

# YELLOW REPORT, SECTION THERMAL RADIATION: STATUS REPORT AND DISCUSSION

## Outline:

- Introduction/Theory
- Photons
- Dileptons
- Other items
  - Peripheral collisions
  - Dark photons
- Summary and discussion

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# INTRODUCTION/THEORY

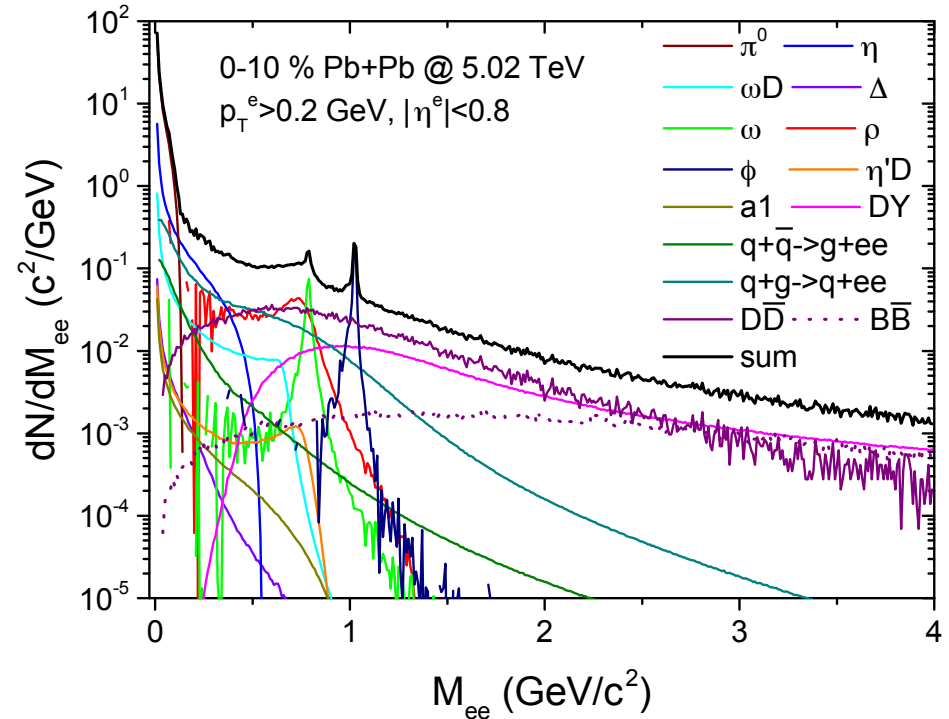
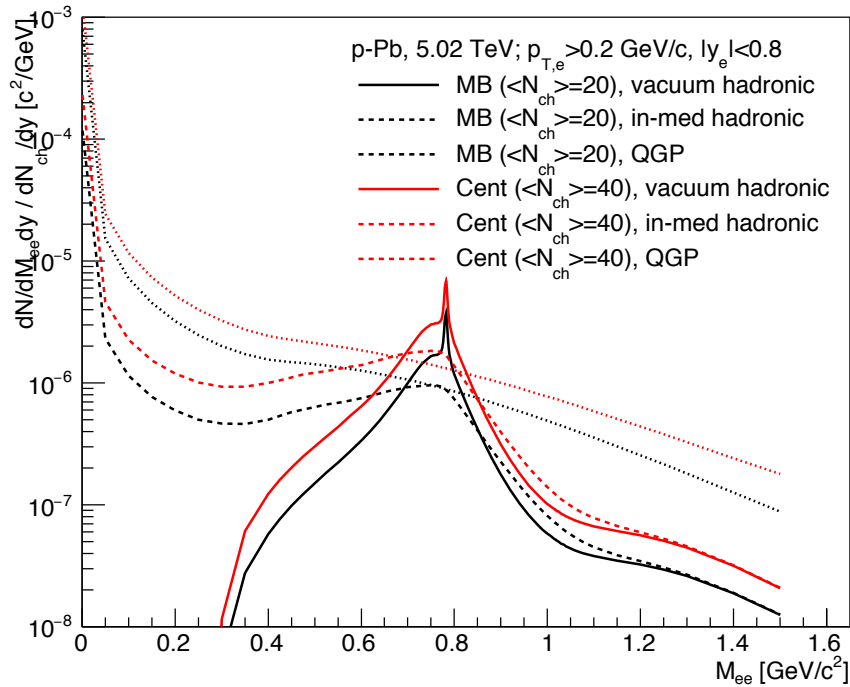
## Standard

- Thermal radiation and photons
  - Do we have (updated) predictions?
- Dileptons
  - Expectations from R.Rapp and pHSD (also for small systems)

## Extension

- Dilepton radiation and bulk viscosity
  - Expectations from Vujanovic et al. (see e.g. [arXiv:1703.06164](https://arxiv.org/abs/1703.06164))?
- Virtual photon polarization
  - See e.g. Baym et al. (*Phys. Rev. C* 95, 044907 (2017))?
- At LHC: direct connection to Lattice QCD
  - Thermal dilepton rates and electrical conductivity (e.g. *Phys. Rev. D* 94, 034504 (2016) or *JHEP*02 (2015) 186)
  - Discuss additional observables that might be accessible in Run 3/4?

# RECENT THEORY INPUT



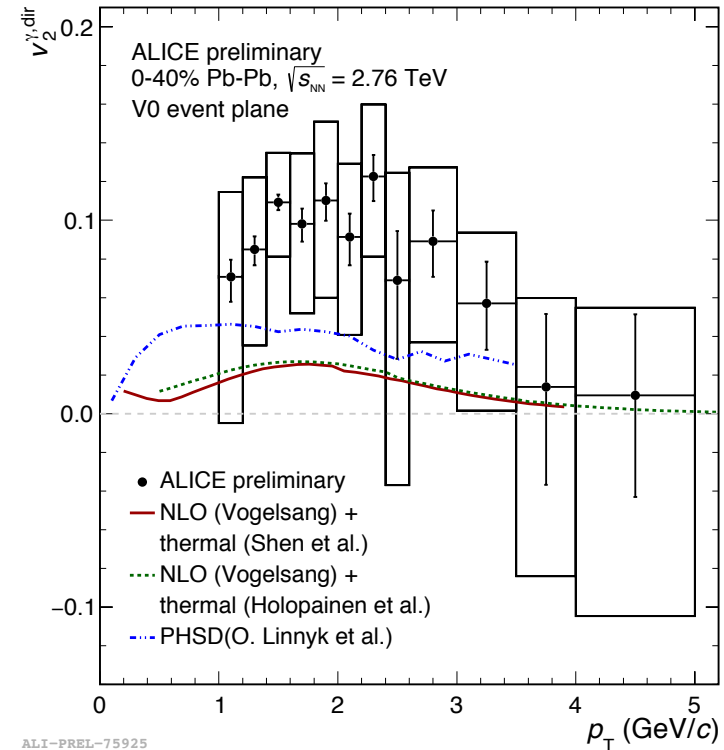
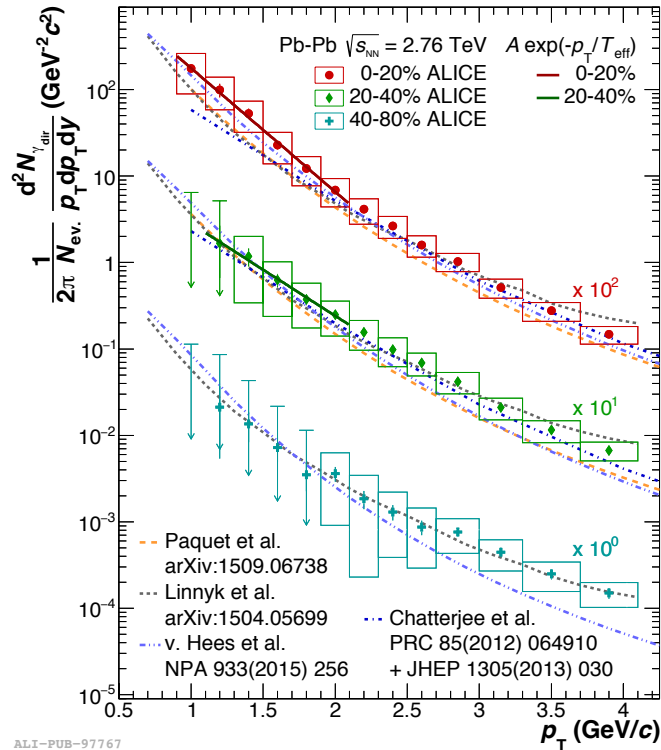
Ralf Rapp (p-Pb)

*Pb-Pb also available (ALICE Lol)*

pHSD model (Pb-Pb)

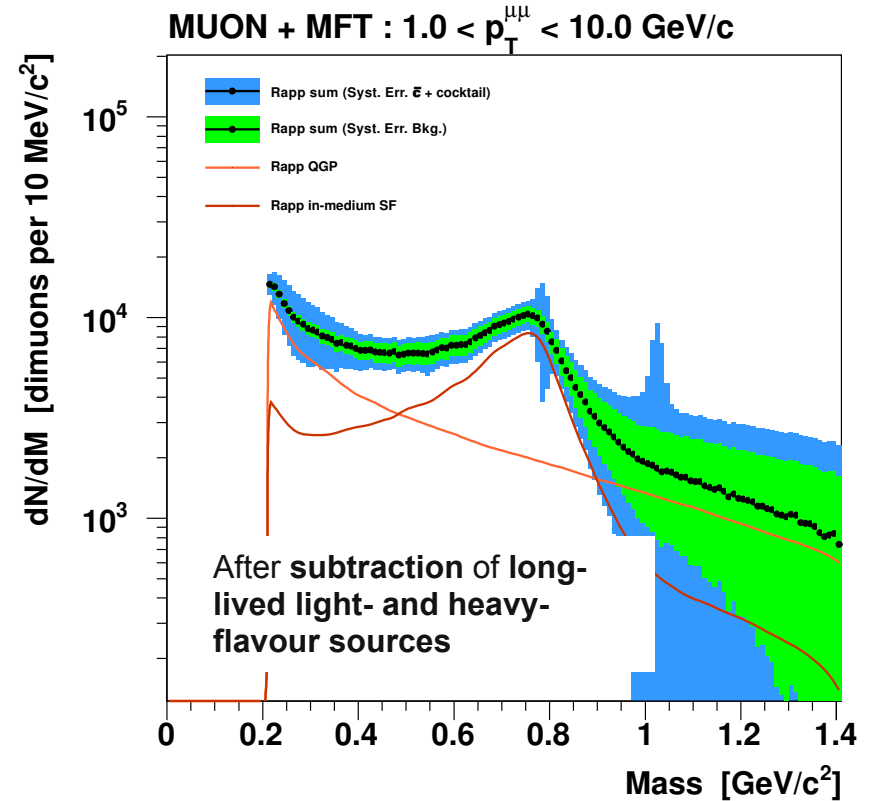
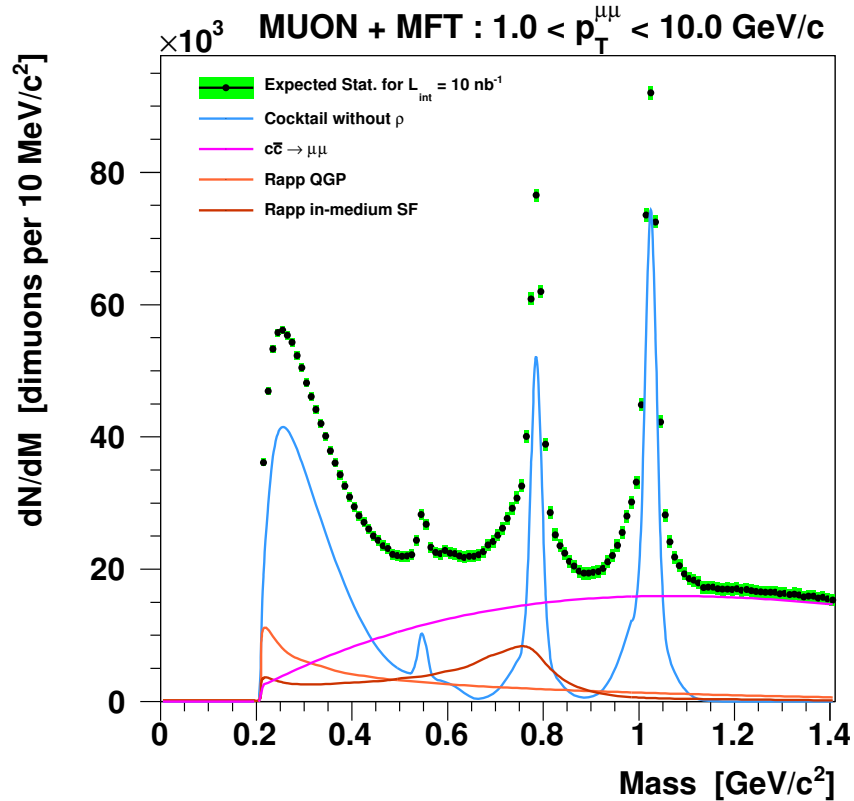
*p-Pb also available*

# PHOTONS



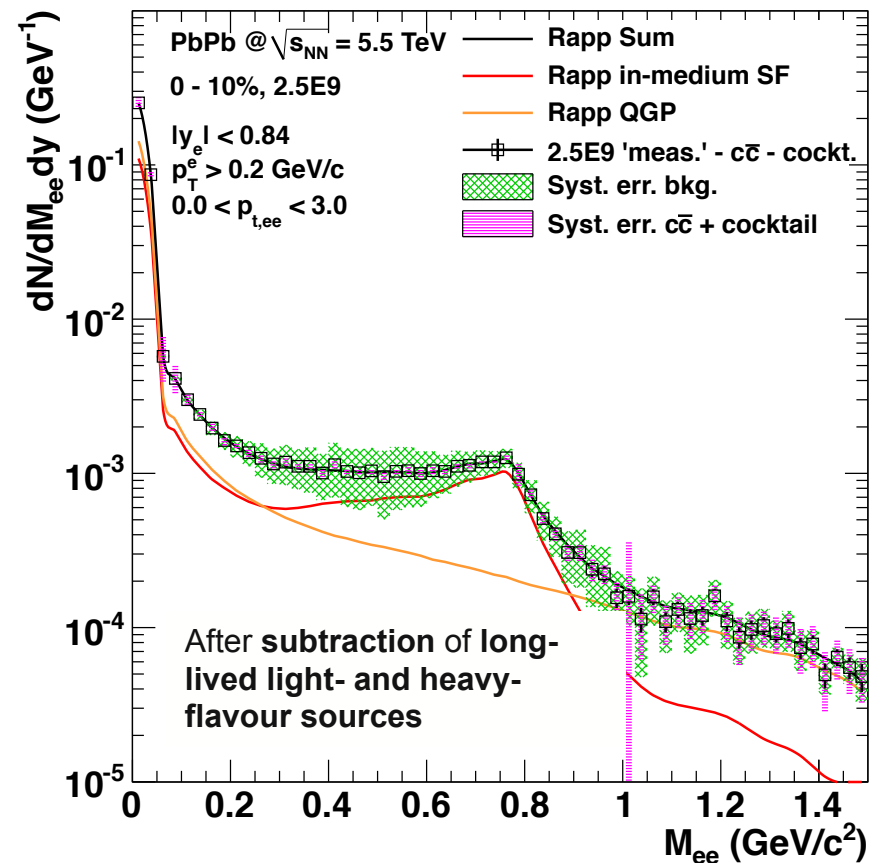
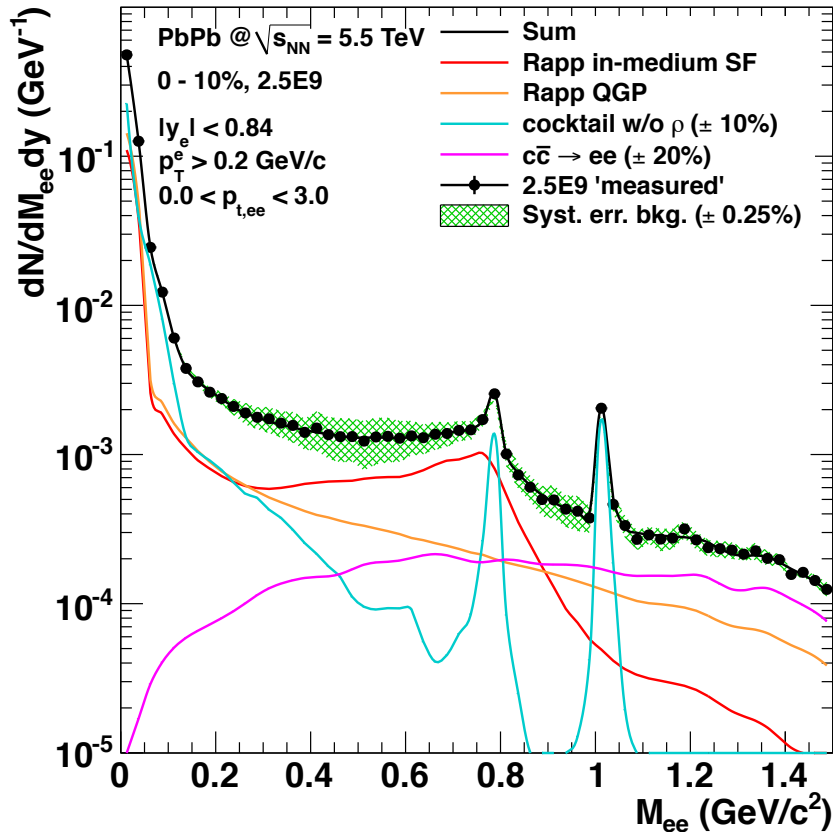
- First measurement at LHC from soft exponential component of photon  $p_T$  spectrum (*ALICE, Phys.Lett. B754 (2016) 235*):  $T \sim 300$  MeV (effective temperature averaged over system evolution)
- Projections for Run3/4 missing

# DIMUONS



- Low mass spectral function with  $\sim 20\%$  uncertainty
- Thermal radiation ( $M > 1 \text{ GeV}/c^2$ ) difficult due to large HF systematic uncertainty

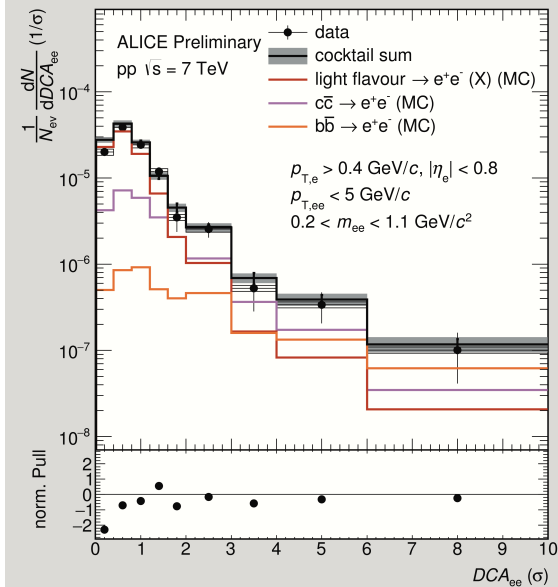
# DIELECTRONS



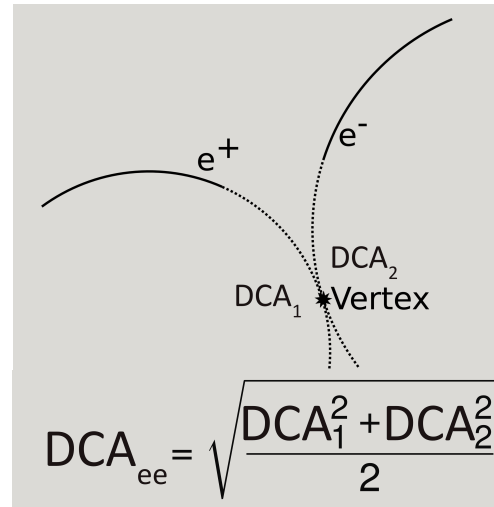
- Low mass spectral function with  $\sim 20\%$  uncertainty
- Temperature and flow with  $\sim 10\%$  uncertainty
- Results from fast simulation with more realistic geometry and photon conversion in preparation

# DIELECTRONS – HF CROSS SECTION

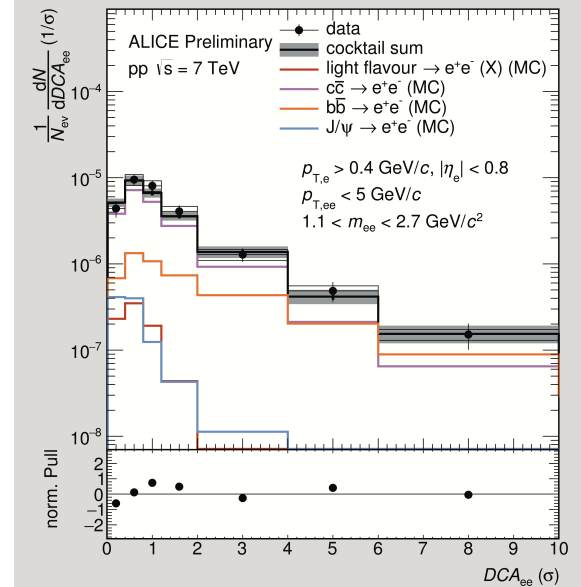
## Resonance Mass Region



S. Scheid [ALICE], QM17

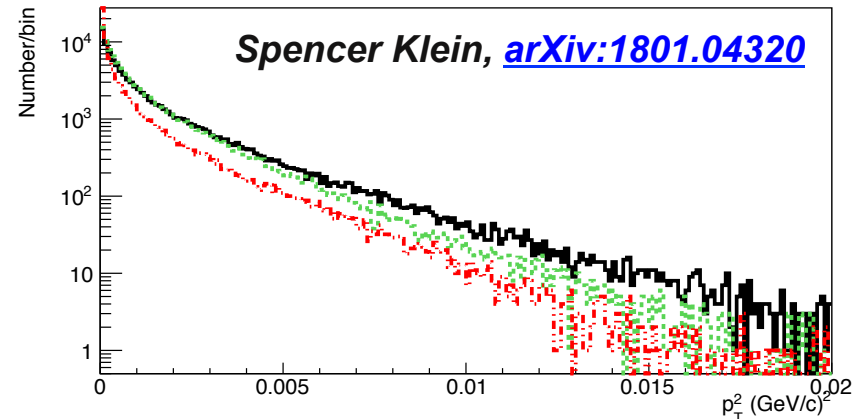
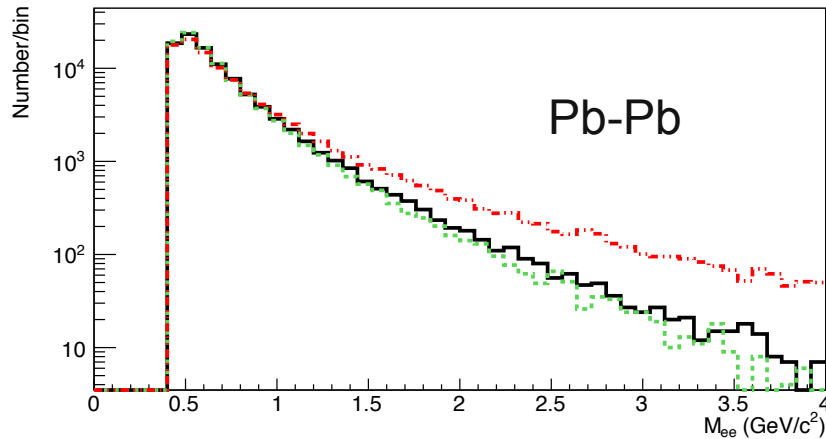


## Intermediate Mass Region



- Run 1/2:
  - use combined  $m_{ee}, p_{T,ee}$  fit for heavy flavour cross section
  - Pair DCA as tool to distinguish between prompt and non-prompt sources
- Projections for Run3/4 missing:
  - better  $DCA_{ee}$  resolution
  - combined fit of  $m_{ee}, p_{T,ee}, DCA_{ee}$
  - $p_{T,ee}$  reach

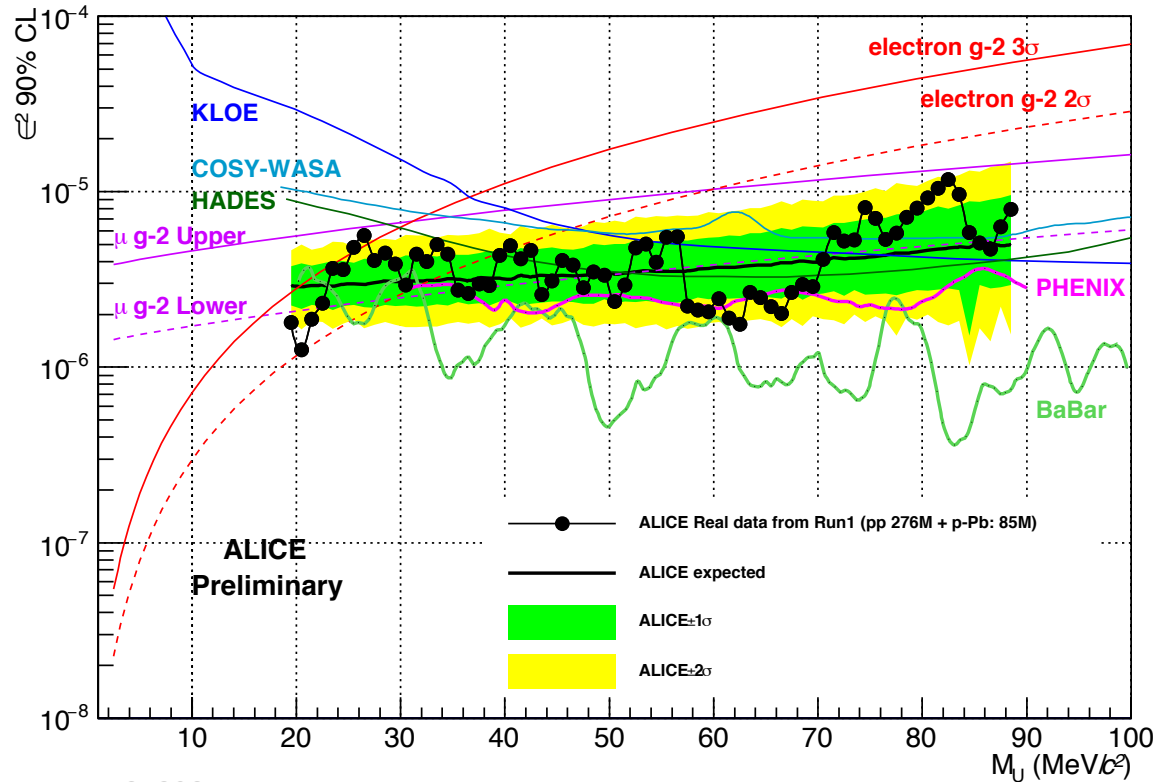
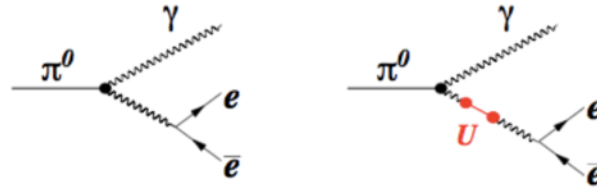
# PERIPHERAL COLLISIONS



- STAR and ALICE have observed an excess of dilepton pairs with  $p_T < \sim 100$  MeV/c in peripheral heavy ion collisions
  - STAR sees  $J/\psi$  + a mass continuum
  - ALICE sees only  $J/\psi$
- The rate and kinematics are consistent with expectations from coherent photoproduction and  $\gamma\gamma \rightarrow l+l-$
- Expectations for ALICE acceptance, Run 3/4?



# DARK PHOTONS



ALI-PREL-85298

- Preliminary Run1 results from ALICE
- Missing updated projections for Run 3/4 (also should this stay in this section?)

# SUMMARY

	Photons	Dielectrons	Dimuons
Spectra	No projections yet	ALICE LoI Fast simulation	ALICE LoI Improved heavy flavour systematics/ lower $p_T$ threshold
Temperature	No projections yet	ALICE LoI Fast simulation	See above
Flow	No projections yet	ALICE LoI Fast simulation	?
Other	Comparison to virtual photon method	HF cross section/ DCA method?	

## Other items (to be put to other chapter/WG?):

- Dark photons
- Peripheral collisions

Available  
In preparation?  
Not for yellow report?

## DISCUSSION ITEMS

- Organize as presented here (theory and then experimental expectations) or by topics
- Responsibles for subsections (a GitHub repository is prepared already), so far no written text
  
- Are we missing possible topics related to this section?
- Contact other theorists (see first slide) for expectations/discussions? Organize a dedicated meeting?
- Move topics to other sections (dark photons, peripheral collisions, small systems)
  
- Will we have updates on expectations?
  - Photons (projections on ALICE performance)
  - Dileptons (fast/full simulation, systematics, hadronic cocktail, virtual photon method, heavy flavour extraction, dimuons)
  - Peripheral collisions (calculations for ALICE acceptance)
  - Dark photons
- Are we statistics limited for some of the observables?

## NEXT STEPS

- **Timeline:**
  - end May/beginning June: next meeting for this section (with updates from the different topics)
  - mid June: all figures placeholders
  - end July: full text draft
  - end September: final version of draft
- See also:  
[https://indico.cern.ch/event/698005/contributions/2902627/attachments/1611619/2559334/Dainese\\_HLLHC\\_WG5\\_Mar2018.pdf](https://indico.cern.ch/event/698005/contributions/2902627/attachments/1611619/2559334/Dainese_HLLHC_WG5_Mar2018.pdf)



ALICE

# BACKUP