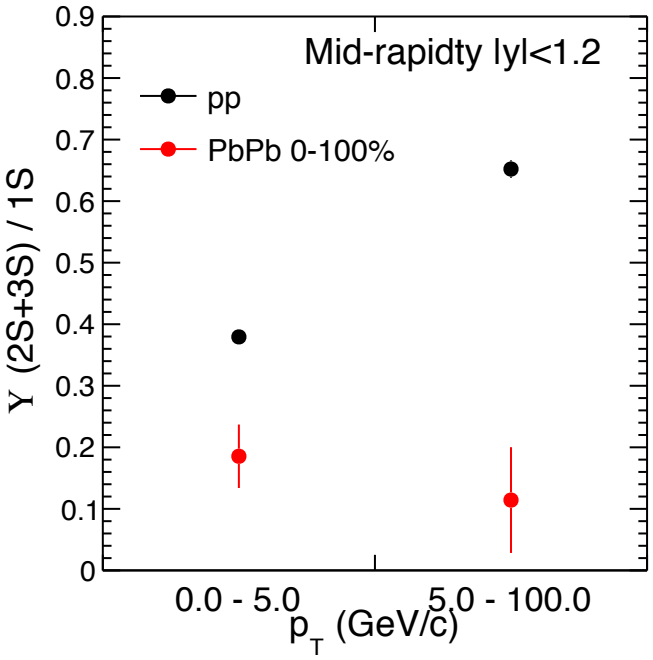
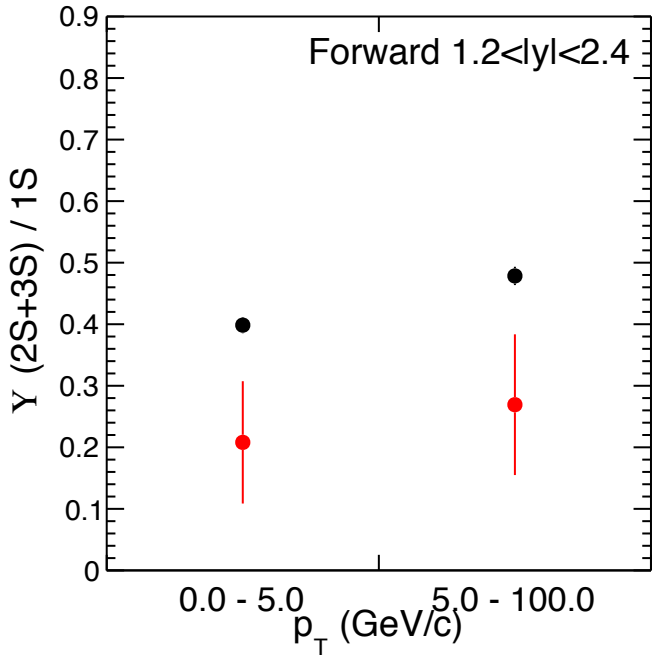
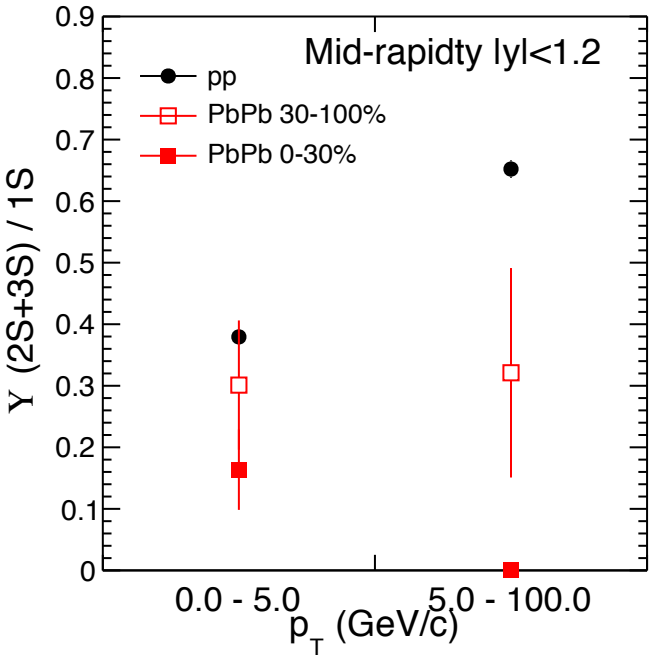
all in ONE

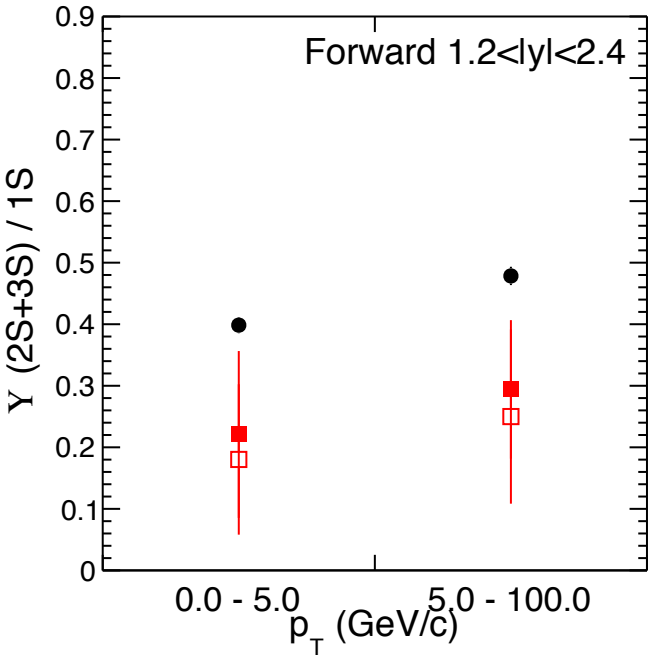




- Large suppression of excited states in overall kinematic ranges
- Suppression is the largest at the high p_T & mid-rapidity. Double Ratio ~0.2
- Double raitios = ~0.5 for other bins

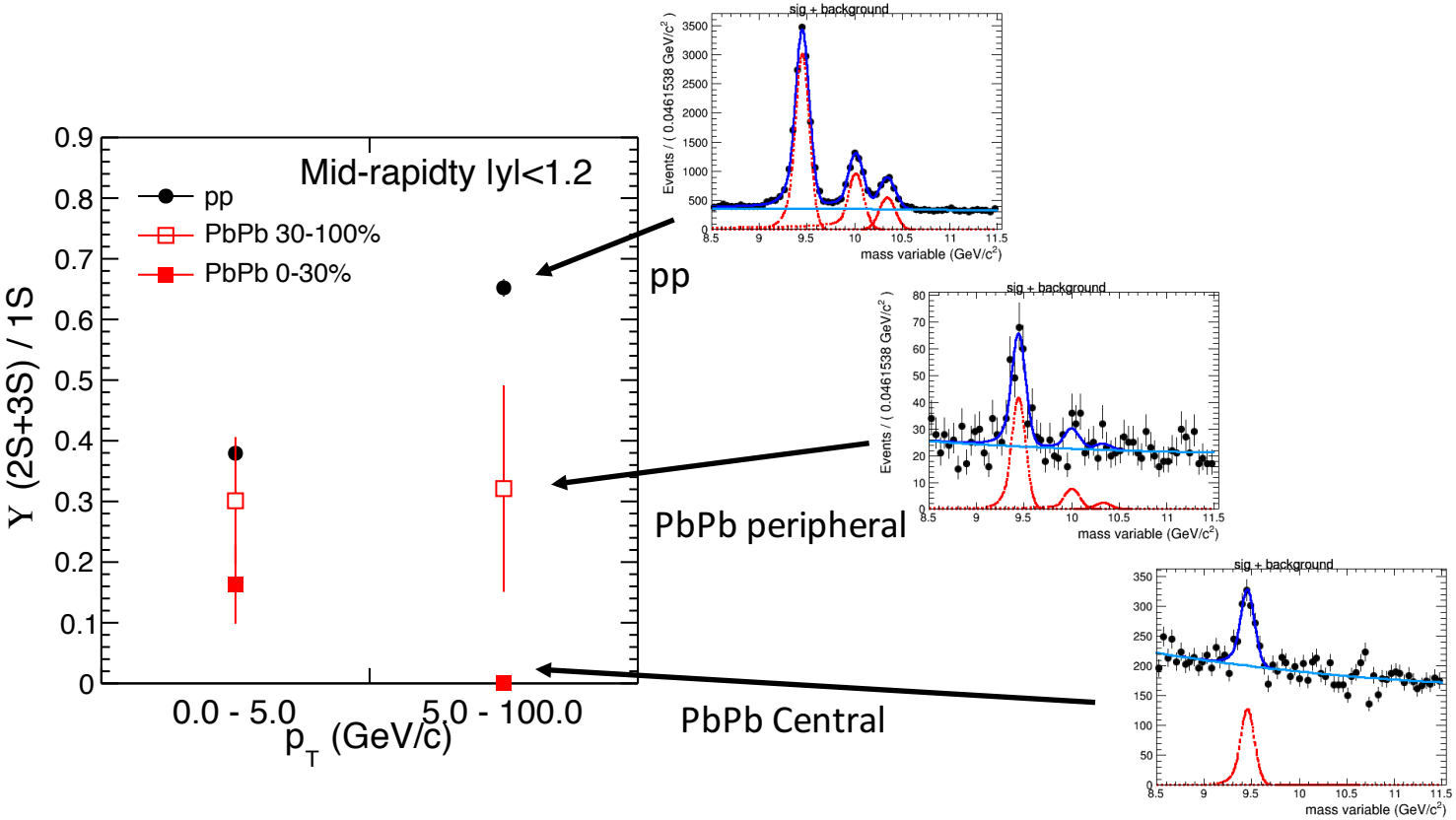
Centrality dependence





- Significant centrality dependence at (high p_T , mid-rapidity)

Centrality dependence

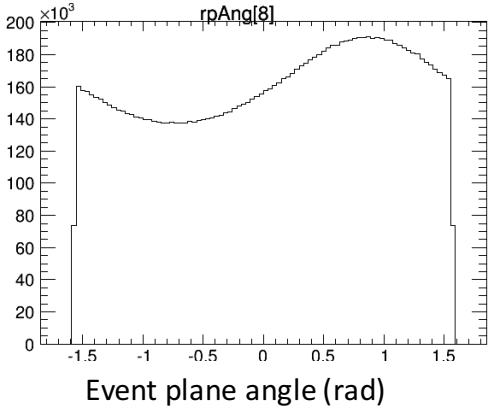


- Significant centrality dependence at (high p_T , mid-rapidity)

Event Plane dependence

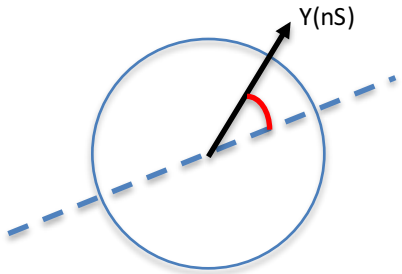
- Used the 2nd order plane using both HF
- It seems not flattened yet in our onia tree

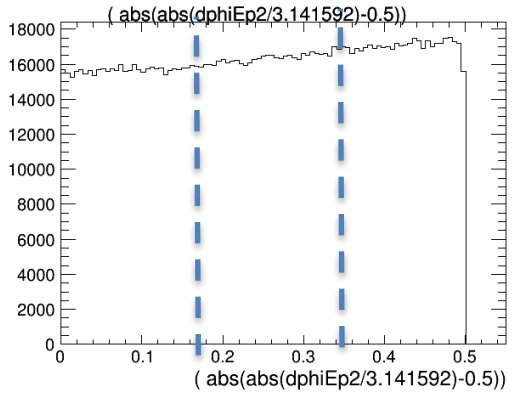
6	HFm2	HF
7	HFp2	HF
8	HF2	HF
9	trackmid2	Tracker
10	trackm2	Tracker
11	trackp2	Tracker



- Yet, still valuable for the Y(nS) ratio study

- Calculated the acute angle of Y(nS) and event plane and classified events into 3 bins [0, PI/6, PI/3, PI/2]

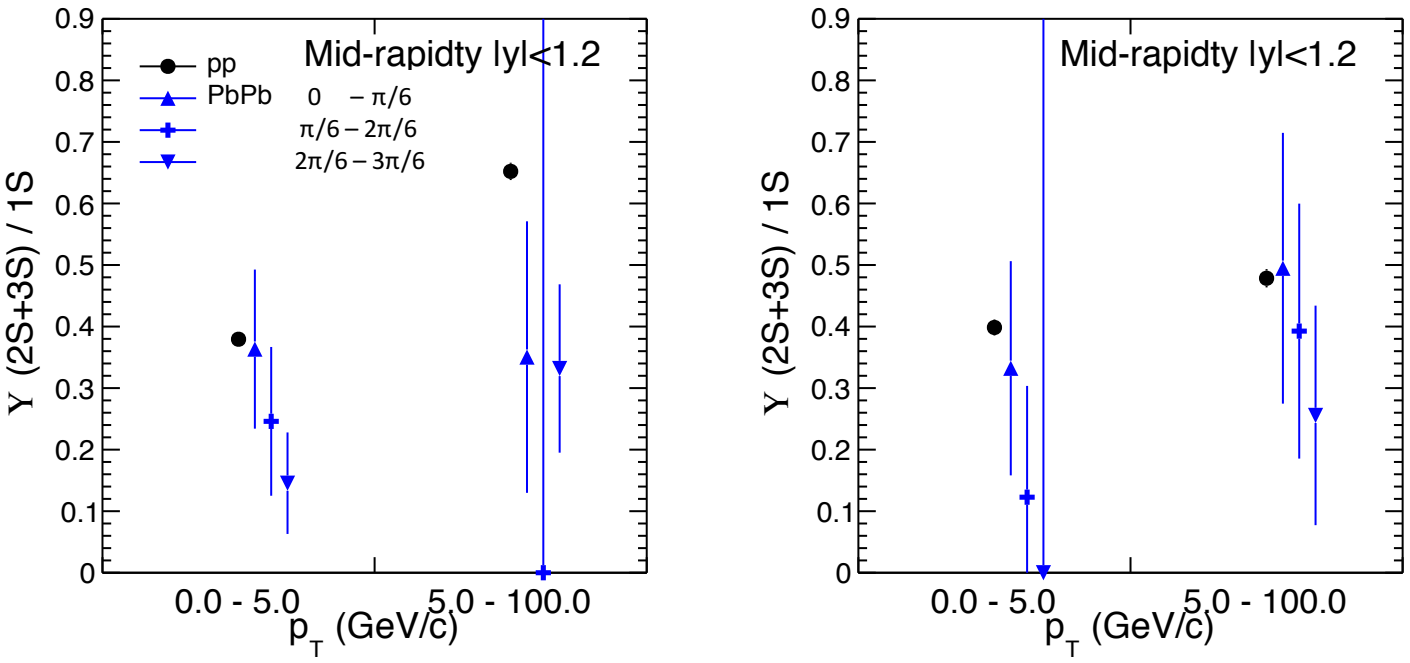




- Centrality : 10% – 60%

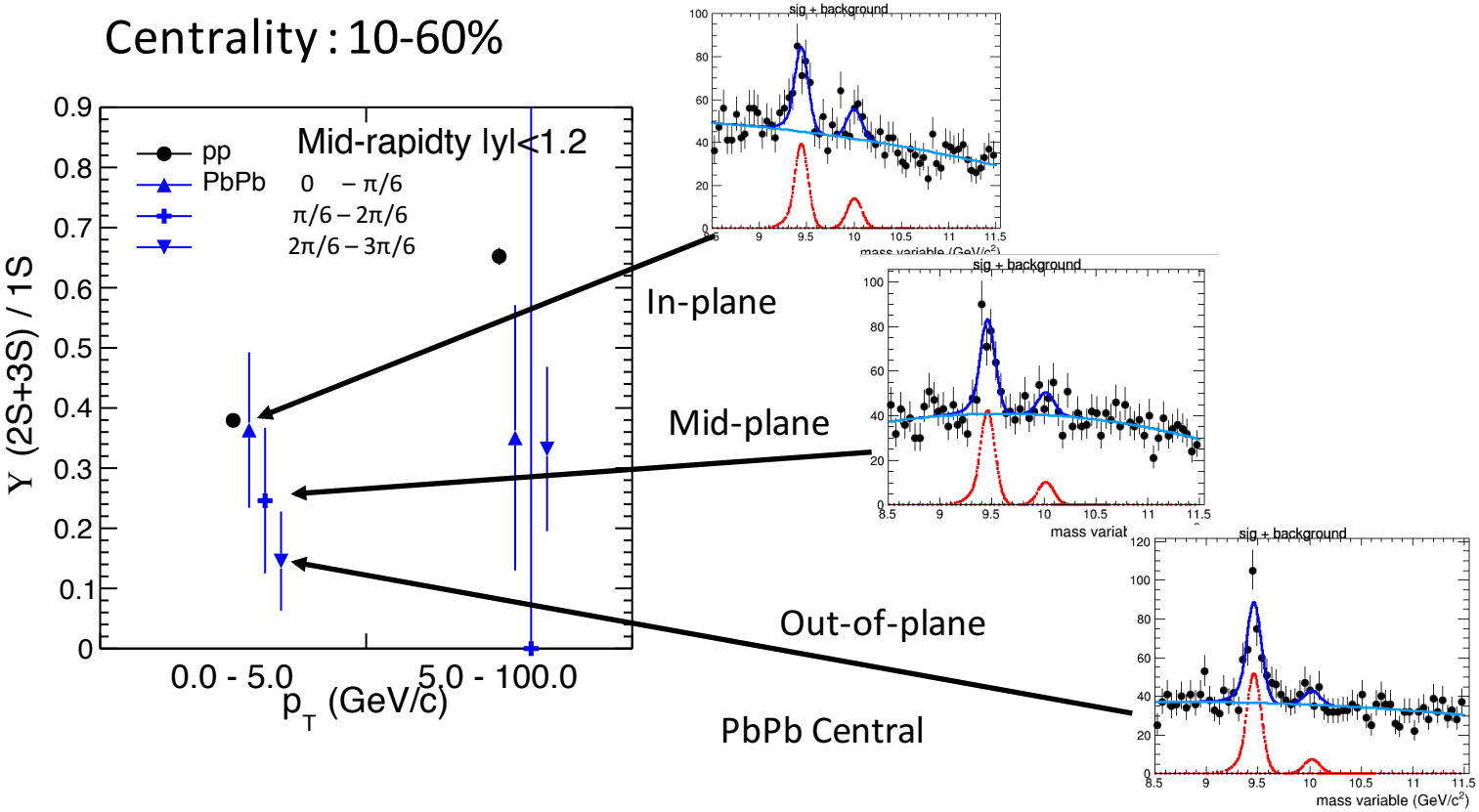
Correlation with event plane

Centrality : 10-60%



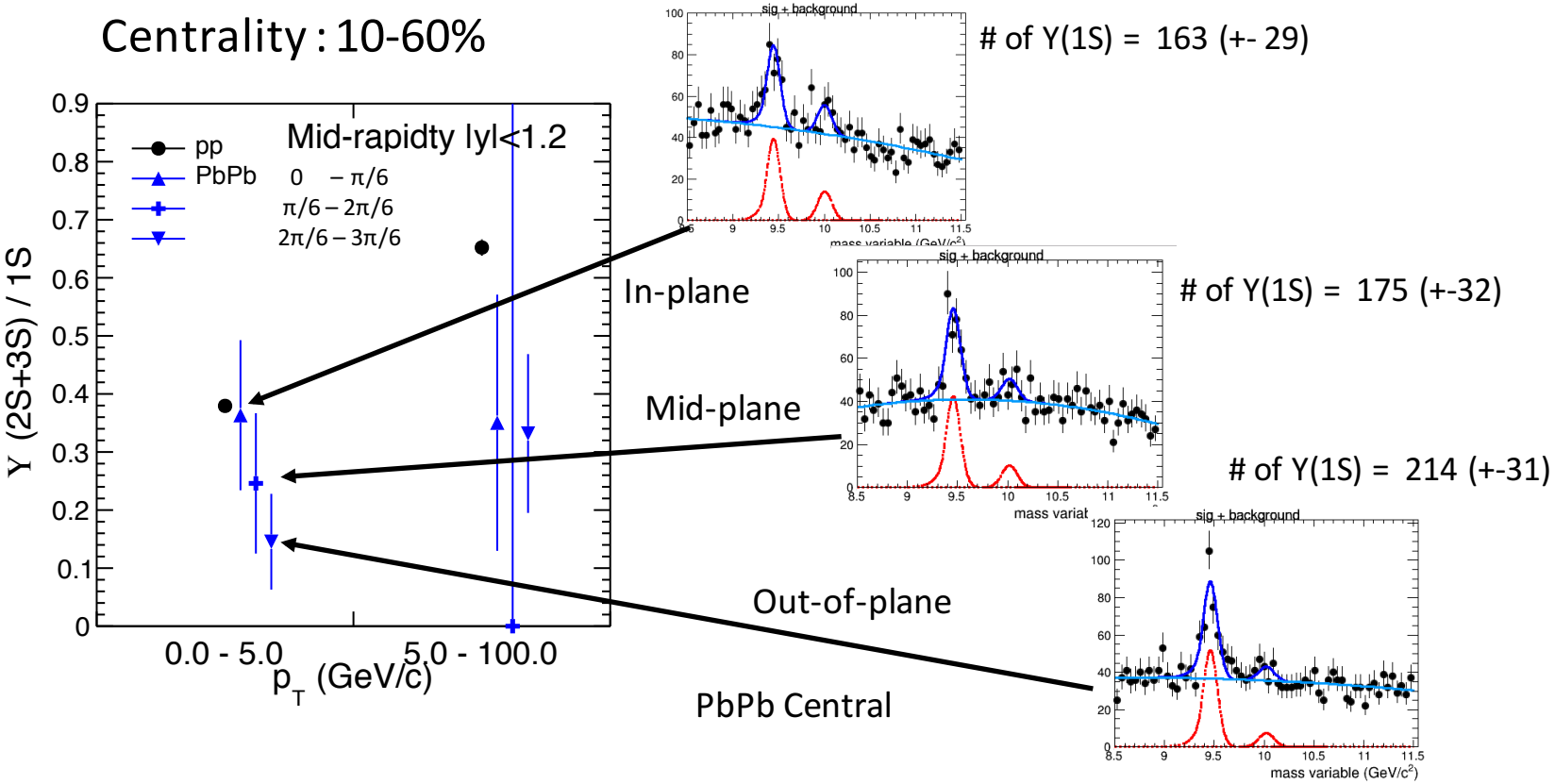
- There is a hint of the gradual correlation with the event plane angle at low p_T and mid-rapidity (w/ large statistical uncertainty)

Correlation with event plane



- Y(3S) disappeared for all event plane bins in 10%-60% centrality
- There is a hint of the gradual correlation with the event plane angle at low p_T , however, with large statistical uncertainty

Correlation with event plane



- As the event plane angle increase
  - Y(2S+3S)/Y(1S) gradually decreased
  - Yield of Y(1S) gradually increased (Uncertainty bar merely meets at 2 sigma)

  ➔ Excited states and the ground state yield evolves in the **opposite** direction

BACKUP

ψ(2S) to J/ψ ratio in CMS and ALICE