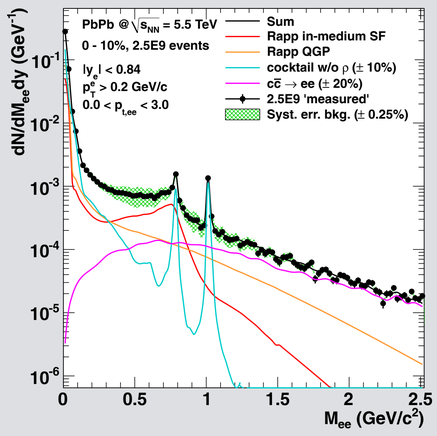
Separating prompt and non-prompt dielectrons in pp collisions at $\sqrt{s} = 7$ TeV with ALICE

S. Scheid[1] for the ALICE Collaboration

Motivation



Prospects for dielectron production in LHC RUN3 [1] with tight DCA cut applied.

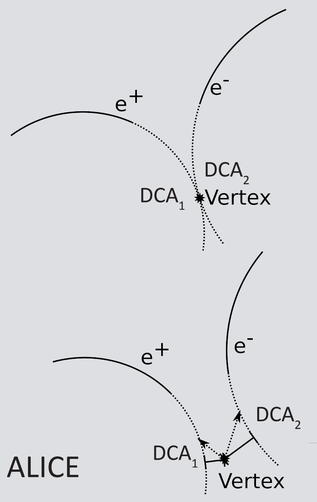
Measurement of the contribution of thermal radiation from Quark-Gluon Plasma (QGP) and hadronic gas in the dielectron mass spectrum in heavy-ion collisions

m_{ee} spectrum in the intermediate mass range
1) directly related to thermal radiation of QGP
2) dominated by heavy-flavour contribution

Idea:
Use combined Distance-of-Closest-Approach (DCA) of the electron and positron tracks to the collision vertex to separate prompt from non-prompt contributions to the dielectron continuum

Pair DCA

$$DCA_{ee} = \sqrt{\frac{DCA_1^2 + DCA_2^2}{2}}$$



Expectation:
Contributions from heavy-flavour decays have larger DCA_{ee} than prompt sources

Procedure:
Obtain templates of DCA_{ee} distributions for the known dielectron sources from full Monte-Carlo simulation
→ Compare the templates to data on dielectron production in MB pp at 7 TeV taken in 2010 by ALICE

Templates from Monte Carlo

- Obtain templates for the main known sources of dielectron pairs from PYTHIA perugia0 /perugia2011 (π^0, charm, beauty, prompt and non-prompt J/ψ)
- Use the π^0 template for all prompt light-flavour sources
- Create a "cocktail" by summing contributions according to their measured cross sections (No fit to data is used)

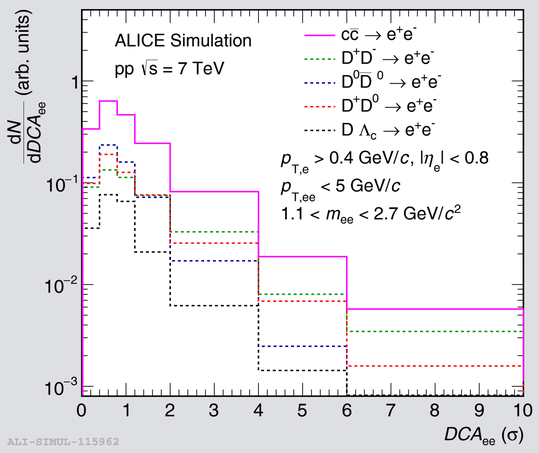
Cocktail Input

Light Flavour		Heavy Flavour	
π^0, η, K, ϕ, ω	measured spectra[2, 3, 4]	charm, beauty	measured cross sections[4, 5]
η', ρ	m_T-scaled from π^0	J/ψ	inclusive measurement[6]

Charm ($\sigma_{pp}^{c\bar{c}}$ = 7.48 mb)

	cτ (μm)	BR → e
D^0	123	6.5%
$D^{\pm}$	311	16%
Λ_c	60	4.5%

Add up the DCA_{ee} distributions of correlated dielectron pairs from open-charm hadrons (see fig)
→ BR and production ratios as weights



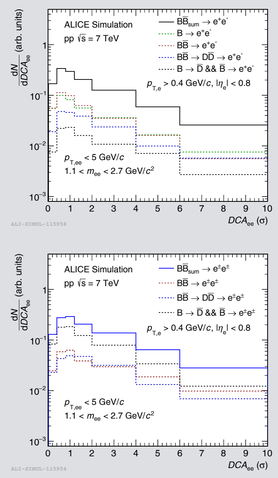
Beauty ($\sigma_{pp}^{b\bar{b}}$ = 0.281 mb)

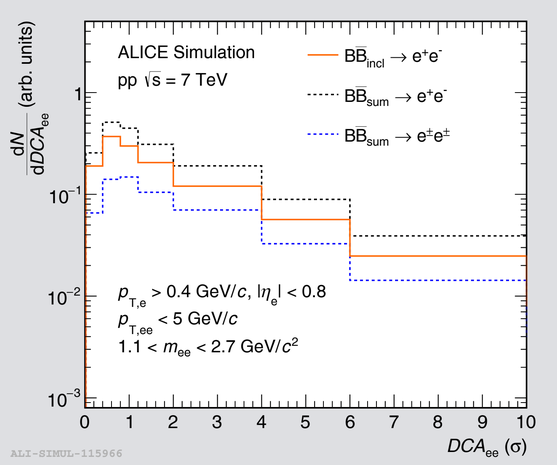
Different decay channels:

B → e	BR: 11%
B → D → e	BR: 8.5%
B → D(e) → ee	BR: 0.8%

B-meson cτ ≈ 450 μm

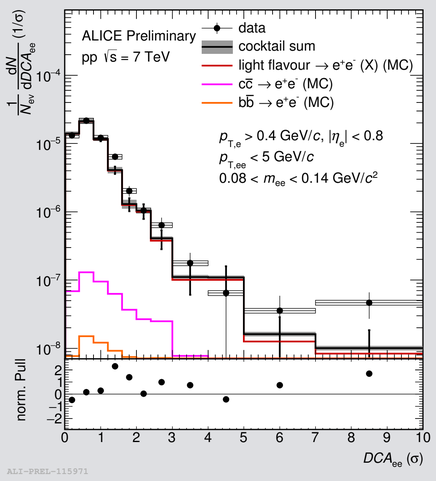
Due to oscillation, need to subtract the like-sign spectrum from the unlike-sign to get the inclusive DCA_{ee} spectrum (see fig)





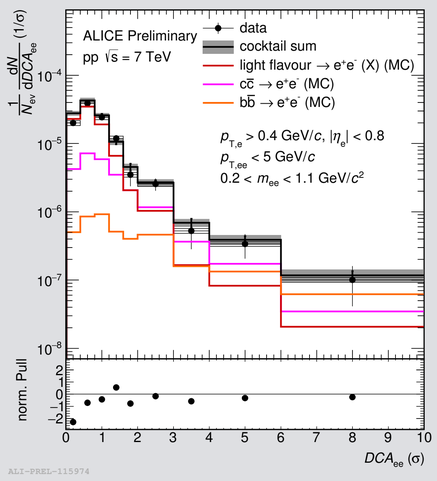
Comparison of Data and Monte Carlo

Pion Mass Region



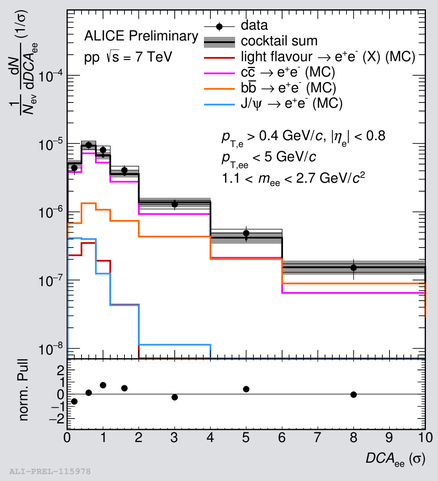
Mass region described by π^0 DCA_{ee}
→ Use π^0 template for other prompt light sources

Resonance Mass Region



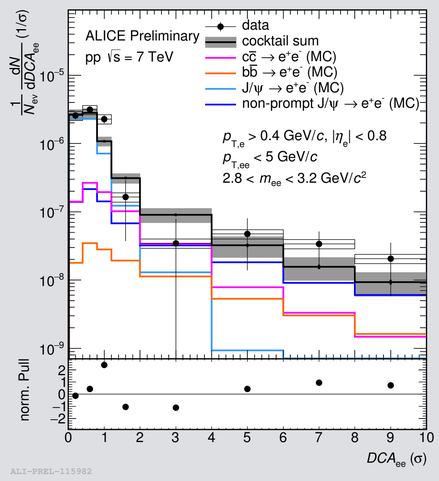
Tail of distribution described by heavy flavour
→ Separation of prompt and non-rompt sources feasible

Intermediate Mass Region



Good description of data by charm and beauty
→ No strong indication of prompt contribution

J/ψ Mass Region



Reasonable description of J/ψ mass region when charm and beauty contributions are taken into account

Summary and Outlook

- All observed mass regions are described by the MC templates normalised to the measured cross sections
- Established powerful method to separate prompt and non-prompt dielectrons in different invariant mass regions
- No strong indication for additional prompt source in heavy-flavour dominated mass region

Outlook

- Expand the analysis to other systems (p–Pb and Pb–Pb) and
- Extract virtual thermal photon contributions

References

[1] J. Phys. G 41, 2014
[2] Phys. Lett. B 717 162-172, 2012
[3] Phys. J. C72 21832, 2012
[4] arXiv: 1702.00766, 2017
[5] Phys. Lett. B 721, 2013
[6] Phys. Lett. B 704, 442-455, 2011; Phys. Lett. B 718, 692-698, 2012

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[1]scheid@ikf.uni-frankfurt.de
IKF, Goethe-Universität Frankfurt