Omega-proton correlations in 200 GeV Au Au collisions

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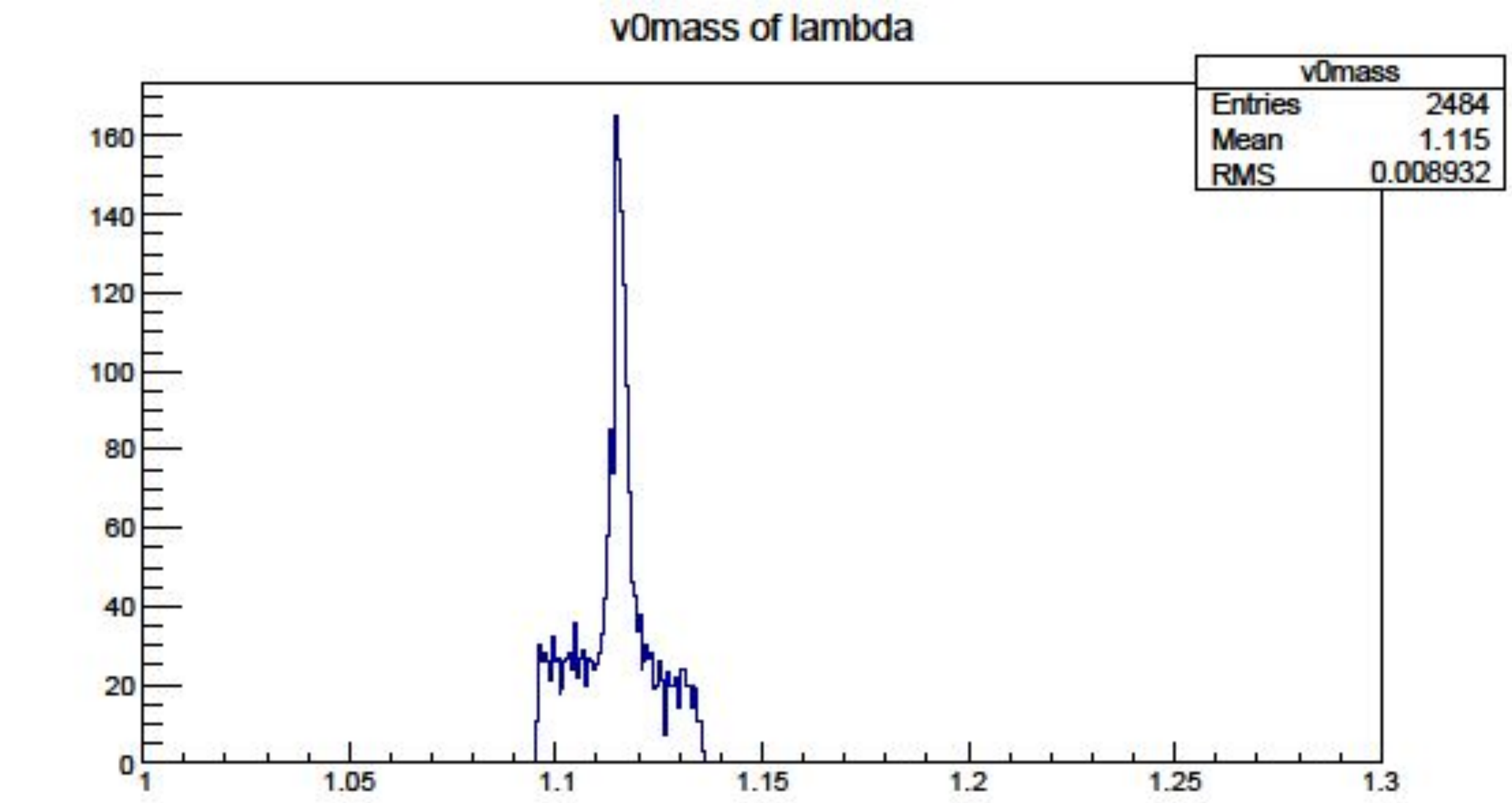
Motivation

- **“Spin-2 $N\Omega$ Dibaryon from Lattice QCD”, arXiv:1403.7284**
- **Nucleon-Omega bound state with binding energy of 18.9 MeV, very small, but perhaps can be observed with correlation**
- **First Omega-proton correlation**

Omega Reconstruction

- Looked for the **Λ -K$^-$** decay channel of **Ω**.
- Charged K identified with nsigma information
- Λ cuts used: topological cuts on Λ, its daughters proton (referred to as daughter 1 or dau1), and pion (referred to as daughter 2 or dau2).
- Lambda cuts:
  dca > 0.4 cm, decay length > 5.0 cm
- Daughter cuts:
  dau1 dca >0.6 cm, dau2 dca>2.0 cm, dca of dau1 to dau2 <0.7cm

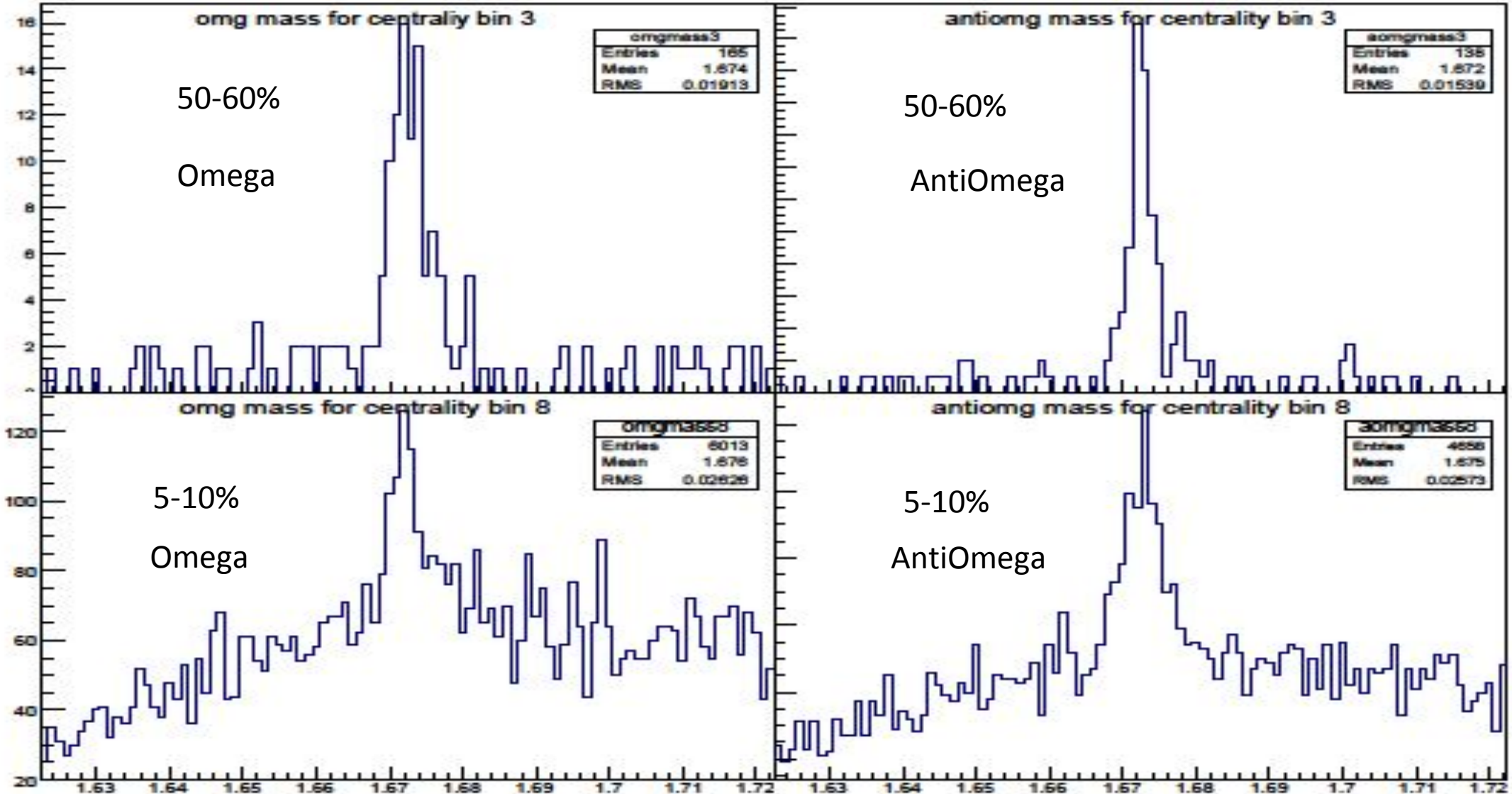


Lambda Invariant Mass

Omega Cuts

- Omega:
  omega dca<0.4 cm, omega decay length > 3.0cm,
  omega rapidity < 0.5
- Daughter cuts:
  dca lambda to K <0.7 cm, lambda decay length > omega decay length
  lambda mass within 6 MeV of peak,
- Additional cut: replace K mass with pion mass and if resulting parent mass is within 10 MeV of Cascade mass then reject.

Omega Invariant Mass: 2 centralities



Background 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 day’s data with all candidates saved to determine that factor and then can use that factor for all days.

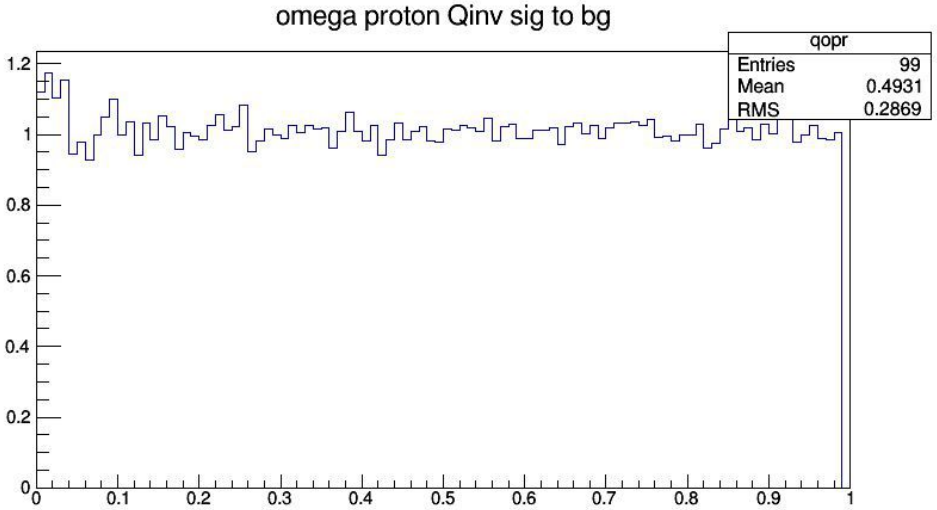
Correlation method

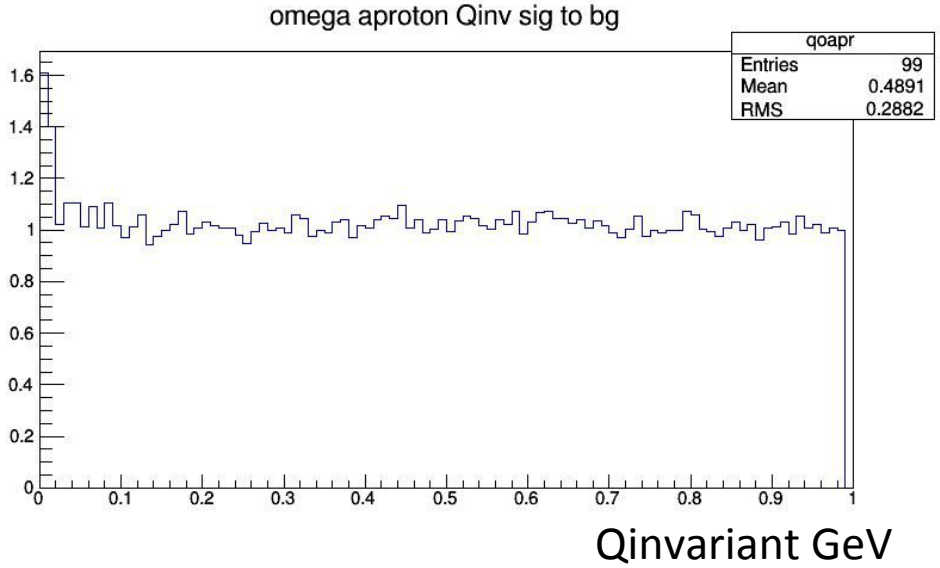
- Calculate Q-invariant between omega and proton using equation:

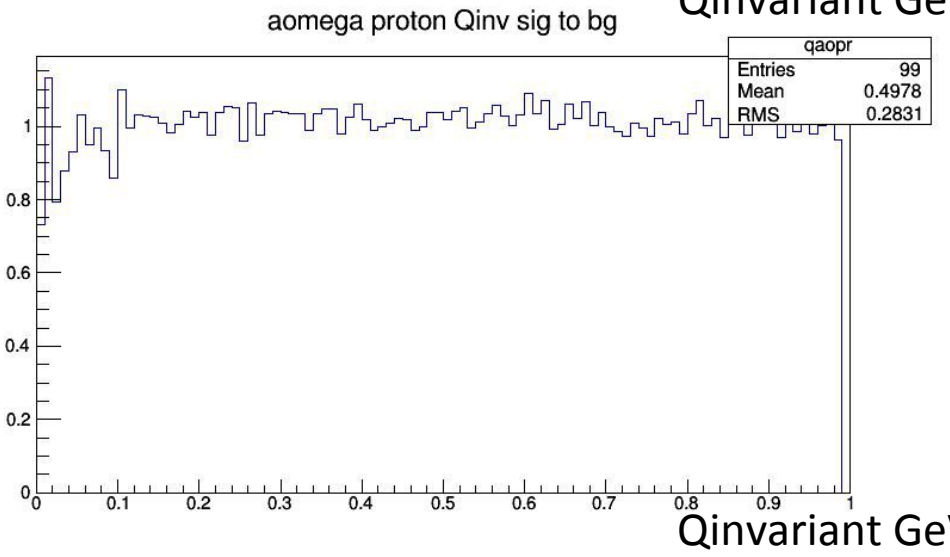
$$Q^2 = |(\mathbf{P}_\Omega - \mathbf{P}_p)^2 - (E_\Omega - E_p)^2|$$

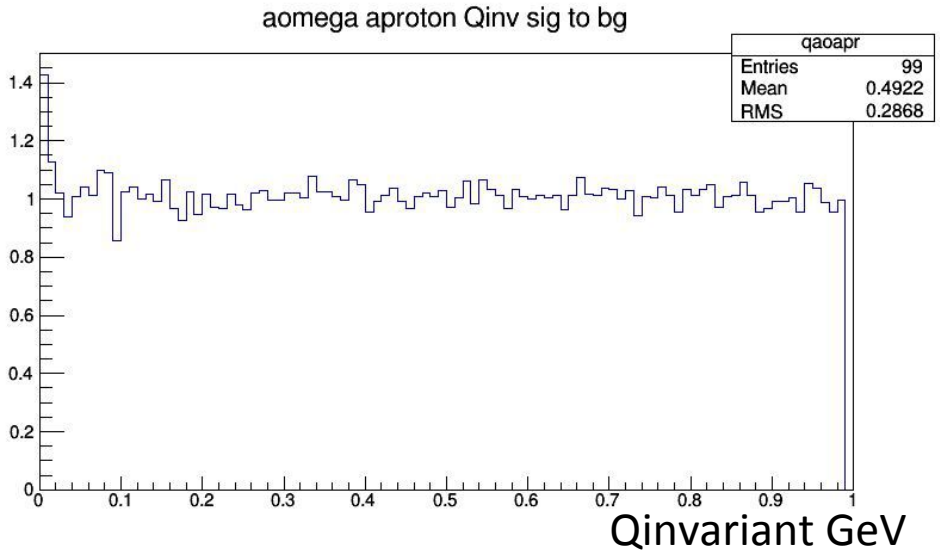
- Rotational Background by rotating proton angle by $\pi/3$, $2\pi/3$, π, $4\pi/3$, $5\pi/3$
- $N_{signal}/N_{background}$ for each Q bin is shown.

Show Graphs of Q sig to bg









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 correlation from Au+Au collisions at sqrt(s)=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 200 GeV, and discuss the physics implications.

[1] STAR Collaboration, Phys. Rev. Lett. 114 (2015)

[2] HAL QCD Collaboration, arXiv:1403.7284