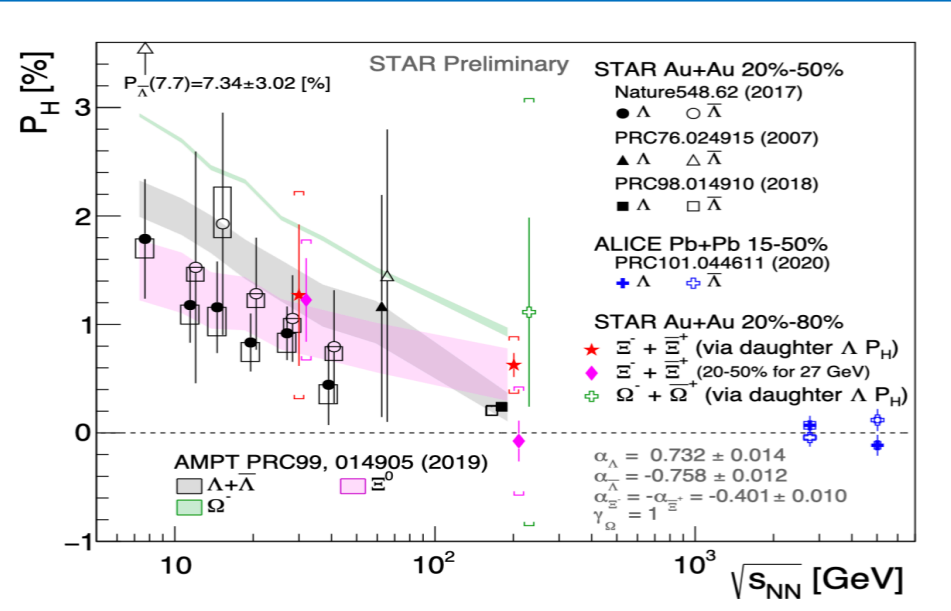
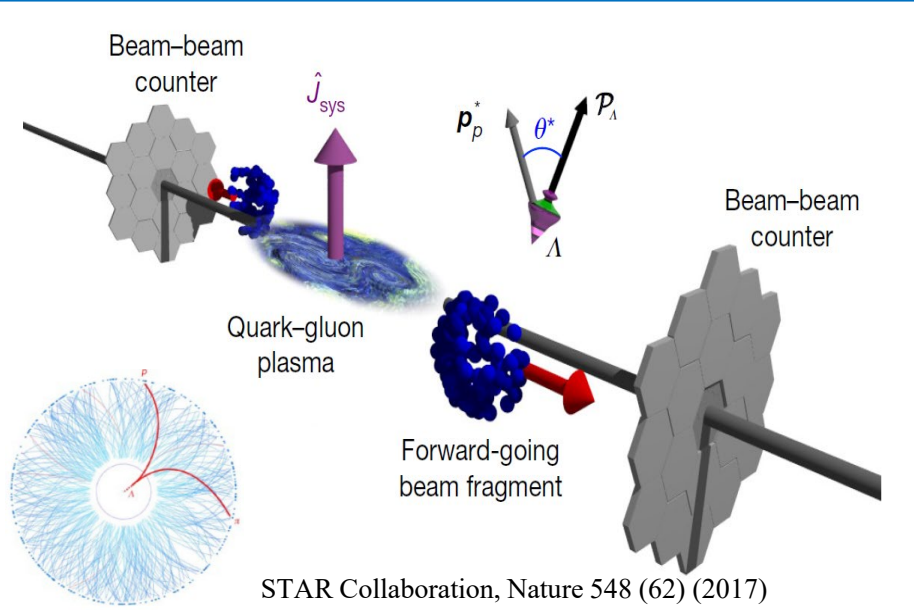




Probing novel baryonic spin Hall effect using Λ polarization at STAR



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$$\Lambda \rightarrow p + \pi^-$$

$$\bar{\Lambda} \rightarrow \bar{p} + \pi^+$$

$$\bar{P}_{\Lambda} = \frac{8}{\pi \alpha_{\Lambda}} \frac{1}{R_{EP}^{(1)}} \langle \sin(\psi_1 - \phi_p^*) \rangle$$

α_{Λ} : Λ 's decay parameter
 ϕ_p^* : the azimuthal angle of the daughter proton in Λ rest frame

Supported in part by the



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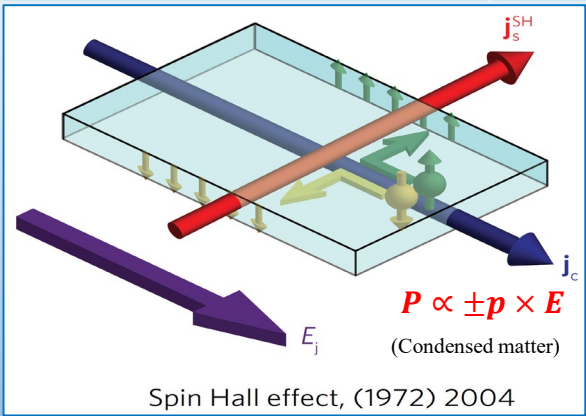
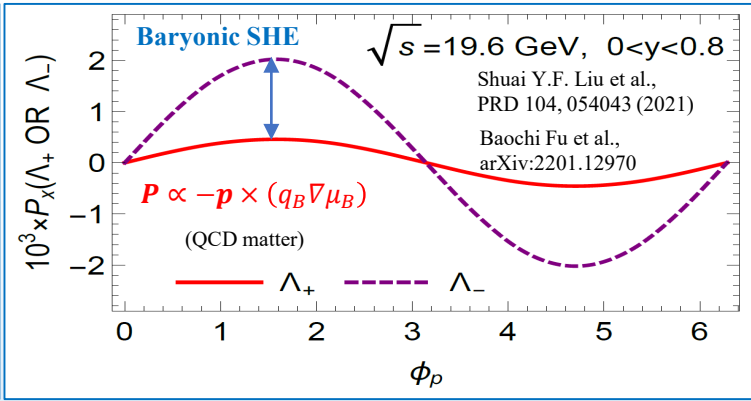
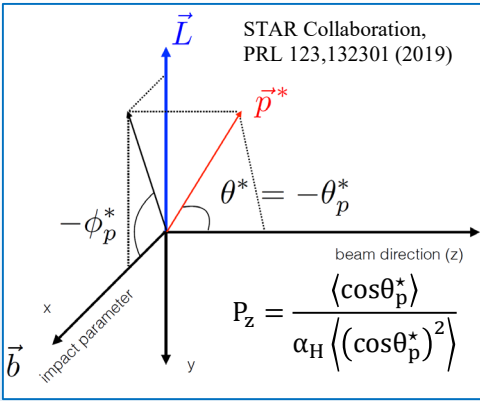


The STAR Collaboration

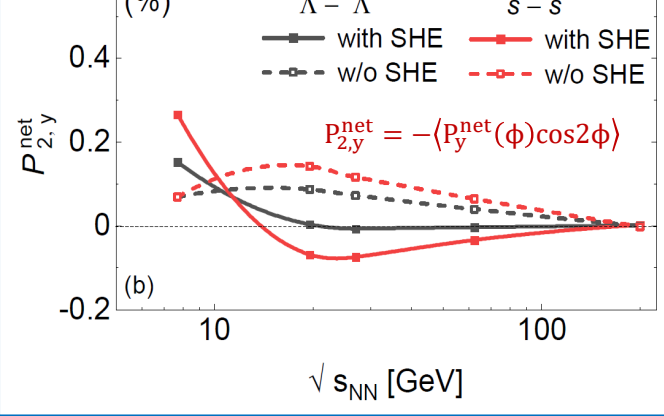
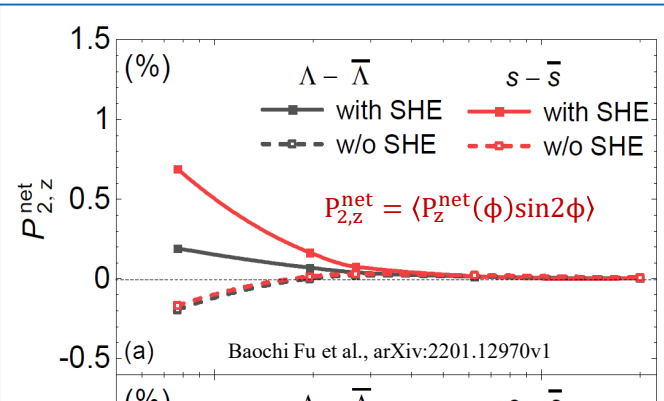
<https://drupal.star.bnl.gov/STAR/presentations>



Baryonic spin Hall effect



- Predicted spin Hall effect (SHE) in HIC driven by baryon density gradient
- $P \propto -\mathbf{p} \times (q_B \nabla \mu_B)$
- SHE can be accessed by net local polarization (P_z^{net}) of $P_\Lambda - P_{\bar{\Lambda}}$
- RHIC BES offers ideal conditions to probe baryonic SHE: large baryon density and abundant $\Lambda/\bar{\Lambda}$ production!

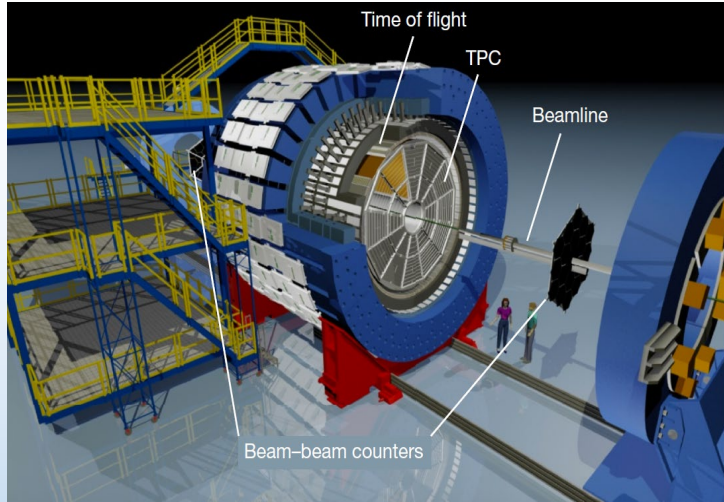


S. Meyer et al., Nature Materials 16 (2017)

θ^* : angle between daughter proton momentum vector in Λ rest frame and polarization direction

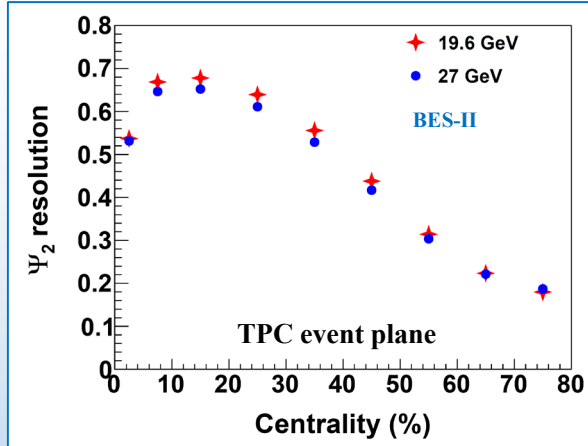
STAR detector, particle reconstruction and signal extraction

STAR detector

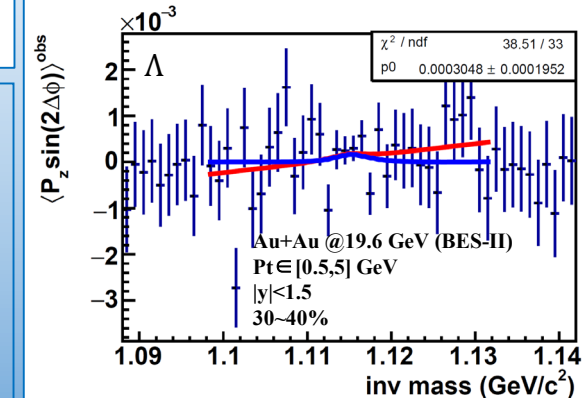
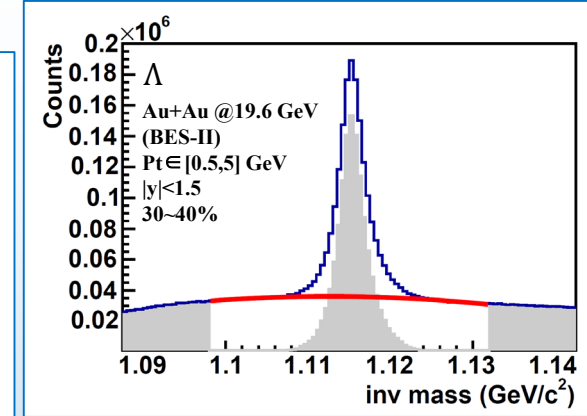


STAR Collaboration, Nature 548 (62) 2017

Event plane reconstruction Au+Au @ 19.6 & 27 GeV



Particle reconstruction



TPC: Time Projection Chamber

Time Of Flight → PID

TPC → Event plane reconstruction

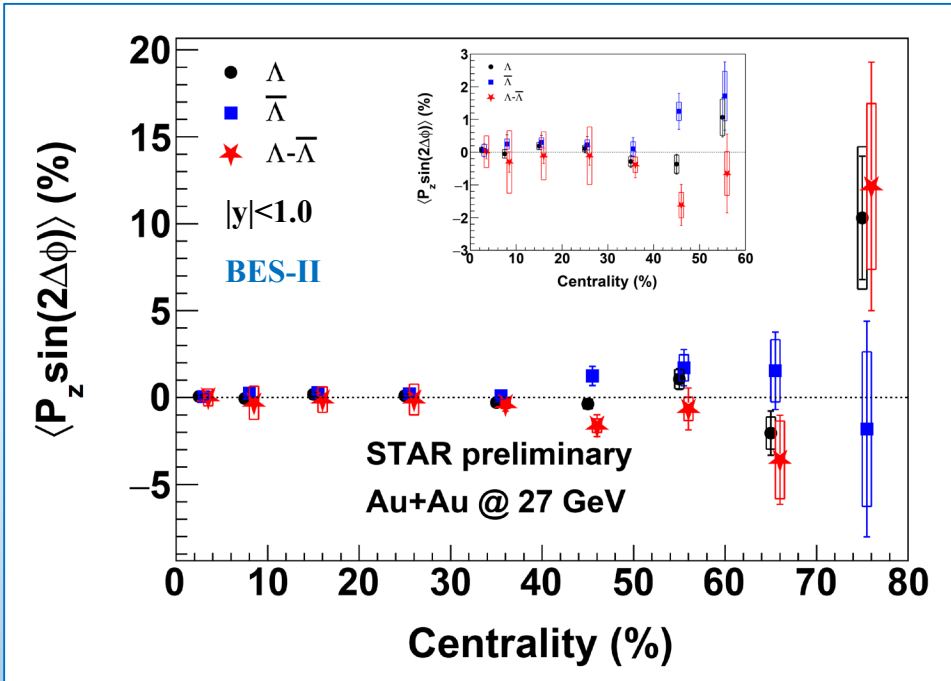
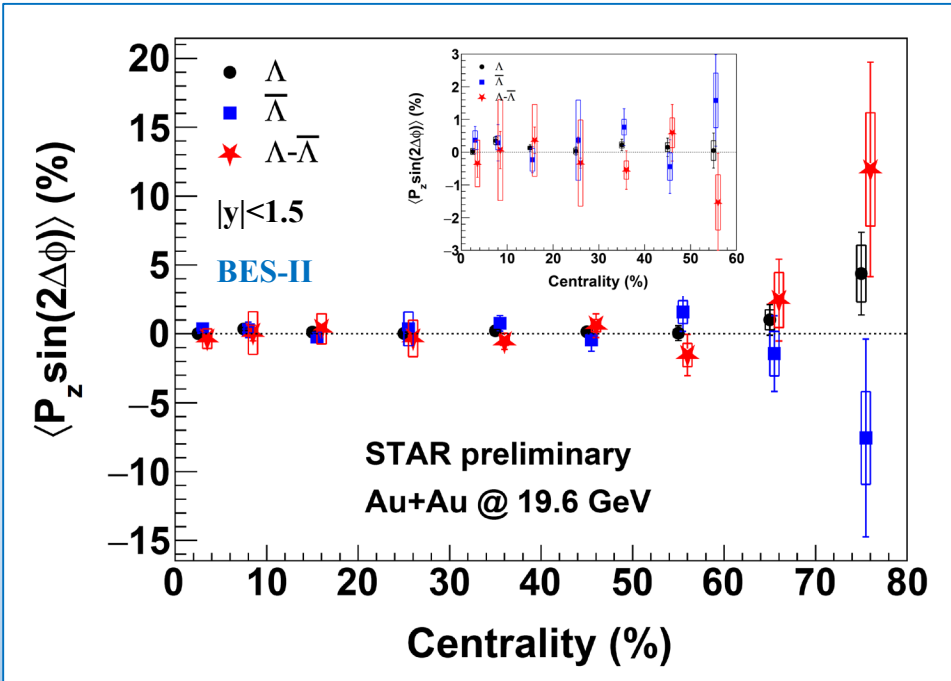
$$\begin{aligned} \langle P_z \sin(2\Delta\phi) \rangle^{obs} \\ = (1 - f^{Bg}(M_{inv})) \langle P_z \sin(2\Delta\phi) \rangle^{Sg} \\ + f^{Bg}(M_{inv}) \langle P_z \sin(2\Delta\phi) \rangle^{Bg} \end{aligned}$$

$$\Delta\phi = \Psi_2 - \phi_p^*$$

Blue: w/o background

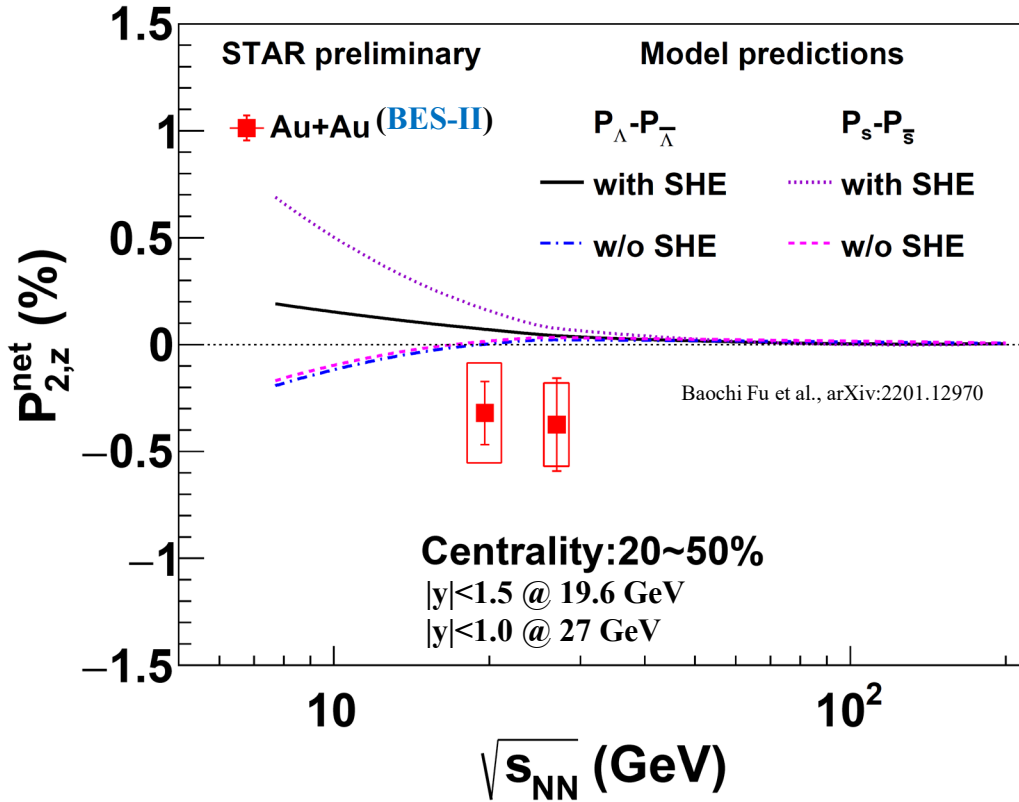
Red: with linear background ($\alpha + \beta M_{inv}$)

Local polarization in Au+Au collisions at 19.6 and 27 GeV



No significant centrality dependence of $\langle P_z \sin(2\Delta\phi) \rangle$ is observed

Results and summary



- ✓ First study of baryonic spin Hall effect by measuring net local polarization in Au+Au @ 19.6 and 27 GeV (BES-II)
- ✓ Local polarization P_Z has been extracted for $\Lambda/\bar{\Lambda}$
- ✓ Net local polarization $P_{2,Z}^{net}$ has been obtained
- ✓ No significant $P_{2,Z}^{net}$ is observed
- ✓ Analysis on other BES energies is underway

$$P_{2,Z}^{net} = \langle P_Z^{net}(\phi) \sin 2\phi \rangle \quad P_Z^{net}(\phi) = P_Z^{\Lambda}(\phi) - P_Z^{\bar{\Lambda}}(\phi)$$