New measurements in fixed-target collisions at LHCb

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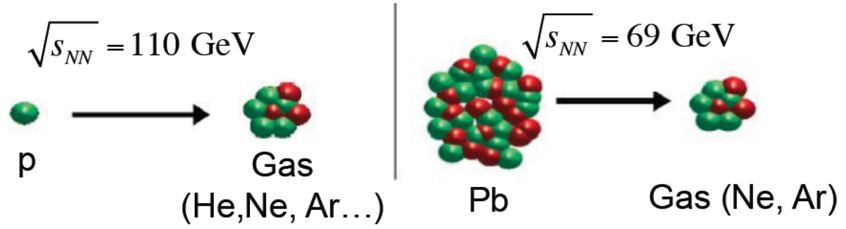
SMOG: fixed-target program

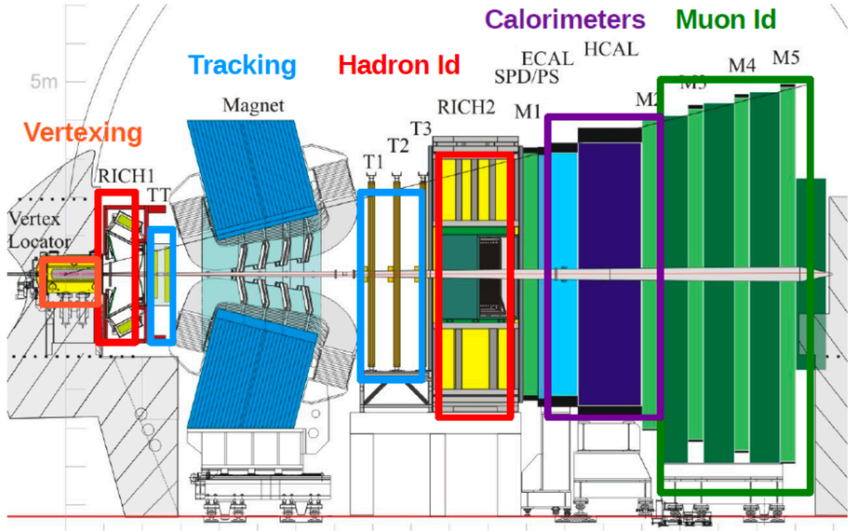
SMOG: System for Measuring Overlap with Gas.

Noble gases at a pressure of O(10^{-7}) mbar are injected into the VELO.



$$y = y^* + ln(\frac{\sqrt{s_{NN}}}{m_p})$$

$$x_F \simeq \frac{2}{\sqrt{s_{NN}}}\sqrt{M^2 + p_T^2} \quad sinh(y^*)$$



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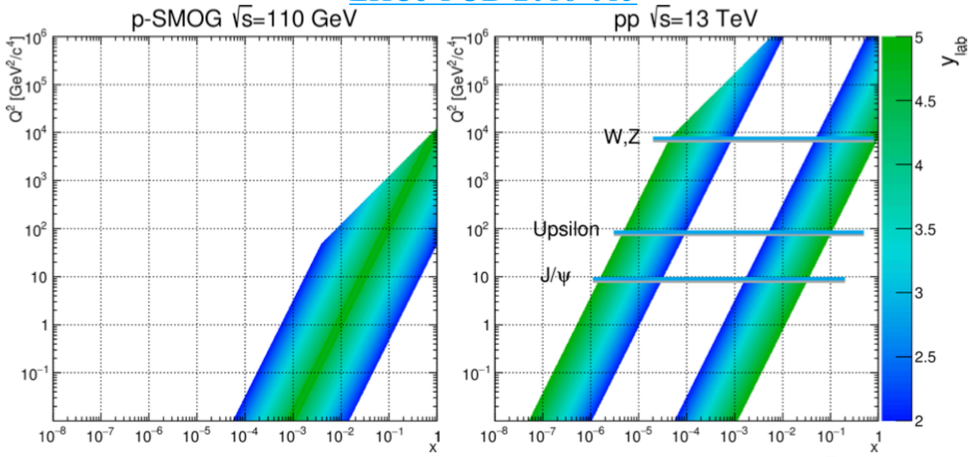
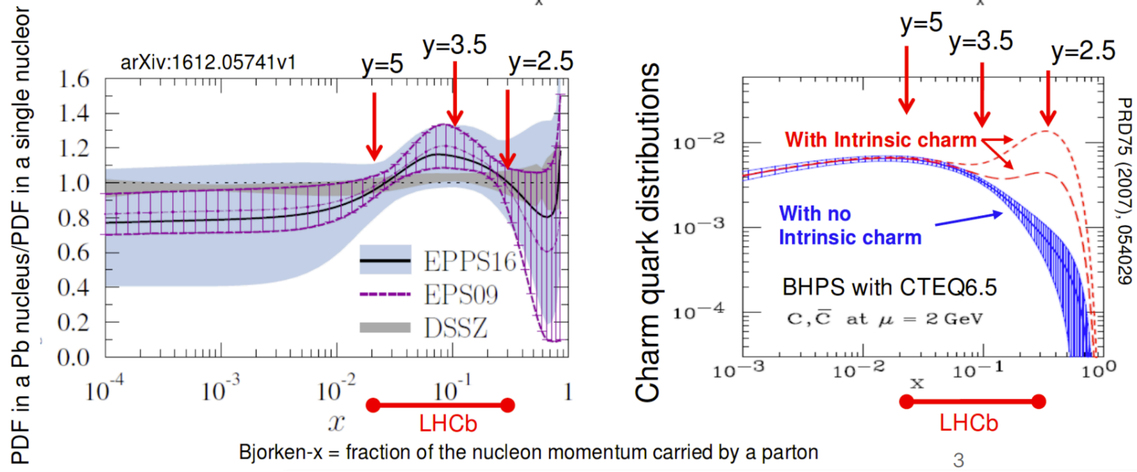


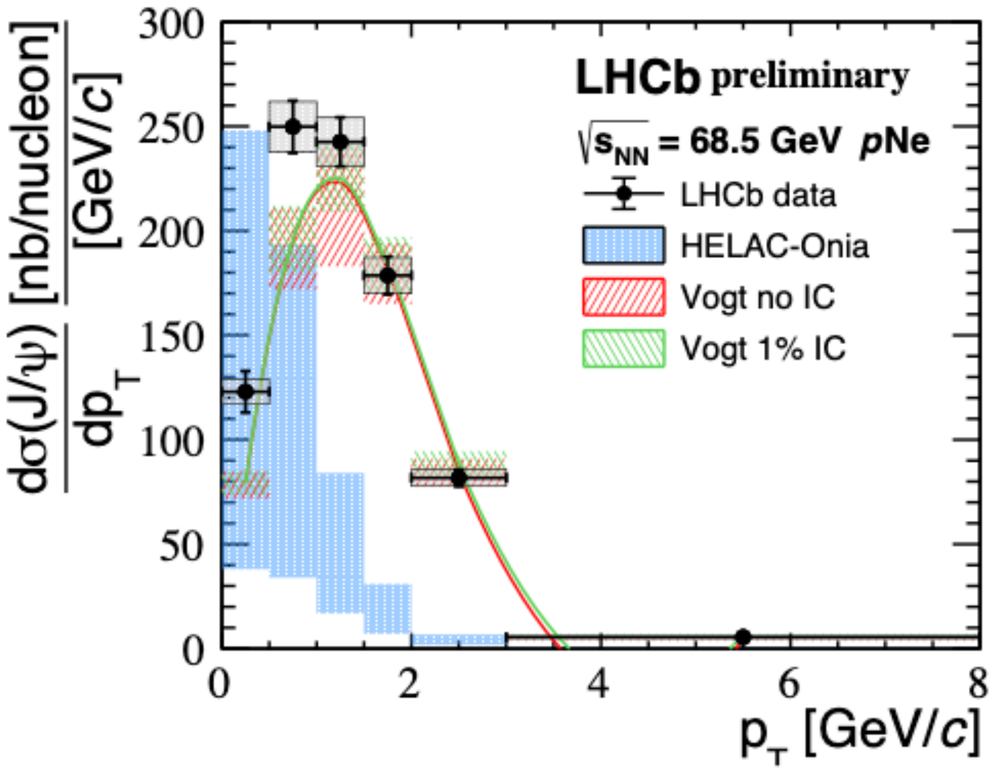


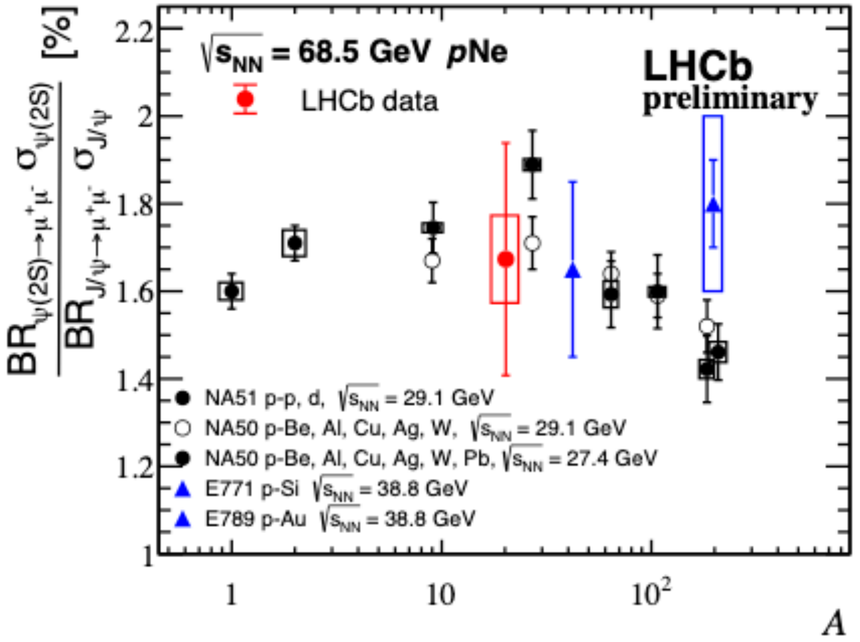
- $-3.0 < y^* < 0$
- Probe intrinsic charm content in the nucleon.
- Access nPDF anti-shadowing region.

Charmonia production in pNe collisions at $\sqrt{s_{NN}} = 68.5\ GeV$

LHCb-PAPER-2022-014 in preparation

- Charmonium production is suppressed by Cold Nuclear Matter effects in proton-nucleus collisions.
- Production cross-section of J/ψ is well produced by Vogt's predictions with both 1% and no Intrinsic Charm contribution.



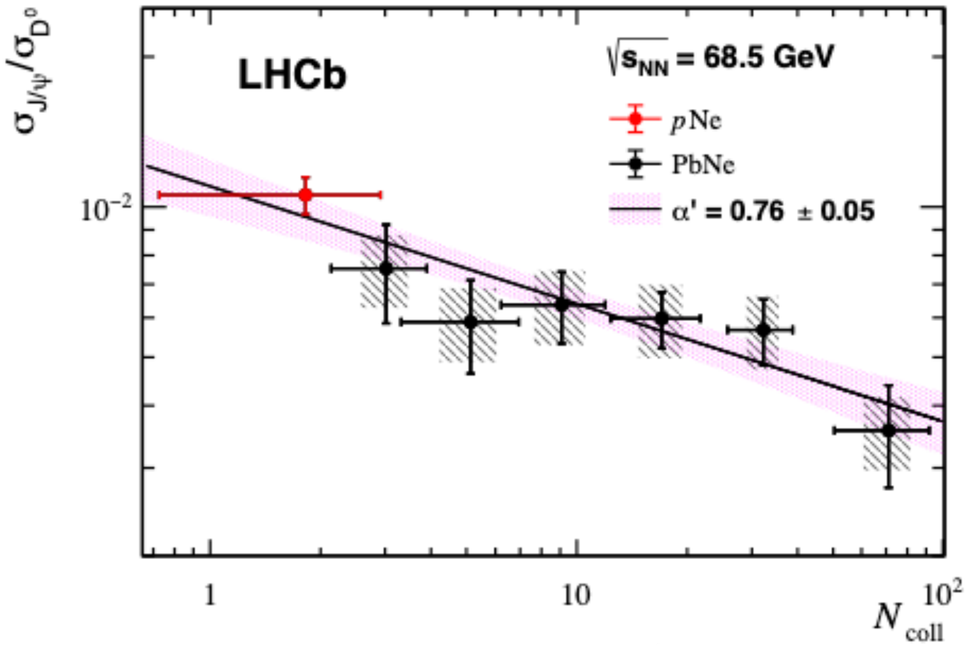


- First measurement of the $\psi(2S)$ over J/ψ production in fixed target mode.
- $\psi(2S)$ to J/ψ production ratio is in agreement with other measurements at small values of target atomic mass number A.

D^0 and J/ψ production in PbNe collisions at $\sqrt{s_{NN}} = 68.5\ GeV$

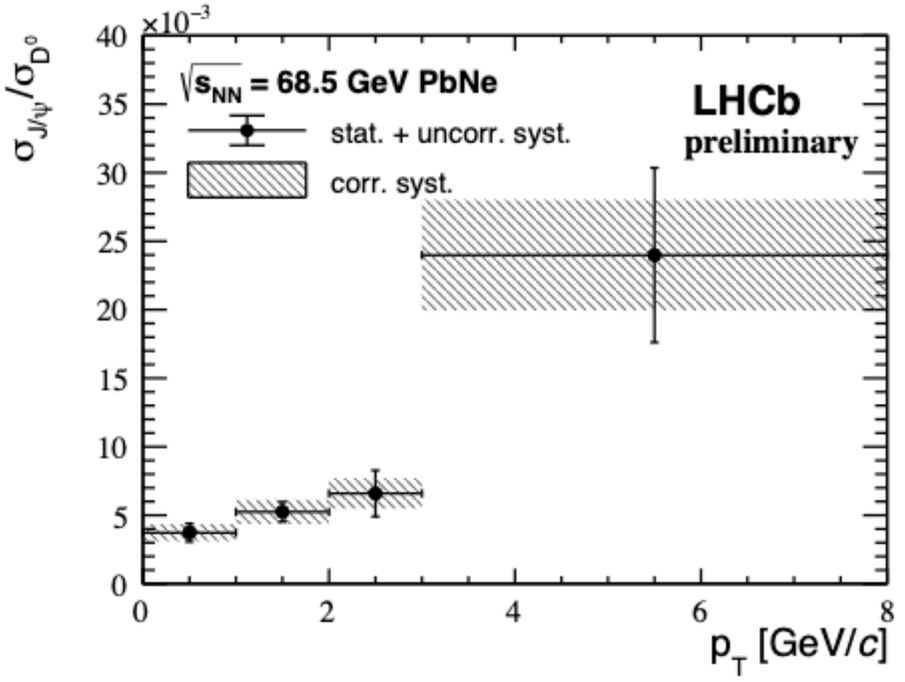
LHCb-PAPER-2022-011 in preparation

- The measurement of J/ψ yield with the D^0 production can improve the interpretation of the charmonium $c\bar{c}$ suppression due to the presence of the hot and dense medium.



Assuming that $\sigma_{J/\psi} \propto < N_{coll} >^{\alpha'}$ and $\sigma_{D^0} \propto < N_{coll} >$

$\Rightarrow \sigma_{J/\psi}/\sigma_{D^0} \propto < N_{coll} >^{\alpha'-1}$



- J/ψ and D^0 production ratio strongly depends on p_T

- J/ψ production is affected by additional nuclear effects with respect to D^0.
- No anomalous J/ψ suppression is observed in the largest N_{coll} that could indicate the formation of QGP.

Detached antiproton production in pHe collisions at $\sqrt{s_{NN}} = 110\ GeV$

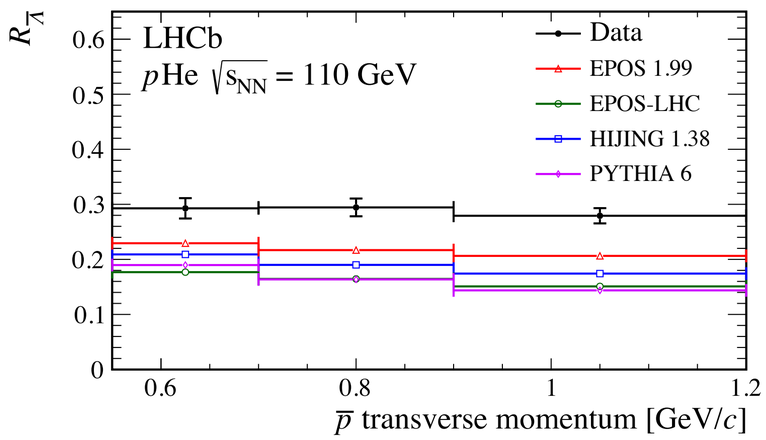
arXiv:2205.09009

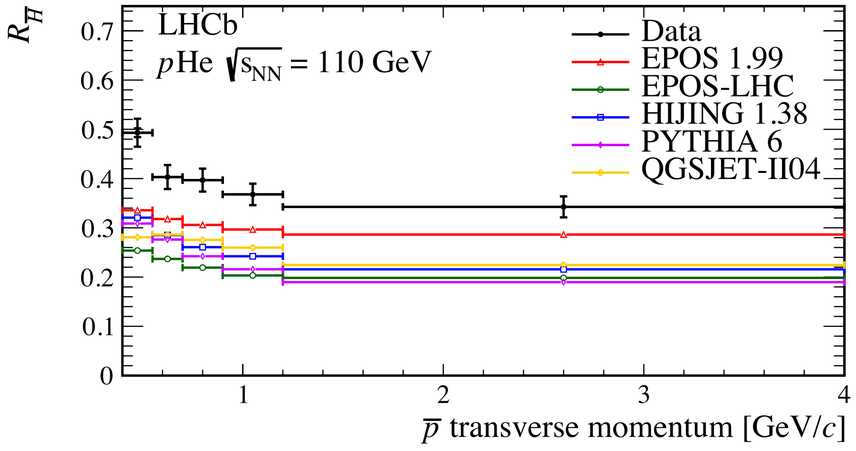
- Models of antiproton production in cosmic rays (CRs) collisions with the interstellar medium limit the interpretation of the $\bar{p}$ flux in CRs measurements.
- The measurement of prompt $\bar{p}$ in pHe collisions at $\sqrt{s_{NN}} = 110$ is extended to include $\bar{p}$ from anti-hyperon decays.

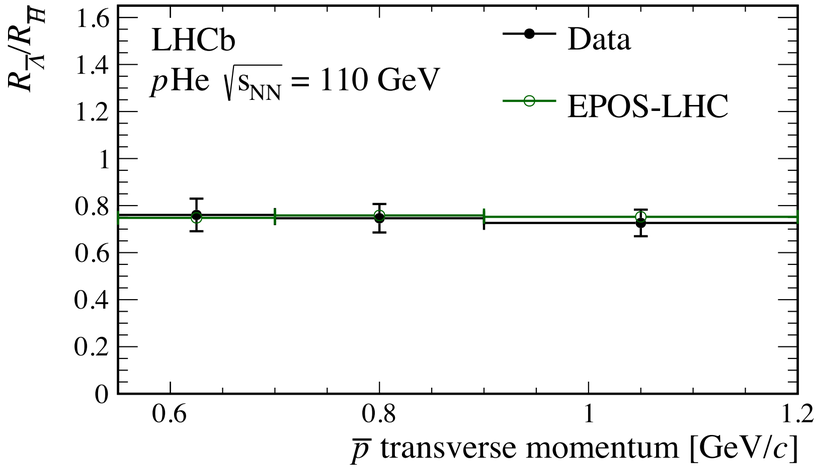
$$R_{\bar{\Lambda}} \equiv \frac{\sigma(pHe \to \bar{\Lambda}X \to \bar{p}X)}{\sigma(pHe \to \bar{p}_{prompt}X)}$$

$$R_{\bar{H}} \equiv \frac{\sigma(pHe \to \bar{H}X \to \bar{p}X)}{\sigma(pHe \to \bar{p}_{prompt}X)}$$

$$R_{\bar{\Lambda}}/R_{\bar{H}}$$

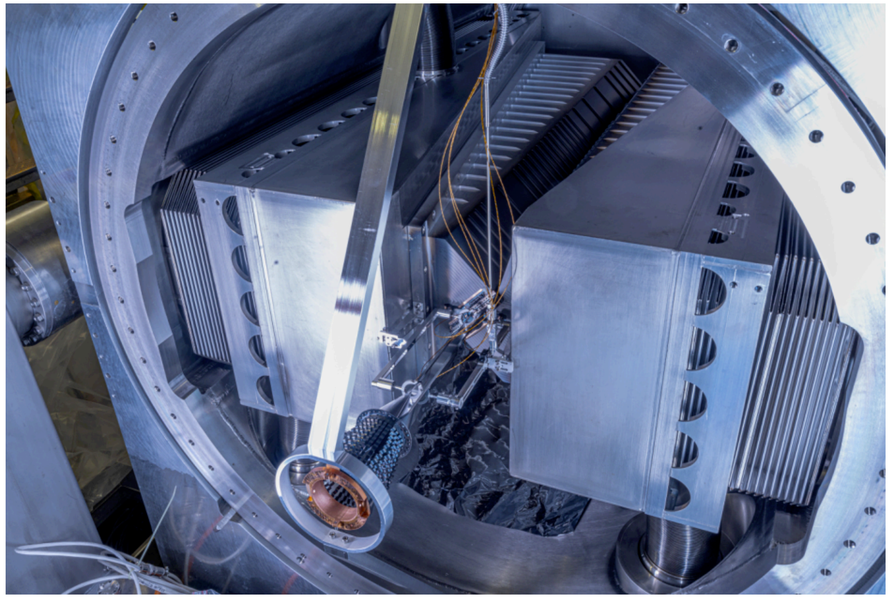






- Models largely underestimate the anti-hyperon contributions to the $\bar{p}$ production.
- The ratio of $\bar{\Lambda}$ over $\bar{H}$ is well reproduced by EPO-LHC

SMOG2: extension of the fixed-target programme



- **SMOG2**: confinement cell for the gas to be installed upstream of the nominal IP (z in [-500,-300]mm).
- More gas target: $H_2, D_2, He, N_2, O_2, Ne, Ar, Kr, Xe$.
- Gas density increased by up to two orders of magnitude for the same gas.

- pp and SMOG2 luminous regions separated
  - → simultaneous data-taking is possible.
  - → Large statistics.
- Unique opportunities to extend heavy-ion, QCD and astrophysics studies.

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