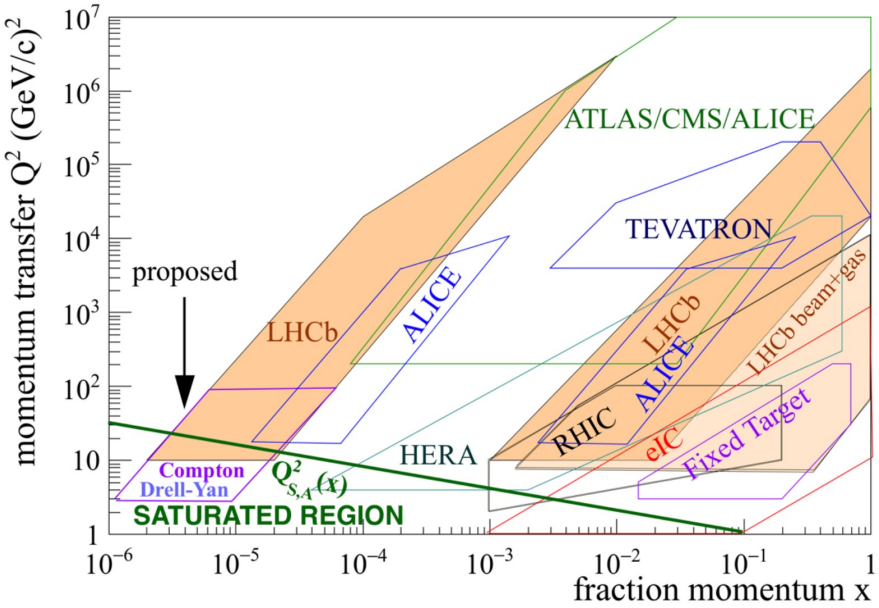
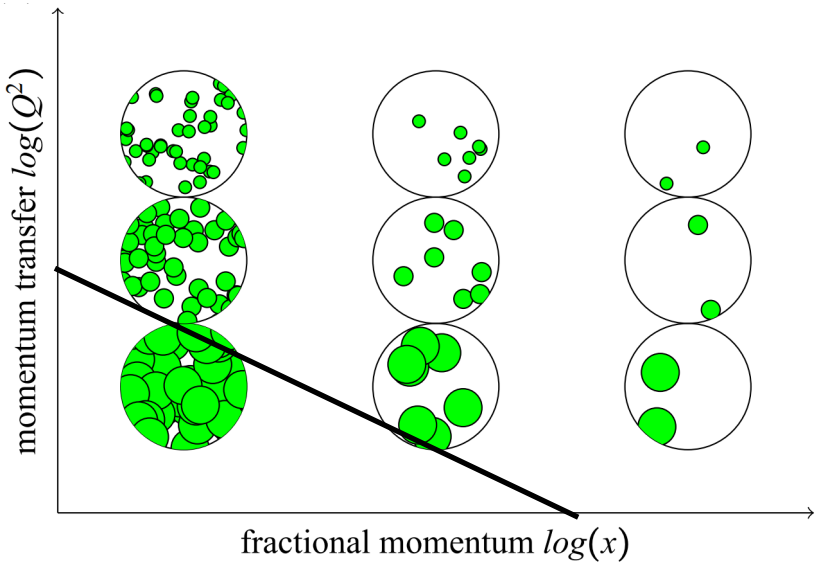
Searching for the gluon saturation scale at $x \sim 10^{-5}$ with the LHCb detector using direct photons.

Cesar L. da Silva – Los Alamos National Lab (USA)
On behalf of the LHCb Collaboration

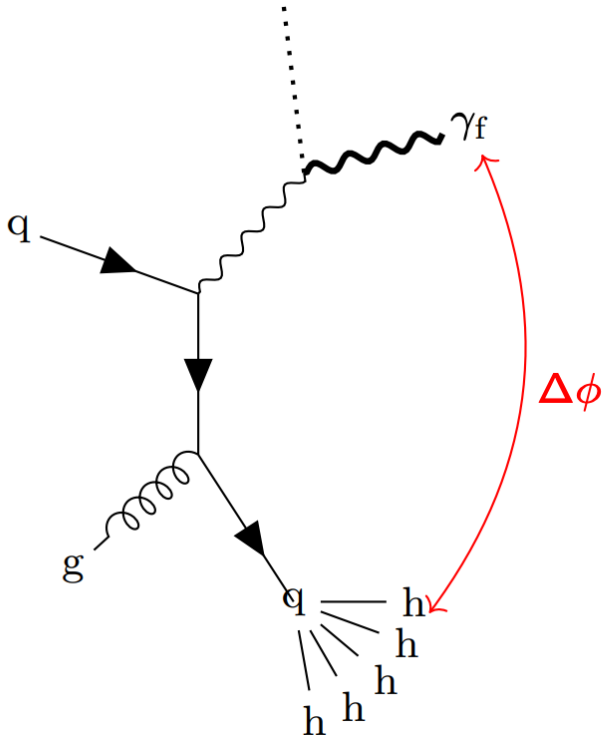


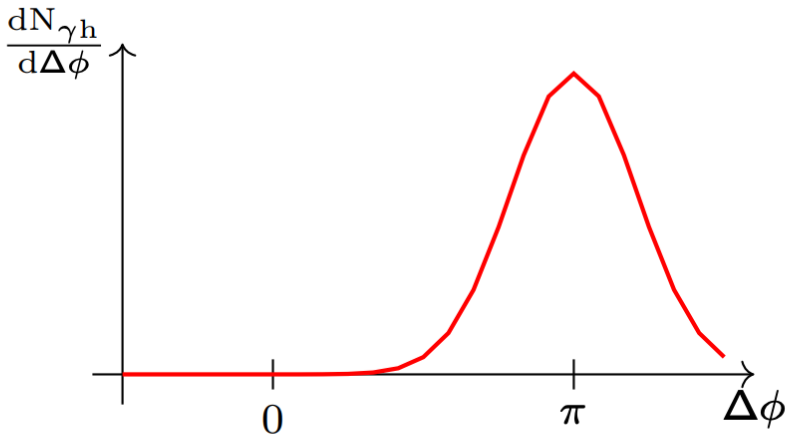


- QCD frontier :
  - is a gluon saturated regime a strong force condensate ?
  - How can we use it to extend our knowledge on gauge theories ?

- LHCb is uniquely positioned to explore gluon saturation in a $Q \gg \Lambda_{QCD}$ region

Gluon Probe : Inverse Compton





$$x_{p_z>0} = \frac{p_{T,\gamma}}{\sqrt{s_{NN}}}\left(e^{y_\gamma} + e^{y_q}\right)$$

$$x_{p_z<0} = \frac{p_{T,\gamma}}{\sqrt{s_{NN}}}\left(e^{-y_\gamma} + e^{-y_q}\right)$$

$$Q^2 = p_{T,\gamma}^2\left(1 + e^{y_q - y_\gamma}\right) \sim 2p_{T,\gamma}^2$$

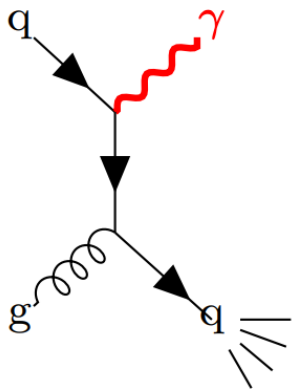
$$\Delta\phi_0 = \phi_\gamma - \phi_h$$

$$\Delta\phi = \begin{cases} \Delta\phi_0 + 2\pi & ,\Delta\phi_0 \leq -\pi/2 \\ \Delta\phi_0 & ,-\pi/2 < \Delta\phi_0 \leq 3\pi/2 \\ \Delta\phi_0 - 2\pi & ,\Delta\phi_0 > 3\pi/2 \end{cases}$$

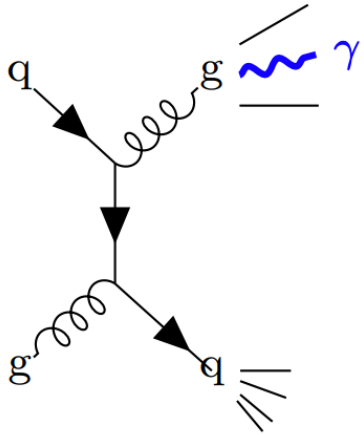
- The inverse Compton signal will show up as an away-side peak in γ+hadron correlations
- minimal activity around the photon (isolated photon)

Background Contributions

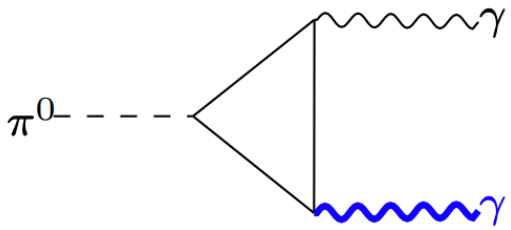
Compton or direct



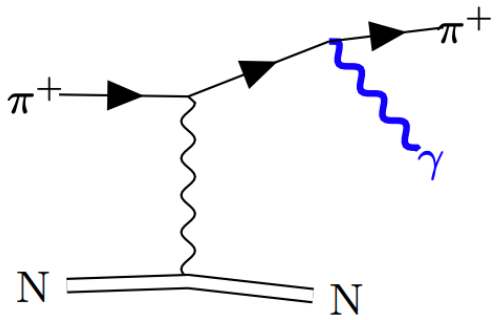
Fragmentation



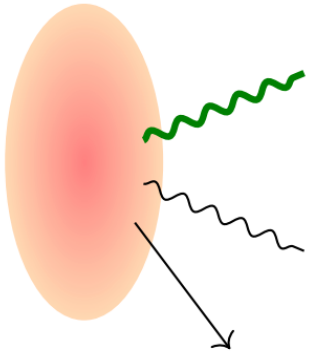
Neutral decays

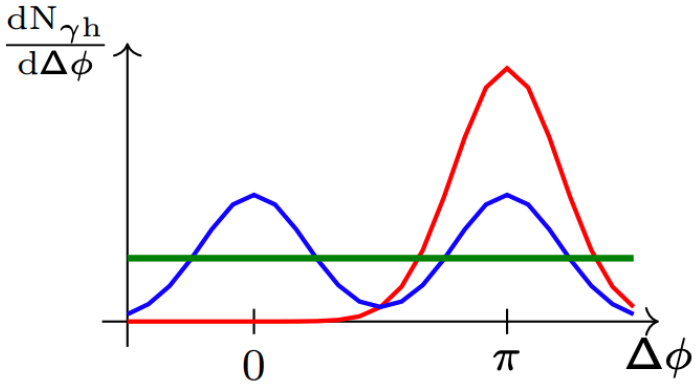


Bremsstrahlung



Thermal

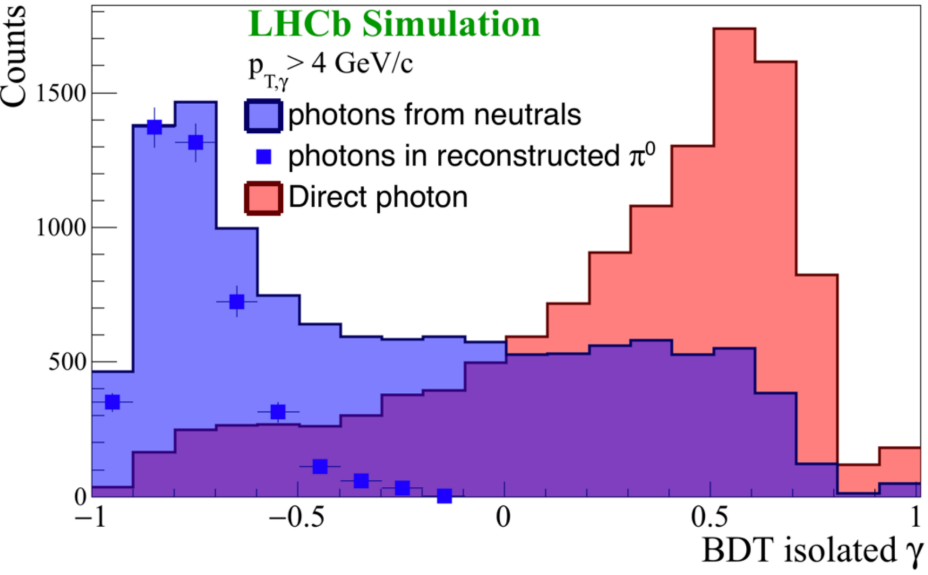




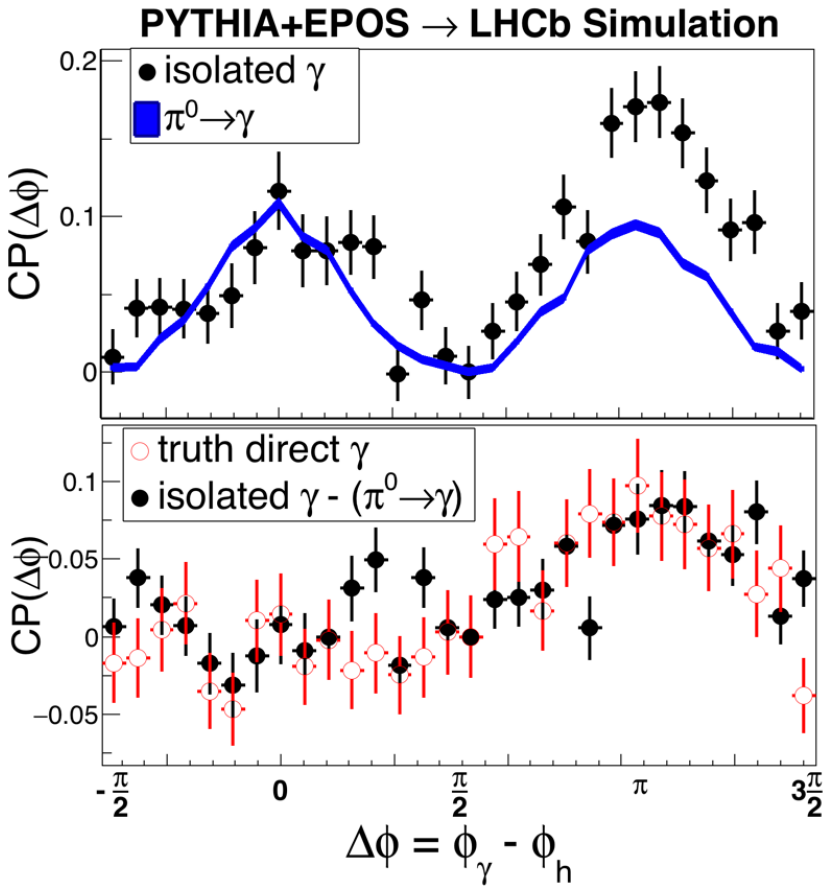
- $\Delta\phi$ line shape of direct photons from inverse Compton processes is unique

Background Subtraction

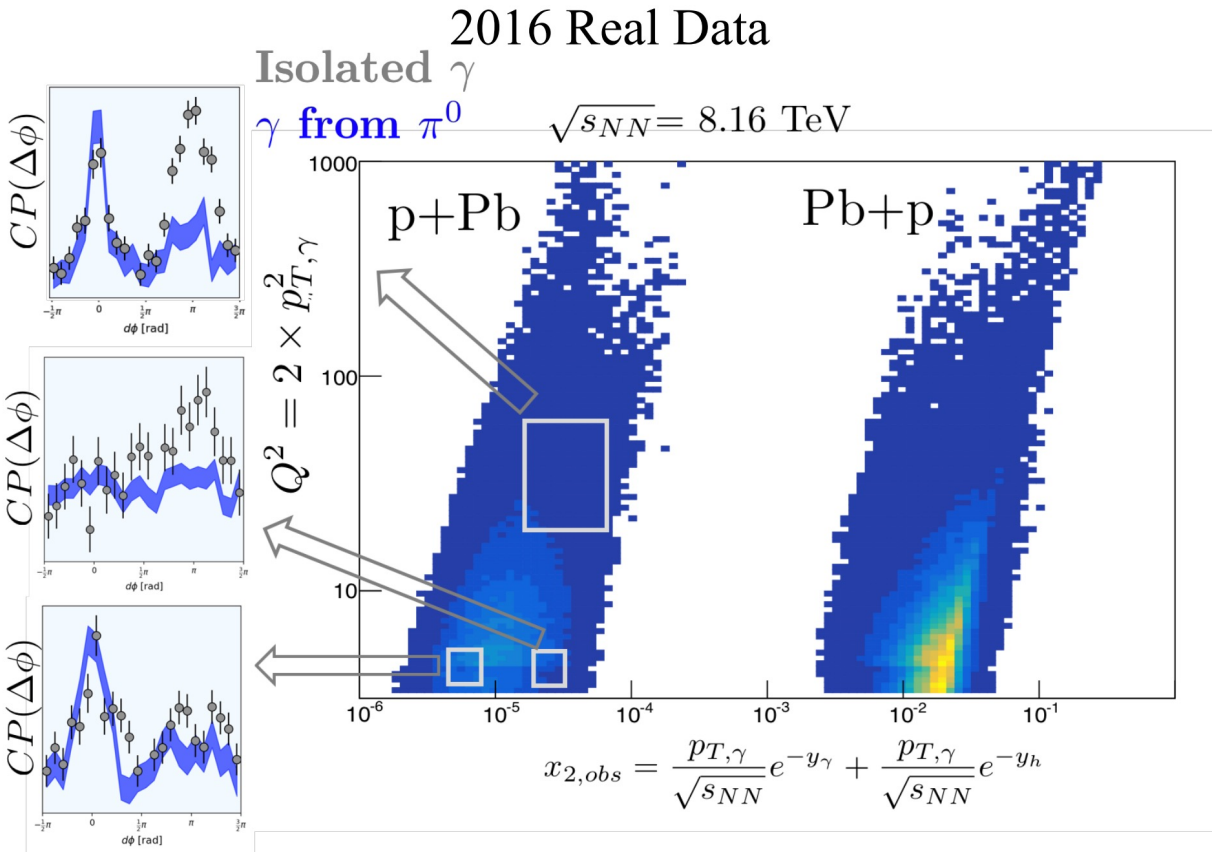
- Boost Decision Tree for Isolated Photons



- Data driven subtraction of remaining background in the away-side peak



Status of the Analysis



- Inverse Compton signal observed for Q^2>2 $(GeV/c)^2$, way inside the expected gluon saturated region.
- Photon efficiency validated with $\eta^0, \omega \to \pi^+\pi^-\pi^0$ full and partially reconstructed decays.
- Hadrons (long tracks) efficiency validated with $K_S \to \pi^+\pi^-$ decays.
- Unfolding detector resolutions. Results coming VERY soon.