Study of charm diffusion with jet-D^0 correlation in heavy ion collisions with CMS

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For the CMS Collaboration

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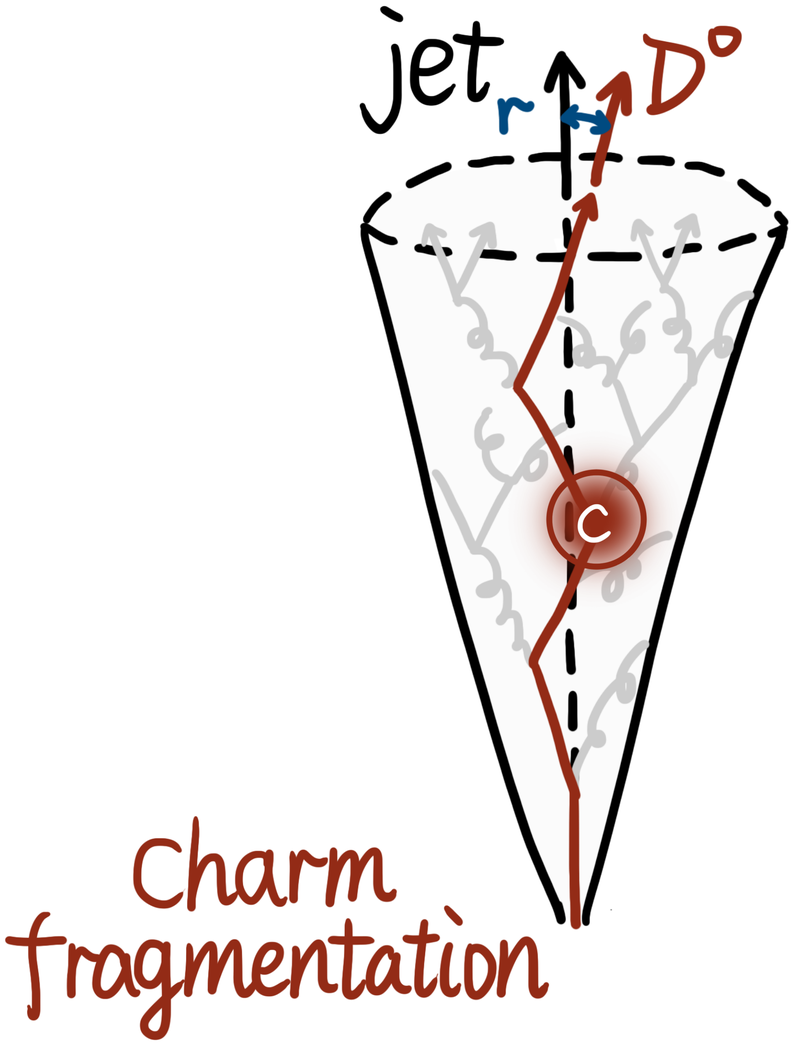
What to study with D-jet angular correlation?



Study effects decoupling charm from jet

- Fragmentation modification in medium

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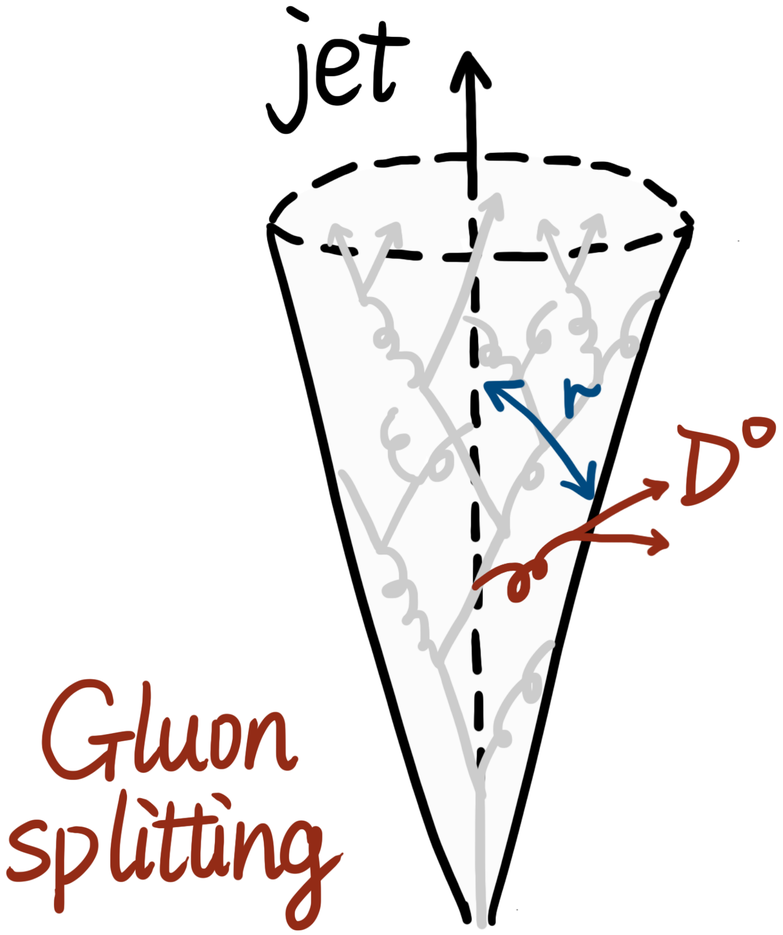

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- Gluon splitting
  - Not fully understood even in pp

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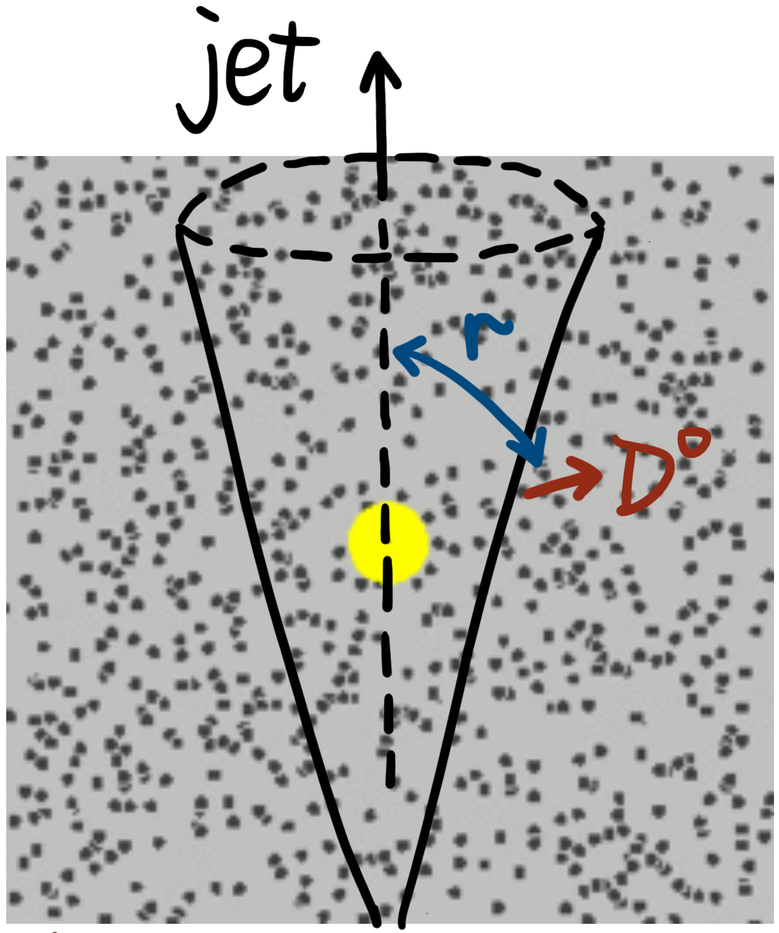

Diffusion

Study effects decoupling charm from jet

- Fragmentation modification in medium
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  - More sensitive observable than inclusive measurements (R_{AA}, v_2)

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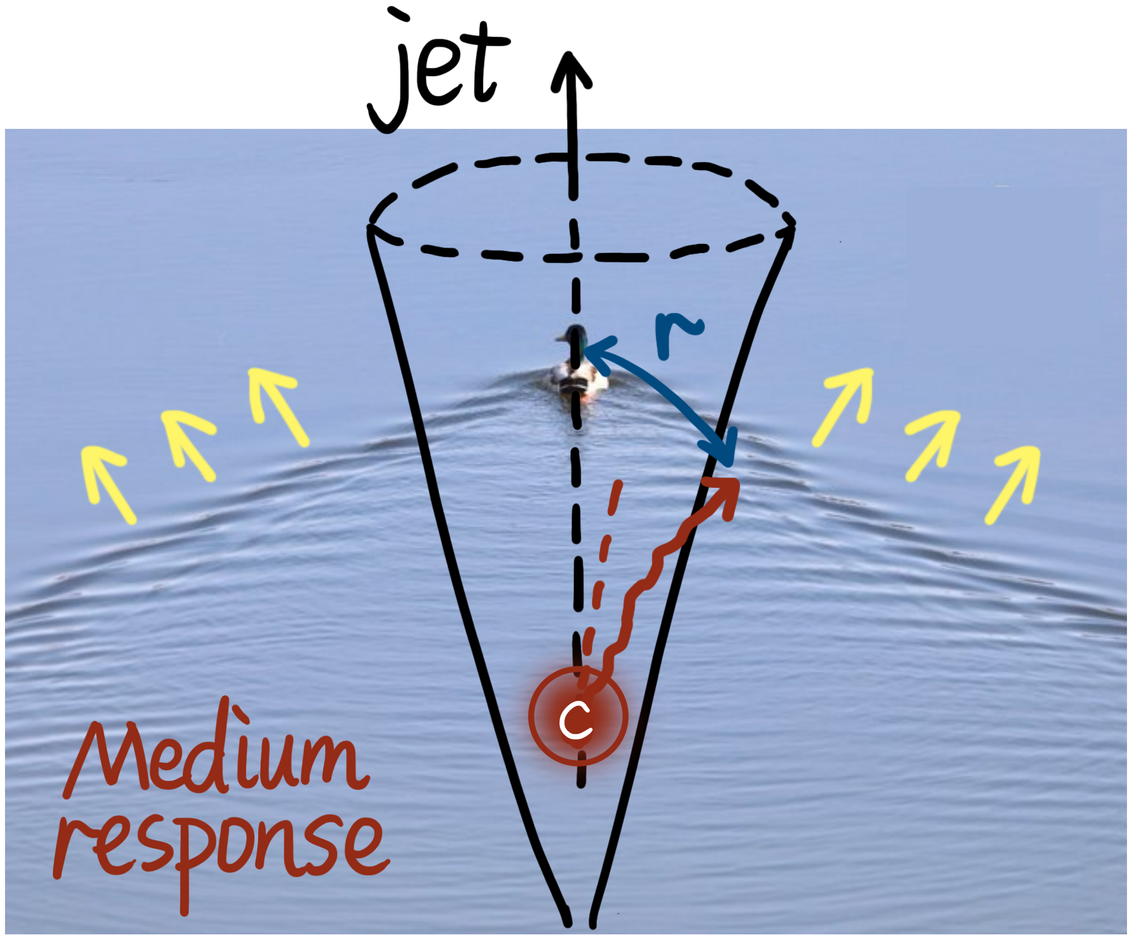

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- Medium response
  - Hard partons change the medium that will change the jet in return as well

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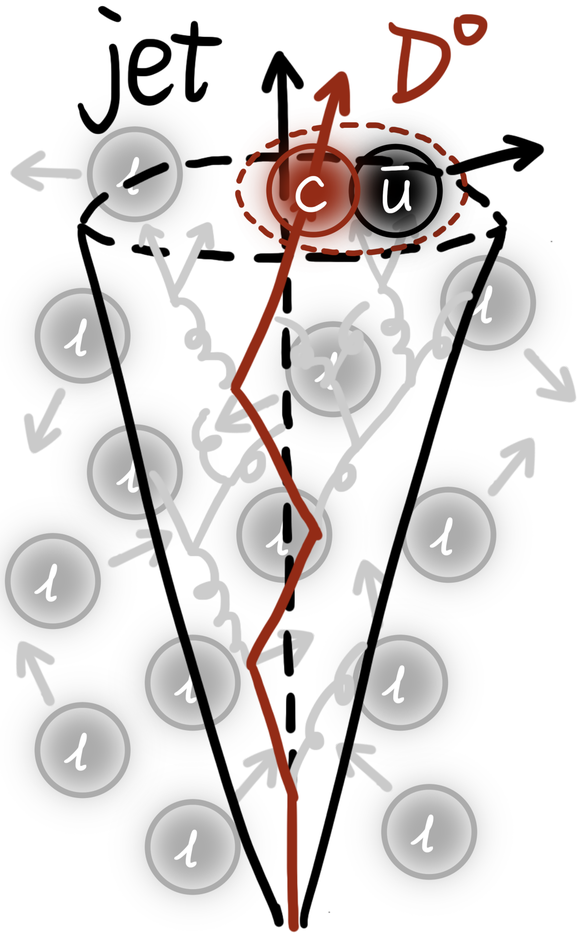

Study effects decoupling charm from jet

- Fragmentation modification in medium
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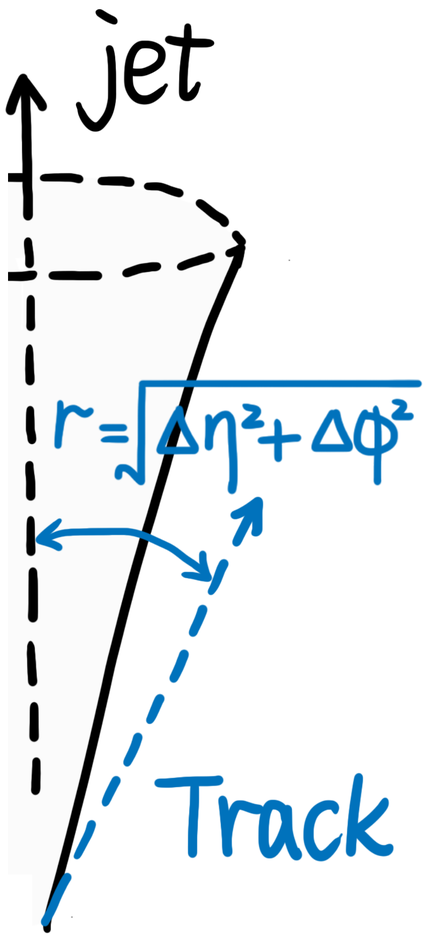
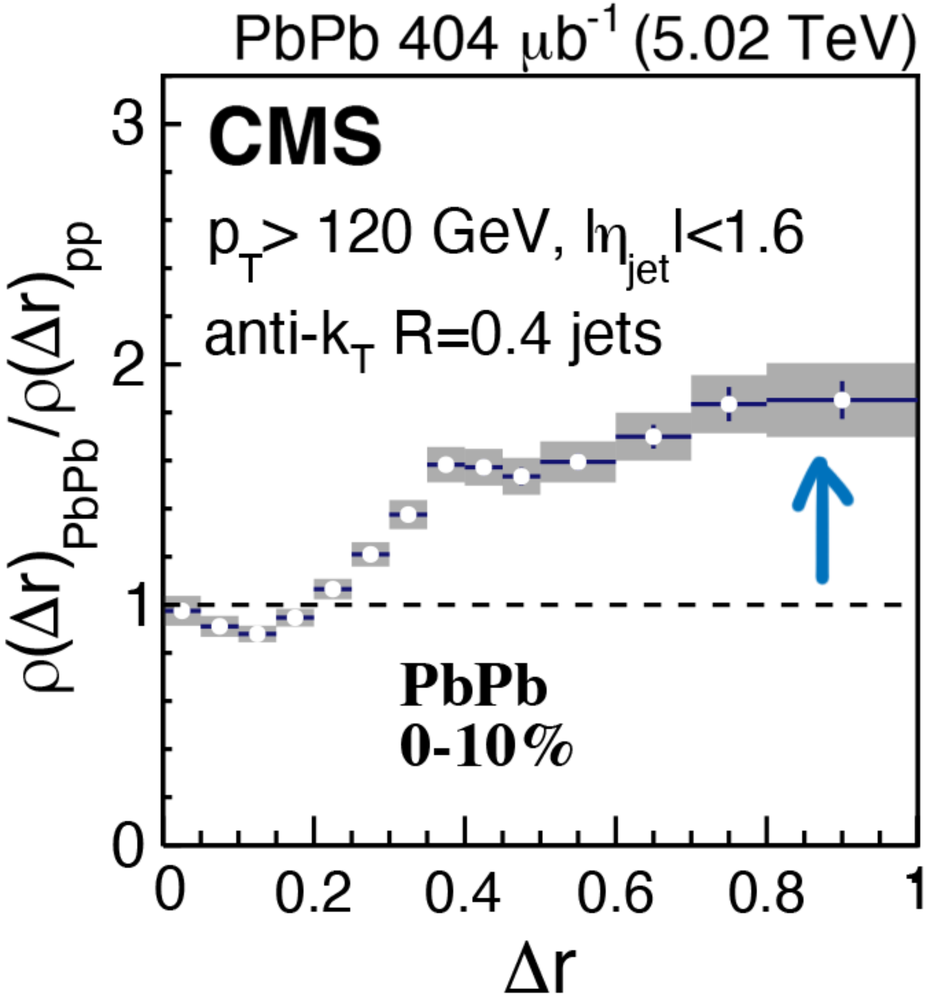
- Diffusion in medium
  - More sensitive observable than inclusive measurements (R_{AA}, v_2)
- Medium response
  - Hard partons change the medium that will change the jet in return as well
- Recombination in medium
  - Combined with uncorrelated partons

Radial Profile for Light Flavor



Jet shape



- Energy redistribution to farther distance from jet axis observed for light flavors
- Can heavy quarks see the modification?

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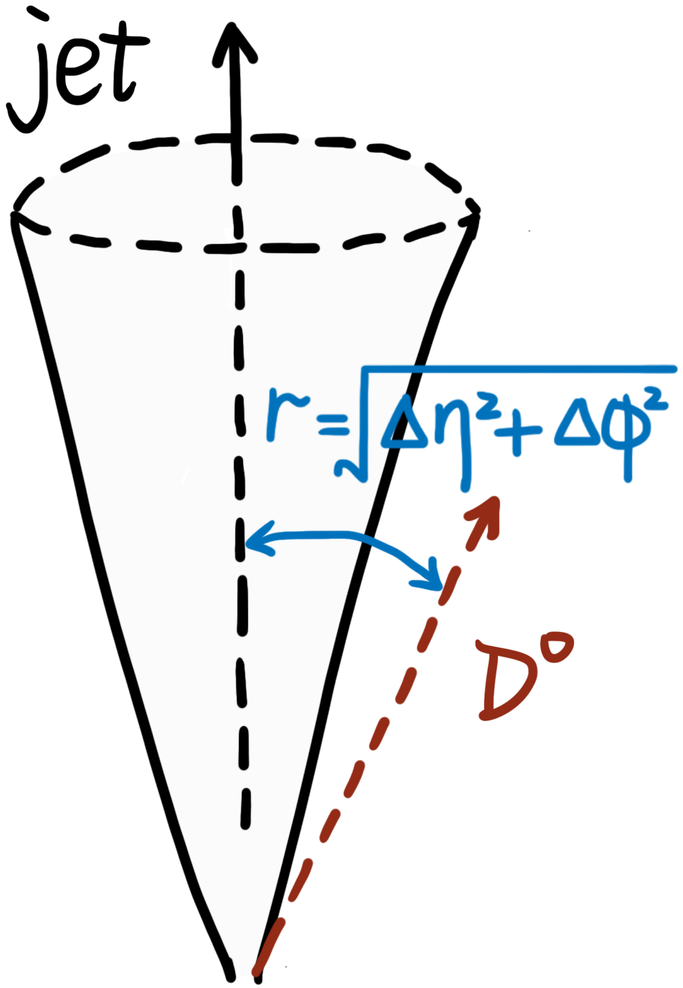
Observable and Dataset

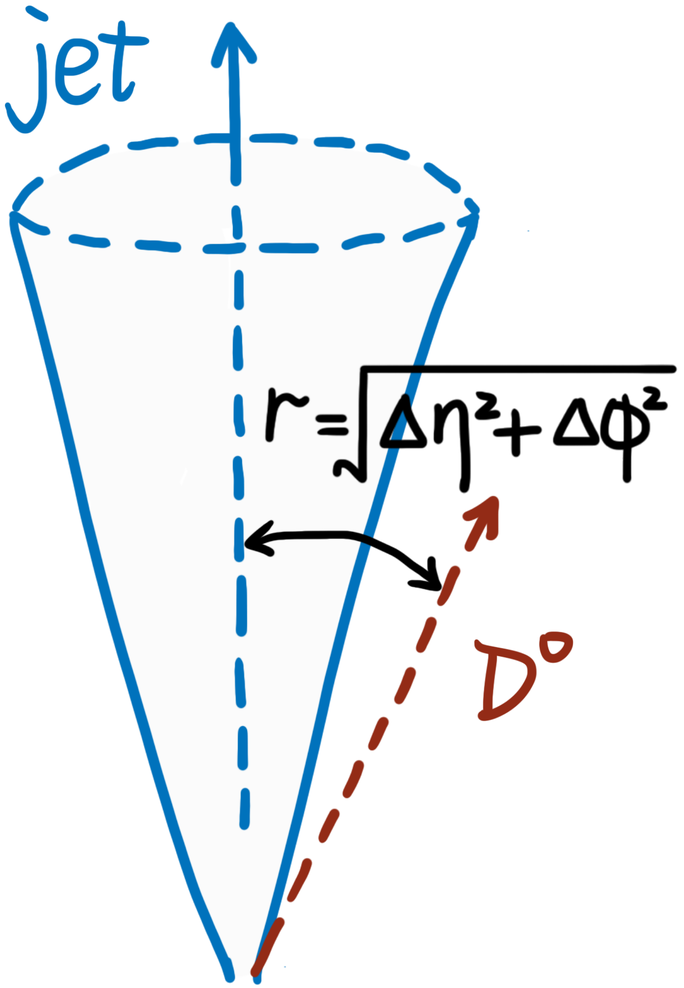


- Dataset
  - Jet-triggered events in pp (27.4 pb^{-1}) and PbPb (404 μb^{-1}) collisions at 5.02 TeV collected in 2015
  - Cross-checked with D-triggered events
- Observable
  - Radial profile of D^0 w.r.t. jet axis

$$\frac{1}{N_{\mathrm{JD}}}\frac{\mathrm{d}N_{\mathrm{JD}}}{\mathrm{d}r_{\mathrm{JD}}}$$

  - The final distribution is normalized to unity in $r < 0.3$
  - No p_T weight as light-hadron jet shape

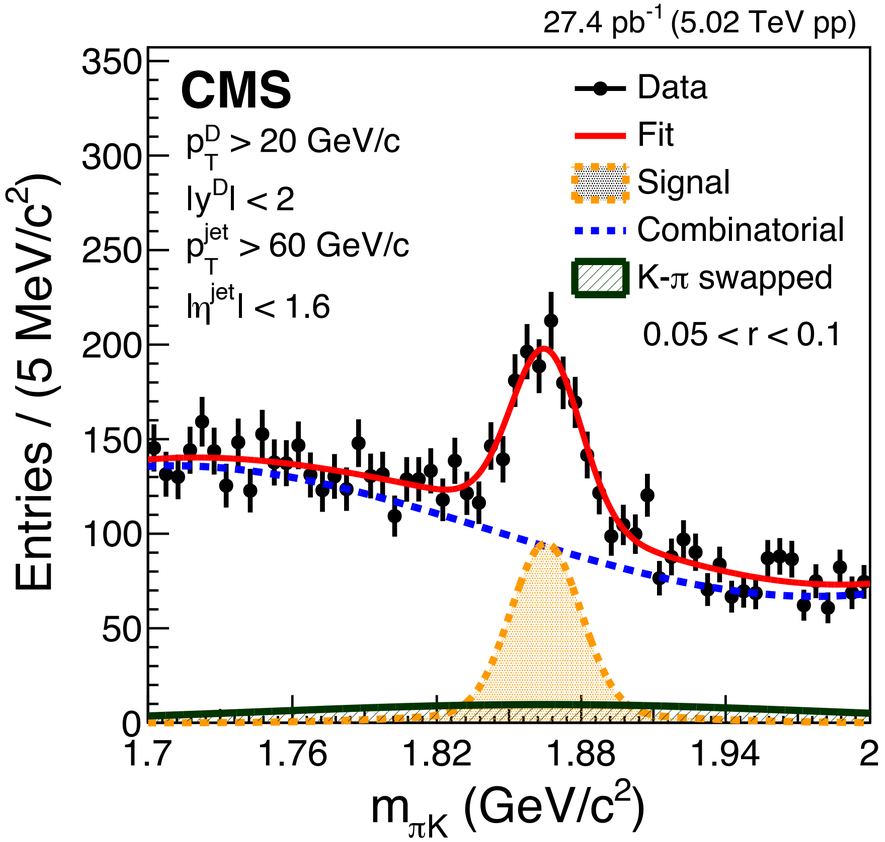
Physics Object Reconstruction



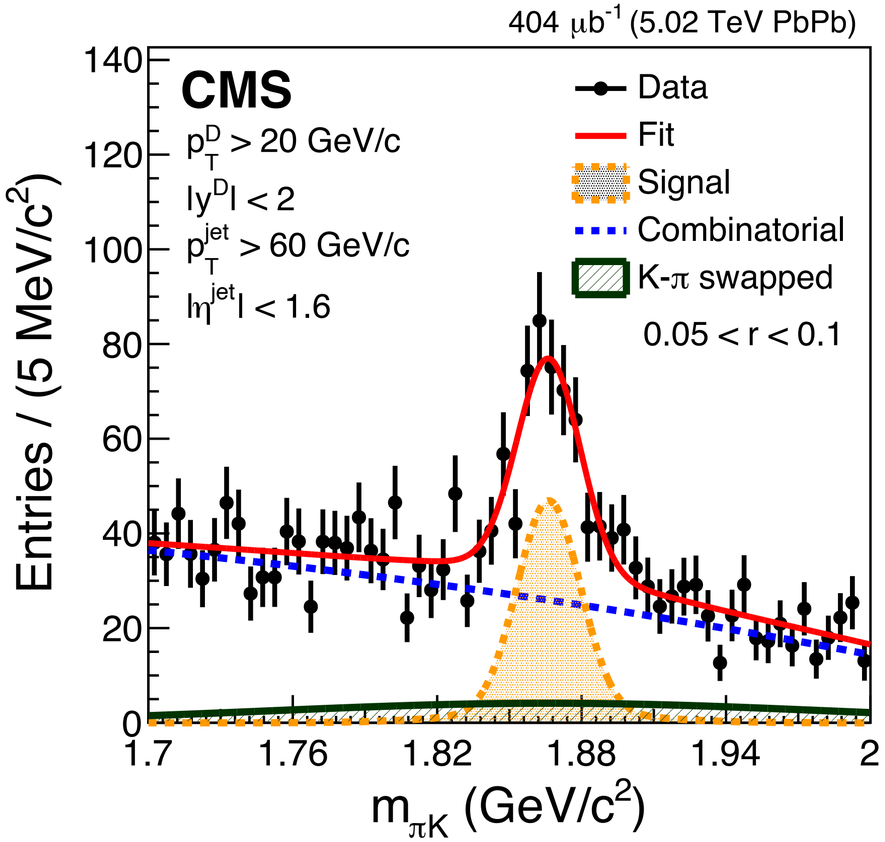
- Jet
  - Particle flow jets, anti-k_T, R = 0.3
  - $p_T^{jet} > 60$ GeV/c
  - $|\eta^{jet}| < 1.6$
- D^0 reconstruction
  - $D^0 \rightarrow K\pi$
  - Topological selections
  - $|y^D| < 2$
  - Two p_T bins
    - $4 < p_T^D < 20$ GeV
    - $p_T^D > 20$ GeV

D^0 Yield Extraction

pp



PbPb



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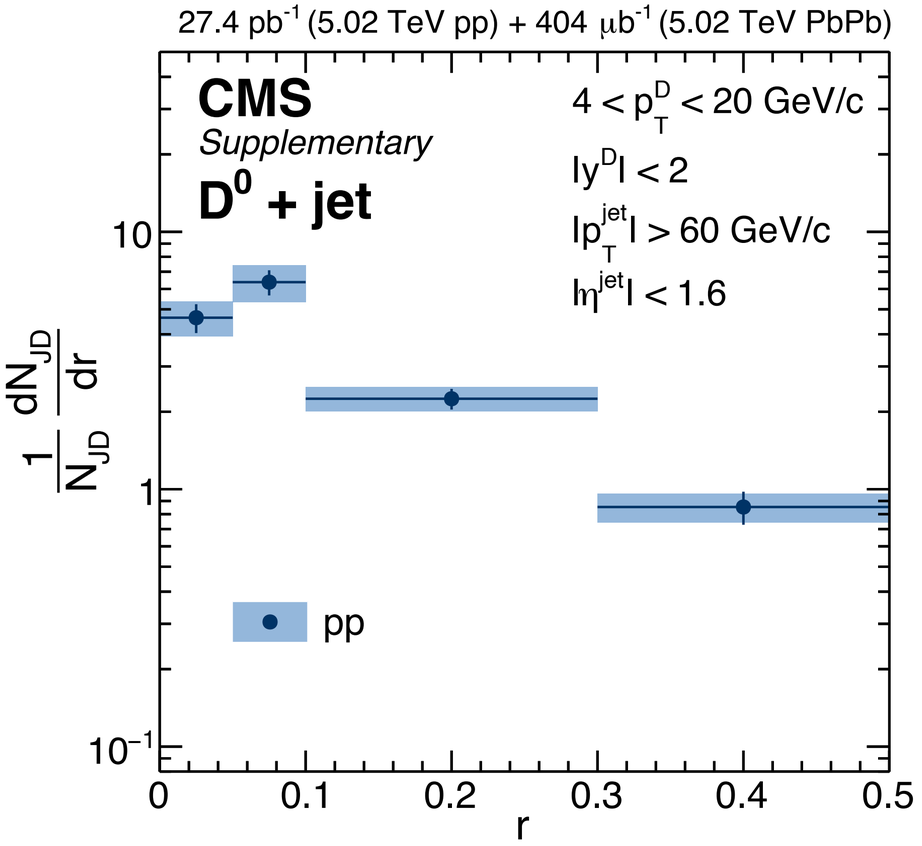
- Subtract combinatorial background of D^0 via invariant mass fits
- Remove underlying event background using event mixing method

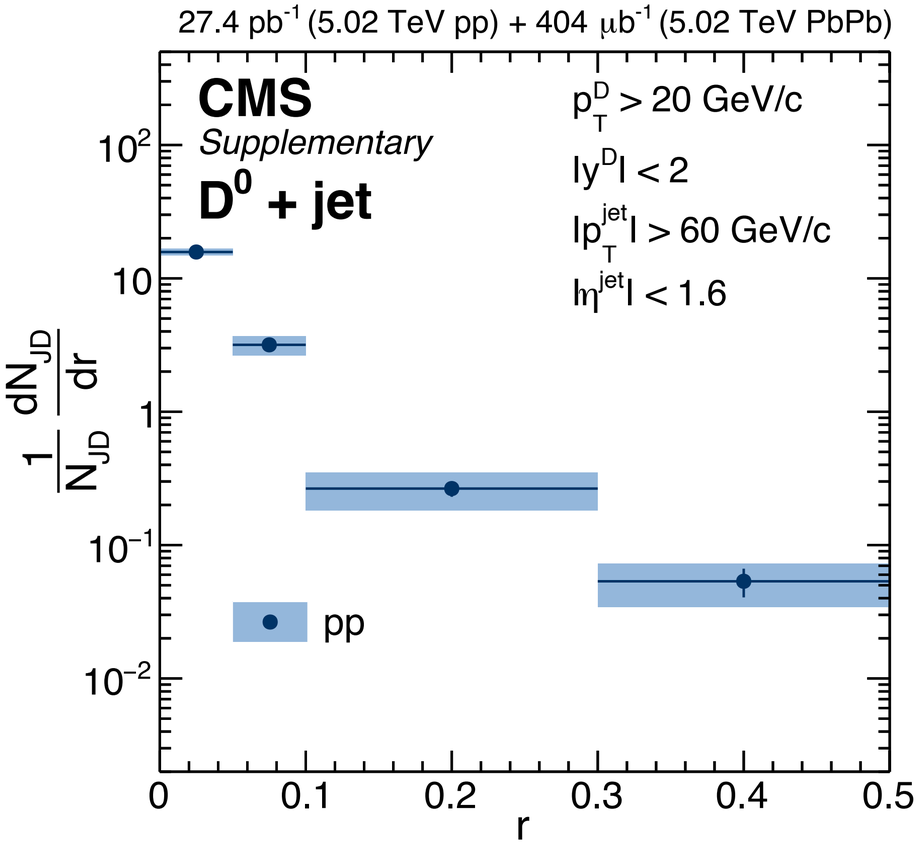
Results: Radial Profile of D^0 in pp

$4 < D\ p_T < 20$ GeV/c



- Reach maximum at $0.05 < r < 0.1$
- Similar to light flavor

$D\ p_T > 20$ GeV/c



- Fall rapidly as a function of r
- Similar to light flavor

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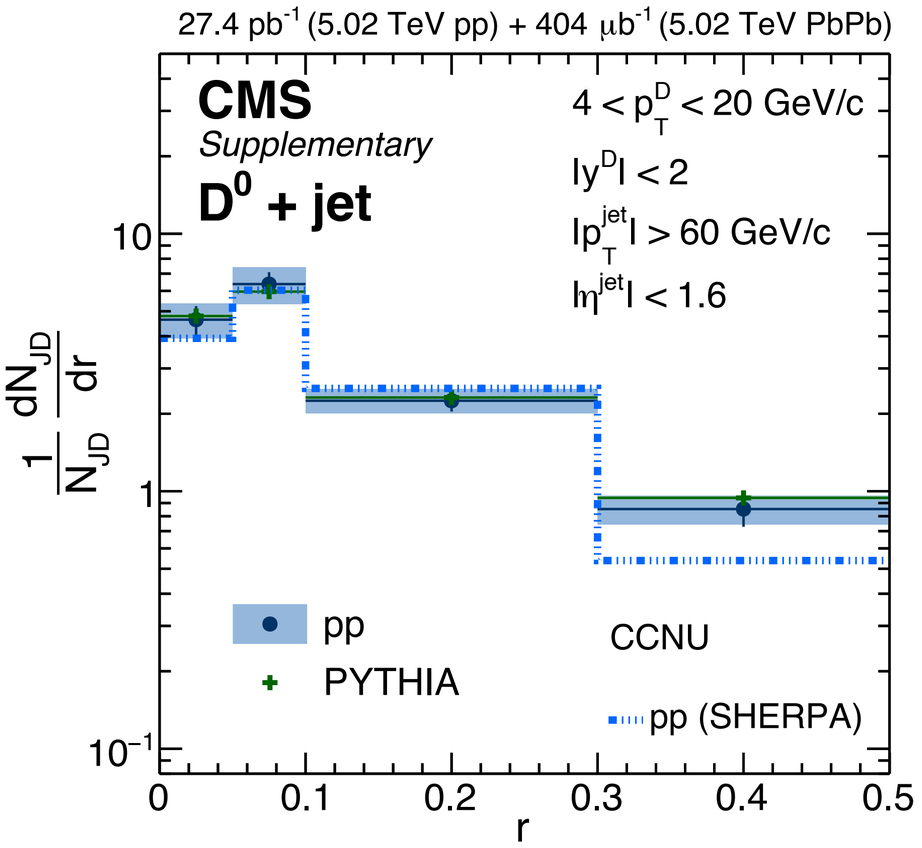
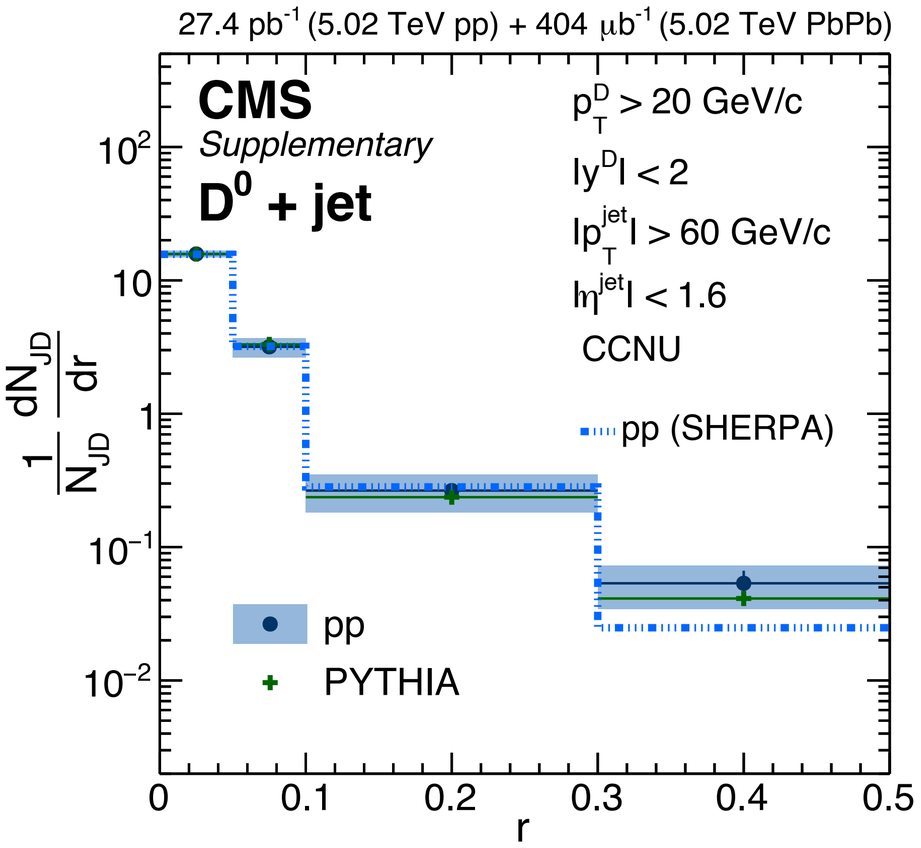
Results: pp vs. Simulation

4 < D p_T < 20 GeV/c



D p_T > 20 GeV/c



- Good agreement with PYTHIA ➜ gluon splitting not plays important role?
  - Qualitatively described by SHERPA

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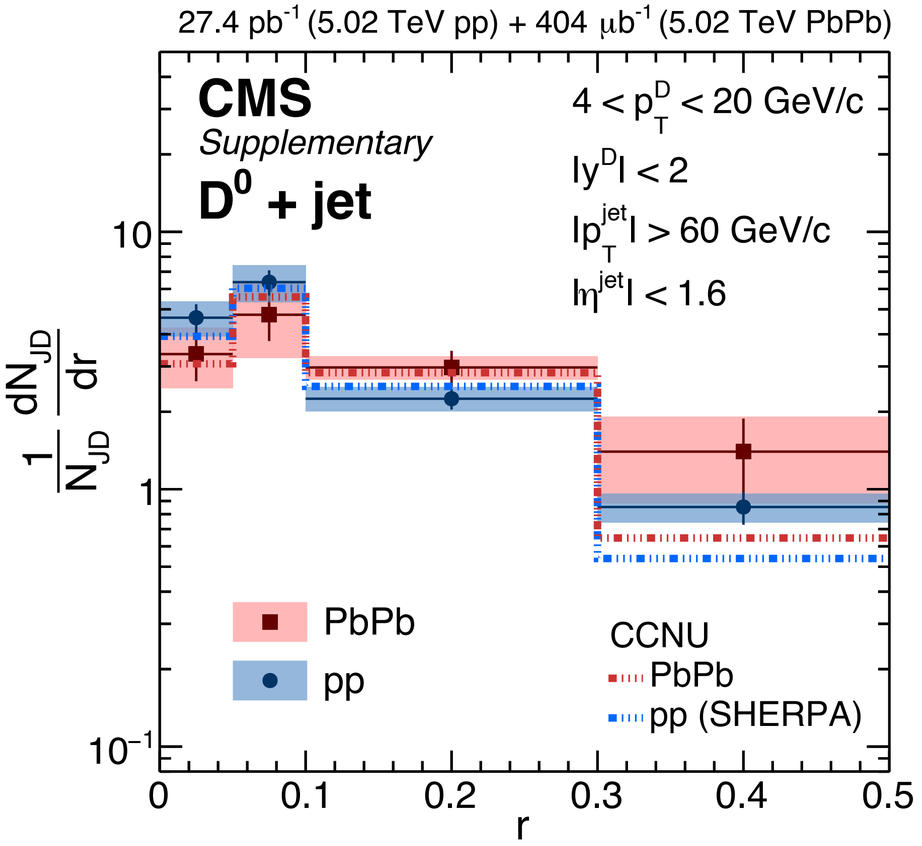
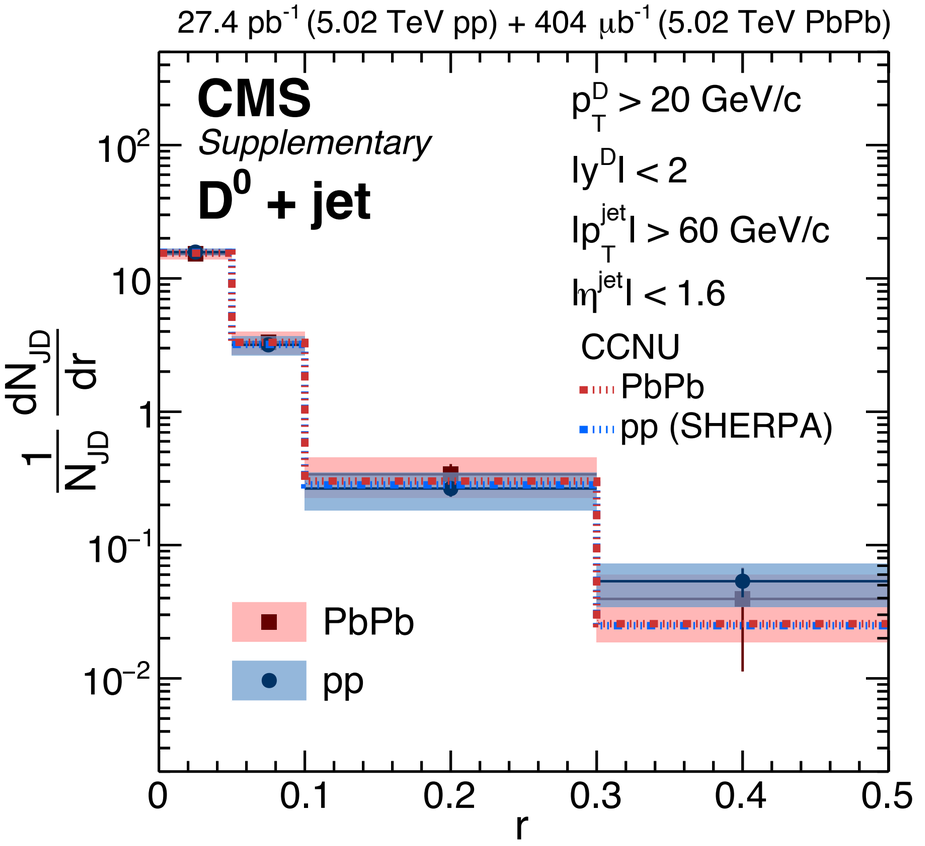
Results: Radial Profile of D^0 in PbPb

$4 < D\ p_T < 20$ GeV/c



- Hint of D^0 distributed farther from jet axis in PbPb than pp

$D\ p_T > 20$ GeV/c



- PbPb consistent with pp

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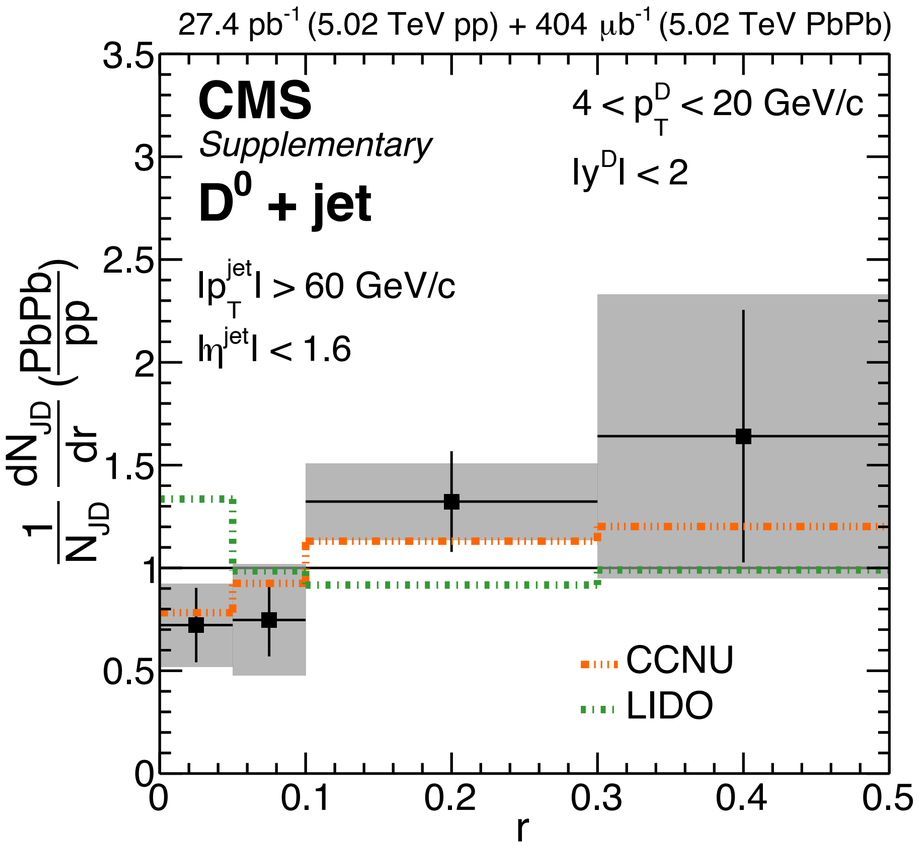
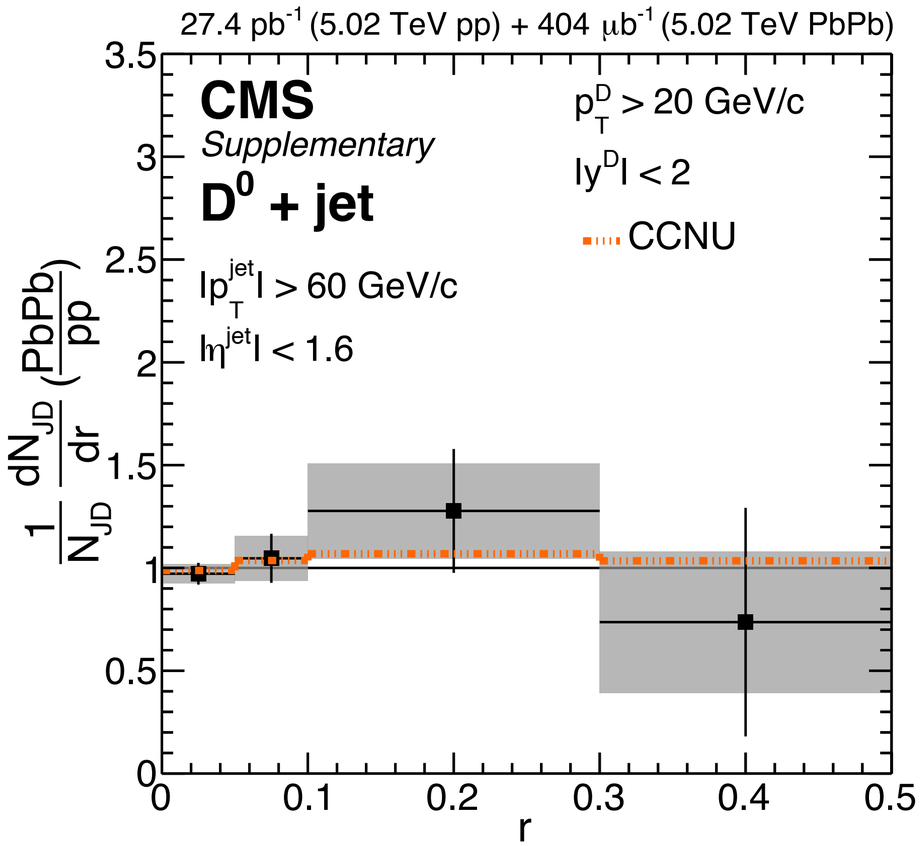
Results: pp vs. PbPb

$4 < D\ p_T < 20$ GeV/c



- Enhancement at large r
- Different predictions from models

$D\ p_T > 20$ GeV/c



- Ratio consistent with unity
- Predicted by CCNU calculation

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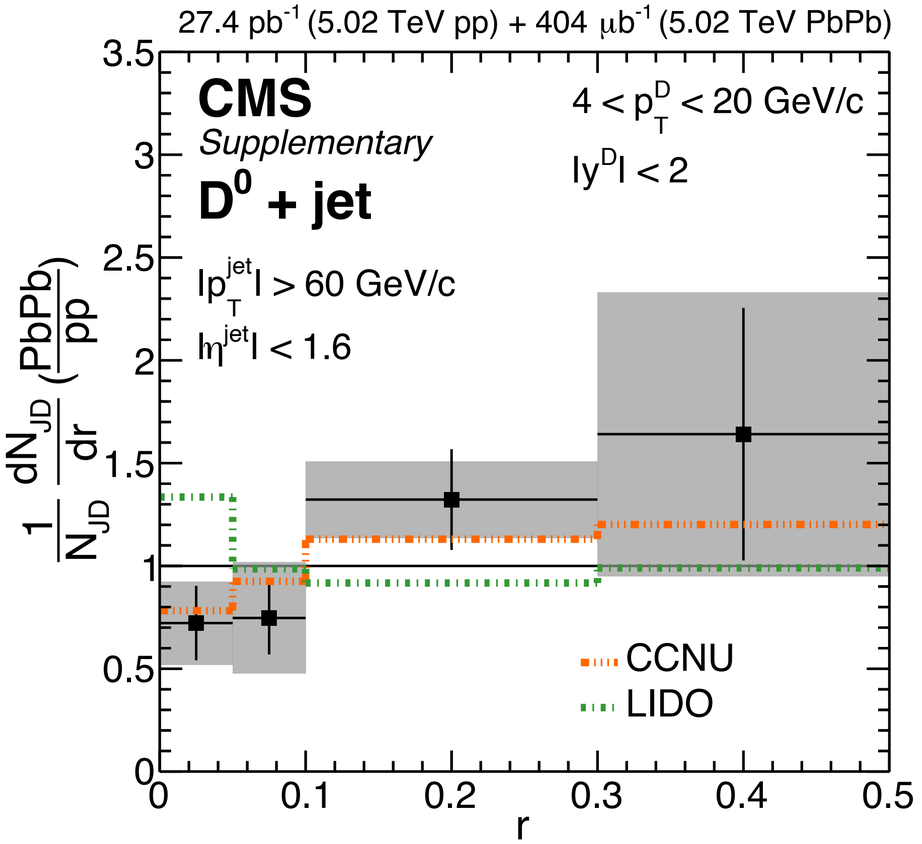
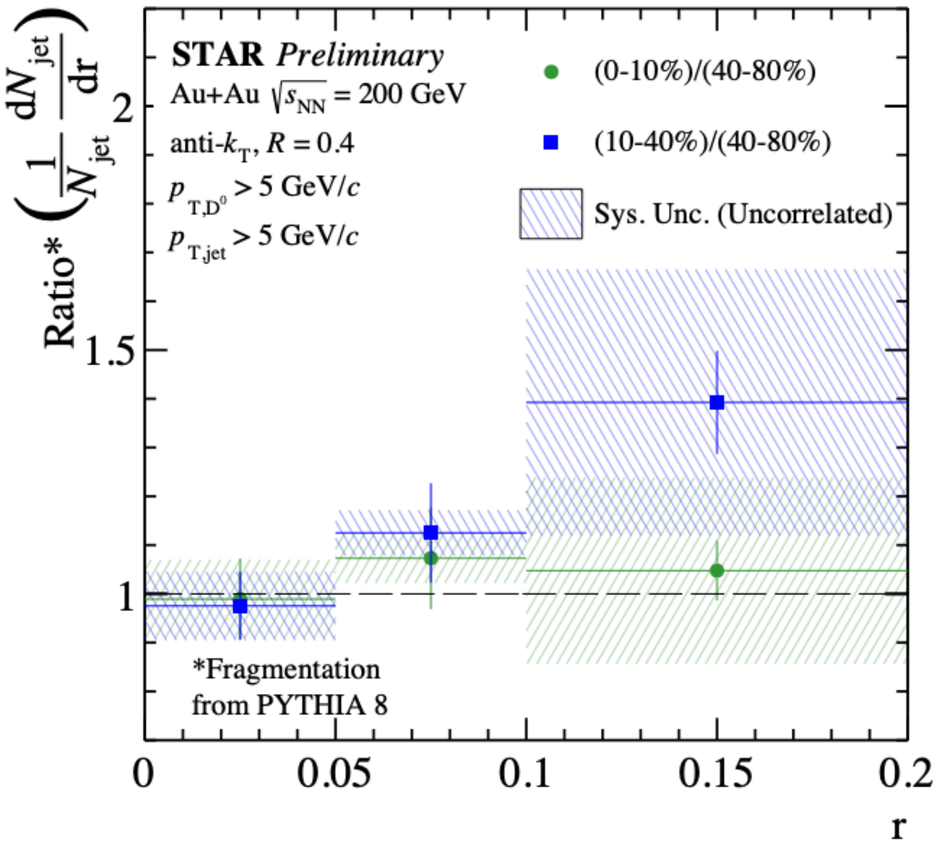
Results: LHC vs. RHIC

CMS (PbPb @ 5 TeV)



STAR (AuAu @ 200 GeV)



- Similar trend in LHC and RHIC?
- Note different kinematics, observable and reference

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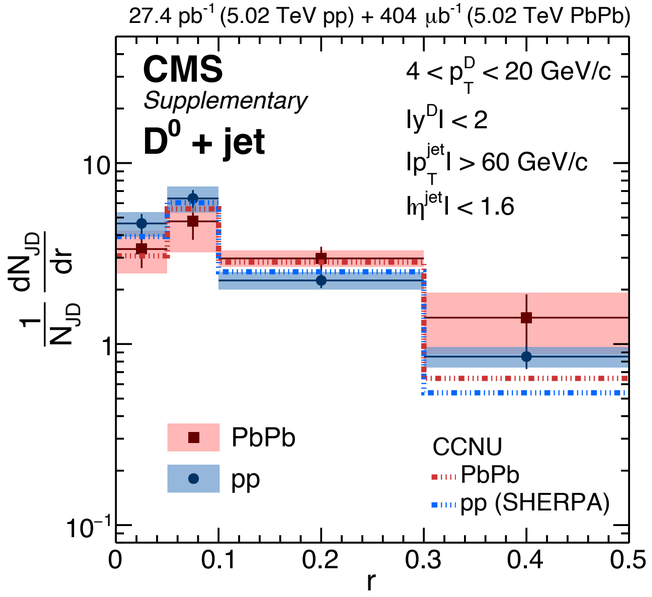
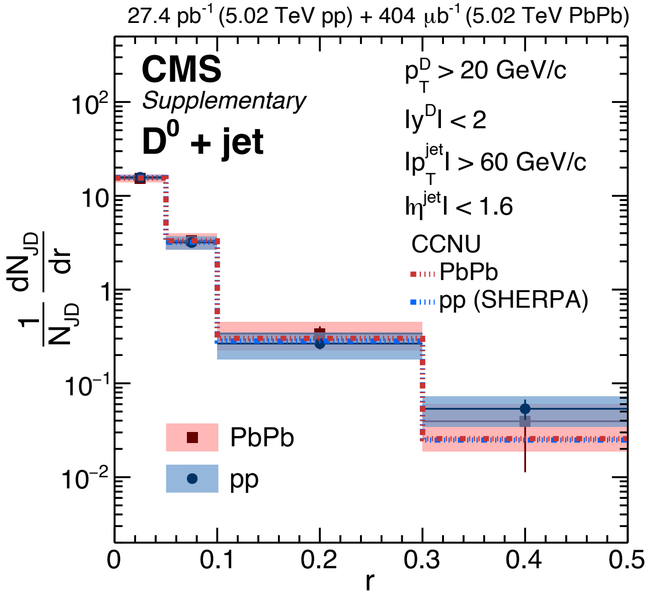
Summary

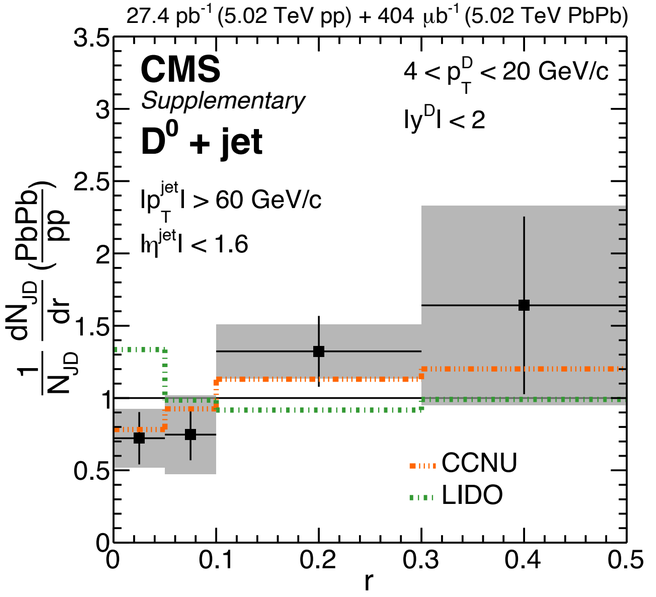
- First measurement of the radial profile of D^0 in jets in PbPb and pp
  - Low D^0 p_T: Hint of enhancement of D^0 at large angle w.r.t. jet axis in PbPb
  - High D^0 p_T: Consistent distribution in pp and PbPb

- Provides new experimental inputs on
  - heavy-flavor production, energy loss and diffusion behavior

- A new measurement using the latest data is under going







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Isabelle
Thanks for your attention!

Back up

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