Measurement of the t-dependence of coherent photoproduction of J/ψ at midrapidity in ultra-peripheral Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV

Miniworkshop difrakce a UPC 2020

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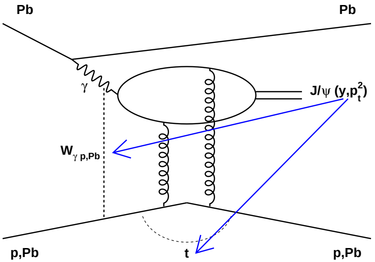
Introduction

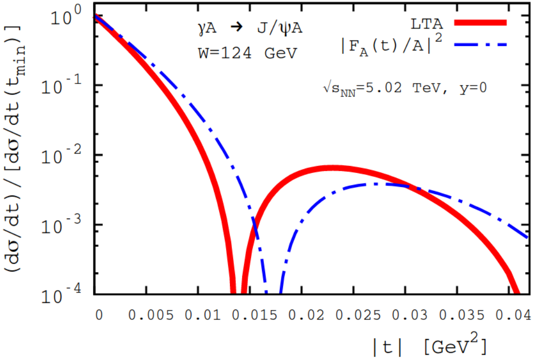
- Follow-up of the analysis "Coherent J/ψ and ψ(2S) photoproduction at midrapidity in ultra-peripheral collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV".
- First measurement of the t-dependence of the coherent production of J/ψ.

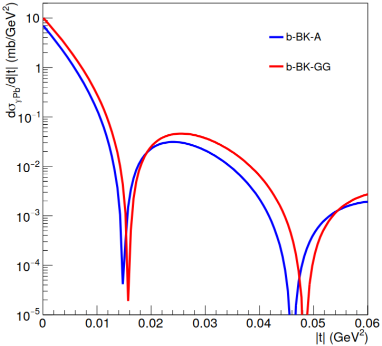


- Coherent J/ψ photoproduction.
  - Hard scale (pQCD valid).
  - Large cross section.
  - Clean experimental signal.
  - Provides information on the evolution of the gluon distribution in nuclei at low-x.
  - For collider kinematics, $|t| \approx p_{\mathrm{T}}^2$.

The t-dependence is sensitive to the gluon distribution in the impact-parameter plane.

t-Dependent models





- Guzey, Strikman, Zhalov.
- Published in Phys.Rev.C 95 (2017) 2, 025204.
- Sensitivity to b-dependent Gribov-Glauber shadowing.

- Bendova, Cepila, Contreras, Matas.
- Published in arXiv.
- Impact-parameter dependent Balitsky-Kovchegov equation.

Data sets

- LHC18qr_pass1.
  - Pb-Pb at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV in 2018,
  - UD_PbPb_ESD train 250.
  - Analysis code is here
- LHC19k1.
  - MC simulation anchored to LHC18qr (JIRA ticket).
  - UD_PbPb_ESD train 254, 287, 290.
    - kTwoGammaToMuMedium - cup31 scaling,
    - kCohJpsiToMu - cup31 scaling,
    - kIncohJpsiToMu - cup31 scaling,
    - kCohPsi2sToMuPi - cup31 scaling,
    - kIncohPsi2sToMuPi - cup31 scaling,
    - kCohPsi2sToMu - cup31 scaling.
- Analysed luminosity 232.8 $\mu\mathrm{b}^{-1}$.
  - Details in the backup, P. 27.

Selection criteria 1/2

- J/ψ reconstructed through the decay into a $\mu^+\mu^-$ pair.
- All details in the analysis notes ANA-806 and ANA-1083.
- Trigger:
  - We are looking for two back-to-back leptons in otherwise empty detector,
  - CCUP31 - more details at UPC Twiki page:
    - **!0VB$_{\mathbf{OR}}$:** Nothing was detected in the VZERO detector,
    - **!0UB$_{\mathbf{OR}}$:** Nothing was detected in the AD detector,
    - **0STG:** Less than 8 hits in the outer layer of SPD detector + opening angle of at least two tracklets $> 36^\circ$ for runs before run 295753 and opening angle $> 144^\circ$ for the other runs,
    - **0OMU:** More than 1 hit and less than 7 hits in the TOF detector + at least two of the hits with an opening angle $> 150^\circ$.
- LEGO train selection:
  - Track selection with AliESDtrackCuts::GetStandardITSTPCTrackCuts2011(kFALSE,1).
  - Details in the backup, P. 28.

Selection criteria 2/2

- Analysis Selection:
  - The event is from the DPG official runlist described in the backup, P. 23, 24,
  - the event has been triggered by the CUP31 trigger,
  - offline 0STG (fired FastOR chips corresponding to the SPD clusters crossed by the two selected tracks),
  - all (two, back-to-back) remaining tracks surviving the previous criteria are more likely to be muons than electrons in units of significance σ using AliTPCPIDresponse class,
  - the invariant mass is between 2.2 [GeV/c^2] and 4.5 [GeV/c^2],
  - nothing in the AD according to the offline processing (AliVAD::Decision(kEmpty)),
  - nothing in the V0 according to the offline processing (AliVVZERO::Decision(kEmpty)),
  - the rapidity of $\mu^+\mu^-$ is within (-0.8,0.8).
  - the pseudorapidity η of each track is within (-0.8,0.8).
  - the tracks have opposite charge,
  - $p_{\mathrm{T}}^{\mu\mu} < 0.11$ [GeV/c].
- 8447 events survived for the invariant mass analysis (full list of selection effects in the backup, P. 29).

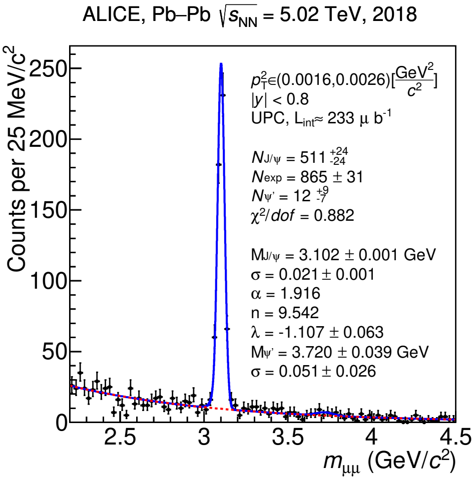
Analysis steps and formulas

$$
{}_{\text{axe}}N^{\text{coh}}_{\mathrm{J}/\psi} = \frac{N^{\text{yield}}}{1 + f_I + f_D^{\text{neutrals}} + f_D^{\text{charged}}} \cdot \frac{1}{(\text{Acc} \times \epsilon)^{\text{coh}}_{\mathrm{J}/\psi}}, \tag{1}
$$

$$
{}_{\text{axe}}N^{\text{coh}}_{\mathrm{J}/\psi} \rightarrow \textbf{UNFOLDING (migration)} \rightarrow^{\text{unf}}_{\text{axe}} N^{\text{coh}}_{\mathrm{J}/\psi}
$$

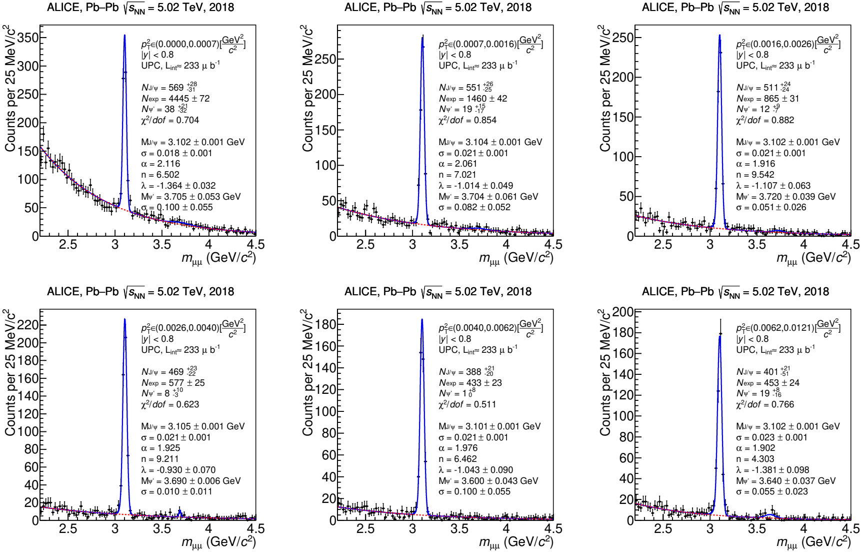
$$
\frac{\mathrm{d}^2\sigma^{\text{coh}}_{\mathrm{J}/\psi}}{\mathrm{d}y\,\mathrm{d}p_{\mathrm{T}}^2} = \frac{{}^{\text{unf}}_{\text{axe}}N^{\text{coh}}_{\mathrm{J}/\psi}}{\epsilon^{\text{VETO}} \cdot \epsilon^{\text{EMD}} \cdot \mathrm{BR}(\mathrm{J}/\psi \rightarrow \mu^+\mu^-) \cdot \mathscr{L}_{int} \cdot \Delta p_{\mathrm{T}}^2 \cdot \Delta y}. \tag{2}
$$

Invariant mass fit

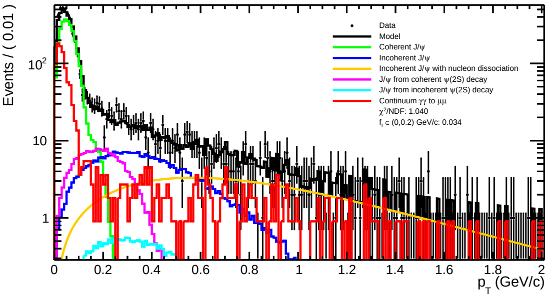


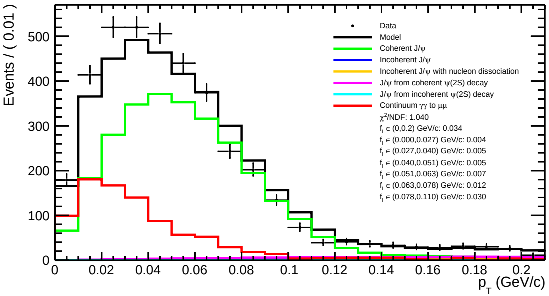
- Measurement performed in 6 p_{T}^2 ranges.
- Extended likelihood fit of unbinned data.
- Fitting model consists of two Crystal Ball function (CB) and one exponential.
- One CB describes J/ψ peaks, second CB describes $\Psi(2S)$ peak.
- CB parameters α and *n* fixed from MC fits.
- Exponential describes background - parameters left free.

Potential paper figures



Incoherent J/ψ contributions - p_T fit - potential paper figures





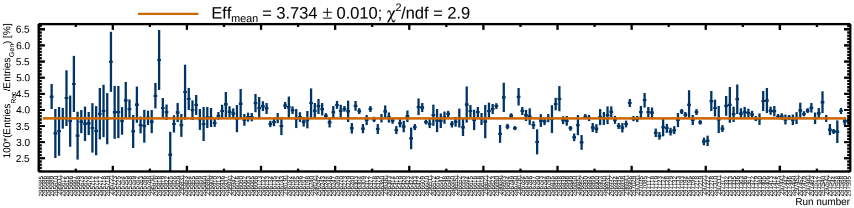
- Extended likelihood fit of unbinned data.
- Feed down fixed (Coherent $\Psi(2S) = 6.98\%$. Incoherent $\Psi(2S) = 7.32\%$).
- Continuum from invariant mass fit in range (3.3,4.5) [GeV/c^2].
  - Mass region bellow 3.0 [GeV/c^2] contaminated by J/ψ from radiative decays.
- Nucleon dissociation from H1 parametrization.
- Low-p_T description not optimal. Better when using formula $\frac{dN_{J/\psi}}{dp_T} = \text{norm} \cdot p_T \cdot e^{-bp_T^2}$.
- Difference added to systematics.

Feed down and Incoherent J/ψ contributions - results

p_{T}^2 interval [GeV$^2/c^2$]	f_{I} [-]	f_{D} [-]
$(0; 0.00072)$	$0.0045 \pm^{0.0059}_{0.0029}$	0.0039
$(0.00072; 0.0016)$	$0.0047 \pm^{0.0062}_{0.003}$	0.0046
$(0.0016; 0.0026)$	$0.0047 \pm^{0.0062}_{0.003}$	0.0058
$(0.0026; 0.0040)$	$0.0072 \pm^{0.0069}_{0.0039}$	0.0072
$(0.0040; 0.0062)$	$0.0120 \pm^{0.0077}_{0.005}$	0.011
$(0.0062; 0.012)$	$0.0300 \pm^{0.01}_{0.0079}$	0.028

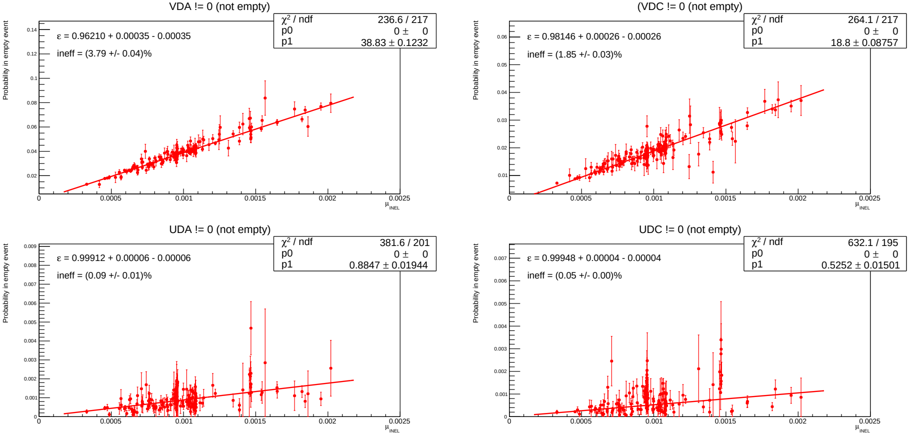
Table: Incoherent correction f_{I} and feed down correction f_{D} for each p_{T}^2 interval. f_{D} calculation in the backup, P. 34, 35.

Acceptance X efficiency - mean over all runs



- Reconstructed particles after cuts divided by generated particles after y/p_{T} cut
- Compatible with inclusive analysis (3.72%).

VETO inefficiencies - CTRUE trigger analysis

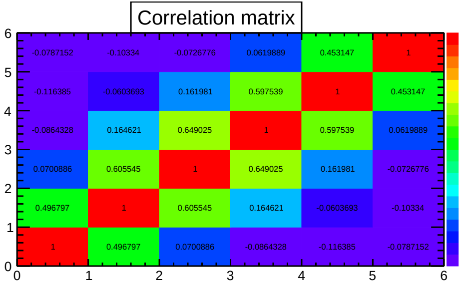


Enters as:

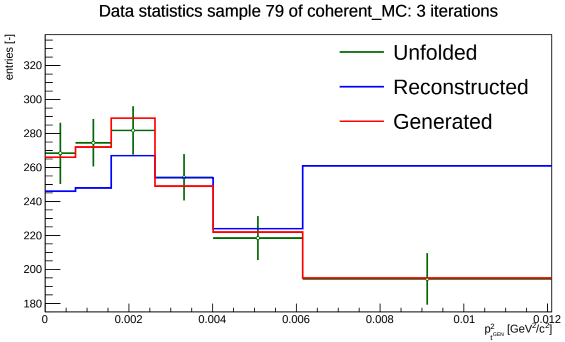
$$\epsilon^{\text{VETO}} = (1 - p_{0\text{VDA}}) \cdot (1 - p_{0\text{VDC}}) \cdot (1 - p_{0\text{UDA}}) \cdot (1 - p_{0\text{UDC}}) = 0.943. \quad (3)$$

Unfolding 1/2

- p_{T}^2-Migration problem:
  - Detector resolution smears the truth p_{T}^2-distribution.
  - Unfolding based on Bayes' theorem used to "put events into correct p_{T}^2-bins".
  - Bayesian unfolding is iterative $\rightarrow$ best number of iteration based on result convergence.
  - Varying binning schemes when unfolding Monte Carlo data decided final p_{T}^2 intervals.



-0.0787152	-0.10334	-0.0726776	0.0619889	0.453147	1
-0.116385	-0.0603693	0.161981	0.597539	1	0.453147
-0.0864328	0.164621	0.649025	1	0.597539	0.0619889
0.0700886	0.605545	1	0.649025	0.161981	-0.0726776
0.496797	1	0.605545	0.164621	-0.0603693	-0.10334
1	0.496797	0.0700886	-0.0864328	-0.116385	-0.0787152



Unfolding 2/2

Iteration:	1	2	3	4	5	6	7	8
Number of bins: 5								
Aver. Rel. Diff. [%]		4.38	1.68	0.83	0.52	0.38	0.32	0.28
Aver. Stat. Err. [%]	2.81	3.74	4.43	4.99	5.45	5.85	6.20	6.52
Number of bins: 6								
Aver. Rel. Diff. [%]		4.69	1.89	0.89	0.54	0.39	0.31	0.28
Aver. Stat. Err. [%]	2.70	3.62	4.33	4.89	5.37	5.79	6.17	6.51
Number of bins: 7								
Aver. Rel. Diff. [%]		4.66	1.90	1.15	0.82	0.65	0.56	0.55
Aver. Stat. Err. [%]	2.94	3.99	4.79	5.44	5.99	6.48	6.93	7.34
Number of bins: 8								
Aver. Rel. Diff. [%]		4.65	1.81	0.83	0.52	0.36	0.27	0.21
Aver. Stat. Err. [%]	2.99	4.09	4.94	5.63	6.23	6.77	7.25	7.70
Number of bins: 9								
Aver. Rel. Diff. [%]		4.61	1.83	0.85	0.51	0.41	0.38	0.36
Aver. Stat. Err. [%]	3.03	4.16	5.04	5.77	6.40	6.96	7.48	7.96

Sources of systematic errors

Source	Correlation in p_{T}^2	Uncertainty [%]
signal extraction	yes	[0.7,2.2]
f_{D}	yes	[0.1,0.5]
f_{I}	yes	[1.1,2.3]
unfolding	yes	[1.8,2.5]
luminosity	no	5
V0 and AD veto	no	3
EM dissociation	no	2
ITS-TPC tracking	no	2.8
SPD and TOF efficiency	no	1.3
Branching ratio	no	0.5

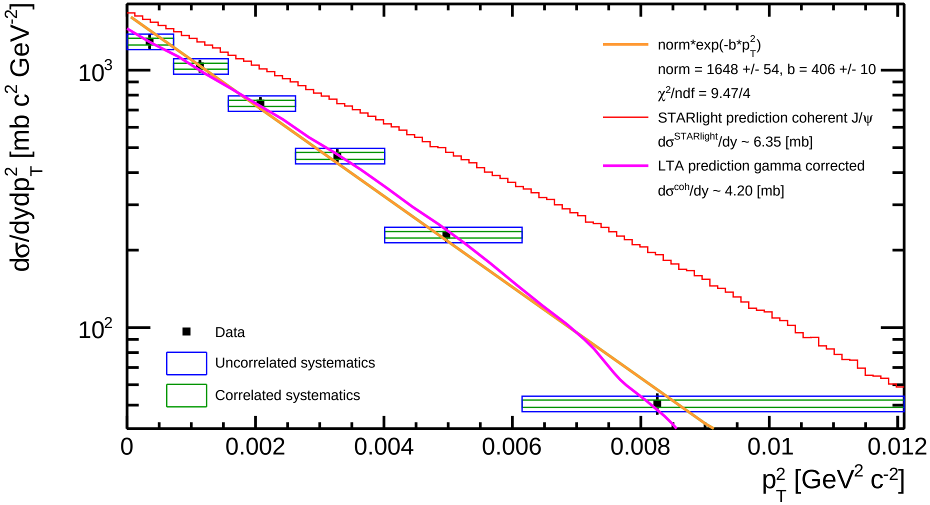
[#, #] brackets show extreme values. Details in the backup, P. 38, 39.

Final cross section - Table

p_{T}^2 interval [GeV$^2/c^2$]	$\frac{\mathrm{d}^2\sigma^{\text{coh}}_{\mathrm{J}/\psi}}{\mathrm{d}y\mathrm{d}p_{\mathrm{T}}^2}$ [mbc^2/GeV^2]	stat [%]	cor. syst [%]
$(0; 0.000724)$	1291	5.7	3.1
$(0.000724; 0.0016)$	1036	4.5	2.7
$(0.0016; 0.0026)$	743	4.6	2.8
$(0.0026; 0.0040)$	465	5.0	3.2
$(0.0040; 0.0062)$	229	5.7	2.9
$(0.0062; 0.0121)$	51	8.3	3.3

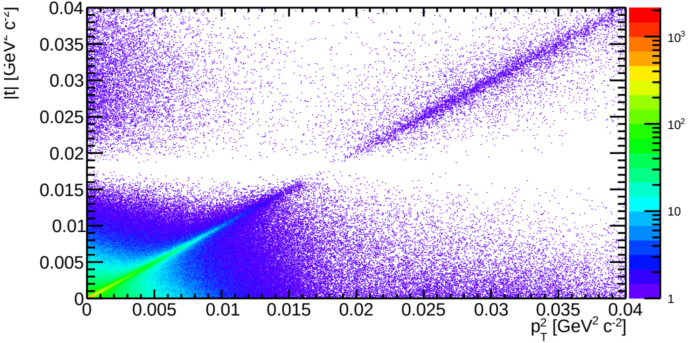
- Uncorrelated systematic uncertainty $= 6.9$ %.
- p_{T}^2-Integrated result: $\frac{\mathrm{d}\sigma^{\text{coh}}_{\mathrm{J}/\psi}}{\mathrm{d}y} = 4.21$ [mb].
- Compatible with result of inclusive analysis: $\frac{\mathrm{d}\sigma^{\text{coh}}_{\mathrm{J}/\psi}}{\mathrm{d}y} = 4.20 \pm 0.08(\text{stat}) \pm 0.04(\text{sys})$ [mb].
- STARlight p_{T}^2-Integrated result: $\frac{\mathrm{d}\sigma^{\text{coh}}_{\mathrm{J}/\psi}}{\mathrm{d}y} \approx 6.35$ [mb].

Work in progress - comparison to theory - potential paper figure



Work in progress - γ contribution correction

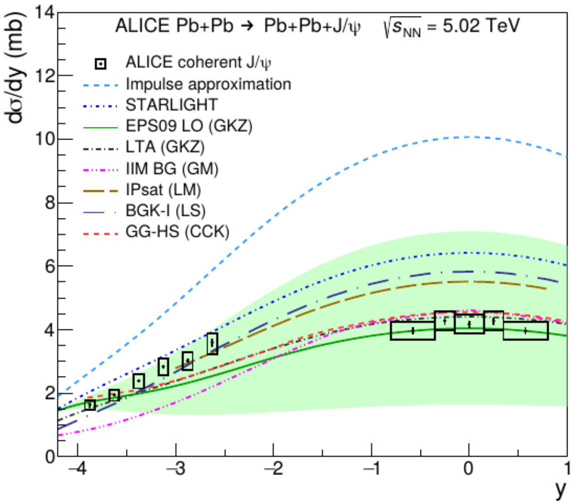
- We measure the dependency on p_{T}^2, but to compare with theory, we need $|t|$.
- γ effect on final state is not negligible and needs to be accounted for before model comparison.



- Correction can be done via unfolding using STARlight.
- Other possibility is to generate the p_{T}^2-dependent photon flux by itself.

back up

Inclusive analysis main result



Runlist LHC18q

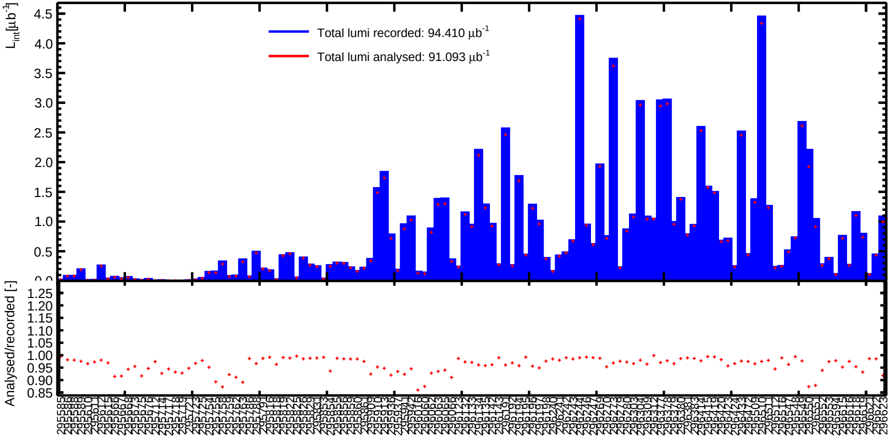
DPG selection for hadron analysis (excluding 296074 - missing CCUP31 - and 296375 and 296376 - AD set to cosmics), 123 runs:
296623, 296622, 296621, 296619, 296618, 296616, 296615, 296594, 296553, 296552, 296551, 296550, 296549, 296548, 296547, 296516, 296512, 296511, 296510, 296509, 296472, 296433, 296424, 296423, 296420, 296419, 296415, 296414, 296383, 296381, 296380, 296379, 296378, 296377, 296312, 296309, 296304, 296303, 296280, 296279, 296273, 296270, 296269, 296247, 296246, 296244, 296243, 296242, 296241, 296240, 296198, 296197, 296196, 296195, 296194, 296192, 296191, 296143, 296142, 296135, 296134, 296133, 296132, 296123, 296066, 296065, 296063, 296062, 296060, 296016, 295942, 295941, 295937, 295936, 295913, 295910, 295909, 295861, 295860, 295859, 295856, 295855, 295854, 295853, 295831, 295829, 295826, 295825, 295822, 295819, 295818, 295816, 295791, 295788, 295786, 295763, 295762, 295759, 295758, 295755, 295754, 295725, 295723, 295721, 295719, 295718, 295717, 295714, 295712, 295676, 295675, 295673, 295668, 295667, 295666, 295615, 295612, 295611, 295610, 295589, 295588, 295586, 295585.

Runlist LHC18r

DPG selection for hadron analysis (excluding 296752 - missing CCUP31), 96 runs:

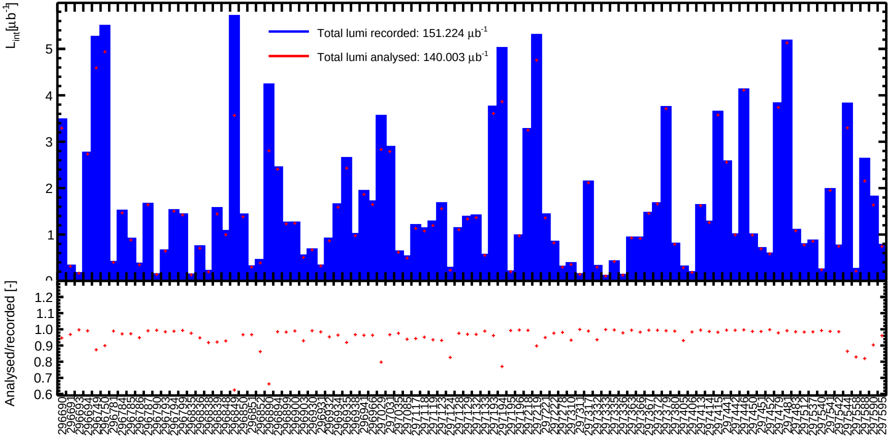
297595, 297590, 297588, 297558, 297544, 297542, 297541, 297540, 297537, 297512, 297483, 297481, 297479, 297452, 297451, 297450, 297446, 297442, 297441, 297415, 297414, 297413, 297406, 297405, 297380, 297379, 297372, 297367, 297366, 297363, 297336, 297335, 297333, 297332, 297317, 297311, 297310, 297278, 297222, 297221, 297219, 297218, 297196, 297195, 297194, 297193, 297133, 297132, 297129, 297128, 297124, 297123, 297119, 297118, 297117, 297085, 297035, 297031, 297029, 296966, 296941, 296938, 296935, 296934, 296932, 296931, 296930, 296903, 296900, 296899, 296894, 296890, 296852, 296851, 296850, 296849, 296848, 296839, 296838, 296836, 296835, 296799, 296794, 296793, 296790, 296787, 296786, 296785, 296784, 296781, 296750, 296749, 296694, 296693, 296691, 296690.

Luminosity Analysed/Recorded LHC18q



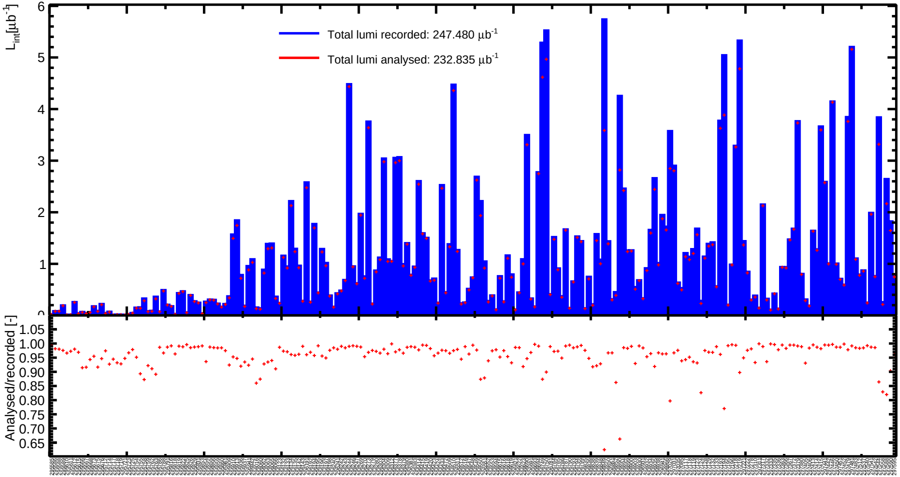
In total more than 96 % of available statistics.

Luminosity Analysed/Recorded LHC18r



In total more than 92 % of available statistics.

Luminosity Analysed/Recorded LHC18qr



In total more than 94 % of available statistics.

(AliESDtrackCuts::GetStandardITSTPCTrackCuts2011(kFALSE,1))

- Minimum number of TPC crossed rows is 70,
- minimum ratio of TPC crossed rows to findable clusters is 0.8,
- maximum TPC fit χ^2 per TPC cluster is 4,
- kink daughters rejected,
- TPC refit required,
- ITS refit required,
- SetClusterRequirementITS(AliESDtrackCuts::kSPD, AliESDtrackCuts::kAny),
- maximum DCA to vertex in XY plane according to:

$$\mathrm{DCA_{XY}} < \frac{0.0105 + 0.0350}{p_{\mathrm{T}}^{1.1}}, \tag{4}$$

- maximum DCA to vertex in Z is 2 cm,
- if σ from track-to-vertex could not be calculated, track is not rejected,
- maximum χ^2 of TPC track constrained with vertex versus global track is 36,
- maximum ITS fit χ^2 per ITS cluster is 36.

In addition, each track has at least 1 hit in inner and outer layer of ITS detector. This is ensured by requirement

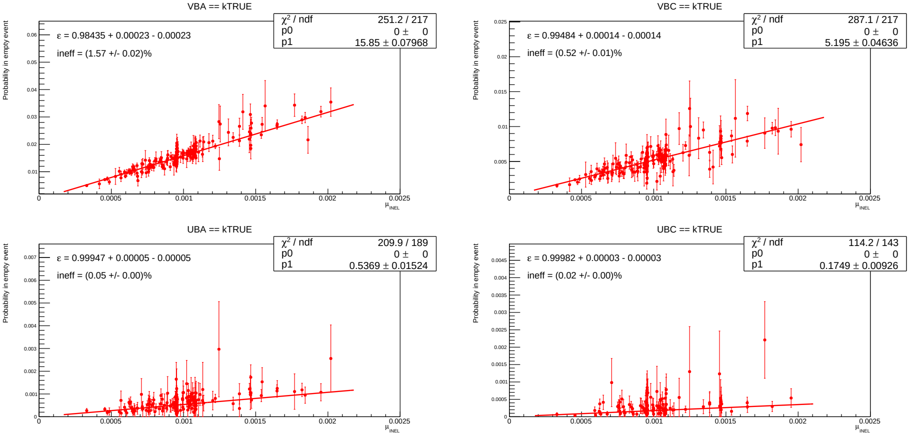
- (AliESDtrack::HasPointOnITSLayer(0) && AliESDtrack::HasPointOnITSLayer(1)).

Application of selection criteria: $J/\psi \rightarrow \mu\mu$

Total no. of events	2441424
DPG official run list	2441424
CUP31 trigger	2204763
SPD cluster matches FOhits	791510
Muon PID$_{TPC}(\sigma^2_{\text{trk1}} + \sigma^2_{\text{trk2}})$ < Electron PID$_{TPC}(\sigma^2_{\text{trk1}} + \sigma^2_{\text{trk2}})$	694970
Mass $\in$ (2.5,4.5) [GeV/c^2]	19357
ADA offline veto	19301
ADC offline veto	19270
V0A offline veto	17179
V0C offline veto	15854
Rapidity $\in$ (-0.8,0.8)	15662
Track $\eta \in$ (-0.8,0.8)	12826
Tracks have opposite charge	11909
$p_{\mathrm{T}}^{\text{dimuon}} < 0.11$ [GeV/c]	8447
Mass $\in$ (3.0,3.2) [GeV/c^2]	3605
No. of selected events for invariant mass fit	8447

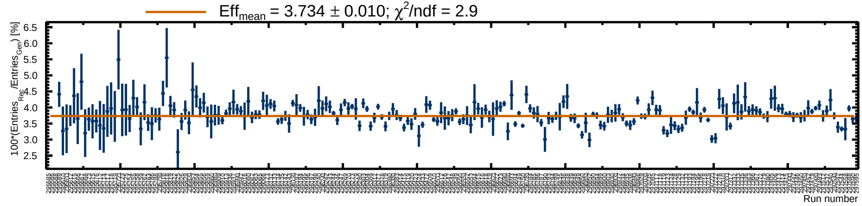
- Abandoned cuts: Muon PID$_{TPC}(\sigma^2_{\text{trk1}} + \sigma^2_{\text{trk2}}) < 9$, max($p_{\mathrm{T}}^{\text{trk1}}$,$p_{\mathrm{T}}^{\text{trk2}}$)$>$ 1 [GeV/c]
- Replaced cut: No ITS standalone track $\rightarrow$ SPD cluster matches FOhits

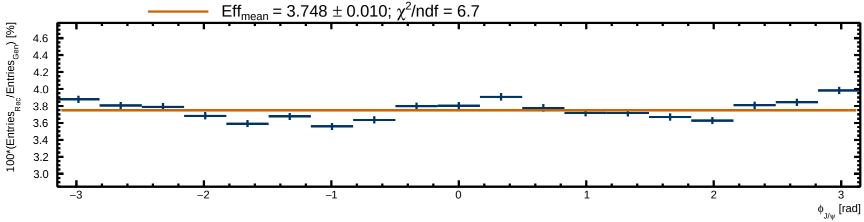
VETO inefficiencies



Online decisions

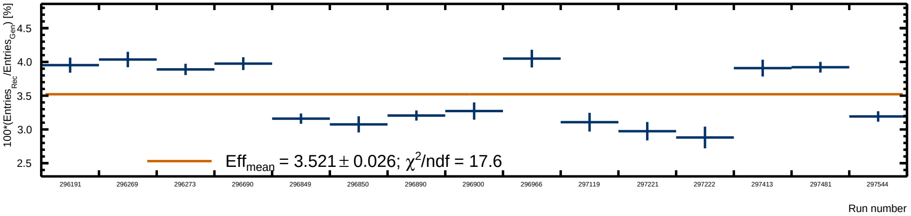
Acceptance X efficiency - mean over all runs

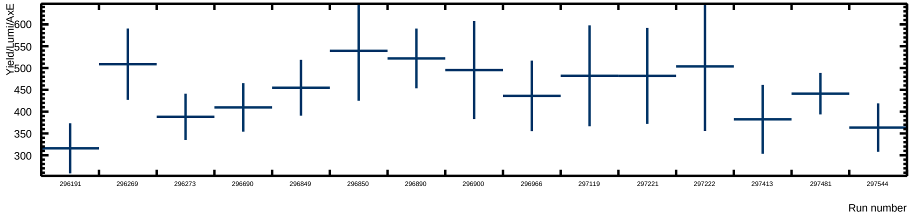




- Reconstructed particles after cuts divided by generated particles after y/p_{T} cut
- Compatible with precedent analysis (3.72%).
- ϕ-modulation investigated and described in MC.

Acceptance X efficiency - outliers





- Yield/lumi/axe ratio investigated with data.
- Looks reasonable.

EMD inefficiencies - CTRUE trigger analysis

- Electromagnetic dissociation (EMD) is another unwanted process. Occurs when one or more photons excite one or both interacting nuclei.
- Upon de-excitation one or more neutrons are emitted. Sometimes, other charged particles are emitted as well.
- These particles can yield fake signal in V0 and AD, and cause a migration across forward-neutron classes due to inefficiencies and pile-up in the neutron ZDC.
- The efficiency calculation is further discussed in inclusive paper Analysis Note and set to $\epsilon^{\text{EMD}} = 0.92$.

Feed down coherent $\Psi(2S)$ contributions (there are two)

- $\psi(2\mathrm{S}) \to \mathrm{J}/\psi + \pi^{+}\pi^{-}$ and $\psi(2\mathrm{S}) \to \mathrm{J}/\psi +$ *neutrals*.
- General formula:

$$f_{\mathrm{D}} = \frac{\sigma_{\psi(2\mathrm{S})}}{\sigma_{\mathrm{J}/\psi}} \cdot \frac{(\mathrm{Acc} \times \epsilon)_{\psi(2\mathrm{S}) \to \mathrm{J}/\psi}}{(\mathrm{Acc} \times \epsilon)_{\mathrm{J}/\psi}} \cdot \mathrm{BR}(\psi(2\mathrm{S}) \to \mathrm{J}/\psi + \mathrm{pions}). \tag{5}$$

- Cross section ratio calculated from data (details in backup).
- f_{D} for each $p_{\mathrm{T}}^{\mu\mu}$-bin scaled from the general formula using MC.
- Details in Analysis Note.

Feed down coherent $\Psi(2S)$ contributions (there are two)

- General formula:

$$f_{\mathrm{D}} = \frac{\sigma_{\psi(2S)}}{\sigma_{J/\psi}} \cdot \frac{(\mathrm{Acc} \times \epsilon)_{\psi(2S)\to J/\psi}}{(\mathrm{Acc} \times \epsilon)_{J/\psi}} \cdot \mathrm{BR}(\psi(2S) \to J/\psi + \text{pions}). \tag{6}$$

- Cross section ratio term:

$$\frac{\sigma_{\psi(2S)}}{\sigma_{J/\psi}} = \frac{R_{\mathrm{N}} \cdot (\mathrm{Acc} \times \epsilon)_{J/\psi\to\mu^+\mu^-} \cdot \mathrm{BR}(J/\psi \to \mu^+\mu^-)}{(\mathrm{Acc} \times \epsilon)_{\psi(2S)\to\mu^+\mu^-} \cdot \mathrm{BR}(\psi(2S) \to \mu^+\mu^-) - R_{\mathrm{N}} \cdot (\mathrm{Acc} \times \epsilon)_{\psi(2S)\to J/\psi} \cdot \mathrm{BR}(\psi(2S) \to J/\psi) \cdot \mathrm{BR}(J/\psi \to \mu^+\mu^-)}. \tag{7}$$

- R_{N} - Data-driven input:

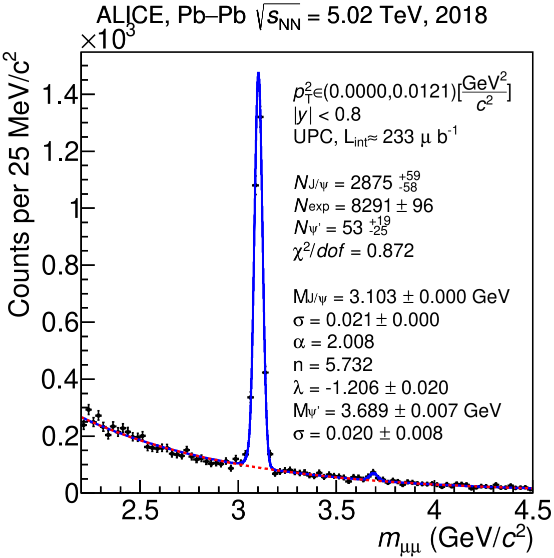
$$R_{\mathrm{N}} = \frac{N_{\psi(2S)\to\mu^+\mu^-}}{N_{J/\psi\to\mu^+\mu^-} + N_{\psi(2S)\to J/\psi\to\mu^+\mu^-}}. \tag{8}$$

- Bin-dependent variant:

$$^{\mathrm{ibin}}f_{\mathrm{D}} = \frac{\sigma_{\psi(2S)} \cdot {}_{\mathrm{gen}}N_{J/\psi}}{\sigma_{J/\psi} \cdot {}_{\mathrm{gen}}N_{\psi(2S)}} \cdot \frac{^{\mathrm{ibin}}_{\mathrm{rec}}N_{\psi(2S)}}{^{\mathrm{ibin}}_{\mathrm{rec}}N_{J/\psi}} \cdot \mathrm{BR}(\psi(2S) \to J/\psi + \text{pions}). \tag{9}$$

- Details in ANA-1083.

Invariant mass fit - full p_T^2 range



- Extended likelihood fit of unbinned data.
- Fitting model consists of two Crystal Ball function (CB) and one exponential.
- One CB describes J/ψ peaks, second CB describes $\Psi(2S)$ peak.
- CB parameters α and n fixed from MC fits.
- Exponential describes background - parameters left free.

Crystal-Ball function

$$\mathrm{CB}(m) = \begin{cases} \exp\left[-(\bar{m}-m)^2/(2\sigma_m)^2\right] & , \; m \geq m_1 \\ A\left[\sigma_m/(m'-m)\right]^n & , \; m < m_1, \end{cases}$$

parameters m_1, A a m' have continuity conditions:

$$\begin{aligned} m_1 &= \bar{m} - \alpha\sigma_m \\ A &= (n/\alpha)^n \cdot \exp\left(-\alpha^2/2\right) \\ m' &= \bar{m} + \sigma_m\left(n/\alpha - \alpha\right). \end{aligned}$$

Sources of systematic errors - uncorrelated

p_{T}^2 interval [GeV$^2/c^2$]	uncertainty [%]
(0; 0.00072)	2.2
(0.00072; 0.0016)	0.9
(0.0016; 0.0026)	0.7
(0.0026; 0.004)	1.2
(0.004; 0.0062)	1.2
(0.0062; 0.012)	0.8

Table: Systematic uncertainties of invariant mass fit for each p_{T}^2 interval.

p_{T}^2 interval [GeV$^2/c^2$]	uncertainty [%]
(0; 0.00072)	0.1
(0.00072; 0.0016)	0.1
(0.0016; 0.0026)	0.2
(0.0026; 0.004)	0.3
(0.004; 0.0062)	0.4
(0.0062; 0.012)	0.5

Table: Systematic uncertainties of feed down correction f_{D} for each p_{T}^2 interval.

p_{T}^2 interval [GeV$^2/c^2$]	fit uncertainty [%]	coherent template diff. [%]	total sys. uncertainty
(0; 0.00072)	1.0	0.2	1.1
(0.00072; 0.0016)	1.2	0.2	1.3
(0.0016; 0.0026)	1.2	0.3	1.3
(0.0026; 0.004)	1.3	0.3	1.4
(0.004; 0.0062)	1.4	0.2	1.5
(0.0062; 0.012)	1.8	1.5	2.3

Table: Uncertainty of p_{T} fit and relative difference of cross sections for each p_{T}^2 interval.

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Sources of systematic errors - correlated

p_t^2 interval [GeV^2/c^2]	relative error [%]
(0; 0.000724)	1.75
(0.000724; 0.001577)	2.12
(0.001577; 0.002623)	2.29
(0.002623; 0.004011)	2.50
(0.004011; 0.006151)	2.43
(0.006151; 0.0121)	2.14

Table: Systematic errors of unfolding for each p_T^2 interval.

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