ALICE

DILEPTONS AND PHOTONS: THERMAL RADIATION AND BEYOND

Outline:
- Status
- Sections / Figures

Overleaf: ***https://www.overleaf.com/17973257zjnpjnhccgky#/68100198/***
GIT: *https://gitlab.cern.ch/miweber/HLLHC-WG5-photons-dileptons*
Mailing list: *hllhc-wg5-photons-dileptons@cern.ch*

MICHAEL WEBER (SMI)
ON BEHALF OF THE «PHOTON AND DILEPTON» SUBGROUP
20.09.2018

ÖAW ÖSTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN

FTE NATIONALSTIFTUNG FORSCHUNG | TECHNOLOGIE | ENTWICKLUNG

	Photons	Dielectrons	Dimuons
Spectra	Working on projections	ALICE LoI Fast simulation Full simulation	ALICE LoI
Temperature	Working on projections	ALICE LoI Fast simulation Full simulation	
Flow		ALICE LoI Fast simulation	
Other		DCA-HF rejection p-Pb projections	
Beyond thermal radiation		**Photon mediated production**	
		Dark photons	

Available
In preparation
Not for yellow report

Last meeting

	Photons	Dielectrons	Dimuons
Spectra	Rgamma (Pb-Pb) Rgamma (p-Pb)	ALICE LoI Fast simulation Full simulation	ALICE LoI
Temperature		ALICE LoI Fast simulation Full simulation	
Flow	v2 for Pb-Pb	ALICE LoI	
Other		DCA-HF rejection p-Pb projections	
Beyond thermal radiation		**Photon mediated production**	
		Dark photons	

Available
In preparation
Not for yellow report

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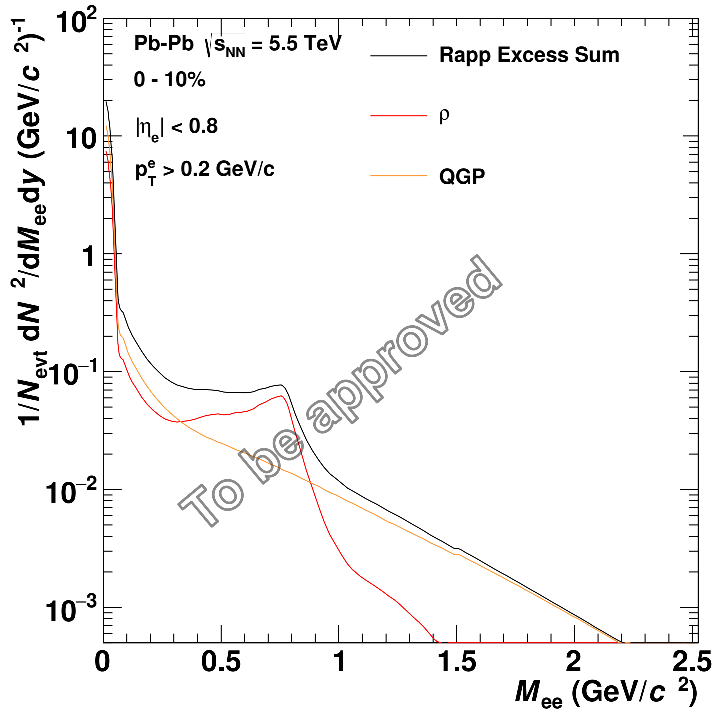
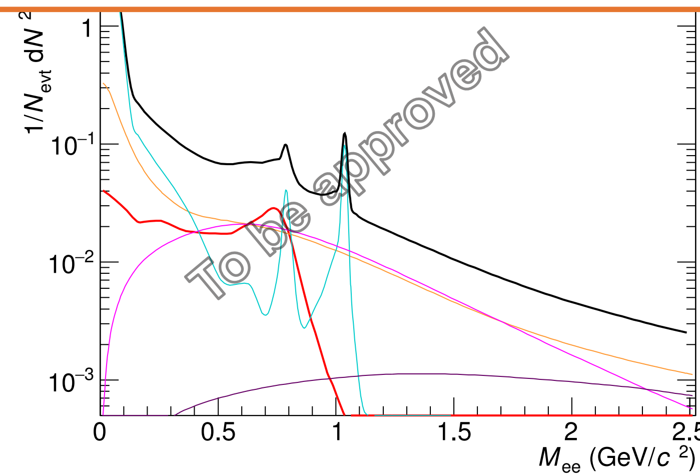
THERMAL RADIATION

A precise measurement of the low-mass dielectro
ALICE physics programme during the LHC Run
electrons from correlated semileptonic open heav
heavy-flavour production in pp collisions at LHC

Status:

- Theory overview dileptons: first version
- Theory plots: **first version**
- Experimental overview: **first version**
- Extend real photon intro: **this week (one add. Figure – first version available)**
- Final cosmetics: **pending**





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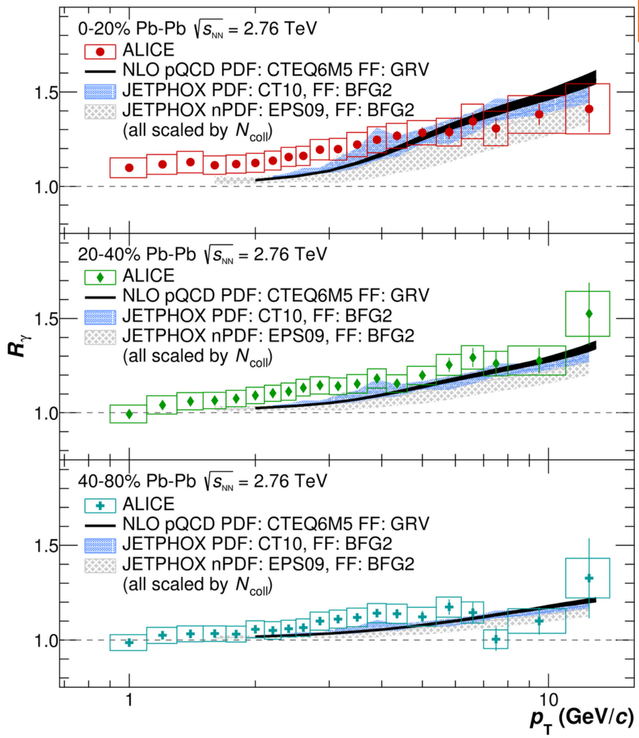
PHOTONS

(PCM) and of PHOS spectrometer. In central c
prompt photon predictions is observed that is at
the most central 0-20% centrality the low p_T exc
of the order of 6%. A signal of direct photons w
while in mid-central and especially in periphera
collisions are important since there one can estim

Status:

- Describe measurement and improvement for Run3/4: **first version**
- Projections: **R_γ and v_2 for Pb-Pb**
- Final cosmetics: **pending**



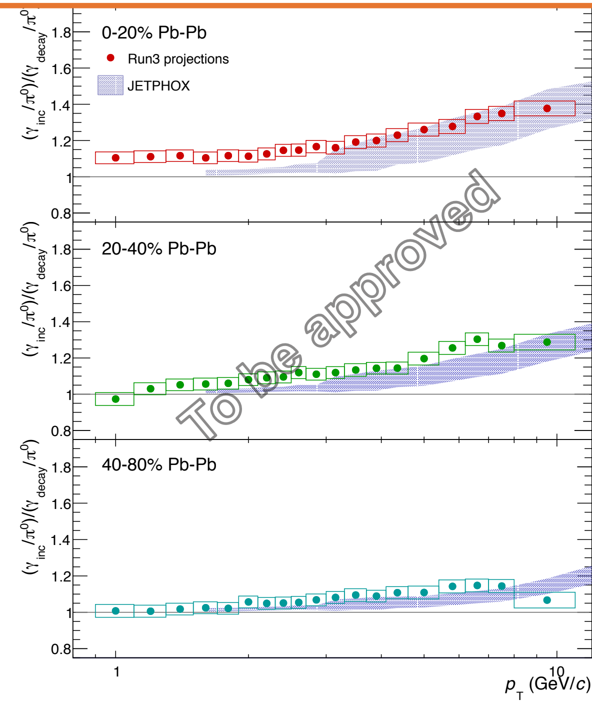


Fig. 3: R_γ measured (left) and R_γ projected.

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DILEPTONS

sign correlated dimuon mass spectrum. A 10 % sy
the normalization of these sources has been consi
has been also applied for the subtraction of the dir
alternatively, these two sources could be separated
on the discrimination of the dimuon offset at the p

Status:

- Description measurement and performance Run 3/4 : first version
- Projections dimuons: LoI version
- Projections dielectrons:
  - **Fast Sim version**
- Final cosmetics: **pending**

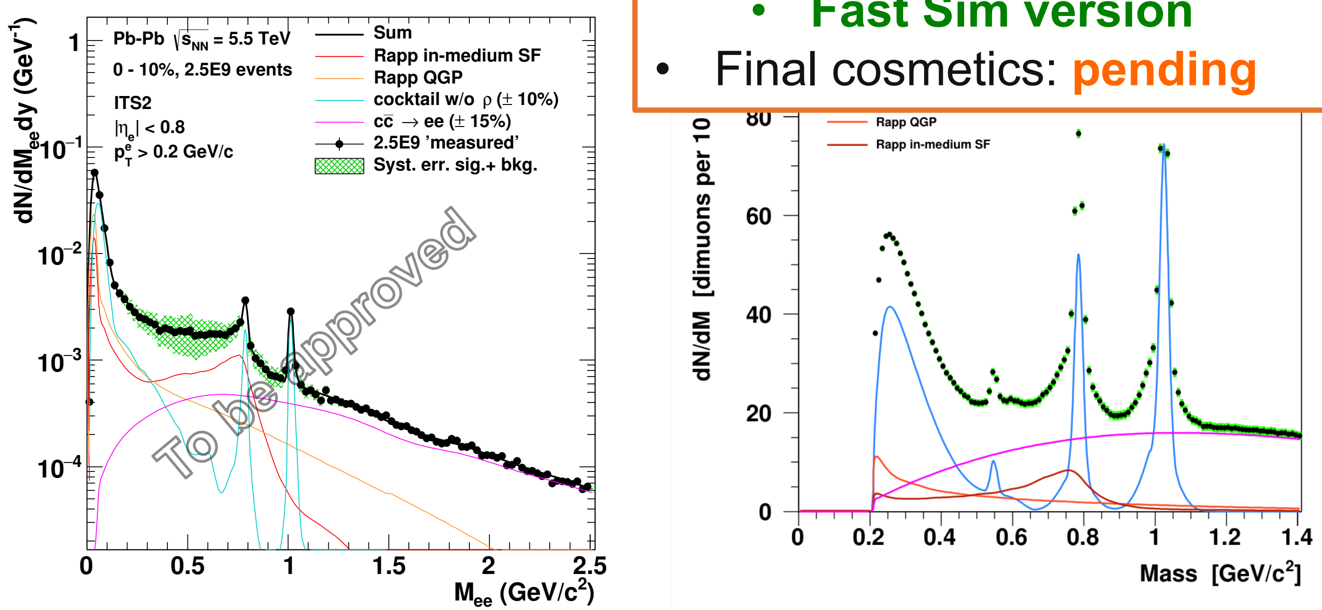


Fig. 5: Inclusive e^+e^- (left) and $\mu^+\mu^-$ (right) invariant mass spectrum for 0–10% most central Pb–Pb collisions at $\sqrt{s_{NN}} = 5.5$ TeV. The green boxes show the systematic uncertainties from the combinatorial background subtraction.

TWO-PHOTON AND PHOTONUCLEAR INTERACTIONS

masses. As pair mass decreases, the average distan… point increases, so the medium should have less an… since they should show increased in-medium effec… $\mu^+\mu^-$ (and possibly $\tau^+\tau^-$), since the lighter lept… interact with the medium, then the electron A distri…

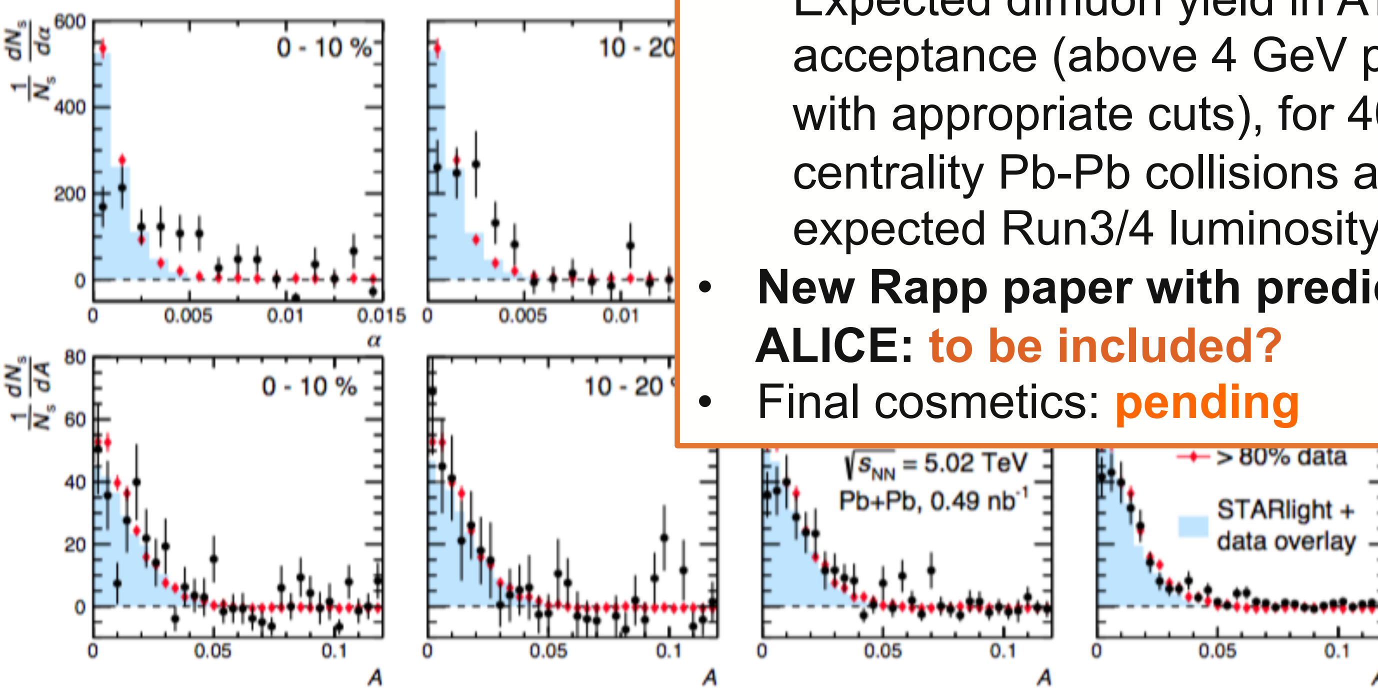


Fig. 7: Acoplanarity (α, top) and lepton energy imbalance (A, bottom) as a function of centrality, for dimuon pairs with pair mass above 10 GeV, observed in the ATLAS detector. From Ref. [64].

Status:

- Photoproduction of dileptons in **peripheral collisions** : first version
- Projections: **this week?**
  Expected dimuon yield in ATLAS acceptance (above 4 GeV pair mass, with appropriate cuts), for 40-80% centrality Pb-Pb collisions and the expected Run3/4 luminosity
- **New Rapp paper with predictions for ALICE: to be included?**
- Final cosmetics: **pending**

DARK PHOTONS

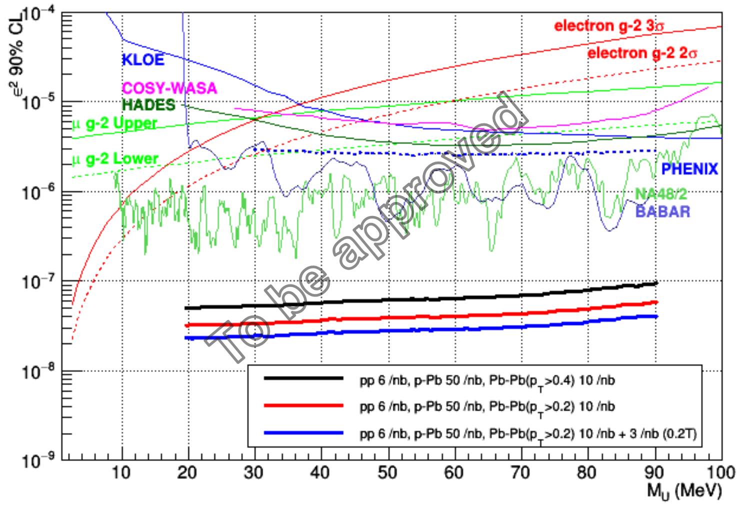
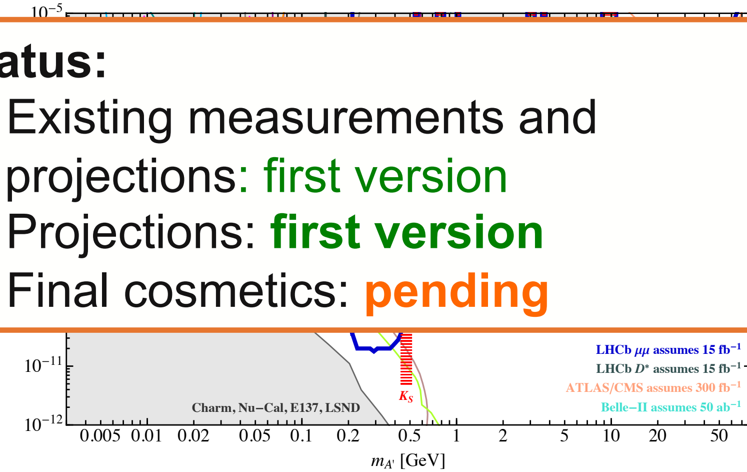


Fig. 13: 90% of CL constrained by ALICE in HL-LHC era



Status:
- Existing measurements and projections: first version
- Projections: **first version**
- Final cosmetics: **pending**

Fig. 14: 90% of CL constrained by LHCb in HL-LHC era

with respect to the event plane (elliptic flow), more differential measurements might still be limited. The measurement of the photon polarization via the angular distribution of dileptons can not only provide information the thermalization of the system, but also on the early stages of collision [100]. Experimentally these distributions have been measured by the NA60 [101], where no polarization was found concluding that the observed excess dimuons are in agreement with the thermal emission from a a ran-

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LIMITATIONS AND OUTLOOK

Status:
- Text: **first version**
  - Polarization
  - Photon HBT
  - ALICE-ITS3 upgrade
- Final cosmetics: **pending**

Another promising direction is measurement of Bose-Eins
this probe one can trace space-time dimensions of the hottest pa
k_T of the photon pair, one can select pairs coming mostly from
and thus look at evolution of the fireball. On the other hand from the correlation strength parameter one can extract direct photon spectrum down to very low $p_T \sim 100$ MeV/c. So far there was one successful measurement of direct photon BE correlations with WA89 collaboration [105], while at RHIC and LHC energies these measurements are still unavailable. The reason is that expected strength of these correlations $\lambda_\gamma = 1/2(N_\gamma^{dir}/N_\gamma^{tot})^2$ is extremely small. Moreover, in contrast to massive particles, averaging of full 3D correlation function $C_2(q_{out}, q_{side}, q_{long})$ to 1D $C_2(q_{inv})$ results in further dramatic decrease of correlation strength [105]. This all requires very big statistics in addition to understanding detector response.

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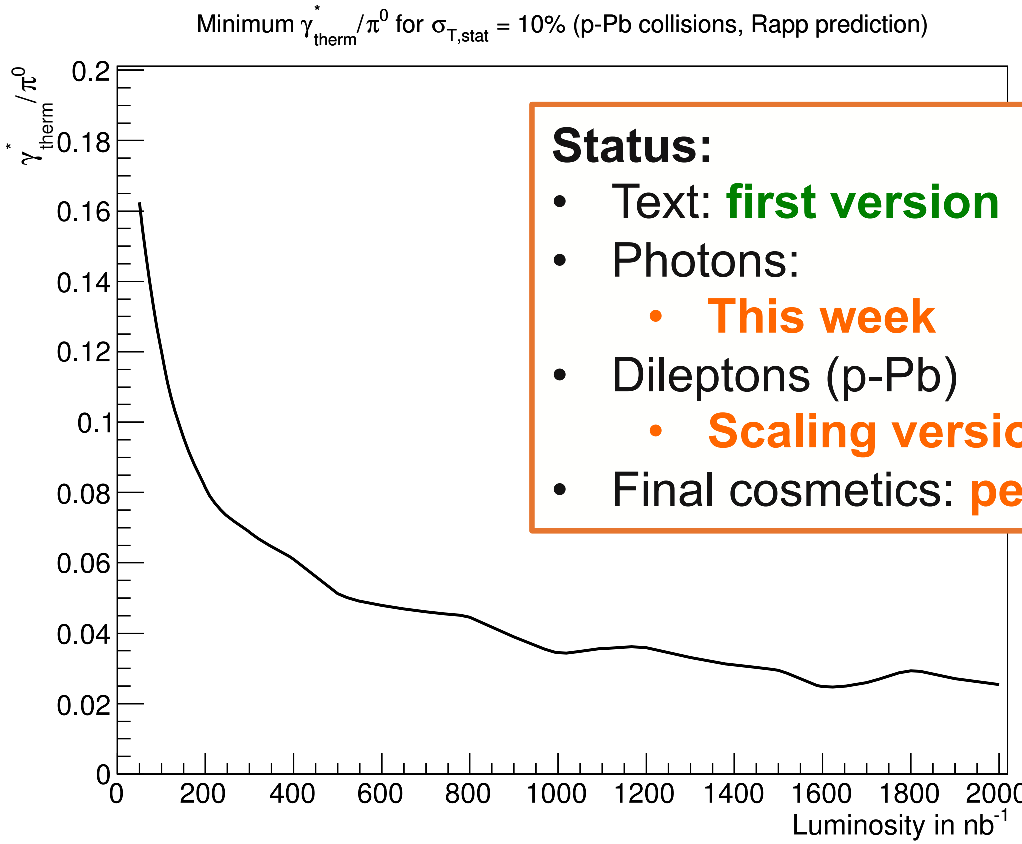
SMALL SYSTEMS (TO BE MOVED TO SECTION)

rejecting e^+e^- pairs from semileptonic charm decays) is assumed to be the same as in Pb–Pb collisions.



Status:

- Text: **first version**
- Photons:
  - **This week**
- Dileptons (p-Pb)
  - **Scaling version (to be updated)**
- Final cosmetics: **pending**

Fig. 16: Placeholder: Minimum thermal photon to π^0 ratio needed to extract the temperature of the QGP with a statistical uncertainty $\sigma_{\mathrm{T,stat}} < 10\%$ as a function of integrated luminosity.

OTHER ITEMS/HOMEWORK

- **Figures:**
  - **Dark photons:** check consistency between world data and other experiments on ALICE projection, create one plot for it (contact LHCb)?
  - **small systems:** real photons, dielectrons
  - **peripheral collisions**
  - ATLAS/LHCb/ALICE **approval** of figures

- **Text:**
  - Real photons section needs still some work
  - Final cosmetics (check consistency of symbols)
  - How to treat private communication (at the moment footnote), presentations (peripheral collisions)

- **Other items?**

TIMELINE

- **Friday 7th September**: meeting "thermal radiation" section: https://indico.cern.ch/event/753073/ **Done**

- **Monday 10th September:** **draft to be sent to internal mailing list(s) for discussion: figures and text close to final** **Done 14th September**

- **Friday 14th September:** WG5 meeting (present section status): https://indico.cern.ch/event/754980/ **Done**

- **Week 17th-21st September:** meeting "thermal radiation" section **Today**

- **Sunday 30th September:** **final version of draft to be uploaded for WG5 review**

- **October 30-31:** next general WG5 meeting at CERN: https://indico.cern.ch/event/752211/

YELLOW REPORT STATUS

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THANK YOU

Especially to all contributors to this section: ***Raphaelle Bailhache, Torsten Dahms, Taku Gunji, Spencer Klein, Ana Marin, Dmitri Peressounko, Klaus Reygers, Antonio Uras, Oton Vazquez, and all I forgot here****…*

BACKUP

Overleaf: ***https://www.overleaf.com/17973257zjnpjnhccgky#/68100198/***
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REAL PHOTON PREDICTIONS (FIRST DRAFT)