# BUP2021
# Upsilon in p+Au

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# BUP 2021 Assumptions

- Assume the 28 weeks run plan for 2023,2024,2025
  - Au+Au recorded luminosity  20.8 $nb^{-1}$ (140 $10^9$ MB events)
  - p+Au sampled luminosity 0.11 $pb^{-1}$ (190 $10^9$ events)
  - pp sampled luminosity 62 $pb^{-1}$ (2400 $10^9$ events)


- Assume the 20 weeks run plan for 2023,2024,2025
  - Au+Au recorded luminosity  11.7 $nb^{-1}$ (in 2023 1.7 $nb^{-1}$)
  - p+Au sampled luminosity 0
  - pp sampled luminosity 62 $pb^{-1}$

# Estimate of Y production in pp and p+Au

- Using measured PHENIX cross section

| | | |
|---|---|---|
| pp total cross section | 42mb | 4.20E-02 |
| PHENIX Y BR ds/dy (\|y\|<0.5) | 108pb | 1.08E-10 |
| sigmatot/ [ds/dy] | 2.74 | |
| | | |
| Br x sigmatot renormalized | 296pb | 2.96E-10 |
| | | |
| 1/Nev_pp BR dN/dy_pp | | |
| (\|y\|<0.5 PHENIX meas) | 2.57E-09 | |
| 1/Nev_pp * N_Upsilon_pp*BR | 7.04E-09 | |

| | Y(1S) | Y(2S) | Y(3S) |
|---|---|---|---|
| normalised yield ratio | 0.72 | 0.18 | 0.1 |

# Estimated Acceptance and Reconstruction Efficiency

- Using same numbers as in the proposal so the new numbers consistent with existing plots

| | |
|---|---|
| Y Acceptance (2 electrons within CEMC) | 31.5% |
| tracking eff pp and p+Au | 91% |
| eid eff pp and p+Au | 95% |
| pair reco eff in pp and p+Au | 75% |
| tracking eff AuAu | 87% |
| eid eff AuAu | 90% |
| pair reco eff in AuAu | 61% |

# Upsilons in pp (28 weeks)

| | | Y(1s) | Y(2s) | Y(3s) |
|---|---|---|---|---|
| pp 2400B sampled events | 2.40E+12 | | | |
| Nupsilon in 2400B events pp | 1.69E+04 | | | |
| Nupsilon in 2400B events pp within CEMC | 5.32E+03 | 3.83E+03 | 9.57E+02 | 5.32E+02 |
| **Nupsilon in 2400B events pp reco** | **3.98E+03** | **2.86E+03** | **7.16E+02** | **3.98E+02** |

# Upsilons in p+Au (28 weeks)

| | | Y(1s) | Y(2s) | Y(3s) |
|---|---|---|---|---|
| Ncoll p+Au MB (0-100%) | 4.7 | 1 | | |
| Ncoll p+Au MB (0-84%) | 5.2 | 0.84 | | |
| | | | | |
| pAu 200B MB sampled events | 2.00E+11 | | | |
| | | | | |
| Nupsilon in 200B events pAu MI | 7.32E+03 | | | |
| Nupsilon in 200B events pAu MB within CEMC | 2.31E+03 | 1.66E+03 | 4.15E+02 | 2.31E+02 |
| **Nupsilon in 200B events pAu MB reco** | **1.72E+03** | **1.24E+03** | **3.10E+02** | **1.72E+02** |

# Y->ee Acceptance

- Upsilon acceptance and $p_T$ distrubution are estimated using Pythia and requiring both electrons within CEMC i.e. $|\eta|<1.1$
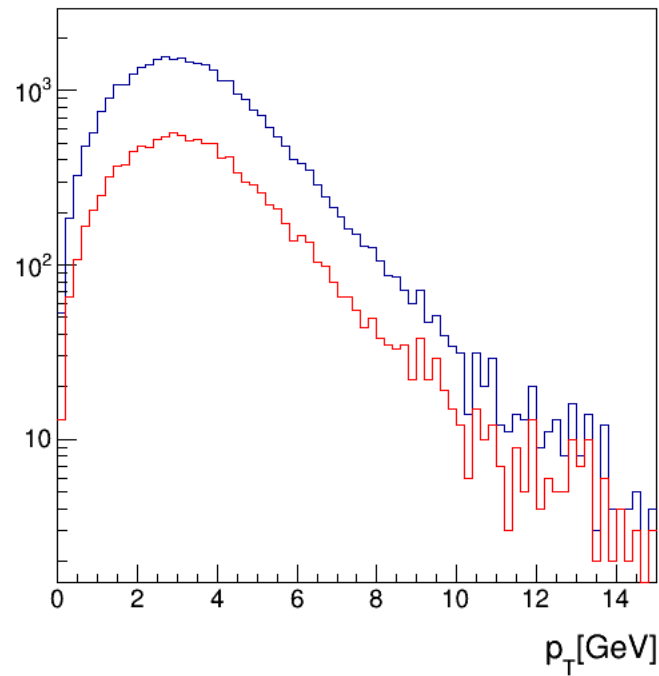


All Upsilon

Upsilon with both electrons within CEMC

# R$_{p+Au}$ vs P$_T$
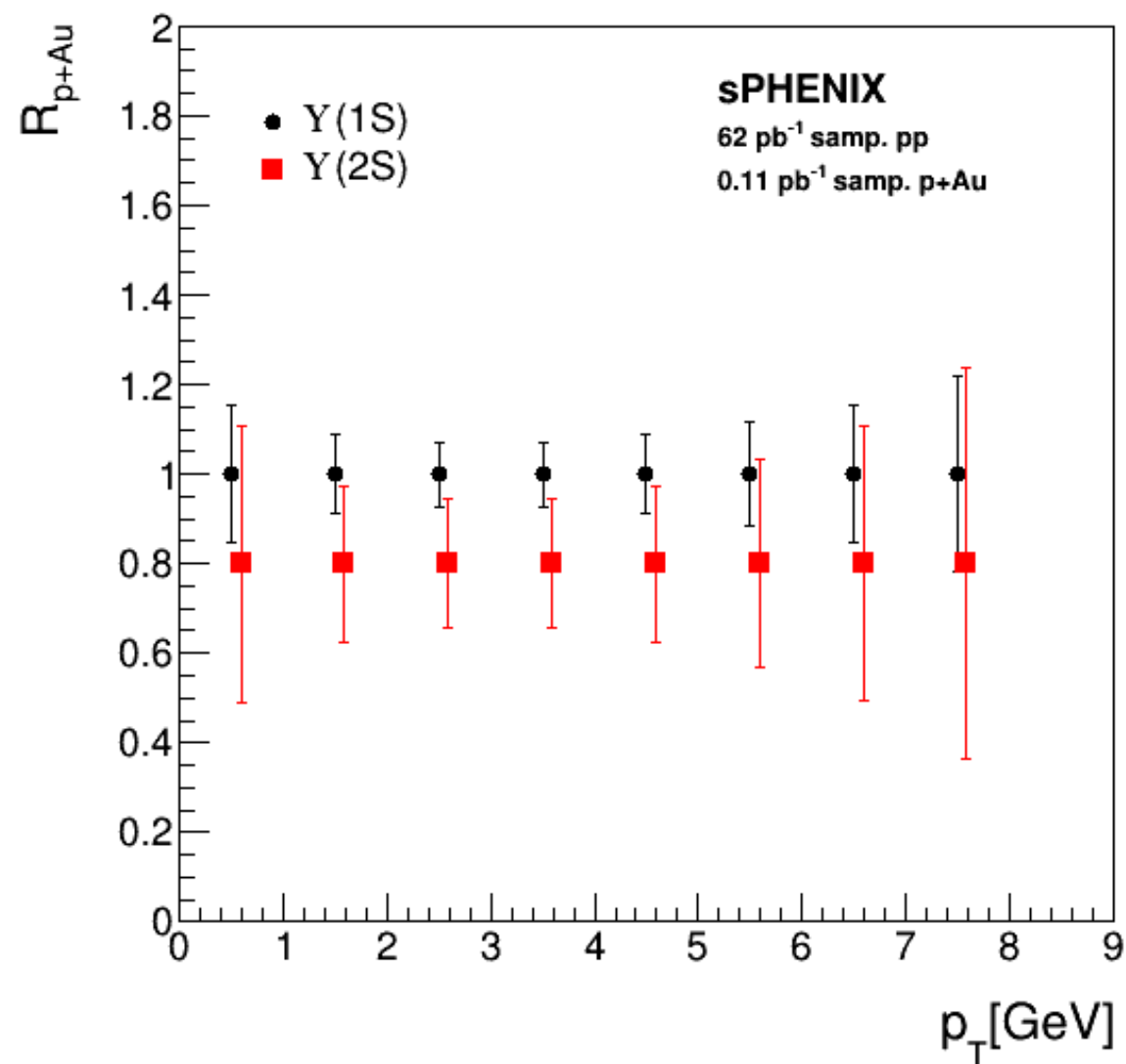
# Upsilon in p+Au vs Centrality (28 weeks)

- Using the centrality dependence of the number of collisions from Glauber simulations by Jamie for PHENIX

|  | Ncoll | Bin width |
|---|---|---|
| Ncoll p+Au 0-20% | 8.2 | 0.2 |
| Ncoll p+Au 20-40% | 6.1 | 0.2 |
| Ncoll p+Au 40-60% | 4.4 | 0.2 |
| Ncoll p+Au 60-84% | 2.6 | 0.24 |

| Centrality dependence | | Y(1S) | Y(2S) | Y(3S) |
|---|---|---|---|---|
| Nupsilon in 200 B MB events pAu 0-20% reco | 6.47E+02 | 4.66E+02 | 8.38E+01 | 8.38E+00 |
| Nupsilon in 200 B MB events pAu 20-40% reco | 4.81E+02 | 3.46E+02 | 6.24E+01 | 6.24E+00 |
| Nupsilon in 200 B MB events pAu 40-60% reco | 3.47E+02 | 2.50E+02 | 4.50E+01 | 4.50E+00 |
| Nupsilon in 200 B MB events pAu 60-84% reco | 2.46E+02 | 1.77E+02 | 3.19E+01 | 3.19E+00 |

# R$_{p+Au}$ vs N$_{coll}$