Dielectron production in proton–proton and proton–lead collisions at $\sqrt{s_{NN}}$ = 5.02 TeV

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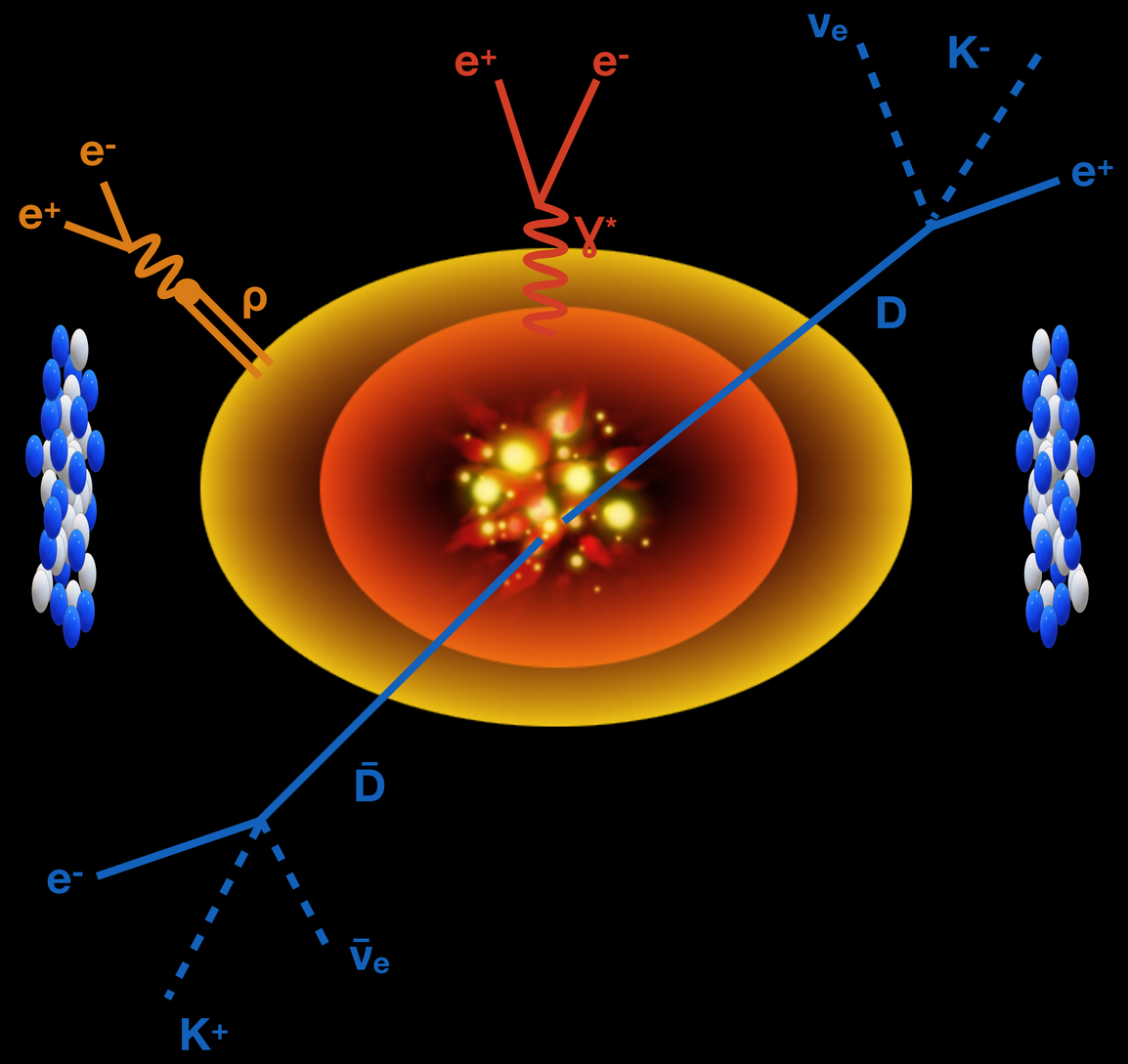
Talk by Elisa on Wednesday 17:30 (Asia/Jerusalem)
https://indico.cern.ch/event/854124/contributions/4134659/

Link to video in my CERNbox
https://cernbox.cern.ch/index.php/s/cL6bXG3bt83Y4Go

Various sources produce correlated pairs of electrons:

- Pseudoscalar and vector mesons (π, η, ρ, ω, ϕ, J/ψ) via direct (e^+e^-) or Dalitz (X e^+e^-) decays
- Semi-leptonic decays of open heavy-flavour (HF) hadrons (e.g. $c\bar{c} \rightarrow D\bar{D} \rightarrow XY\ e^+e^-$)
- Thermal radiation from QGP and hadronic phase

Excellent probe to study hot and dense QCD matter as well as QGP properties



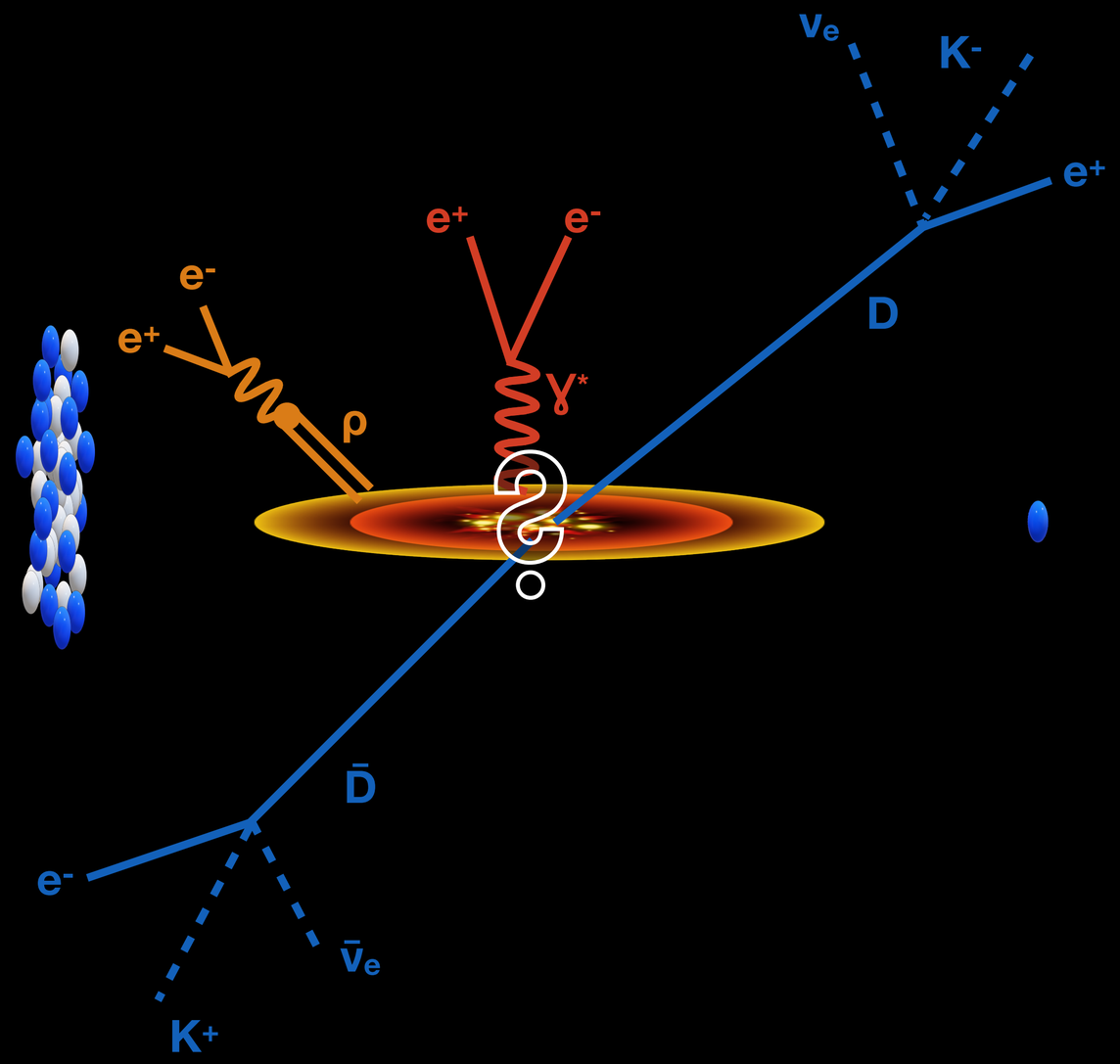
Dielectrons in the initial conditions of heavy-ion collisions

pp collisions:

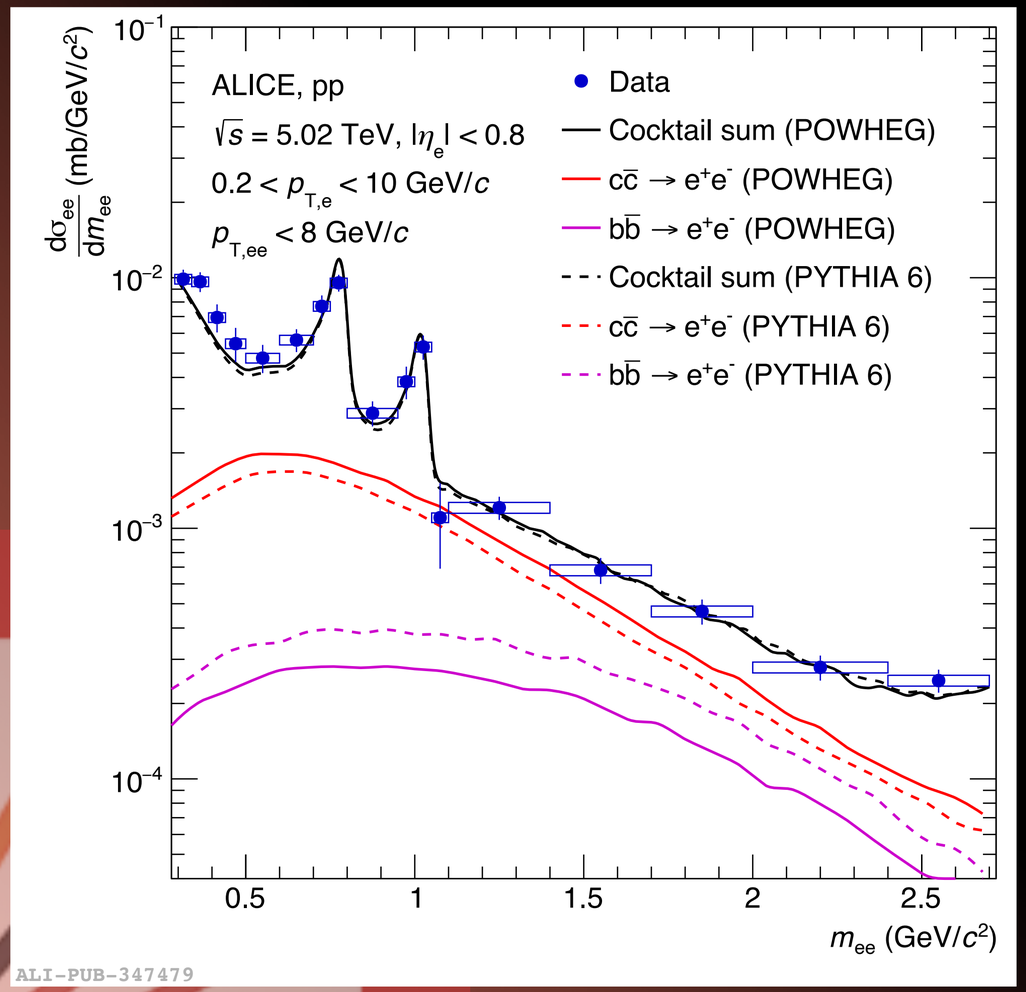
- Vacuum baseline for p–Pb and Pb–Pb collisions
- Correlations of heavy-quark production

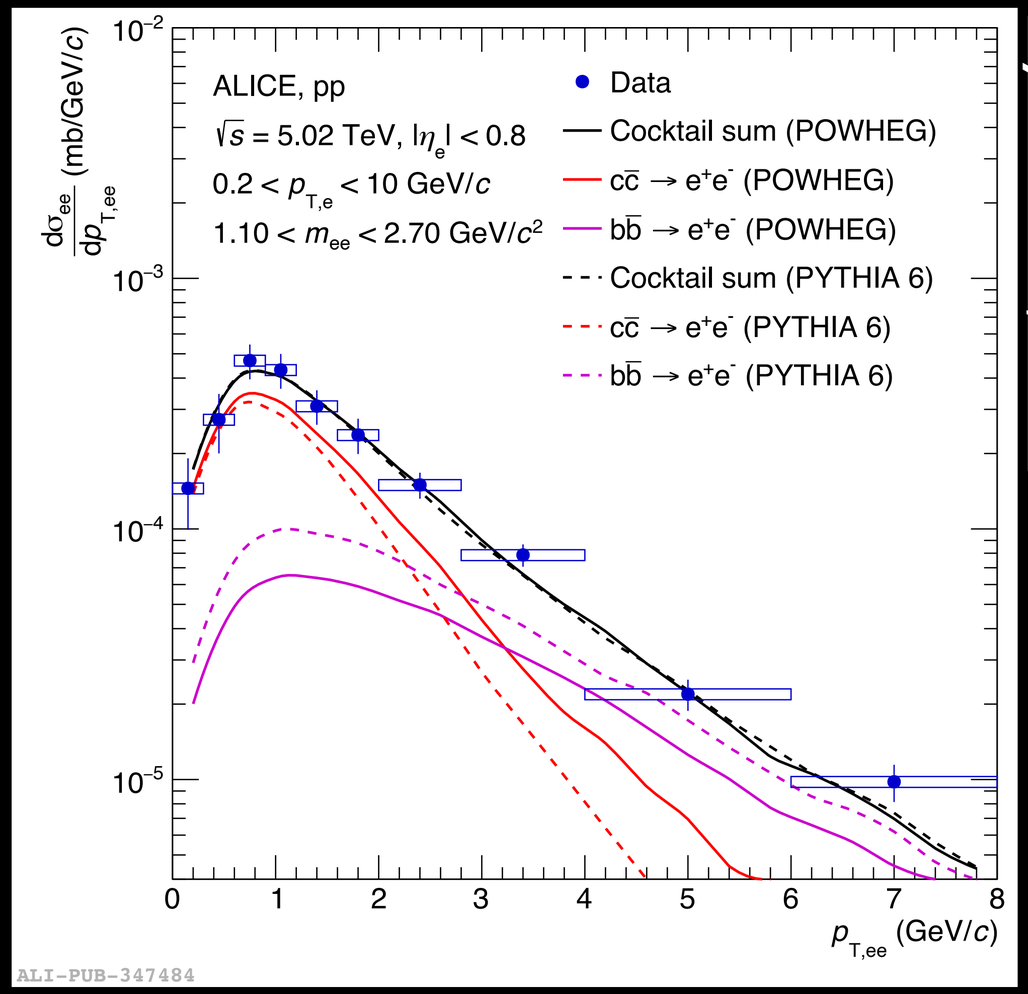
p–Pb collisions:

- Modifications of heavy-flavour production via CNM effects (e. g. shadowing)
- Possible thermal radiation from QGP droplets



Use distinct shape of charm and beauty as a function of m_{ee} and $p_{T,ee}$ to extract cross sections from fit to distributions





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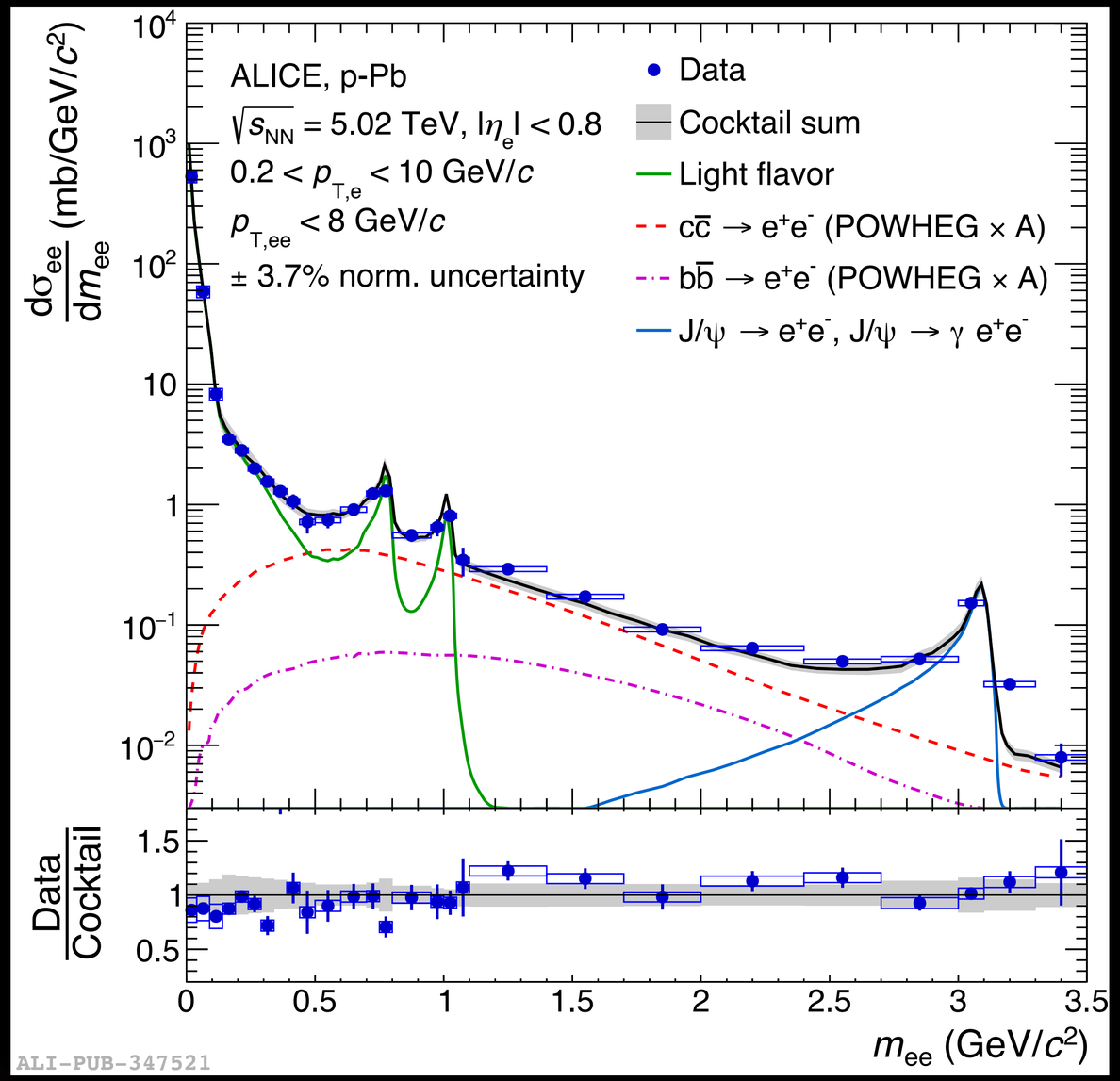
Model dependence of PYTHIA and POWHEG similar to previous measurements performed at $\sqrt{s}$ = 7 and 13 TeV

Dielectron production in p–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV

- HF from binary NN collision scaling of cross section measured in pp collisions
- Overall good agreement of hadronic cocktail with data
- Systematic uncertainties on cocktail limit interpretation of data

Compare data to data to circumvent dependence on cocktail uncertainties



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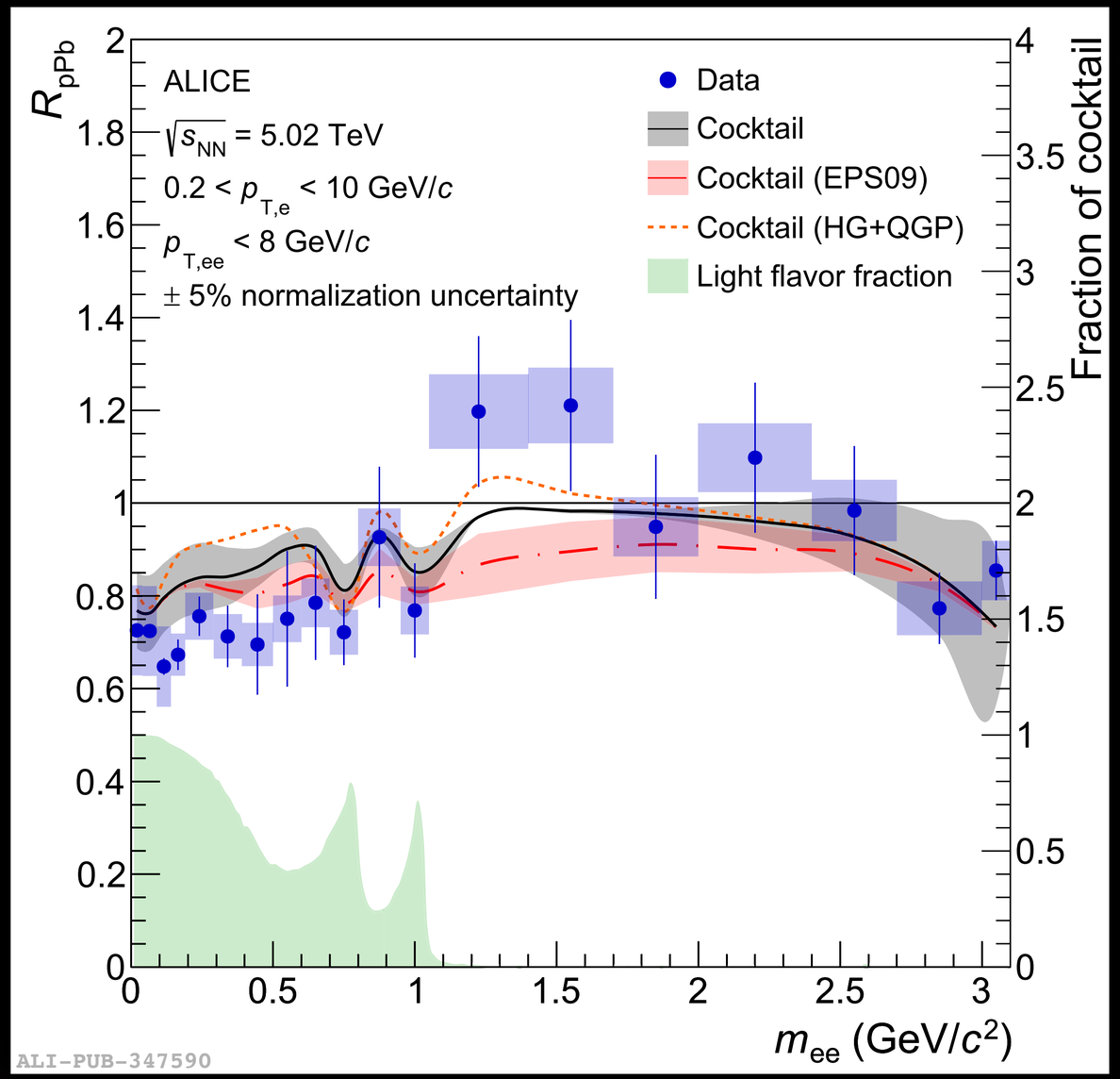
$$R_{\mathrm{pPb}} = \frac{1}{A}\frac{\mathrm{d}\sigma_{\mathrm{ee}}^{\mathrm{pPb}}/\mathrm{d}m_{\mathrm{ee}}}{\mathrm{d}\sigma_{\mathrm{ee}}^{\mathrm{pp}}/\mathrm{d}m_{\mathrm{ee}}}$$

Dielectron nuclear modification factor as a function of m_{ee} at $\sqrt{s_{NN}}$ = 5.02 TeV compared to cocktails:

1. Assuming binary NN collison scaling of the HF contributions (vacuum baseline)
2. Including modifications of charm production via CNM effects based on EPS09 nPDF (red dashed line)
3. Including additional thermal dielectrons from a hadronic and partonic phase based on a fireball model (orange dashed line)



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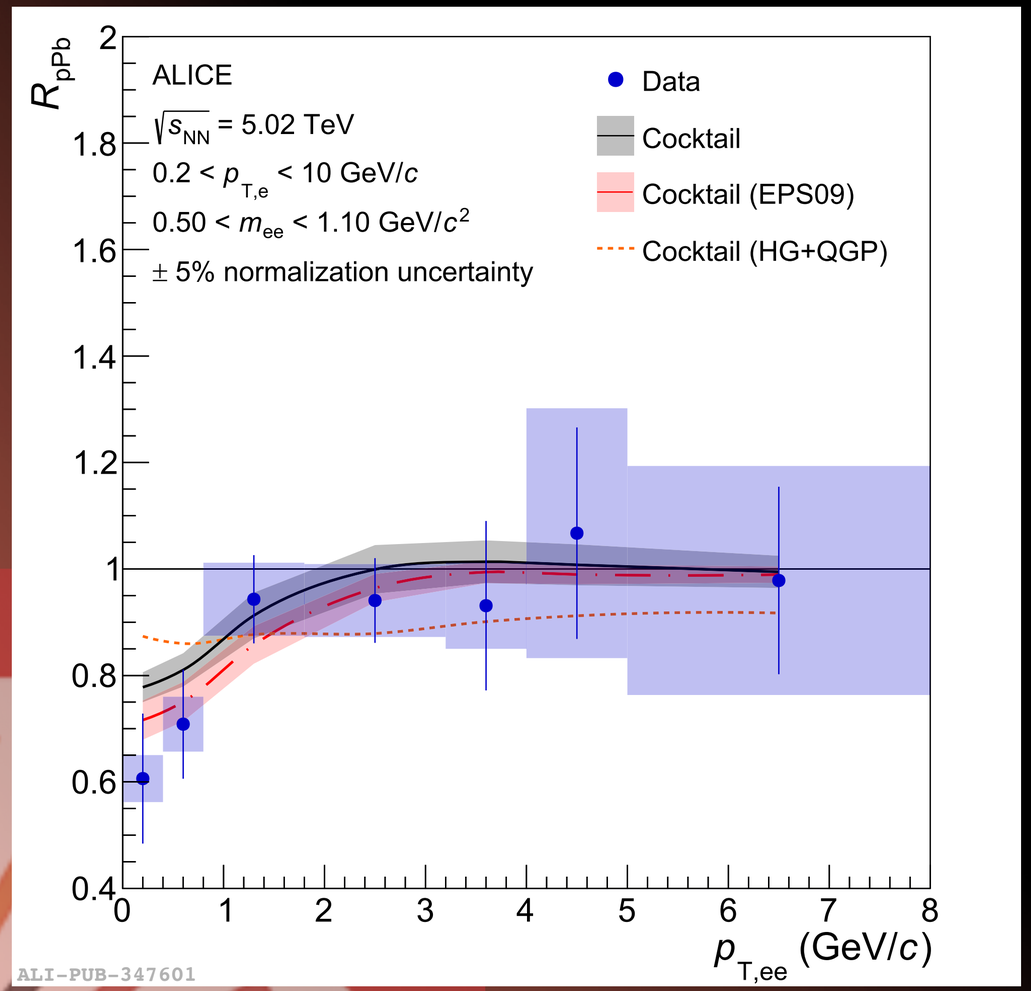
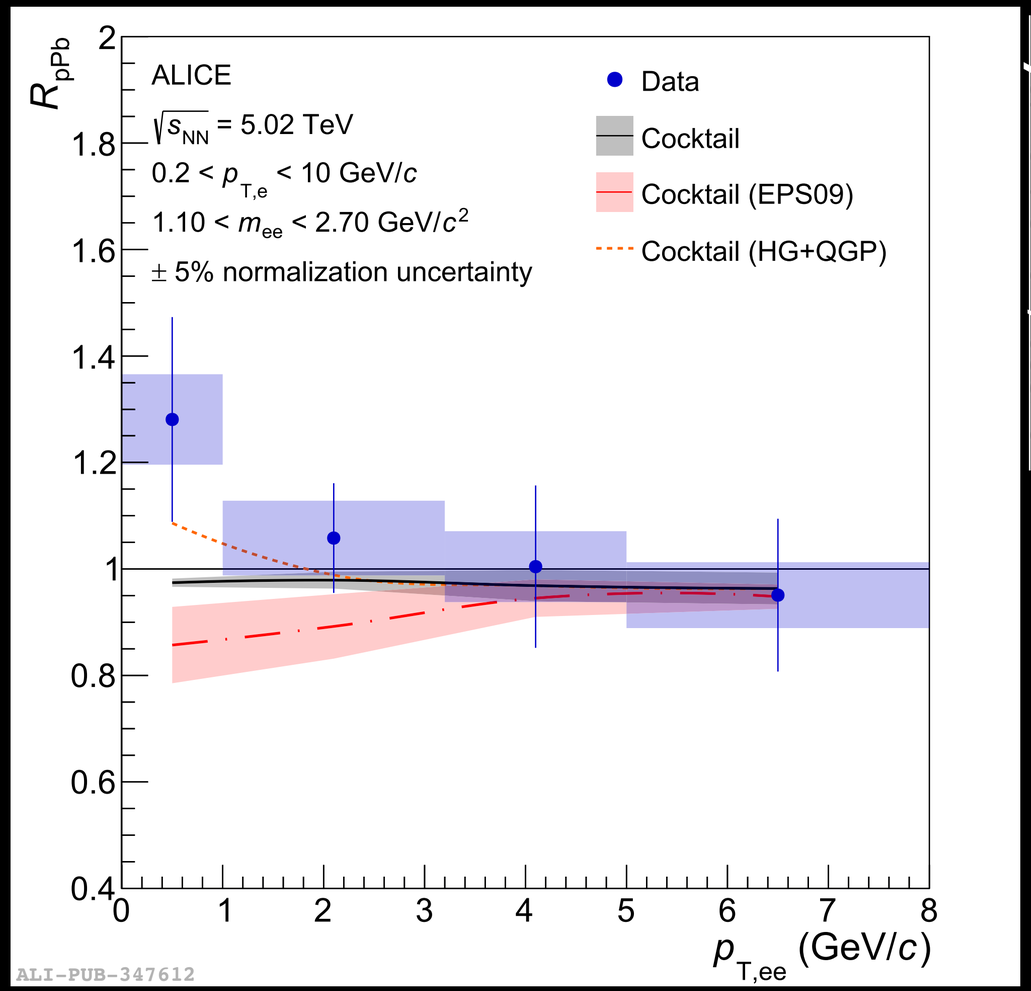
Dielectron nuclear modification factor vs $p_{T,ee}$ compared to cocktail calculations in different mass intervals

$0.5 < m_{ee} < 1.1$ GeV/c^2



$1.1 < m_{ee} < 2.7$ GeV/c^2



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Above 1 GeV/c data described by binary NN collision scaling

Deviations can be described by vacuum cocktail

Data consistent with unity over whole $p_{T,ee}$ range within uncertainties

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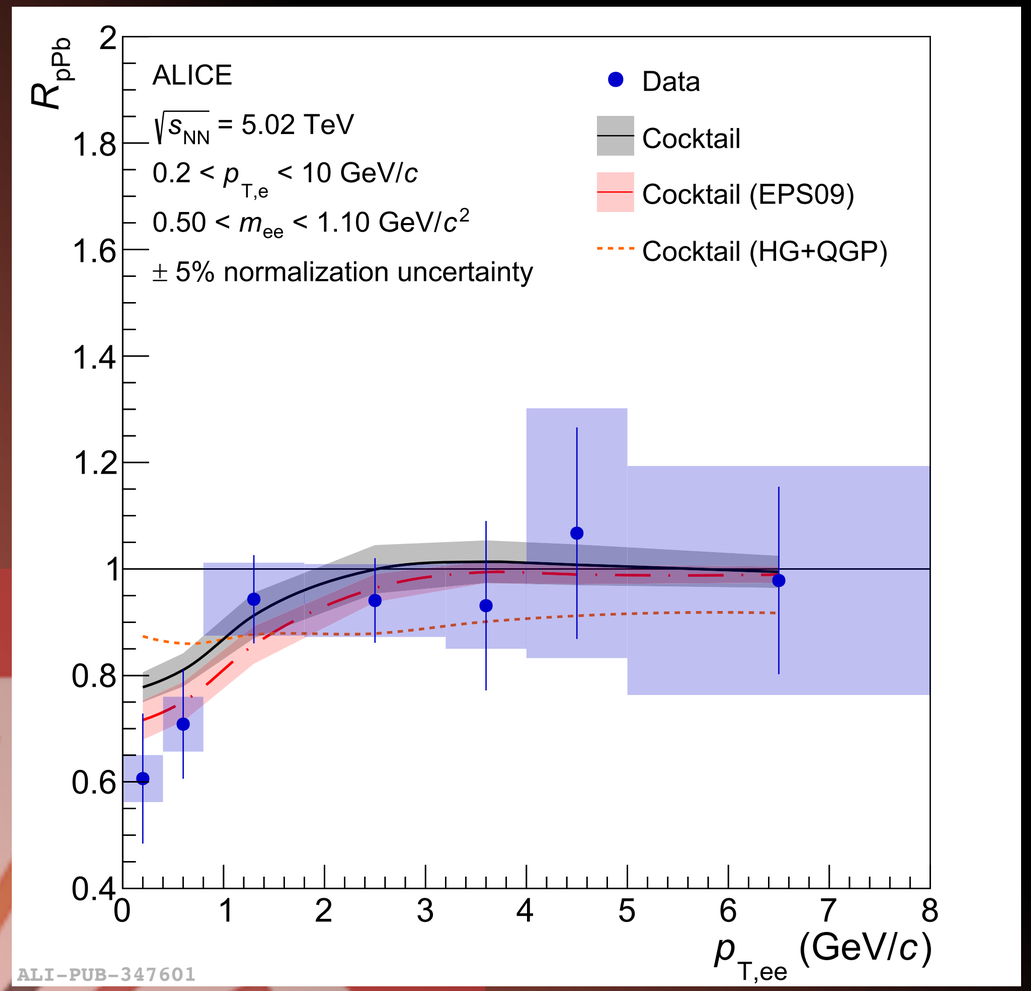

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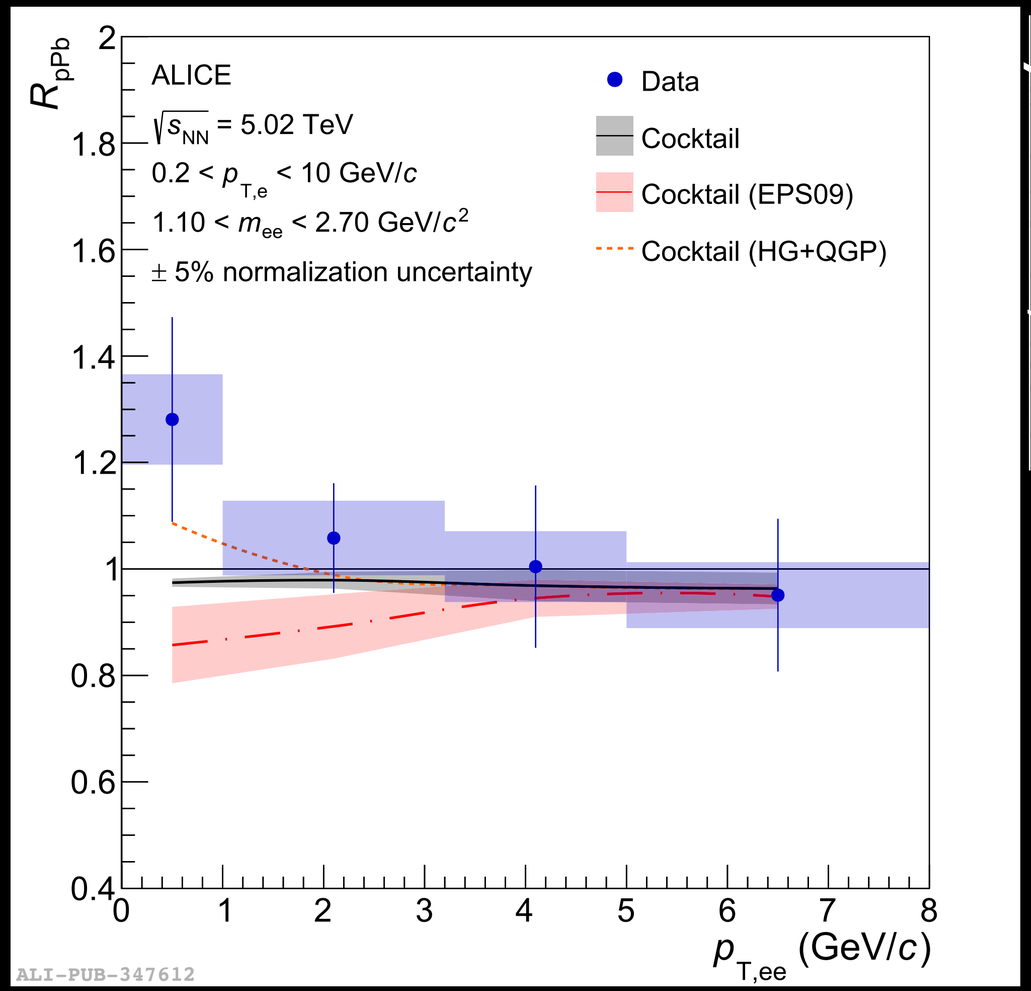

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Modification of charm via CNM improves description

Inclusion of thermal sources is disfavoured

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Inclusion of thermal sources helps to improve description

Established baseline for HF production in pp measurement

- PYTHIA and POWHEG event generators both describe data well, however yield significantly different production cross sections
  → sensitivity to implementation of production mechanisms of heavy flavour quarks

Direct comparison of pp and p–Pb measurement in terms of R_{pPb}

- Different scaling behaviour of light flavour and HF dielectrons indicates different production mechanism, similar observation is made for different $p_{T,ee}$ in the mass region below 1 GeV/c
- Inclusion of CNM effects on charm production as well as additional dielectrons from thermal production give inconclusive results

1. CNM effects help in the description of the dielectron production below masses of 1 GeV/c^2
2. Additional thermal dielectrons help in the description of dielectron production in the intermediate mass range ($1.1 < m_{ee} < 2.7$ GeV/c^2)

Since both effects could very well cancel each other:
Means to separate prompt and non-prompt contributions necessary