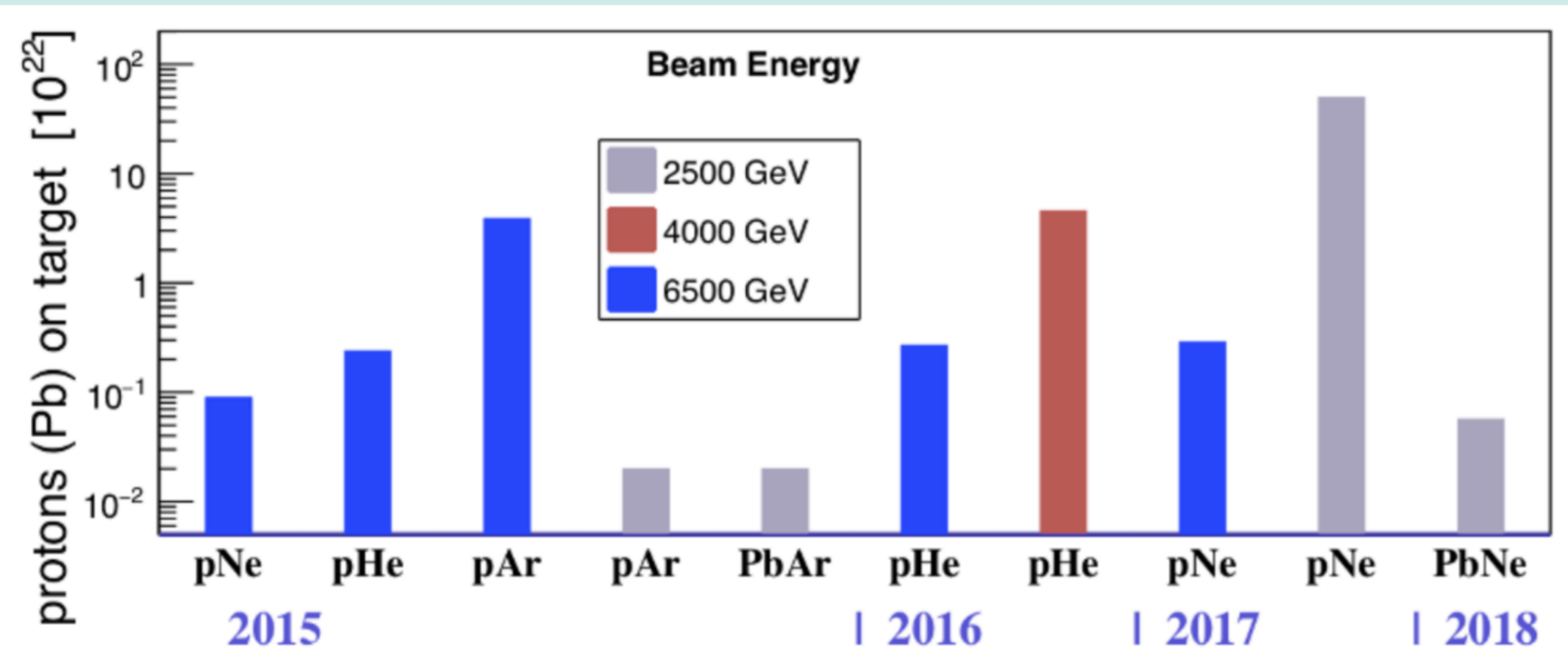
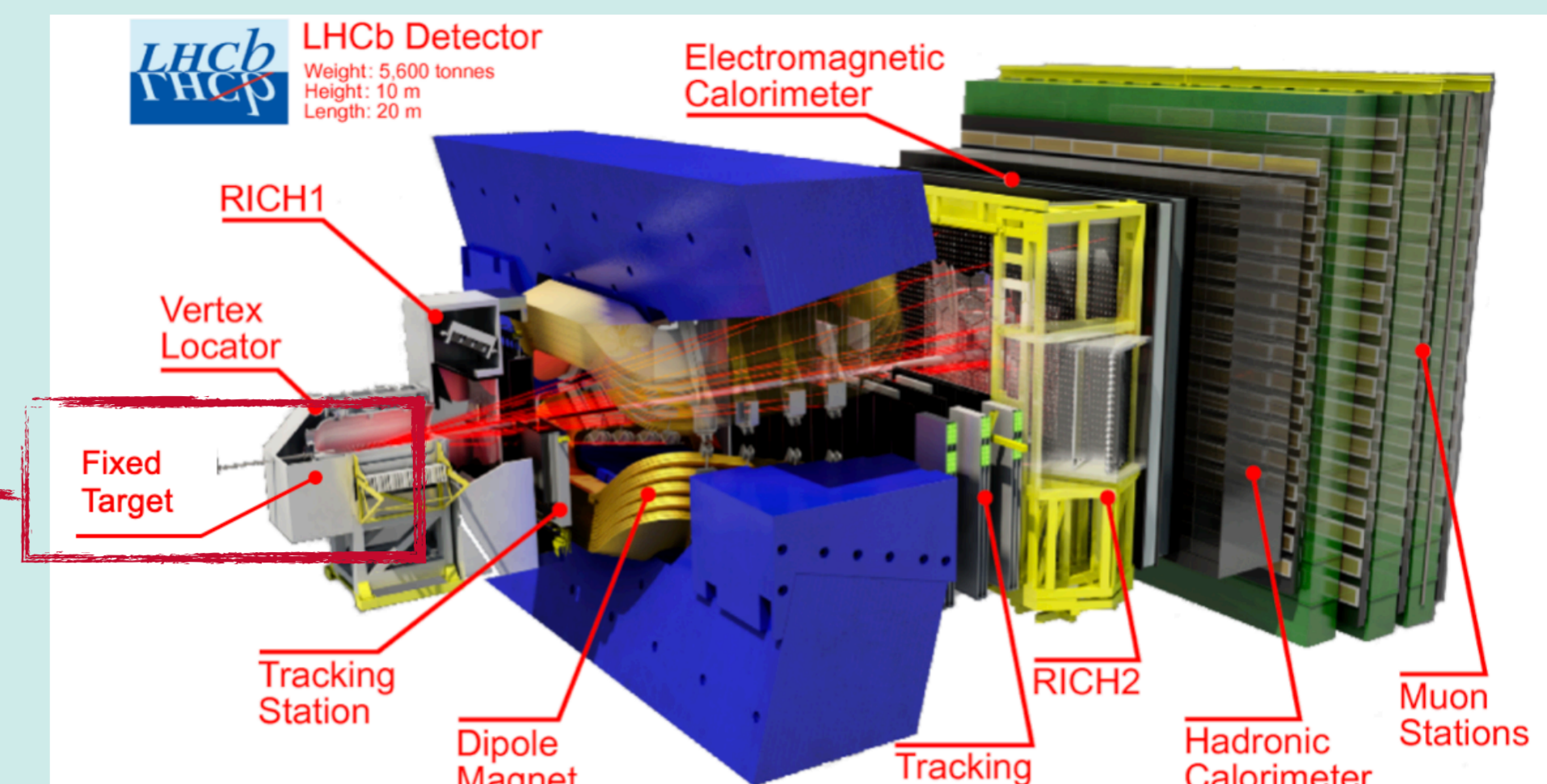
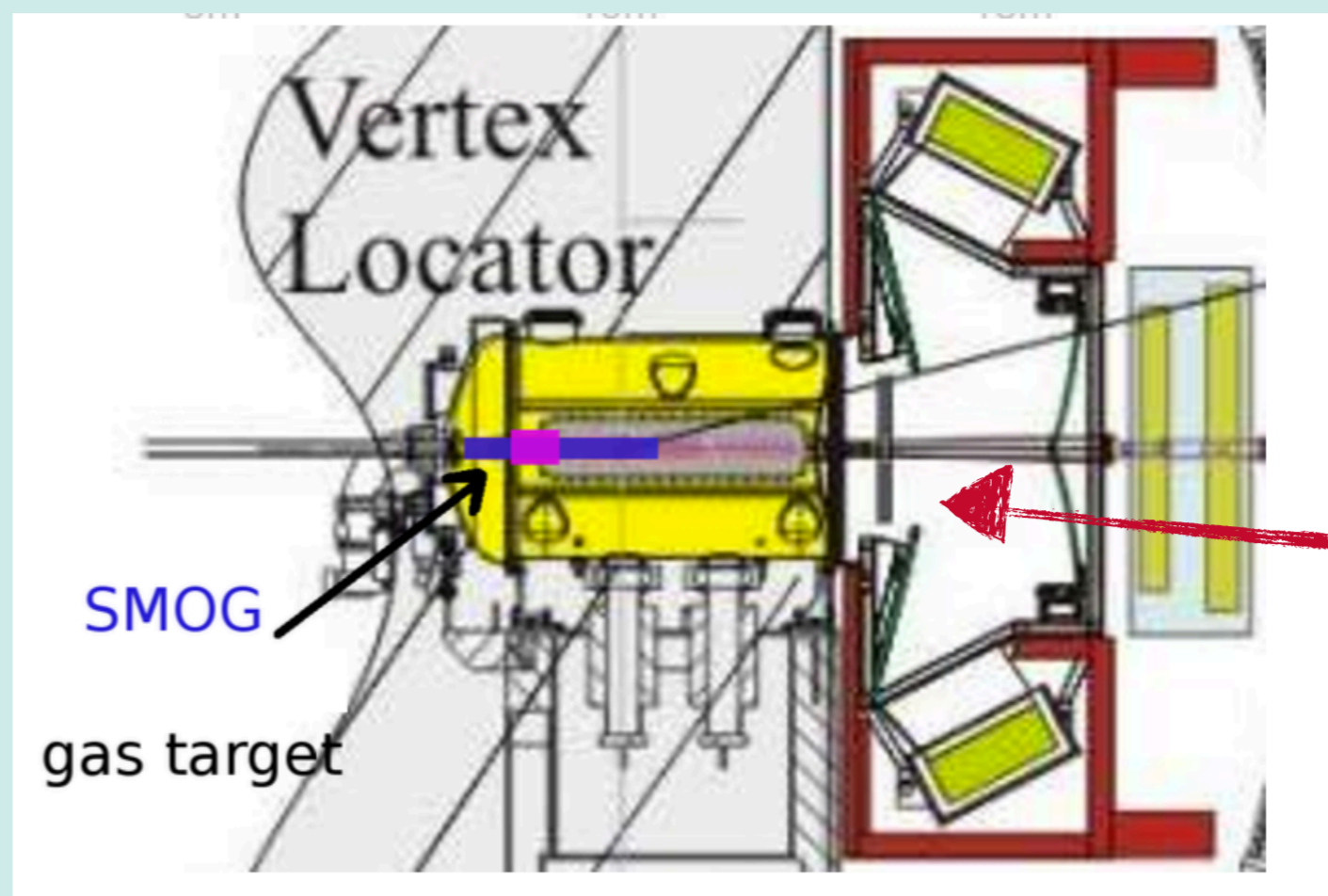
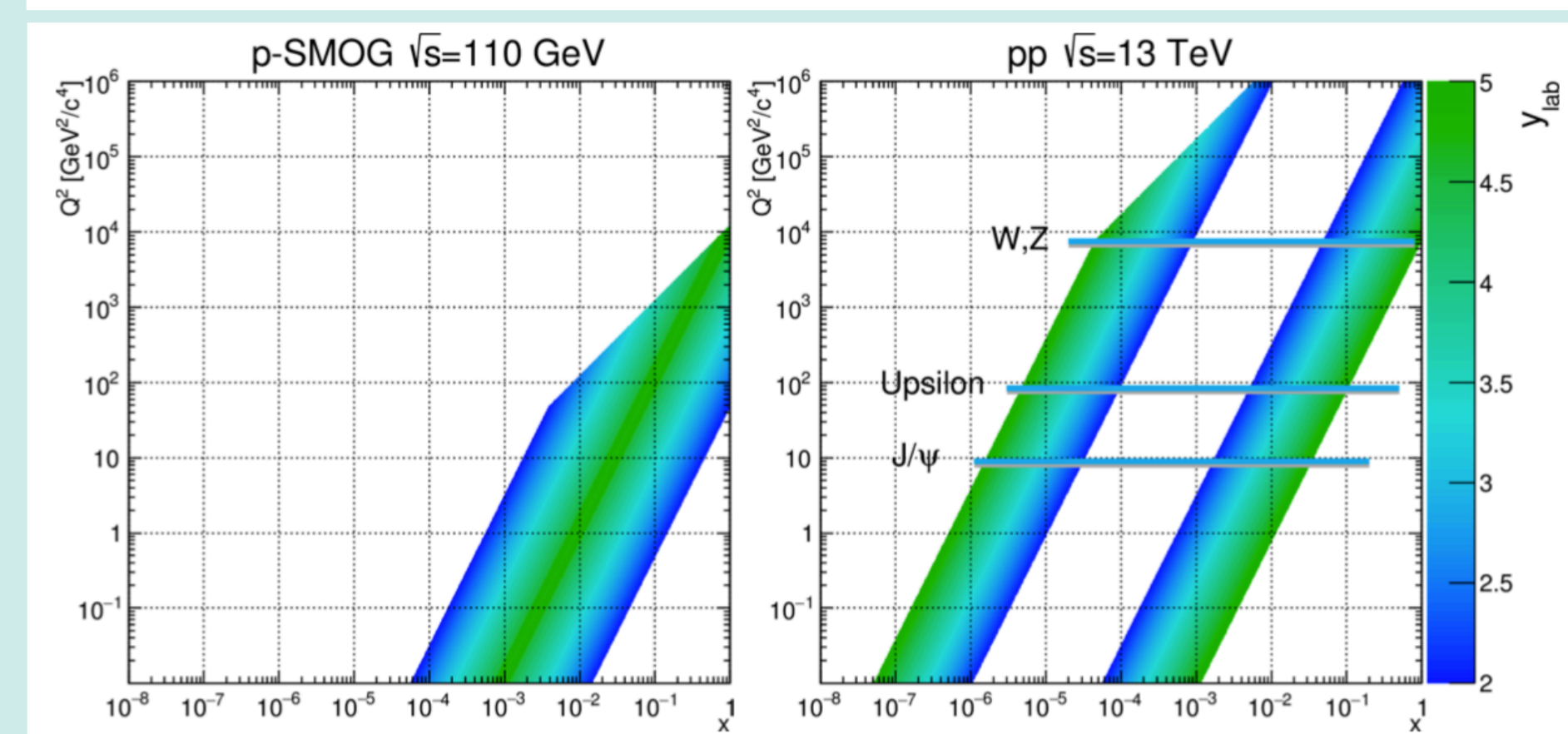


Fixed-Target Collisions at LHCb

- LHCb: one of the 4 main experiments at CERN
- SMOG: the LHCb fixed-target system
- Noble gases (He, Ar, Ne) injected into the LHC vacuum around the LHCb interaction region
- Highest-energy fixed-target experiment ever built!

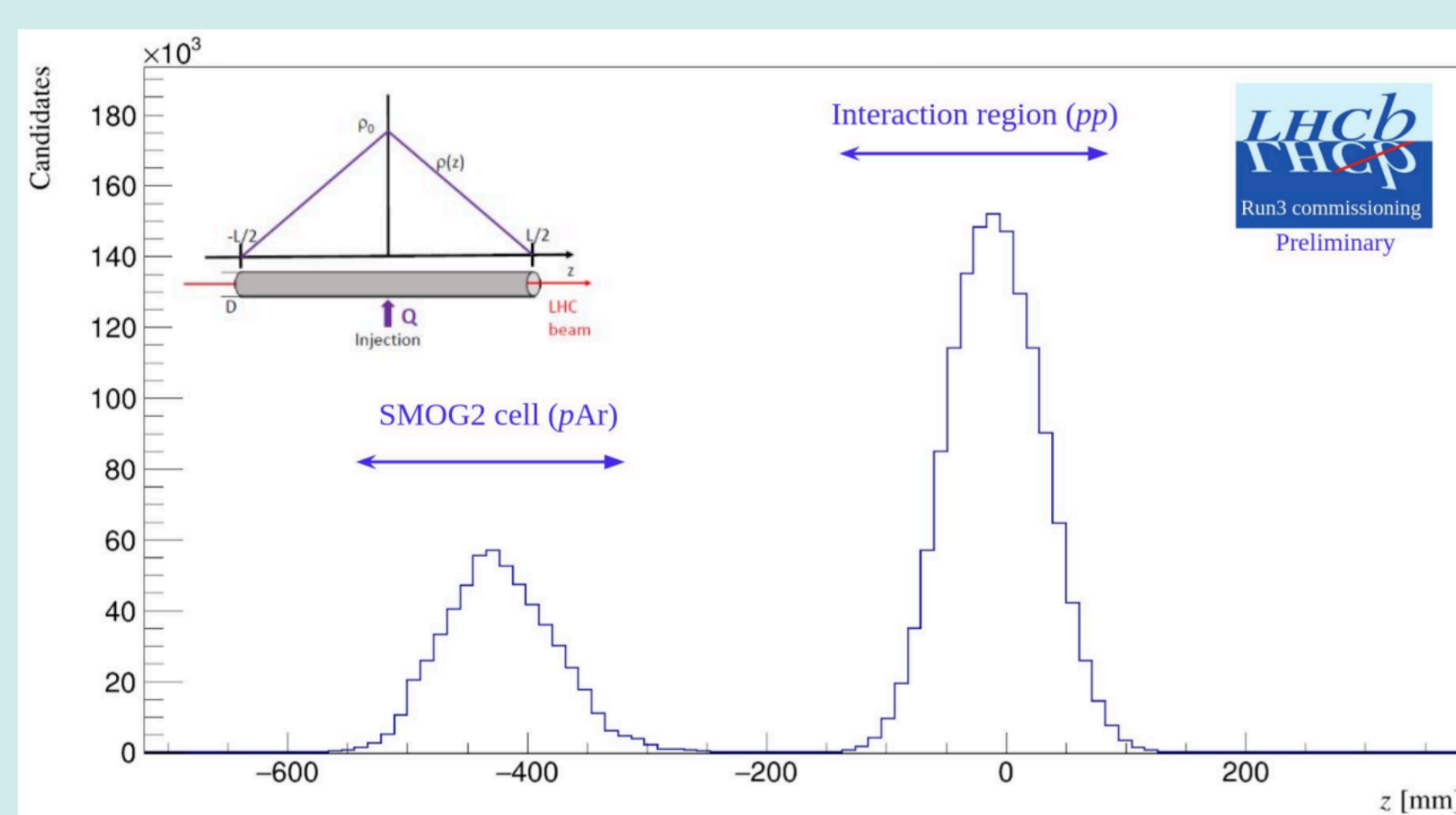
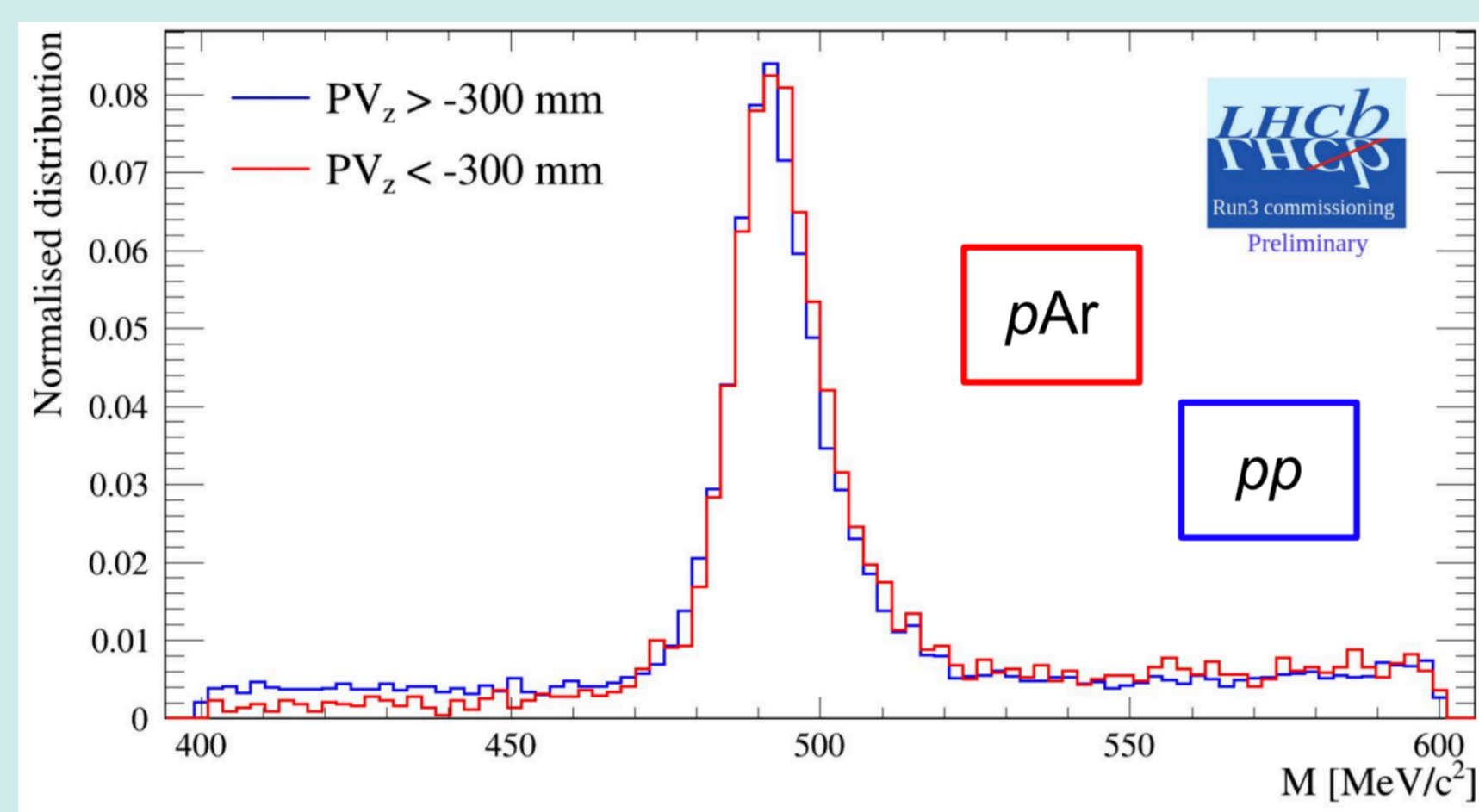
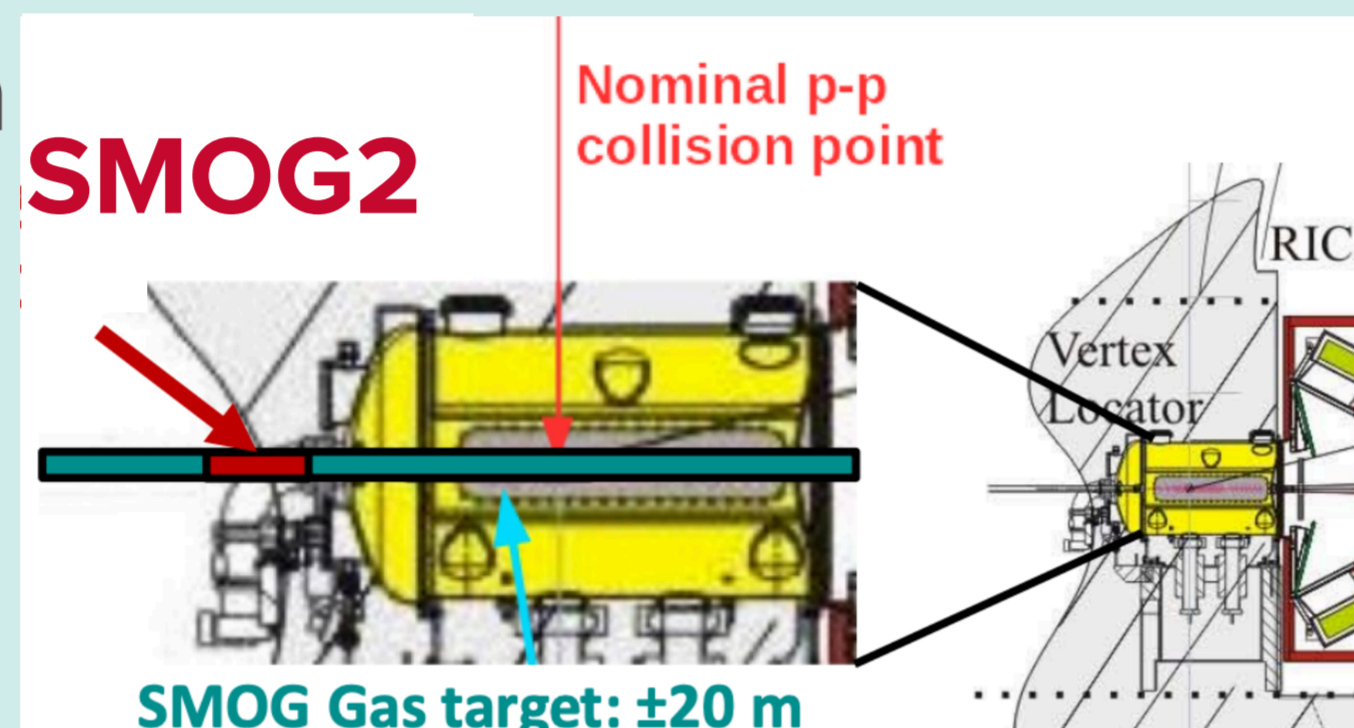


- Unique kinematical region accessible
- $\sqrt{s_{NN}} \sim \sqrt{2E_N M_N} = 41 - 115 \text{ GeV}$
- Investigates the high- x of the nucleon target at intermediate Q^2

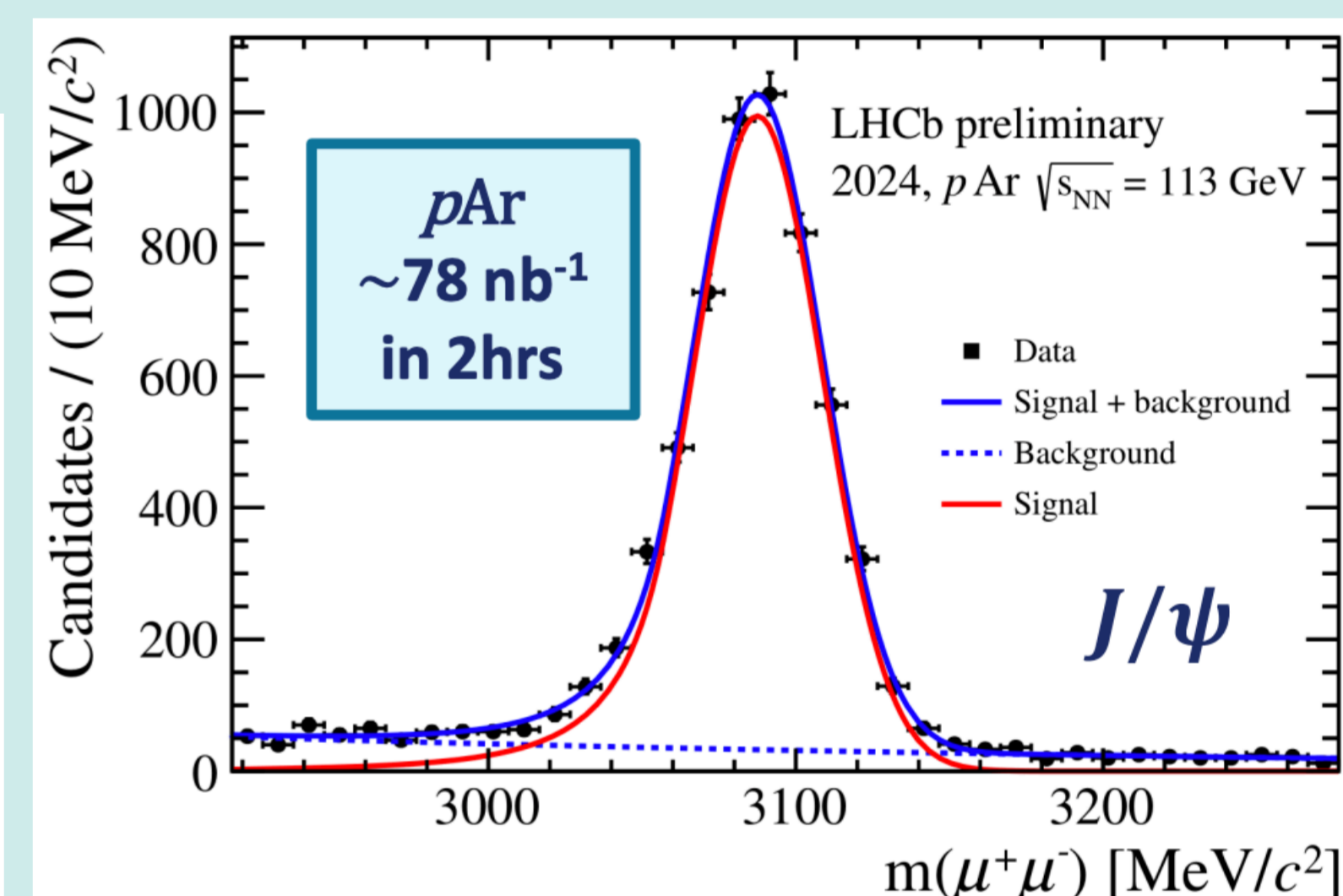
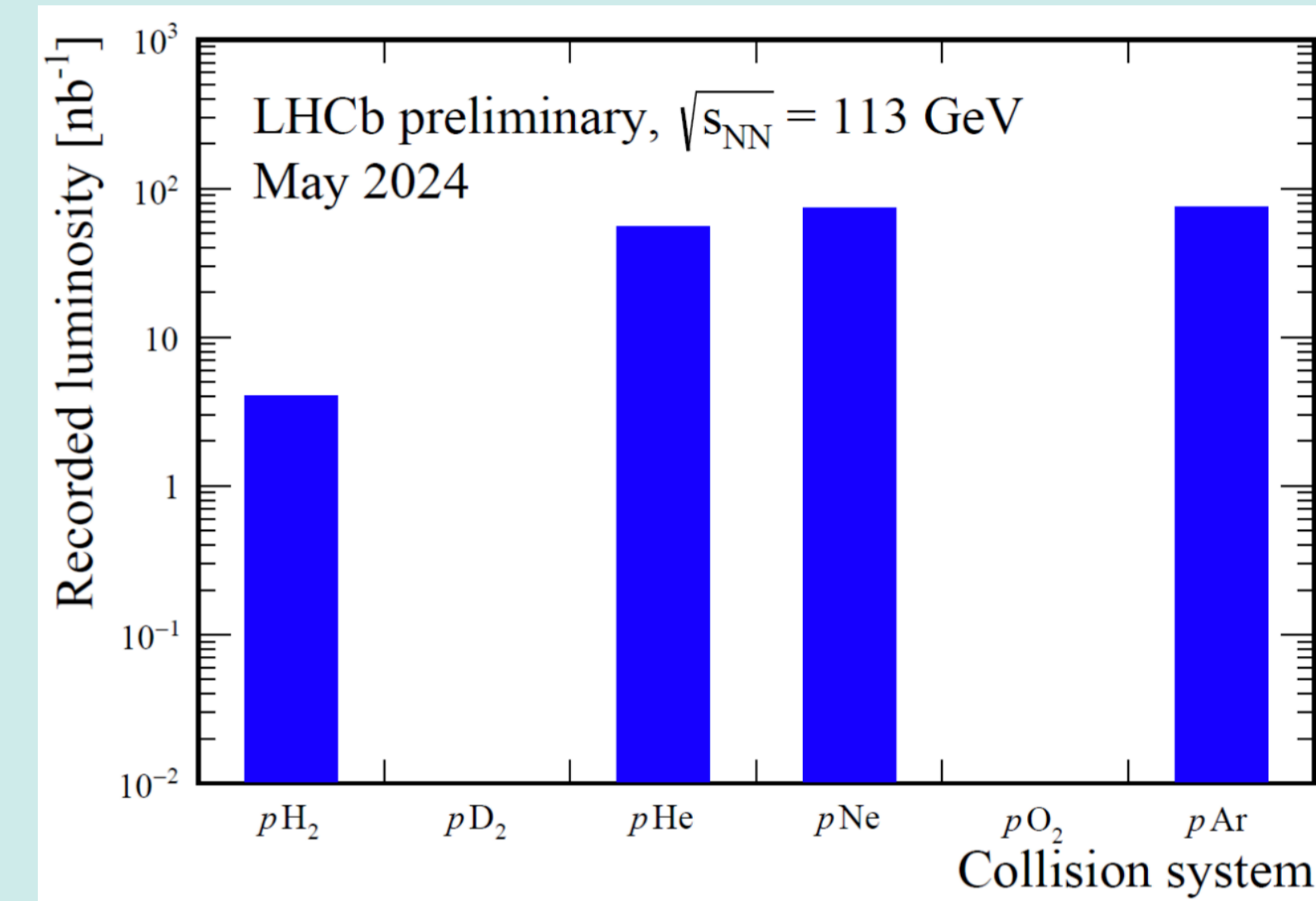
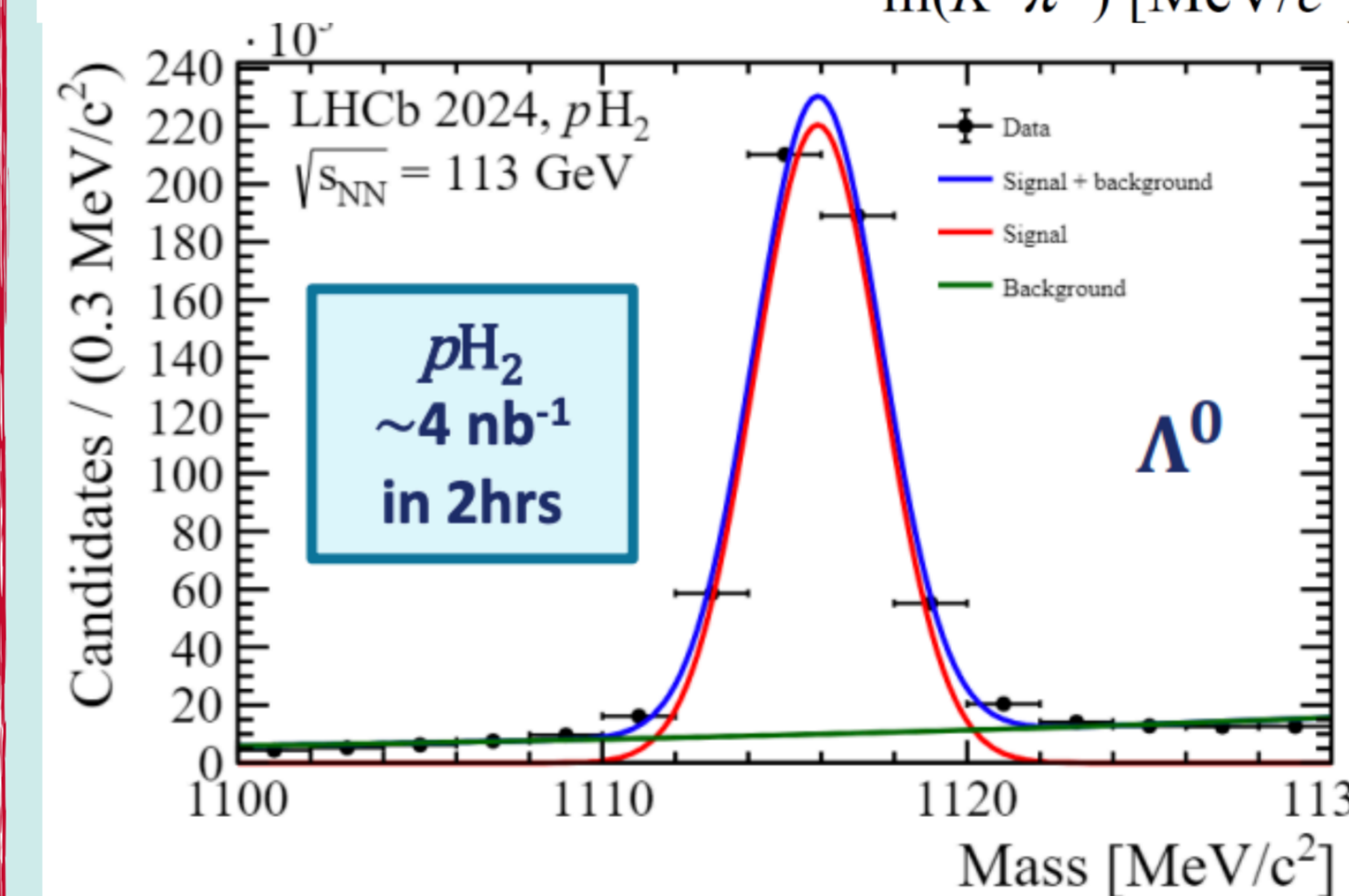
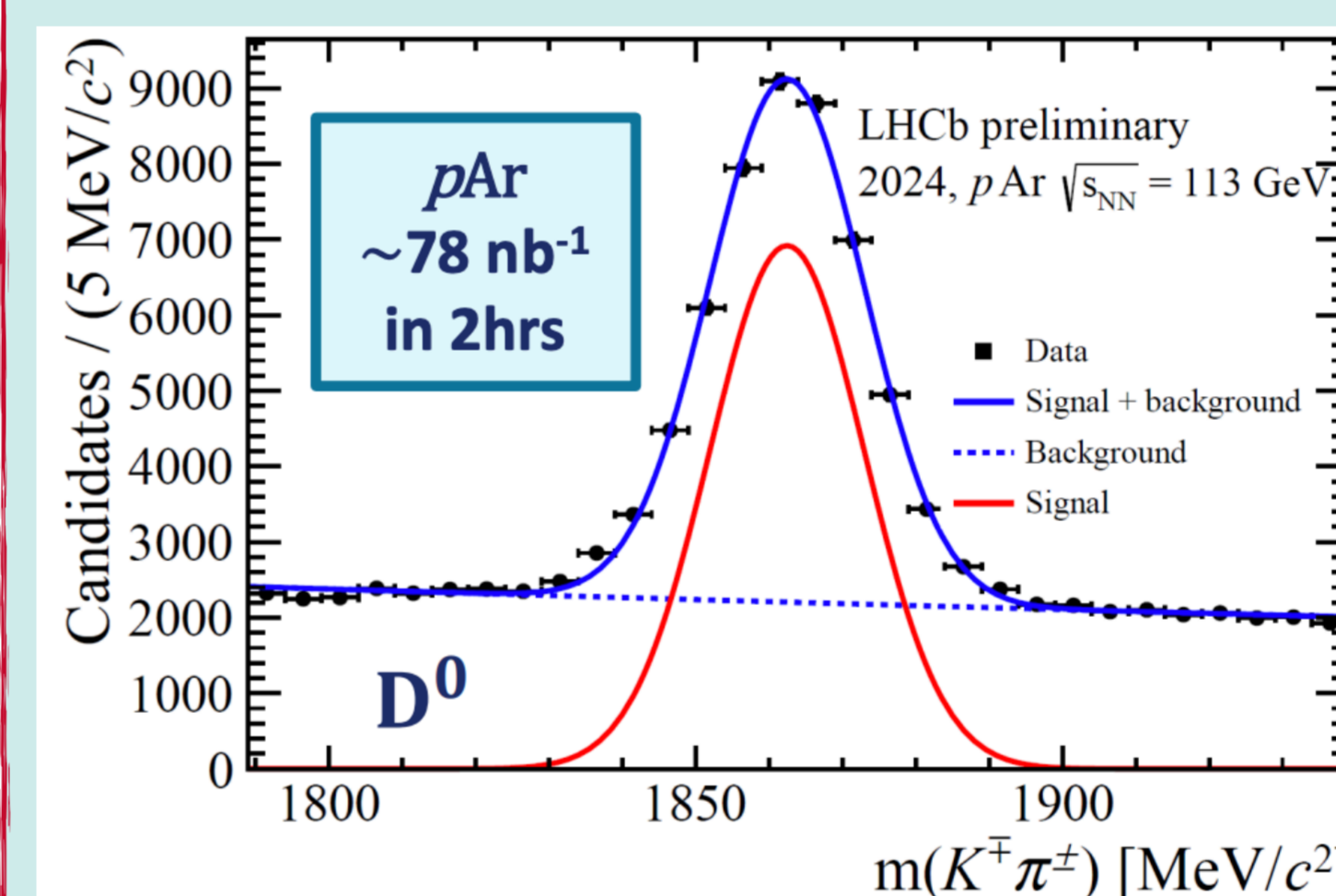


SMOG Upgrade: SMOG2

- SMOG2 [1,2,3]: gas confined in 20 cm storage cell installed upstream the LHCb interaction point
- Higher areal density than SMOG
- Wider choice of gases to be injected: H₂, D₂, He, Ne, N₂, O₂, Ar, Kr, Xe → Fast switch between gas species
- Data taking simultaneous in pp and pA modes
- Same resolution for the two collision modes

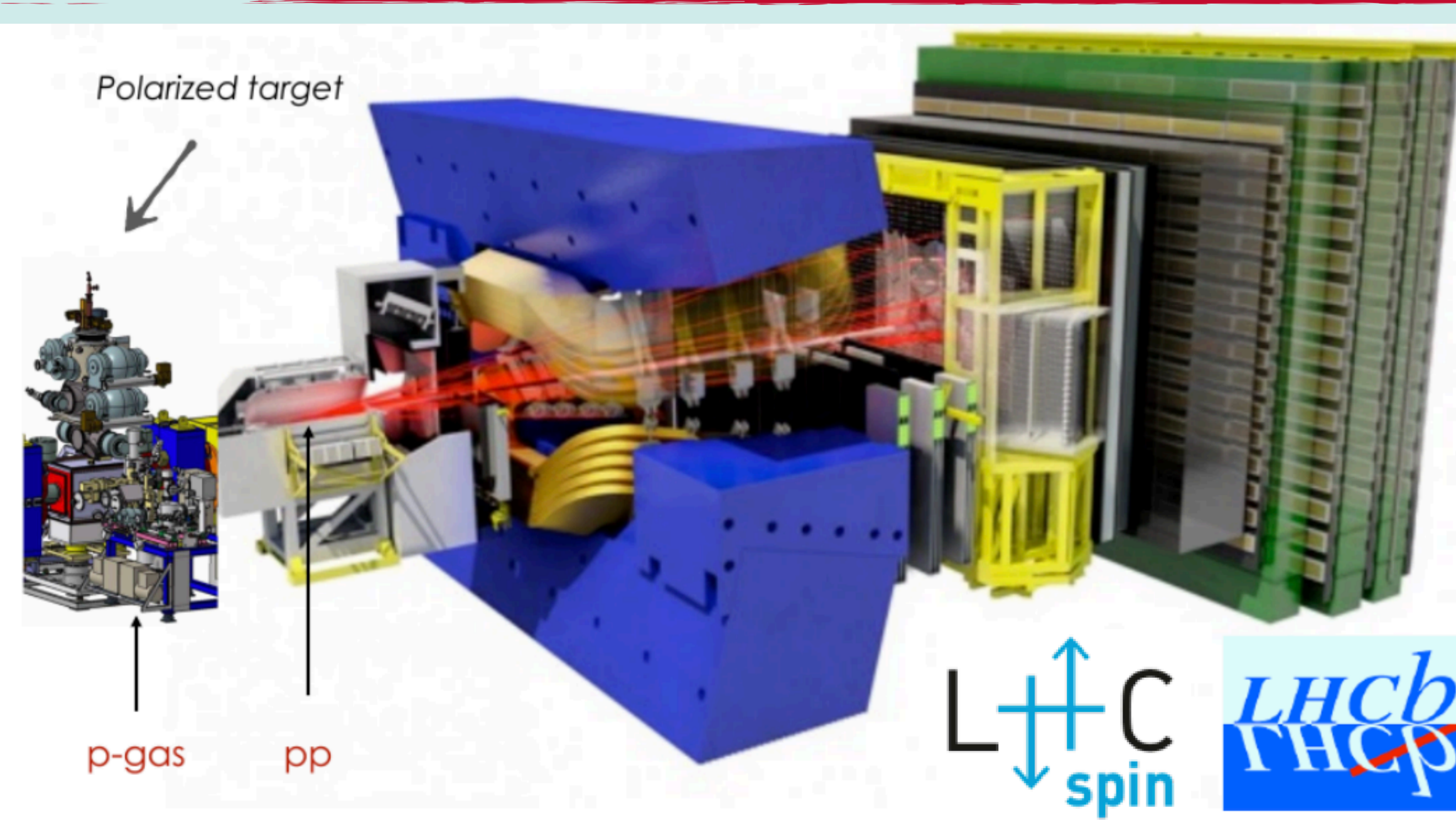


- Unique physics opportunities never explored at LHC [4,5]:
- Charmonium production → baseline for QGP → study intrinsic charm
- p-H₂, -He, -D₂, -O₂ and O-H₂ collisions → extend Cosmic Ray models

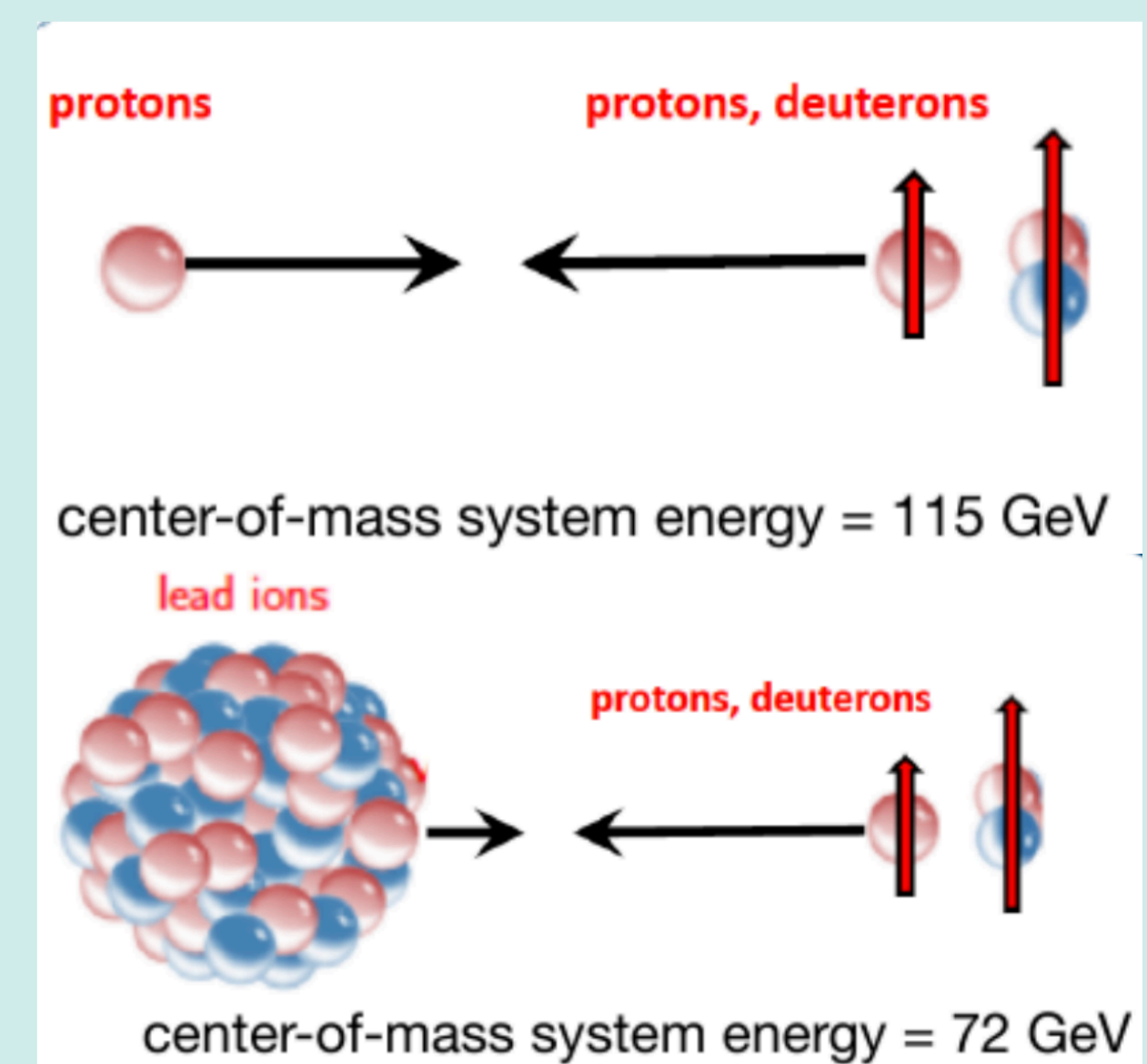


- Λ transverse polarization with different beam energies and mass targets
- High-statistics Pb-gas UPC: ρ , ω , charmonia and bottomonia states with high-Z targets

Future Prospects: Polarized Fixed-Target



- R&D for a polarized gas target upgrade [6,7]
- Studies ongoing within the Physics Beyond Colliders forum at CERN
- Unique opportunity for parton TMDs with transversely polarised DY, complementary to EIC
- Spin physics in HI collisions!



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- [3] Boente Garcia, O. et al., "A high-density gas target at the LHCb experiment", arXiv:2407.14200, in print on Physics Review Accelerators and Beams
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- [6] Santimaria, M. et al., "The LHCspin project, a polarised gas target at the Large Hadron Collider", EPJ Web Conf. Volume 276, 2023
- [7] Di Nezza, P. et al., "Fixed Target Program at the LHC", PoS (SPIN2023)036