Heavy flavour correlations

A. Rossi, Padua University and INFN
M. Nardi, INFN Turin

Correlations with heavy-flavour signals are sensitive to:

Angular correlations involving heavy-flavour signals

HF production kinematics more than p_T-differentially (beyond FONLL capabilities) in pp collisions
→ Test Event Generators

HF jet properties
(→ Test Event Generators)
and their modifications in different QCD environments

Charm/beauty separation of HF electrons in pp

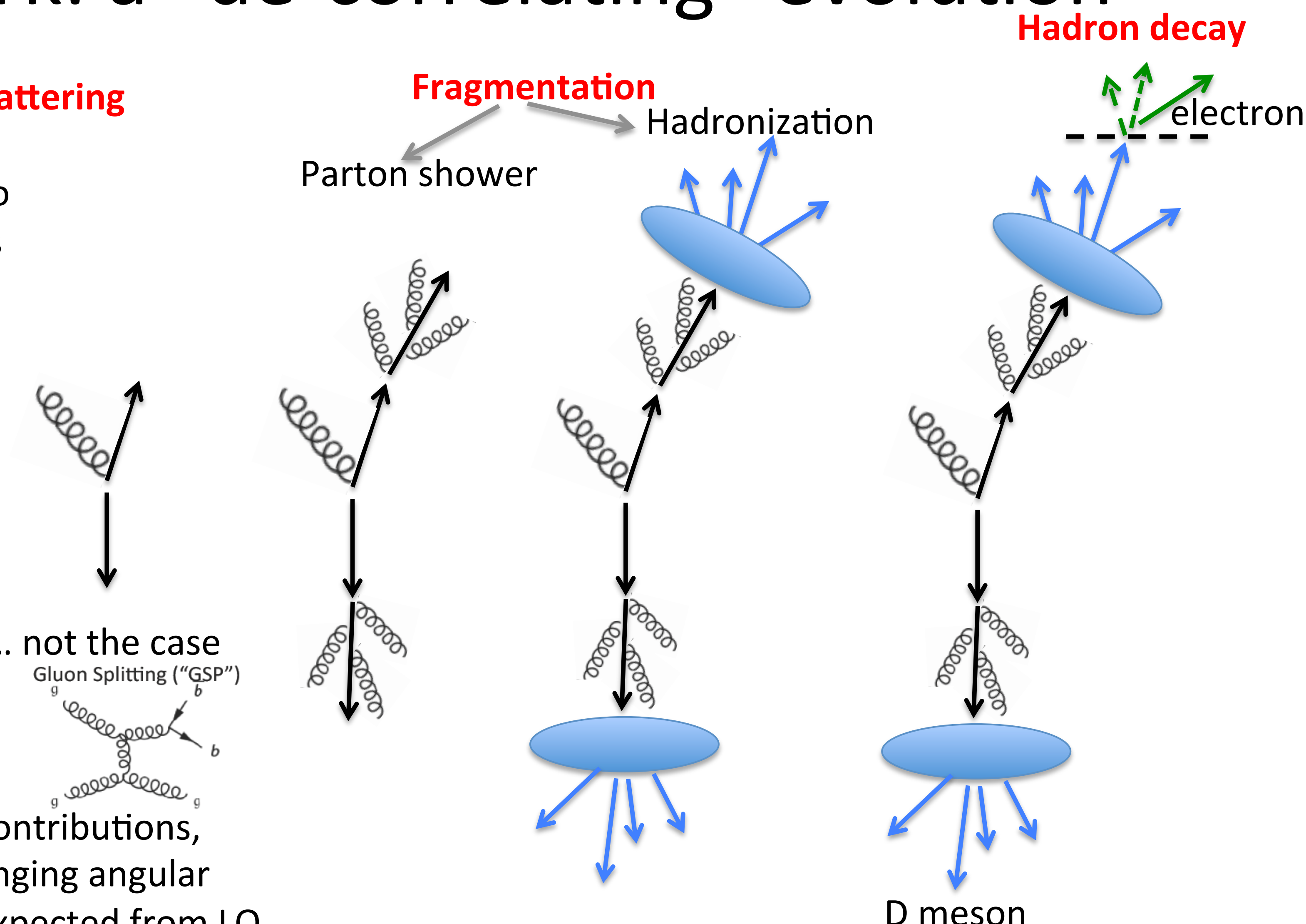
In-medium heavy-flavour energy loss
Complement R_{AA} and v_2 measurements
Path length dependence of energy loss

Collective effects in all collision systems

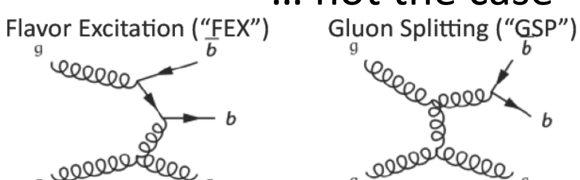
Remark: a "de-correlating" evolution

Hard scattering

We would desire nature to be LO, giving us only back-to back HQ pairs



… not the case



Several NLO contributions, smearing/changing angular correlations expected from LO

→ And this depends on √s

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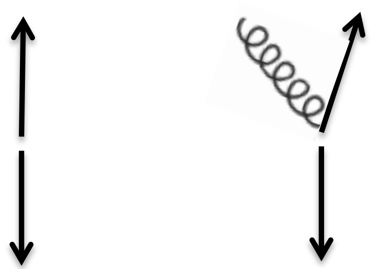
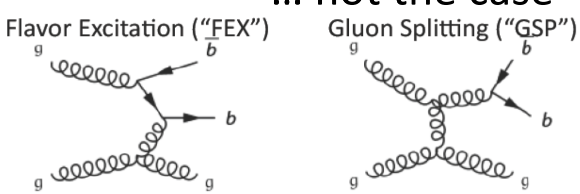
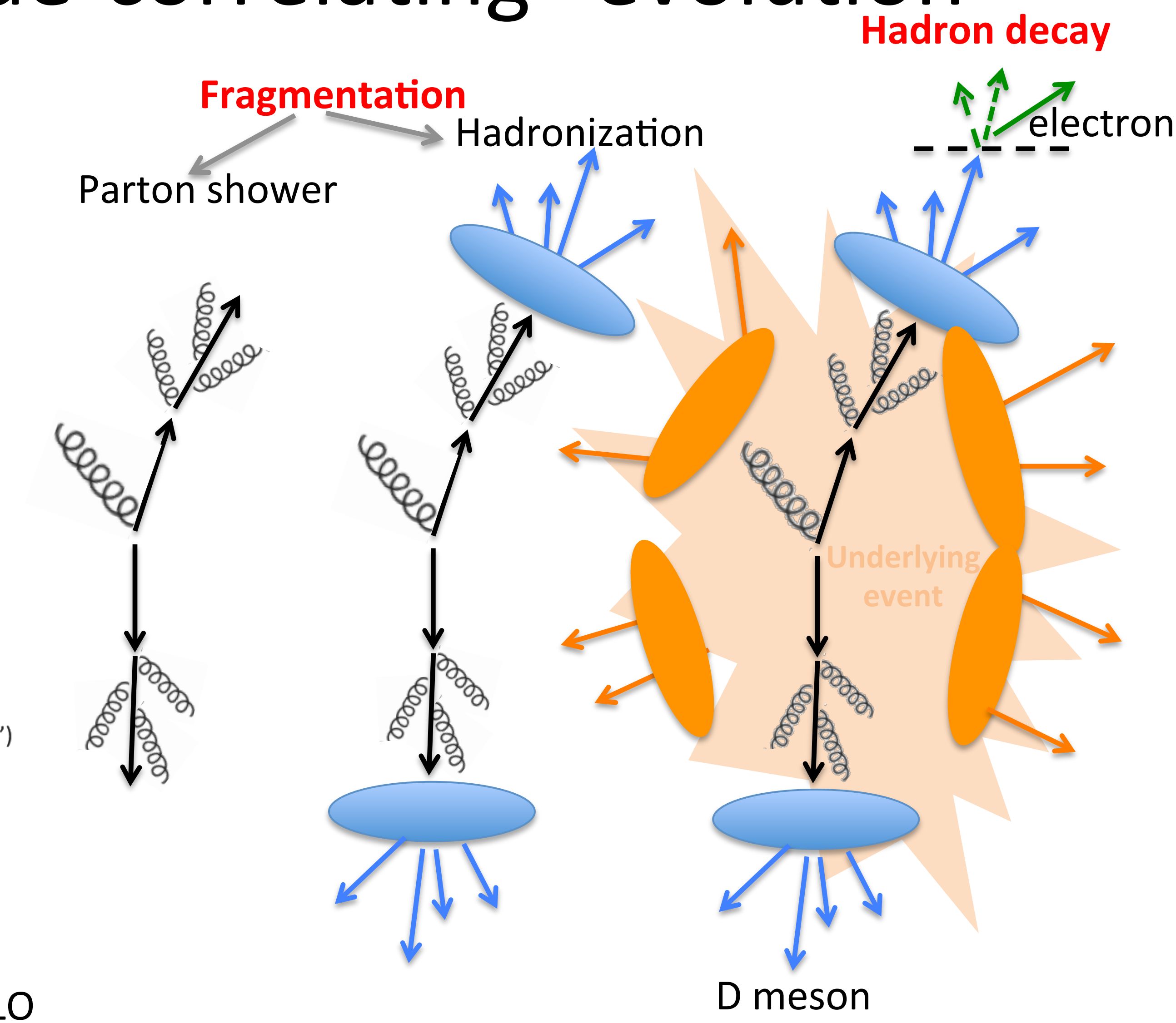


… not the case





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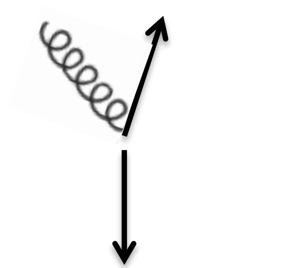

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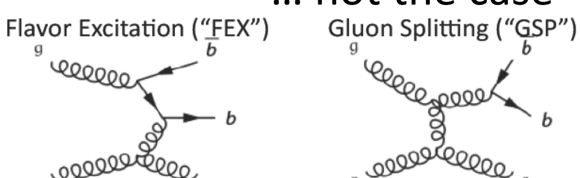

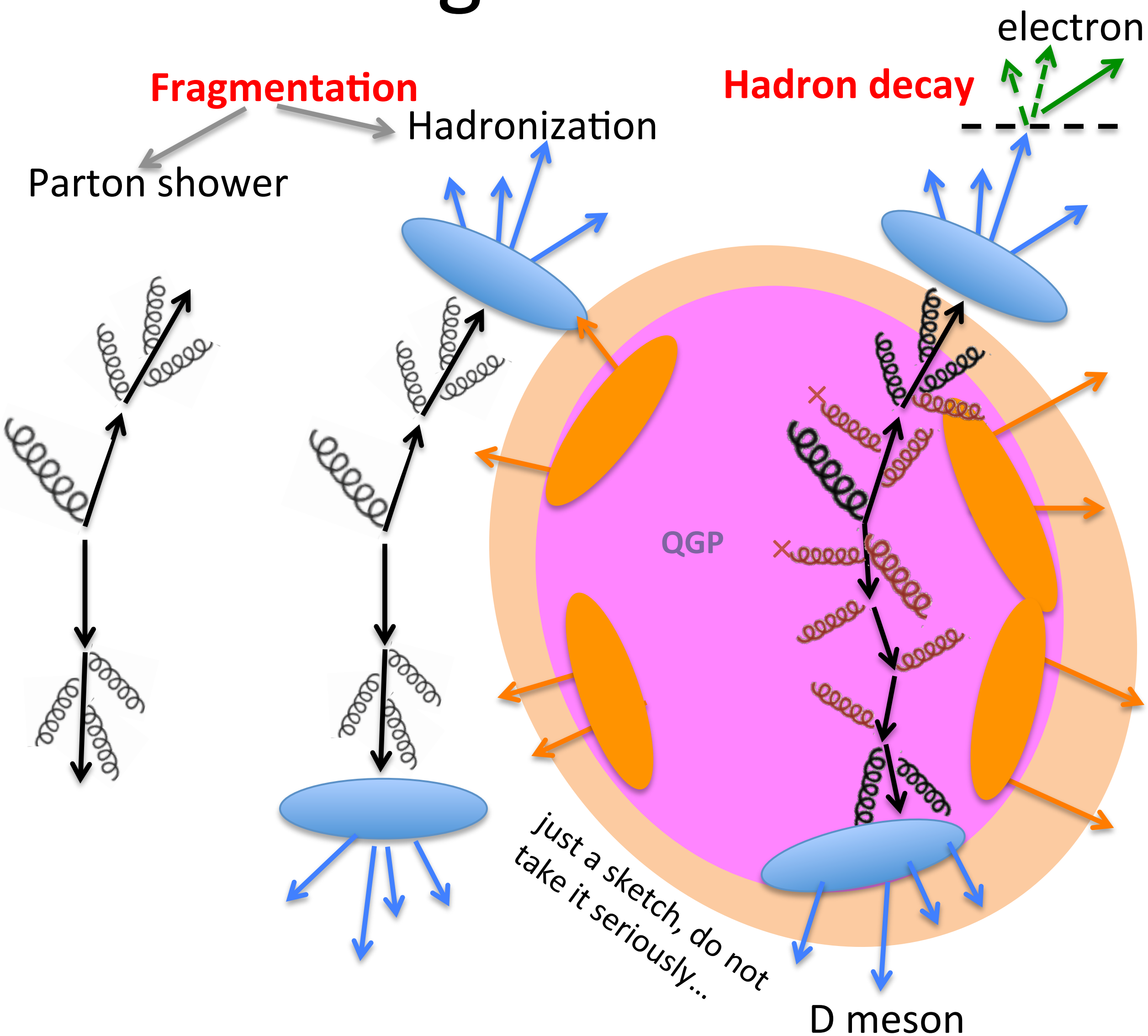

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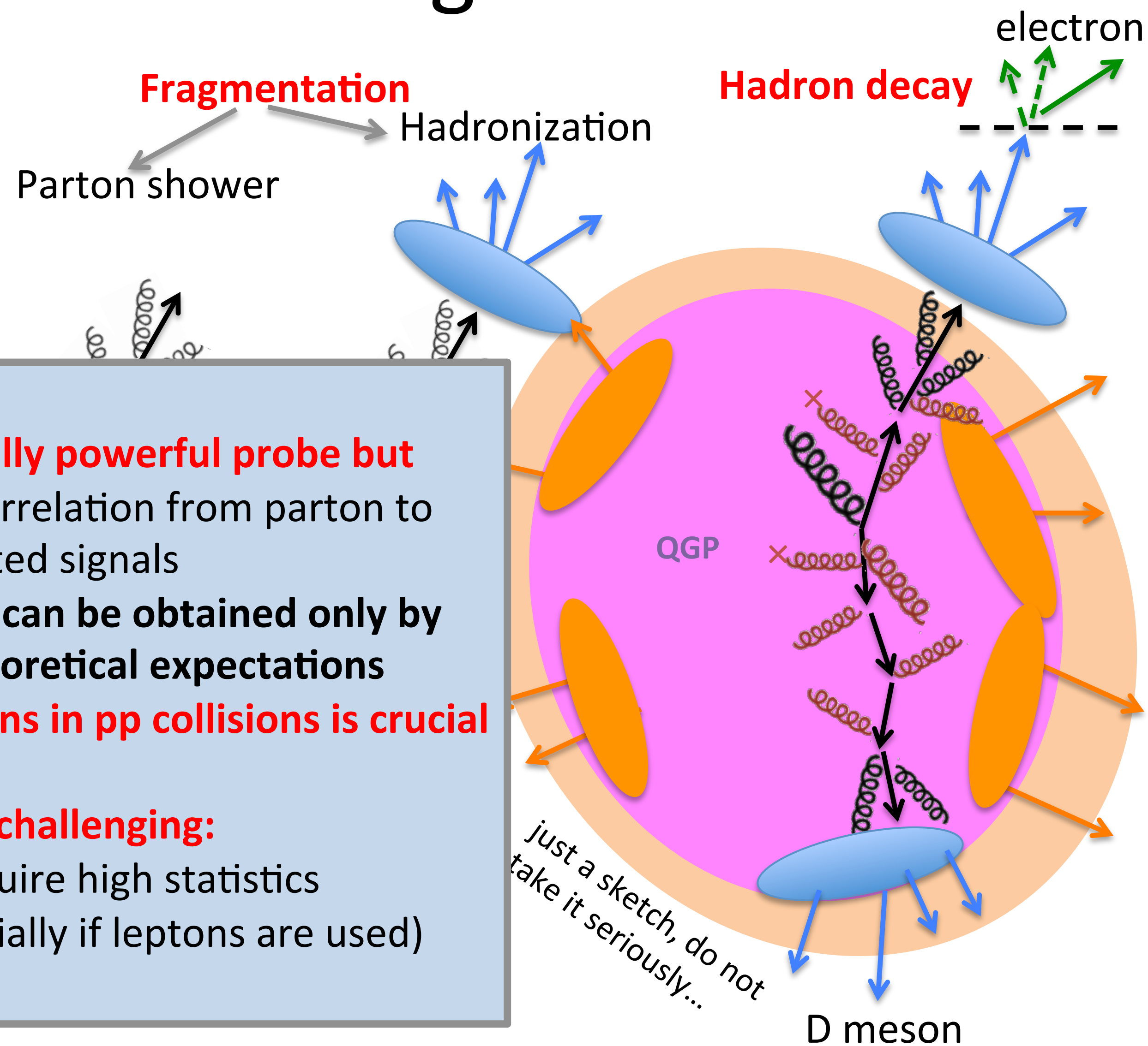


Correlations are a potentially powerful probe but

- Angular + kinematic decorrelation from parton to reconstructed signals
- **Quantitative conclusions can be obtained only by comparing data to theoretical expectations**

→ Understanding of correlations in pp collisions is crucial

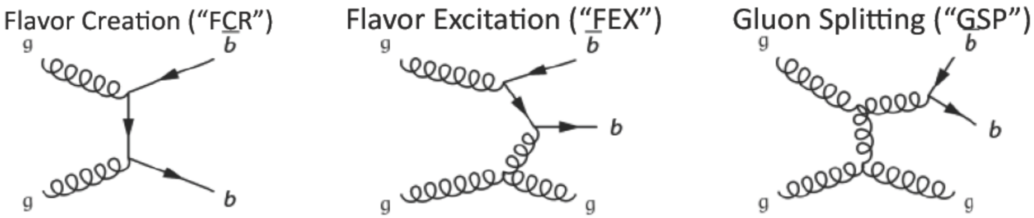
Experimentally challenging:

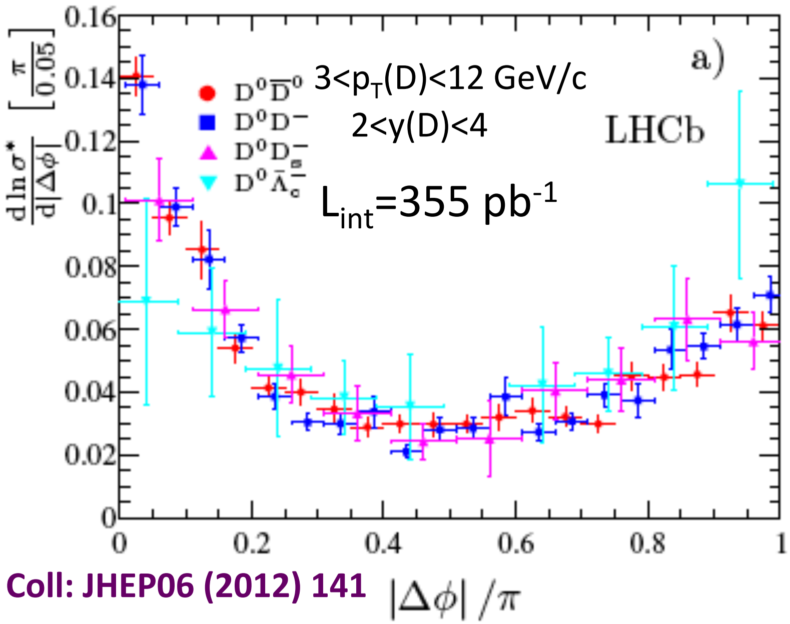
- Rare signals → require high statistics
- Many corrections (especially if leptons are used)

→ And this depends on √s

HF production in pp collisions

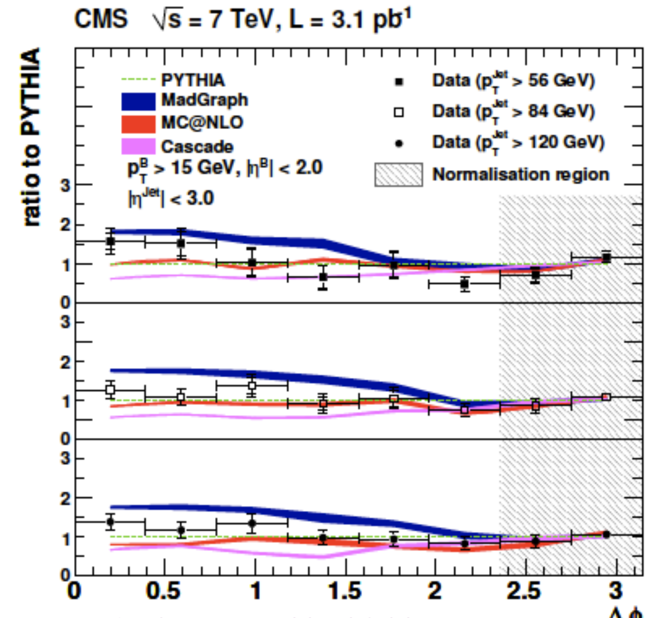
- Investigate HF production processes





LHCb Coll: JHEP06 (2012) 141

CMS: B-Bbar via displaced vertices



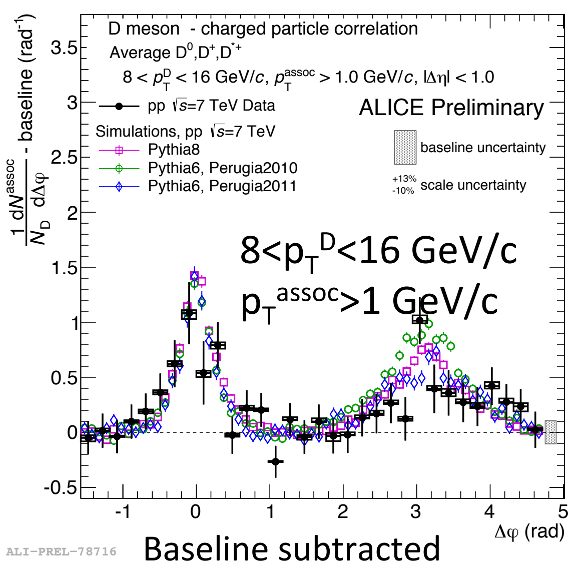
CMS: JHEP 1103:136,2011

General trend from LHCb, CDF, and CMS (B-Bbar with displaced vertices) measurements:
Significant collinear production, often underestimated by MC generators

HF production in pp collisions

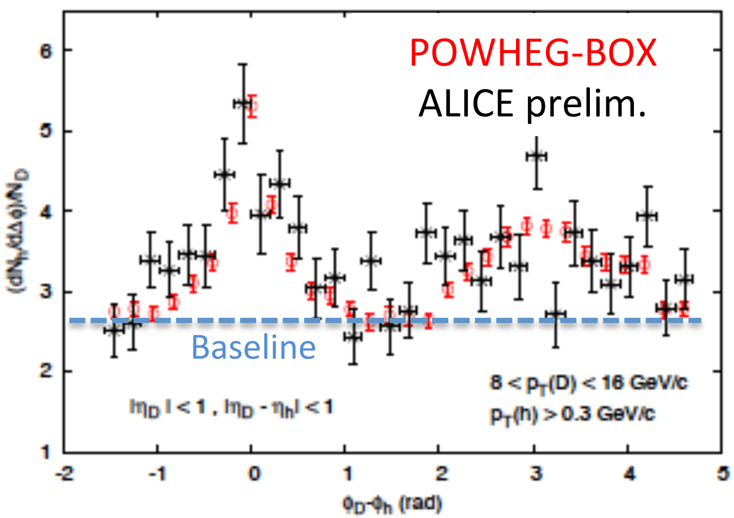
- Investigate HF production mechanism
- Investigate HF quark fragmentation in vacuum

E.g. D meson – charged particle azimuthal correlations

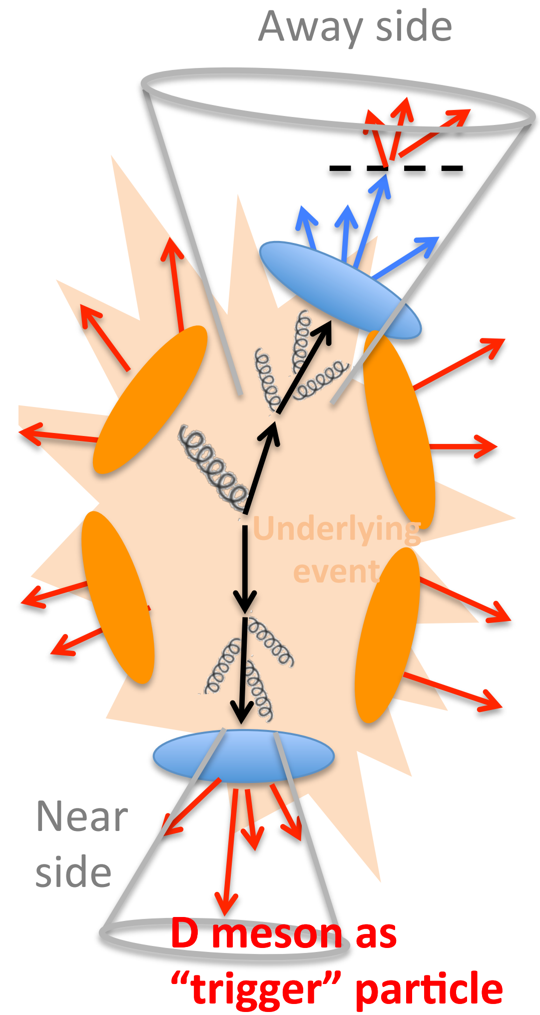


Baseline subtracted

A. Beraudo et al. Eur. Phys. J. C75 (2015) 3, 121



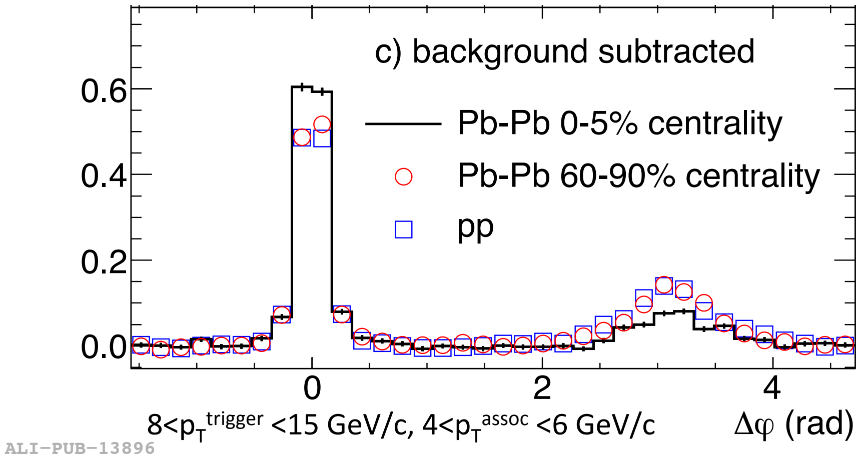
NLO pQCD matrix element (POWHEG)
+ parton shower (PYTHIA)

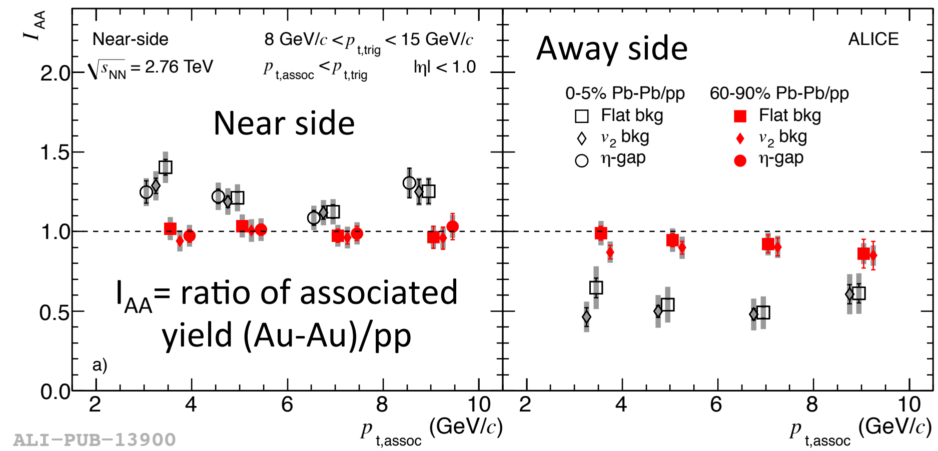


Precise measurement expected with run 2 data

Modification of hadron-hadron azimuthal correlations in Pb-Pb

ALICE, Phys. Rev. Lett. 108, 092301 (2012)





Away-side suppression

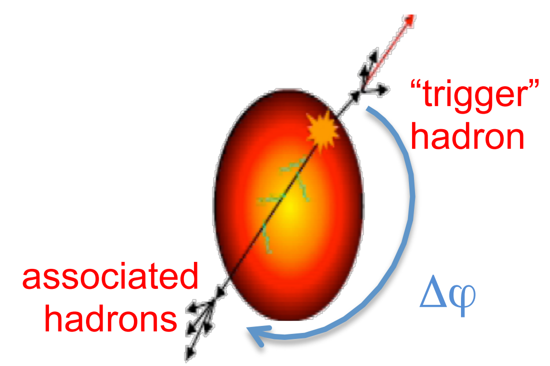
→ path-length dependence of in-medium energy loss ("surface biase")

Near side peak enhancement (not clear interpretation)

→ modification to quark/gluon ratio

→ contribution from higher p_T partons

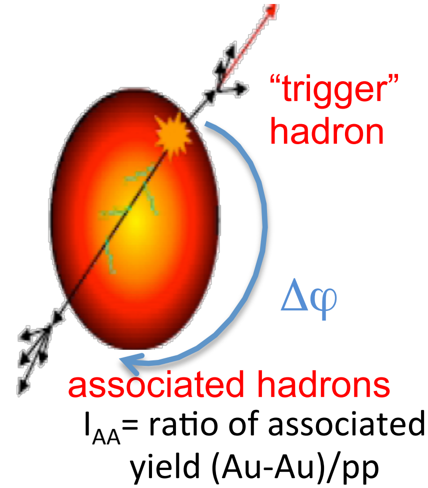
→ modified fragmentation



Angular correlations with heavy-flavour signals

Correlations of heavy-flavour signals vs. light particles

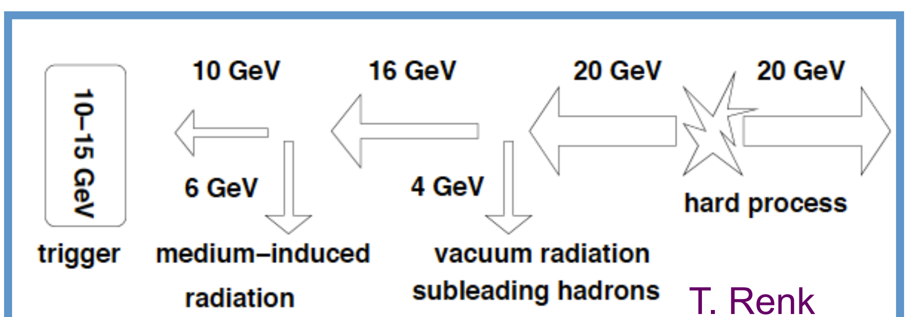
- Trigger particle defined by identity, not by momentum range as in e.g. hadron-hadron correlations → **(heavy)quark tagging**
- **Different fragmentation** than light quarks and gluons
- **Different energy loss** for heavy quarks than light quarks and gluon
  - C_R, "dead-cone" effect
  - Possible different contributions of radiative and collisional energy loss, which have a different **path length dependence**

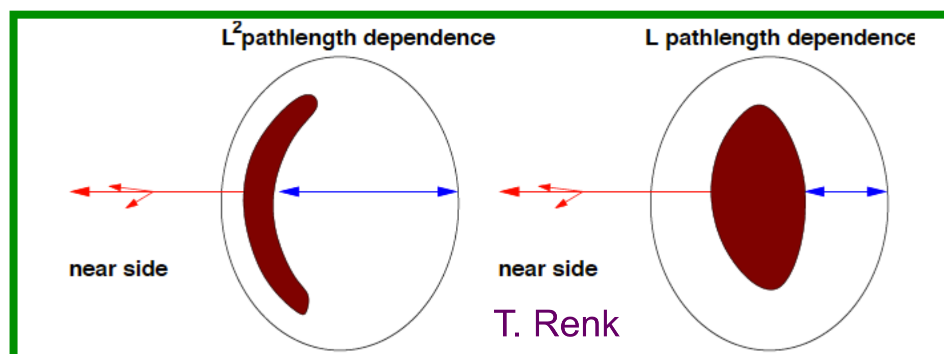


→ Different "kinematic bias", different "geometrical bias"

→ Different biases might translate into different I_{AA} for light and heavy quarks.

→ Complementary information than v_2 and R_{AA} → further constrain energy loss models



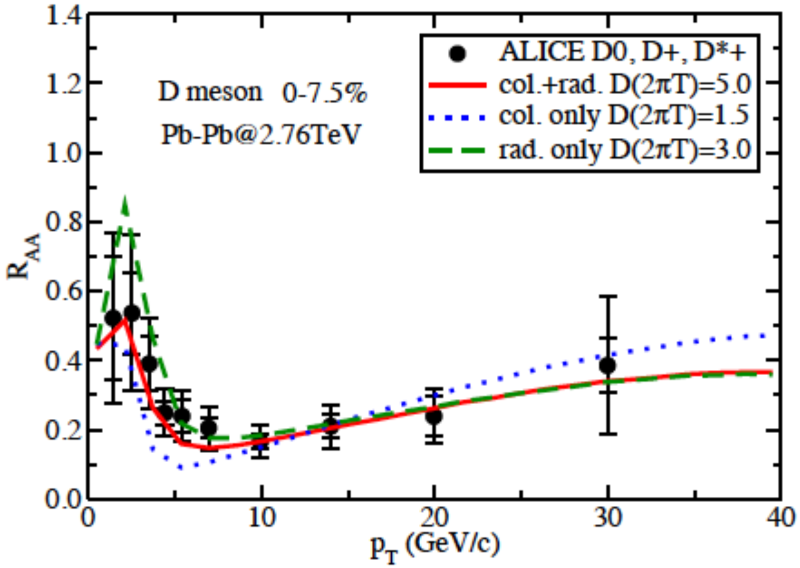


Radiative vs. collisional energy loss

See V. Greco's talk

S. Cao, G-Y. Qin, S.A. Bass arXiv:1505.01869

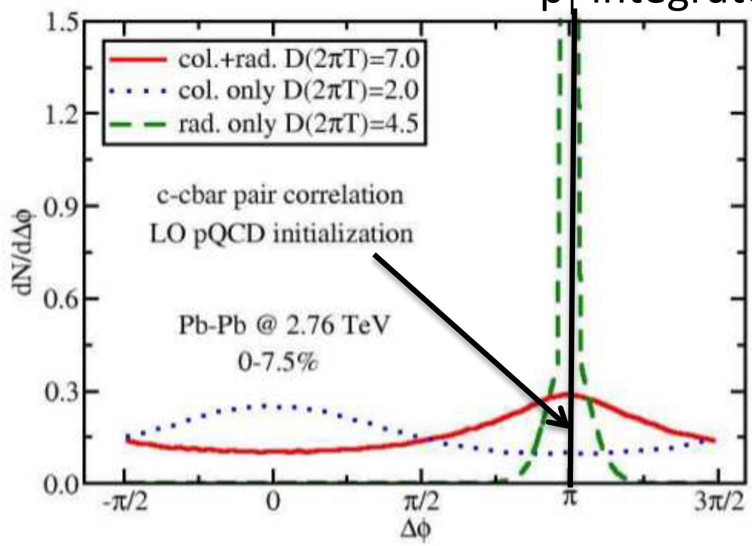
Transport code based on Langevin equation with radiative energy loss introduced as external force



G-Y. Qin at Sapore Gravis 2014 Padova

"Academic case"

p_T integrated

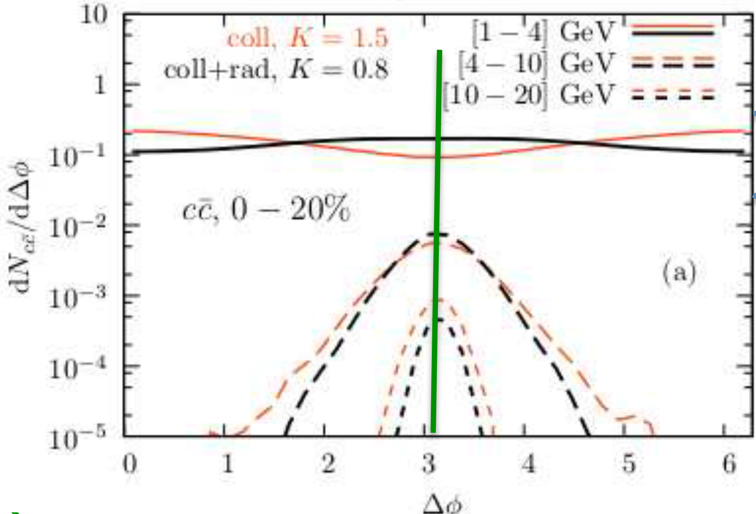


D meson R_{AA}: data described within uncertainties by both radiative only and collisional only energy loss → R_{AA} alone not sufficient for discriminating collisional and radiative contribution

Dramatic effect with azimuthal correlations (with back-to-back initial topology)

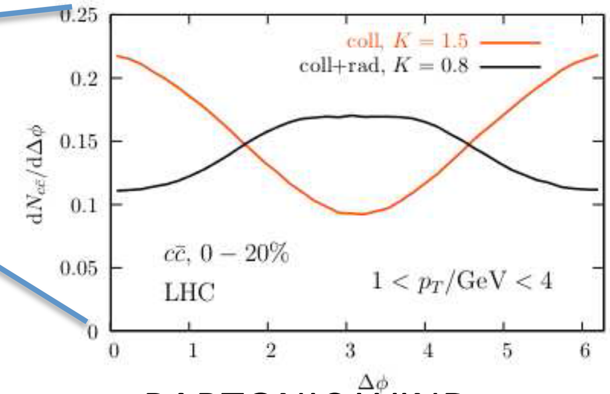
Radiative vs. collisional energy loss

charm quarks



MC@sHQ+EPOS: M. Nahrgang et al, Phys. Rev. C 90, 024907 (2014)

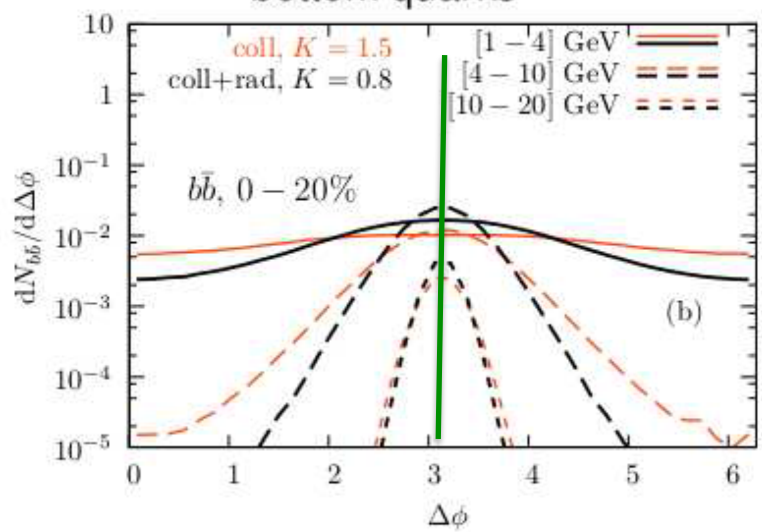
(Boltzman equation, radiative + collisional energy loss)

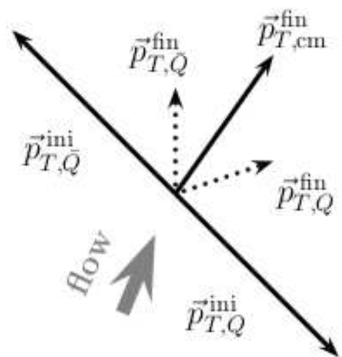


PARTONIC WIND

LO→ Initial distribution: Δφ=π

bottom quarks



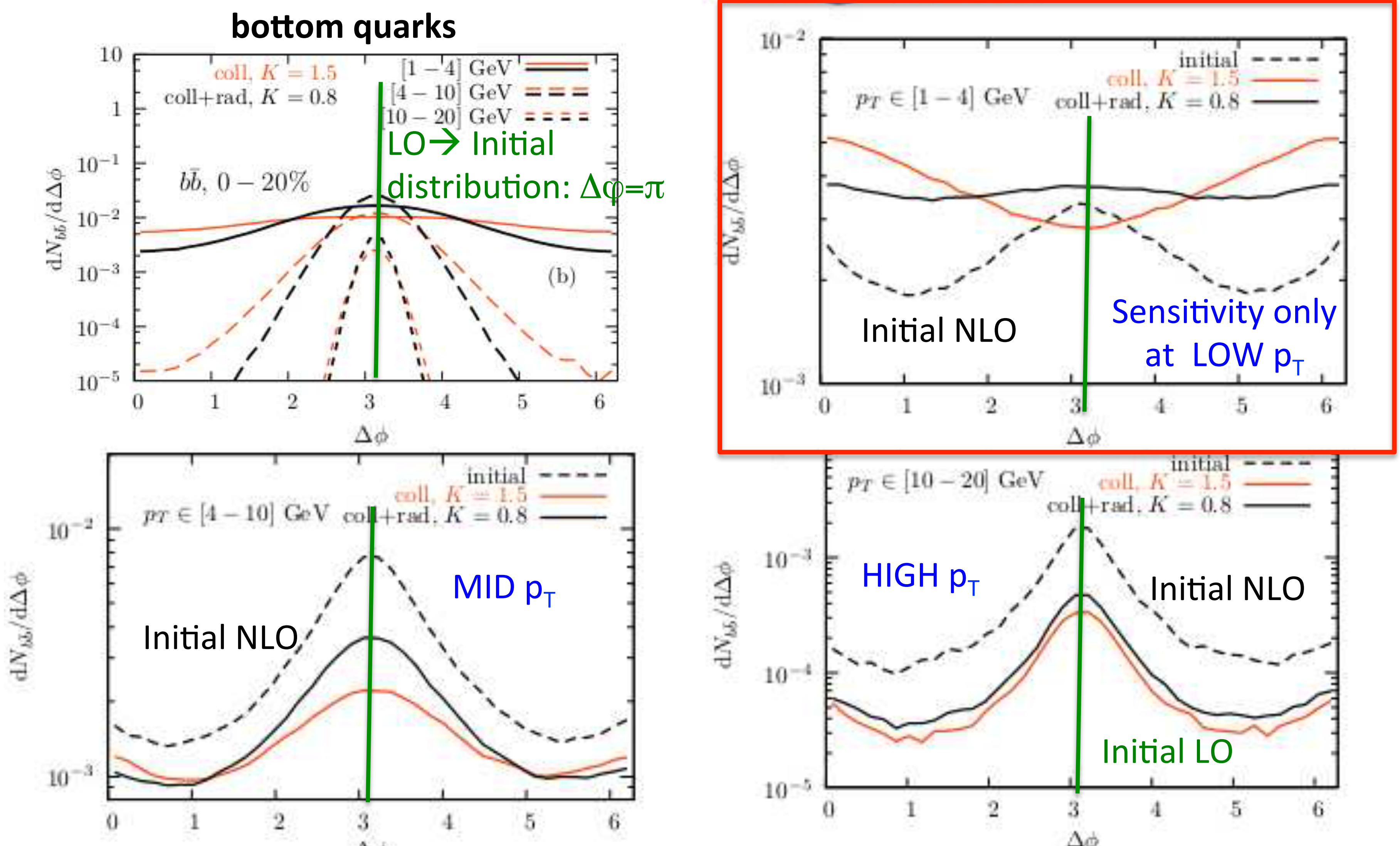


Radial flow pushes quarks from a pair toward the same direction.

-- effective only with collisional processes --

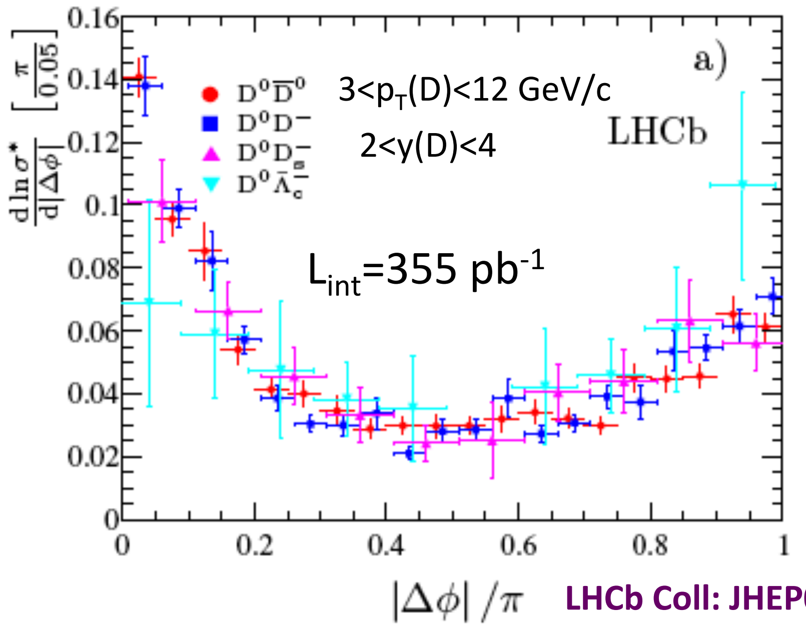
Medium de-correlation "dilution" into NLO initial de-correlation

M. Nahrgang et al, Phys. Rev. C 90, 024907 (2014)

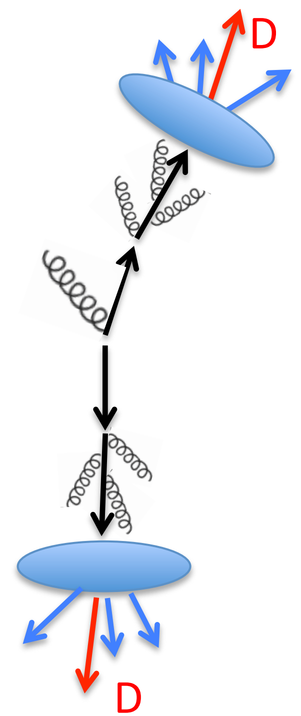


Which observables?

Observables directly tracking QQbar azimuthal correlations:
D-D, B-B (or proxy)



LHCb Coll: JHEP06 (2012) 141



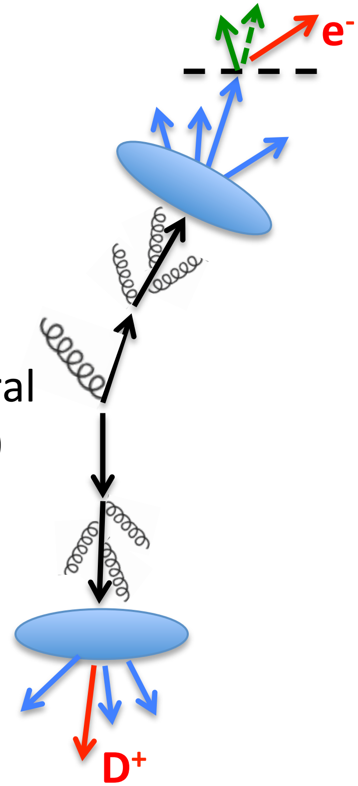
Never done in p-A, or in A-A
Experimentally very challenging (statistics, acceptance)

Which observables?

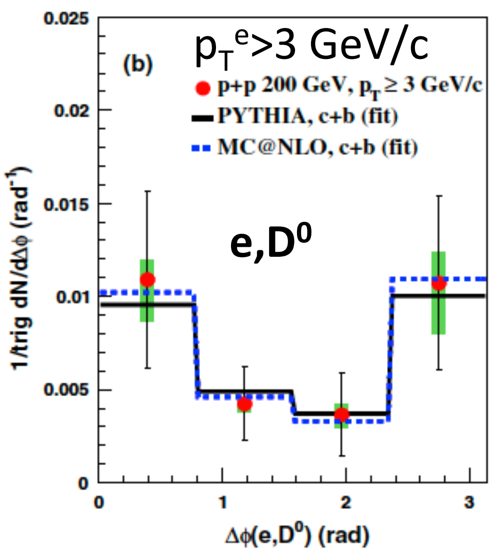
Observables directly tracking QQbar azimuthal correlations:
D-D, B-B (or proxy)

b jet – b jet

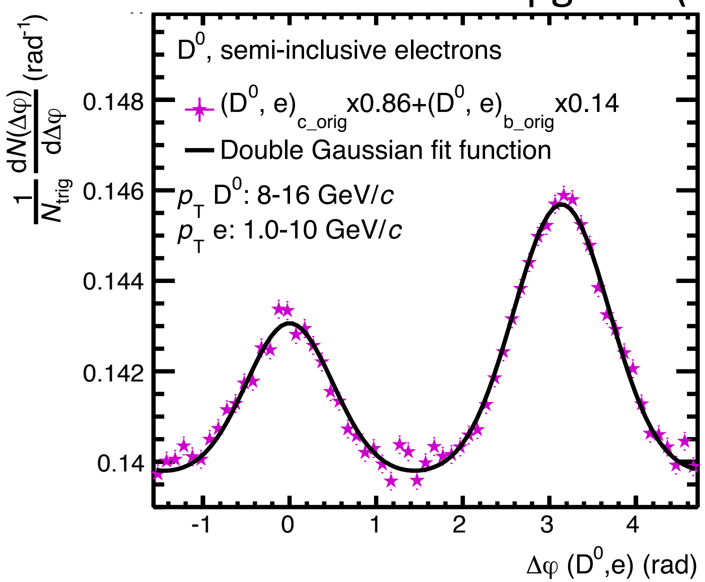
B or D - HF (e/μ)



pp: STAR Coll: PRL 105, 202301 (2010)



Statistically doable with ALICE in central Pb-Pb after detector upgrade (run 3)



Which observables?

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D-D, B-B (or proxy)

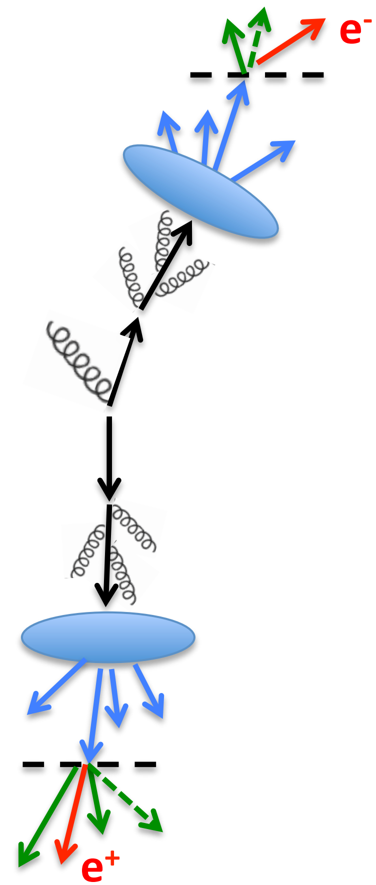
b jet – b jet

B or D - HF (e/μ)

HF (e/μ) – jets

HF (e/μ) – HF (e/μ)

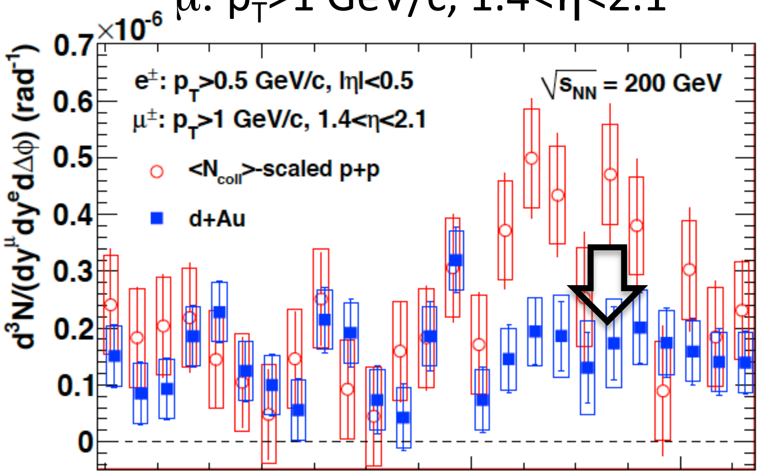
Reduced angular and kinematic correlation w.r.t. parent quarks



PHENIX: $e^{\pm}$ - $\mu^{\mp}$ correlations in pp and d-Au

e: p_T>0.5 GeV/c, |η|<0.5

μ: p_T>1 GeV/c, 1.4<η<2.1



PHENIX Coll.: PRC 89, 034915 (2014)

pp

d-Au

Hint of away-side peak suppression

Initial (e.g. CGC) or final state effect?

Which observables?

Observables directly tracking QQbar azimuthal correlations:

D-D, B-B (or proxy)

b jet – b jet

B or D - HF (e/μ)

HF (e/μ) – jets

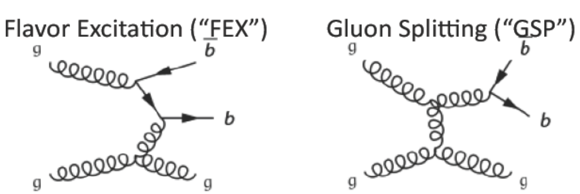
HF (e/μ) – HF (e/μ)

Observables determined **ALSO** by heavy-flavour fragmentation and "intra-jet" properties

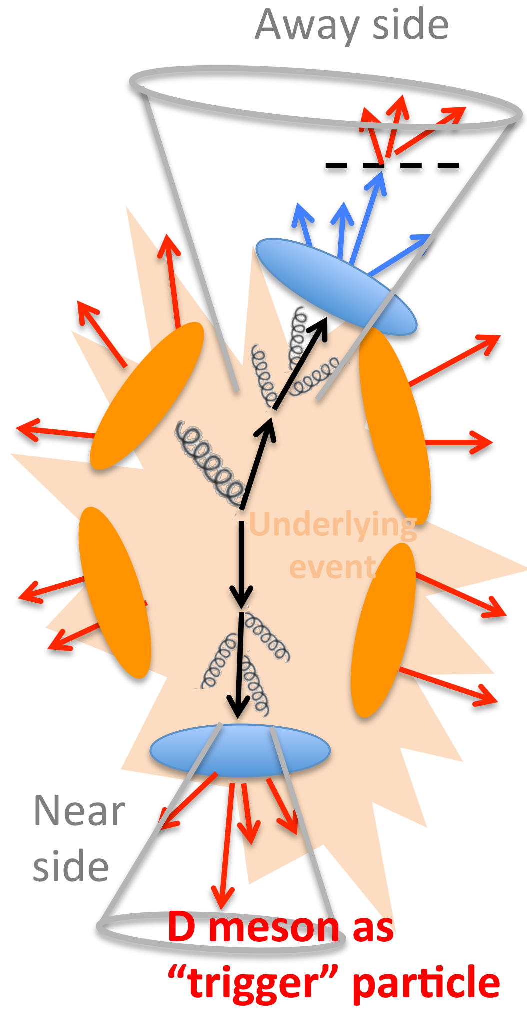
D – hadron

HF (e/μ) – hadron

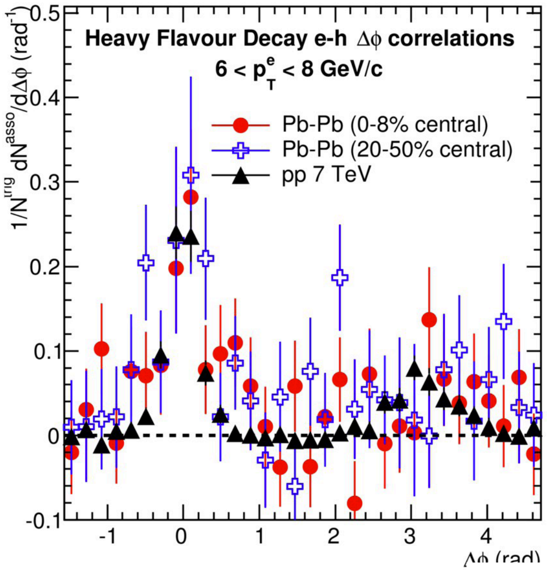
D – jets (for measuring FF)



not directly tagging heavy quarks



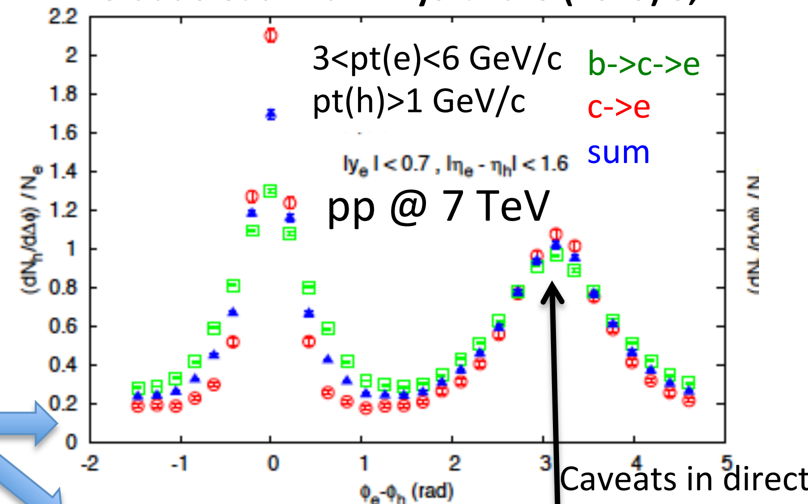
HF electron- hadron correlations



ALICE measurements in pp and Pb-Pb

Precise measurements expected with run 2 data

A. Beraudo et al. Eur. Phys. J. C75 (2015) 3, 121



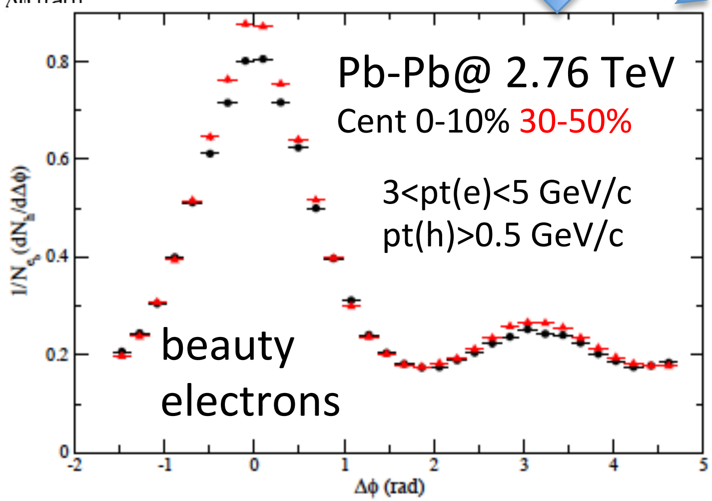
6<pt(e)<8 GeV/c

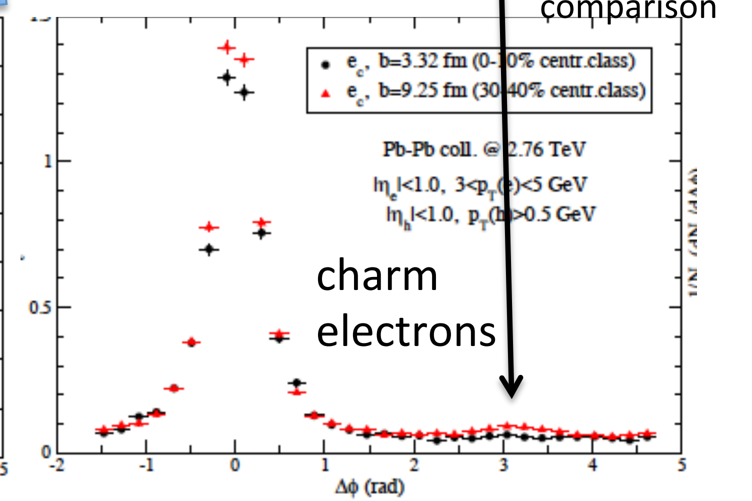
4<pt(h)<6 GeV/c

Predictions (POWLANG)

Strong away side suppression

Caveats in direct comparison





POWLANG (transport model, Langevin in a 2+1 hydro medium; hadronization from Q - medium q string decay)

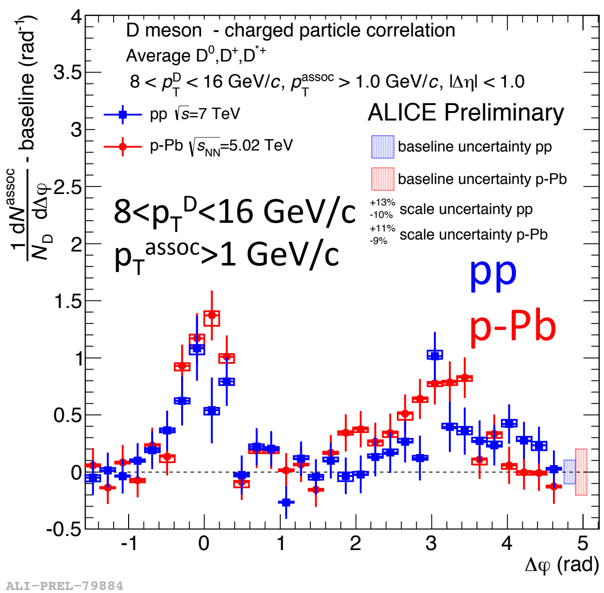
D meson – charged particle correlations

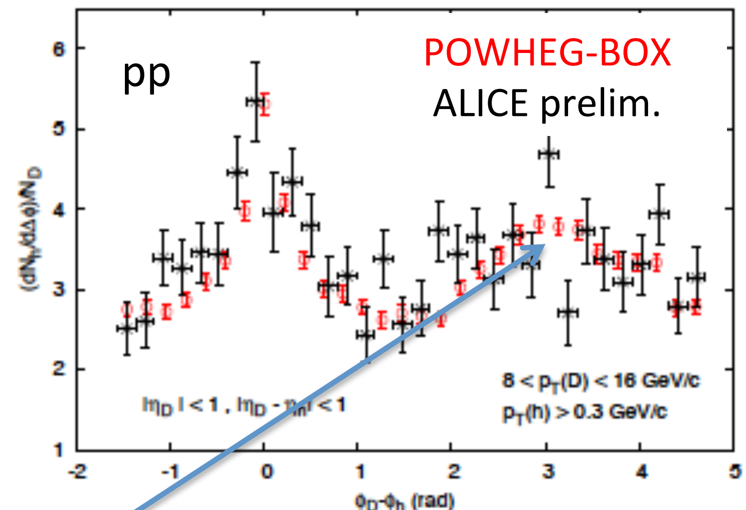
A. Beraudo et al. Eur. Phys. J. C75 (2015) 3, 121

So far: measurement in pp and p-Pb collisions

Precise measurements expected in pp, p-Pb with run 2

Pb-Pb likely accessible only after detector upgrade

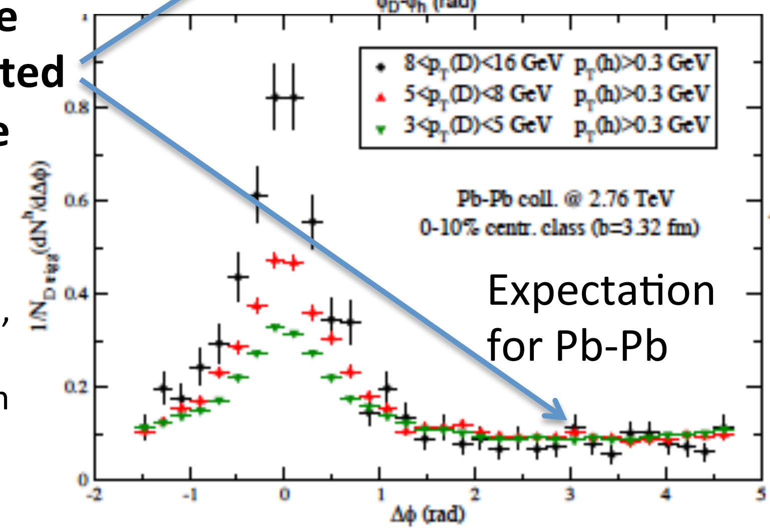




Strong away side suppression expected in wide p_T range

(but caveats in direct comparison)

POWLANG (transport model, Langevin in a 2+1 hydro medium; hadronization from Q - medium q string decay)



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D-D, B-B (or proxy)
b jet – b jet
B or D - HF (e/μ)
HF (e/μ) – jets
HF (e/μ) – HF (e/μ)

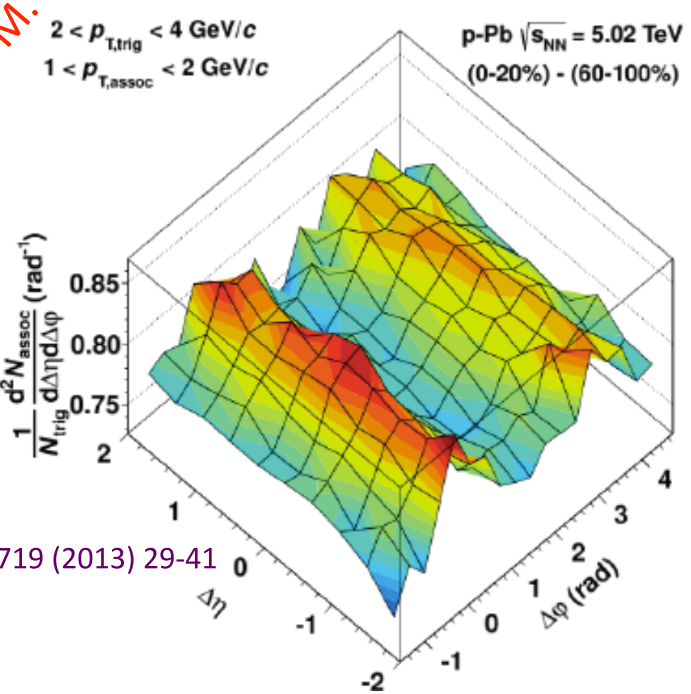
Observables determined **ALSO** by heavy-flavour fragmentation and "intra-jet" properties
D – hadron
HF (e/μ) – hadron
D – jets (for measuring FF)

Both types of observables can be used to probe initial state and/or collective effects
- Impact of flow on QQbar correlation (e.g. v_2, partonic wind)
- (second set of observables) Study modulation of the baseline induced by collective effect (→ "alignment" of HF quarks with event asymmetry)

e.g. HF e – hadron correlations (w/o jet contribution)→ $\frac{dN}{d\Delta\varphi} \propto \sqrt{v_2^{\mathrm{HF\,e}} \cdot v_2^{\mathrm{h}}} \cdot \cos(2\Delta\varphi)$

The famous double ridge in p-Pb in light flavour sector at the LHC

Discussed yesterday (talk by M. Floris)

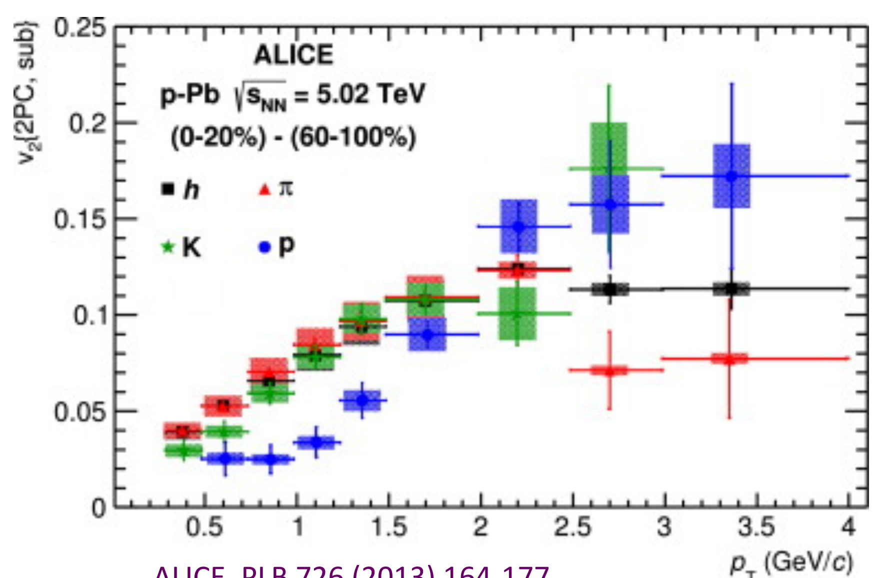


ALICE, PLB719 (2013) 29-41

Long-range correlations observed by ALICE, ATLAS, CMS in high multiplicity p-Pb collisions

CMS, PLB 718 (2013) 795
ALICE, PLB 719 (2013) 29-41
ATLAS, PRL 110 (2013) 182302

"Double-ridge" structure observed after removal of "jet contribution" estimated from low multiplicity collisions



ALICE, PLB 726 (2013) 164-177

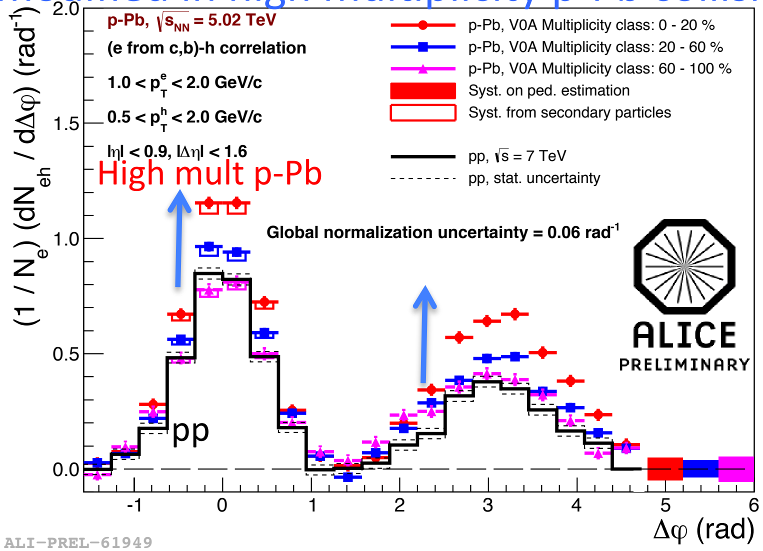
v_2 of identified particles show similar mass hierarchy than in peripheral Pb-Pb collisions

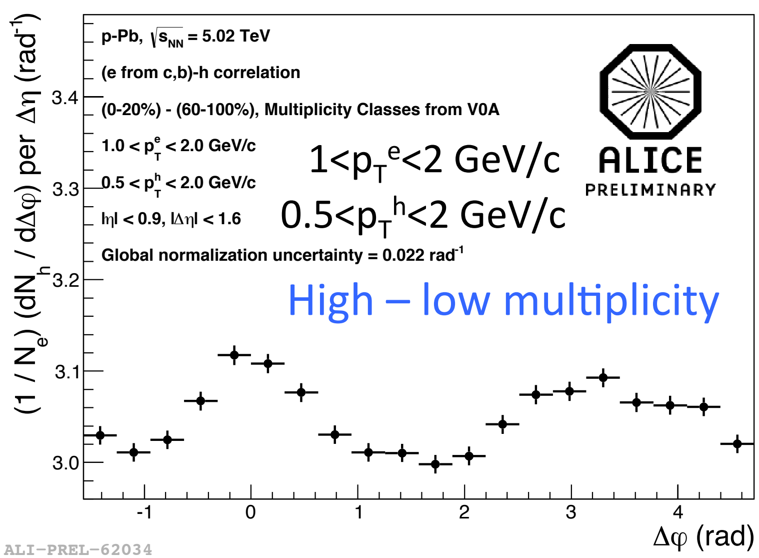
Initial state or collective effects?

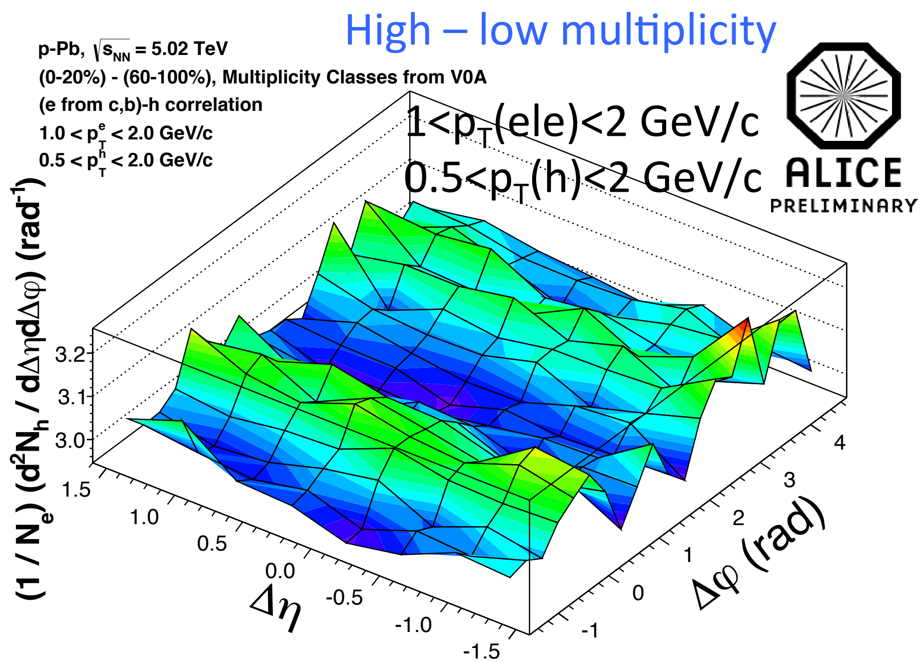
What happens in the heavy flavour sector?

Heavy-flavour decay electron – hadron correlations in p-Pb at the LHC

Near and away-side correlation peaks modified in high multiplicity p-Pb collisions







Long-range correlations in high-multiplicity p-Pb collisions also in the heavy-flavour sector?

Initial-state effect or sign of collectivity?

(e.g. CGC: Dusling, Venugopalan, PRD87 (2013) 094034; hydro in final state: Bozek, Broniowski, PLB718 (2013) 1557)

More precise measurement expected with run 2 data

Summary

- The study of **azimuthal correlations can complement elliptic flow and R_{AA} measurements**
  - Gain information on path-length dependence of energy loss, also in central collisions (v_2~0) with kinetically "tunable" surface biases?
  - Gain sensitivity to relative contribution of collisional and radiative energy loss?
- But up to which extent the measurements can go beyond the observation level, constraining models? The convolution of many ingredients can prevent a straightforward physics interpretation

  → **need of theoretical inputs** (but it is a **strongly observable related question**, we need predictions for measurable observables)
- **Unique possibility for addressing modification to heavy-quark fragmentation**: quantitative predictions needed to understand precision required on experimental observables.
- **Measurements performed so far in A-A collisions are statistically limited**
- Experimentally challenging

  → **We should (experimentalists and theorists) work together to define the most promising observables**
- Great opportunity for measuring possible **collective effects** affecting heavy-flavour hadron production in small systems.

Observables status & perspectives

Just a tentative, unofficial summary table… with a personal bias

	RHIC	LHC
HF (e/μ) – HF (e/μ)	pp, d-Au, (Au-Au?)	? (but doable)
D-D	/ (?)	pp
B-B (or proxy)	/	pp, (p-Pb? Pb-Pb?)
D - HF (e/μ)	pp, d-Au, Au-Au	pp, p-Pb, (Pb-Pb?)
B - HF (e/μ)	/	?
HF (e/μ) - hadron	pp, d-Au, Au-Au	pp, p-Pb,Pb-Pb
D - hadron	? (doable with STAR HFT)	pp, p-Pb, Pb-Pb
D - jets	/	pp, p-Pb,Pb-Pb
HF (e/μ) - jets	?	pp, p-Pb (Pb-Pb?)
b jet – b jet	/	pp, p-Pb, Pb-Pb

Legend:

Done

First observation

Ongoing/scheduled (e.g. for run 2 at the LHC)

Doable in the future (e.g. after detector upgrades)

? = Estimates not available

/ = likely never doable

N.B.

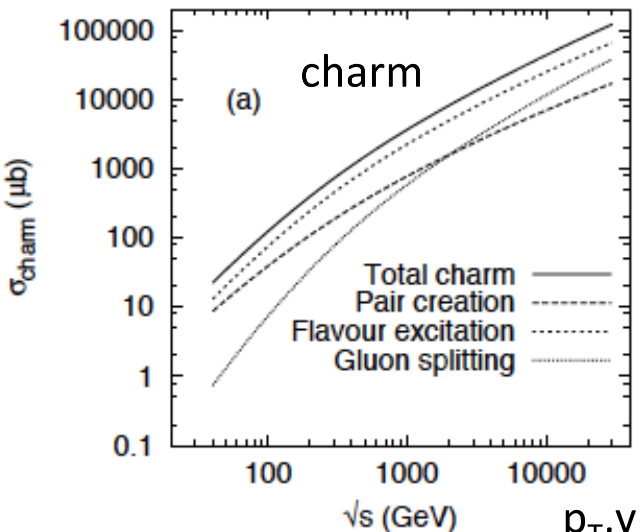
I assumed that if doable in Pb-Pb →doable in pp and p-Pb (which might not be always true)

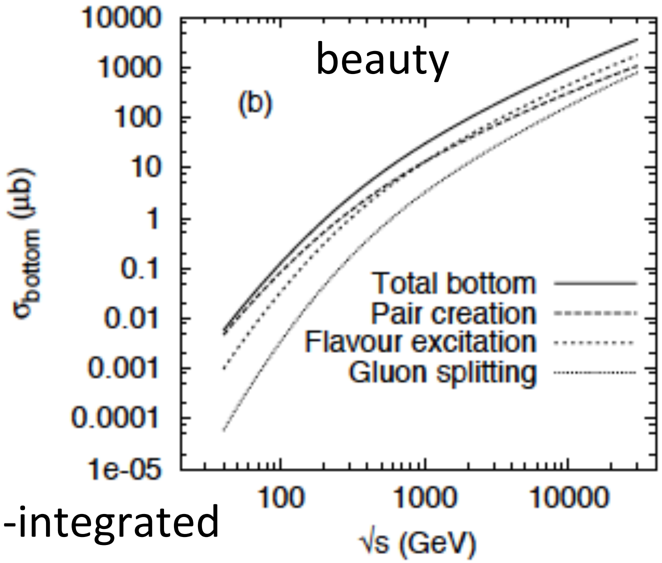
For most of observables: first observation → can become "done" in the future (hopefully)

Extra

Heavy-quark production processes

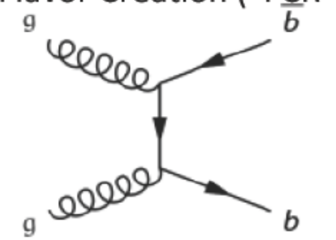
PYTHIA (E. Norrbin, T. Sjostrand, Eur.Phys.J.C17:137-161,2000)



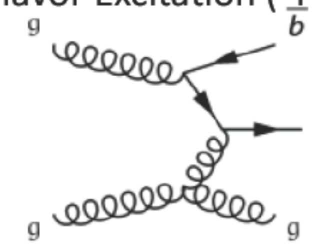


p_T,y -integrated

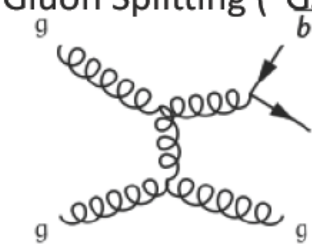
Flavor Creation (“FCR”)



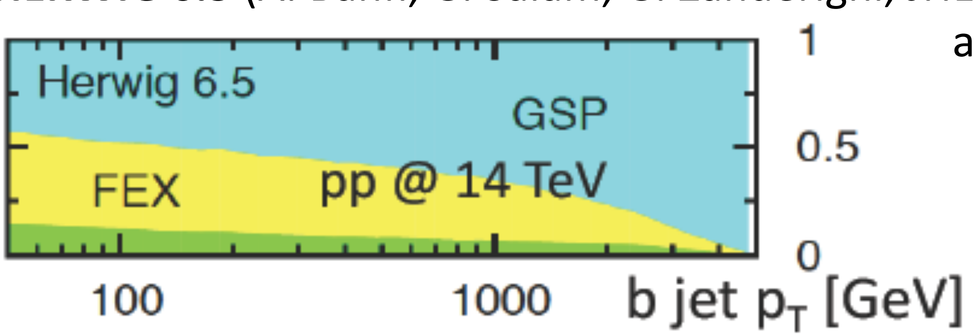
Flavor Excitation (“FEX”)



Gluon Splitting (“GSP”)



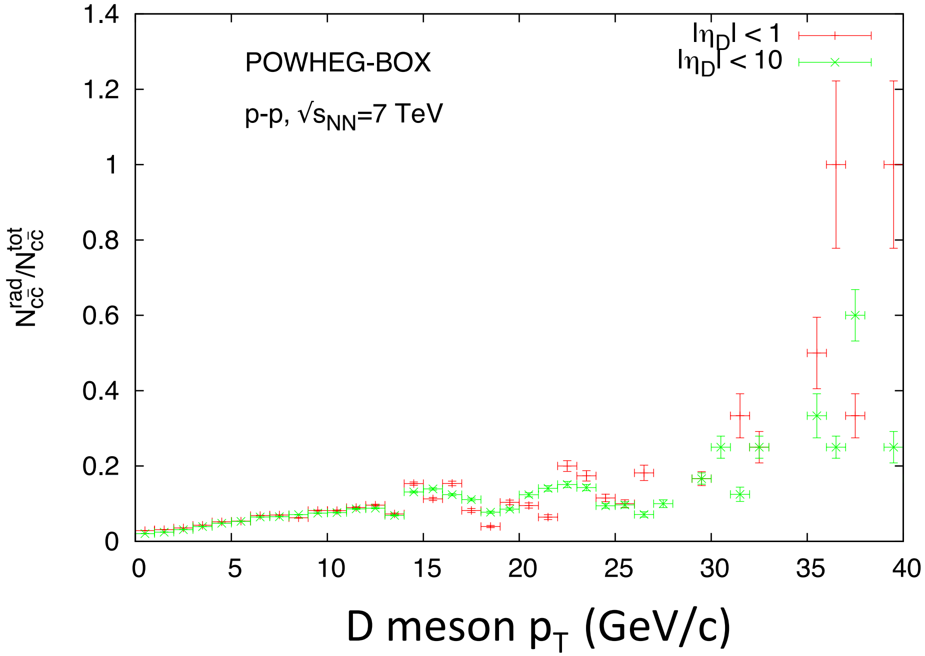
HERWIG 6.5 (A. Banfi, G. Salam, G. Zanderighi, JHEP 0707:026,2007, arXiv:0704.2999)



Heavy-quark production processes

M. Nardi

POWHEG + PYTHIA: fraction of D meson from charm quarks produced in parton shower

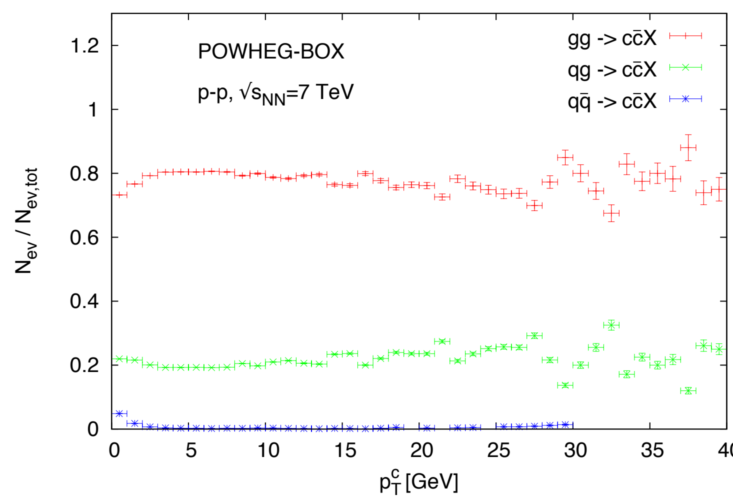


1 ccbar pair produced always in simulated event

→ Fraction lower than reality

(gg->gg(g), g->ccbar cases not included)

Increasing trend with D meson p_T



Which observable is suited for probing

	Production process (including IS effects)	Fragmentation and jet properties	In-medium energy loss	Collective phenomena in small systems
HF (e/μ) – HF (e/μ)	✔ (red) ✔ (blue)	✔ (green)	✔ (red)	✔ (green)
D-D	✔ (black)	✔ (blue)	✔ (black)	✔ (green)
B-B (or proxy)	✔ (black)	✔ (blue)	✔ (black)	✔ (green)
D - HF (e/μ)	✔ (blue)	✔ (green)	✔ (blue)	✔ (green)
B - HF (e/μ)	✔ (blue)	✔ (green)	✔ (blue)	✔ (green)
HF (e/μ) - hadron	✔ (green)	✔ (red)	✔ (red)	✔ (blue)
D (B) - hadron	✔ (red)	✔ (blue)	✔ (red)	✔ (black)
D in jets	✔ (black)	✔ (black)	✔ (green) ✔ (blue)	✔ (green)
HF (e/μ) - jets	✔ (red)	✔ (green)	✔ (blue)	✔ (green)
b jet – b jet	✔ (black)	✔ (black) ✔ (green)	✔ (black)	✔ (green)

A simplified and schematic view:

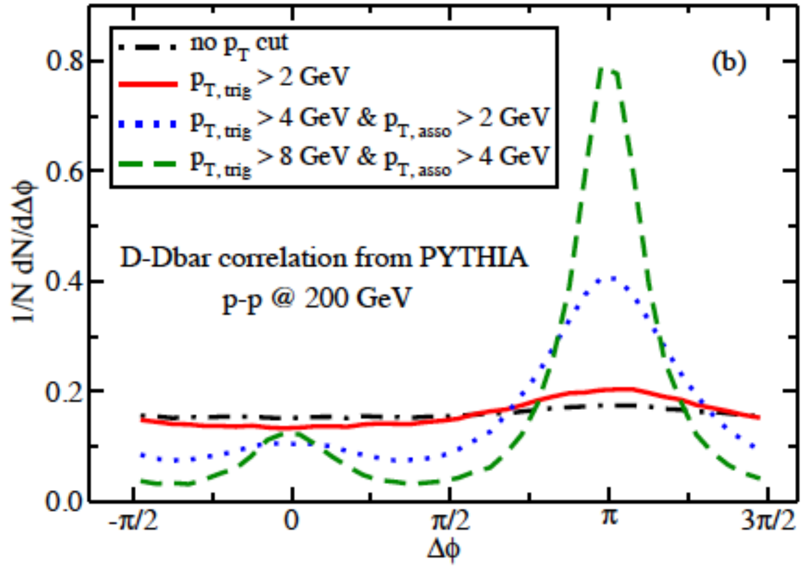
- ✔ (black) ideal
- ✔ (blue) good
- ✔ (red) not so good
- ✔ (green) poor or no sensitivity or logically complex

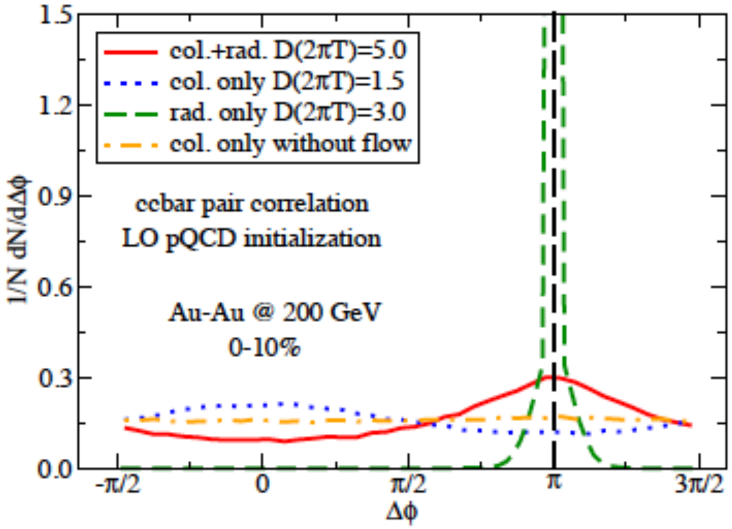
It also depends on the specific quantity measured (some double ✔)

Radiative vs. collisional energy loss

S. Cao, G-Y. Qin, S.A. Bass arXiv:1505.01869

Transport code based on Langevin equation with radiative energy loss introduced as external force





D meson R_{AA}: data described within uncertainties by both radiative only and collisional only energy loss → RAA alone not sufficient for discriminating

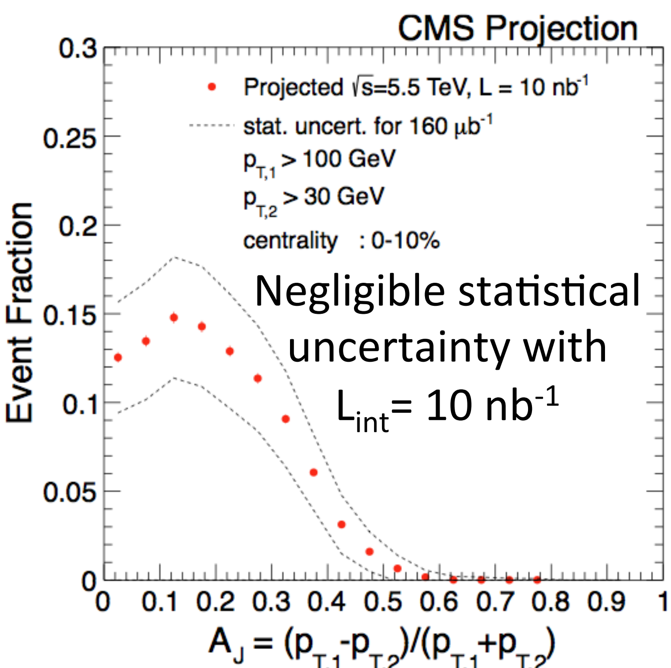
Dramatic effect with azimuthal correlations

Which observables?

Observables directly tracking QQbar azimuthal correlations:
D-D, B-B (or proxy)

b jet – b jet

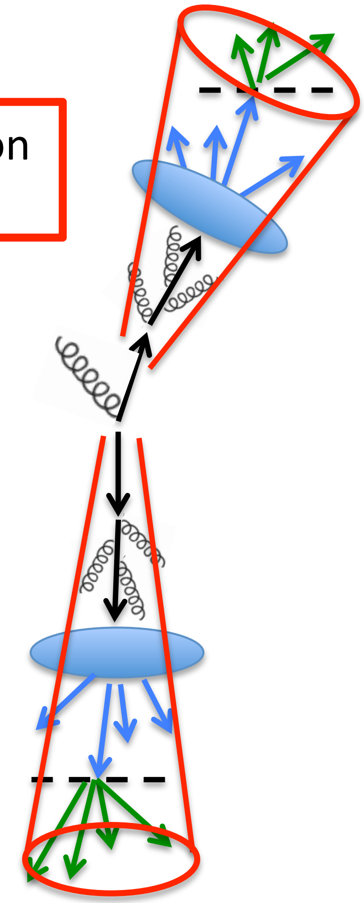
jets vs. single particle → sensitive to distribution of radiated energy (see E. Bruna's talk)



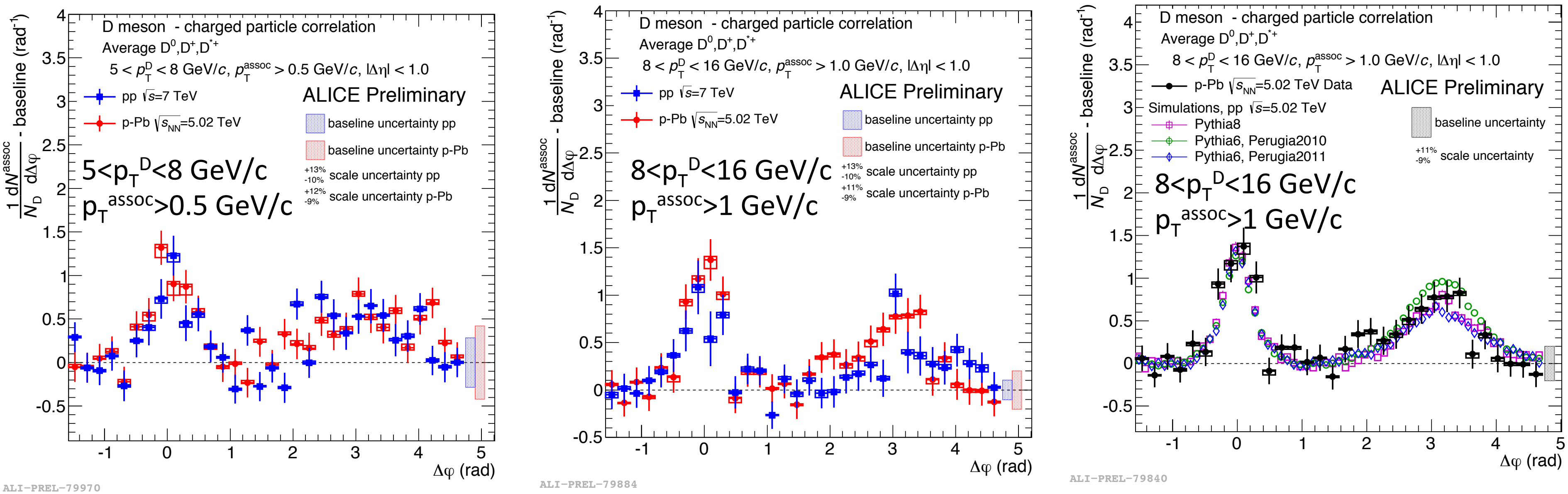
CMS-FTR-13-025

Dijet p_T imbalance for b-jets with CMS in Pb-Pb

From run 3 (>2020)



D meson –hadron correlations in p-Pb collisions



- Baseline subtracted measurements in pp collisions at √s=7 TeV and in (multiplicity-integrated) p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV compatible within uncertainties
- p-Pb data described well by Pythia

→ **Look forward to data from future runs**: observation of a possible positive v_2 might be obtained with run 2 data, precise measurement with run 3 data and ALICE detector upgrade

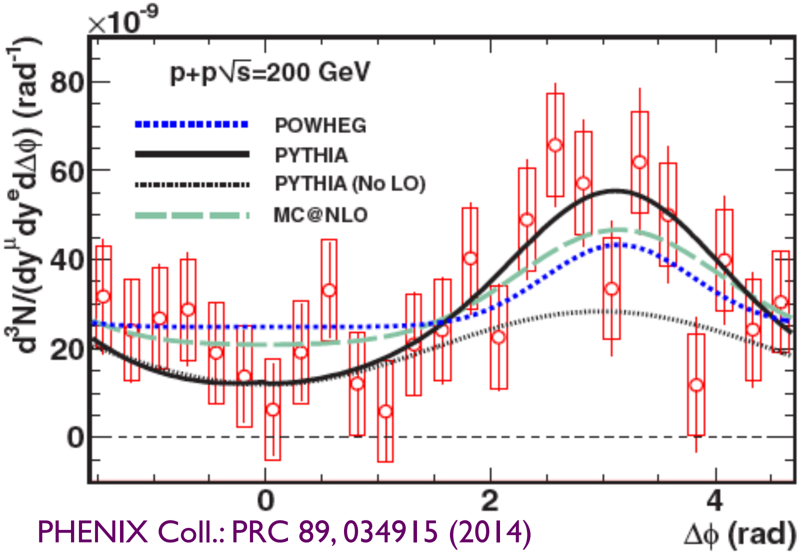
Further results in pp collisions: probing heavy-quark production kinematics

Charm-charm in pp at RHIC and Tevatron

PHENIX: $e^{\pm}$ - $\mu^{\mp}$ correlations

e: p_T>0.5 GeV/c, |η|<0.5
μ: p_T>1 GeV/c, 1.4<η<2.1

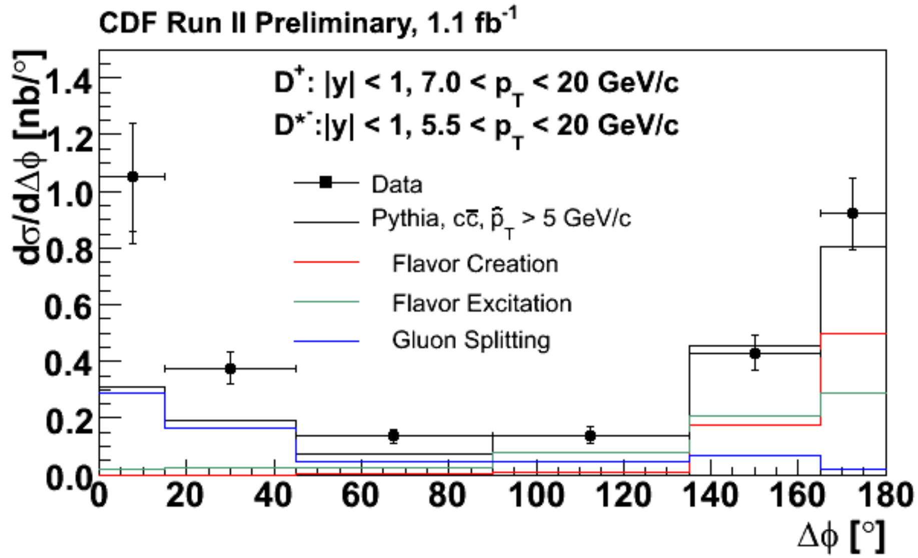
Published in 2014



PHENIX Coll.: PRC 89, 034915 (2014)

N.B. only 3% of sampled electrons have p_T>3 GeV/c
Beauty/charm contribution estimated to be ~1%

CDF, preliminary (2006)
D^+-D^{*-} correlations at mid-rapidity

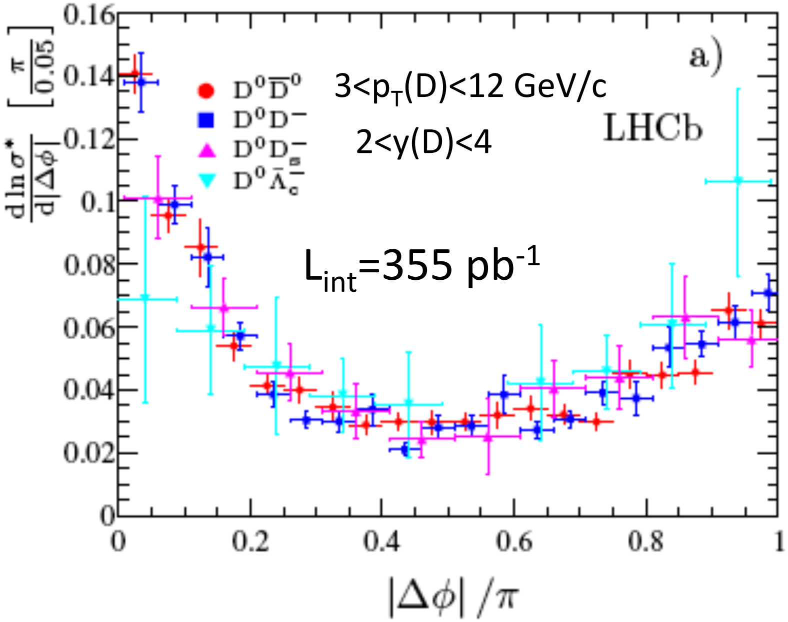


Data described by MC generators within uncertainties
Pythia (Tune A) slightly underestimates collinear production (gluon splitting) at Tevatron energy

Charm-charm correlations in pp at LHC(b)

LHCb Coll: JHEP06 (2012) 141

c-$\bar{c}$ correlations

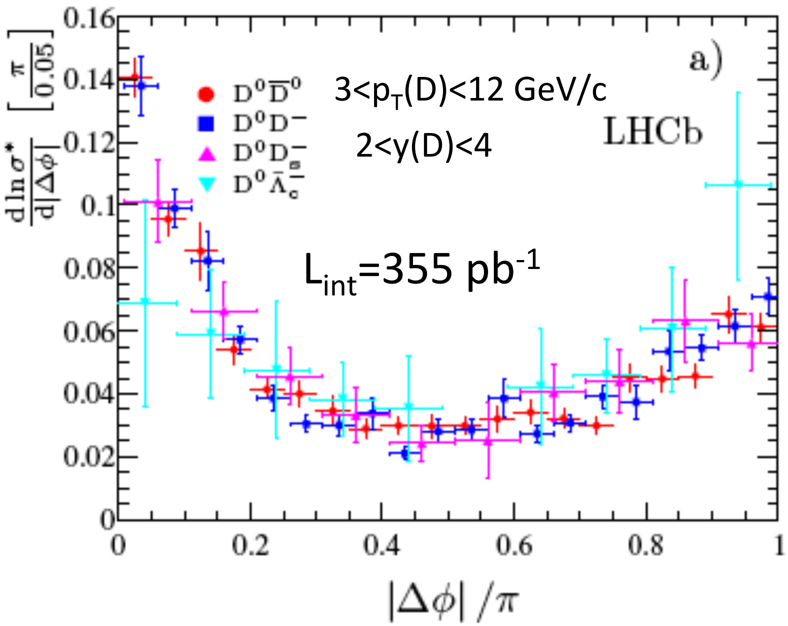


- Peak at $\Delta\varphi$~0 expected from gluon-splitting processes

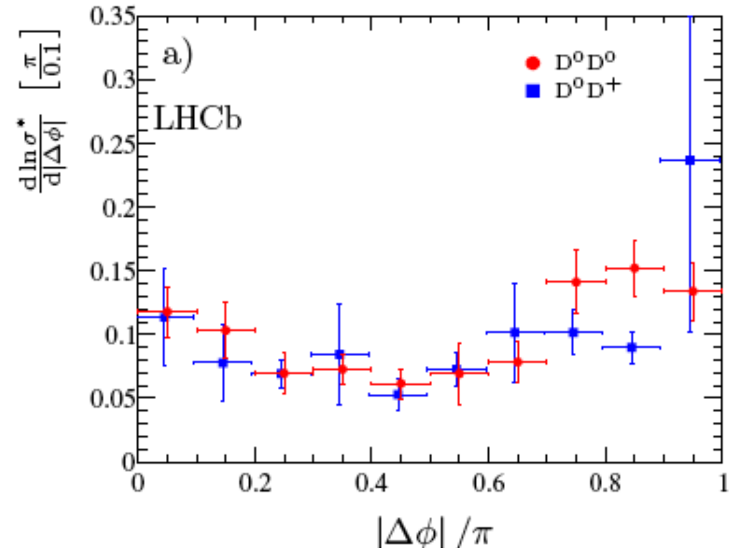
Charm-charm correlations in pp at LHC(b)

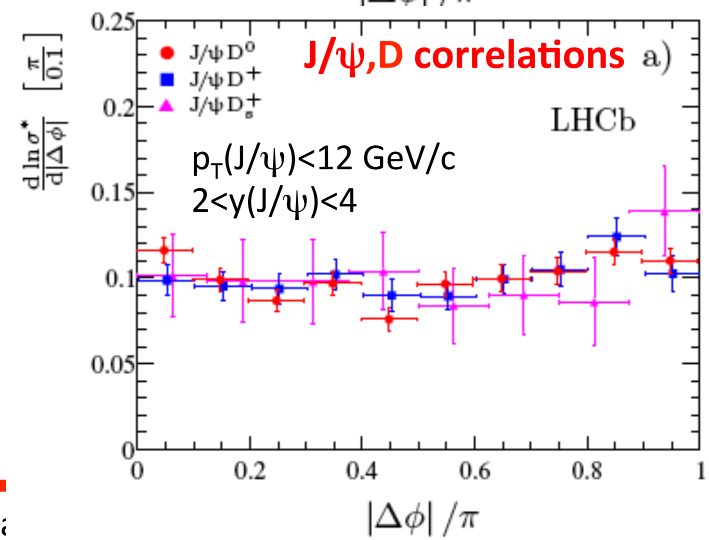
LHCb Coll: JHEP06 (2012) 141

c-$\bar{c}$ correlations



c-c correlations

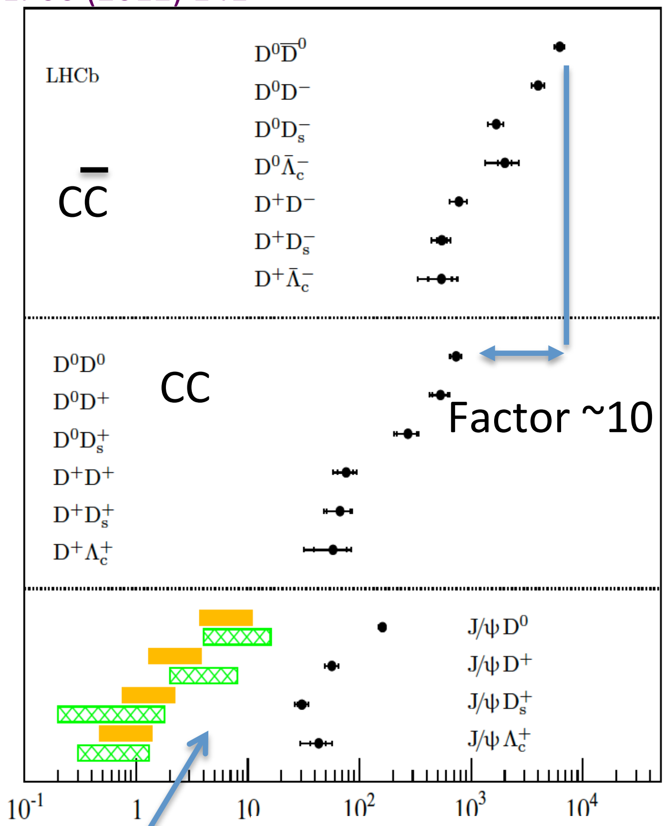




- Peak at $\Delta\varphi$~0 expected from gluon-splitting processes
- **Double charm pair production measured**
- First measurement of J/ψ D events in hadronic interactions
- **Multiple partonic interactions or charm from** gg(q$\bar{q}$)->c$\bar{c}$c$\bar{c}$ **processes?**

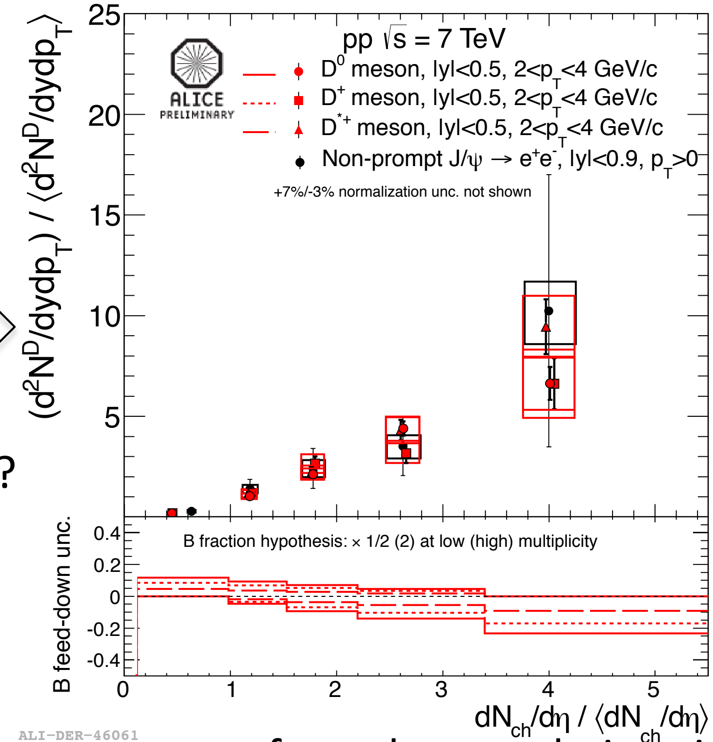
Double charm quark pairs from Multiple Partonic Interactions?

JHEP06 (2012) 141



Is there a connection?

D, J/ψ meson yield/ev vs. multiplicity



Measurements of angular correlations in high multiplicity pp events (e.g. D – h vs. mult., doable with ALICE with run 2 data) could provide additional information for understanding the origin of the observed trend

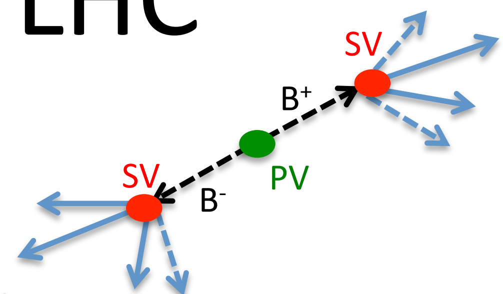
$J/\psi D(\Lambda_c^+)$ production underestimated by models calculating $gg(q\bar{q}) \to c\bar{c}c\bar{c}$ at LO

Phys.Rev. D57 (1998) 4385-4392; Phys.Rev. D73 (2006) 074021

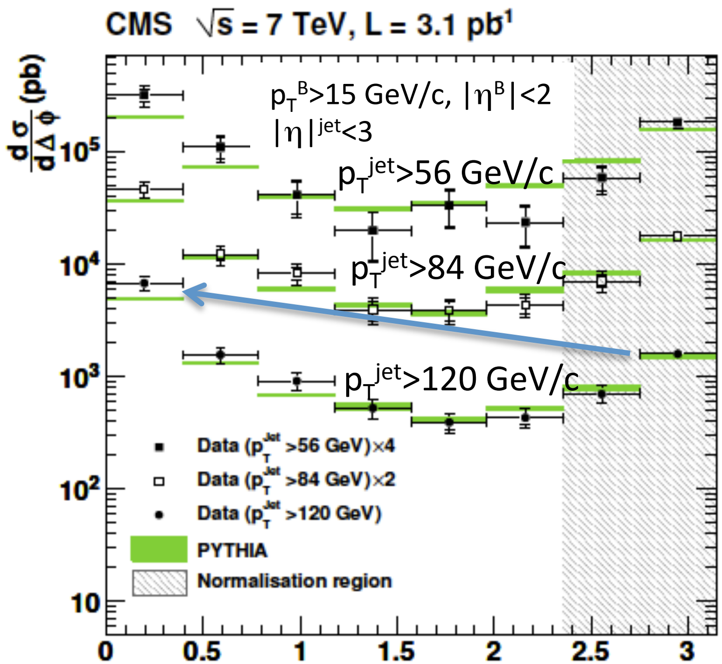
Eur. Phys. J C 61 (2009) 693

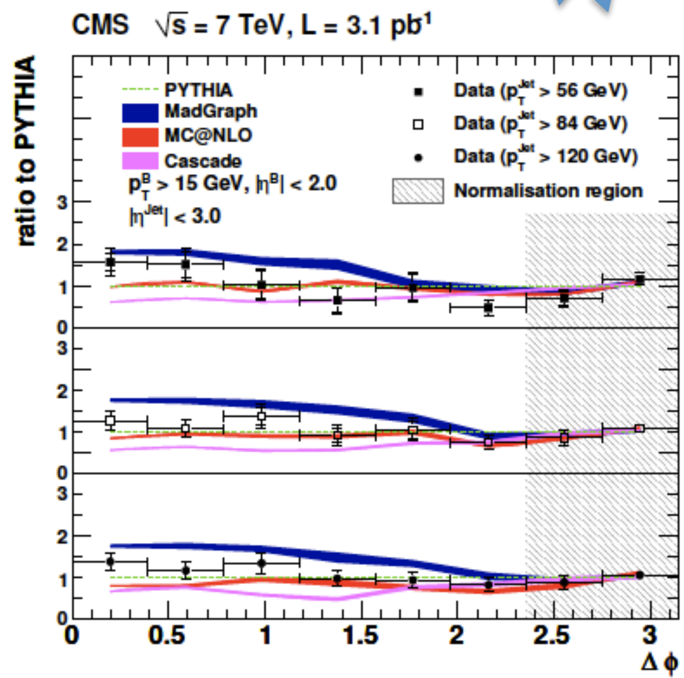
B-Bbar correlations at LHC

From displaced secondary vertex reconstruction
(B direction from PV-SV flight line)



Analysis performed in 3 events classes defined by trigger jet p_T, setting the hard interaction scale



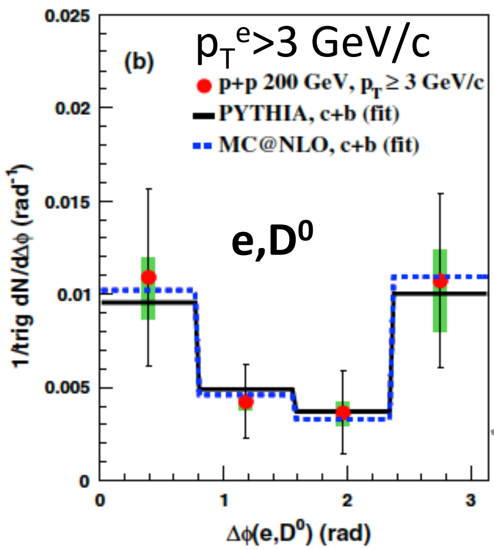


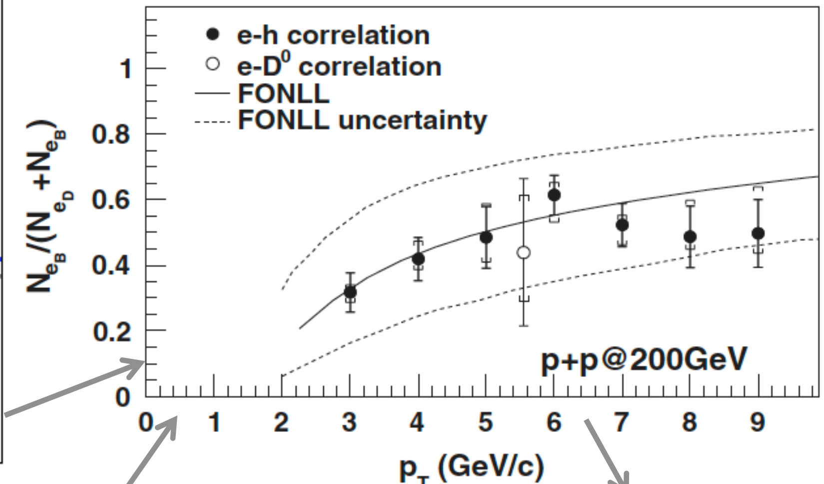
CMS: JHEP 1103:136,2011

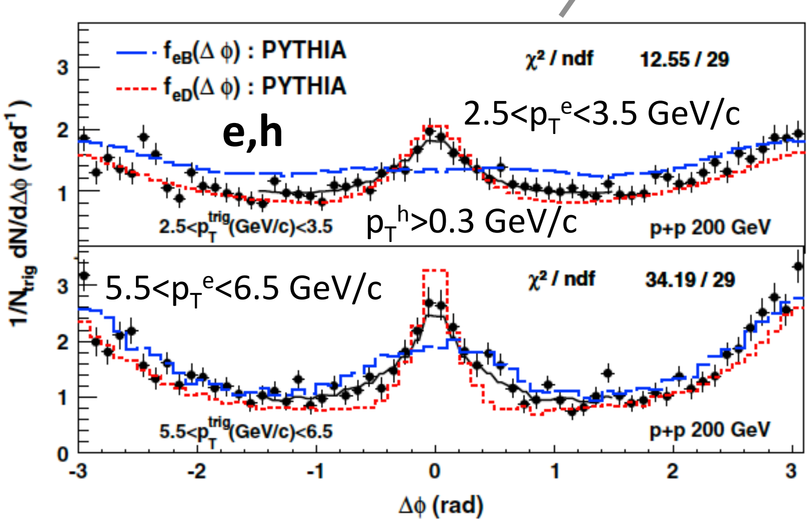
Significant contribution of correlations with small $\Delta\varphi$, increasing with jet p_T
Monte Carlo generators tend to slightly underestimate the collinear production
(opposite trend from MadGraph)

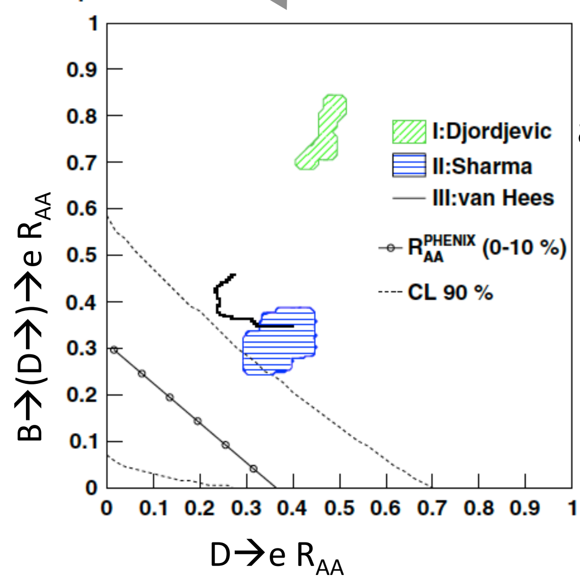
Charm-beauty electron separation at RHIC

STAR Coll: PRL 105, 202301 (2010)









Azimuthal correlations of non-γ electrons and

- **charged hadrons**
- **D⁰**

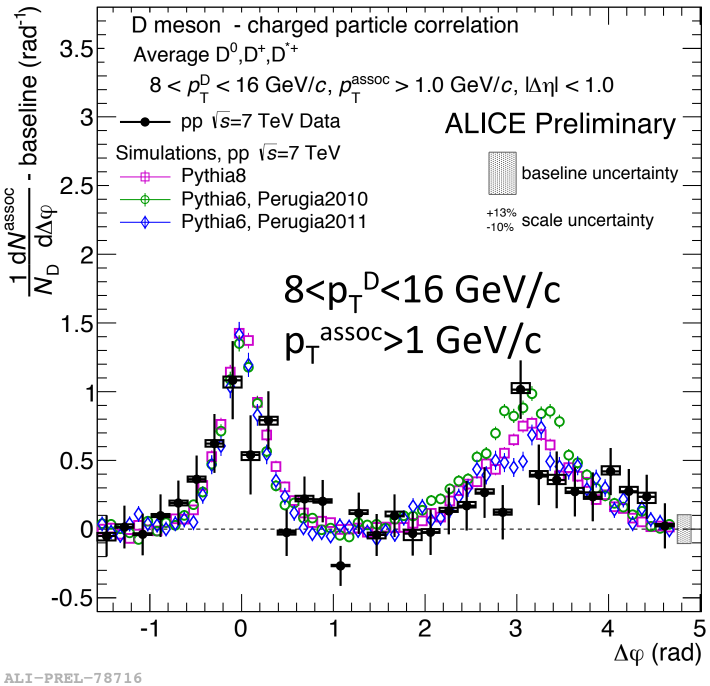
→ extract the fraction of electrons beauty hadron decay in **pp collisions**

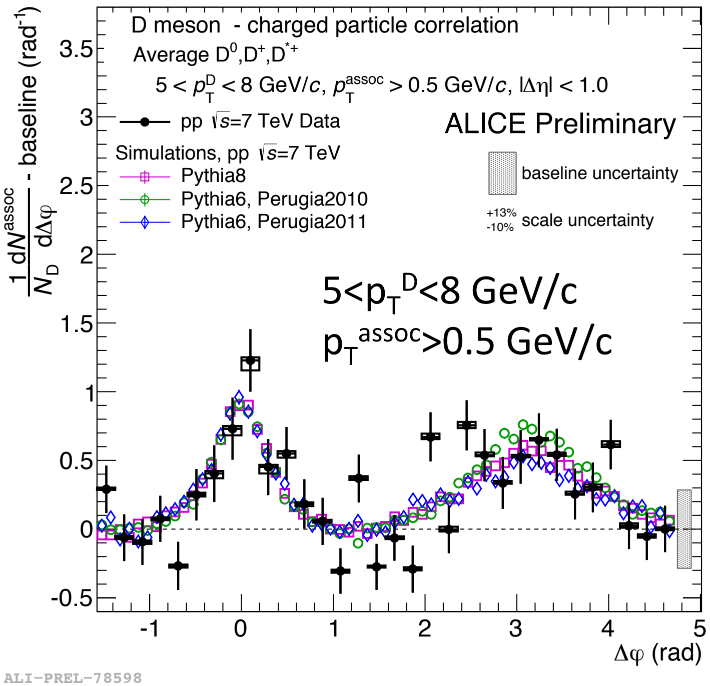
Data results described by FONLL

Obtained fraction used along with measured R_{AA} of non-γ electrons for p_T>5 GeV/c to constrain range of (R_{AA}^{eD}, R_{AA}^{eB}) values

Suggest suppression of high p_T B mesons at RHIC

D meson-charged particle correlations





Observable sensitive to details of **charm production processes and to charm fragmentation**
→ address charm jet properties
→ useful to constrain models including charm parton shower

Results described within uncertainties by Pythia, after baseline subtraction
Precise measurement expected with data from run 2 at LHC

Heavy-flavour correlations in p/d-A collisions:
Probing initial state and/or collective effects?

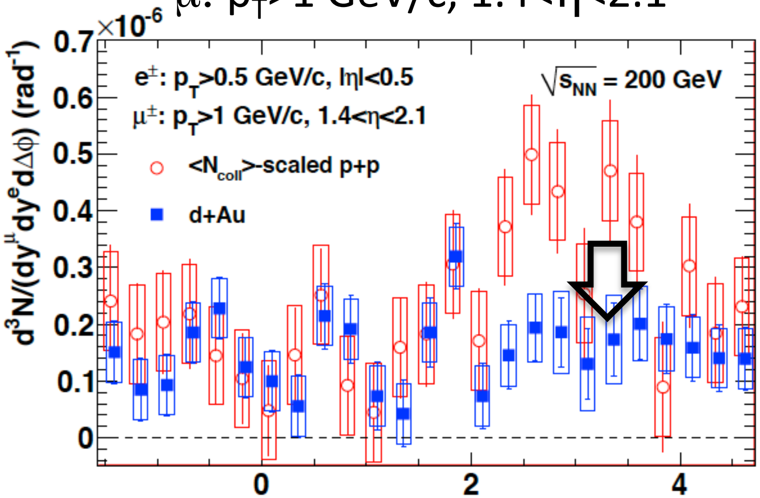
Charm-charm correlations in d-Au at RHIC

PHENIX: $e^{\pm}$ - $\mu^{\mp}$ correlations

e: p_T>0.5 GeV/c, |η|<0.5

μ: p_T>1 GeV/c, 1.4<η<2.1

Published in 2014

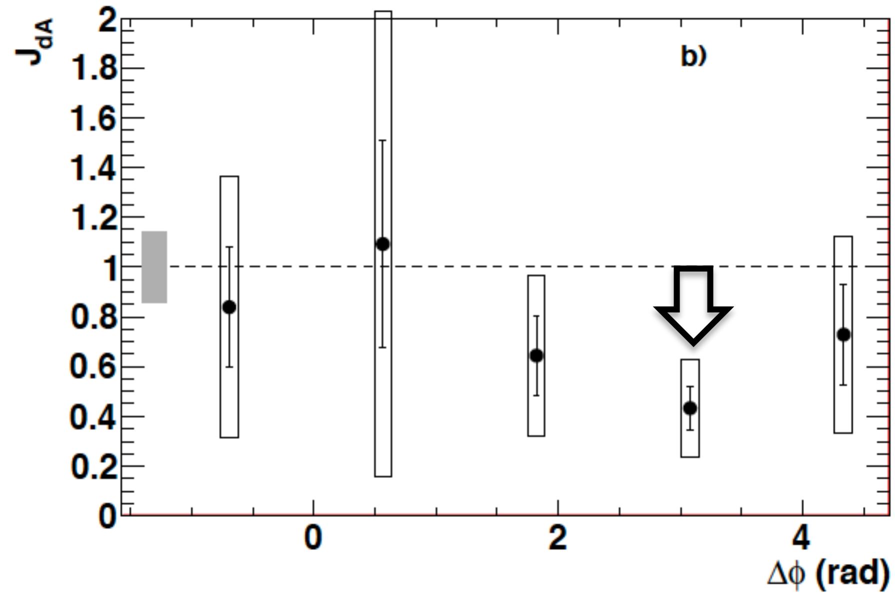


PHENIX Coll.: PRC 89, 034915 (2014)

pp

d-Au

$$J_{dA} = \frac{d + \text{Au pair yield}}{\langle N_{\text{coll}} \rangle \; p + p \text{ pair yield}}.$$

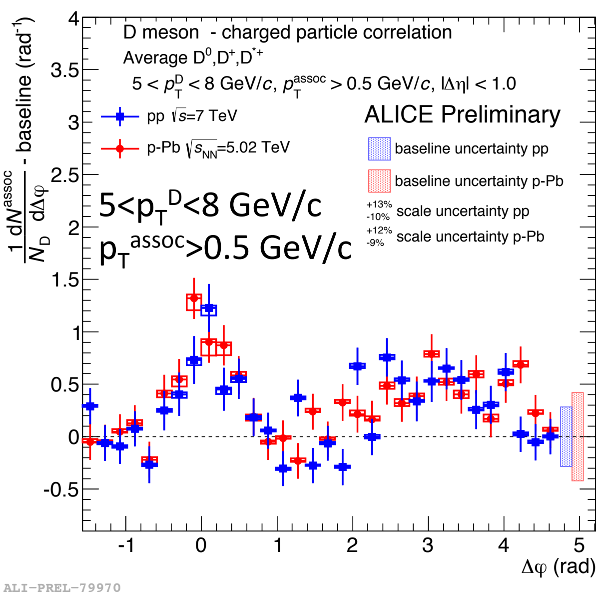


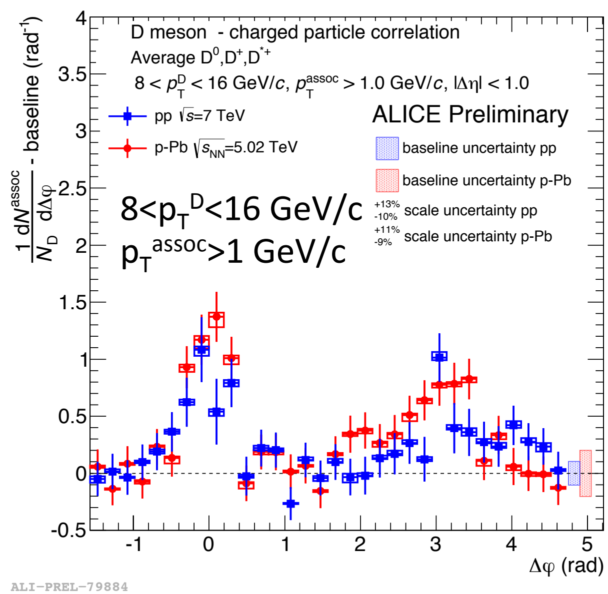
Away-side peak suppression

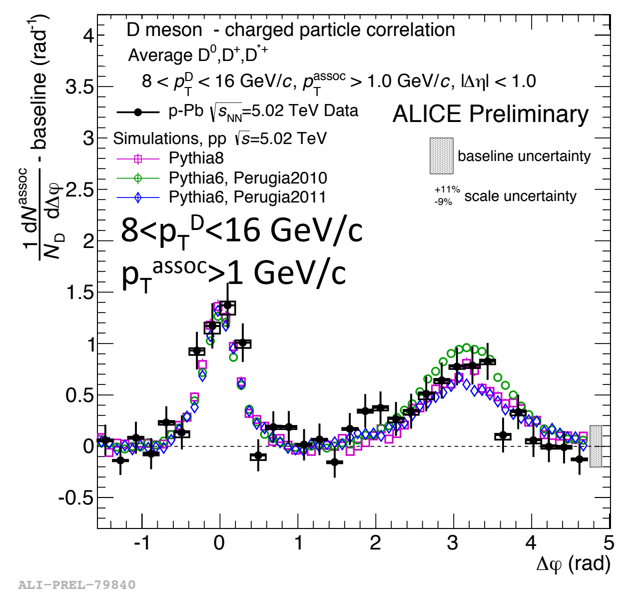
Initial (e.g. CGC) or final state effect?

D meson –hadron correlations in p-Pb collisions

New at SGW







- Baseline subtracted measurements in pp collisions at √s=7 TeV and in (multiplicity-integrated) p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV compatible within uncertainties
- p-Pb data described well by Pythia

→ **Look forward to data from future runs**: observation of a possible positive v_2 might be obtained with run 2 data, precise measurement with run 3 data and ALICE detector upgrade

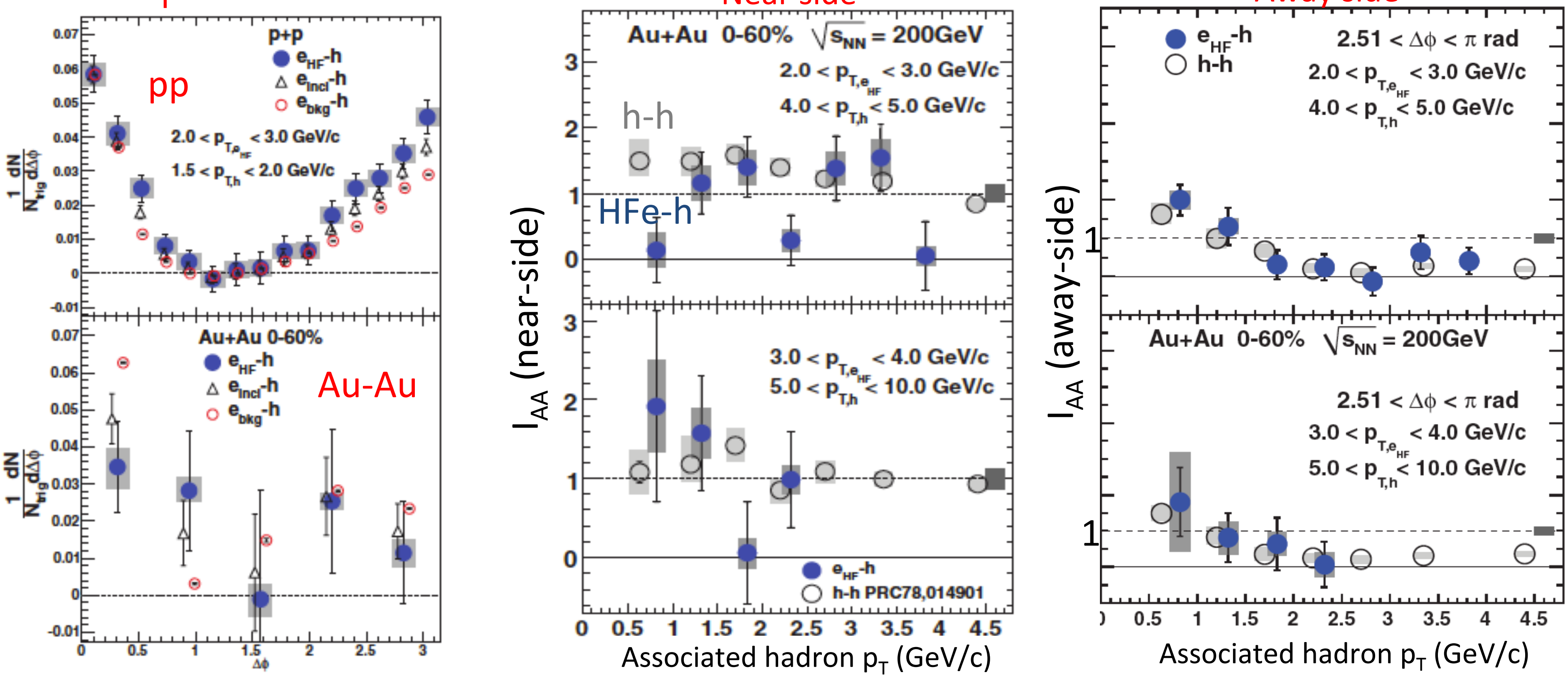
A-A results

Heavy-flavour electron – charged particle correlations at RHIC, PHENIX

PHENIX Coll.: PRC 83, 044912 (2011)

I_{AA}= ratio of associated yield (Au-Au)/pp

$\Delta\varphi$ distributions | Near side | Away side

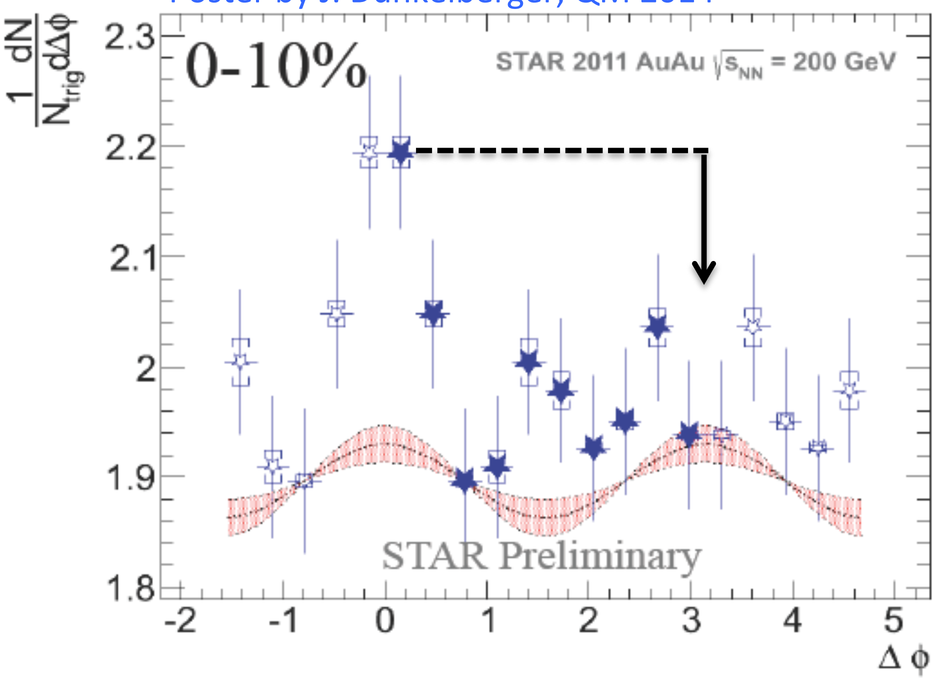


Large uncertainties in Au-Au measurement prevent firm conclusions
Suggest a decreasing I_{AA} trend with hadron p_T in the away side
Similar results than hadron-hadron correlations (a coincidence?)

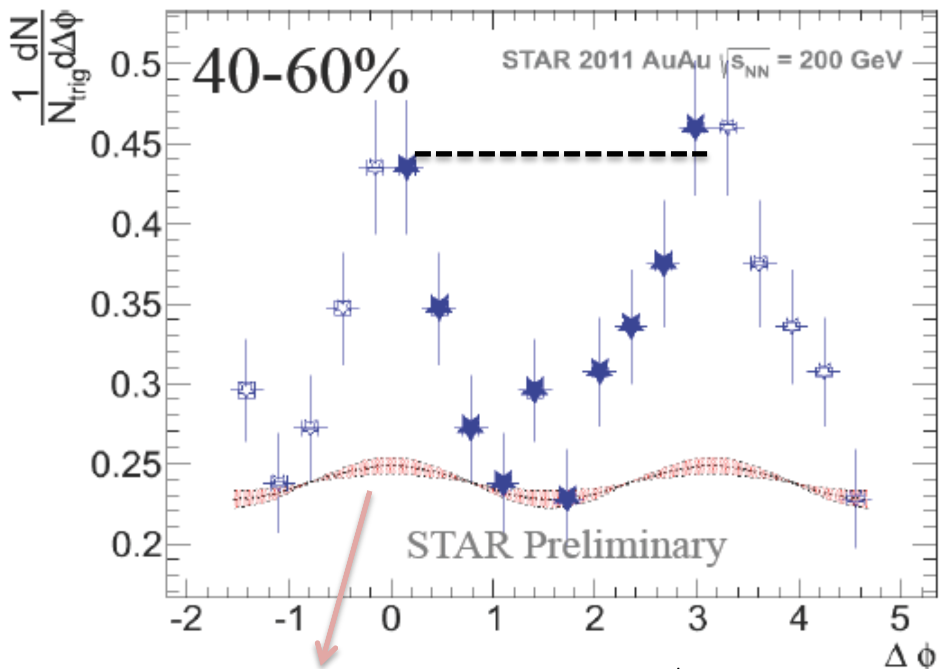
→ **Higher precision with new data**

Heavy-flavour electron – charged particle correlations at RHIC, STAR

Poster by J. Dunkelberger, QM 2014



$3<p_T^e<6$ GeV/c
$p_T^h>2$ GeV/c



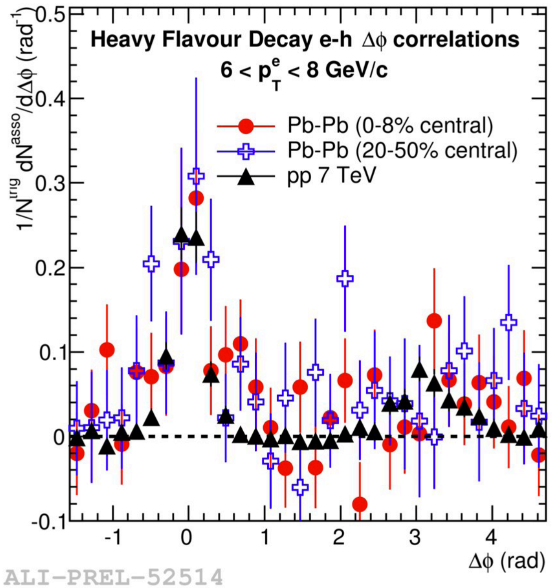
flow background: $1+2v_2^e v_2^h \cos(2\Delta\varphi)$
$0.05<v_2^e<0.15$

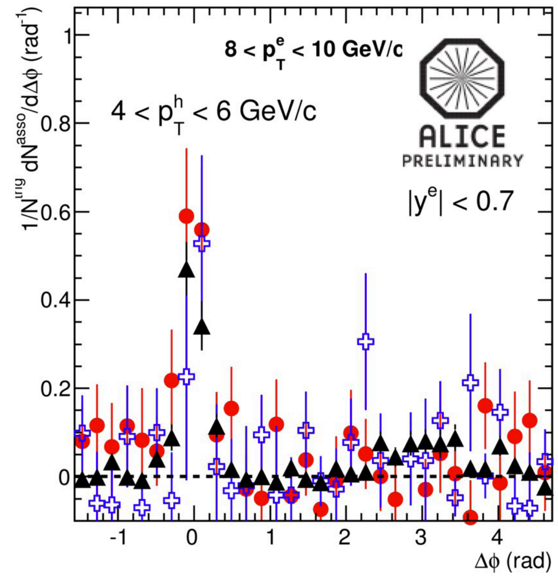
Maybe a too rigorous usage of the ZeroYieldAtMinimum prescription for estimating the baseline

Hint of away side peak suppression in central collisions

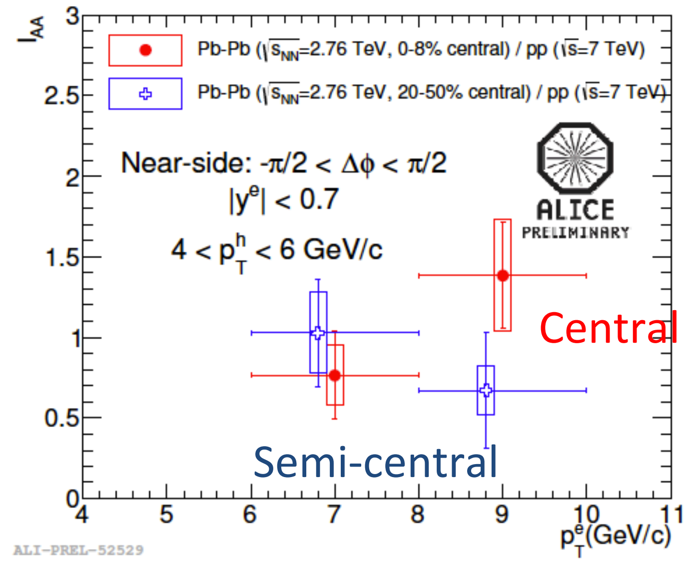
Heavy-flavour electron – charged particle correlations at the LHC

$\Delta\varphi$ distributions in pp and Pb-Pb





Near-side I_{AA}



Near-side I_{AA} compatible with 1 within uncertainties in both central and semi-central collisions

Looking forward to higher precision measurements with run 2 data

More to come in future runs and after detector upgrades

Present or very near future:

RHIC: STAR HFT and MTD, PHENIX MPC-EX

LHC: Pb-Pb at top energy

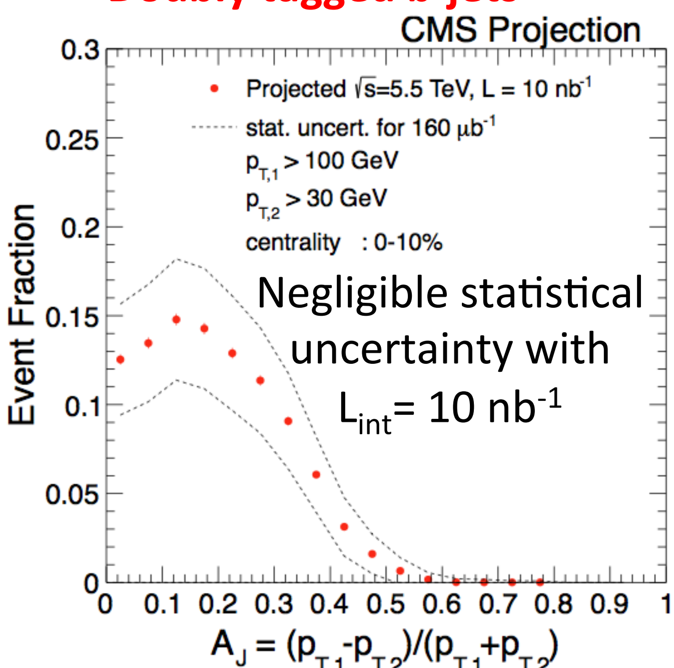
Longer terms:

LHC and detector upgrades (a major one for ALICE after LS2 in 2018)

RHIC and detector upgrades (2020)

→ **High precision measurements + new observables accessible**

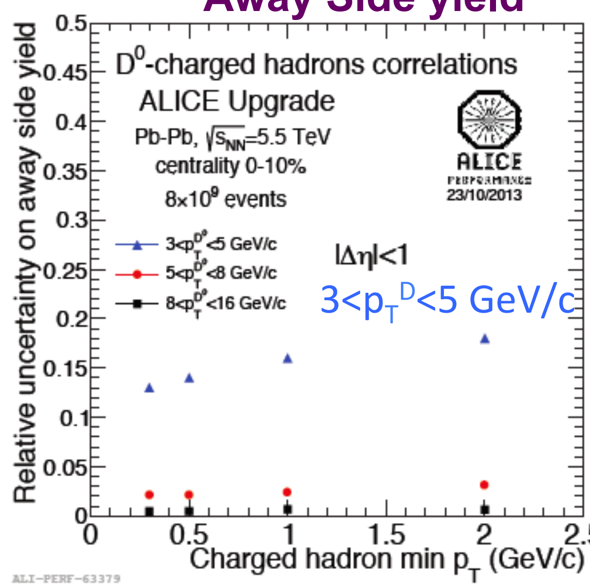
Doubly tagged b-jets



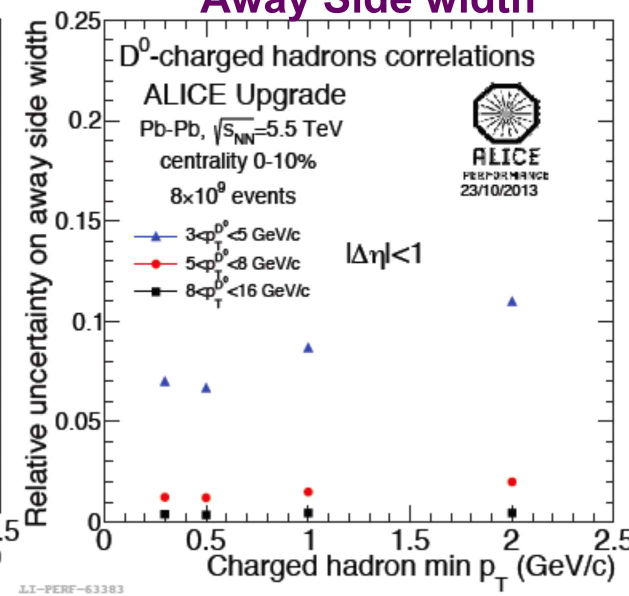
CMS-FTR-13-025

D^0-h correlations in 0-10% Pb-Pb

Away Side yield

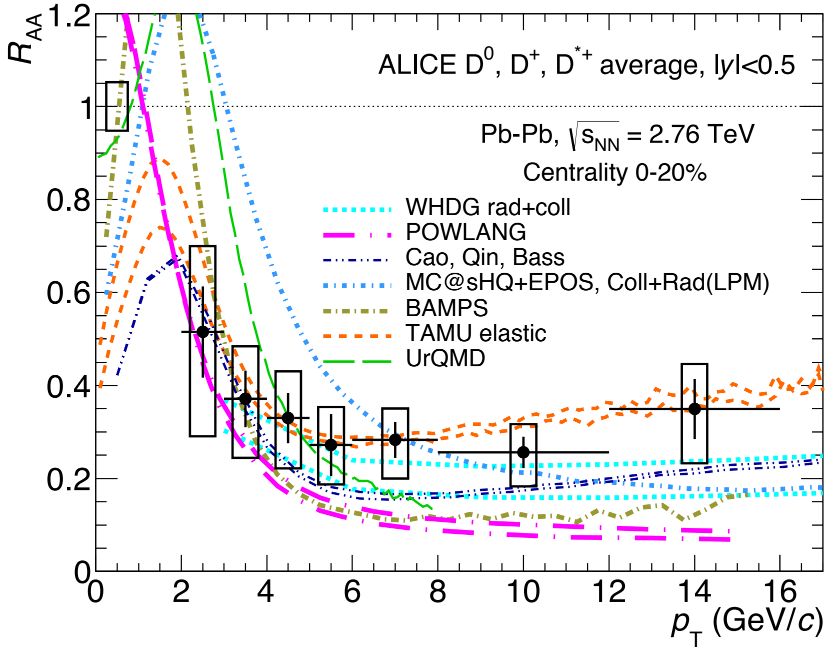


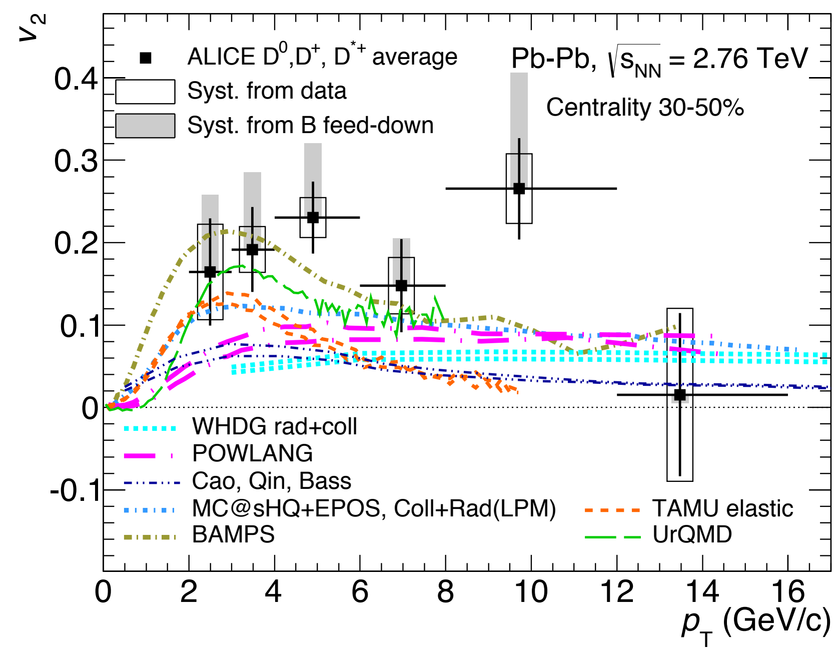
Away Side width



Good precision also for low p_T D^0!

D meson R_{AA} and v_2 vs. theoretical predictions





Many models can reproduce R_{AA} reasonably well but they are challenged by simultaneous description of R_{AA} and v_2

Can heavy-flavour correlations further constrain the models?

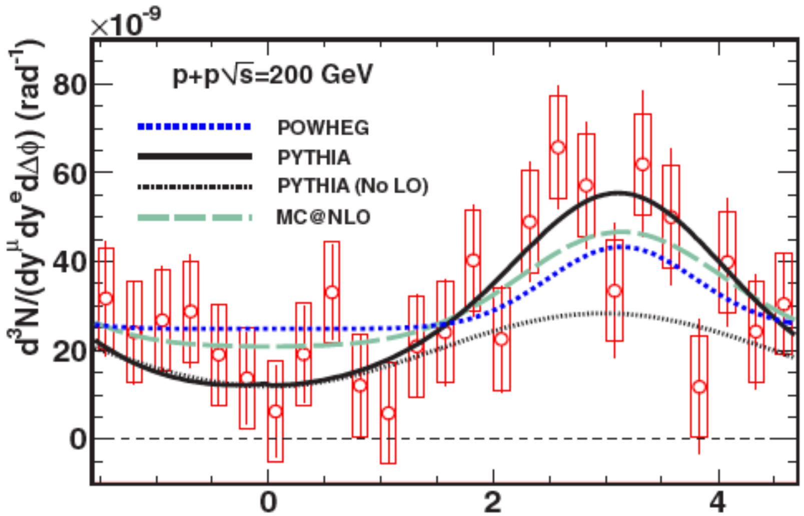
Charm-charm in pp at RHIC and Tevatron

PHENIX: $e^{\pm}$ - $\mu^{\mp}$ correlations

e: p_T>0.5 GeV/c, |η|<0.5

μ: p_T>1 GeV/c, 1.4<η<2.1

Published in 2014



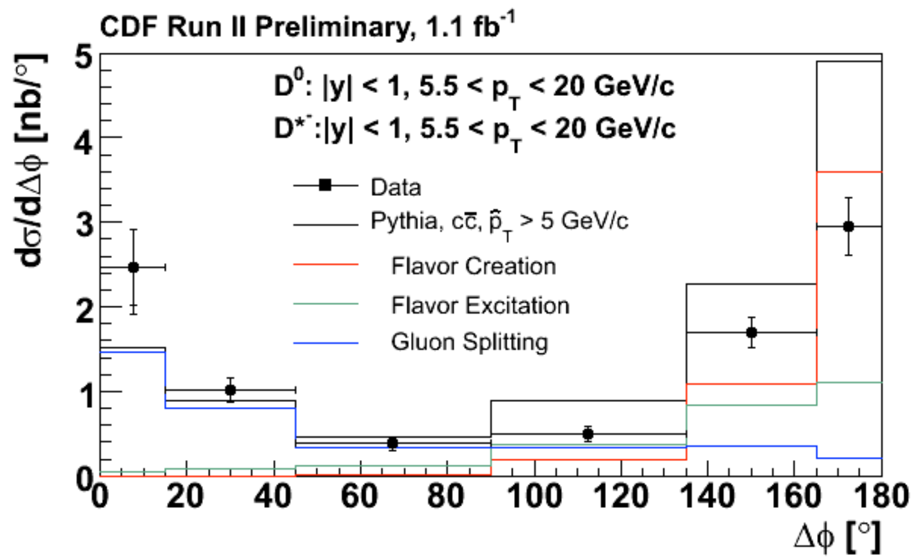
PHENIX Coll.: PRC 89, 034915 (2014)

N.B. only 3% of sampled electrons have p_T>3 GeV/c

Beauty/charm contribution estimated to be ~1%

CDF, preliminary (2006)

D^0-D^{*-} correlations at mid-rapidity

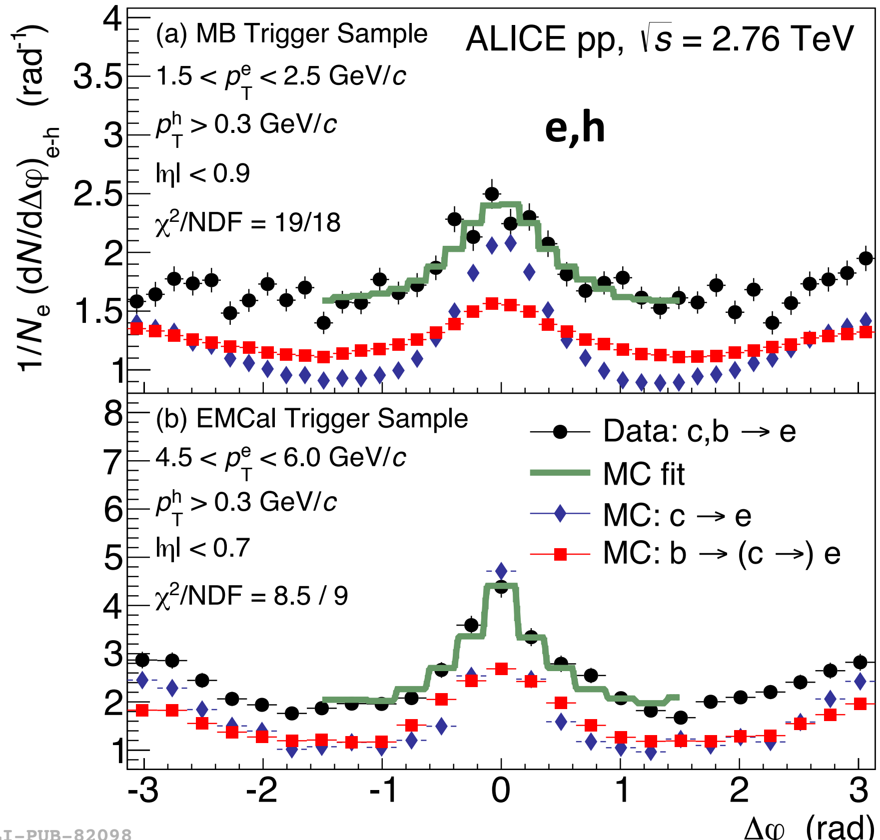


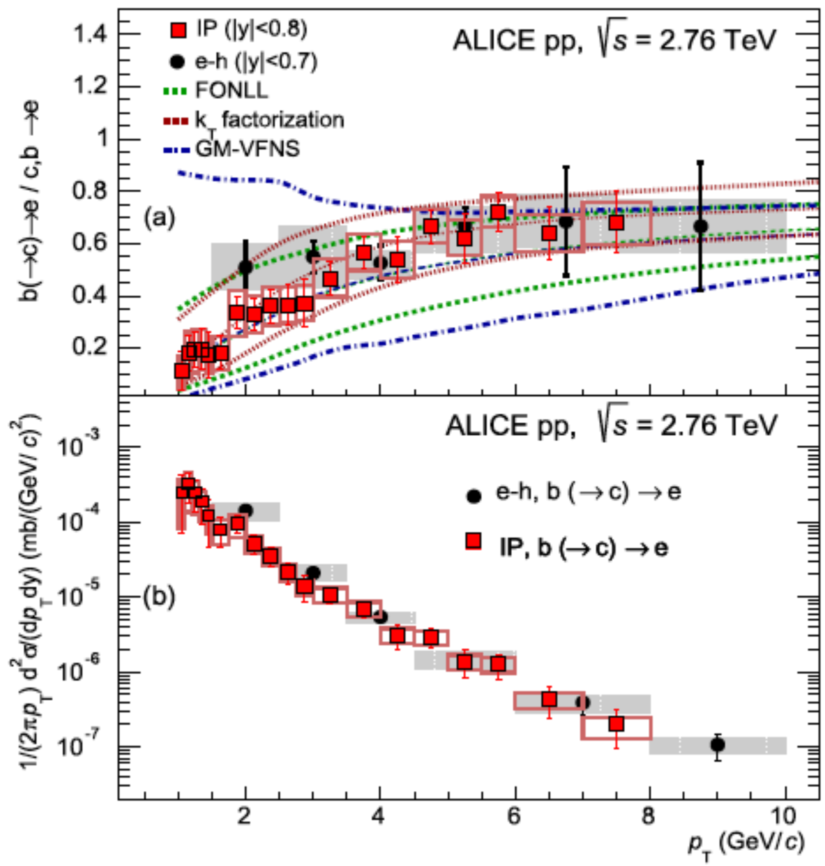
Data described by MC generators within uncertainties

Pythia (Tune A) slightly underestimates collinear production (gluon splitting) at Tevatron energy

Charm-beauty electron separation in pp collisions at LHC with ALICE

Published in 2014





PLB 738 (2014) 97-108

ALICE: important cross-check for results obtained with impact parameter analysis

Results described well by pQCD calculations

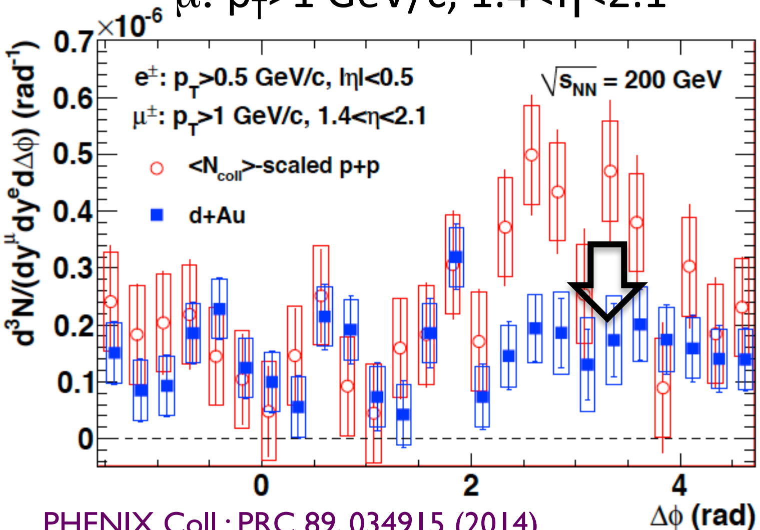
Charm-charm correlations in d-Au at RHIC

PHENIX: $e^{\pm}$ - $\mu^{\mp}$ correlations

e: p_T>0.5 GeV/c, |η|<0.5

μ: p_T>1 GeV/c, 1.4<η<2.1

Published this year (on arXiv last year)

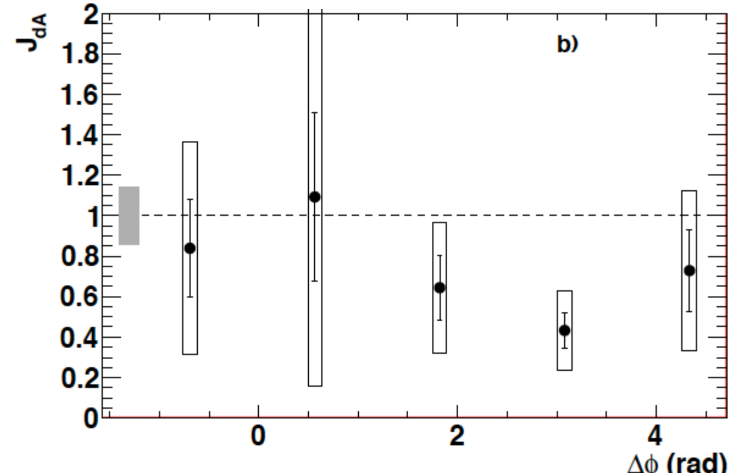


pp

d-Au

PHENIX Coll.: PRC 89, 034915 (2014)

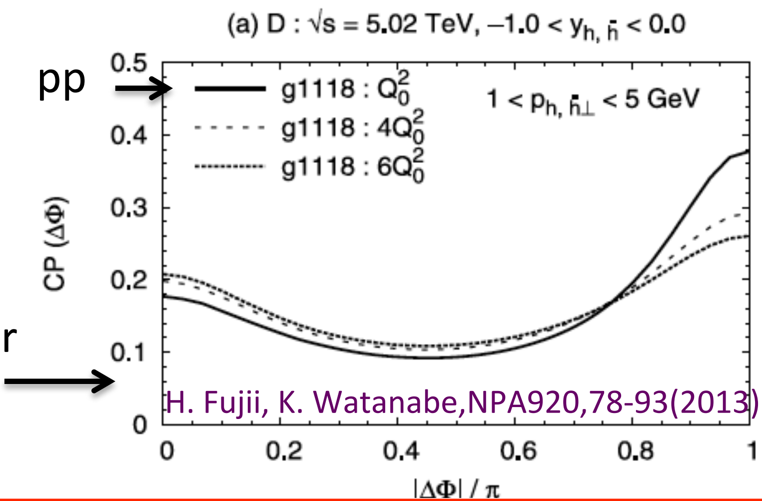
$$J_{dA} = \frac{d + \text{Au pair yield}}{\langle N_{\text{coll}} \rangle \; p + p \text{ pair yield}}.$$



Away-side peak suppression

Gluon shadowing? Multiple scattering?

CGC?



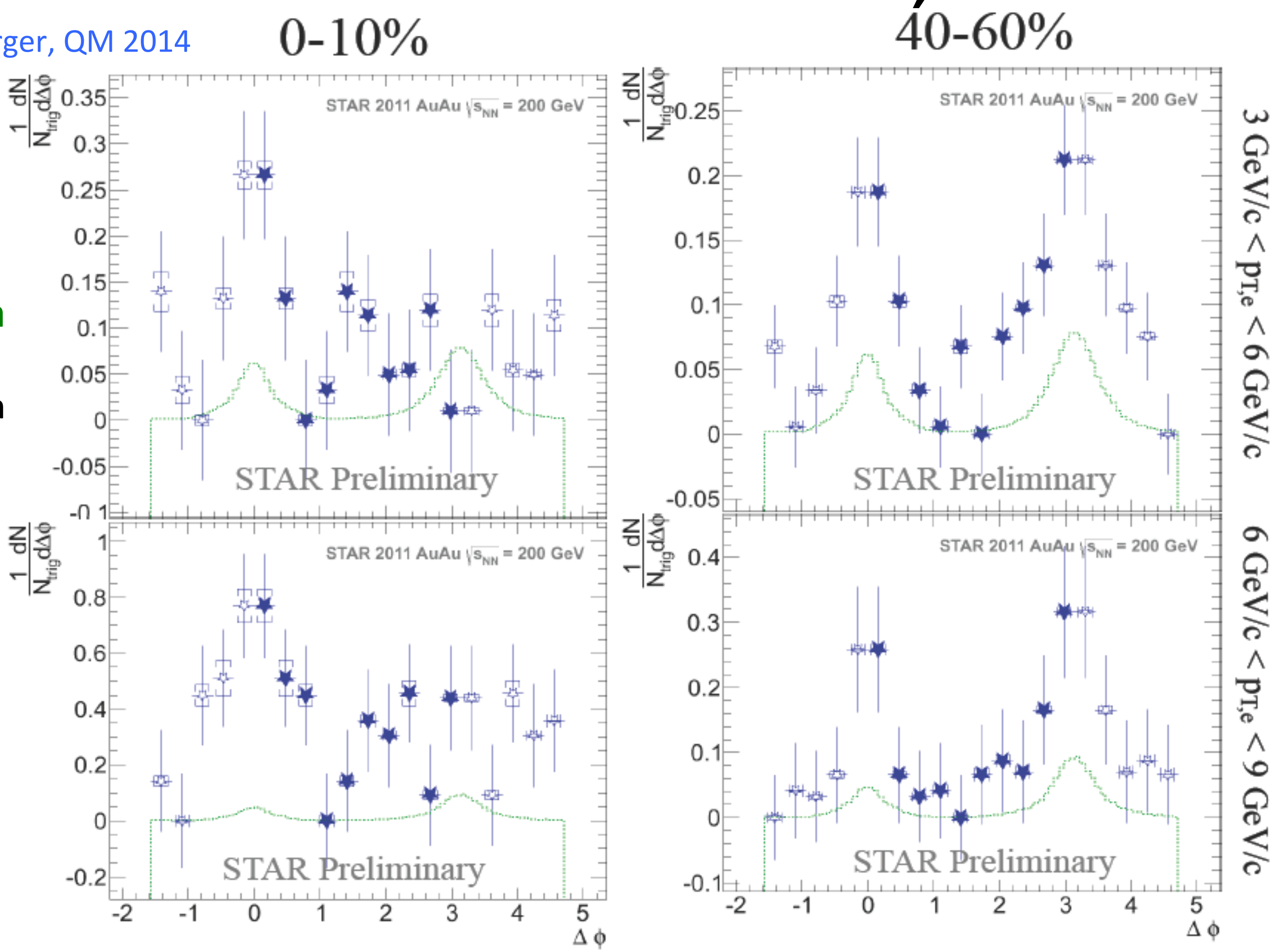
Predictions for DDbar correlations at LHC

Heavy-flavour electron – charged particle correlations at RHIC, STAR

Poster by J. Dunkelberger, QM 2014

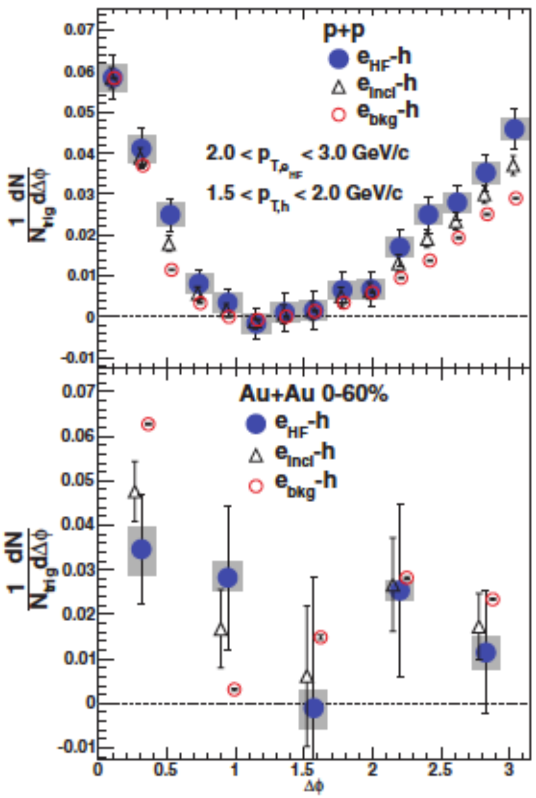
p_T^h>2 GeV/c

Compared to Pythia too rigorous usage of the ZYAM prescription for estimating the baseline?



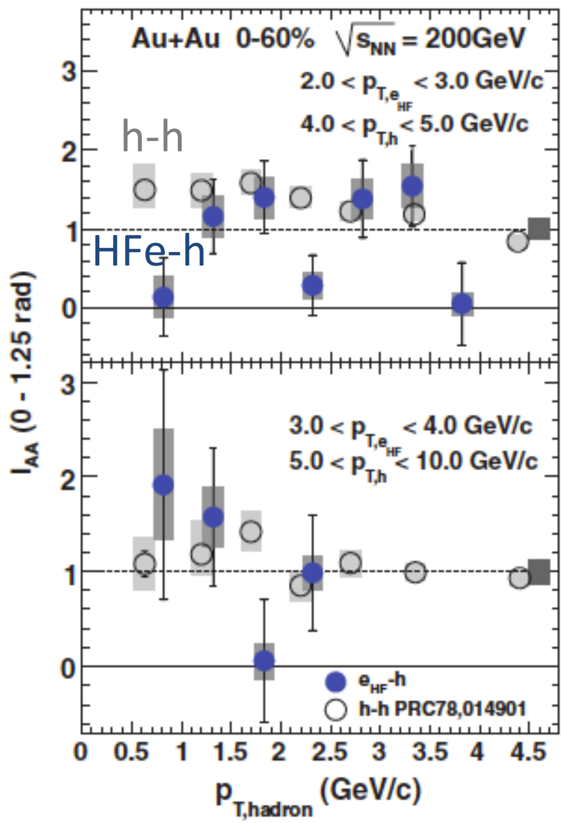
Heavy-flavour electron – hadron correlations at RHIC

$\Delta\varphi$ distributions in pp and Au-Au

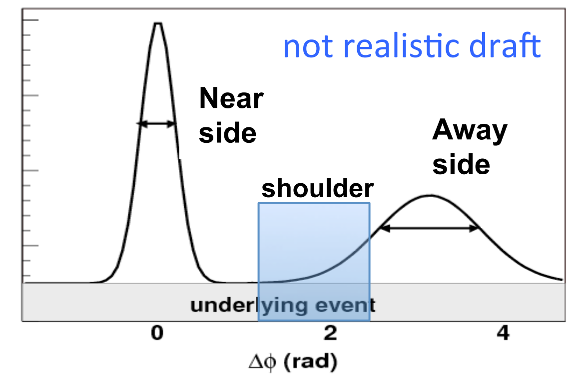


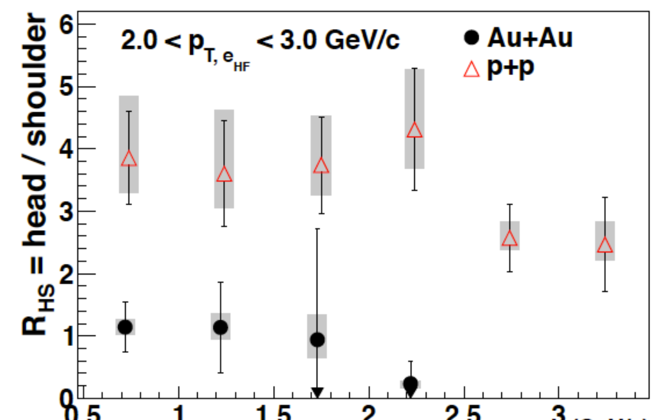
PHENIX Coll.: PRC 83, 044912 (2011)

Near-side I_{AA} = ratio of associated yield (Au-Au)/pp



Away-side (2.51-π) / Shoulder (1.25-2.51)





Different scaling of charm (N_{coll} x R_{AA}) and baseline