Heavy Flavor Results from ALICE

Zaida Conesa del Valle (CERN & IPHC/CNRS-IN2P3)
for the ALICE Collaboration

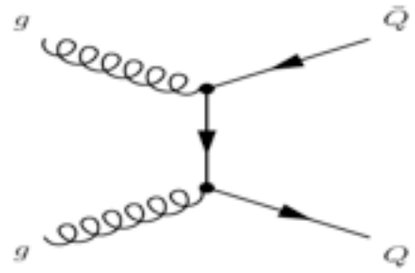
ALICE

QM12 Quark Matter

Outline

- Introduction
- Overview of heavy flavor measurements in ALICE
- Results in proton-proton and lead-lead collisions
  - Cross sections in pp collisions
  - **Nuclear modification factor: electrons**, muons, **D^0, D^+, D^{*+}, D_s^+**
  - ***Azimuthal anisotropy:***
    - **v_2 in semi-central collisions: electrons,** D^0, D^+, D^{*+}
    - **D^0 v_2 vs. centrality and R_{AA} vs Event Plane**
- Summary

Why measuring Heavy Flavor ?



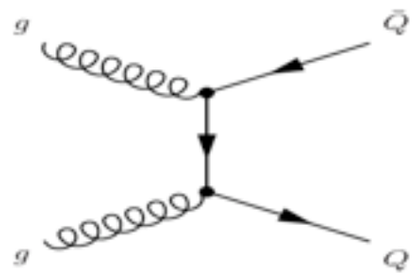
[Dokshitzer and Kharzeev, PLB 519 (2001) 199. Armesto, Salgado, Wiedemann, PRD 69 (2004) 114003. Djordjevic, Gyulassy, Horowitz, Wicks, NPA 783 (2007) 493...]

Why measuring Heavy Flavor ?

Why charm and beauty ?

- Production in hard partonic collisions ⇨ ⇨ pp data
  - Production time $\tau_p \sim 1/m_Q \sim 0.05 - 0.15$ fm/c

    ⇨ **Tool to test pQCD calculations**



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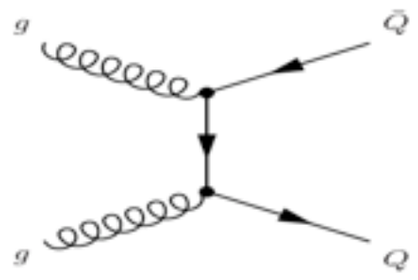

- Nuclear environment influence: p-A collisions ⇨ ⇨ p-Pb data coming in Jan. 2013
  - Shadowing (PDF modifications in nuclei) and Gluon saturation

    ⇨ **Tool to study high density small-x gluons**

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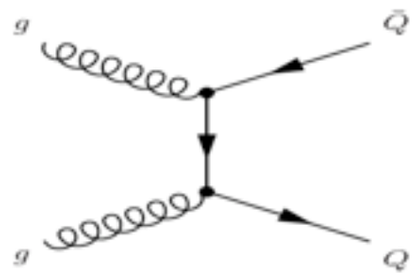

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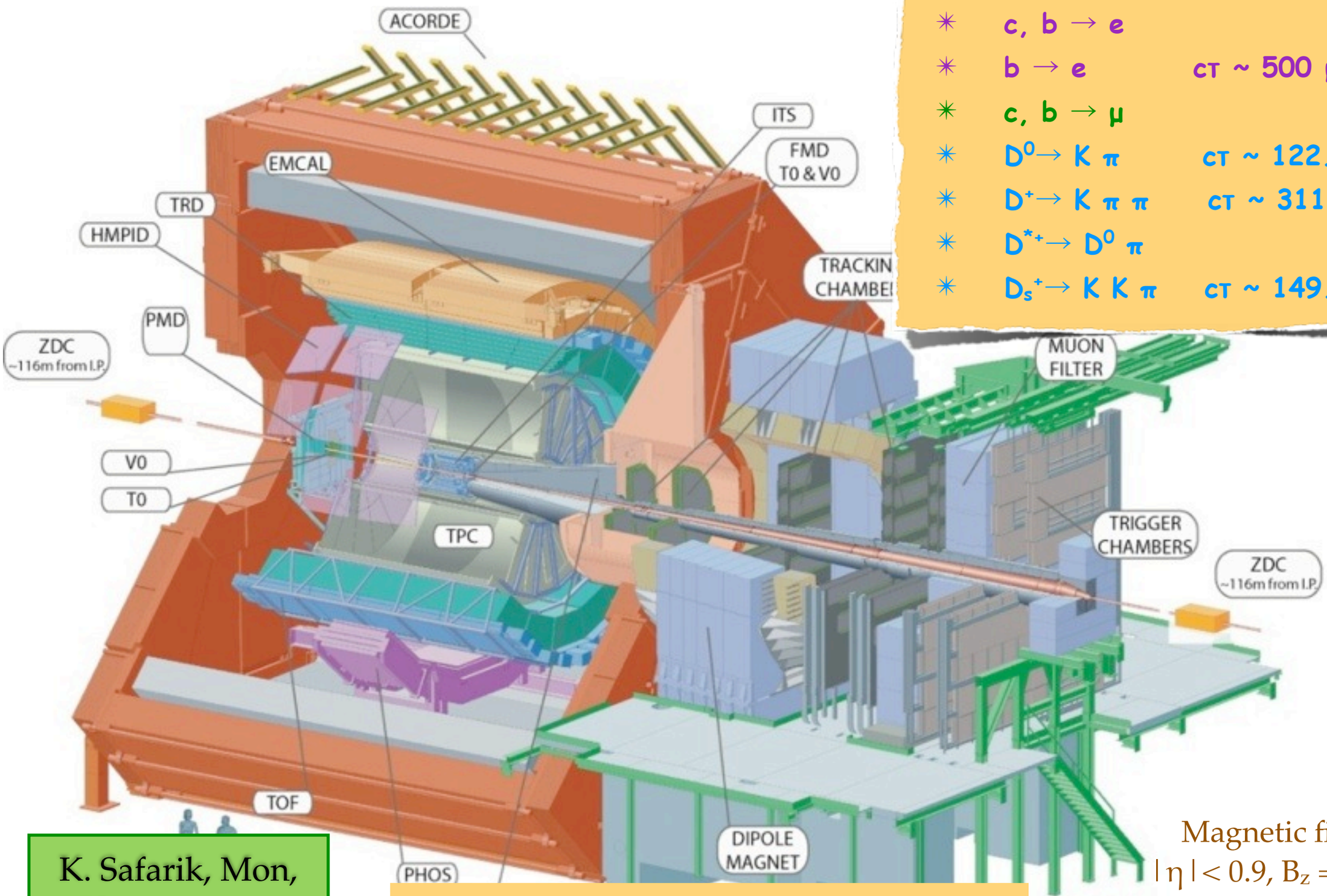
- Effects in a QGP: A-B collisions ⇨ ⇨ Pb-Pb data in 2010 + 2011
  - Thermalisation in the QGP (low p_T)
    - Medium transport properties ⇨ dN/dp_T, R_{AA}, v_2
  - Energy loss in the QGP (high p_T)
    - Medium density and size ⇨ dN/dp_T, R_{AA}, v_2
    - Color charge (Casimir factor) : $\Delta E_{u,d,s} < \Delta E_g$ ⇨ compare to light hadrons
    - Parton mass (dead cone effect) : $\Delta E_b < \Delta E_c < \ldots$ ⇨ compare c and b production
      - ⇨ **Probe of the QCD medium**

W. Horowitz, Tu, Plenary, 12:30

[Dokshitzer and Kharzeev, PLB 519 (2001) 199. Armesto, Salgado, Wiedemann, PRD 69 (2004) 114003. Djordjevic, Gyulassy, Horowitz, Wicks, NPA 783 (2007) 493...]

ALICE & Heavy Flavor

- ✳ c, b → e
- ✳ b → e cτ ~ 500 μm
- ✳ c, b → μ
- ✳ $D^0 \rightarrow K\,\pi$ cτ ~ 122.9 μm
- ✳ $D^+ \rightarrow K\,\pi\,\pi$ cτ ~ 311.8 μm
- ✳ $D^{*+} \rightarrow D^0\,\pi$
- ✳ $D_s^+ \rightarrow K\,K\,\pi$ cτ ~ 149.9 μm



K. Safarik, Mon, Plenary, 11:35

VZERO: trigger, centrality determination

Magnetic field
$|\eta| < 0.9$, $B_z = 0.5$ T
$-4.0 < \eta < -2.5$, $B_y \leq 0.7$ T

ALICE & Heavy Flavor

HF electrons, $|\eta|<0.8$

TOF: e PID

TPC: tracking, e PID

EMCAL: e PID, trigger

TRD: e PID

ITS: vertexing, tracking

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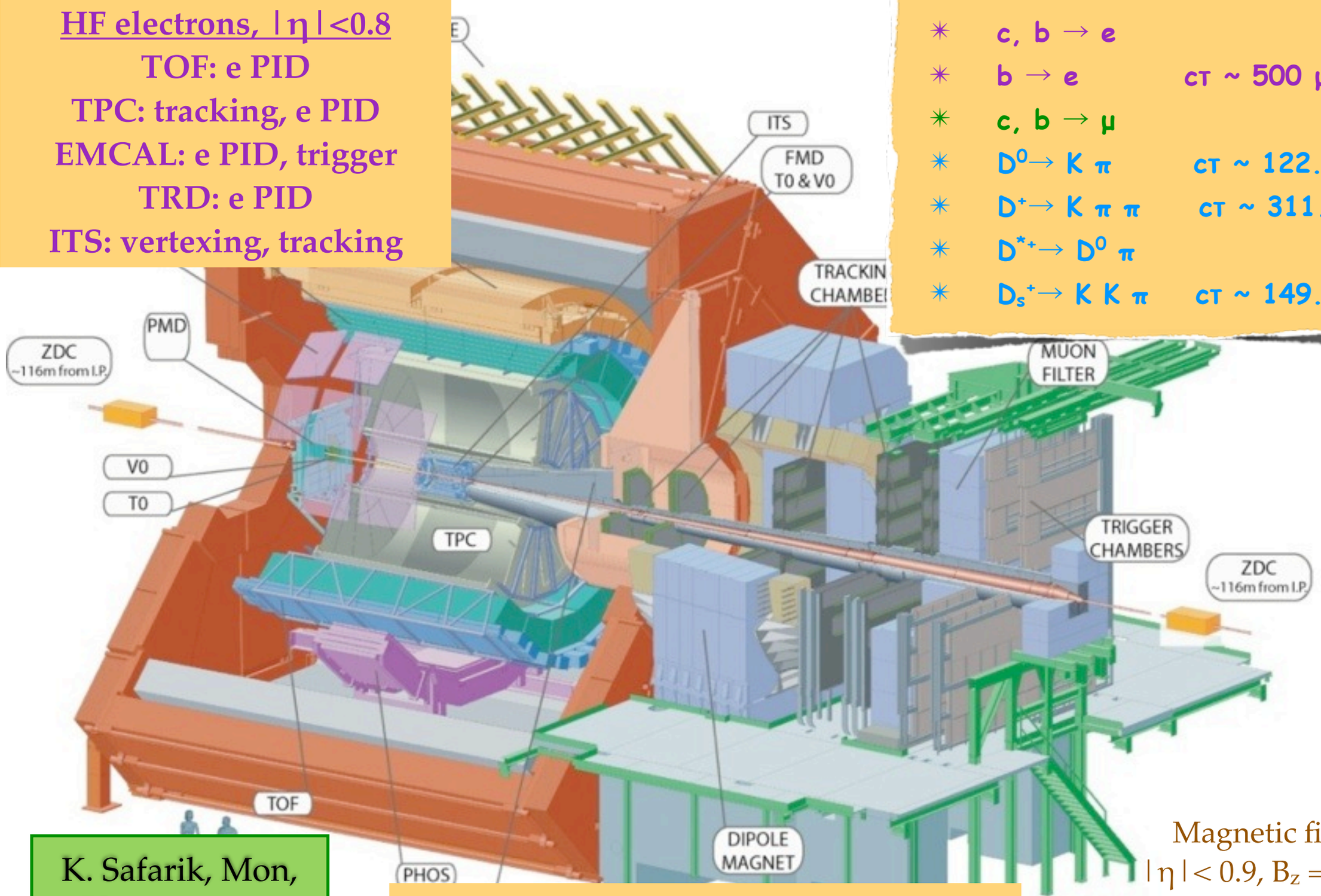

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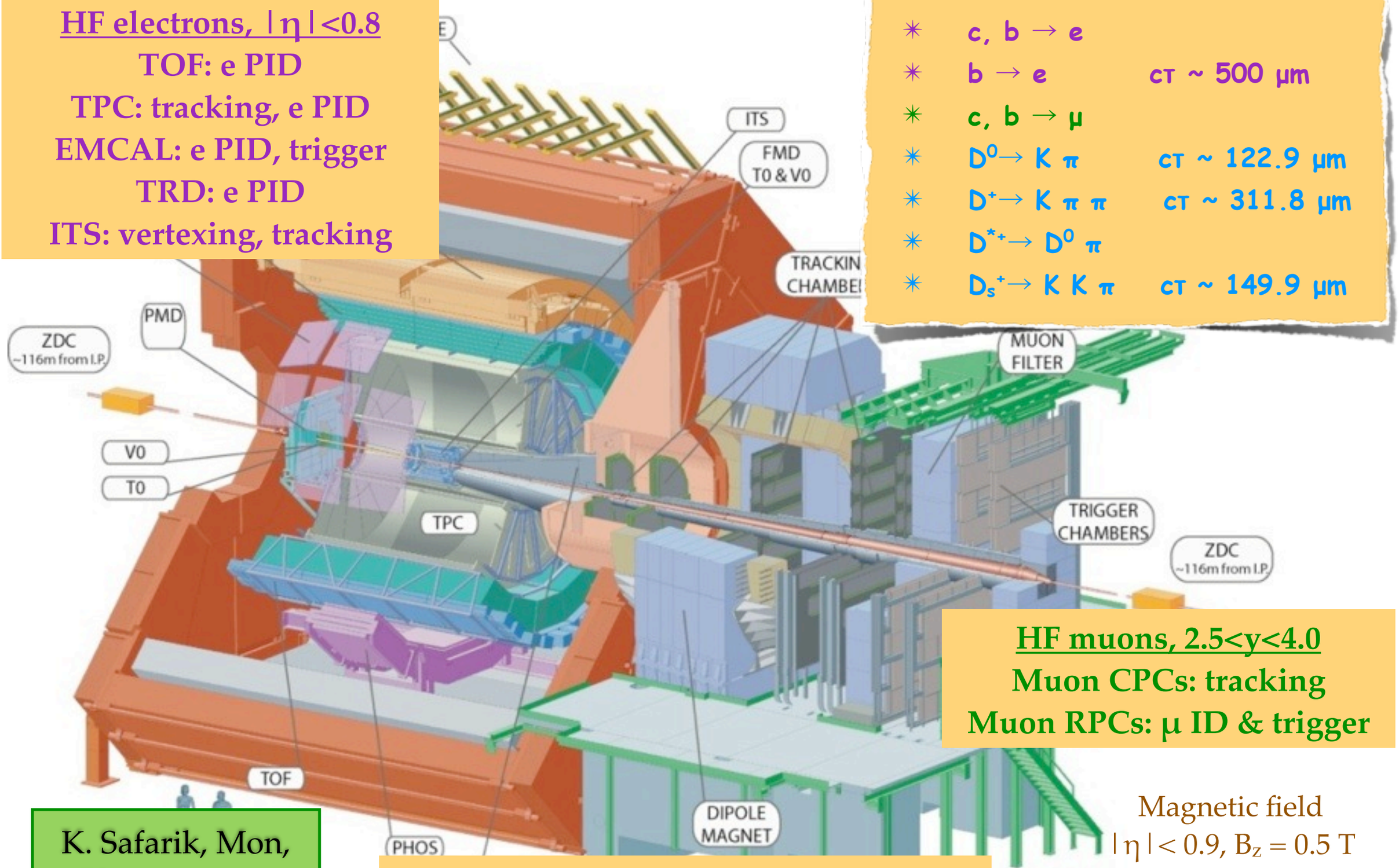

HF muons, $2.5<y<4.0$
Muon CPCs: tracking
Muon RPCs: μ ID & trigger

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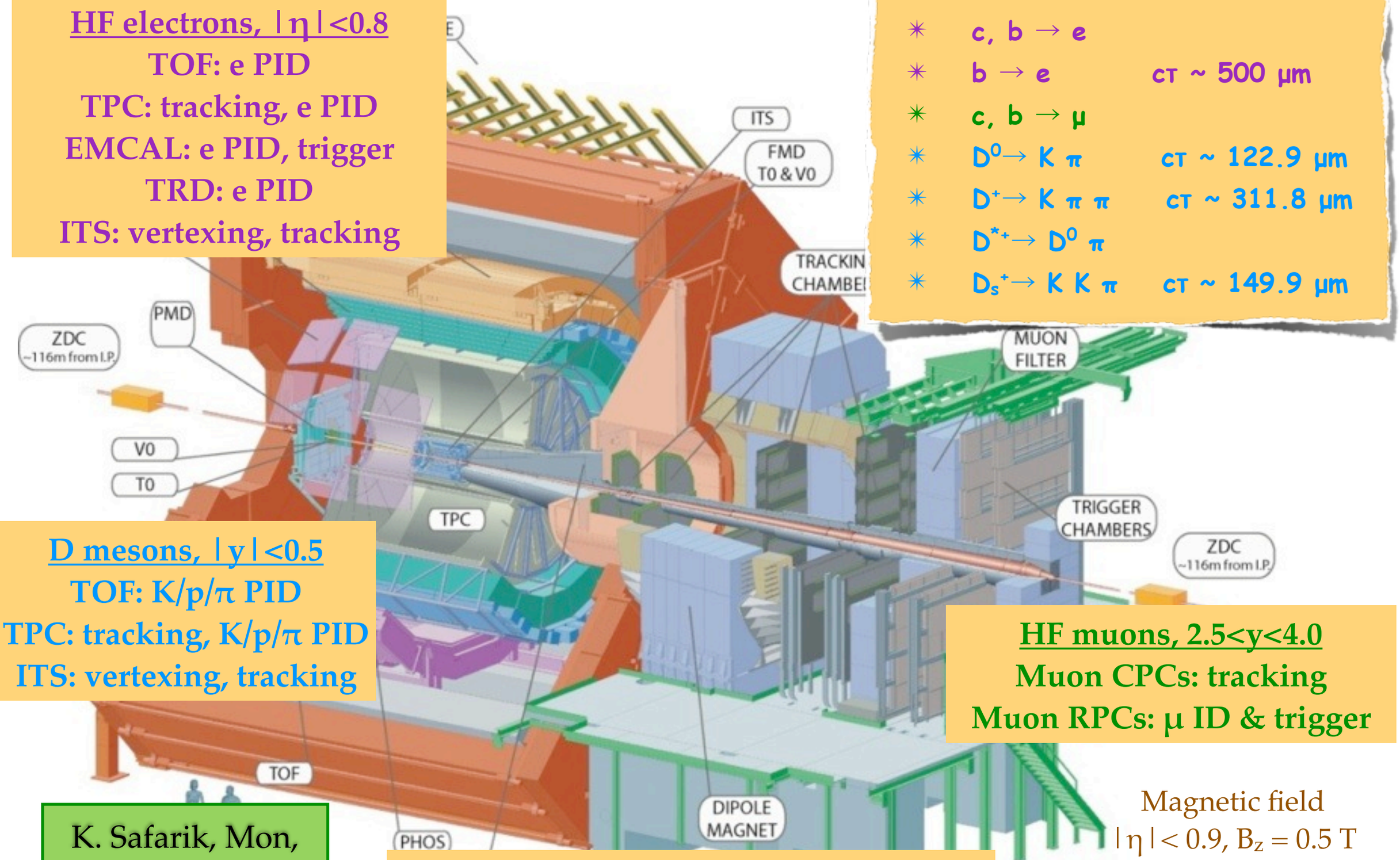

D mesons, $|y|<0.5$
TOF: K/p/π PID
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$-4.0 < \eta < -2.5$, $B_y \leq 0.7$ T

Heavy Flavor Measurements

LHC Run	Data sample	HF electrons	Beauty electrons	HF muons	D^0 / D^+ / D^{*+}	D_s^+
2010	pp, 7 TeV	2.6 nb^{-1} (MB trig) **arXiv: 1205.5423**	2.2 nb^{-1} (MB trig) **arXiv:1208.1902**	16.5 nb^{-1} (Muon trig) **PLB 708 (2012) 265**	5 nb^{-1} (MB trig) **JHEP 01 (2012) 128**	5 nb^{-1} **arXiv:1208.1948**
2010	PbPb, 2.76 TeV	2.0 μb^{-1} (0-80%) MB trig.		2.7 μb^{-1} (Muon trig) **arXiv:1205.6443**	2.12 μb^{-1} (0-80%) **arXiv: 1203.2160**	–
2011	pp, 2.76 TeV	0.5 (11.9) nb^{-1} of MB(EmCal) trig	0.5 (11.9) nb^{-1} of MB(EmCal) trig	19 nb^{-1} (Muon trig) **arXiv:1205.6443**	1.1 nb^{-1} (MB trig) **JHEP 07 (2012) 191**	–
2011	PbPb, 2.76 TeV	22 (37) μb^{-1} in 0-10% 6 (34) μb^{-1} in 20-40% MB (EMCAL) trig.			28 μb^{-1} (0-7.5%) 6 μb^{-1} (15-50%)	28 μb^{-1} (0-7.5%)

- **List of HF talks:**
  - D. Caffarri: D mesons v_2
  - A. Grelli: D mesons R_{AA}
  - G.M. Innocenti : D_s^+ meson in pp and Pb-Pb
  - S. Sakai : HF electron R_{AA} and v_2
  - X. Zhang: HF muon R_{AA}
- List of HF posters:
  - T. Aronsson : B electron vertexing in pp
  - S. Bjelogrlic : D^{*+}-hadron correlations
  - D.A.M. De Godoy : HF electron v_2 at high p_T
  - B.R. Hicks : HF electrons in pp at 2.76 TeV
  - M. Kweon : Beauty electrons
  - G. Luparello : D^{*+} meson v_2
  - T. Rascanu : HF electron v_2 background
  - R. Russo : D^+ meson in pp and Pb-Pb
  - T.S. Sinha : J/ψ and HF muon vs multiplicity in pp
  - D. Thomas : HF electron-hadron correlations

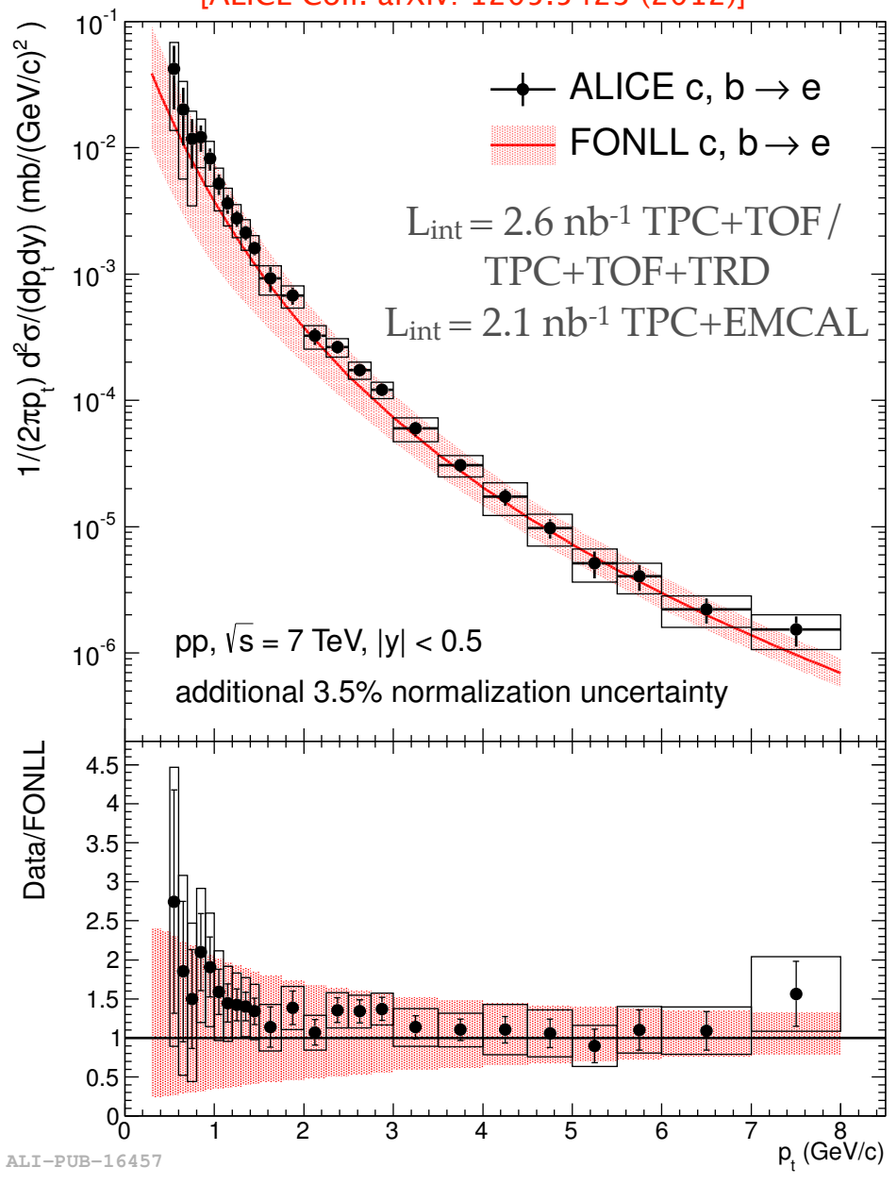
Proton-proton Results

$\sqrt{s} = 7$ TeV & $\sqrt{s} = 2.76$ TeV

HF decay Leptons (e,μ), pp √s=7 TeV

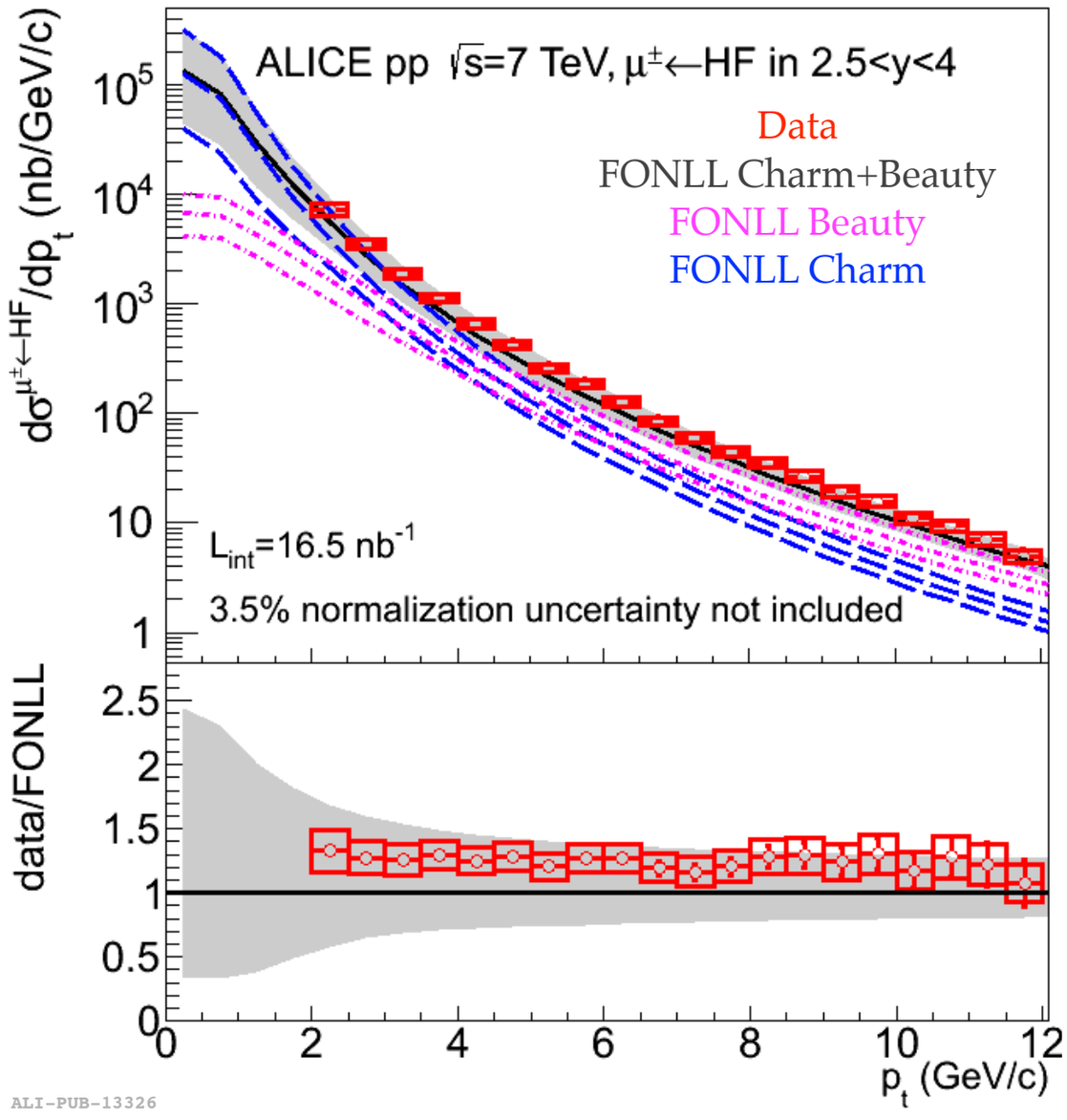
HF electrons, |y|<0.5

[ALICE Coll. arXiv: 1205.5423 (2012)]



HF muons, 2.5<y<4.0

[ALICE Coll. PLB708 (2012) 265]



➡ **HF decay lepton differential cross sections are well described by pQCD calculations (FONLL)**

[Cacciari et al arXiv:1205.6344 (2012)]

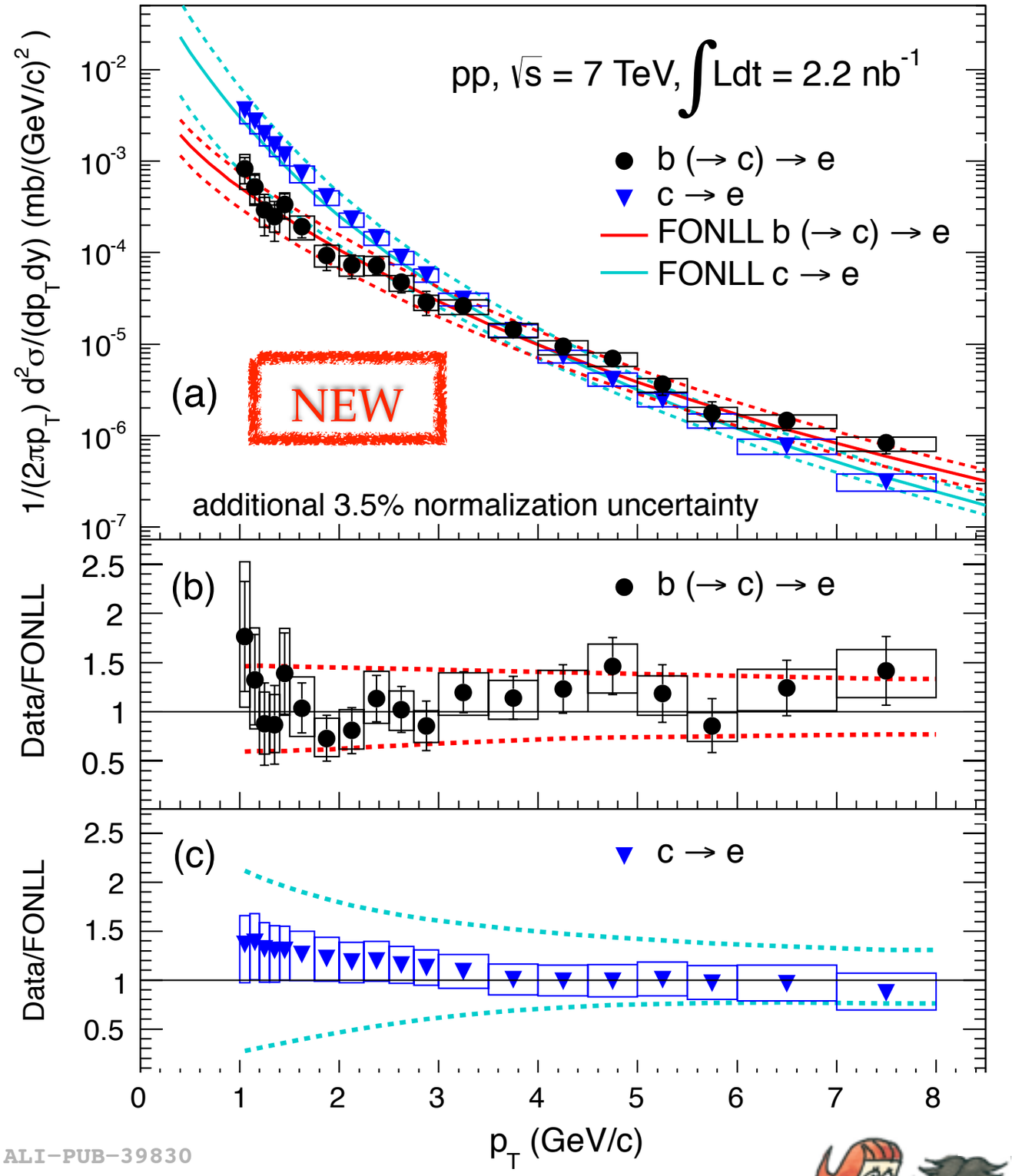
Beauty decay electrons, pp $\sqrt{s}$=7 TeV

[ALICE Coll. arXiv:1208.1902 (2012)]

- Measurement of $B \longrightarrow e^{\pm}$, $|y|<0.5$
  - B hadrons $c\tau \sim 500\mu m$
    ⇨ Impact parameter cut (d_0)
    e.g. $|d_0| > 250$ μm for $p_T \sim 2.5$ GeV/c
  - Subtraction of remaining background electrons with a cocktail.

➡ **Total beauty cross section**

➡ **Evaluation of the $c \rightarrow e^{\pm}$ cross section by subtraction from the inclusive heavy flavor electrons**



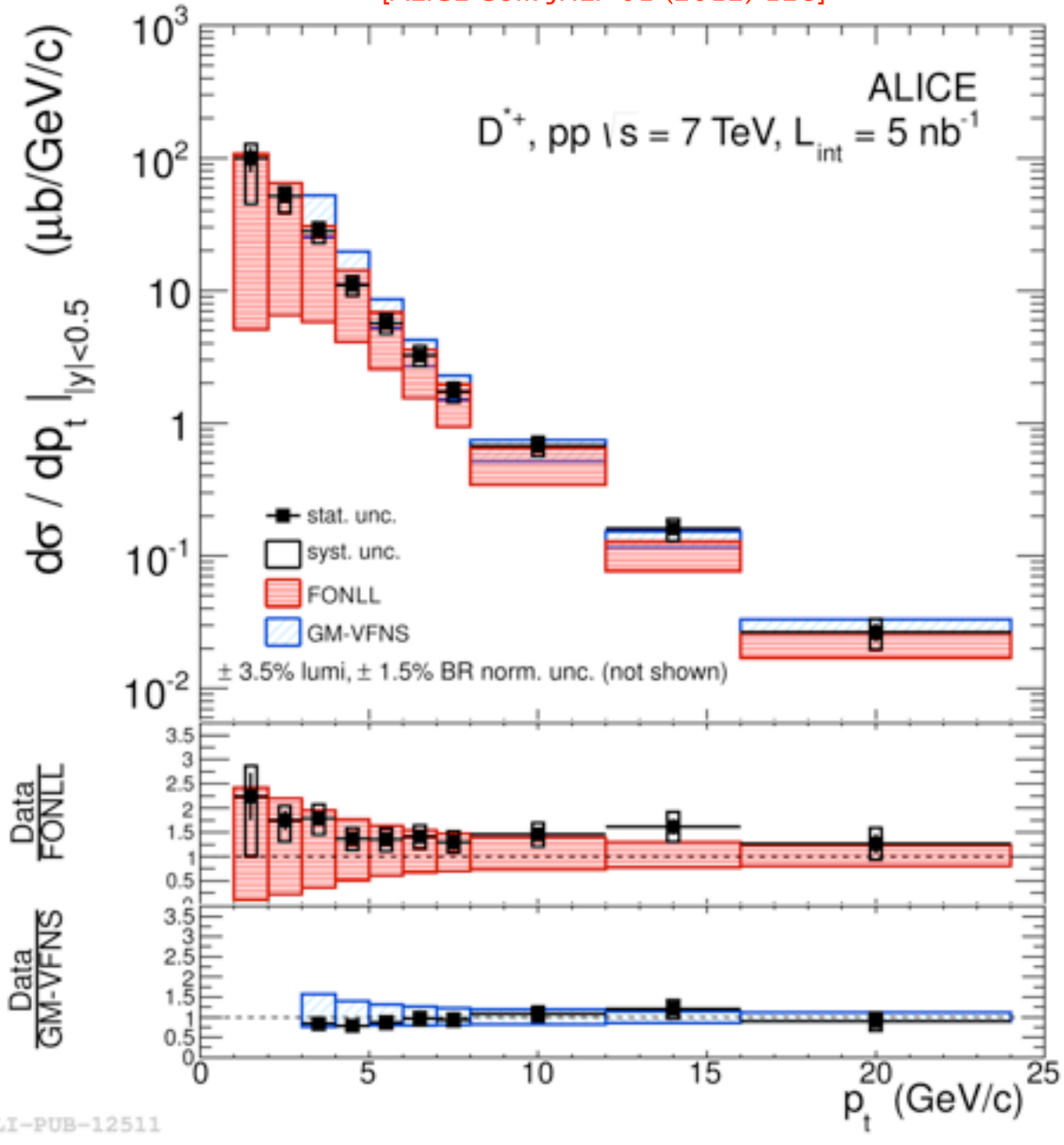
[Cacciari et al arXiv:1205.6344 (2012)]

ALI-PUB-39830

D mesons, pp $\sqrt{s}$=7 TeV

- p_T-differential cross sections of D^0, D^+, D^{*+} measured in the $1 < p_T < 24$ GeV/c range

[ALICE Coll. JHEP 01 (2012) 128]



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[Kniehl et al, arXiv:1202.0439]

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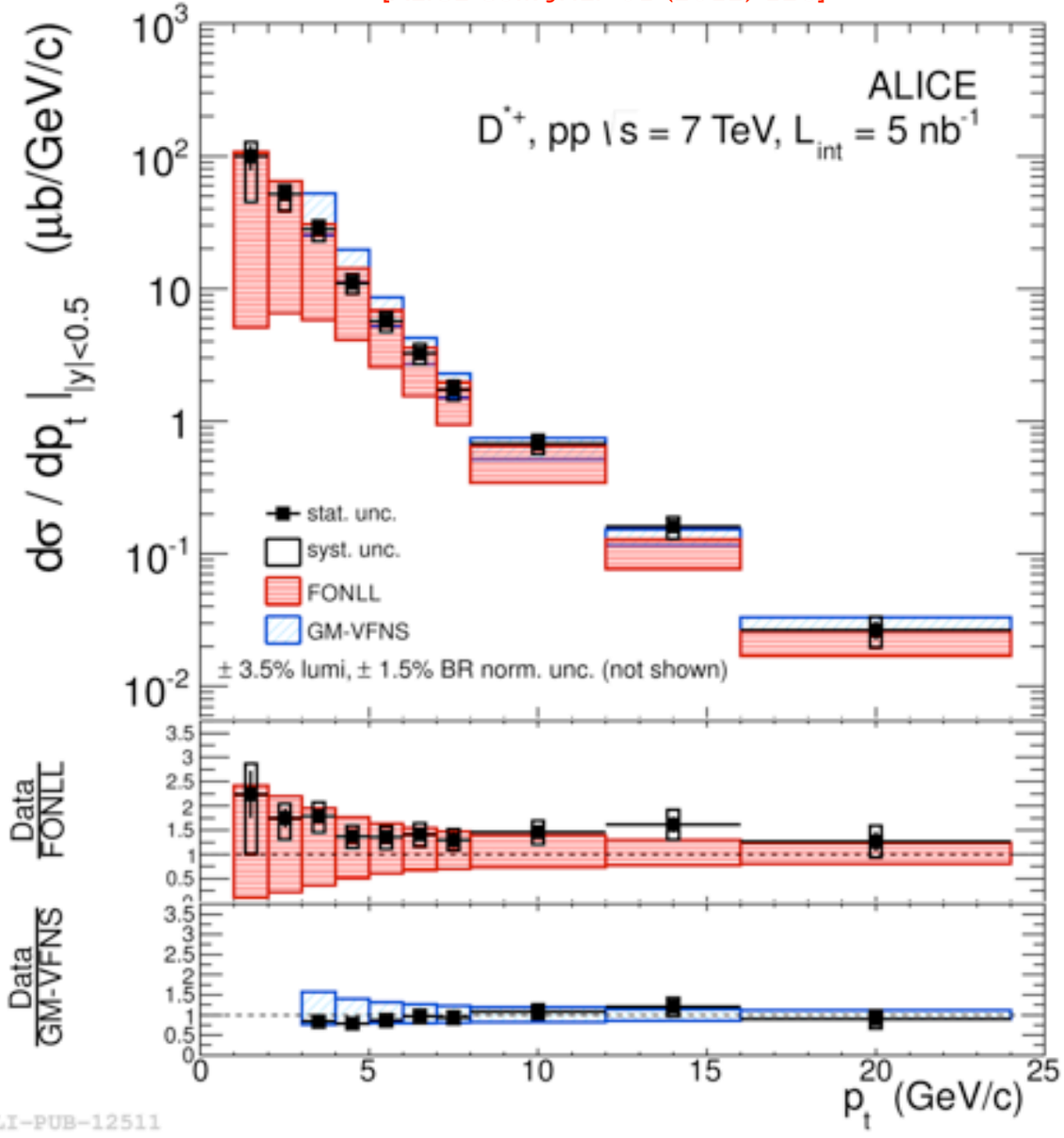

- p_T-differential cross section of D_s^+ now measured in $2 < p_T < 12$ GeV/c

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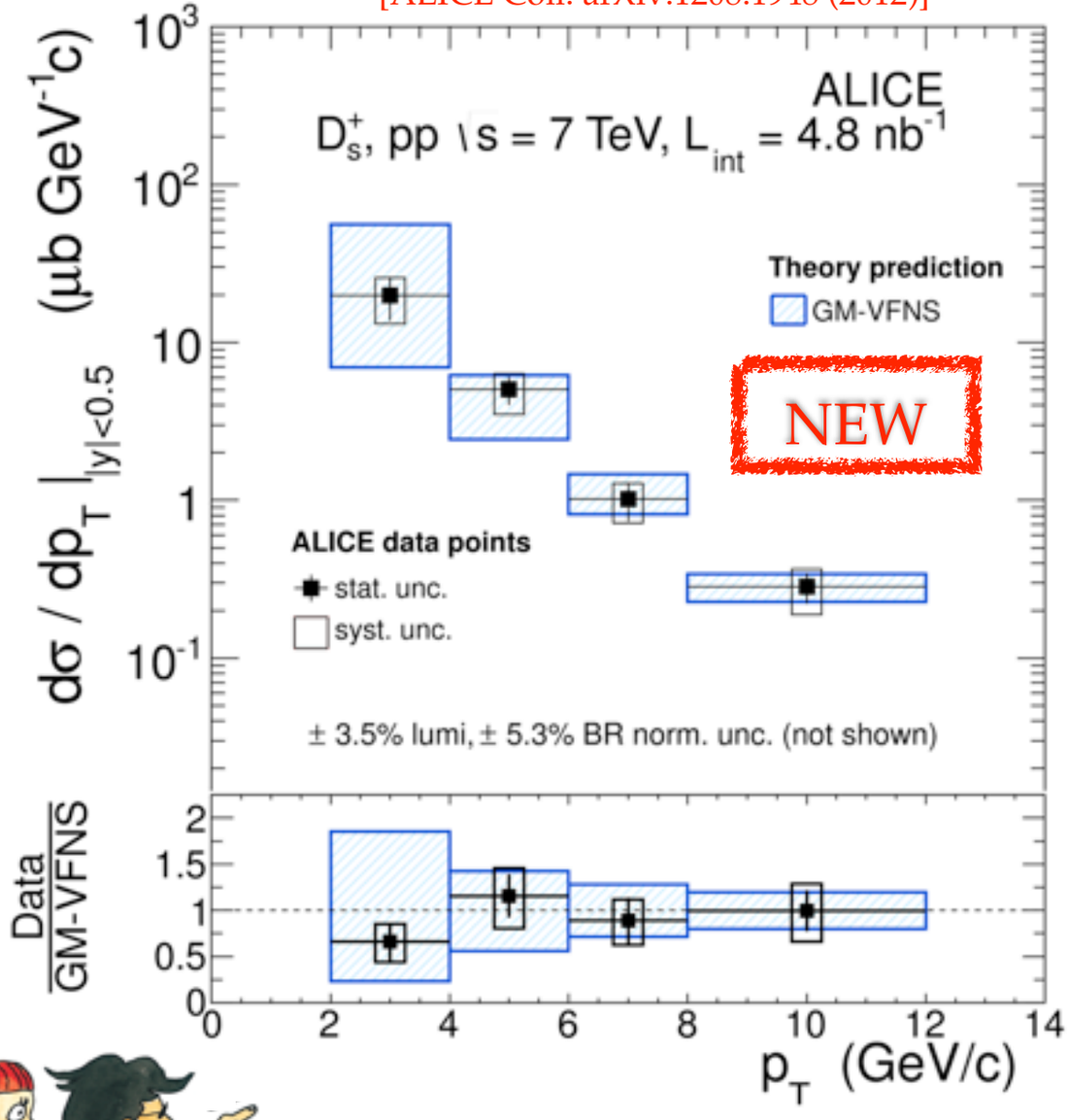

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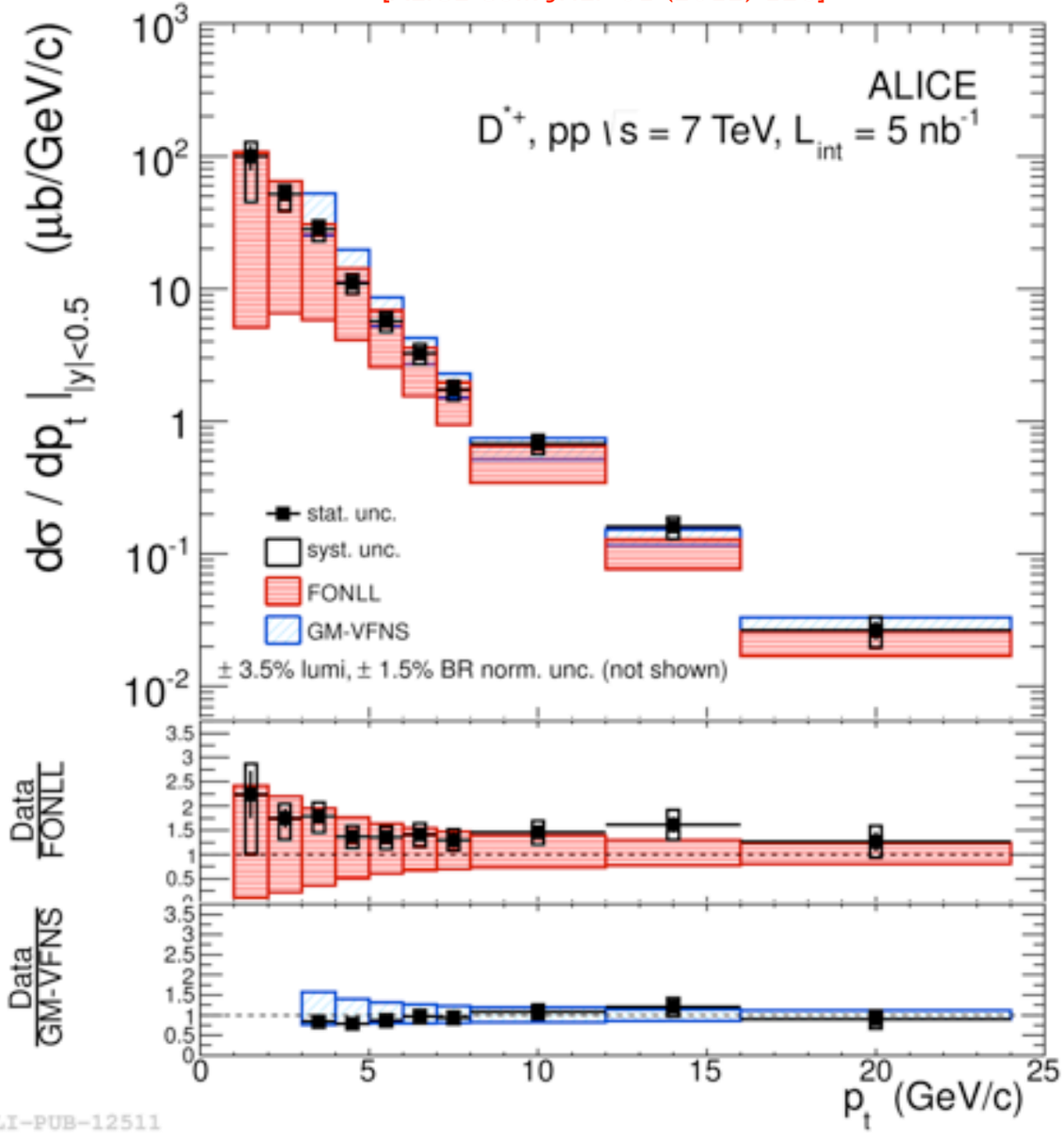

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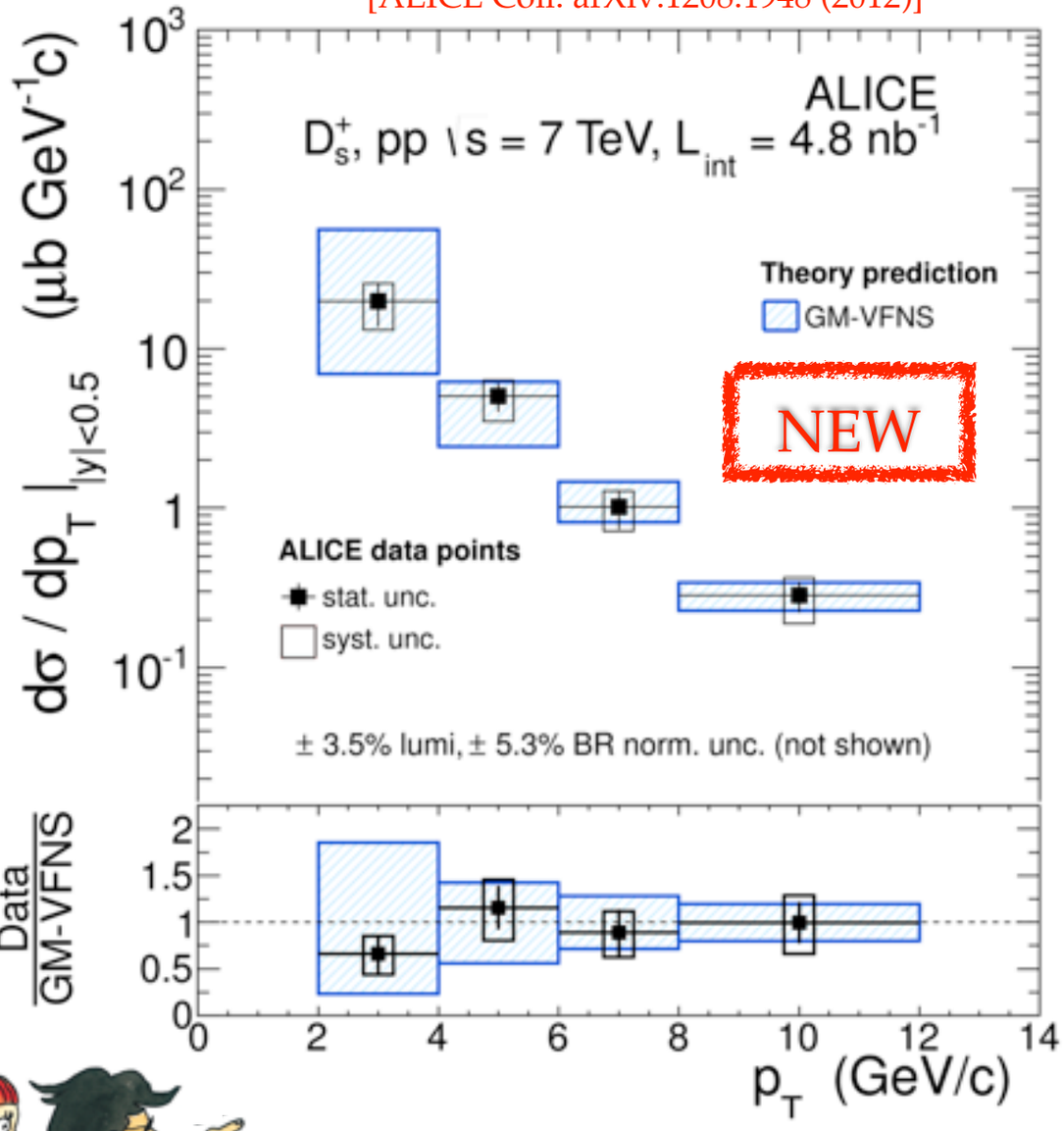

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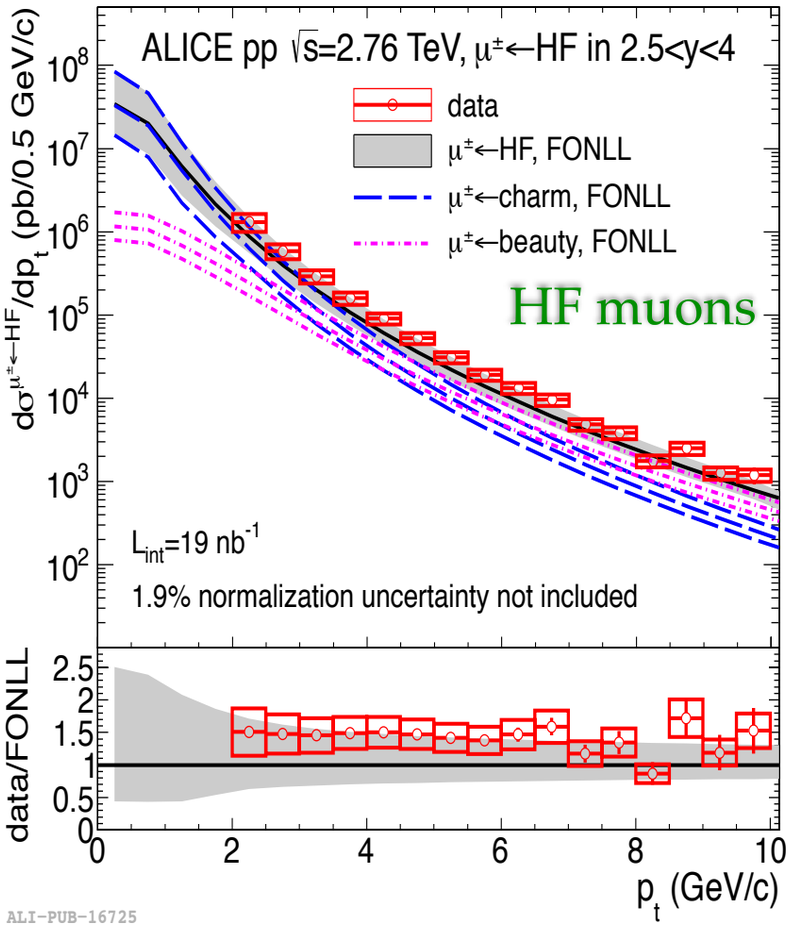
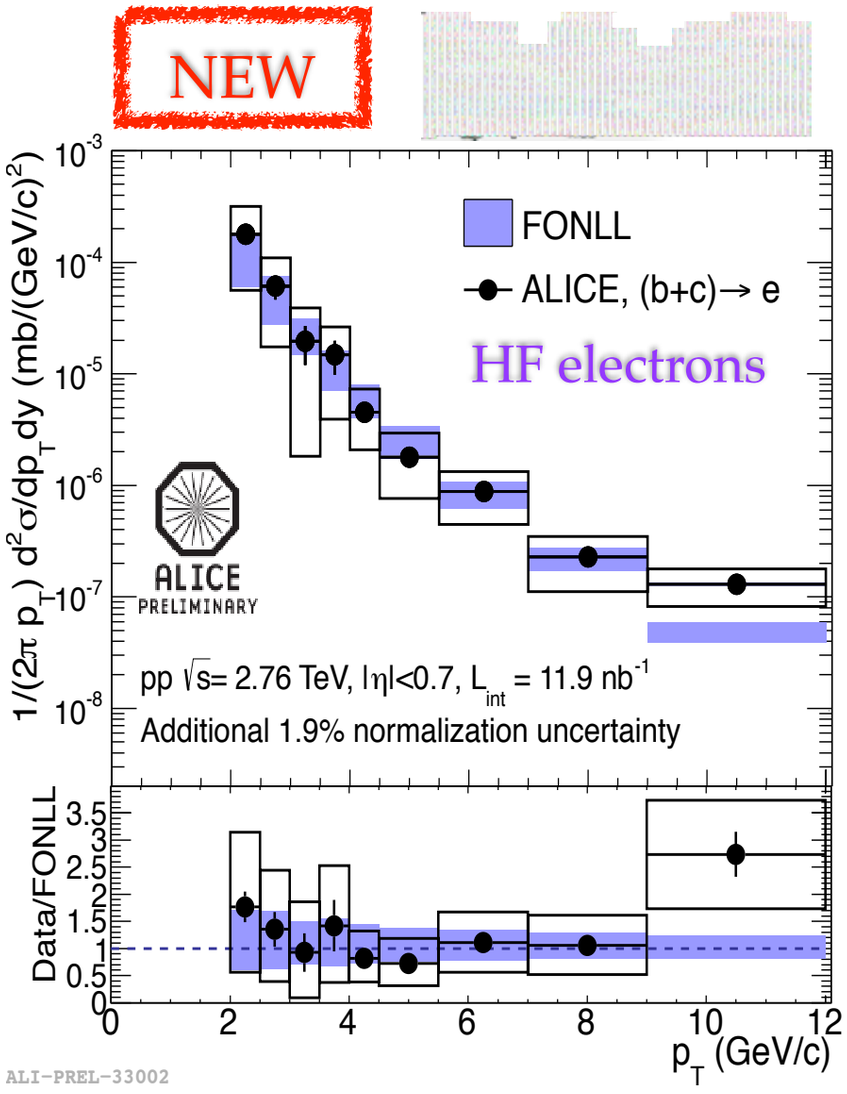
➡ **D mesons p_T-differential cross sections are well described by pQCD calculations (FONLL & GM-VFNS)**

Measurements in pp $\sqrt{s}$=2.76 TeV

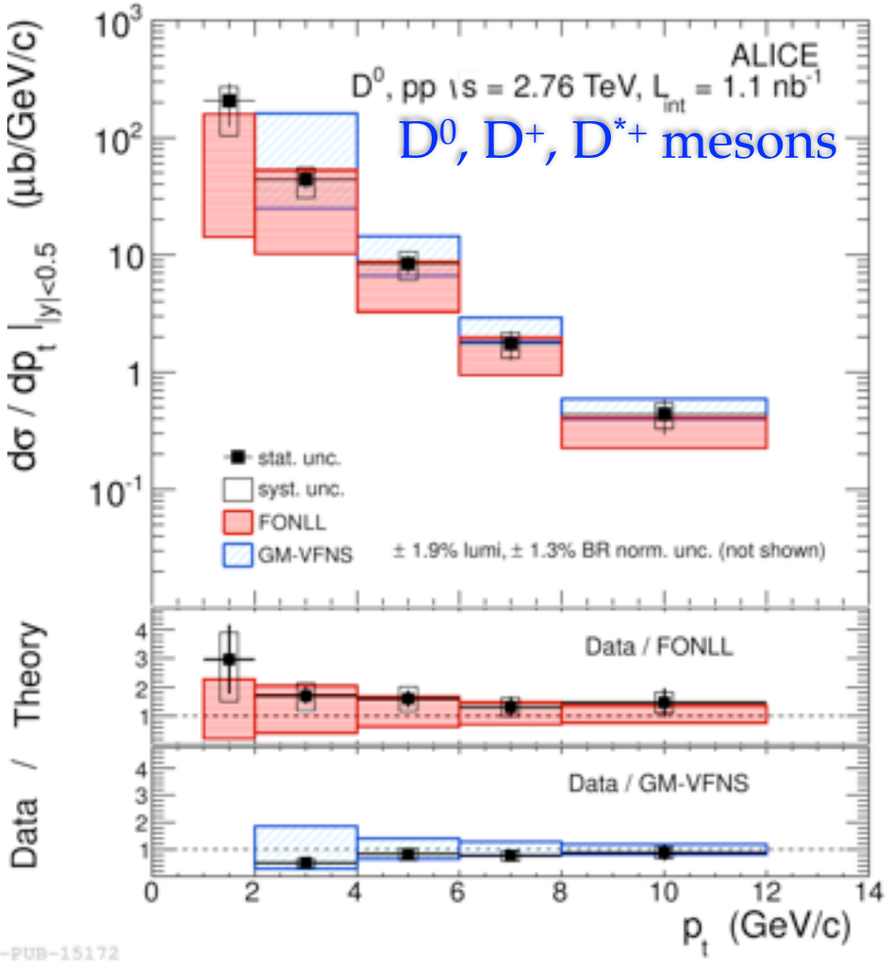
[ALICE Coll. arXiv:1205.6443 (2012)]



NEW



[ALICE Coll. JHEP 07 (2012) 191]

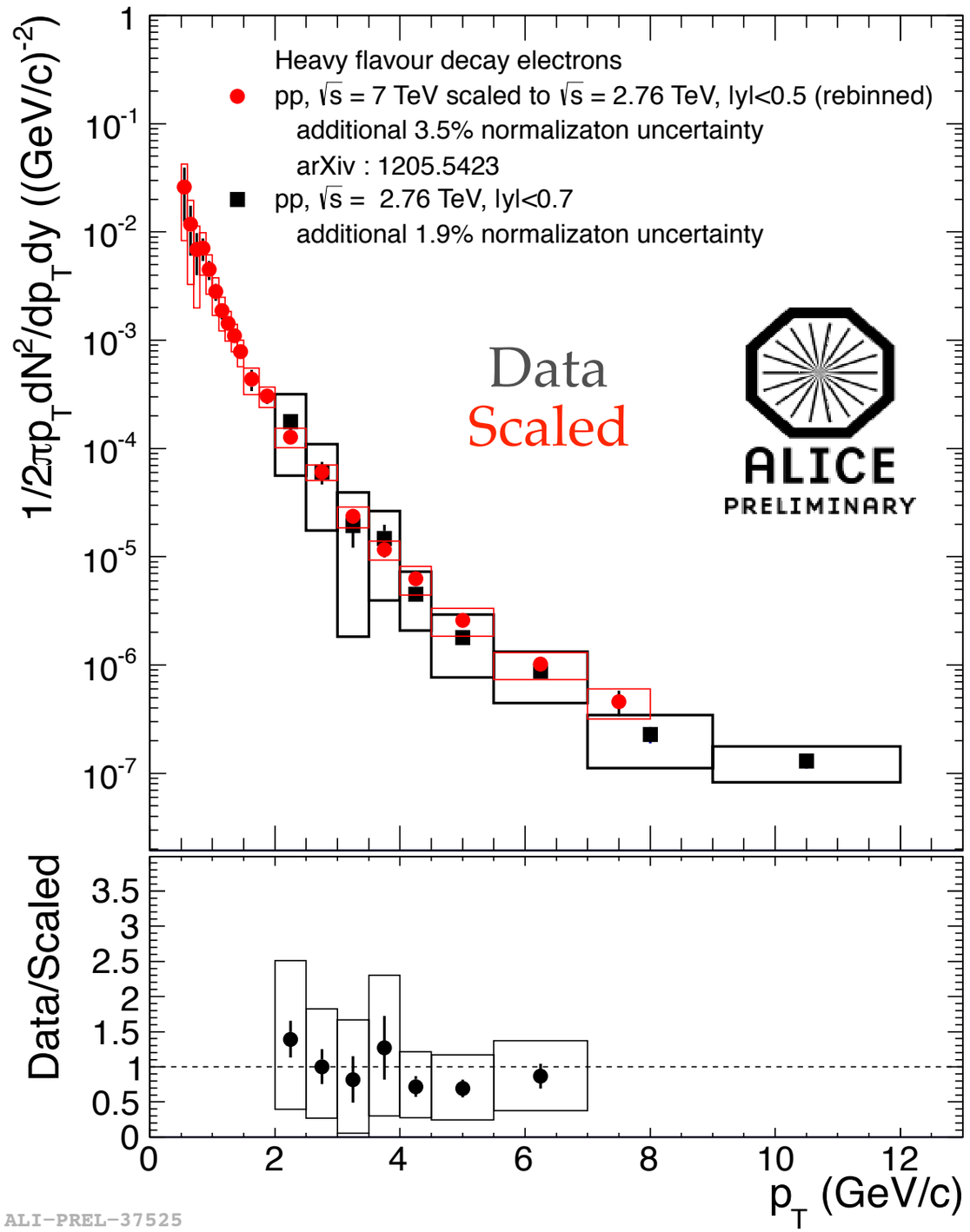


➡ **Well described by pQCD calculations**

Reference for Pb-Pb measurements

- HF muons: pp data at 2.76 TeV
- HF electrons and D mesons: 7 TeV data scaled to 2.76 TeV
- Scaling: ratio of FONLL cross sections at the two energies
- D mesons and HF electron data at 2.76 TeV are compatible with 7 TeV data scaled to 2.76 TeV

HF electrons, $|y|<0.7$



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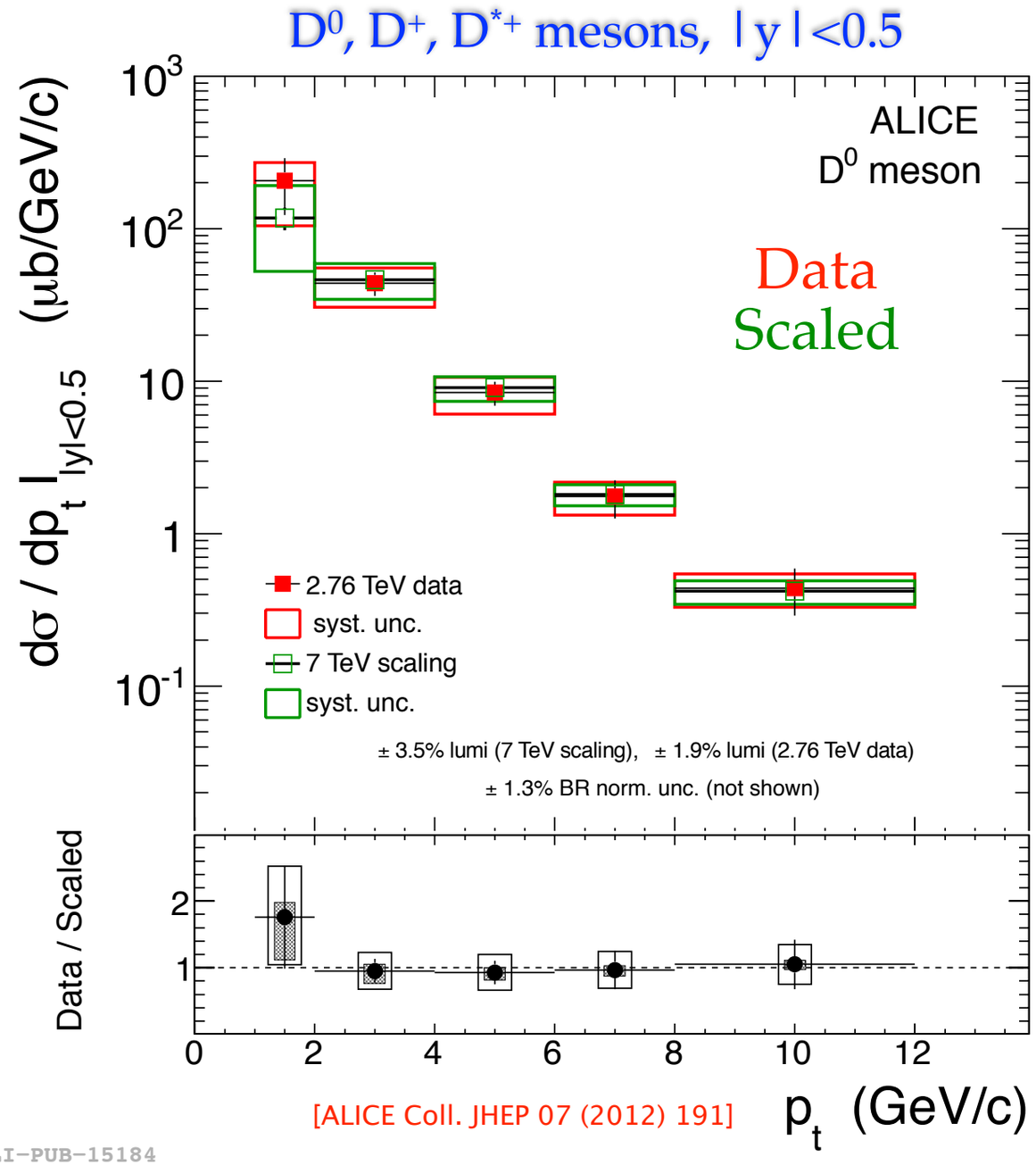


[ALICE Coll. JHEP 07 (2012) 191]

ALI-PUB-15184

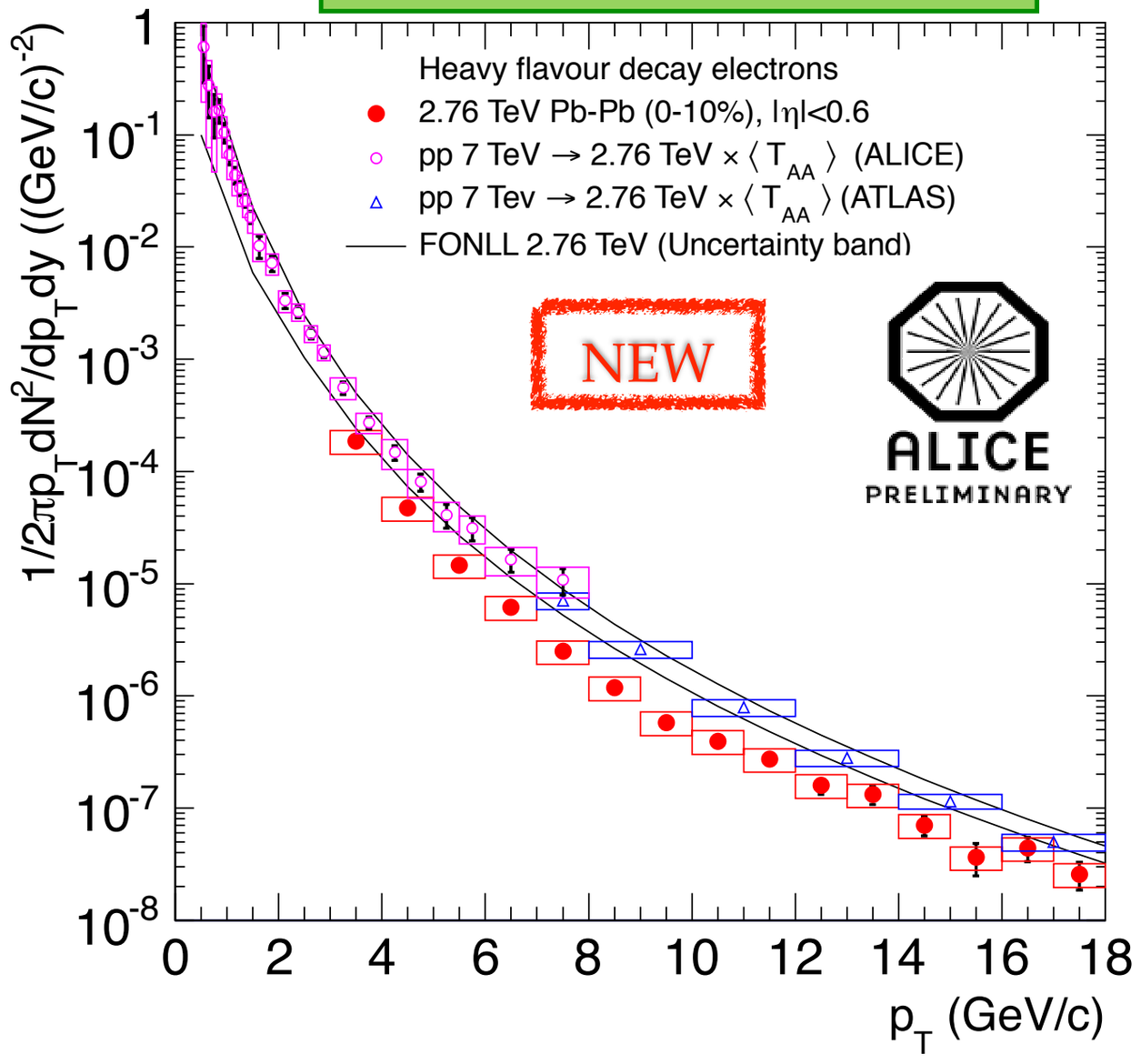
Pb-Pb Results

$\sqrt{s_{NN}} = 2.76$ TeV

Heavy Flavor Electrons, 0-10%

S.Sakai, Thu, Parallel 7A, 16:30

- Data: 2011 Pb-Pb run, EMCAL + centrality triggers (normalization with MB sample)
- Electron identification: TPC+EMCAL
- Subtract background electrons from the inclusive electrons
- Background electrons:
  - π^0 + Dalitz($\pi^{\pm}$,η) + γ-conversions via invariant mass analysis
  - Plus J/ψ cocktail based on pp data with ($0.2 < R_{AA}(J/\psi) < 0.8$)
- pp reference: 7 TeV pp data scaled to 2.76TeV + FONLL at high p_T

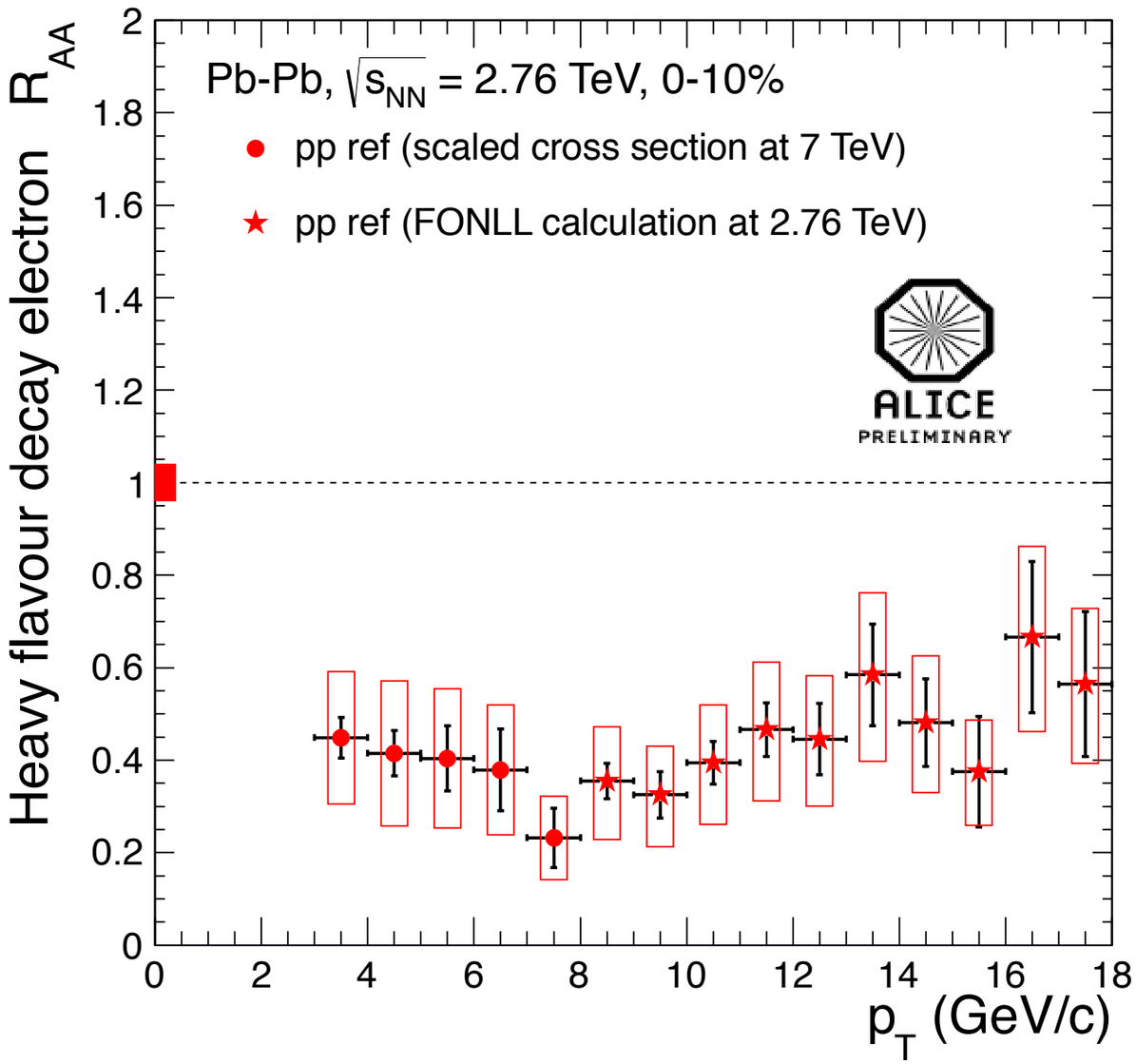


[ALICE Coll., arXiv:1205.5423 (2012)]
[ATLAS Coll., PLB 707:438-45]

Heavy Flavor Electrons, 0-10%

S.Sakai, Thu, Parallel 7A, 16:30

NEW



$$R_{\mathrm{AA}} = \frac{1}{\langle T_{\mathrm{AA}} \rangle} \frac{\mathrm{d}N_{\mathrm{AA}}/\mathrm{d}p_{\mathrm{T}}}{\mathrm{d}\sigma_{\mathrm{pp}}/\mathrm{d}p_{\mathrm{T}}}$$

➡ Clear suppression for $3<p_T<18$ GeV/c

- Amounts to a factor of 1.5-3 for $3<p_T<10$ GeV/c

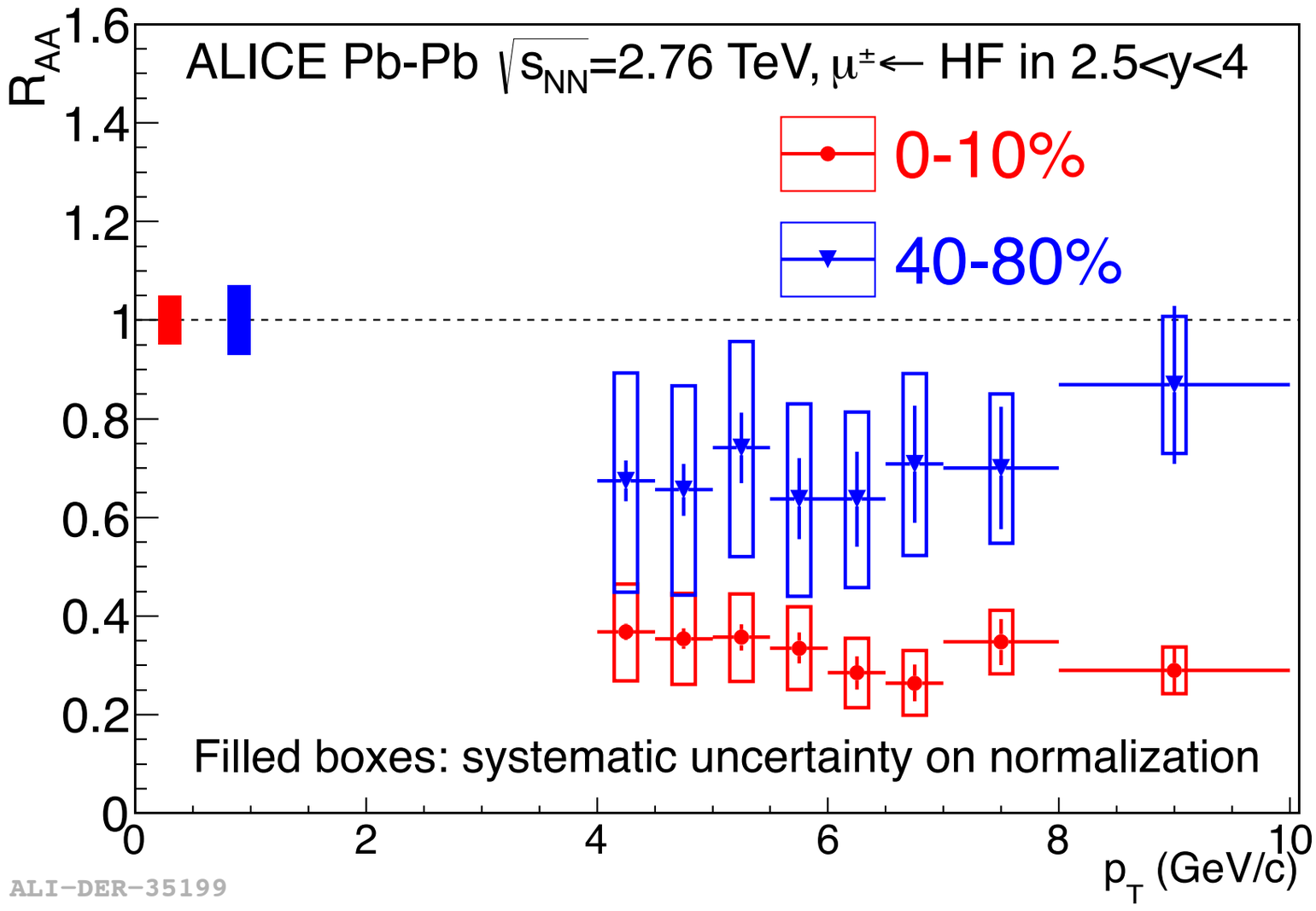
Heavy Flavor Muons, 0-10%

- Data: 2010 Pb-Pb run, MB + muon triggers
- Subtract background muons from π, K decays
- Background muons: π, K extrapolated from mid-rapidity measurements. Consider $R_{AA}^{\pi}(y=0)$, $R_{AA}^{K}(y=0)$, and let vary $0 < R_{AA}^{\pi,K}(\text{y-forward}) < 2\ R_{AA}^{\pi,K}(y=0)$
- pp reference: pp data at 2.76 TeV

X. Zhang, Thu, Parallel 7A, 17:50

[ALICE Coll. arXiv:1205.6443 (2012)]

Heavy Flavor Muons, 0-10%

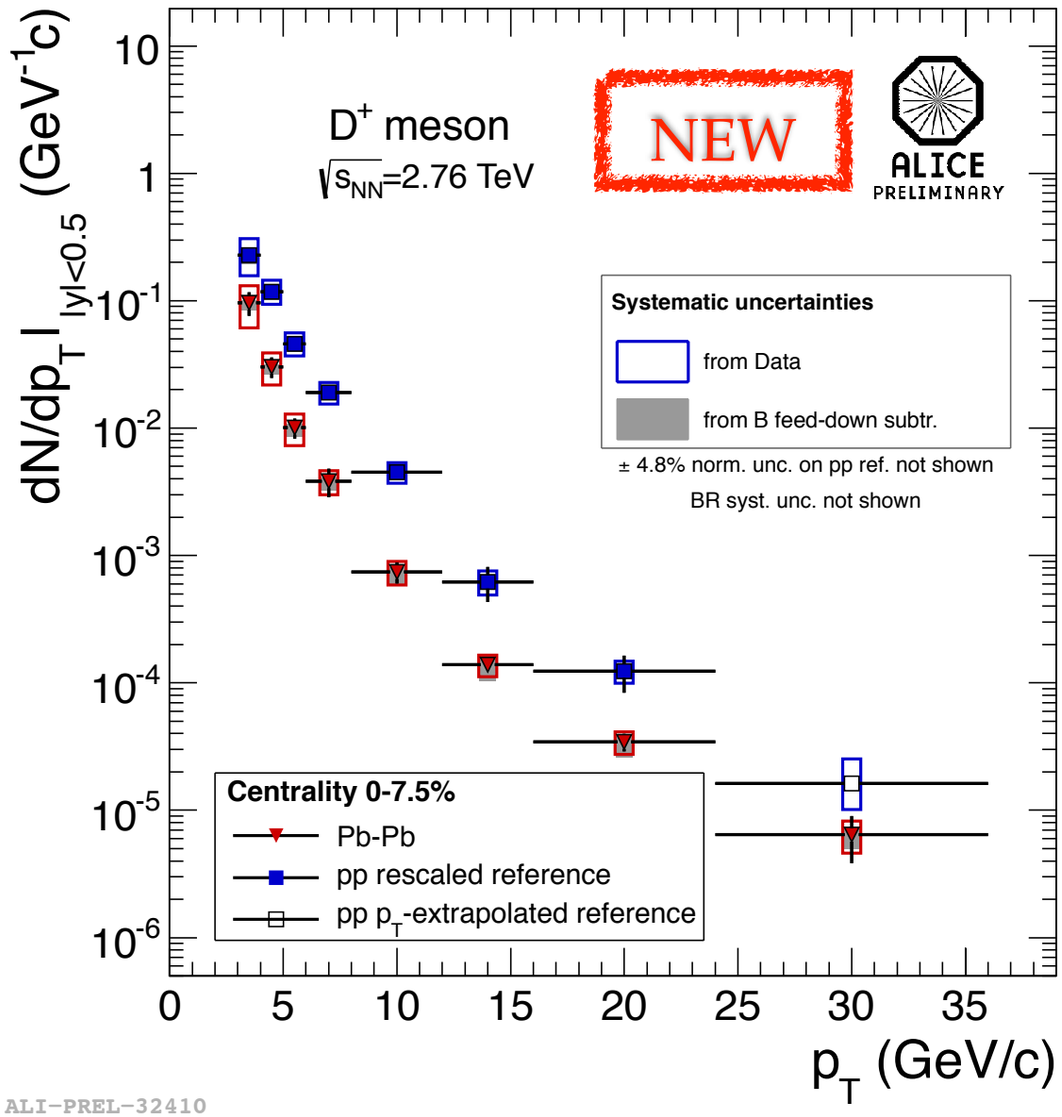


➡ **Suppression by a factor of 2-4 in 0-10%**

X. Zhang, Thu, Parallel 7A, 17:50

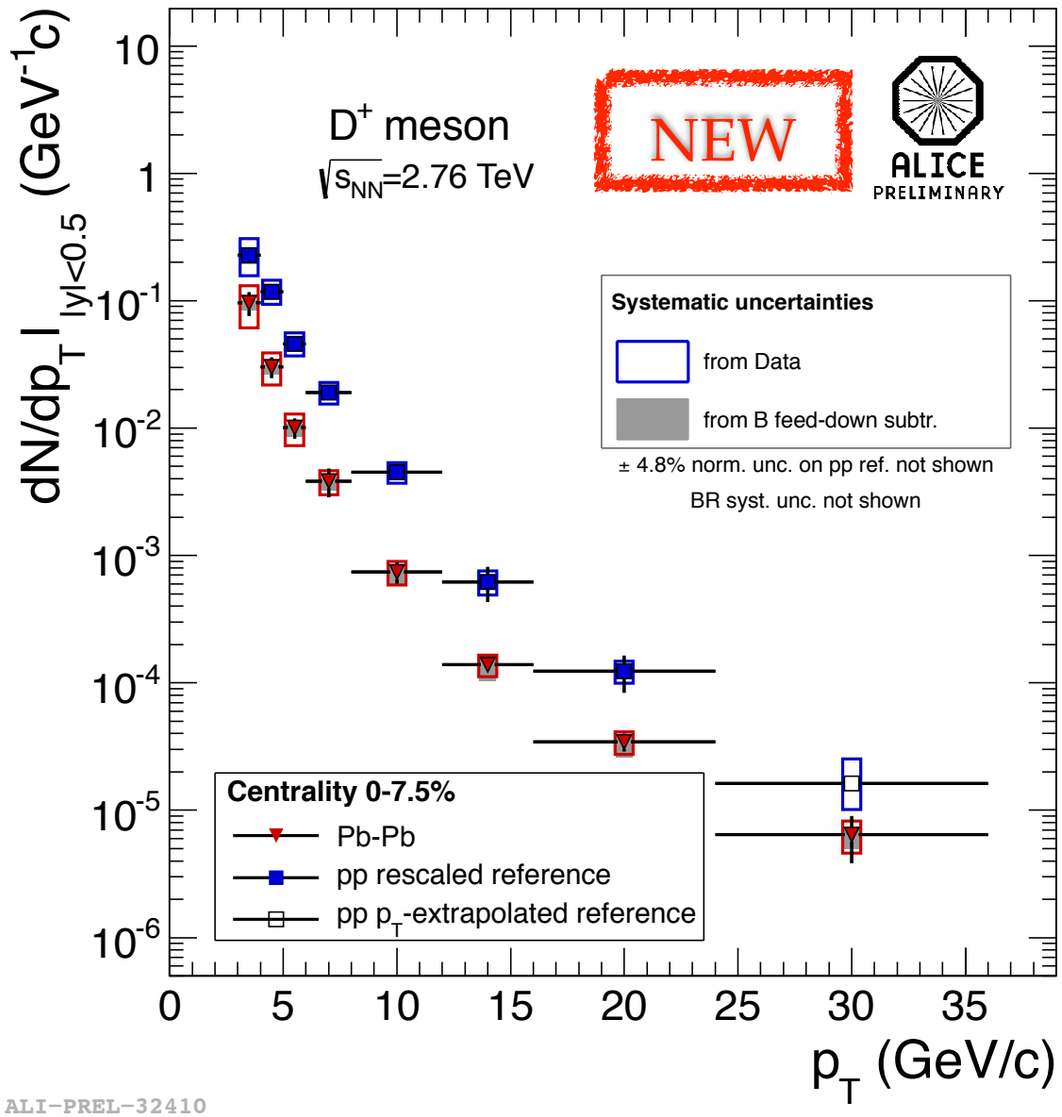
[ALICE Coll. arXiv:1205.6443 (2012)]

D^0, D^+, D^{*+} mesons, 0-7.5%

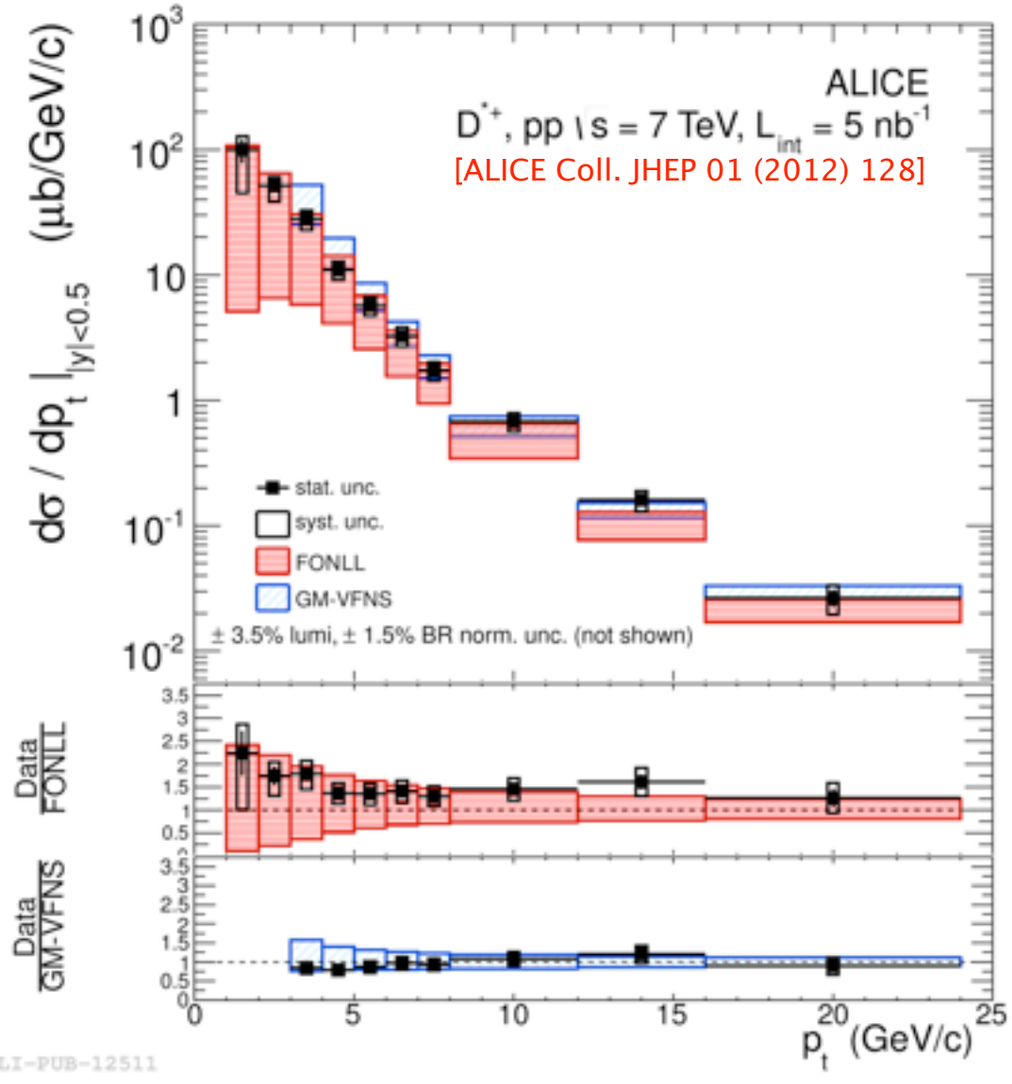


- Data: 2011 Pb-Pb run, MB + centrality triggers
- Prompt D mesons = inclusive D mesons – D mesons from B decays
- pQCD-based subtraction of D from B decays, with the constrain $1/3 < R_{AA}(\mathrm{DfromB})/R_{AA}(\mathrm{D}) < 3$
- pp reference: 7 TeV data scaled to 2.76 TeV + high p_T-pQCD-extrapolation

D^0, D^+, D^{*+} mesons, 0-7.5%



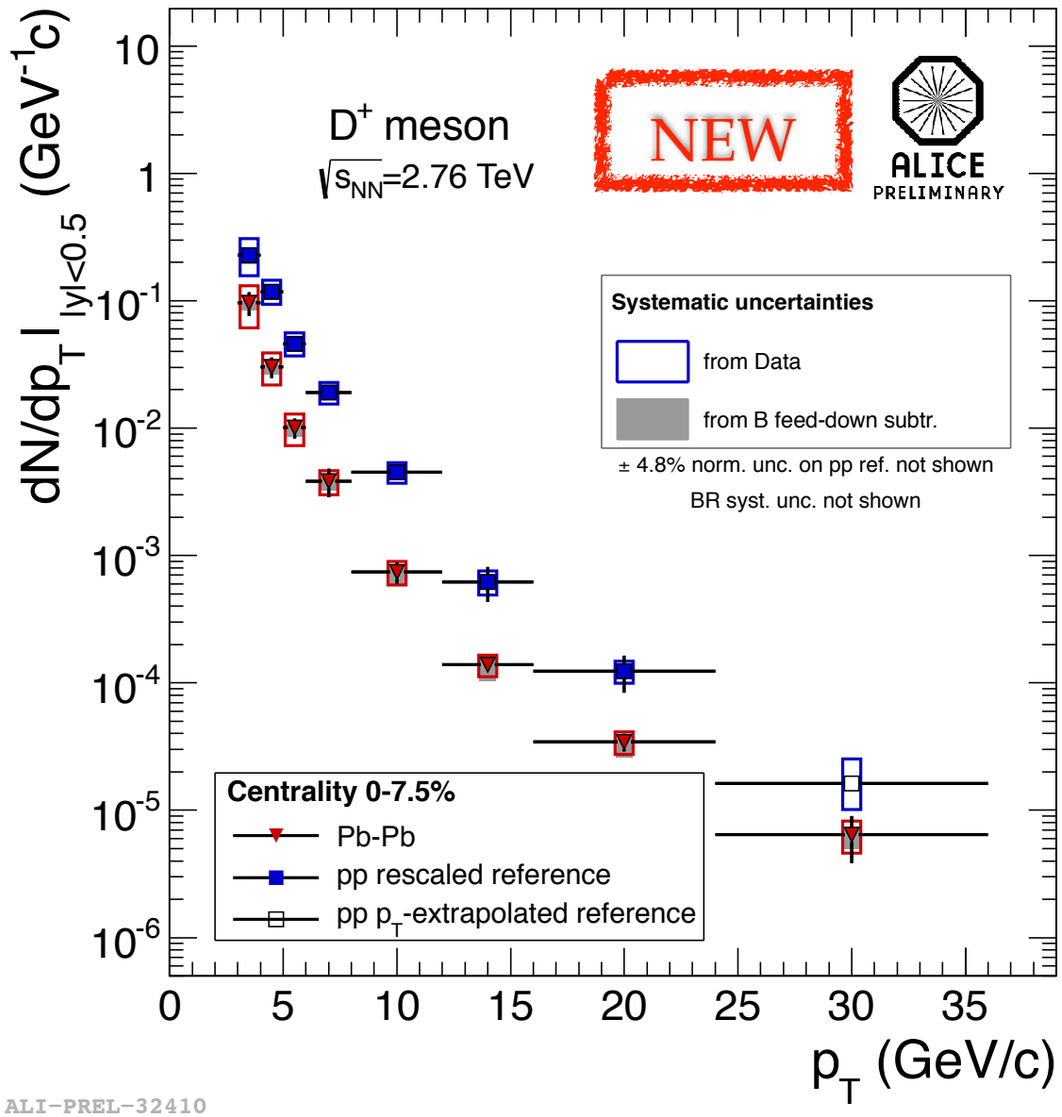
ALI-PREL-32410



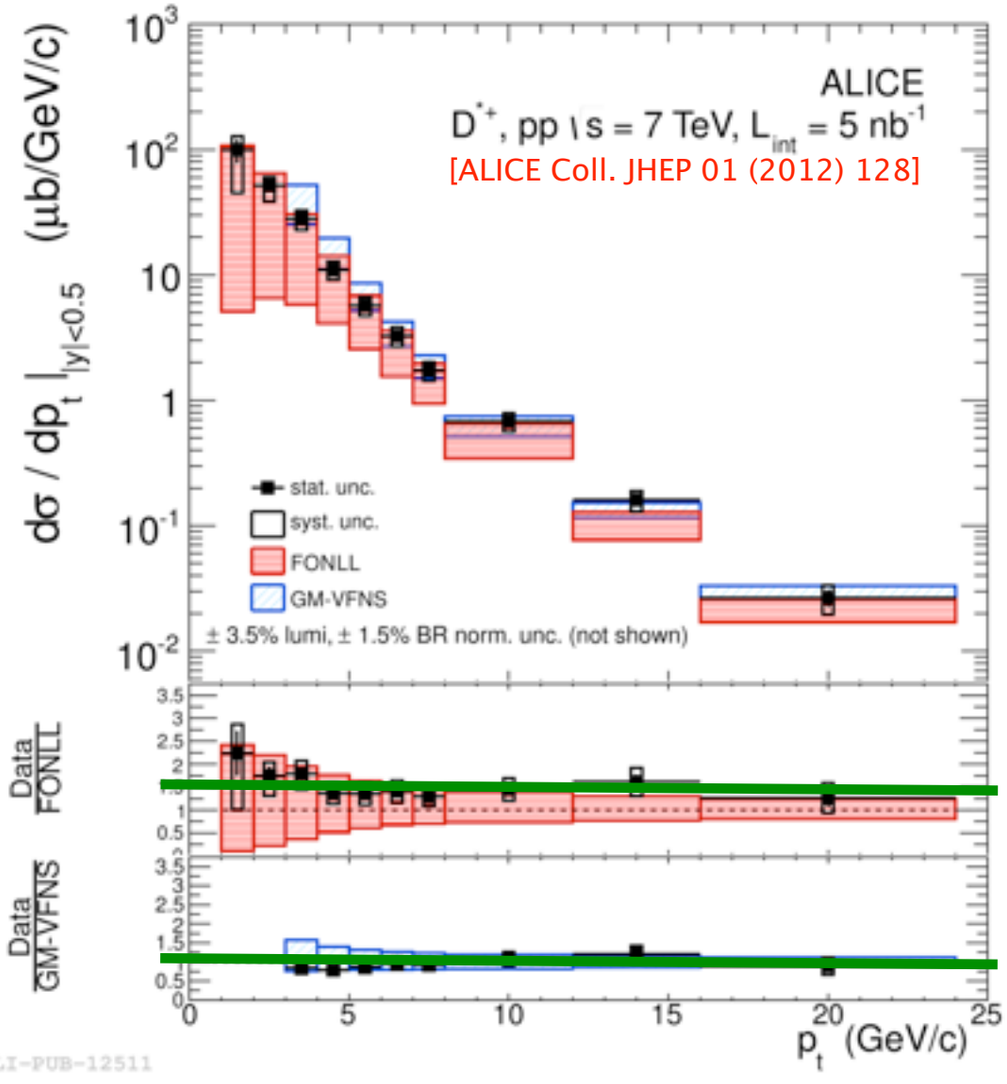
ALI-PUB-12511

- Data: 2011 Pb-Pb run, MB + centrality triggers
- Prompt D mesons = inclusive D mesons – D mesons from B decays
- pQCD-based subtraction of D from B decays, with the constrain $1/3 < R_{AA}(\mathrm{DfromB})/R_{AA}(\mathrm{D}) < 3$
- pp reference: 7 TeV data scaled to 2.76 TeV + high p_T-pQCD-extrapolation

D^0, D^+, D^{*+} MESONS, 0-7.5%



ALI-PREL-32410



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- Data: 2011 Pb-Pb run, MB + centrality triggers
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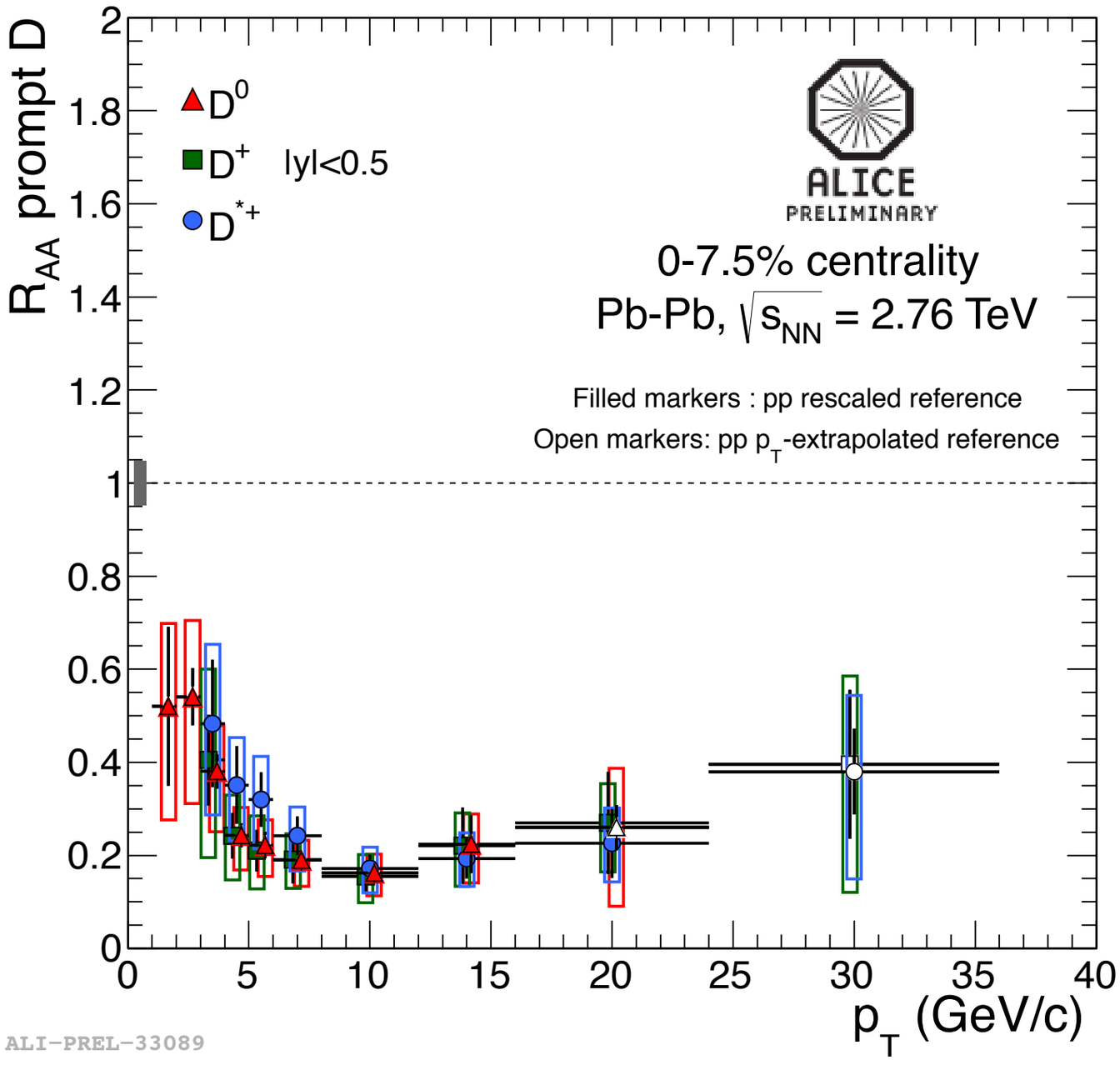
- pp reference: 7 TeV data scaled to 2.76 TeV + high p_T-pQCD-extrapolation

D^0, D^+, D^{*+} MESONS, 0-7.5%

NEW

A. Grelli, Thu, Parallel 6A, 14:00

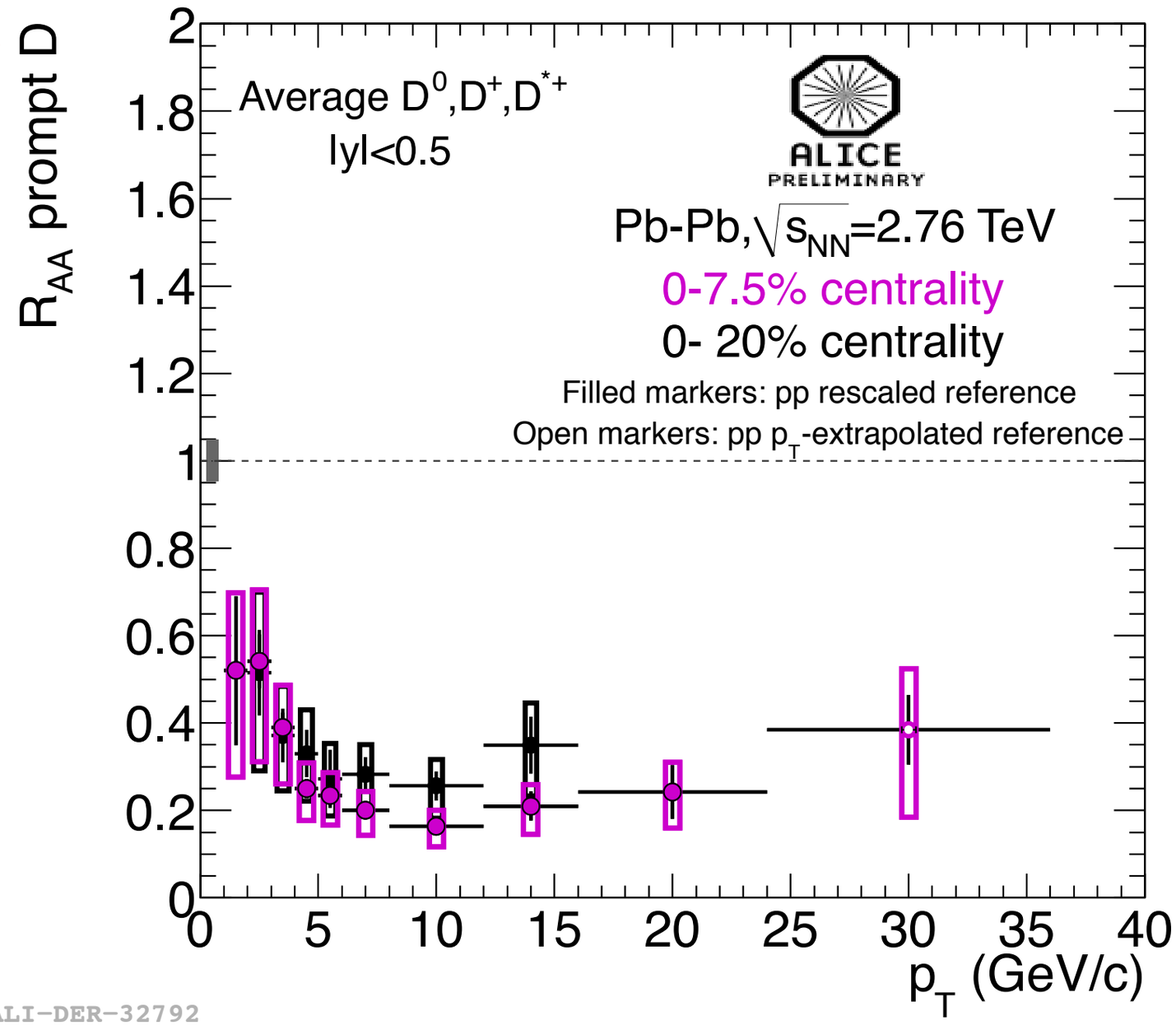


D^0, D^+, D^{*+} MESONS, 0-7.5%

NEW

A. Grelli, Thu, Parallel 6A, 14:00

[ALICE Coll. arXiv:1203.2160 (2012)]

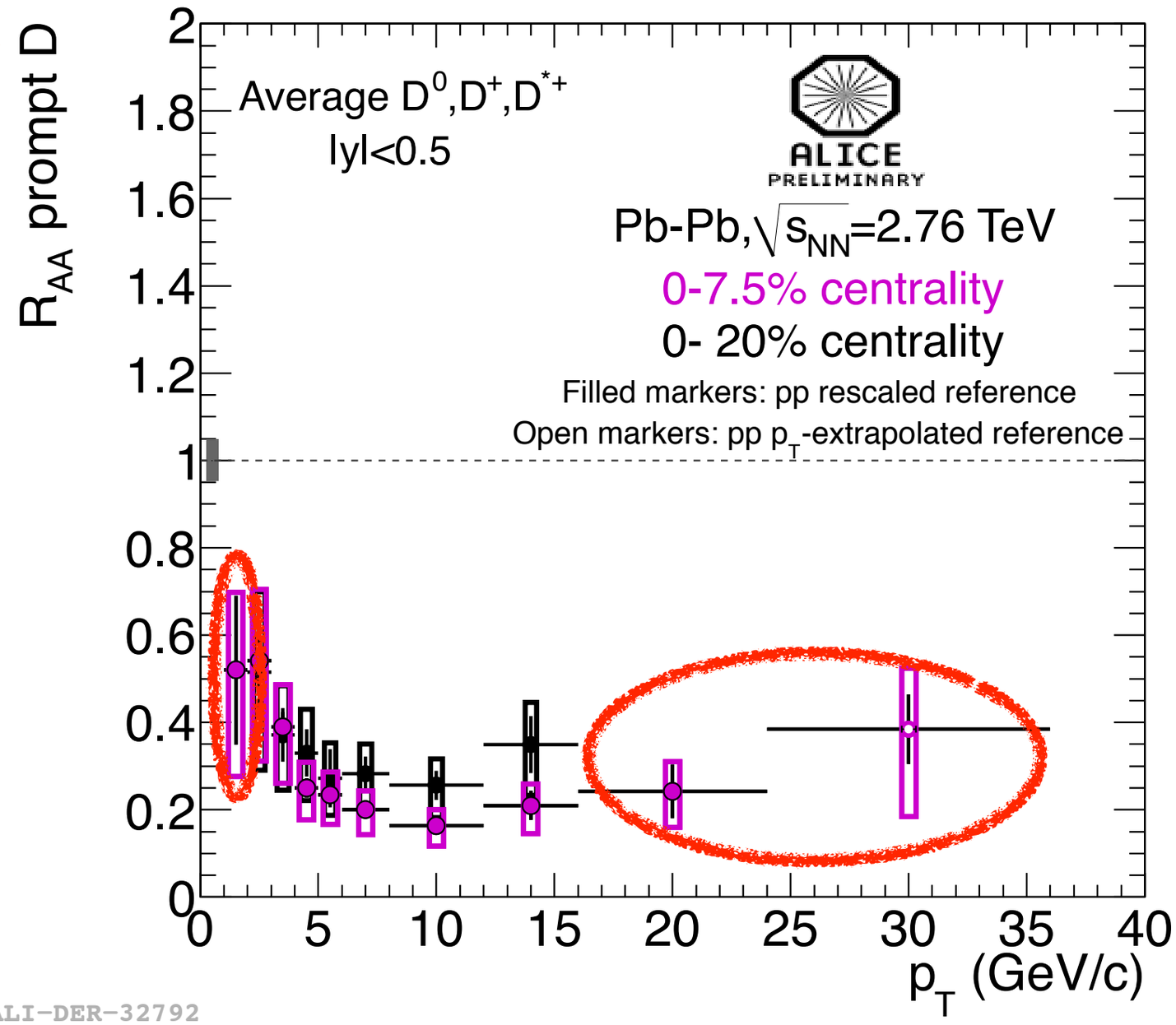


ALI-DER-32792

D^0, D^+, D^{*+} MESONS, 0-7.5%

NEW

A. Grelli, Thu, Parallel 6A, 14:00



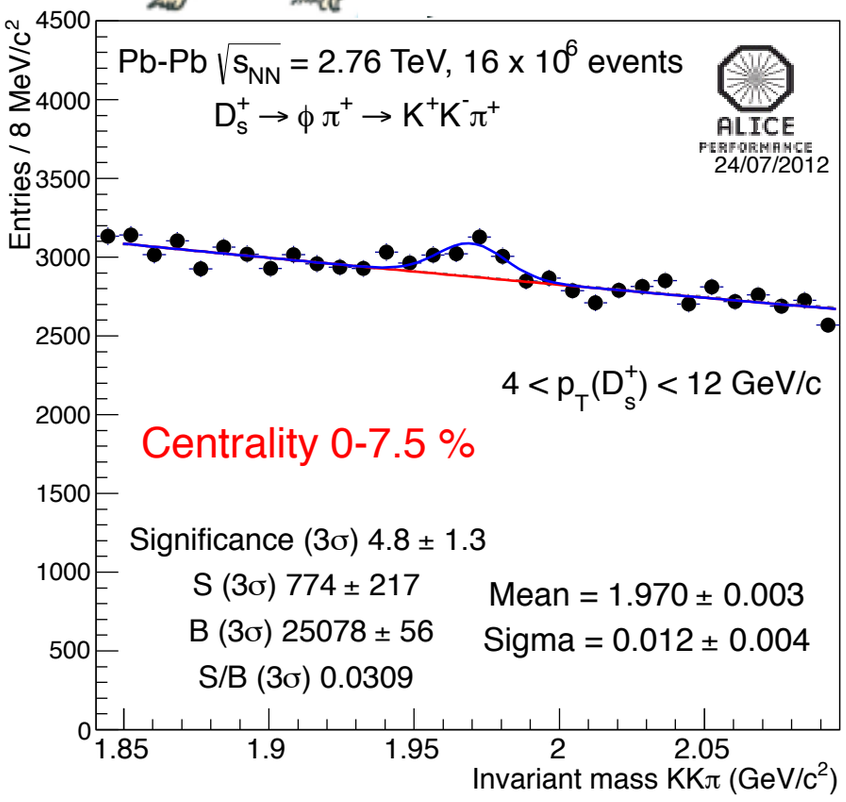
[ALICE Coll. arXiv:1203.2160 (2012)]

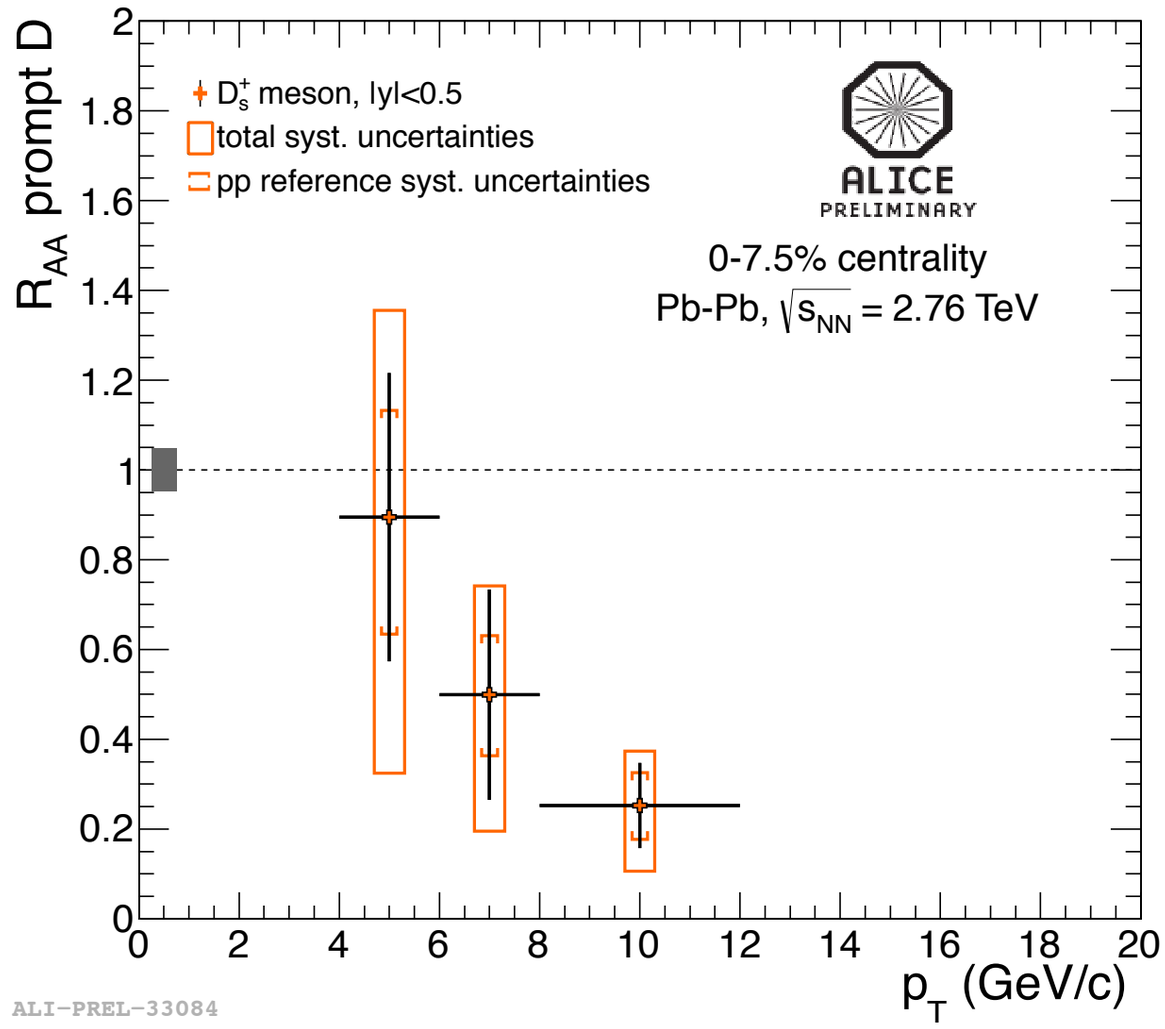
- Extended measurement to $1<p_T<36$ GeV/c
- Suppression by up to a factor of 5 at p_T ~10 GeV/c in 0-7.5%

First D_s^+ meson measurement, 0-7.5%

- Expectation: relative enhancement of the strange/non-strange D mesons at intermediate p_T - charm in-medium hadronization ?

NEW





- **First measurement of D_s^+ dN/dp_T and R_{AA}**
- **Suppression by a factor of 3-5 for p_T~8-12 GeV/c**
- **Similar to that of the D^0, D^+, D^{*+}**

G.M. Innocenti, Wed, Parallel 4A, 12:20

[I. Kuznetsova, J. Rafelski, Eur.Phys.J.C51:113-133 (2007)] [M. He, et al, arXiv:1204.4442] [A. Andronic, et al, arXiv:0708.1488v3]

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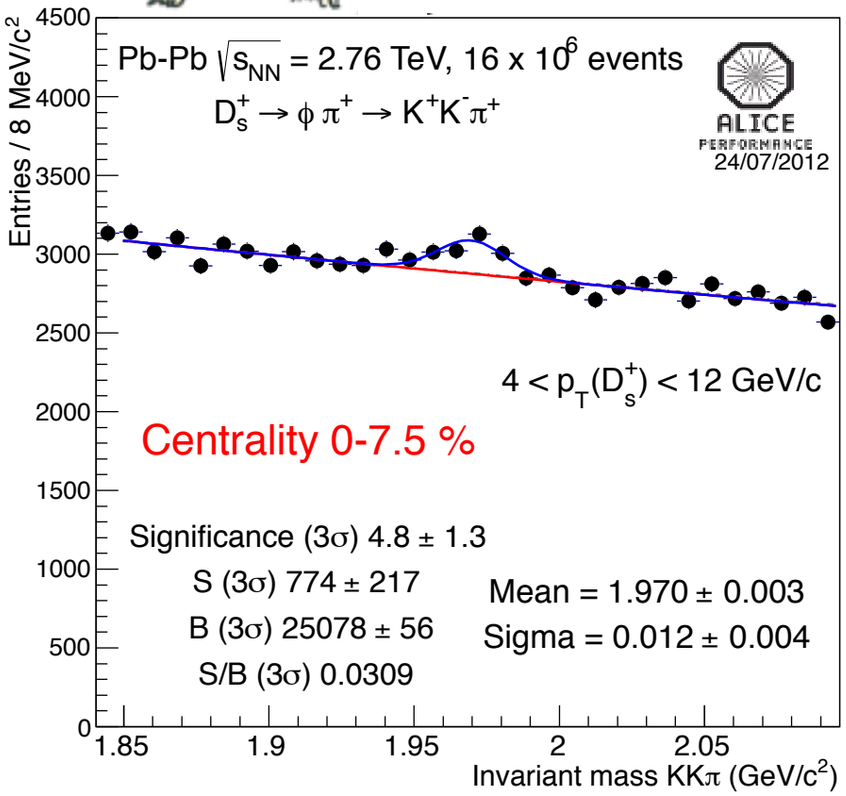
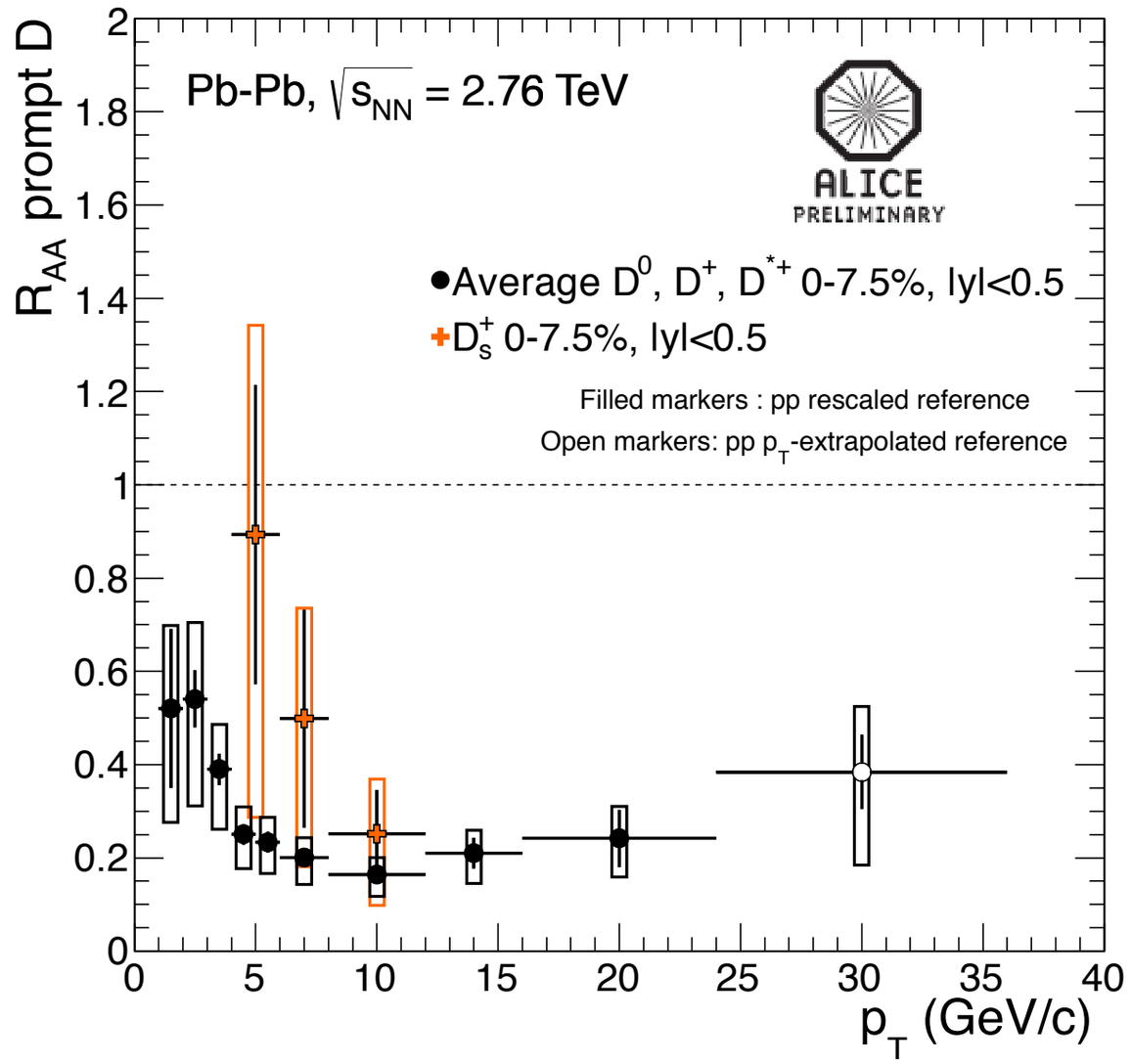
NEW





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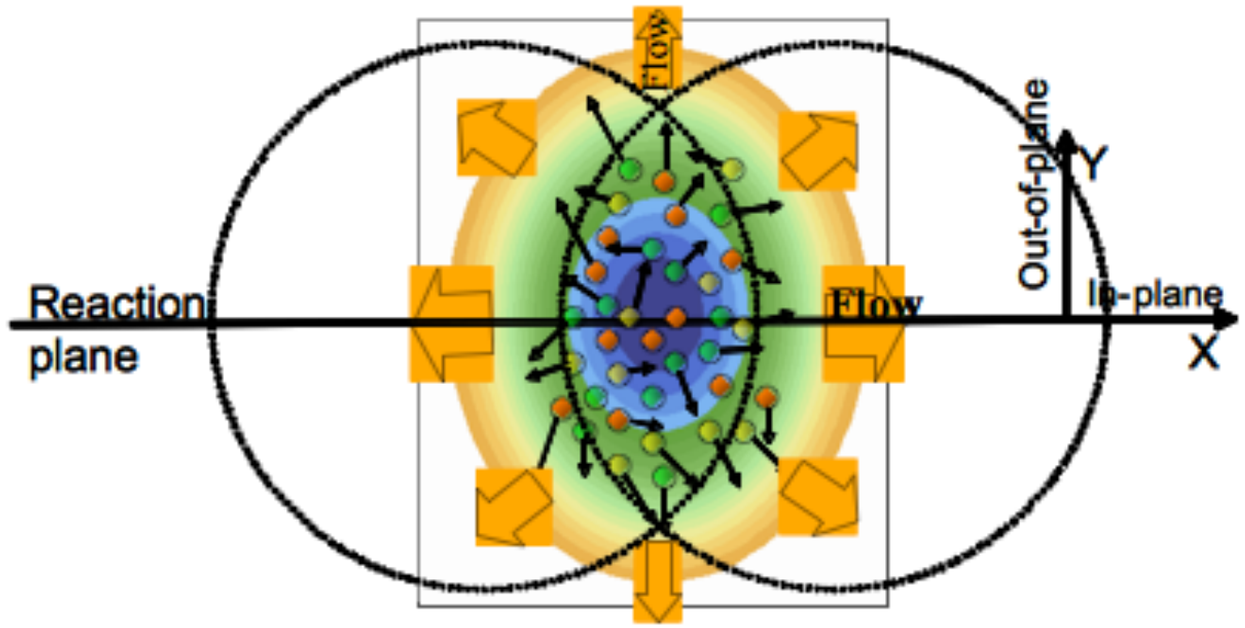
Azimuthal Anisotropy

- Heavy flavor is suppressed up to high p_T... Azimuthal dependence ?
- Address path length dependence of HQ energy loss at high p_T ?
- Collective motion (flow) at low p_T ?



$$\frac{\mathrm{d}N}{\mathrm{d}\varphi} = \frac{N_0}{2\pi}\left(1 + 2v_1\cos(\varphi - \Psi_1) + 2v_2\cos[2(\varphi - \Psi_2)] + \dots\right)$$

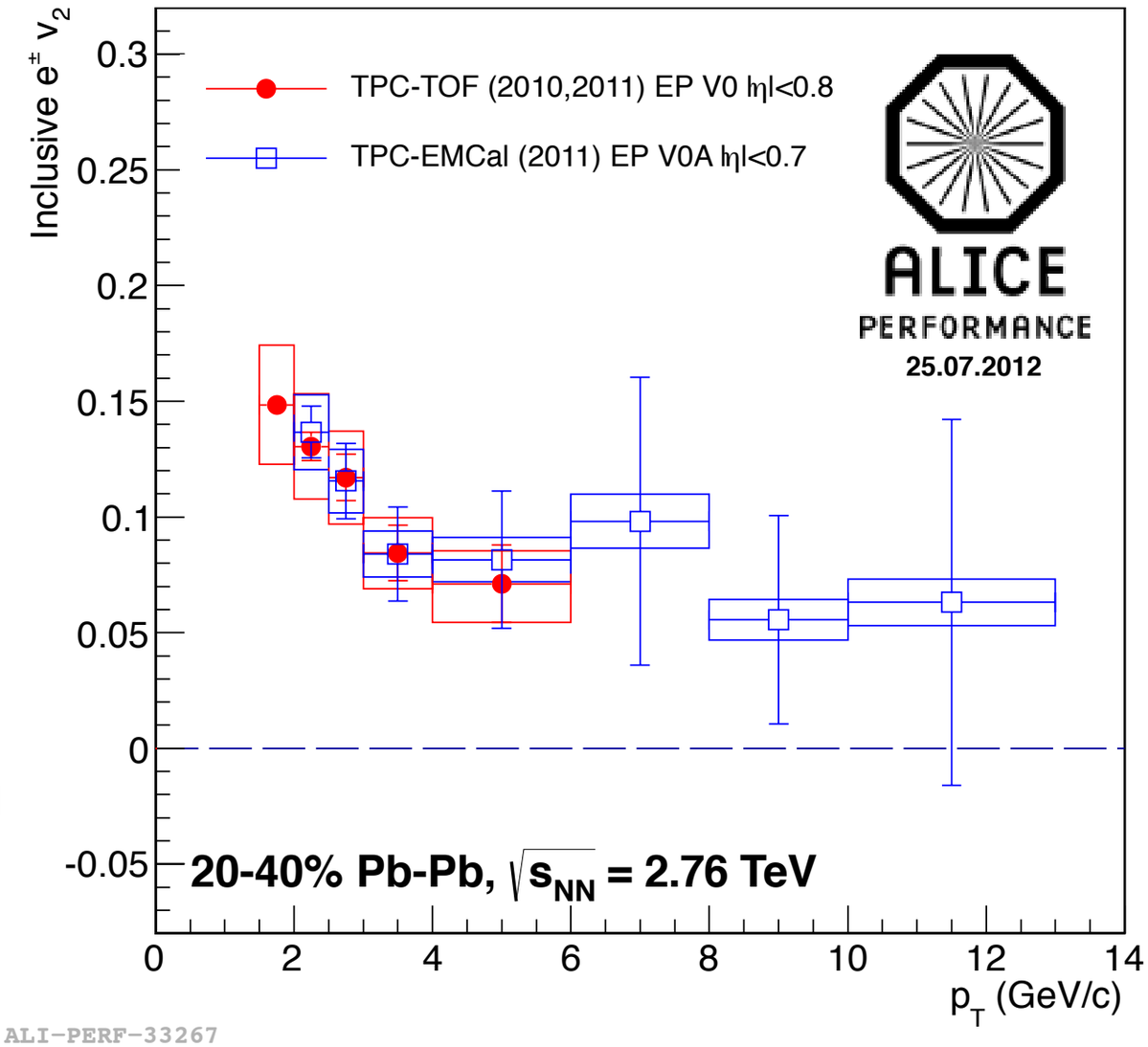
HF Electron v_2, 20-40%

- Data sample: 2010 + 2011 Pb-Pb runs TPC+TOF (MB+centrality trig.) and TPC+EMCAL analyses (EMCAL +centrality trig.)
- v_2 measured with the event plane (EP) method

$$v_2^{\mathrm{HFe}} = \frac{(1+\alpha)\, v_2^{\mathrm{e\ inclusive}} - v_2^{\mathrm{e\ background}}}{\alpha}$$

$$\alpha = N^{\mathrm{HFe}} / N^{\mathrm{e\ background}}$$

- Background electrons: π^0 + Dalitz($\pi^{\pm}$,η) + γ-conversions via cocktail with their measured v_2



ALI-PERF-33267

S.Sakai, Thu, Parallel 7A, 16:30

HF Electron v_2, 20-40%

NEW

- Data sample: 2010 + 2011 Pb-Pb runs TPC+TOF (MB+centrality trig.) and TPC+EMCAL analyses (EMCAL +centrality trig.)
- v_2 measured with the event plane (EP) method

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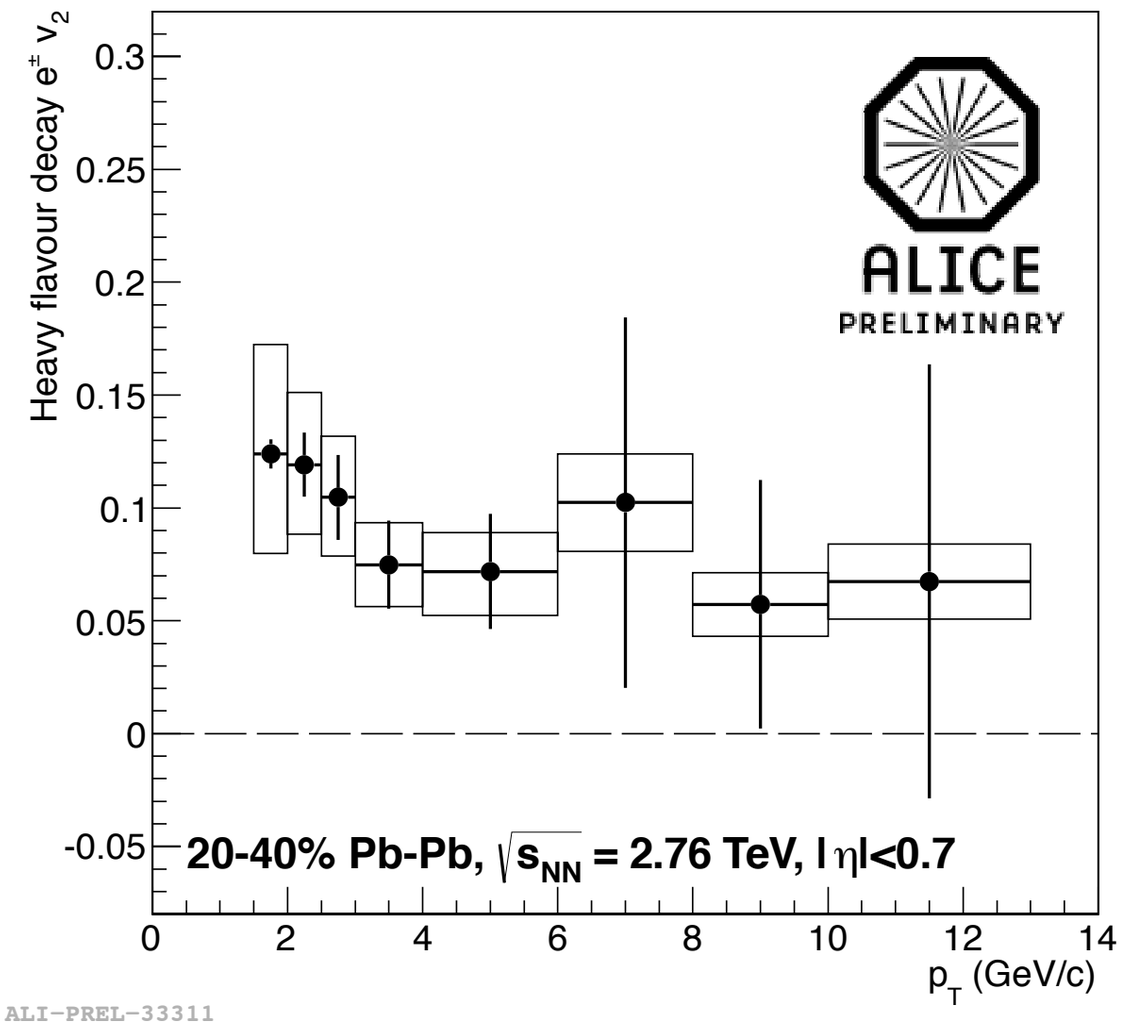


➡ **Heavy flavor electron $v_2>0$ at low p_T (>3σ effect in $2<p_T<3$ GeV/c)**

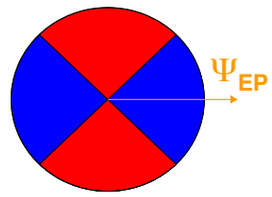
S.Sakai, Thu, Parallel 7A, 16:30

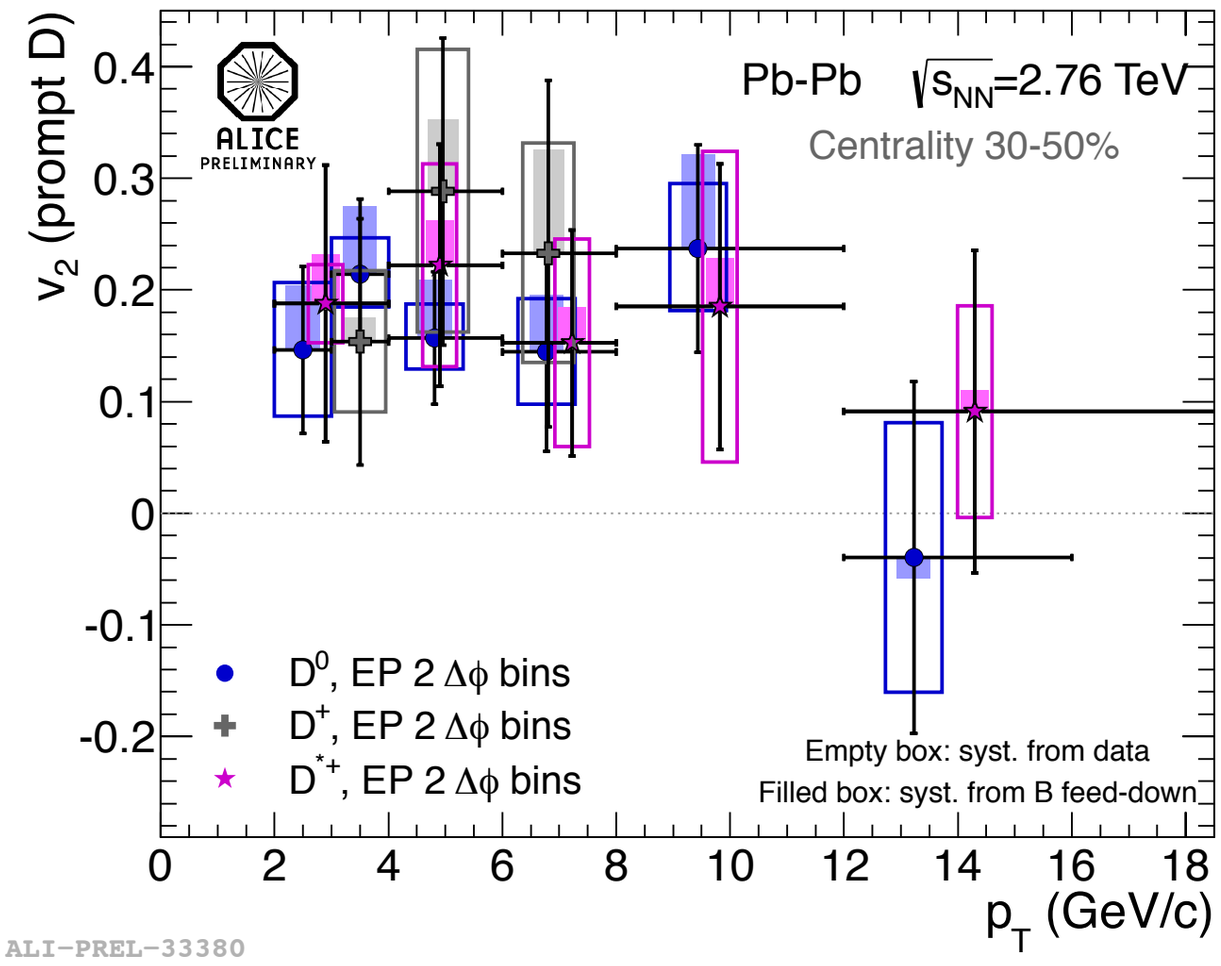
D meson v_2

- Data: 2011 Pb-Pb run, MB + centrality triggers
- v_2 measured with the event plane method

$$v_2 = \frac{1}{R_2}\frac{\pi}{4}\frac{N^{\mathrm{In-Plane}} - N^{\mathrm{Out-Ot-Plane}}}{N^{\mathrm{In-Plane}} + N^{\mathrm{Out-Ot-Plane}}}$$

R_2 : event plane resolution





- **Consistency among D meson species (D^0,D^+,D^{*+})**
- **Indication of non-zero D meson v_2 (3σ effect in $2<p_T<6$ GeV/c)**

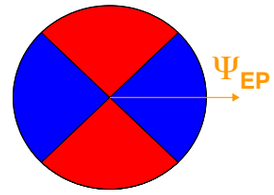
D. Caffarri, Thu, Parallel 6A, 14:40

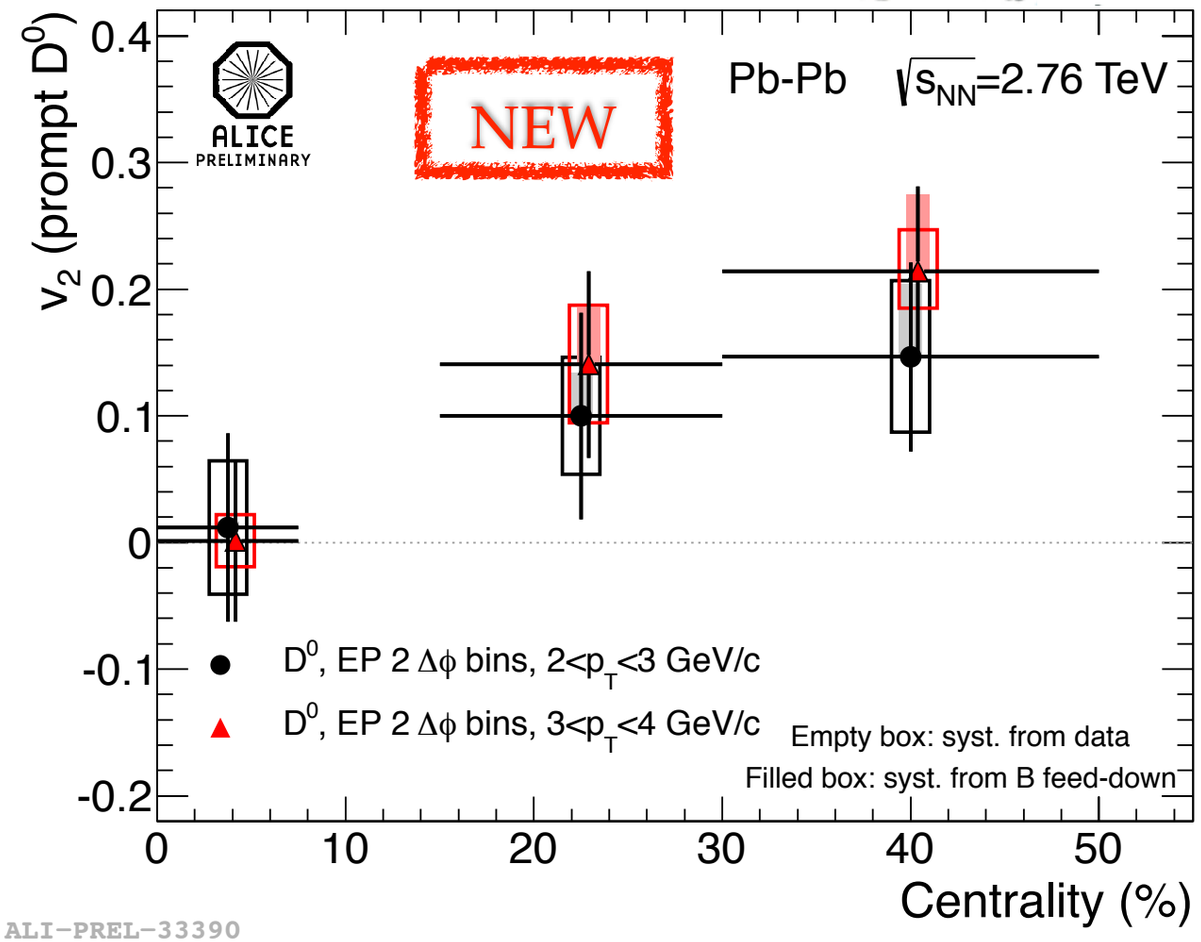
D MESON v_2

- Data: 2011 Pb-Pb run, MB + centrality triggers
- v_2 measured with the event plane method

$$v_2 = \frac{1}{R_2}\frac{\pi}{4}\frac{N^{\text{In-Plane}} - N^{\text{Out-Ot-Plane}}}{N^{\text{In-Plane}} + N^{\text{Out-Ot-Plane}}}$$

R_2 : event plane resolution





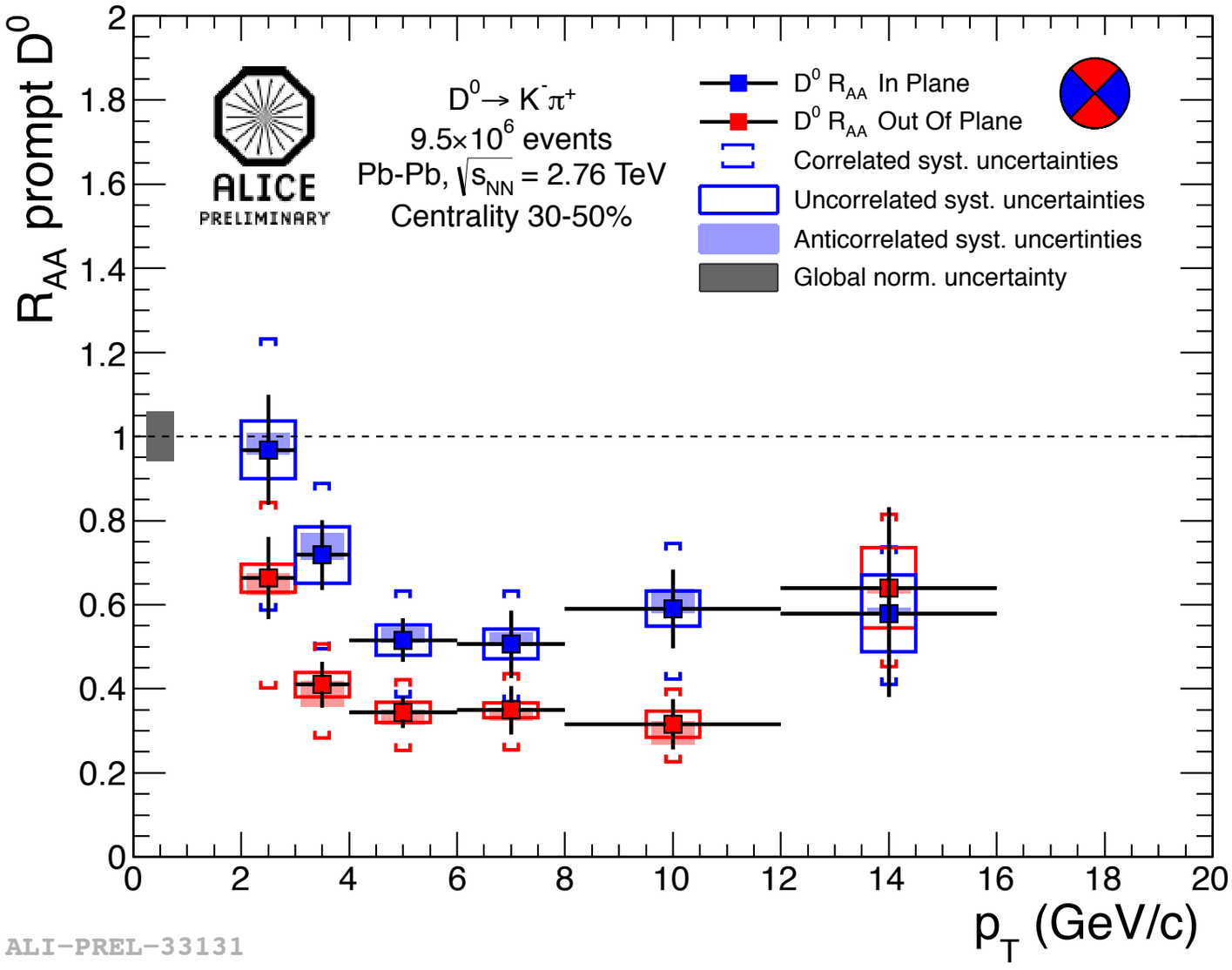
- Consistency among D meson species (D^0,D^+,D^{*+})
- Indication of non-zero D meson v_2 (3σ effect in $2<p_T<6$ GeV/c)
- Hint of centrality dependence at low p_T

D. Caffarri, Thu, Parallel 6A, 14:40

D⁰ RAA vs Event Plane, 30-50%

D. Caffarri, Thu, Parallel 6A, 14:40

NEW

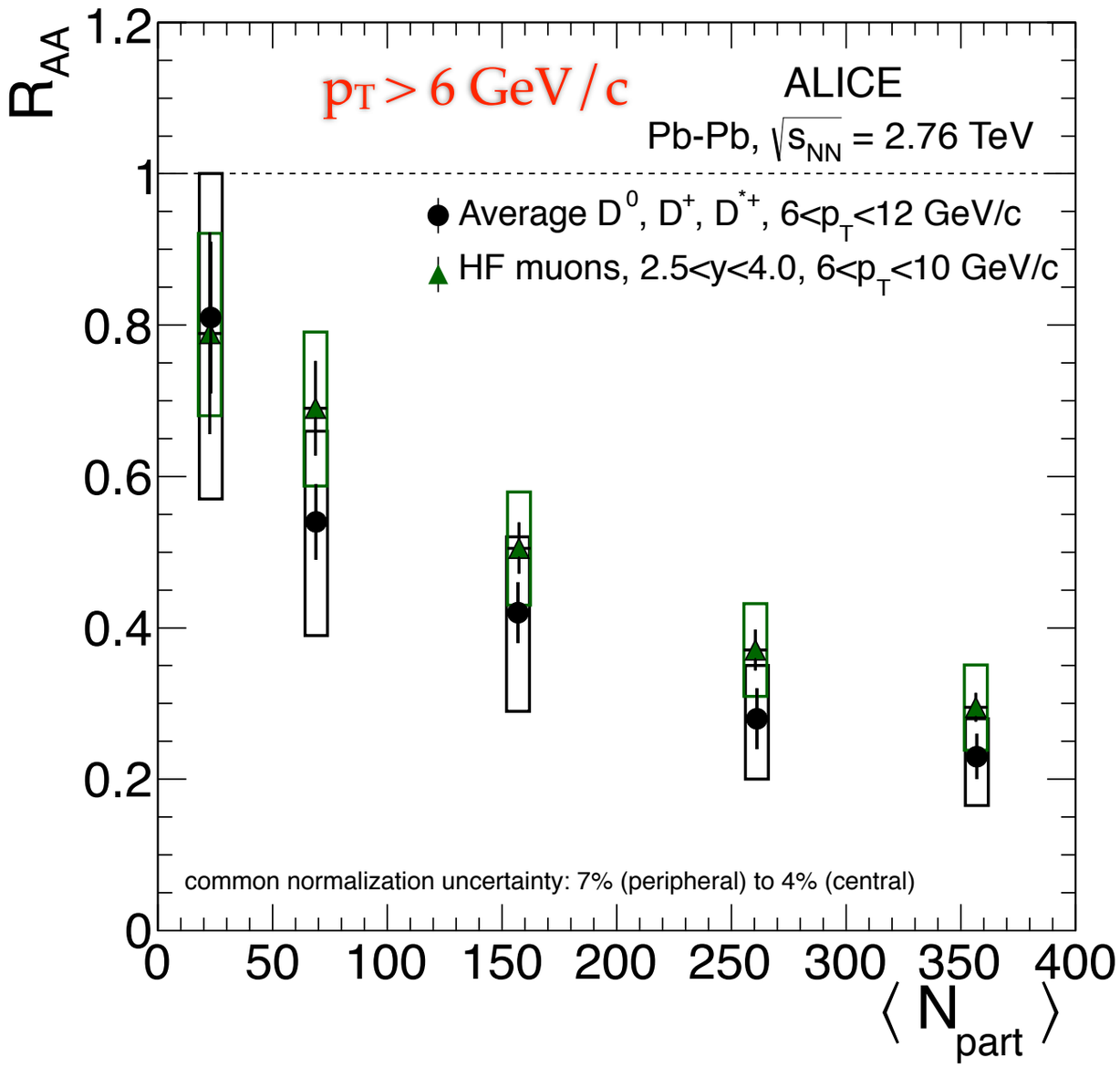


- Larger suppression **OutOfPlane** than **InPlane** up to p_T~10 GeV/c
  - might indicate elliptic flow at low p_T
  - might indicate longer path length at high p_T

Comparison with data and models

QM12 QuarkMatter

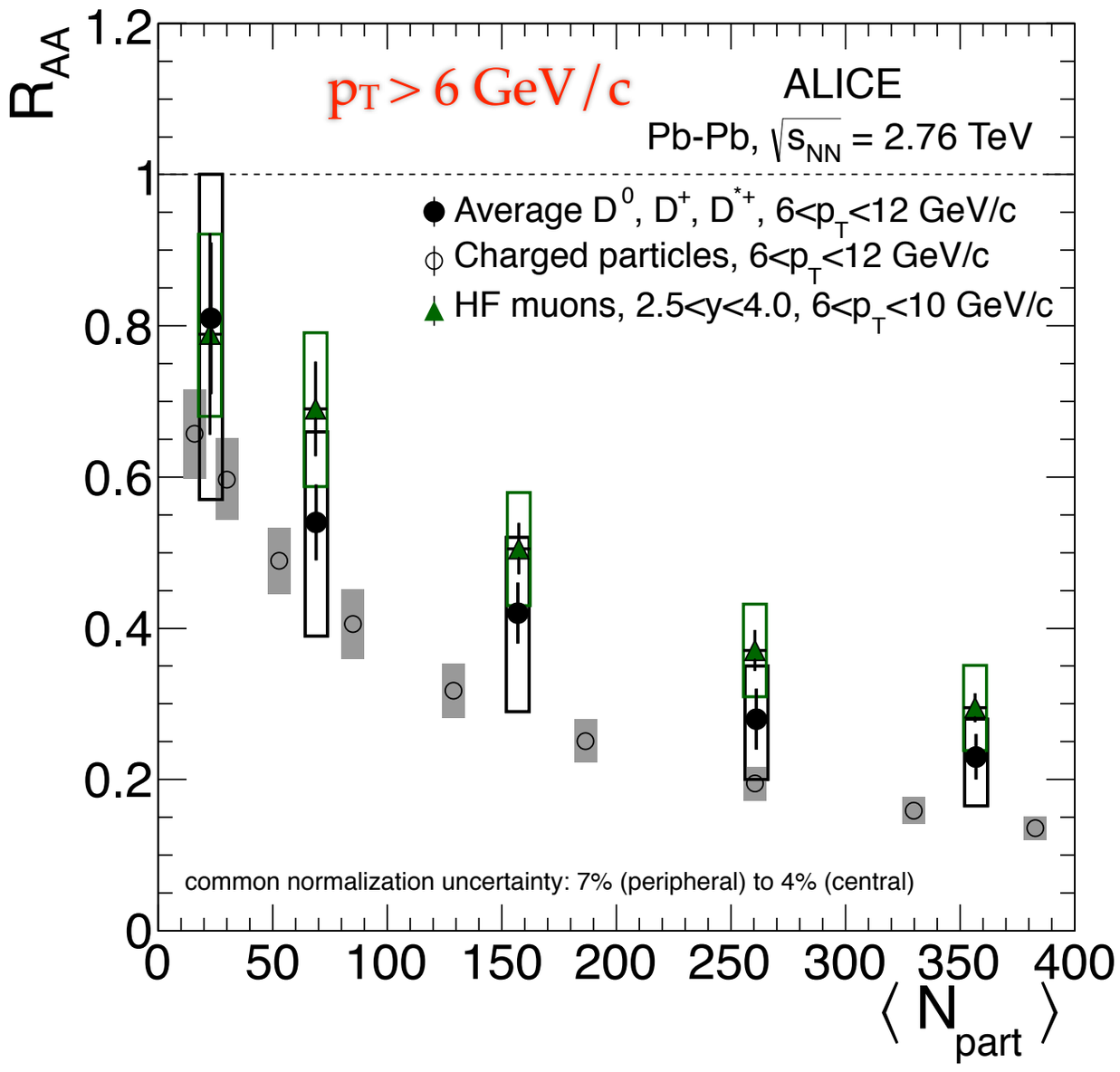
RAA Centrality Dependence



[ALICE Coll. arXiv:1203.2160 (2012)]
[ALICE Coll. arXiv:1205.6443 (2012)]

➡ **D mesons and HF muon R_{AA} at high-p_T show a similar centrality trend**

R_{AA} Centrality Dependence



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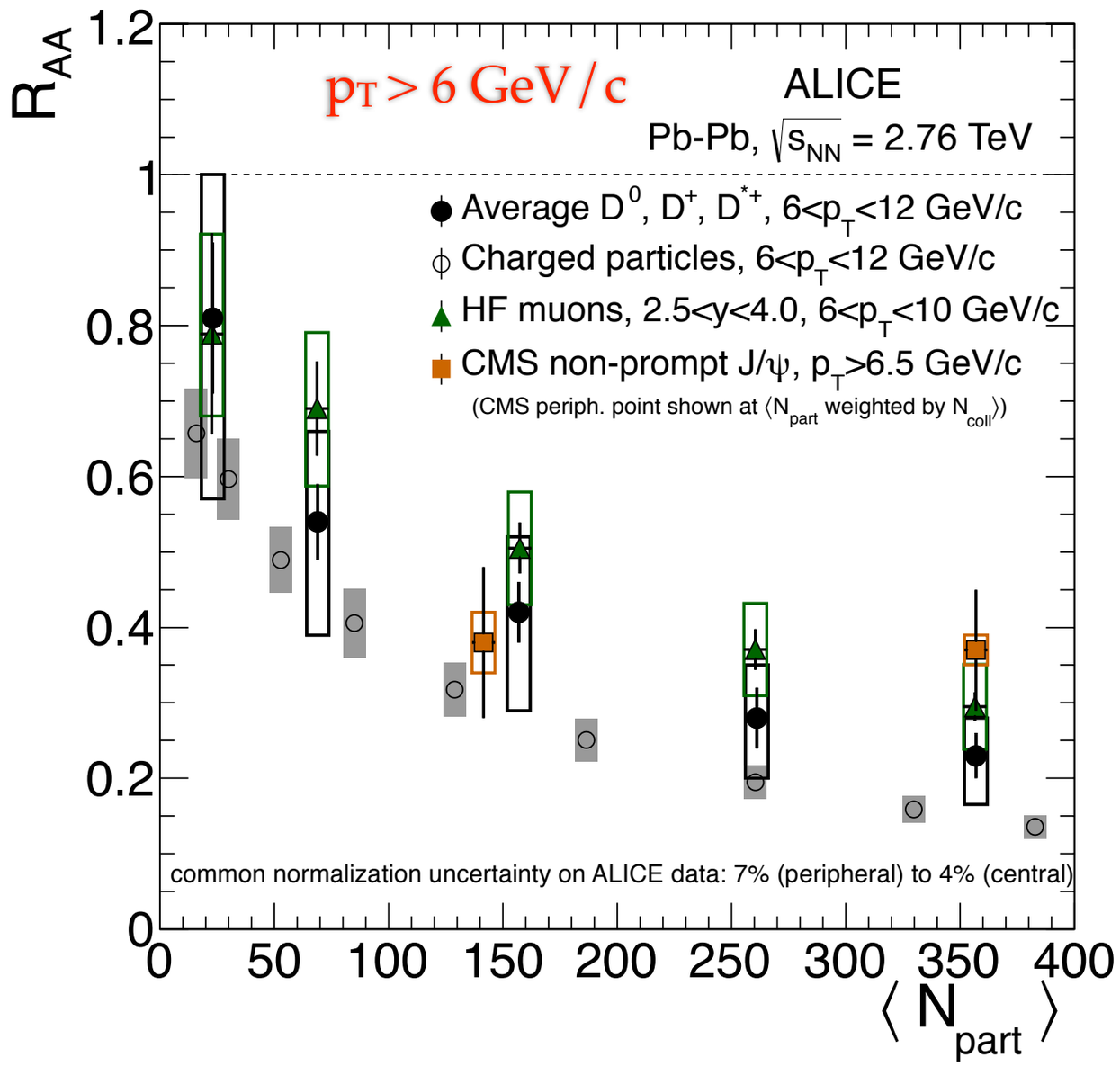

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[CMS Coll., JHEP 05 (2012) 063]

- D mesons and HF muon R_{AA} at high-p_T show a similar centrality trend
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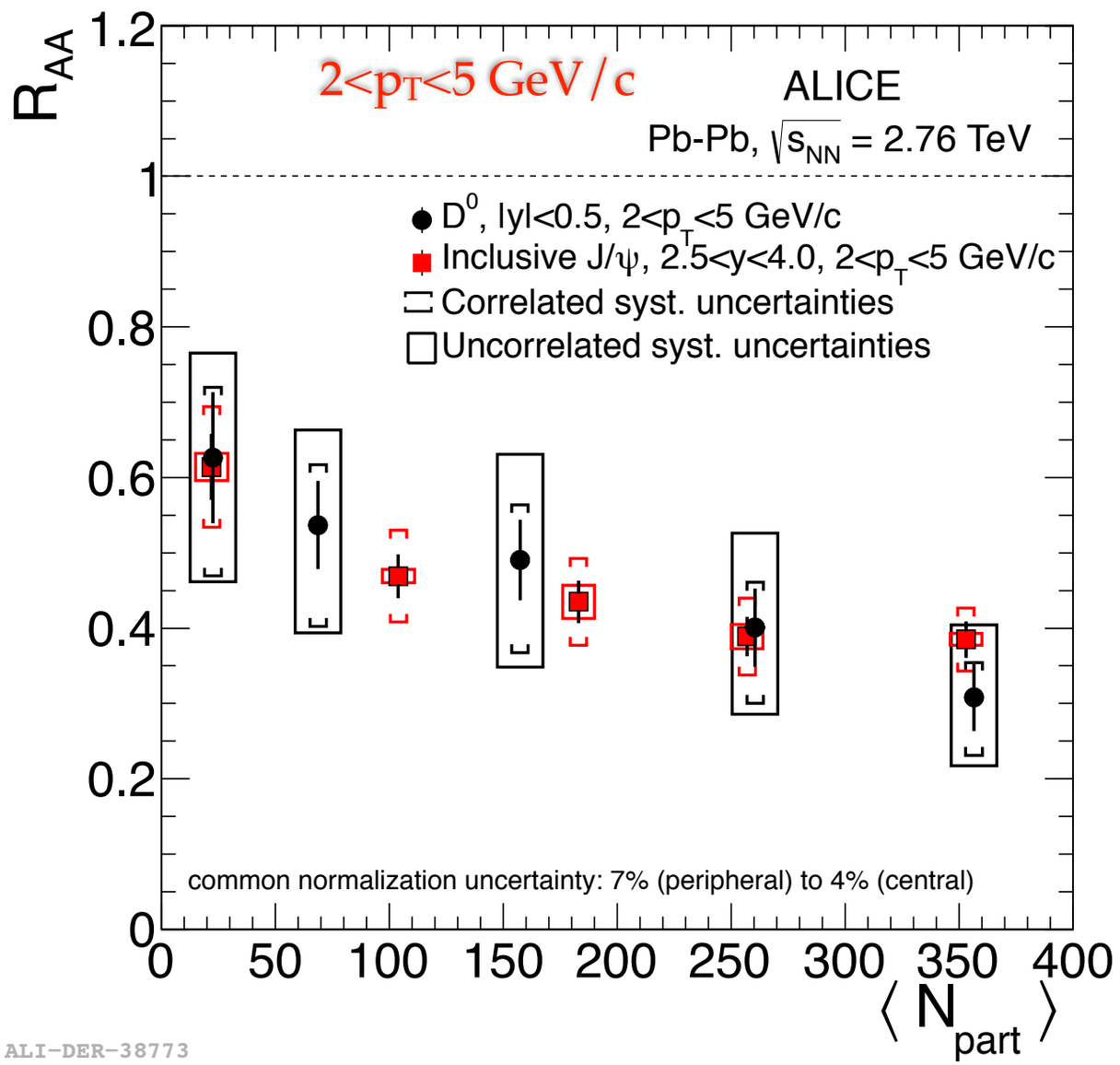
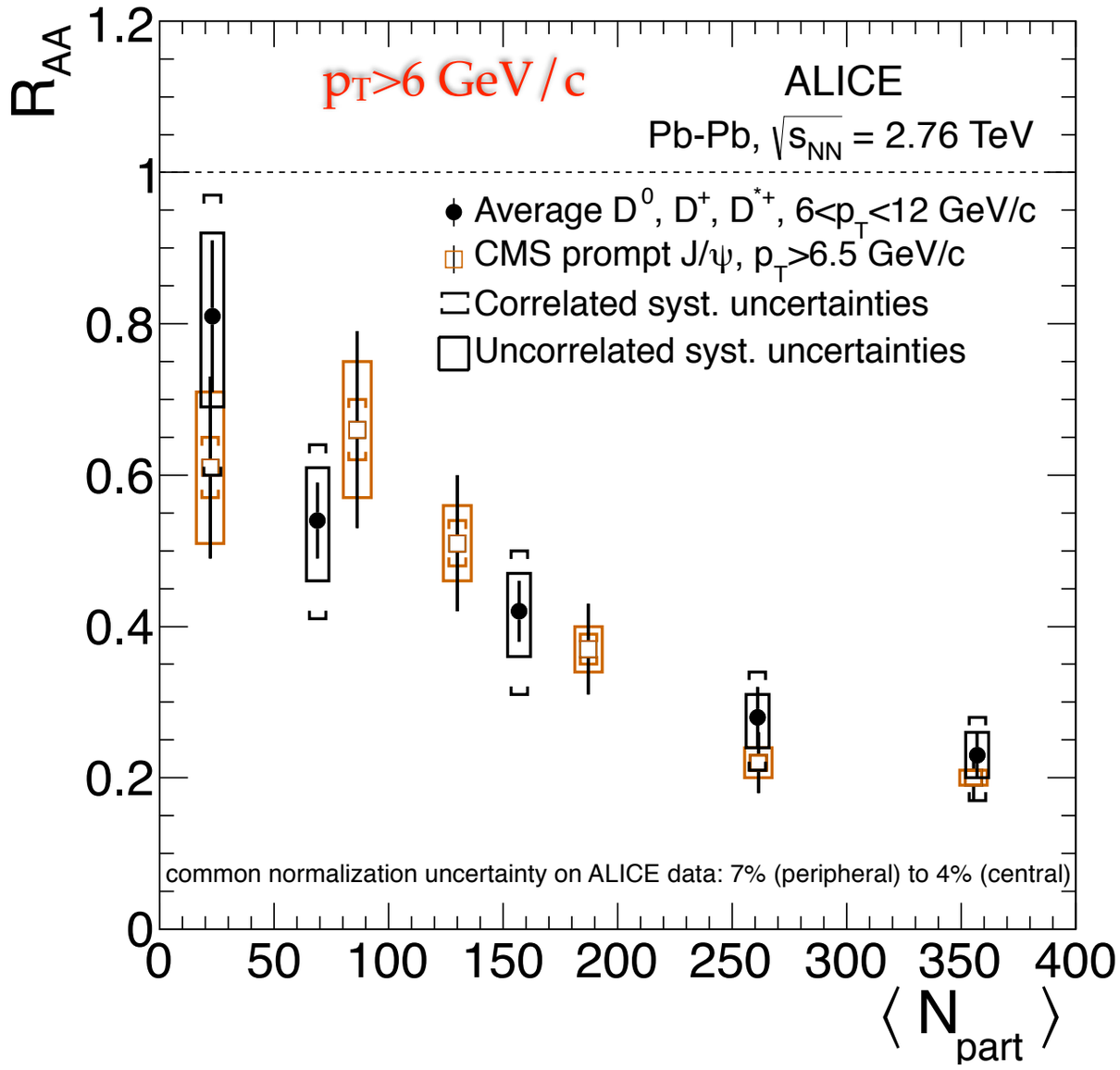
- Non-prompt J/ψ (CMS) consistent with HF muon R_{AA}

R_{AA} of Open and Hidden Charm



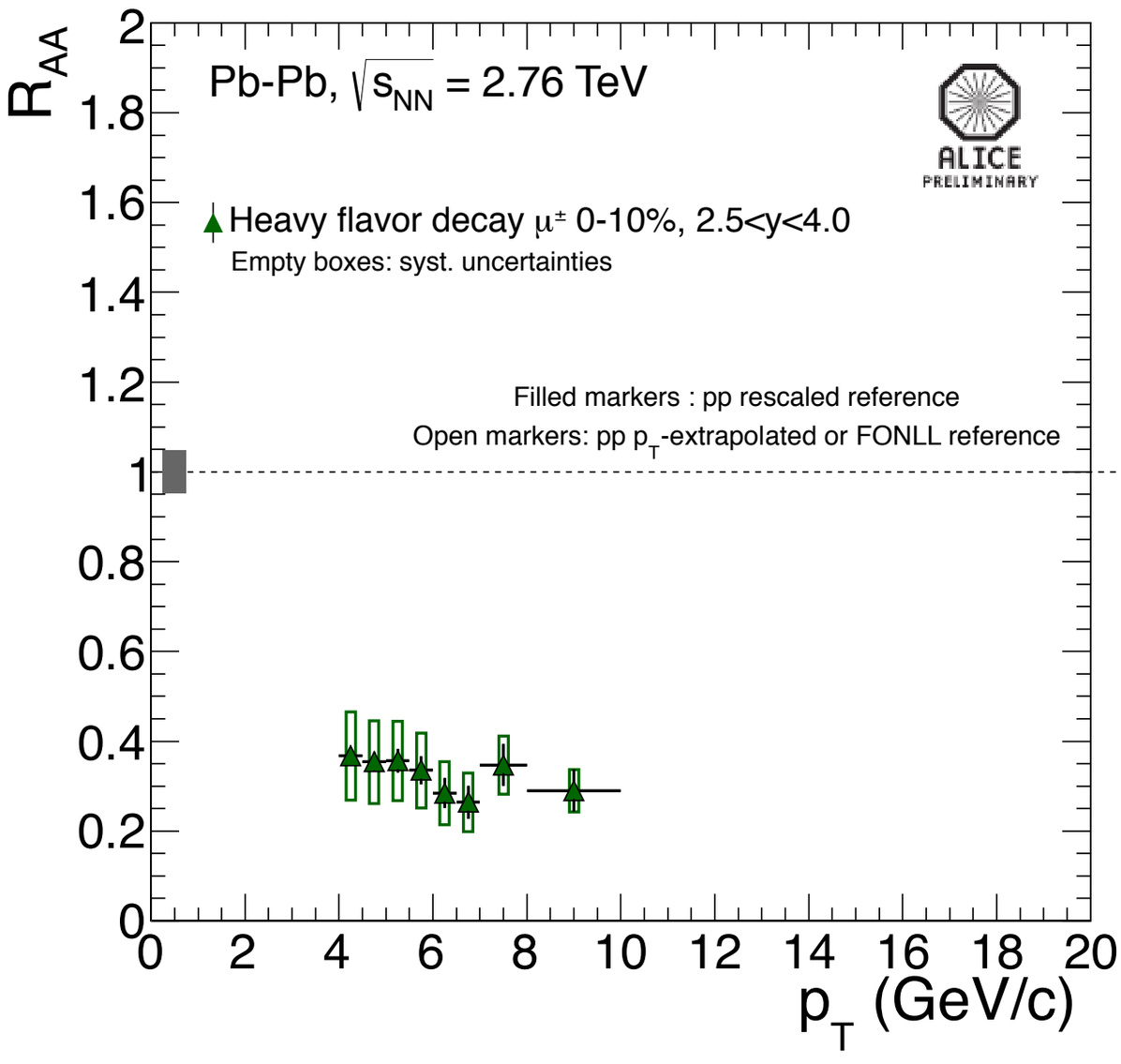


ALI-DER-38773

[ALICE Coll. arXiv:1203.2160 (2012)] [CMS Coll., JHEP 05 (2012) 063]

- ➡ Similar trend of D mesons and J/ψ at low and high p_T
  - 2<p_T<5 GeV/c D (|y|<0.5) vs inclusive J/ψ (ALICE, 2.5<y<4.0)
  - $p_T \gtrsim 6$ GeV/c D (|y|<0.5) vs prompt J/ψ (CMS, |y|<2.4)

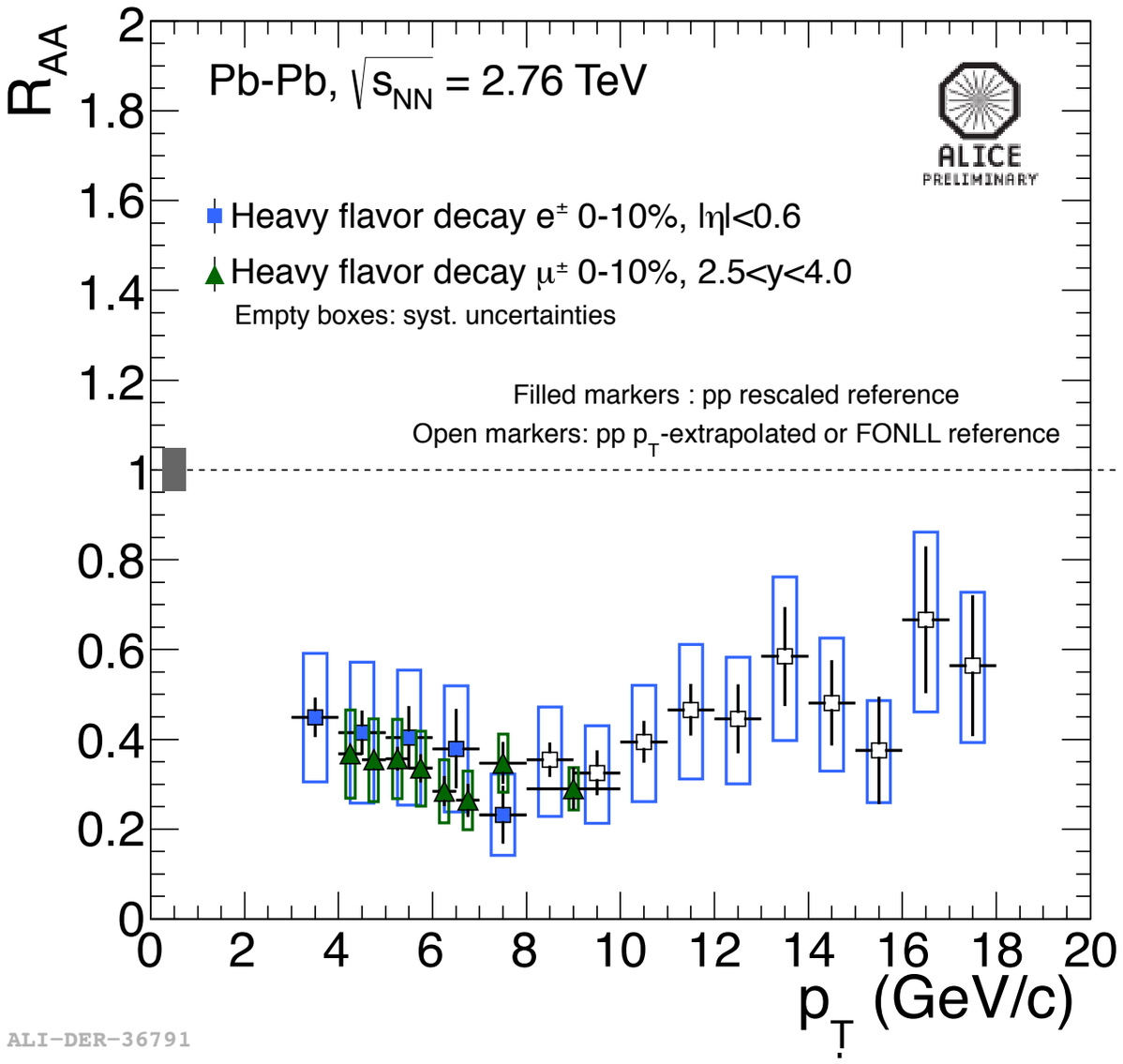
R_{AA} p_T Dependence



➡ Similar HF decay e (|y|<0.6) and μ (2.5<y<4.0) R_{AA} in 0-10%

[ALICE Coll. arXiv:1205.6443 (2012)]

R_{AA} p_T Dependence



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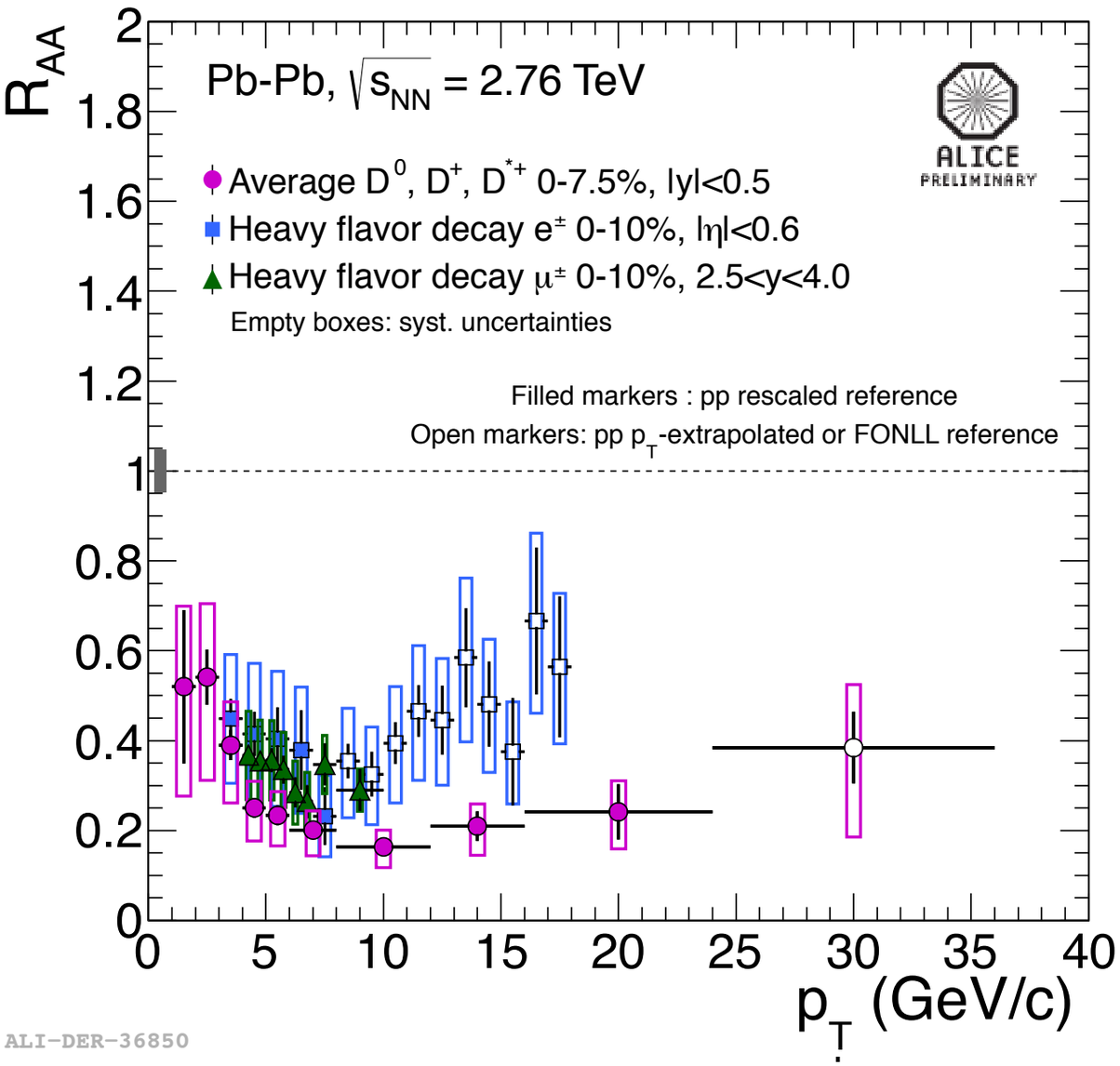
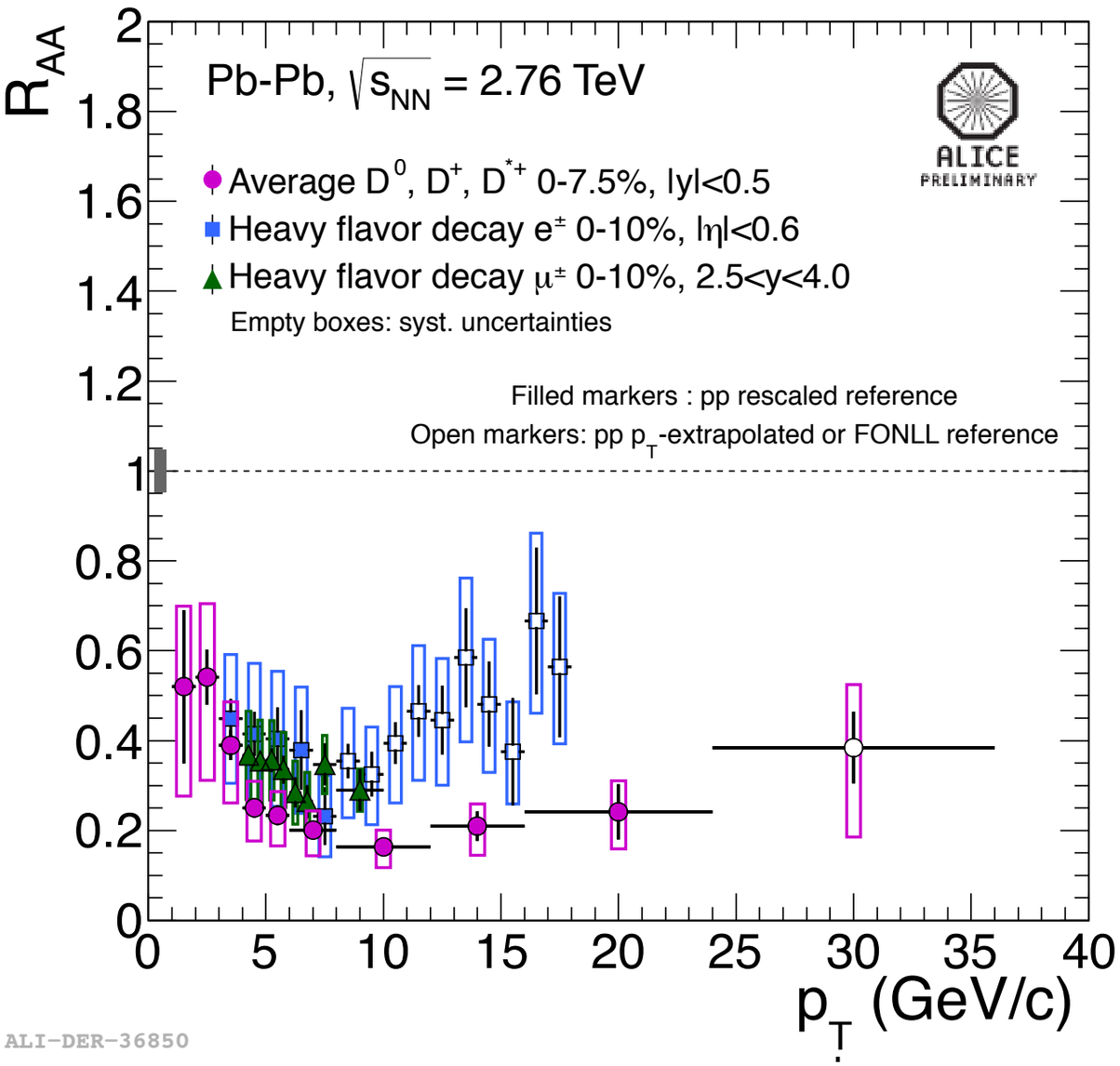
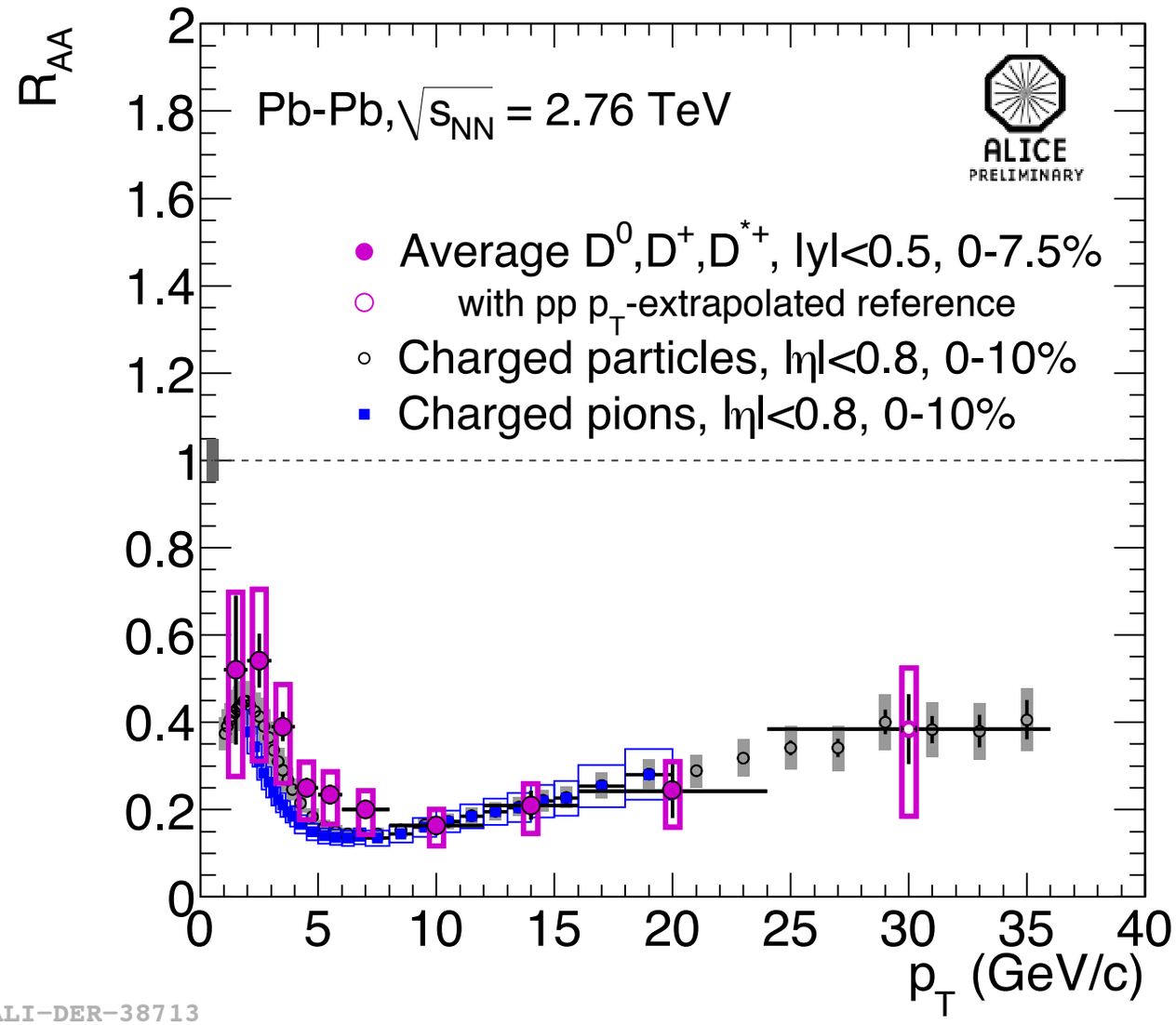


- Similar HF decay e (|y|<0.6) and μ (2.5<y<4.0) R_{AA} in 0-10%
- they are also comparable with D mesons R_{AA} (|y|<0.5) in 0-7.5% considering the semileptonic decay kinematics ($p_T^e \sim 0.5\ p_T^B$ at high p_T)
- D R_{AA} shows a similar trend as charged particles and $\pi^{\pm}$ in 0-10%

[ALICE Coll. arXiv:1205.6443 (2012)]

R_{AA} p_T Dependence





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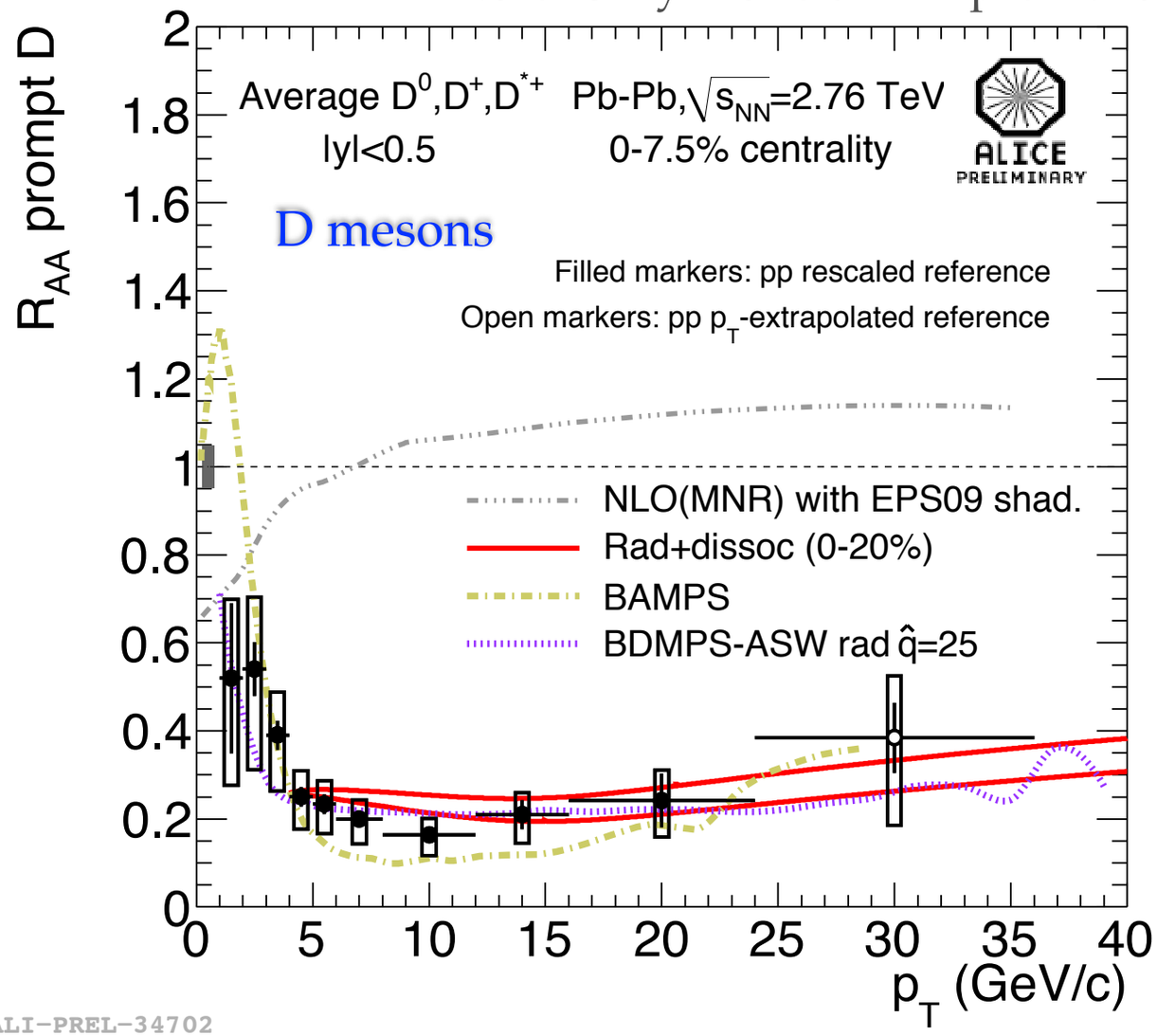
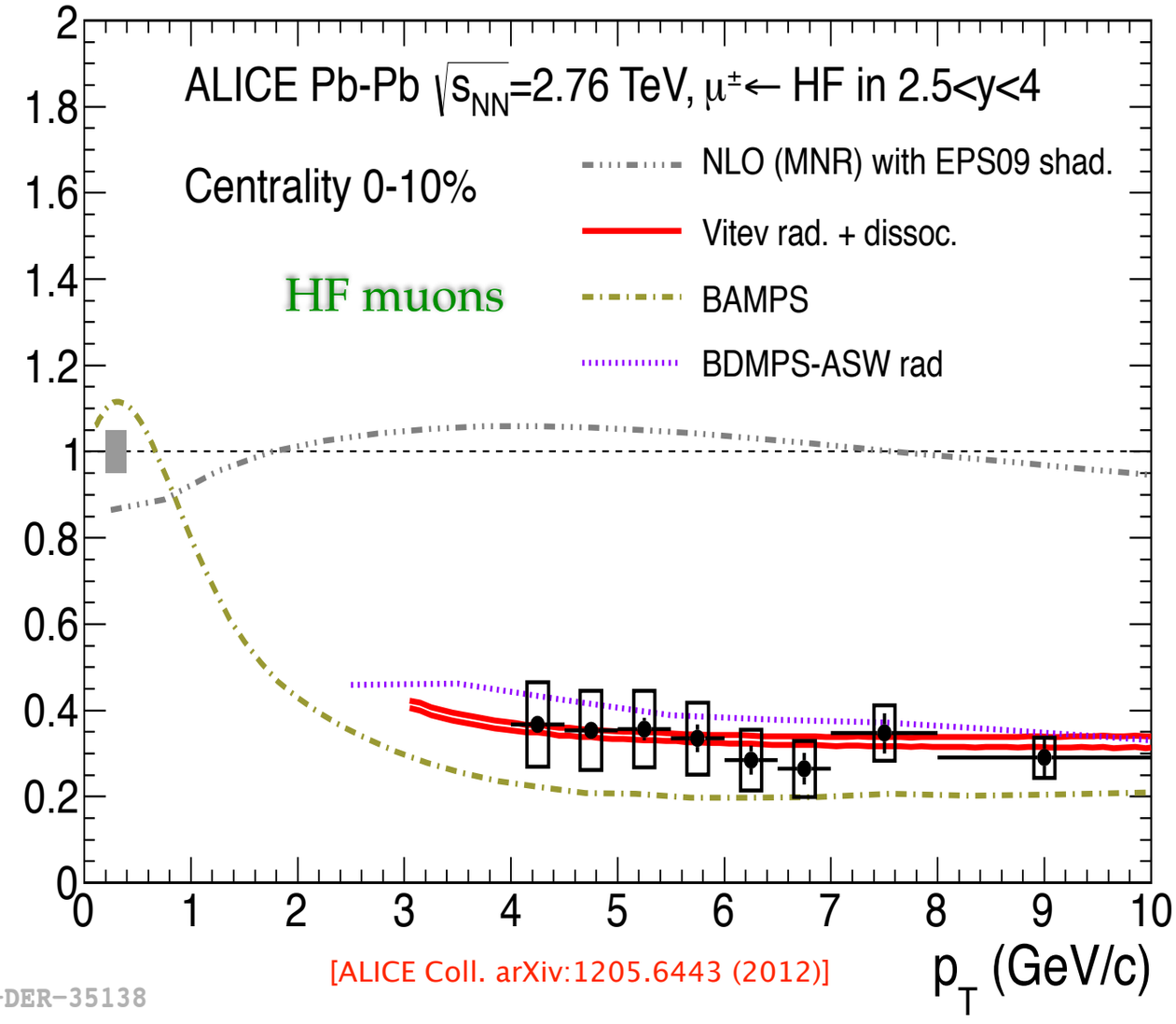
[ALICE Coll. arXiv:1205.6443 (2012)]

Models Description of R_{AA}

Note: Only models with predictions for HF muon and D mesons are shown.

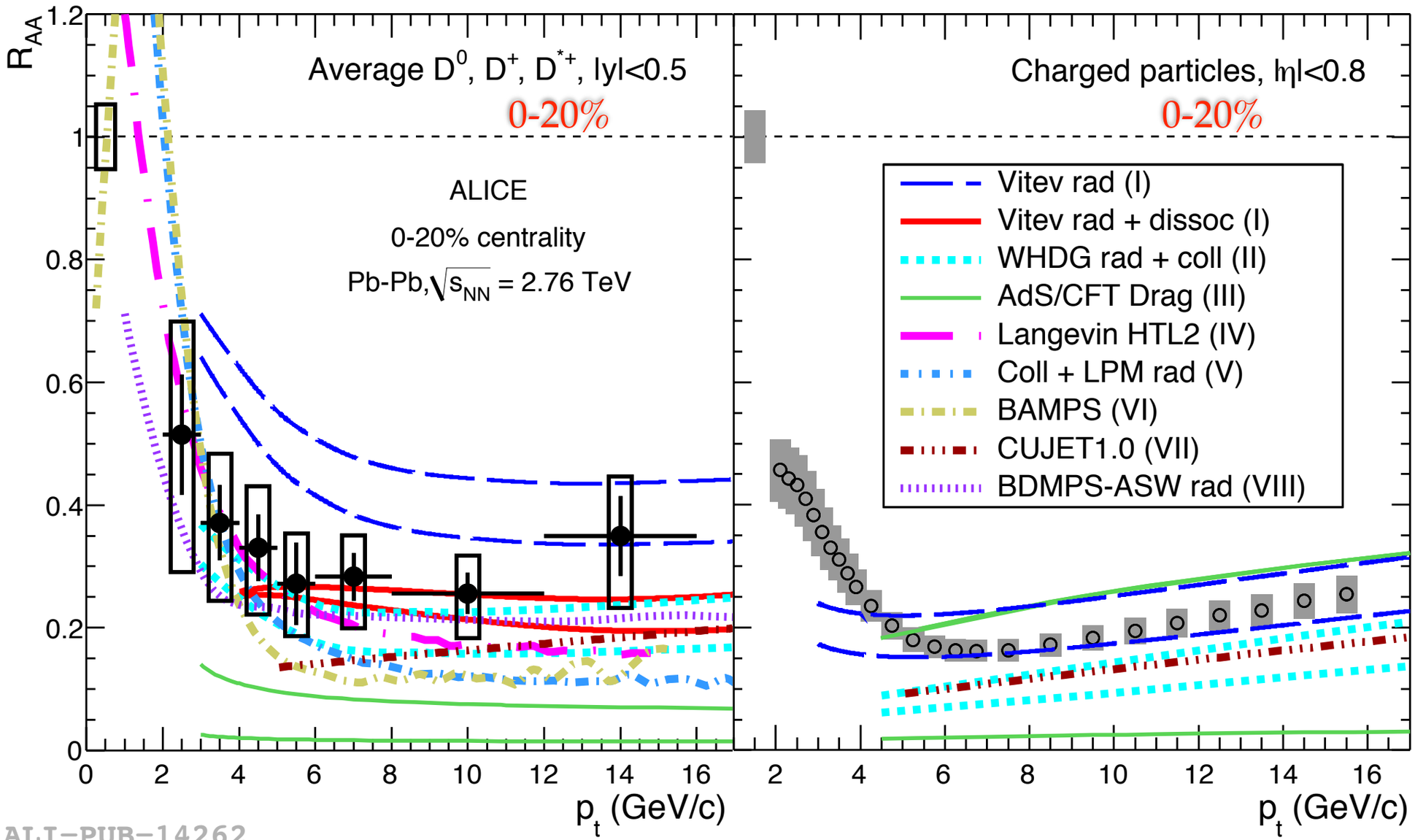




- HF decay μ & D mesons R_{AA} suppression in the most central collisions can not be explained by shadowing alone for p_T>4 GeV/c
  - ⇨ likely a final state effect
  - ⇨ need pPb data to quantify initial state effects
- Models describe reasonably well both HF decay μ and D mesons R_{AA}

Models Description of R_{AA}

D mesons | Charged particles

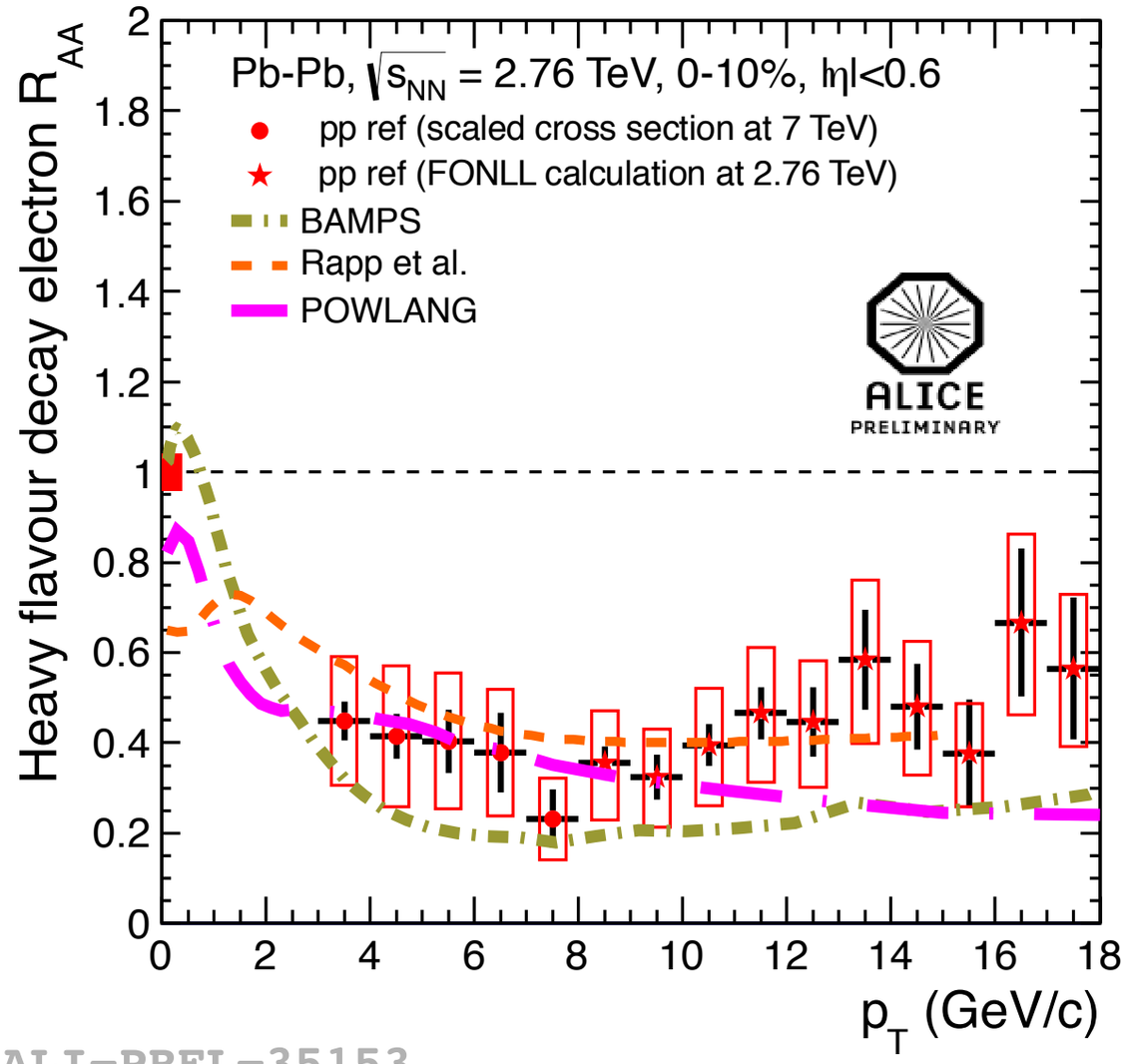


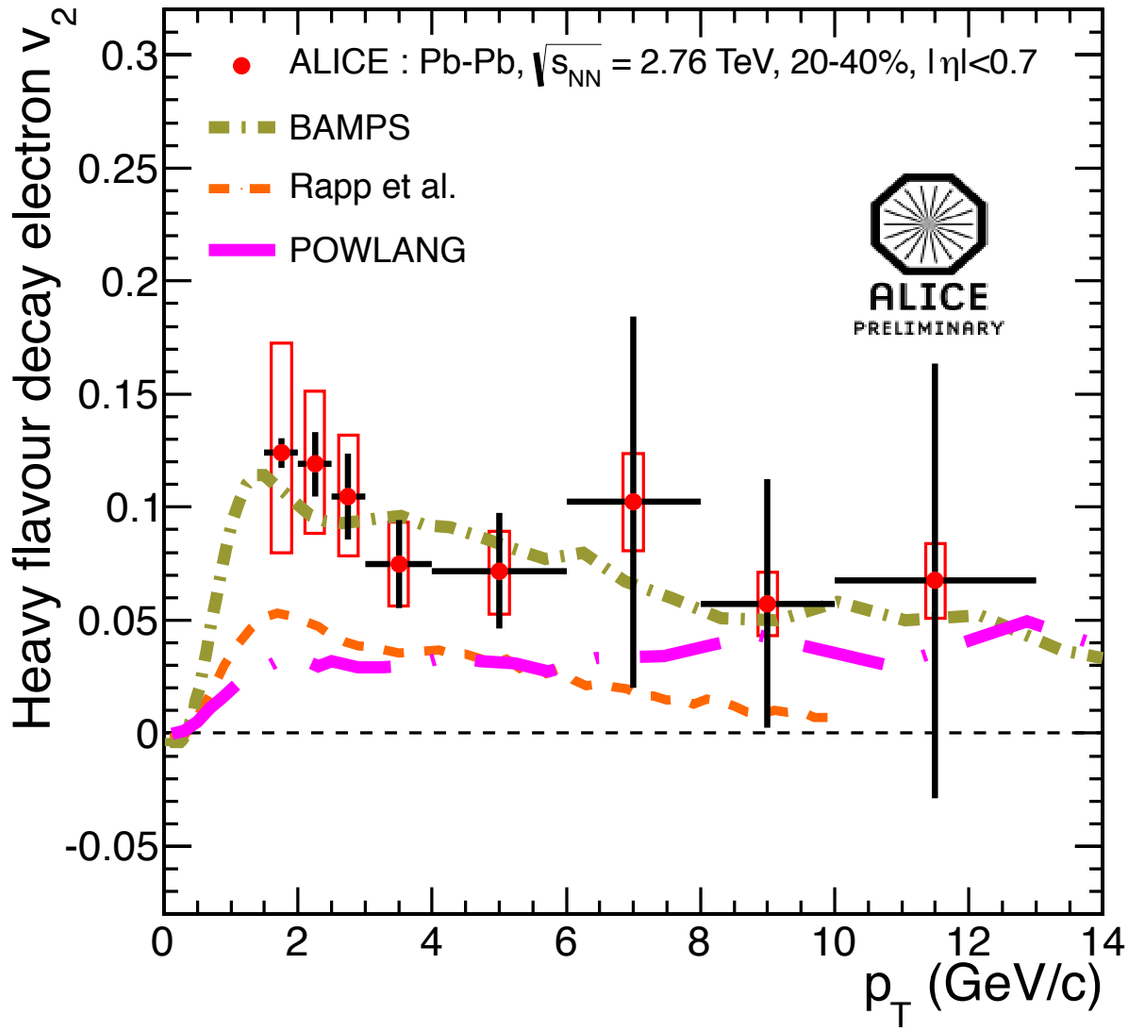
[ALICE Coll. arXiv:1203.2160 (2012)]

➡ **Models predict reasonably well both charged particles and D mesons R_{AA}**

✳ AdS/CFT drag coefficients underestimate the charm R_{AA} and have limited predictive power for the light flavor R_{AA}.

Heavy Flavor electron R_{AA} & v_2

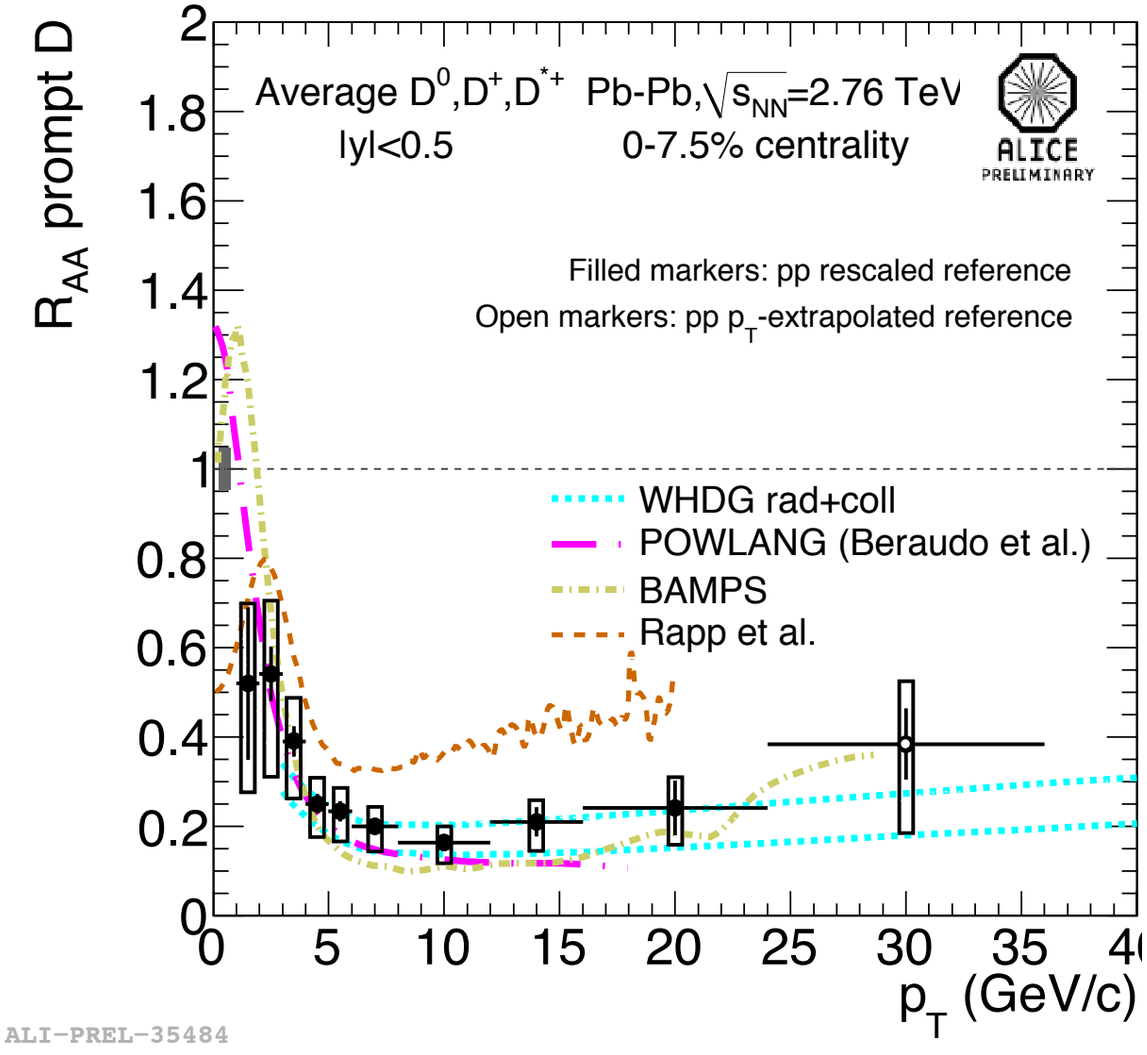


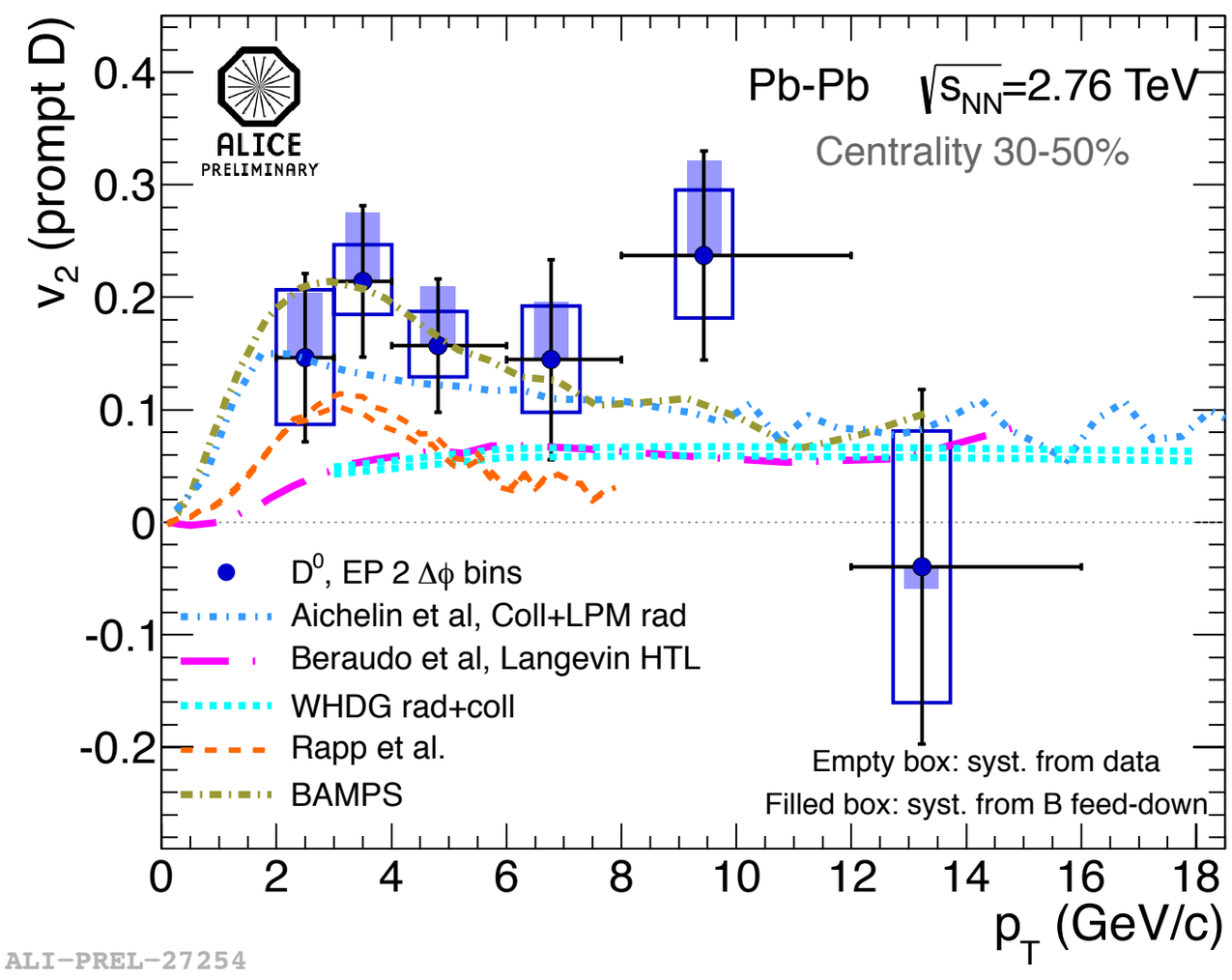


ALI-PREL-35153

➡ **The simultaneous description of HFe R_{AA} and v_2 is challenging**

D meson R_{AA} & v_2





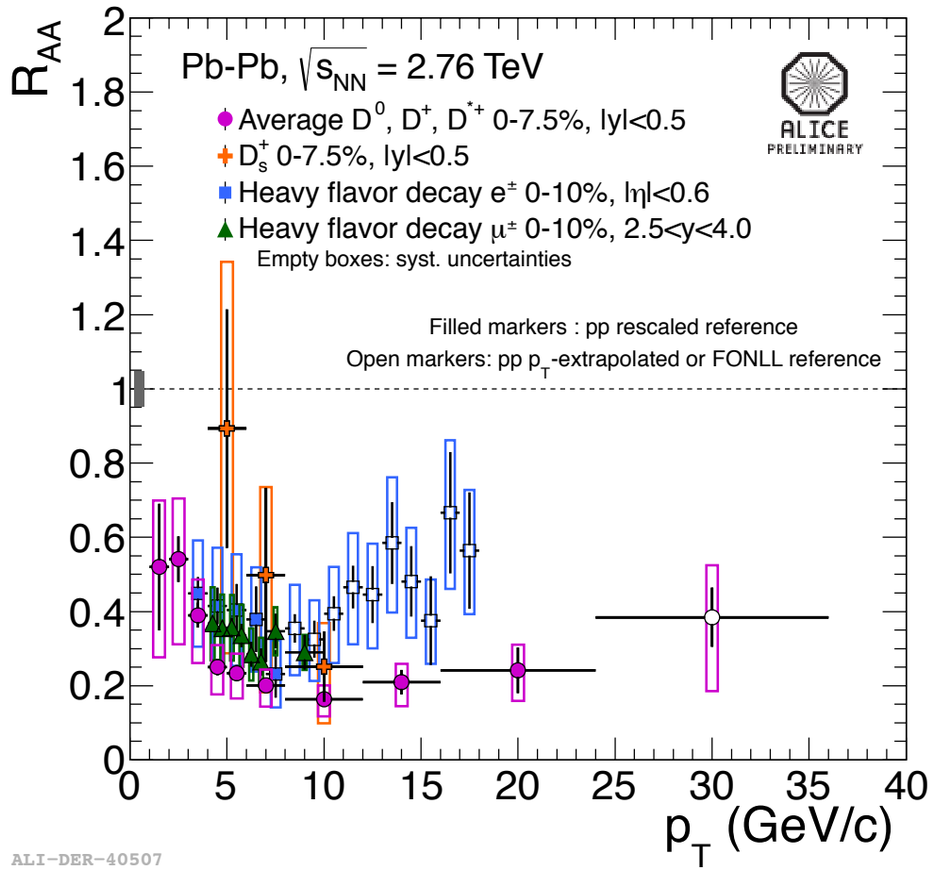
➡ **The simultaneous description of D mesons R_{AA} and v_2 is challenging**

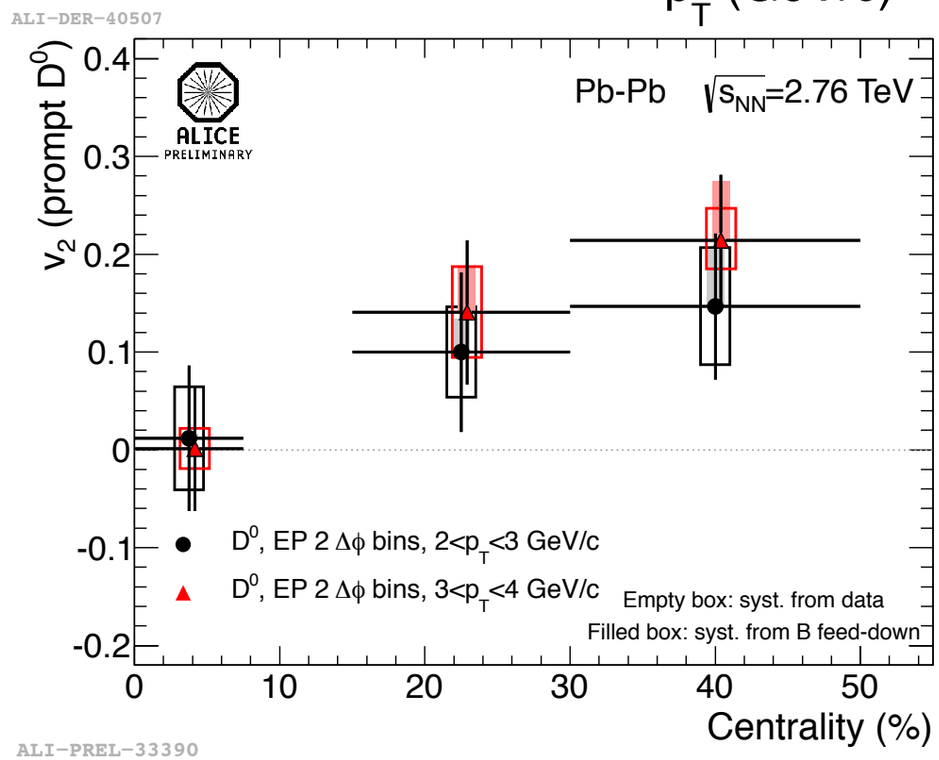
SUMMARY

- HF e, HF μ & D mesons are suppressed in the most central collisions
  - First measurement of D_s^+ meson in HIC
  - Charged particles and pions have a similar p_T and centrality trend than D meson R_{AA}

- HF azimuthal anisotropy:
  - $v_2>0$ for HFe (D mesons) at $2<p_T<3$ GeV/c ($2<p_T<6$ GeV/c)
  - Hint of centrality dependence at low p_T (D^0)

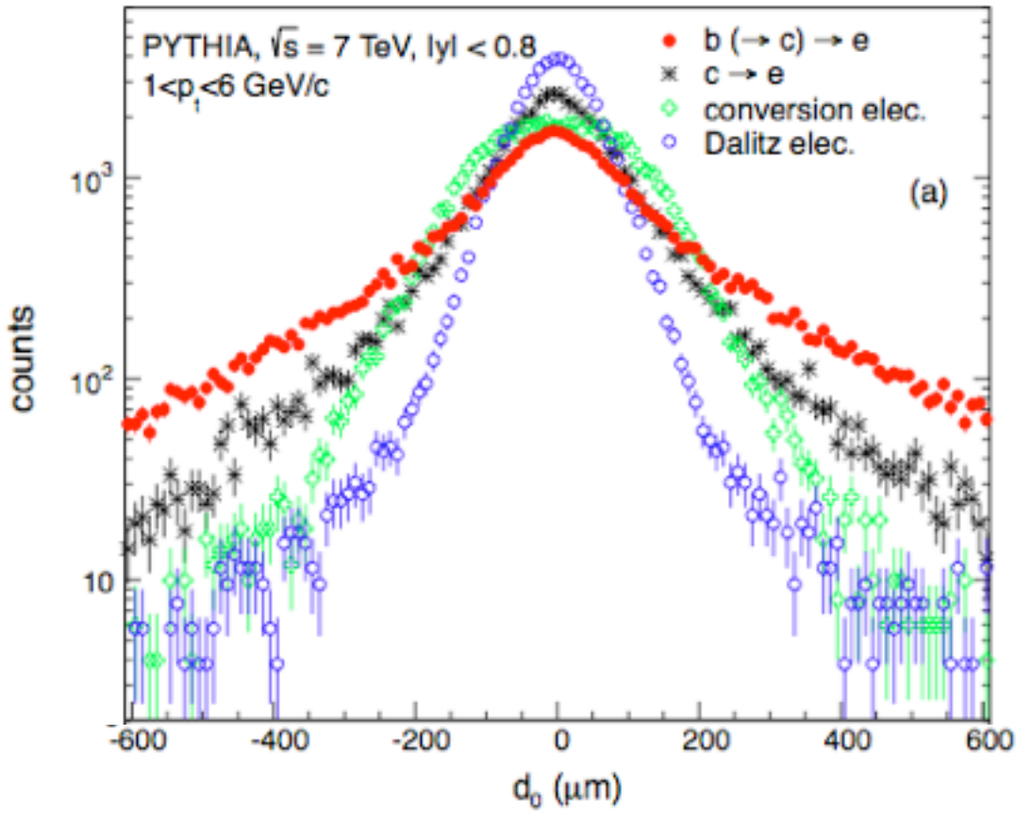
- HQ energy loss models reproduce reasonably well heavy flavor R_{AA} measurements.
  Challenging simultaneous description of R_{AA} and v_2



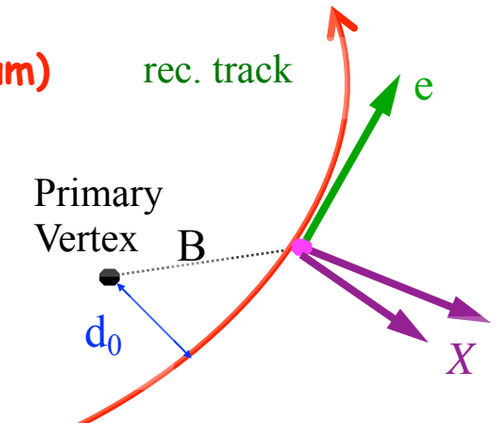


Backup

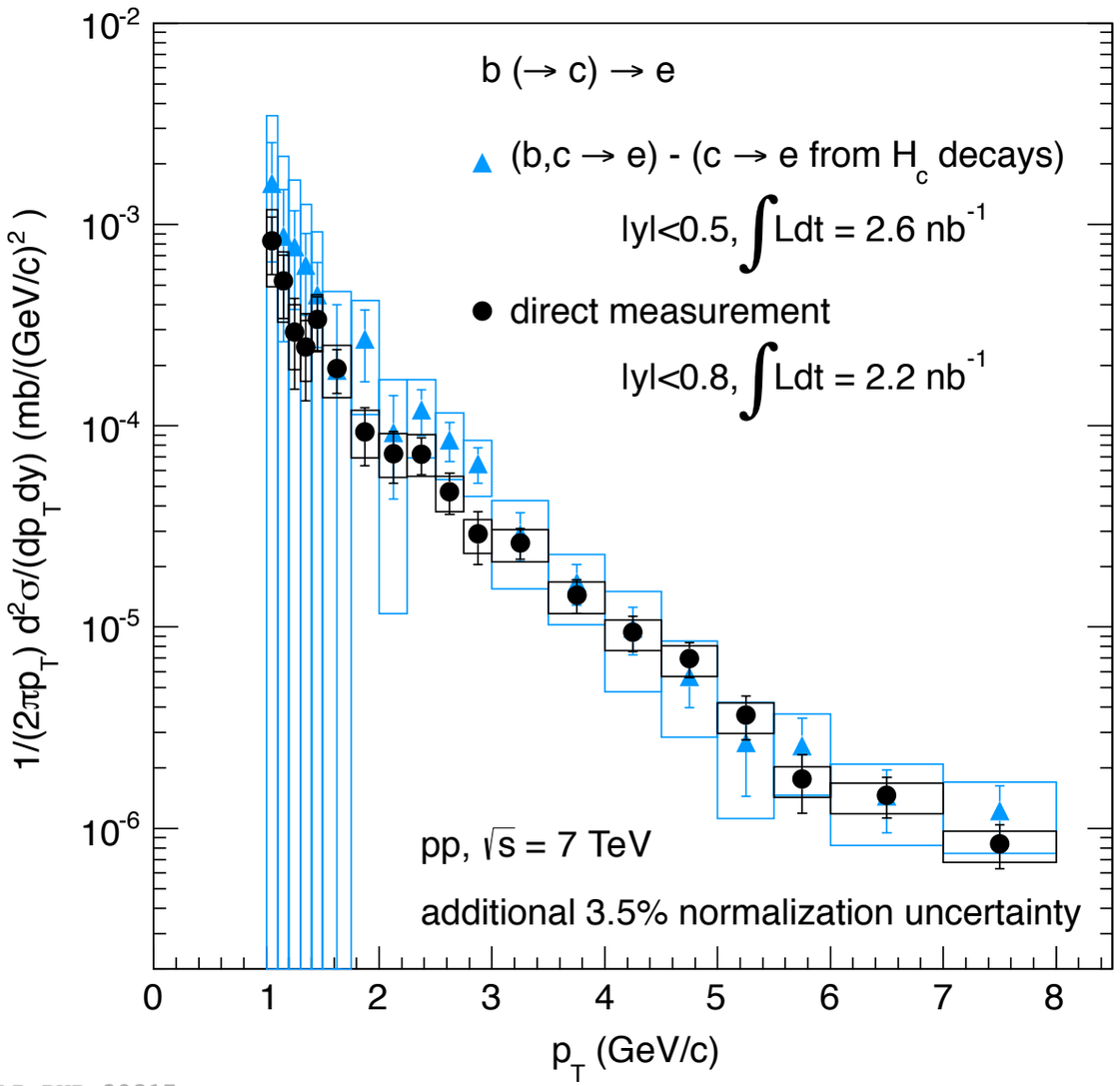
Beauty decay electrons, pp $\sqrt{s}$=7 TeV



(b-tagging, $c\tau$~500μm)

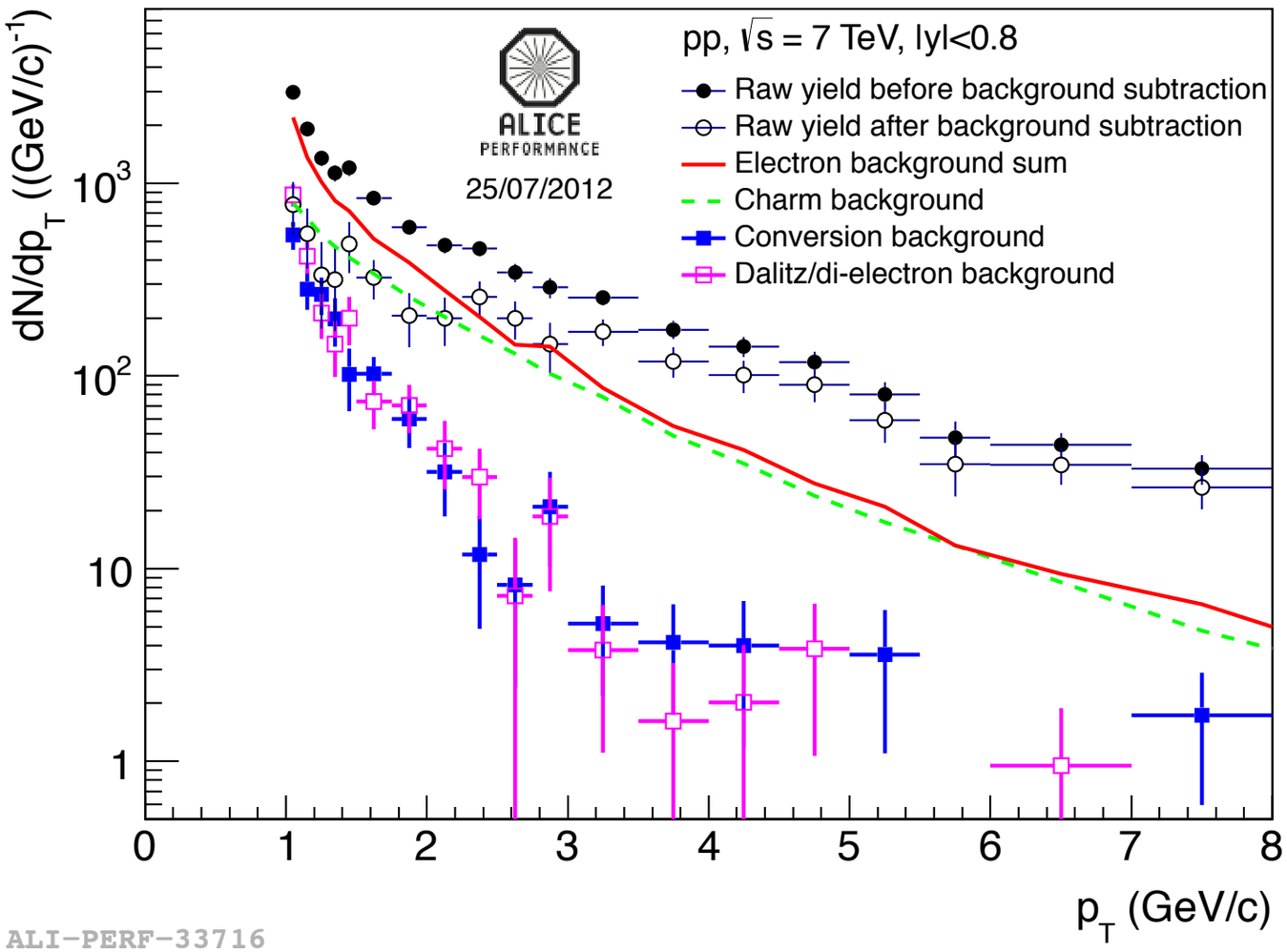


- Measurement of B⟶$e^{\pm}$
  - B hadrons lifetime ($c\tau$ ~ 500μm)
    ⇨ Selection on impact parameter (d_0)
    $|d_0(\mu m)| > 64 + 780 \exp(-0.56\ p_T(GeV/c))$
  - Electron identification : TPC+TOF
  - Background subtraction : cocktail of measured π^0, η, J/ψ, ϒ, D^0, D^+, D^{*+} + simulated light hadrons, γ, Λ_c,...

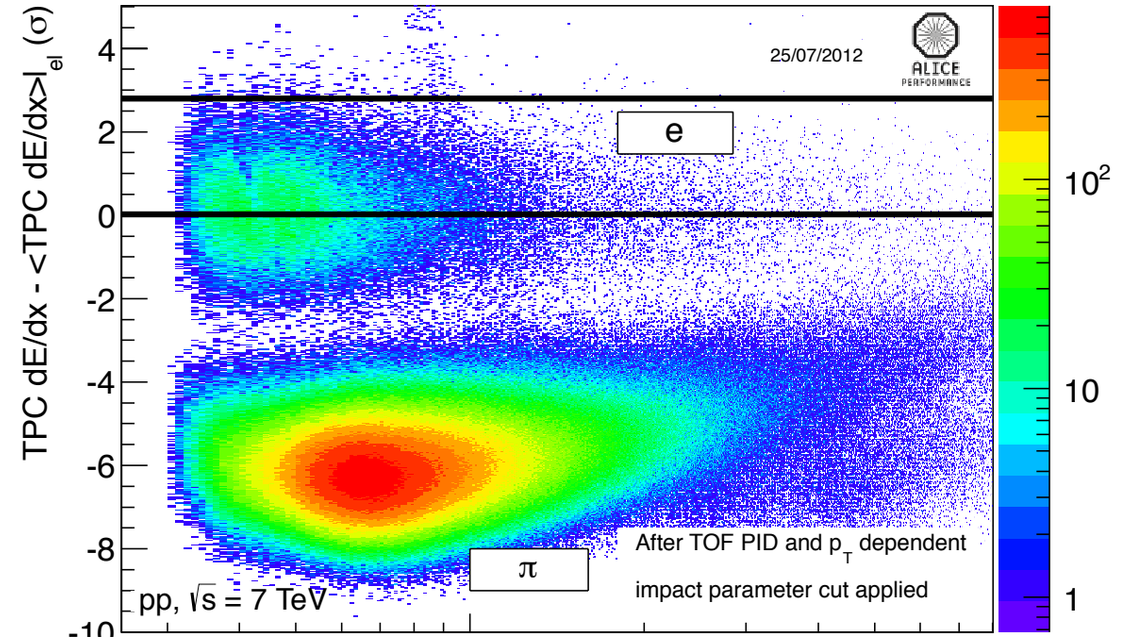


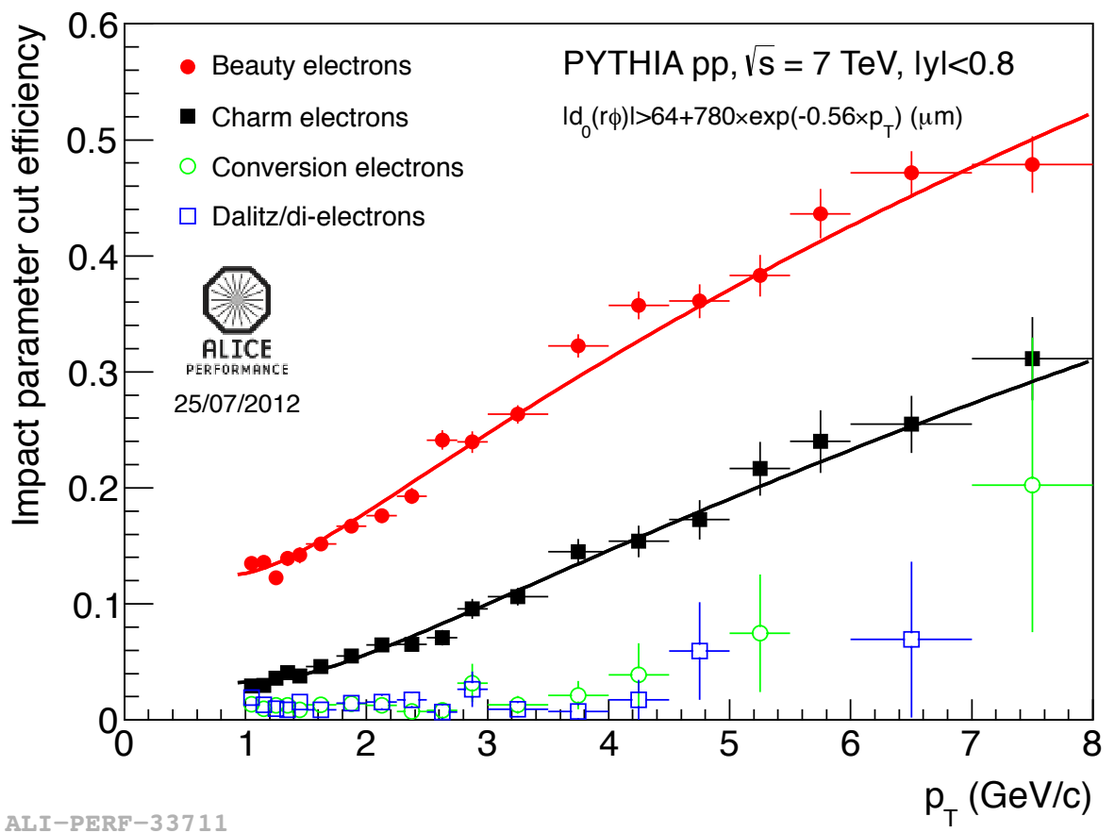
ALI-PUB-39817

Beauty decay electrons, pp $\sqrt{s}$=7 TeV



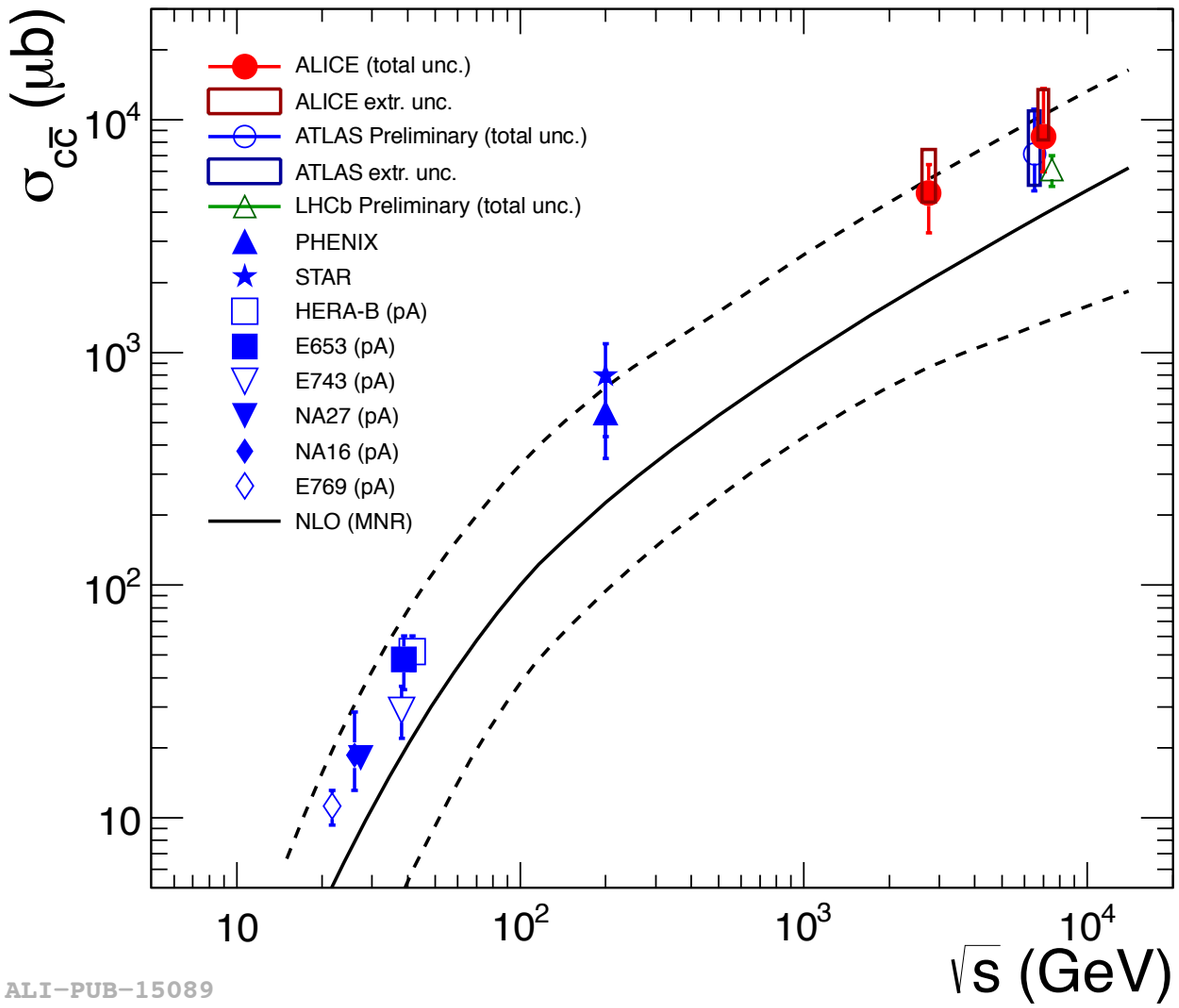
ALI-PERF-33716

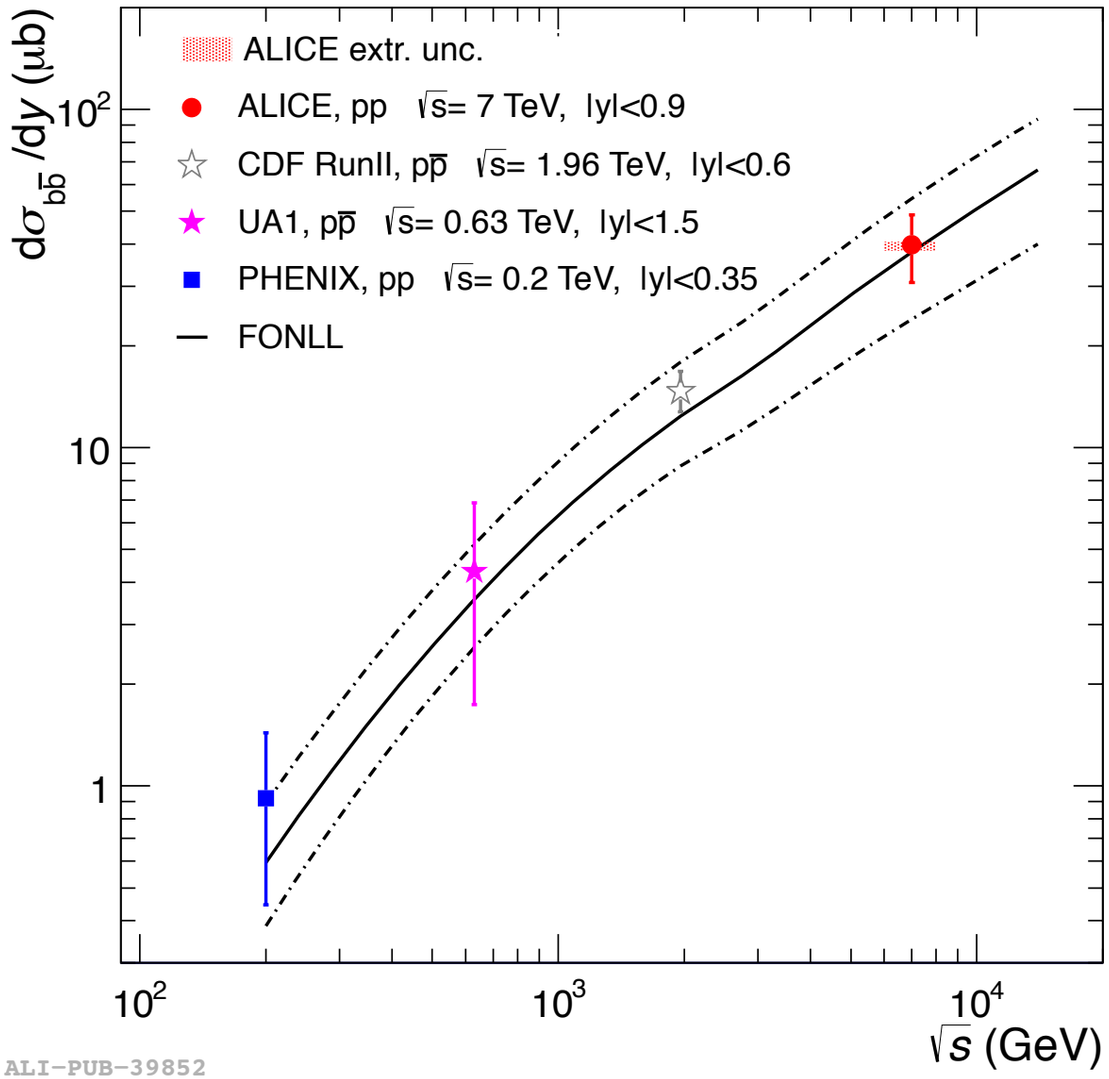




ALI-PERF-33711

Charm & Beauty Cross Sections



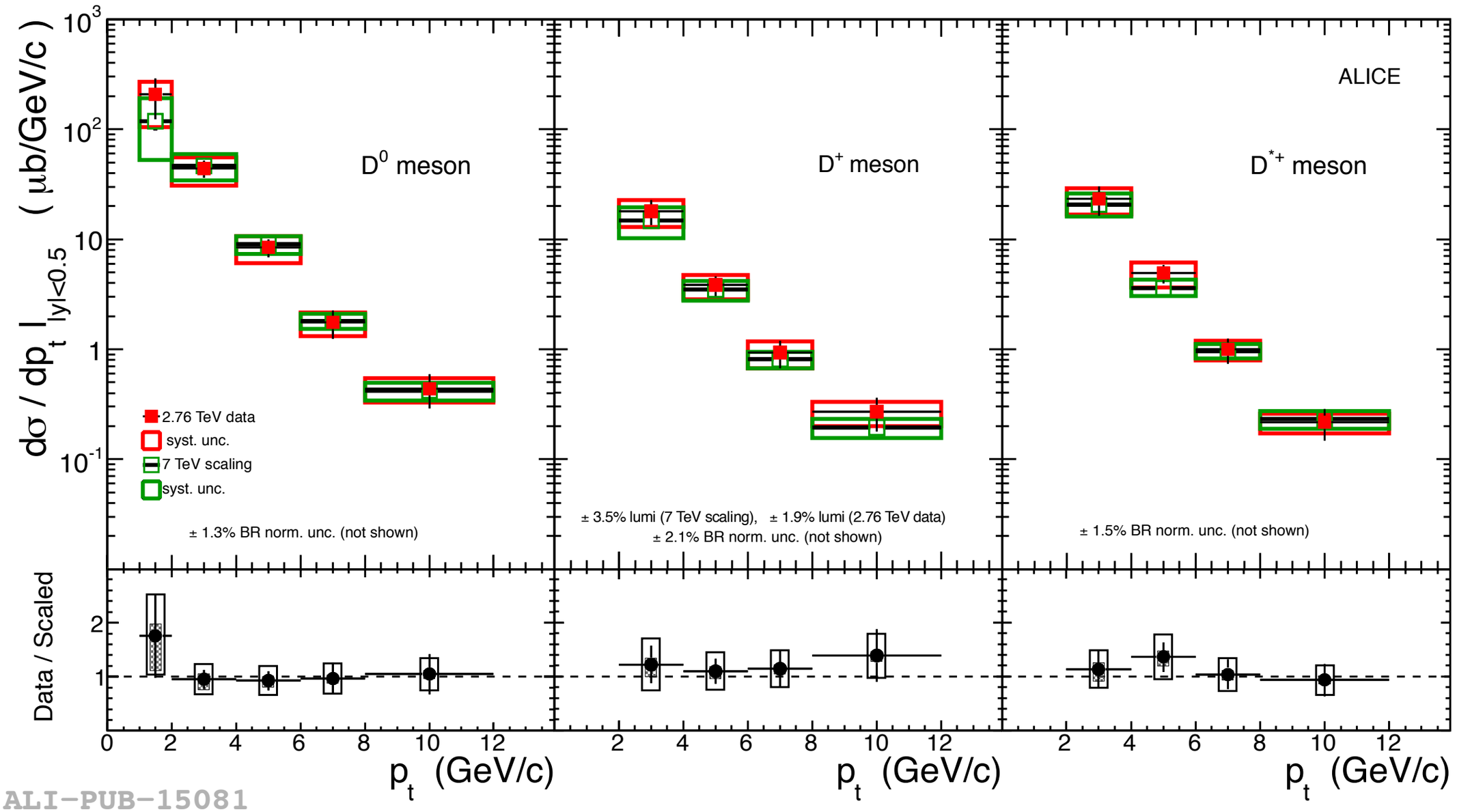


[ALICE Coll. JHEP 07 (2012) 191]

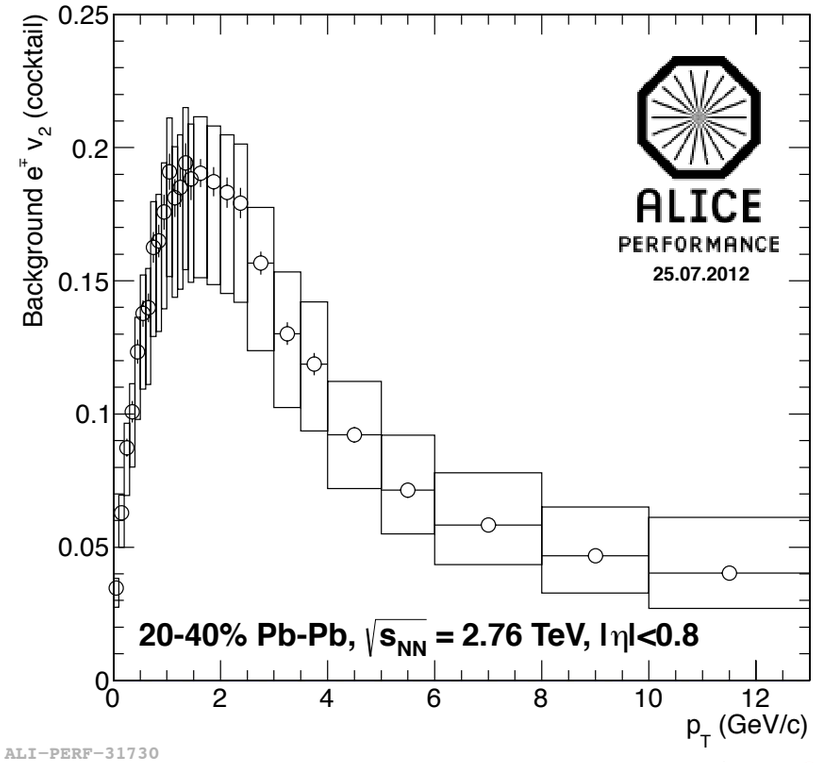
- Evaluated the total charm and beauty production cross sections.
- Their cross section evolution with $\sqrt{s}$ is well described by pQCD.

D Meson pp 2.76TeV, the reference

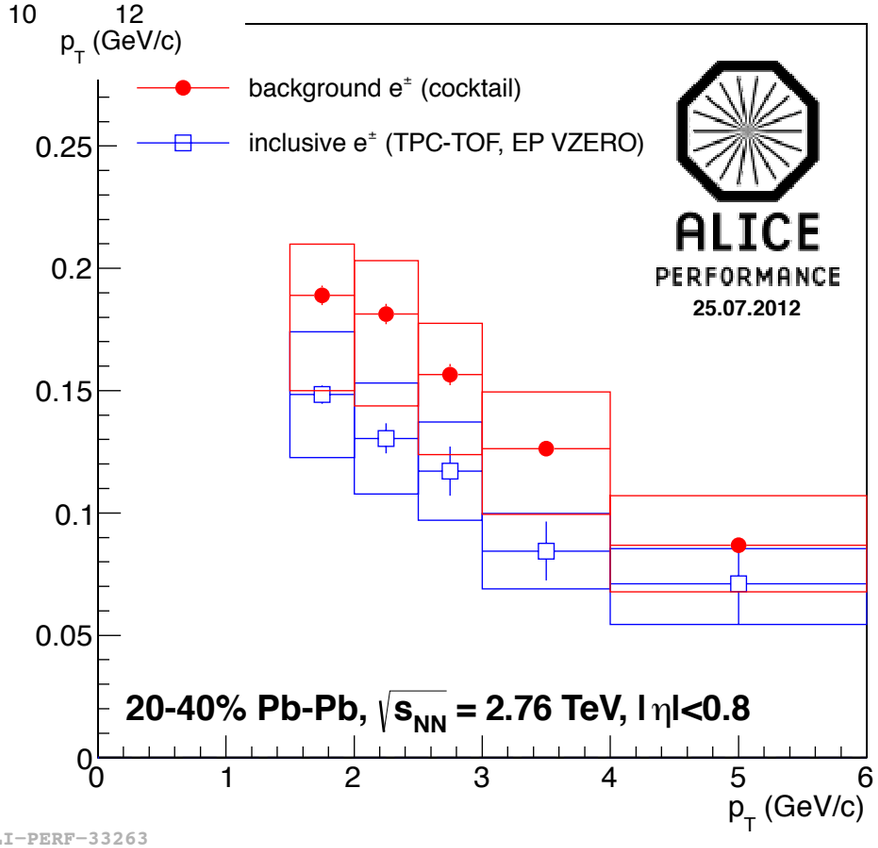
[ALICE Coll. JHEP 07 (2012) 191]



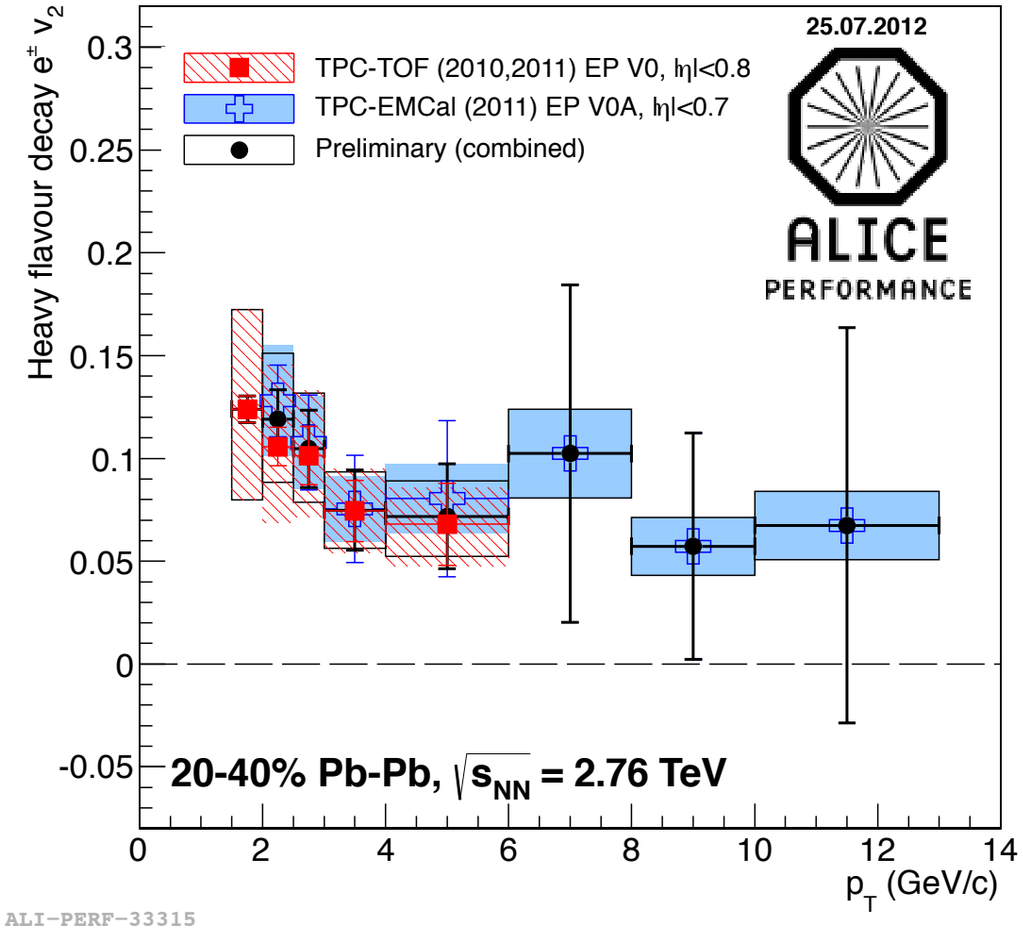
HF electron Background v_2



ALI-PERF-31730

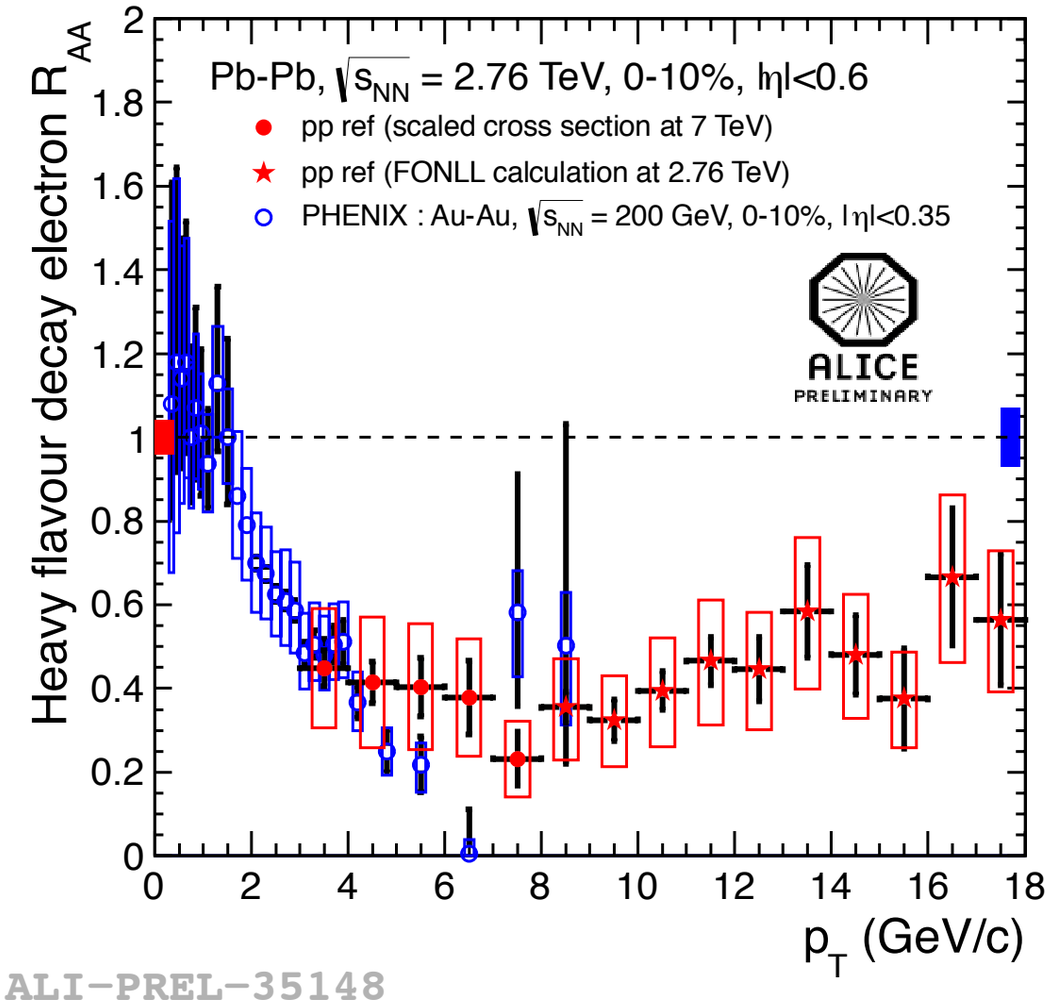


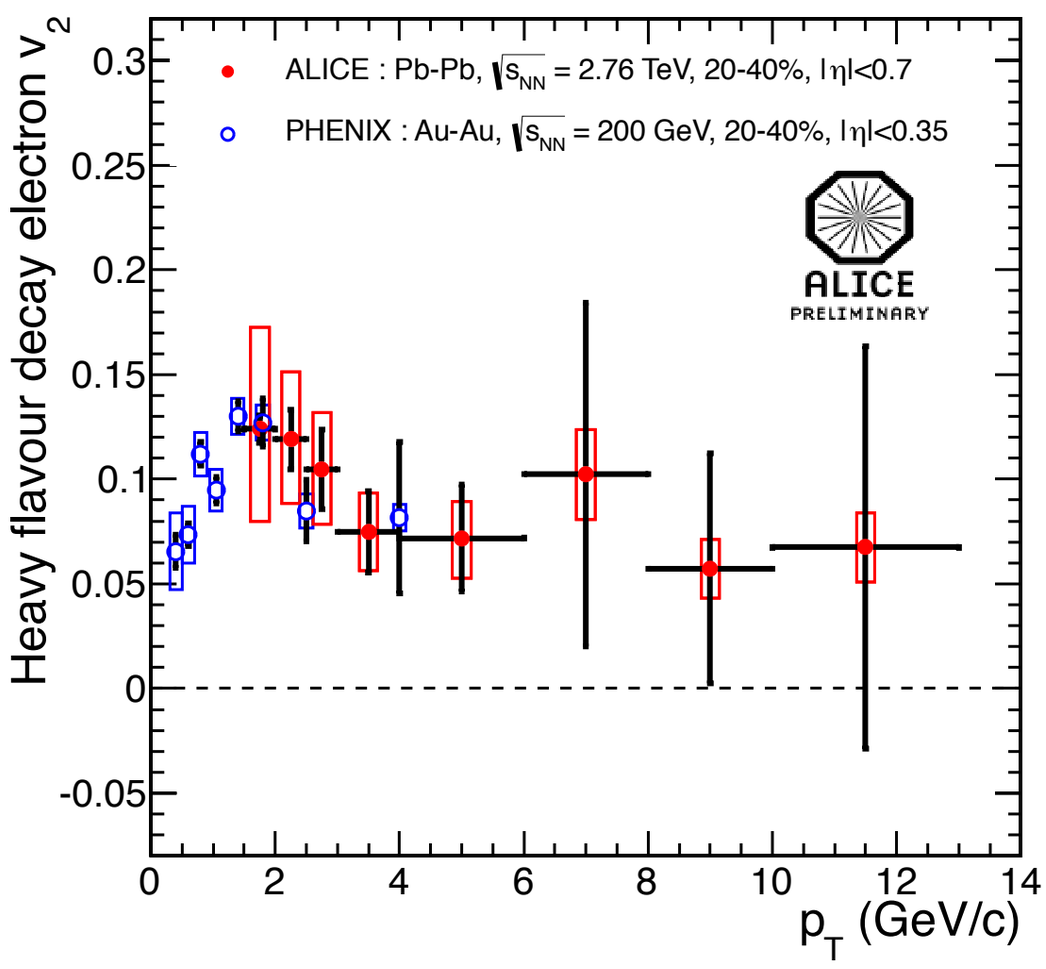
ALI-PERF-33263



ALI-PERF-33315

HFE R_{AA} AND v_2 AT RHIC AND LHC





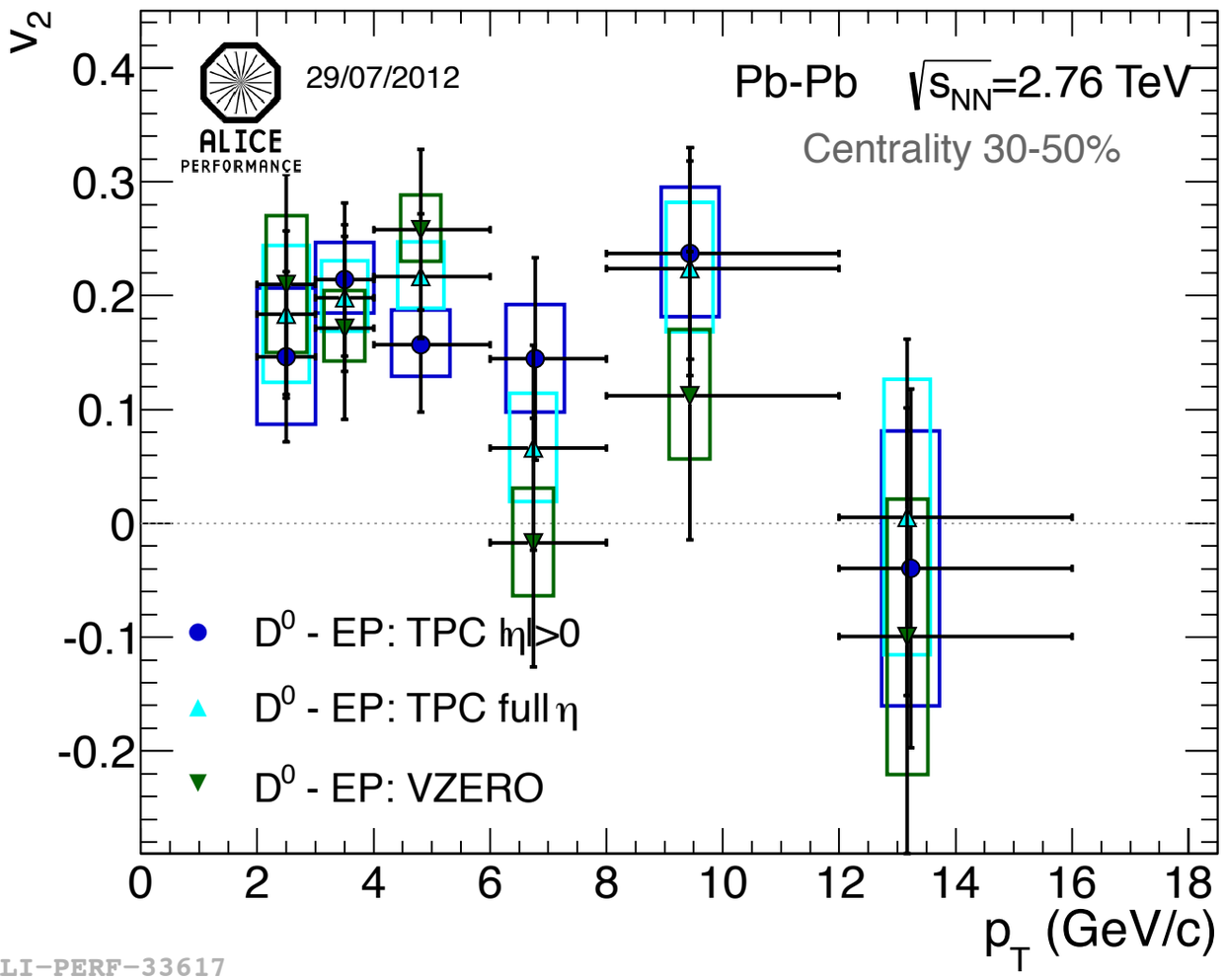
ALI-PREL-35148

➡ **Similar magnitude of heavy flavor electron R_{AA} ($3<p_T<9$ GeV/c) and v_2 ($1.5<p_T<4$ GeV/c) at $\sqrt{s_{NN}}$=200GeV (PHENIX) and $\sqrt{s_{NN}}$=2.76TeV (ALICE)**

✳ Caveat: c/b contribution to the HF electron spectra may differ at RHIC and LHC

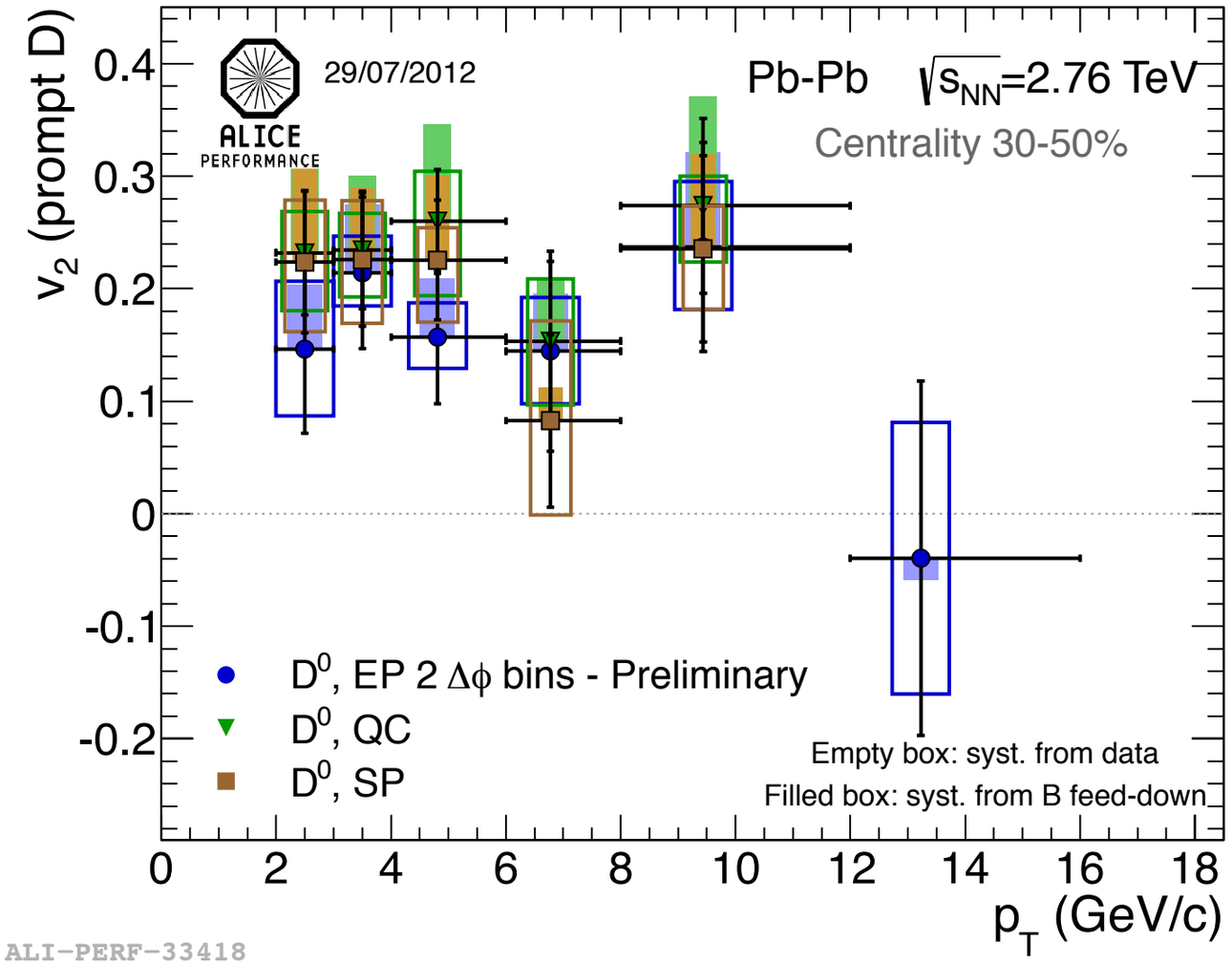
D meson v_2 details

D^0 v_2 with TPC and VZERO EP



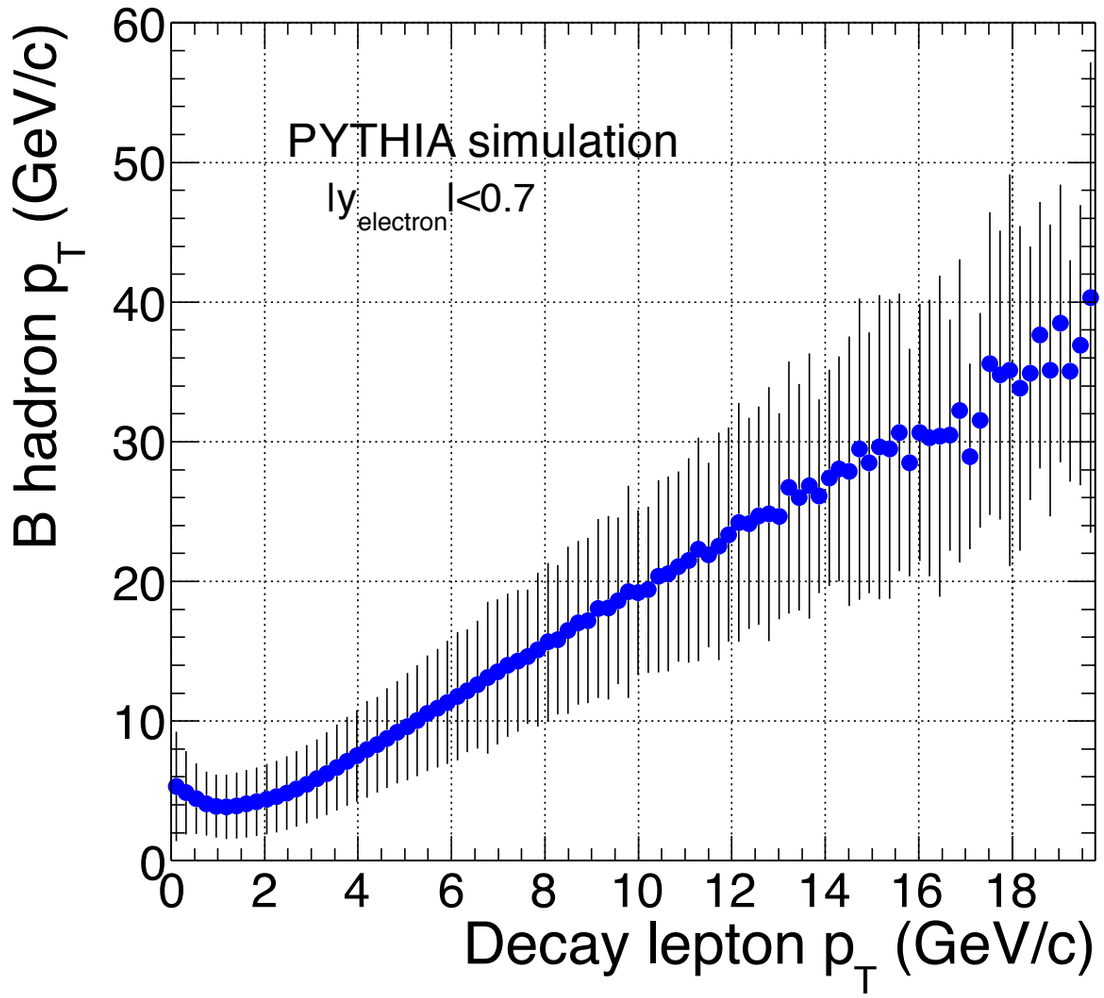
ALI-PERF-33617

D^0 v_2 with EP, SP and QC methods

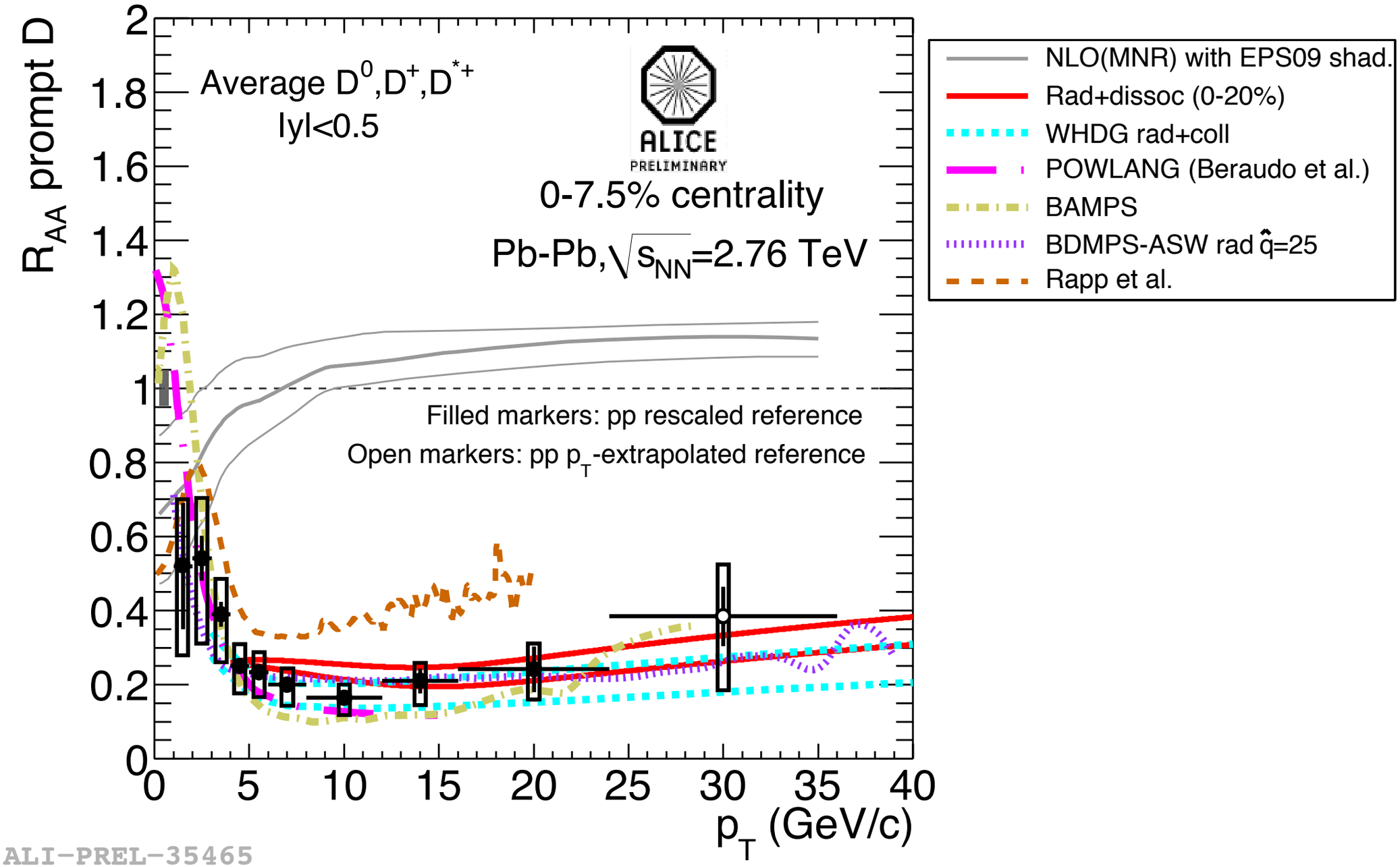


ALI-PERF-33418

Correlation of pT(B) & pT(D) vs PT(lepton)

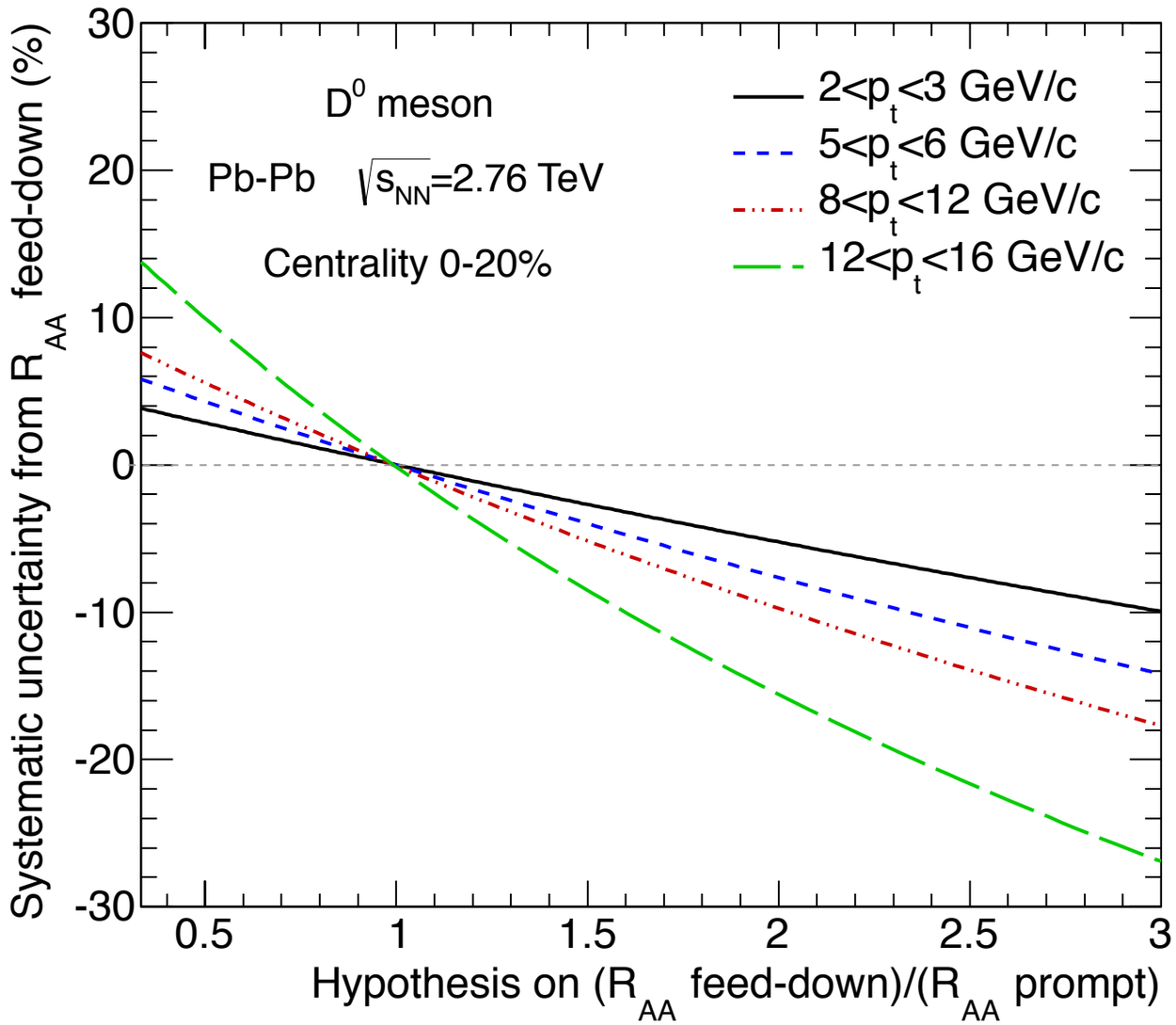


D meson R_{AA}



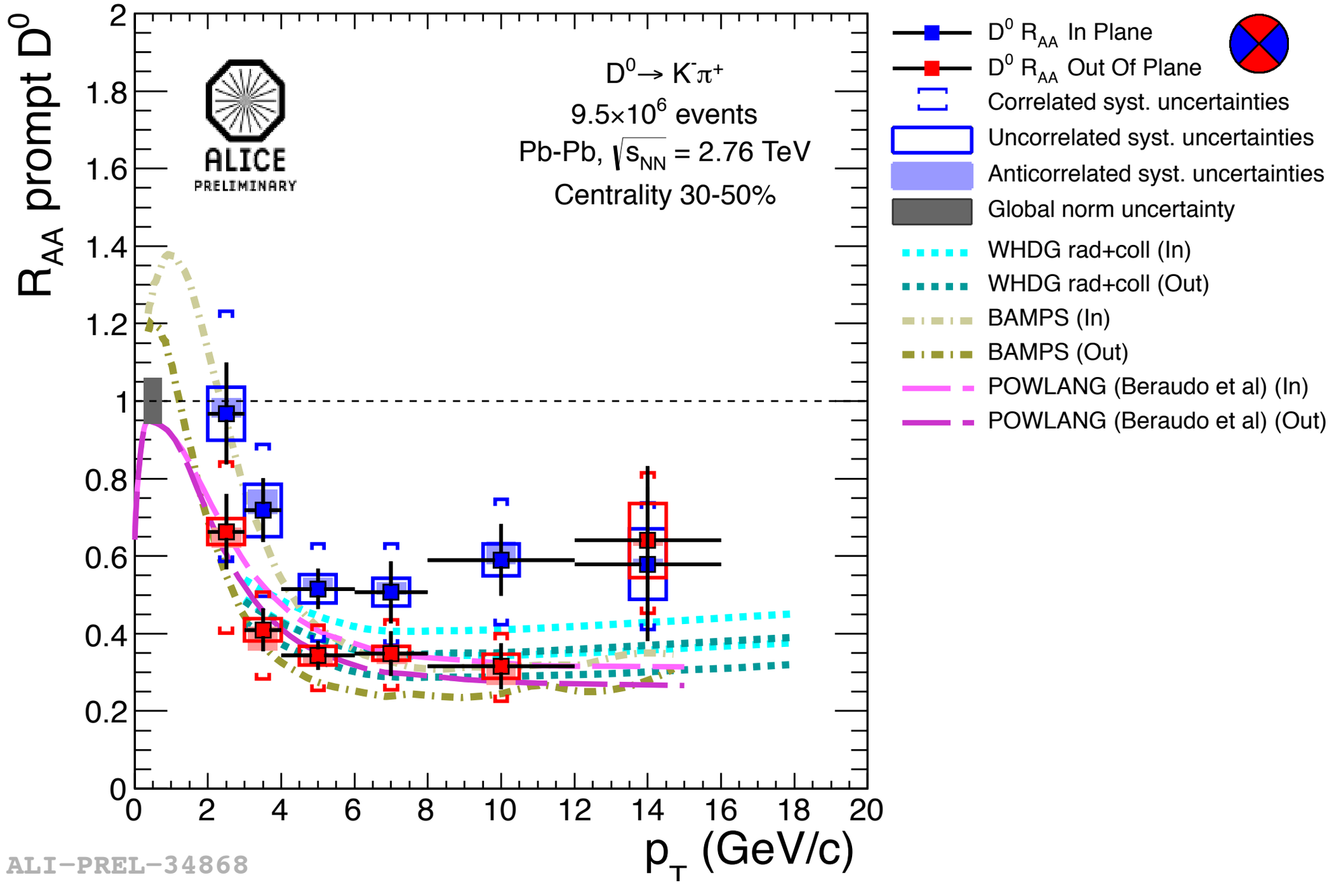
ALI-PREL-35465

Systematics on D meson R_{AA}



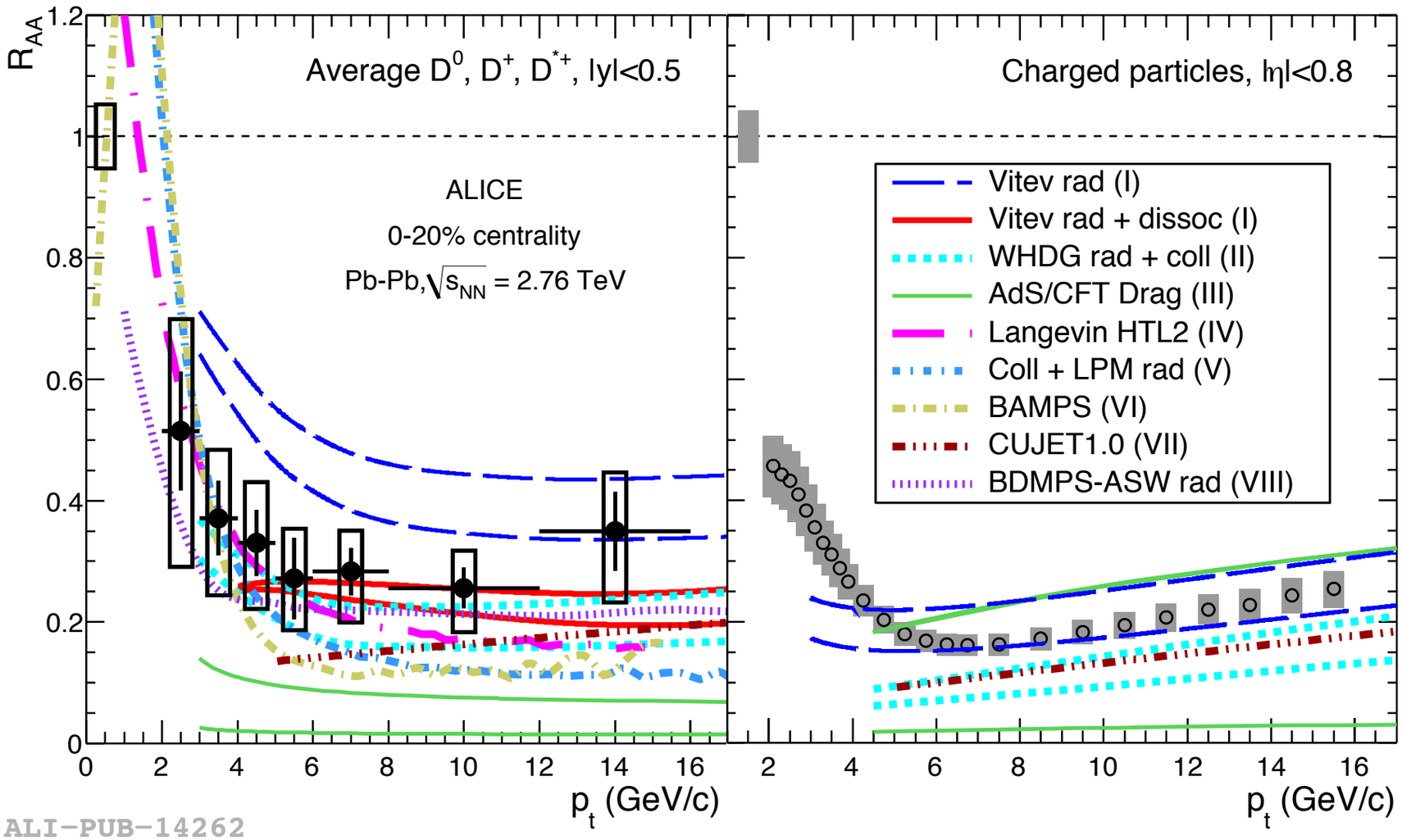
ALI-PUB-14238

D⁰ R_{AA} vs Event Plane vs Theory



Models Description of R_{AA}

[ALICE Coll. arXiv:1203.2160 (2012)]



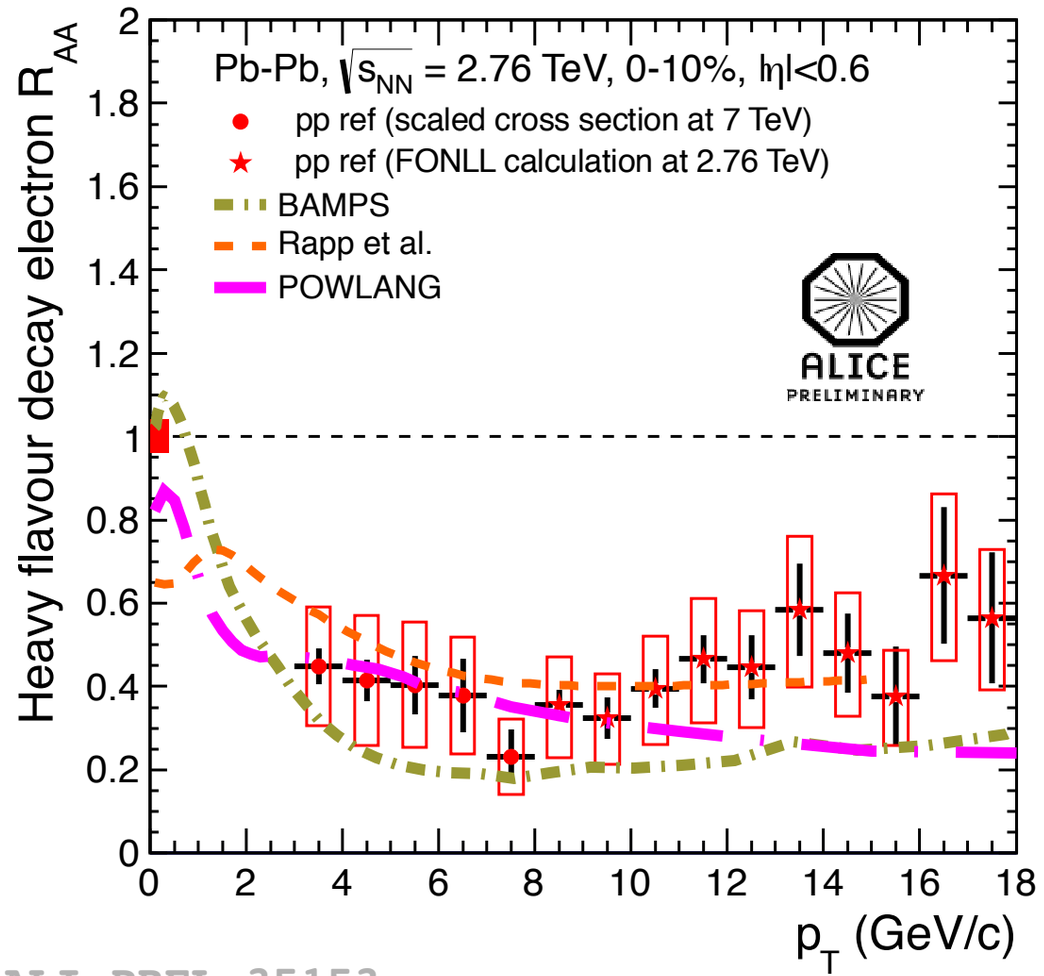
ALI-PUB-14262

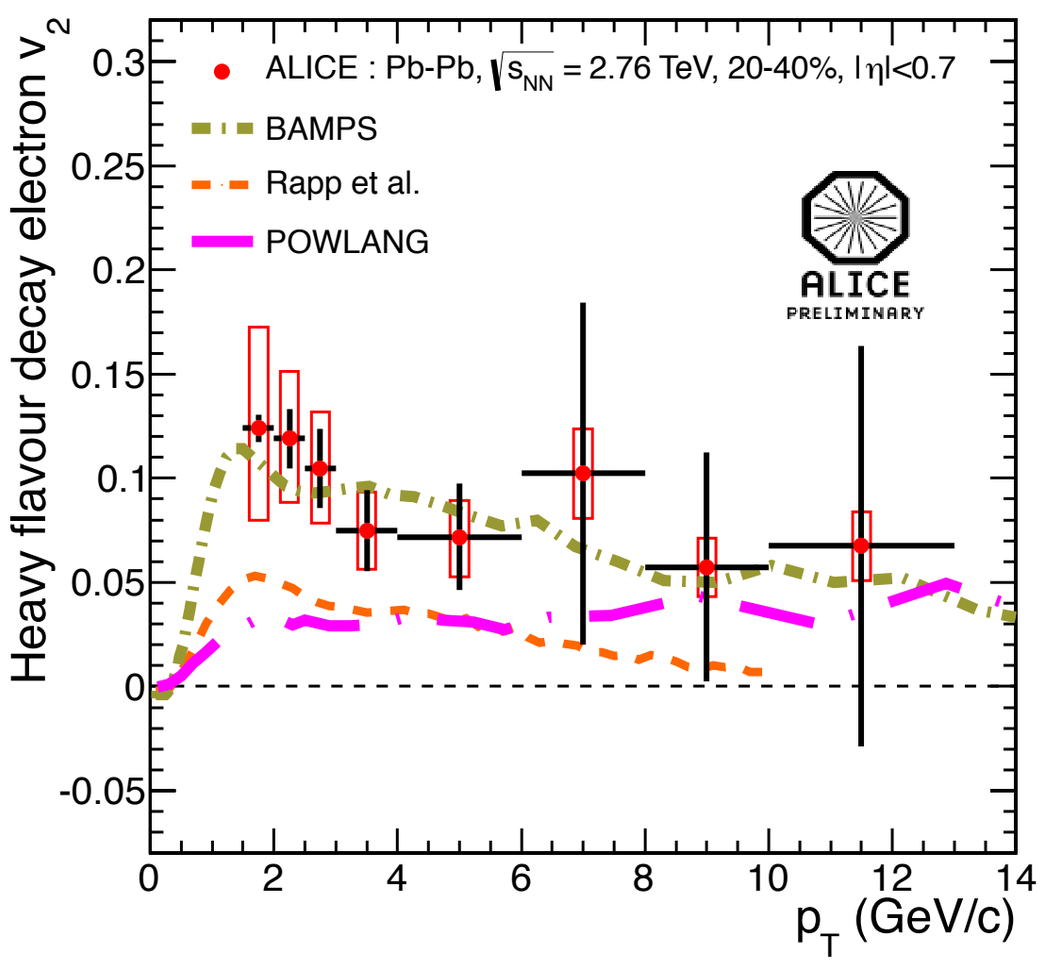
- Models predicting reasonably well both charged particles and D meson R_{AA} :
  - I. Radiative energy loss + D meson in-medium dissociation (tuned to jet LHC data)
  - II. Radiative + collisional energy loss (tuned to RHIC data)
  - VII. Radiative + collisional energy loss (tuned to RHIC data)
- AdS/CFT drag coefficients (III) underestimate the charm R_{AA} and have limited predictive power for the light flavor R_{AA}.

Heavy Flavor electron R_{AA} & v_2

- BAMPS model: HQ transport with collisional energy loss in expanding QGP. Seems to over-suppress HFe R_{AA}, while it is consistent with HFe v_2.
- Rapp: heavy quarks transport with in-medium resonance scattering and coalescence. Consistent with HFe R_{AA}, but seems to underestimate HFe v_2.

➡ **The simultaneous description of HFe R_{AA} and v_2 is challenging**





ALI-PREL-35153

D meson R_{AA} & v_2

- Some models can describe v_2 but they seem to underestimate R_{AA}.
  - Models with collisional and radiative Eloss (Alichelin et al)
  - HQ transport with collisional energy loss in expanding QGP (BAMPS)
- Others can describe R_{AA} but they seem to underestimate v_2
  - Evaluate energy loss but not the hydrodynamical expansion (WHDG and Beraudo et al.)
- Others seems to underestimate v_2 and it slightly overestimates R_{AA}
  - HQ transport in expanding QGP with resonance scattering (Rapp et al.)

➡ **Challenging simultaneous description of D meson R_{AA} and v_2.**