Measurement of low-mass dielectrons in p-Pb collisions with ALICE

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Quark Matter Studies

Outline

- Introduction
- The ALICE detector
- Electron identification
- Signal extraction
- Hadronic cocktail
- Results
- Summary

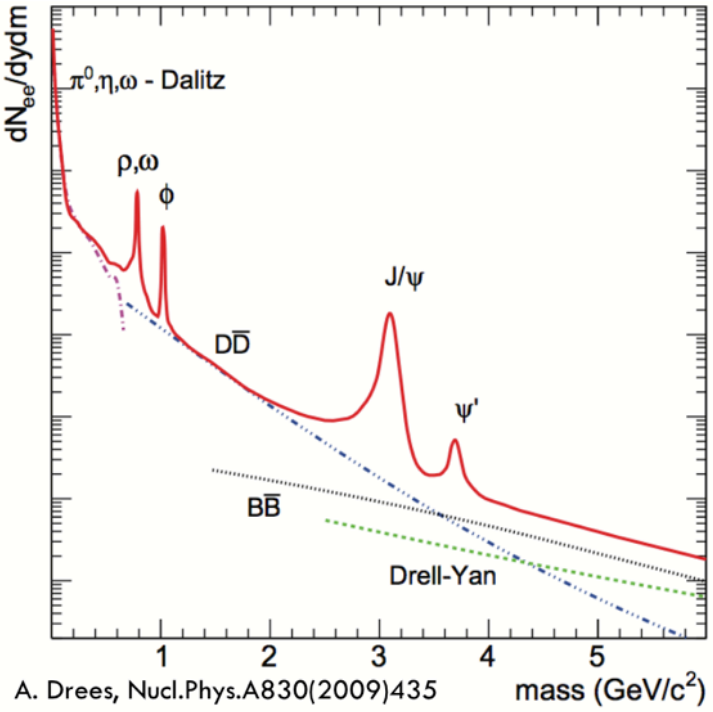
Studies in different collision systems

pp collisions:

- vacuum reference

Pb-Pb collisions:

- medium modifications of light mesons
- thermal radiation from hot medium
- heavy-flavor modification in the medium



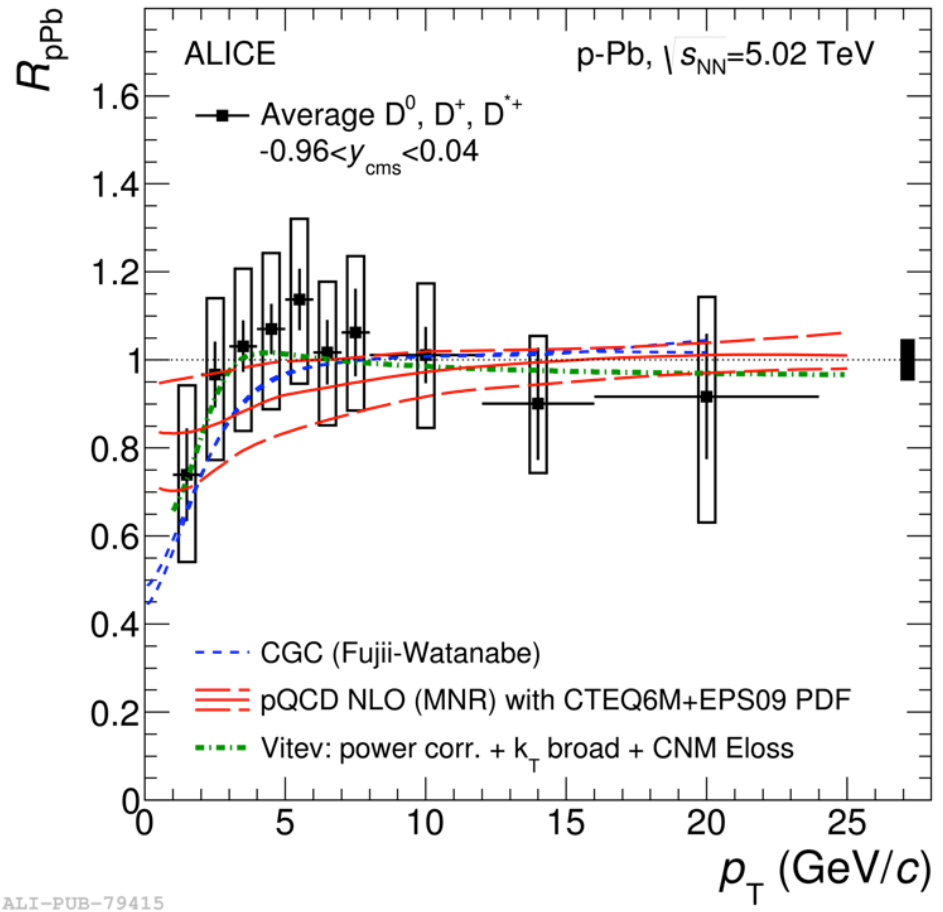
p-Pb collisions:

- modifications from cold nuclear matter effects
  - initial state suppression of charm production
  - final state effects, energy loss
- thermal radiation in (high multiplicity) p-Pb?

Cold nuclear matter effects

- charm suppression expected in p-Pb at low p_T by different models
- no strong conclusion from present D meson results
- open heavy-flavor dielectron results provide complementary measurement of charm suppression at low p_T due to sensitivity for very soft dielectrons (p_T^e > 0.2 GeV/c)

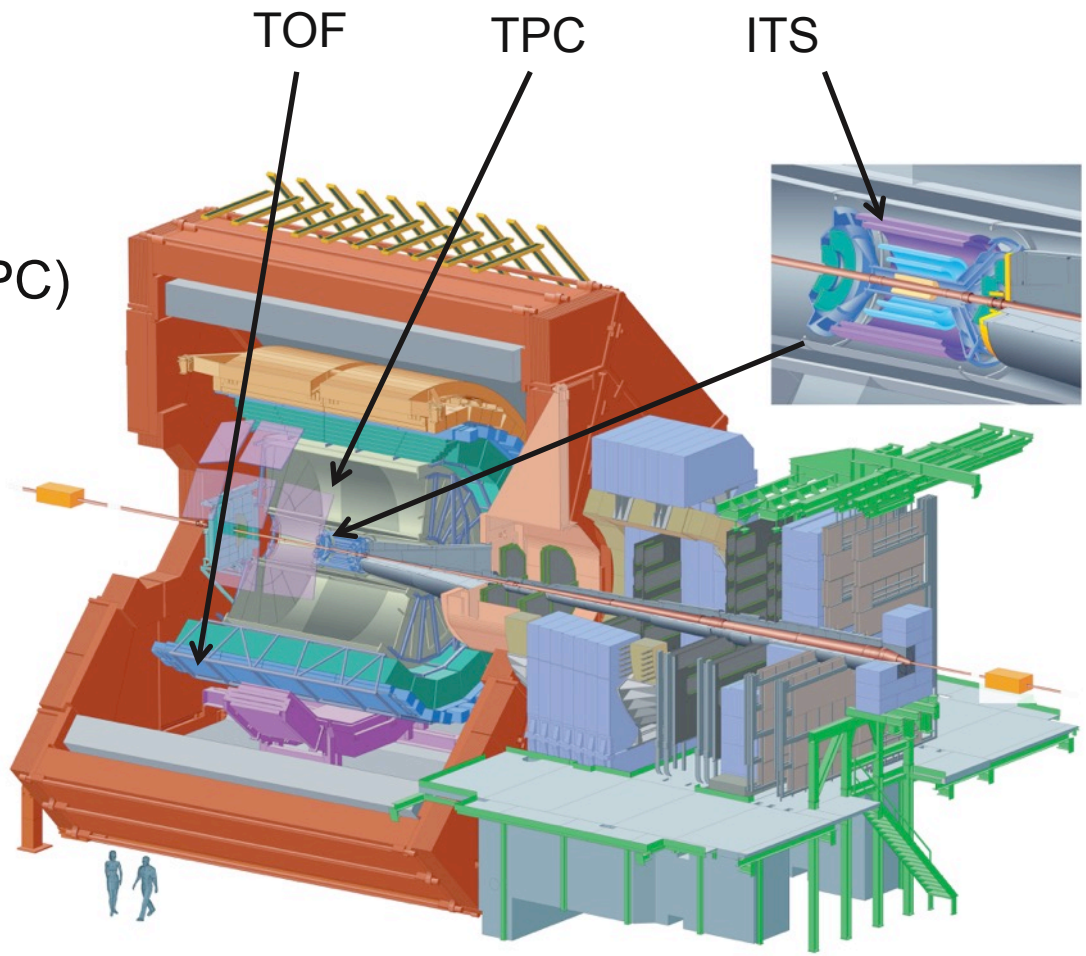
arXiv:1405.3452, submitted to PRL



ALI-PUB-79415

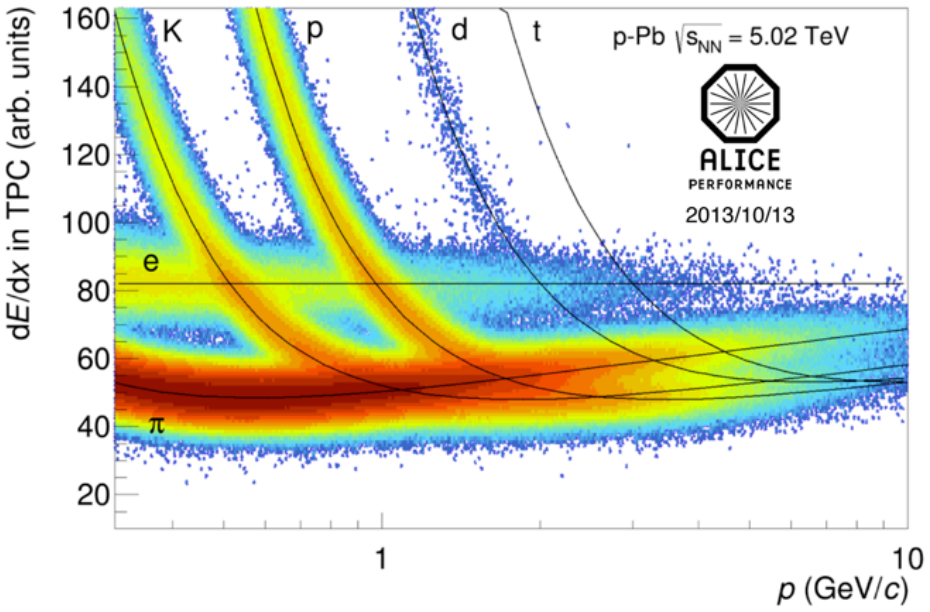
The ALICE detector

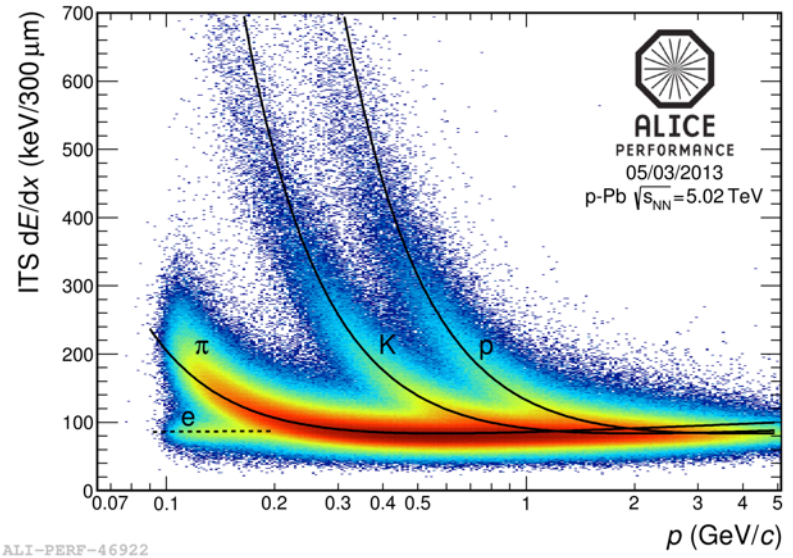
- Inner Tracking System (ITS)
  - tracking & vertexing
  - PID (dE/dx)
- Time Projection Chamber (TPC)
  - tracking
  - PID (dE/dx)
- Time Of Flight (TOF)
  - PID (hadron rejection)
- p-Pb: ≈ 106 million min. bias events at 5.02 TeV

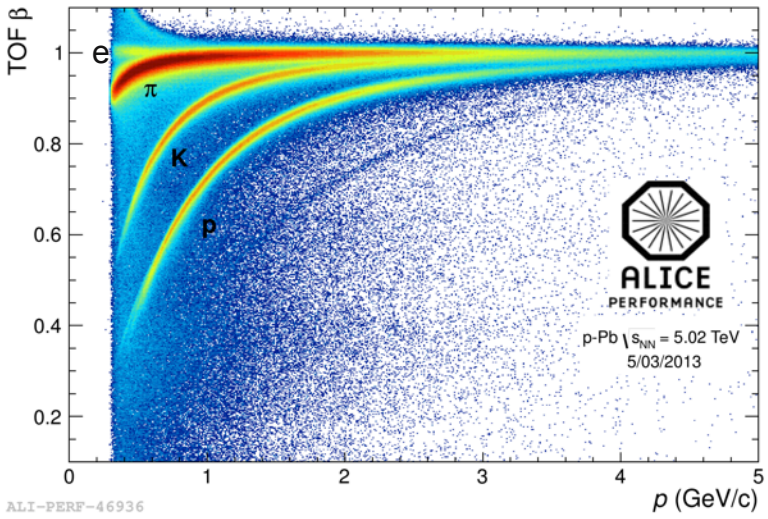


Electron identification

- ITS
  - select electrons
- TPC
  - select electrons
  - reject pions
- TOF
  - reject hadrons, if TOF signal available

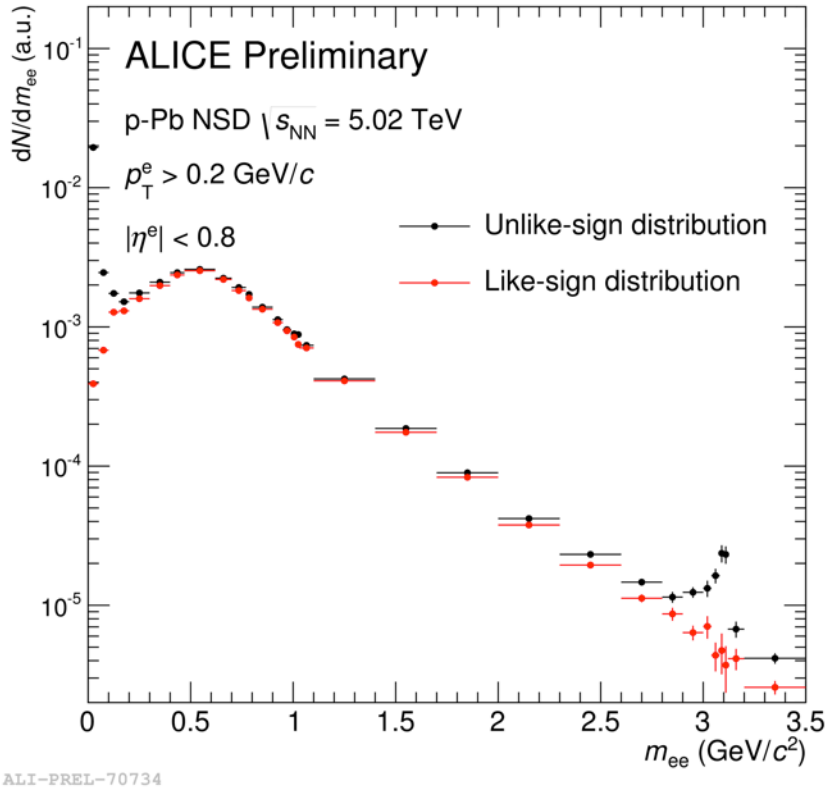






Signal extraction

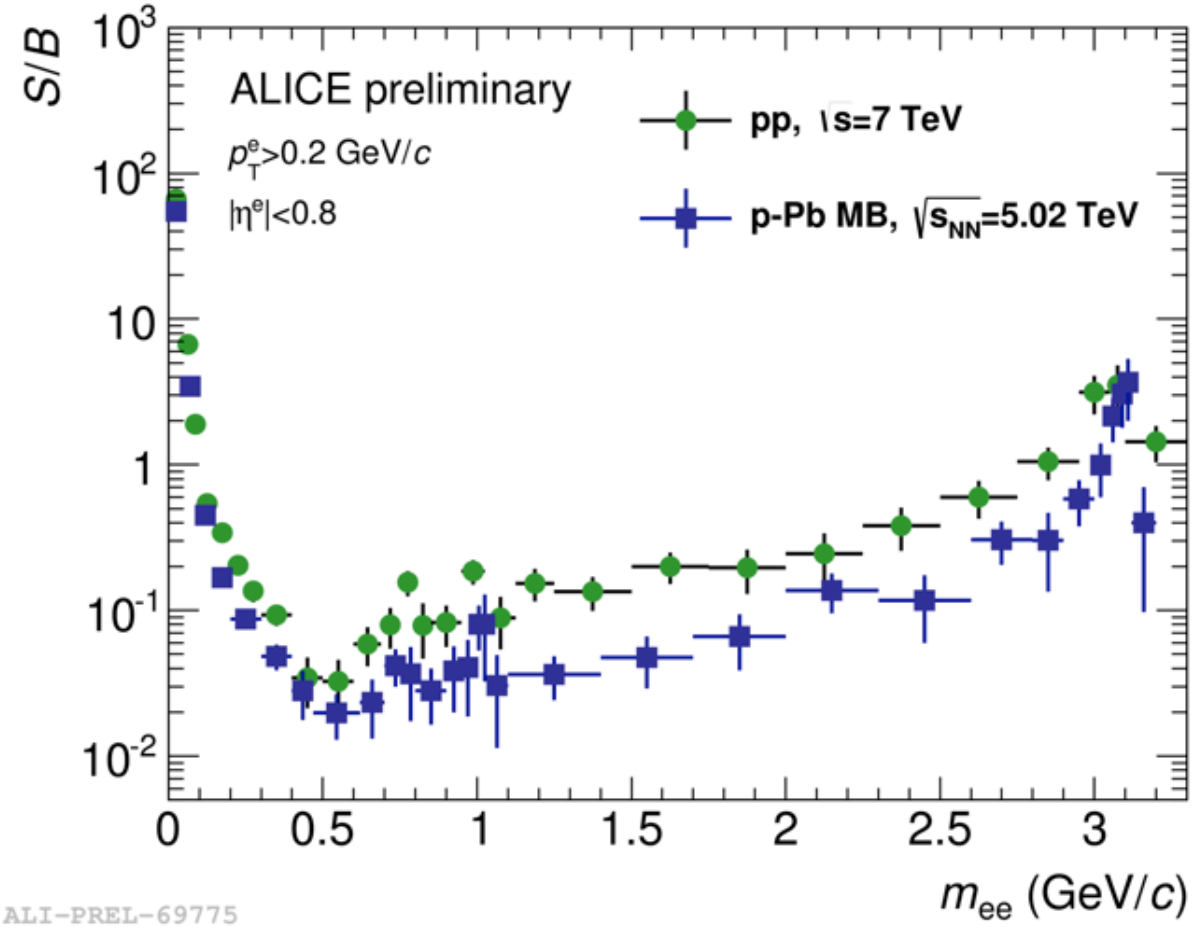
- calculate all possible unlike-sign (ULS) pairs
  - ULS contains real signal, combinatorial and correlated background
- background estimation by like-sign (LS)
  - LS describes combinatorial and correlated background
- signal subtraction:
  - S = ULS – LS × R
- R: Acceptance correction factor for LS
  - R calculated from mixed events



Signal extraction

- signal to background ratio smaller in p-Pb than in pp

➡ challenging analysis



Hadronic cocktail

known hadronic dielectron sources:

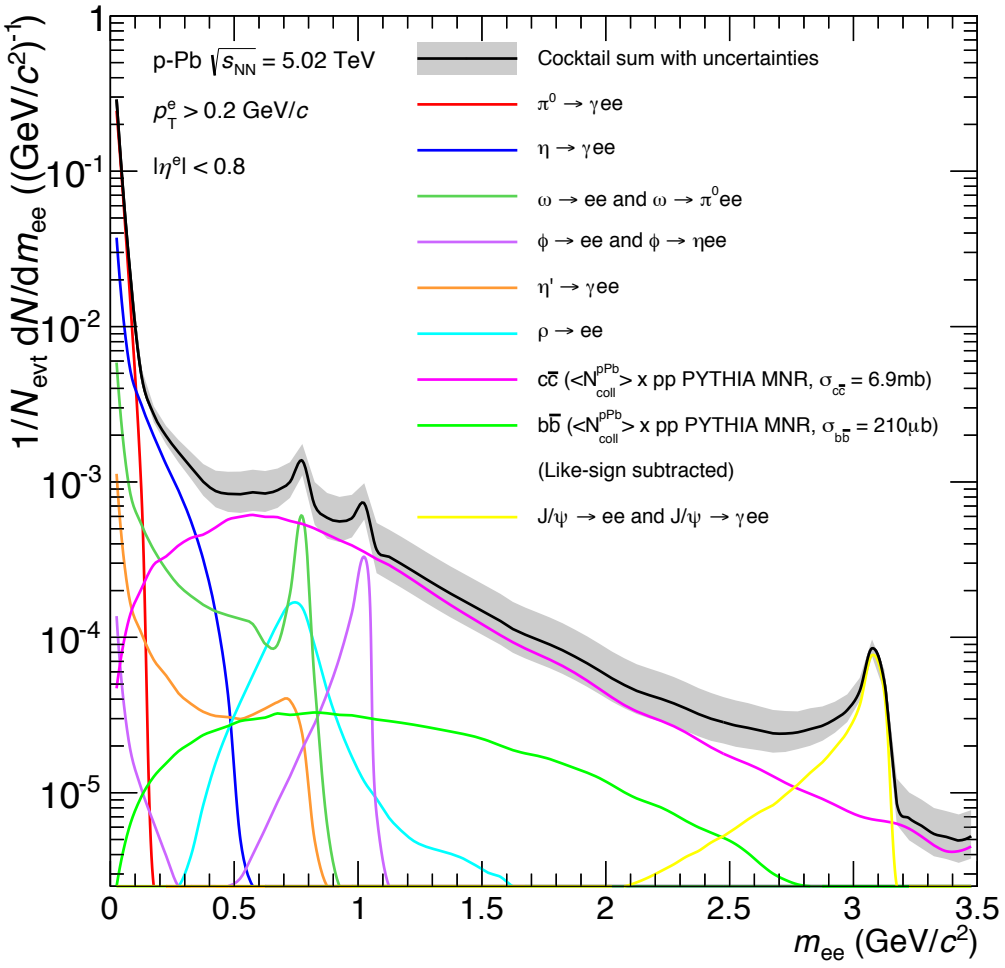
- π^0 contribution based on charged pion ALICE measurement in p-Pb

  Phys. Lett. B **728** (2014) 25

- η, η', ω, φ, ρ from m_T-scaling
- J/ψ based on pp calculations scaled to p-Pb measurements

  dx.doi.org/10.1016/j.nuclphysa.2014.09.062

- open heavy flavor based on pp expectations at 2.76 & 7 TeV scaled by $\langle N_{coll} \rangle = 6.9$



Heavy flavor contribution

- heavy-flavor cocktail contribution based on measured cross section
- large uncertainty of ALICE result
- additional uncertainty from scaling to p-Pb energy

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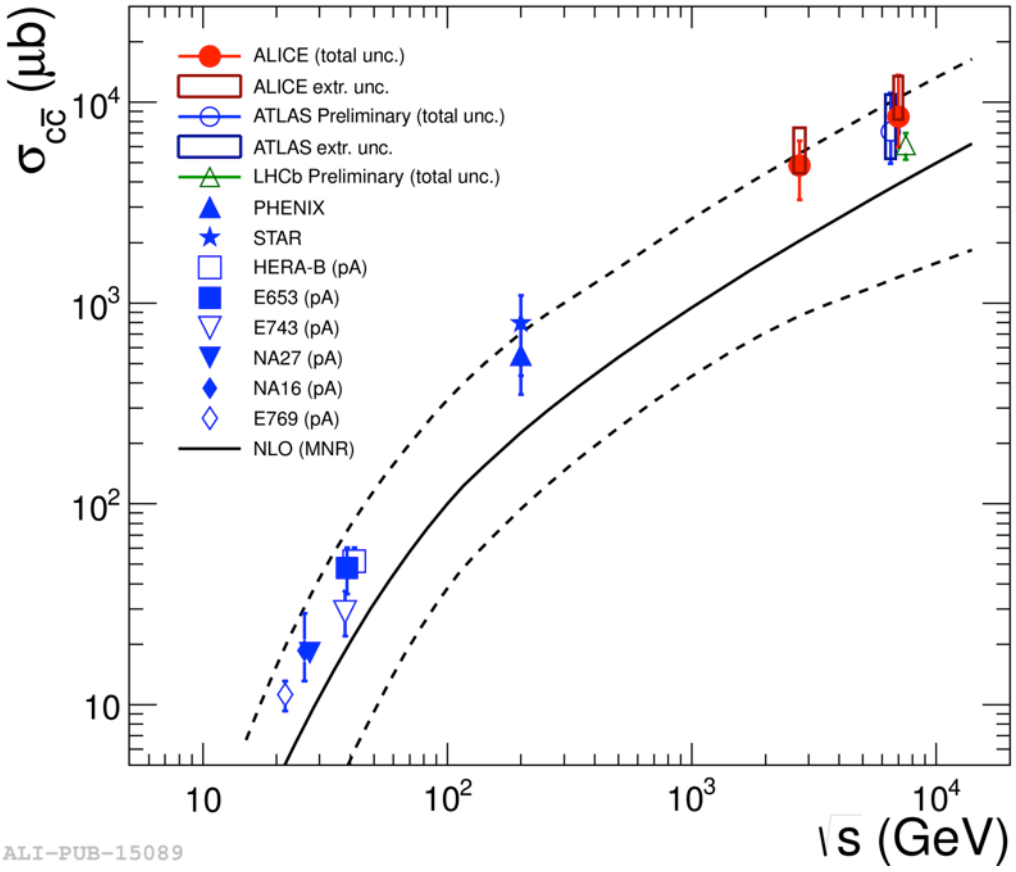
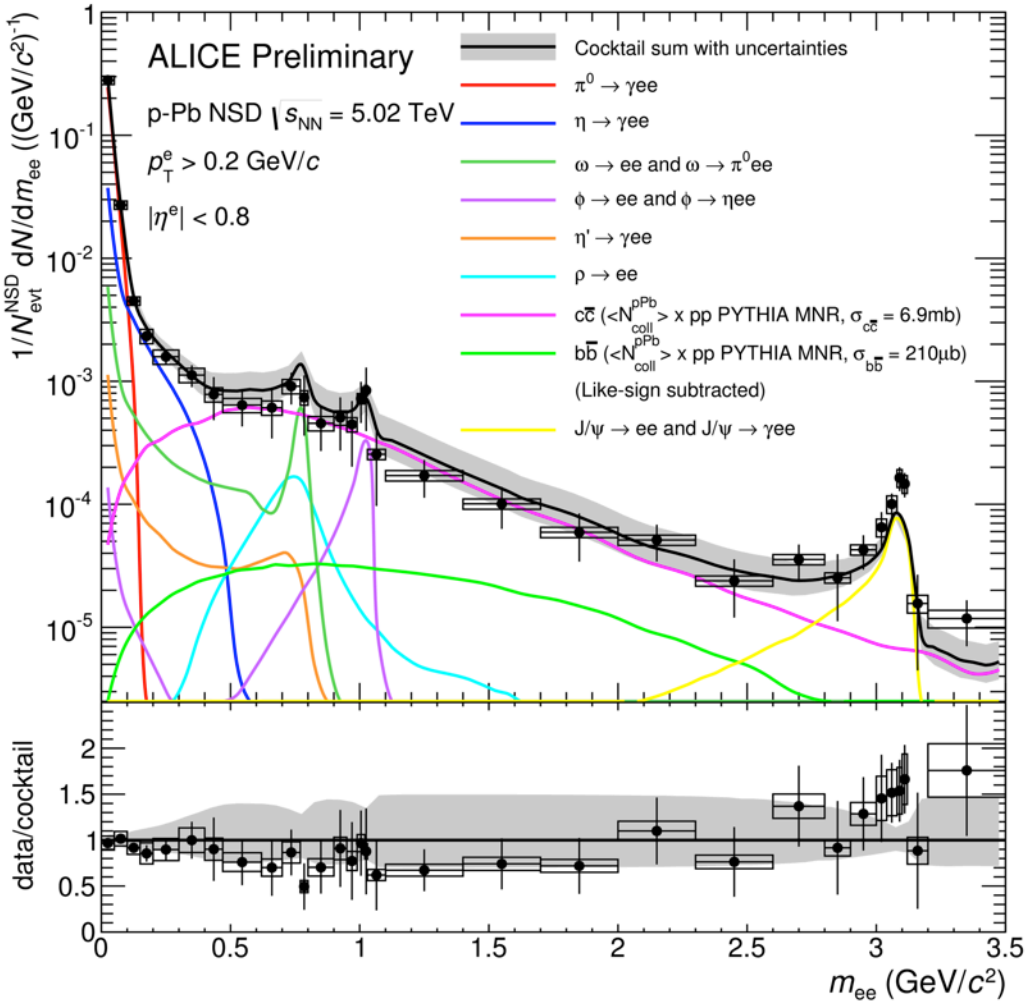


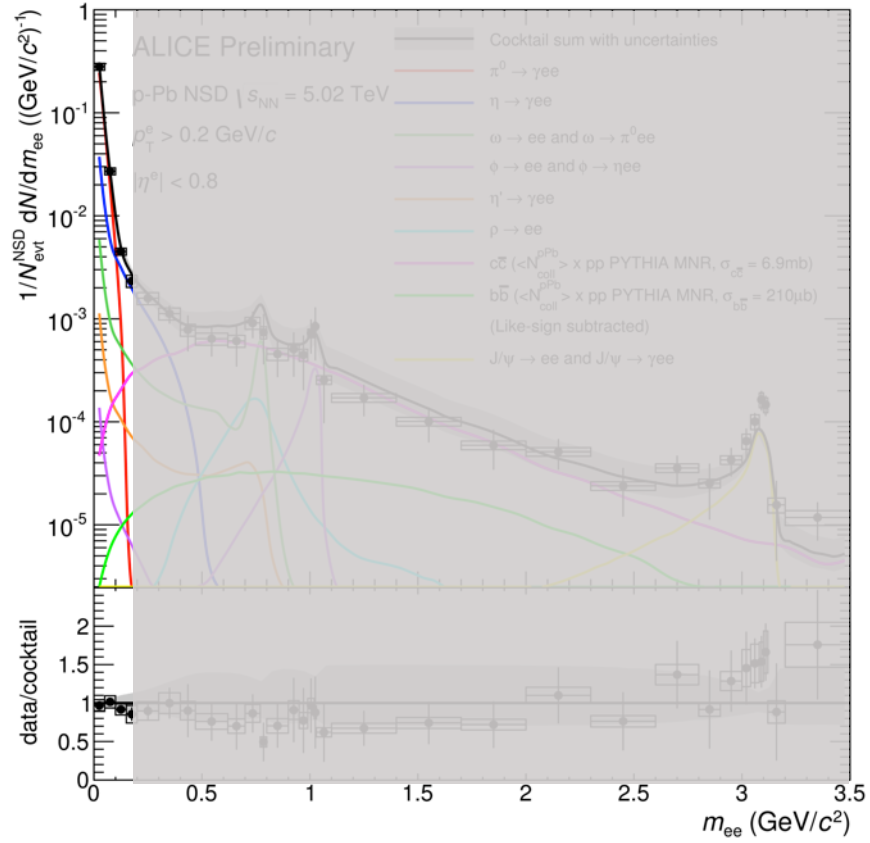
Invariant mass spectrum

- data comparison to known hadronic sources
- agreement of cocktail and data within uncertainties
- no hint for thermal contribution
- maybe hint for suppression in charm dominated mass region
- cocktail uncertainties do not allow for strong conclusion on CNM effects
- more checks in MC needed



ALI-PREL-69715

Pair p_T spectrum in $0 < m_{ee} < 0.14$ GeV/c^2



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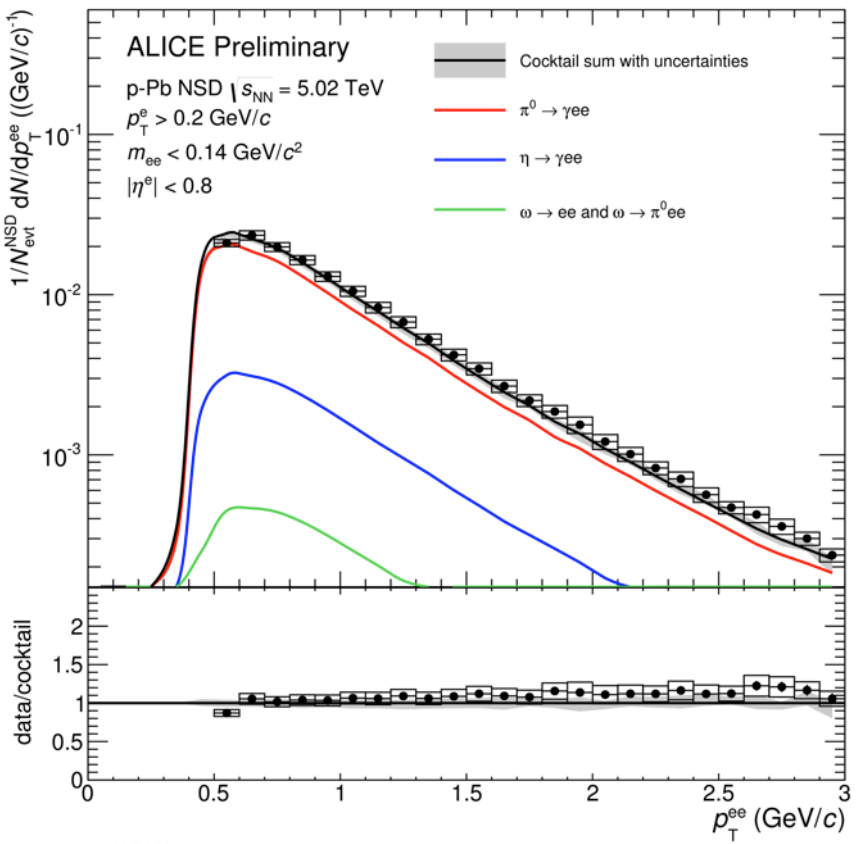
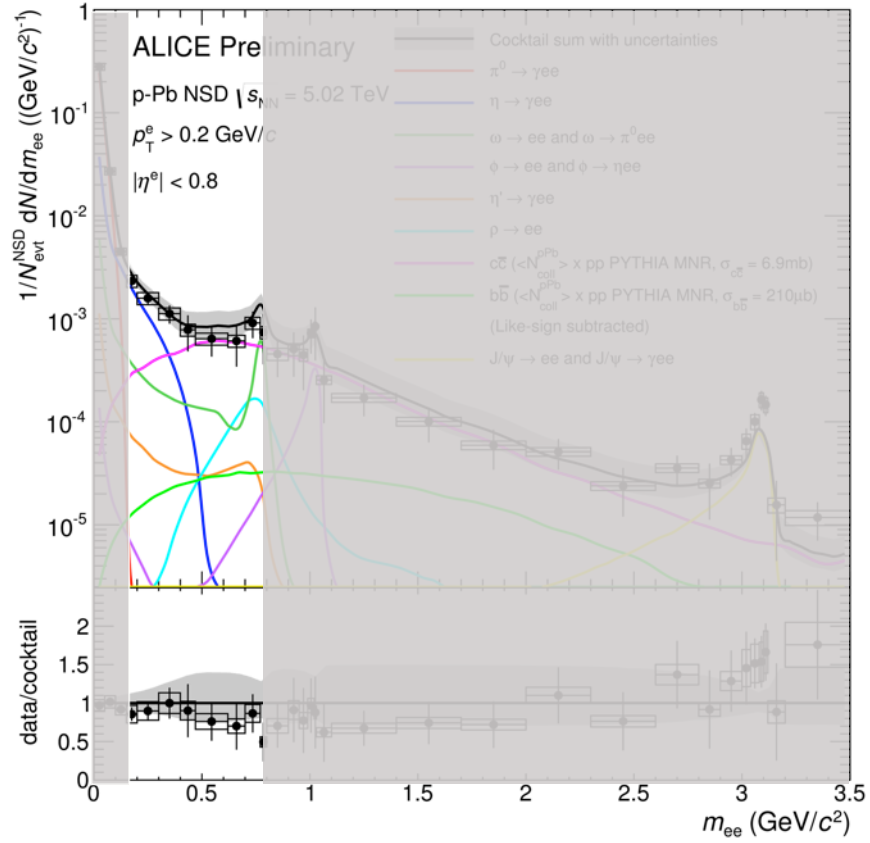


ALI-PREL-69723

- pair p_T spectrum dominated by π^0 contribution
- data in agreement with cocktail expectations

Pair p_T spectrum in $0.14 < m_{ee} < 0.75$ GeV/c^2



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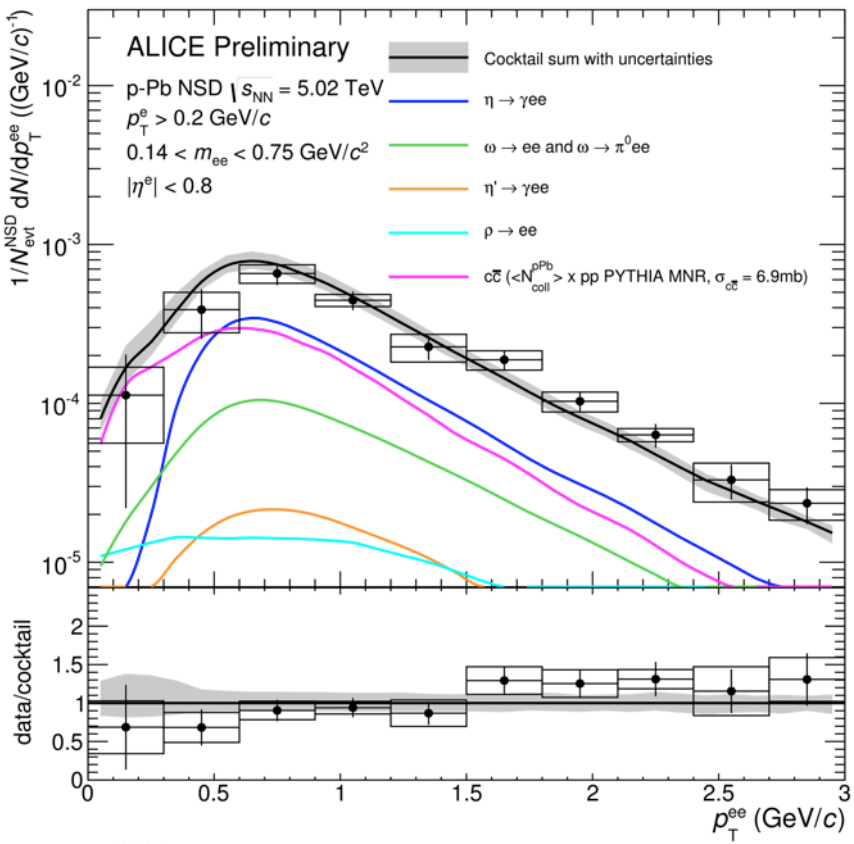
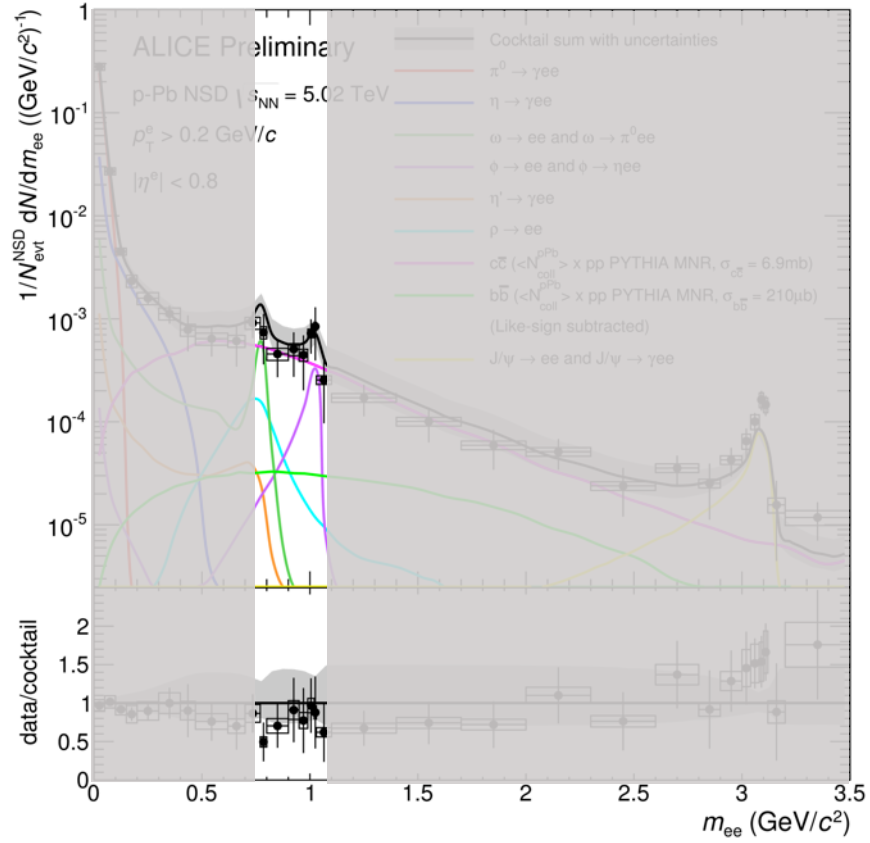


ALI-PREL-69731

- mass region dominated by η-meson and open charm contribution
- no thermal enhancement at low p_T

Pair p_T spectrum in $0.75 < m_{ee} < 1.1$ GeV/c^2



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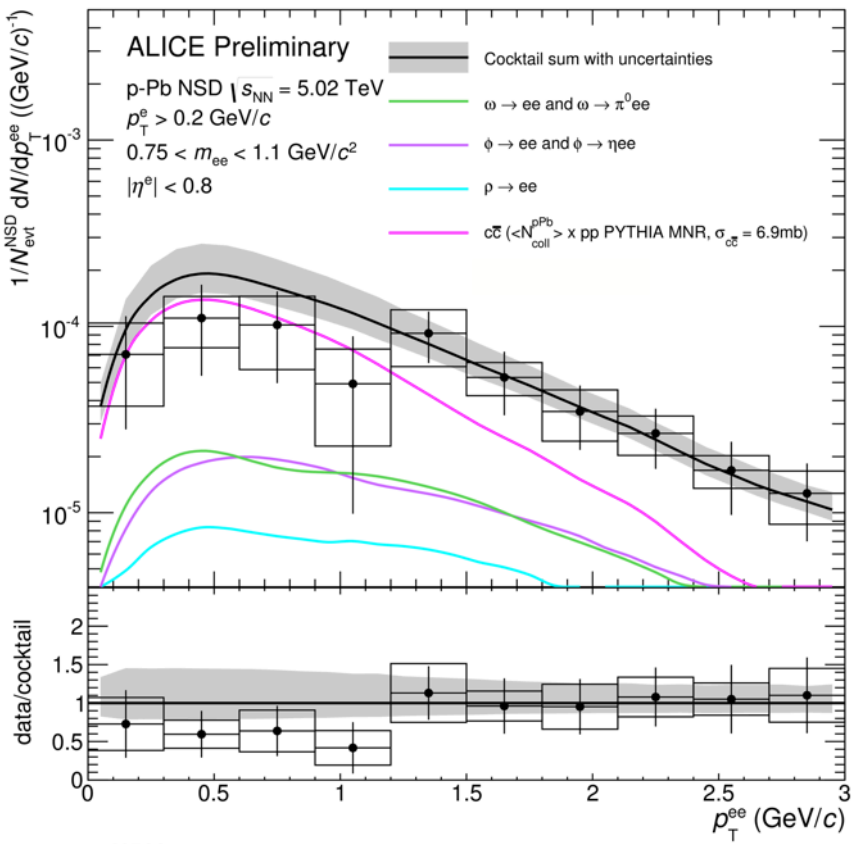
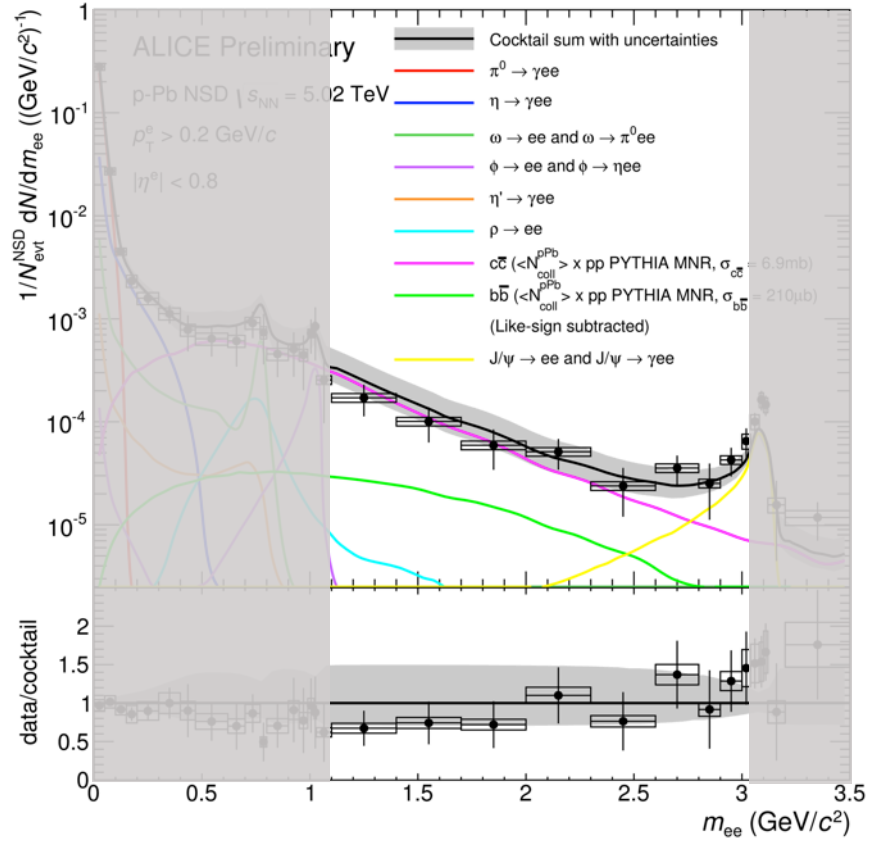


ALI-PREL-69739

- mass region of ω, φ dominated by open charm contribution
- data in agreement within cocktail uncertainties

Pair p_T spectrum in $1.1 < m_{ee} < 3$ GeV/c^2



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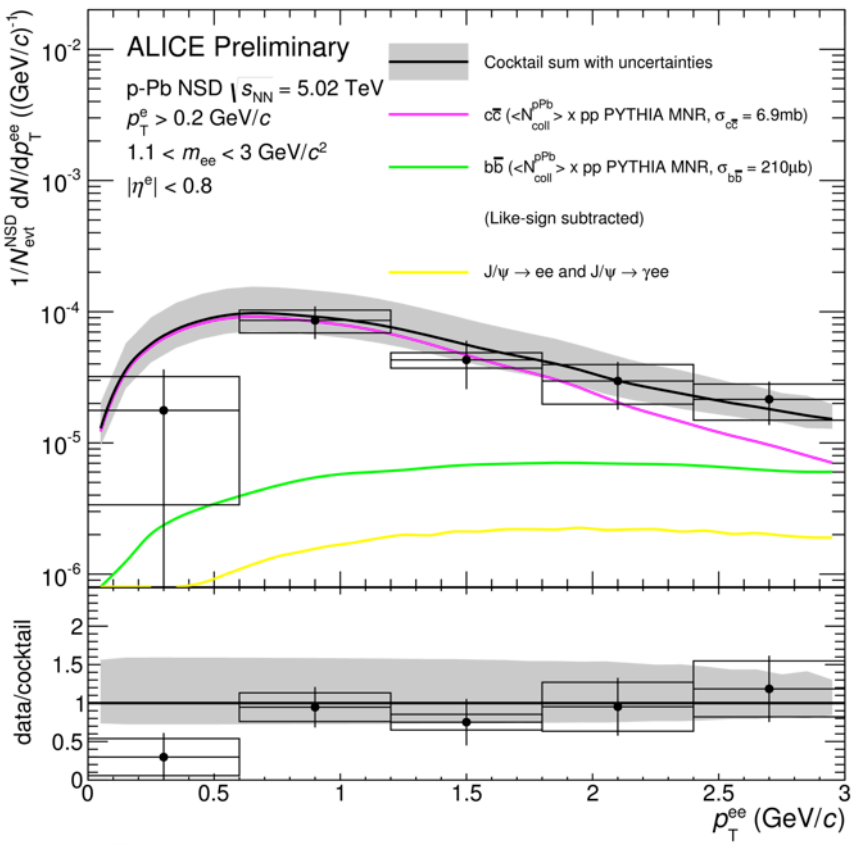

ALI-PREL-69747

- intermediate mass region dominated by open heavy flavor contribution
- data in agreement within cocktail uncertainties

Summary

- dielectrons are good probe to study CNM effects in p-Pb at low p_T
- p-Pb measurement in agreement with cocktail calculations within uncertainties
- no conclusion on possible charm suppression due to large uncertainties

Outlook

- attempt to reduce uncertainties on cocktail
- alternatively data-driven approach by compairing p-Pb with scaled pp reference ➡ $R_{pPb}(m_{ee})$
- search for thermal radiation in high multiplicity p-Pb events
- possible charm suppression due to CNM effects would have important impact on Pb-Pb measurement