Ω-proton correlations in 200 GeV Au+Au collisions

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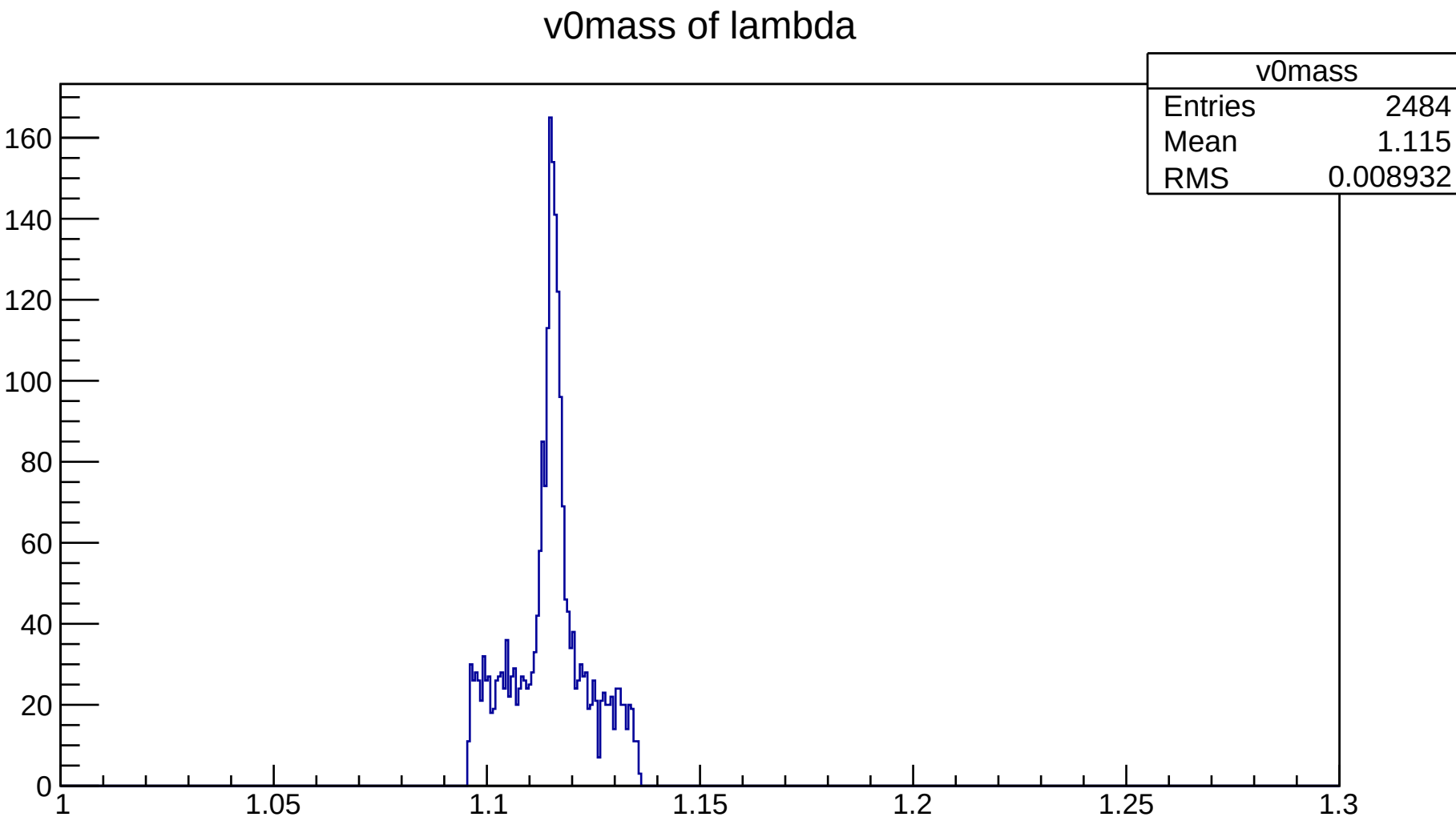
Motivation

- HaI Lattice QCD result predicts stable Ω-proton state with 18.9 (5.0) MeV binding energy. ("Spint 2 $N-\Omega$ Dibaryon from Lattice QCD") arXiv:1403.7284
- Correlation measurements potentially sensitive to this state.

Omega Reconstruction

- Reconstruct Ω from $\Lambda - K^-$ decay channel
- Charged K identified with nsigma information
- Event cuts: $|\text{vertex z}| < 40$ cm, vertex r difference (TPC and VPD) $<$ 4cm, nhits > 15,
- Λ cuts used: dca > 0.4 cm, decay length > 5.0 cm, daughter proton dca > 0.6 cm, daughter pion dca > 2.0 cm, proton to pion dca < 0.7 cm

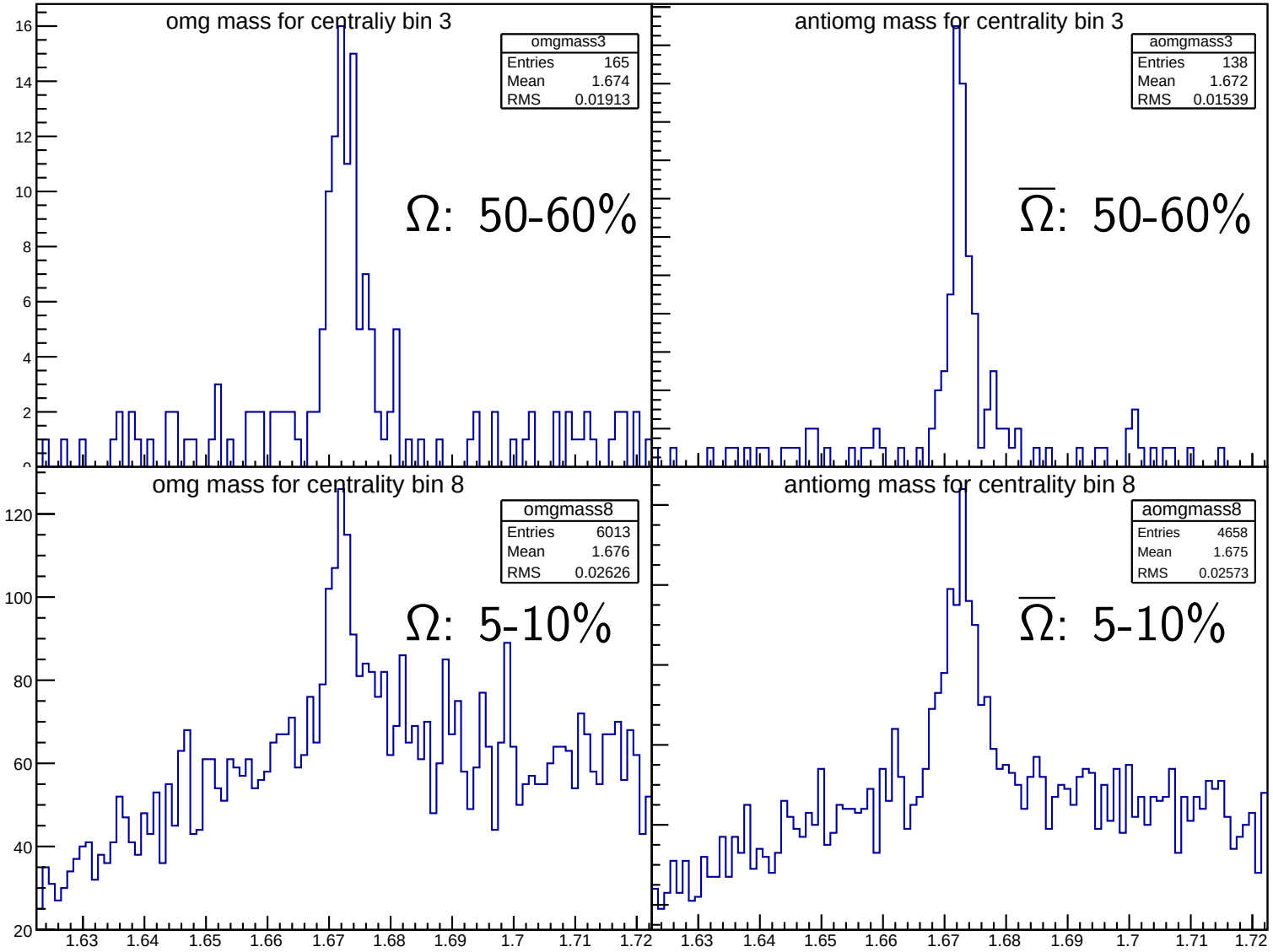
Lambda Mass


v0mass of lambda
v0mass
Entries 2484
Mean 1.115
RMS 0.008932
160
140
120
100
80
60
40
20
0
1
1.05
1.1
1.15
1.2
1.25
1.3

Omega Cuts

- Ω dca < 0.4 cm, Ω decay length > 3.0 cm, Ω rapidity < 0.5
- daughter cuts: dca Λ to $K < 0.7$ cm, Λ decay length $>$ Ω decay length, Λ mass within 6MeV of peak
- Additional cut: replace K mass with pion mass and if resulting parent mass is within 100 MeV of Ξ mass then reject

Omega Mass


omg mass for centraliy bin 3
omgmass3
Entries 165
Mean 1.674
RMS 0.01913
Ω: 50-60%
antiomg mass for centrality bin 3
aomgmass3
Entries 138
Mean 1.672
RMS 0.01539
Ω̄: 50-60%
omg mass for centrality bin 8
omgmass8
Entries 6013
Mean 1.676
RMS 0.02626
Ω: 5-10%
antiomg mass for centrality bin 8
aomgmass8
Entries 4658
Mean 1.675
RMS 0.02573
Ω̄: 5-10%
1.63 1.64 1.65 1.66 1.67 1.68 1.69 1.7 1.71 1.72

Backgroud for Omega Mass

- Because not all omega candidates were saved, rotational background does not describe true background at this point. Instead it is lowered by some constant factor
- Need to reproduce one days data with all candidates saved to determine that factor and then can use that factor for all days

Correlation Cuts

- Proton cuts: 0.8 GeV $<$ tof mass $<$ 1.1 GeV, Pt $>$ 0.6 Gev
- Omega Cuts: Mass within 6 MeV of peak

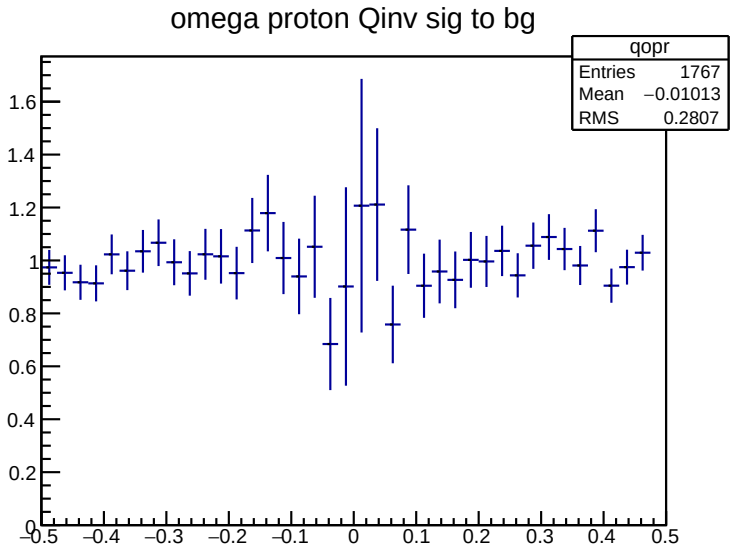
Correlation Method

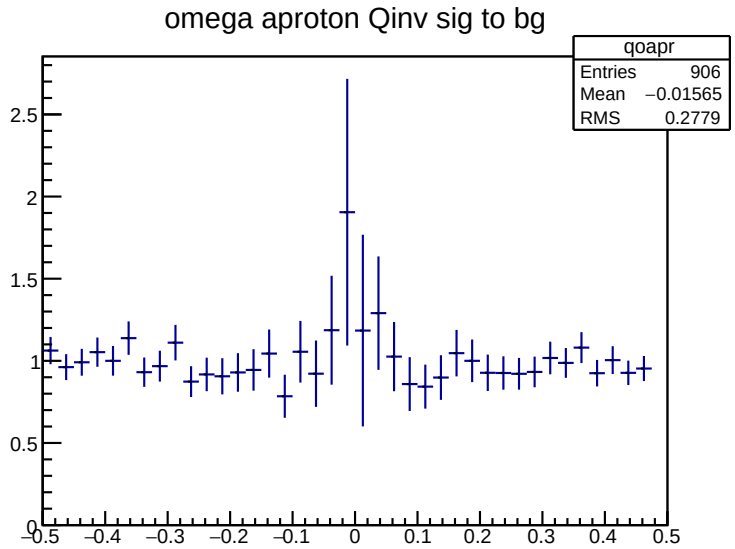
- Calculate Q-invariant betweent Ω and p using:

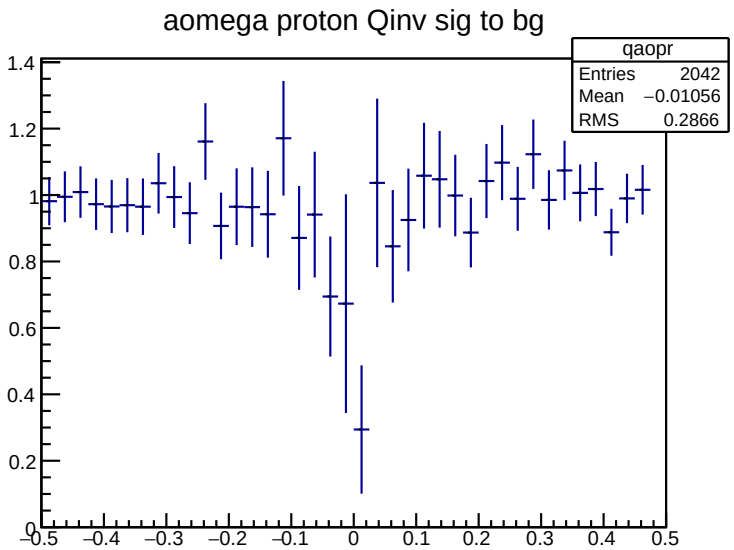
$$Q^2 = |(\mathbf{P}_\Omega - \mathbf{P}_p)^2 - (E_\Omega - E_p)^2|$$

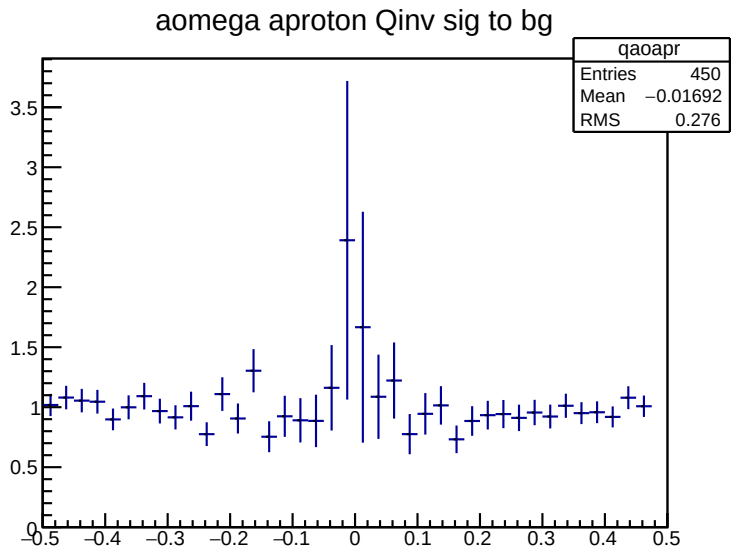
- If $(\mathbf{P}_\Omega - \mathbf{P}_p)^2 - (E_\Omega - E_p)^2$ is negative then designate Q to be negative
- Rotational Background by rotating proton angle by $\pi/3$, $2\pi/3$, π, $4\pi/3$, $5\pi/3$
- $N_{signal}/N_{background}$ for each Q bin is shown.

Q invariant signal to background









Items to Complete

- Obtain accurate background description with full candidate data for one day
- Use background data to improve correlation method: subtract from both sig and bg contribution from omega background
- Use improved background on additional data to be generated

Proposed Abstract

Recently the STAR experiment at RHIC measured Lambda-Lambda correlations from Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV [1] to search for the H particle (uuddss). The correlation strength indicated that the Lambda-Lambda interaction is weak and is unlikely to be attractive enough to form a bound state. A recent lattice QCD calculation [2] predicted a possible di-baryon bound state with Omega-nucleon. Thus, we will extend the correlation measurements to Omega-proton, which could potentially be a sensitive approach to search for such a state.
We will present the Omega-proton correlations based on data collected by STAR in Au+Au collisions at $\sqrt{s_{NN}}$ =200 GeV, and discuss the physics implications.
[1] L. Adamczyk et al [STAR Collaboration], Phys. Rev. Lett.114(2015)022301
[2] F. Etminan et al [HAL QCD Collaboration], arXiv:1403.7284

Thank You