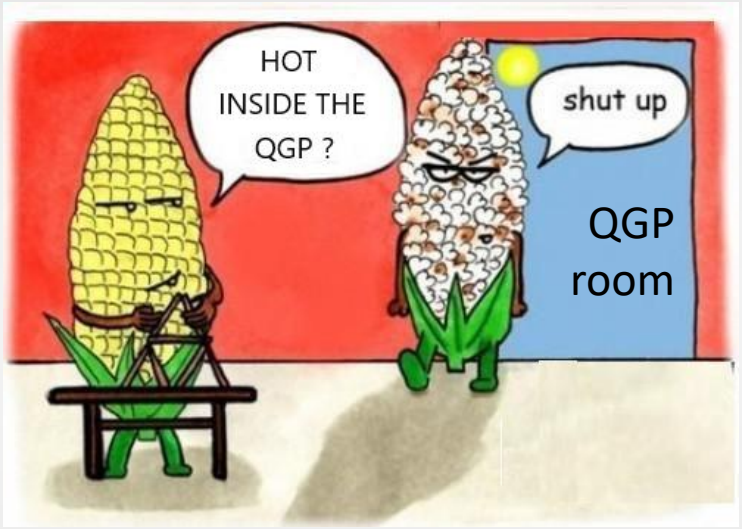
Heavy flavour dynamics in event-by-event viscous hydrodynamic backgrounds



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Flash talk – Hard Probes 2018 – Aix-les-Bains

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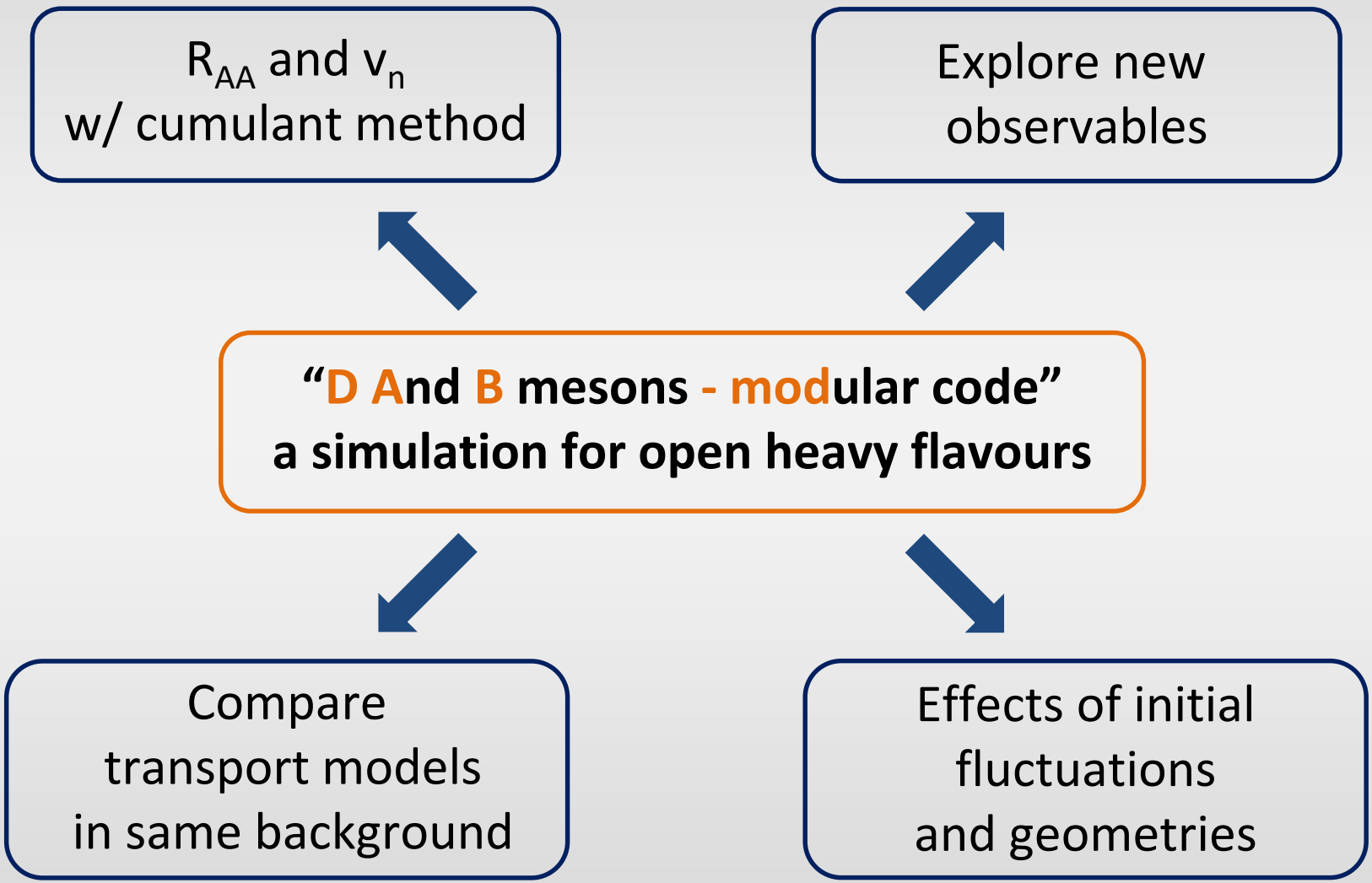
Instituto de Física da USP

DAB-mod


R_{AA} and v_n
w/ cumulant method
Explore new
observables
"D And B mesons - modular code"
a simulation for open heavy flavours
Compare
transport models
in same background
Effects of initial
fluctuations
and geometries

DAB-mod timeline

- Transverse momentum:
  FONLL
- Spatial distribution:
  w/ initial bulk densities

Heavy quarks…

Initial conditions

Bulk…

Initial fluctuations

-"**MCKLN**": CGC kt-factorization model

or

- **T_RENTo**: entropy deposition via a "reduced-thickness" function

DAB-mod timeline

- Parametric **energy loss** $\frac{dE}{dx} = -f(T,p,x)\,\Gamma_{\text{flow}}$

or

- Relativistic **Langevin** w/ two drags:
  Moore & Teaney or Gossiaux & Aichelin
  (QCD+HTL models)

Parameters fixed w/ 0-10% high-p_T R_{AA}

Heavy quarks… — **Transport**

Bulk… — **Expansion**

v-USPhydro
2D+1 event-by-event relativistic viscous hydrodynamic model

DAB-mod timeline

Decoupling temperature: $120 < T_d < 160$ MeV

- **Fragmentation**: Peterson function

  with or without

- **Coalescence**: instantaneous a la Dover et al.
  Probabilities depend on $\overrightarrow{p_{HQ}}$ and $\overrightarrow{\text{local flow}}$.
  Includes “new” thermal & baryon factors.

Heavy quarks…

Hadronization

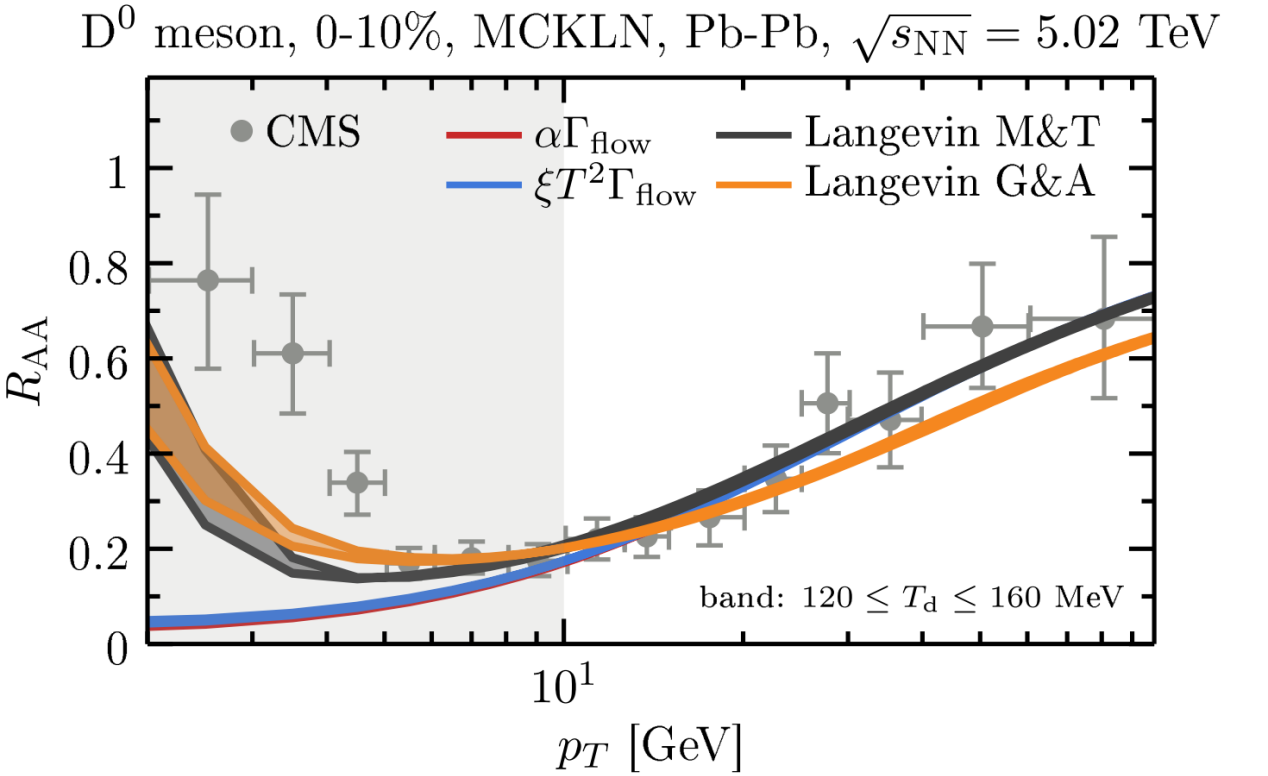
Bulk…

Final stages

- **Cooper-Frye** with viscous corrections
- Describes soft data
  => **hydrodynamic parameters fixed**

Compare transport models: R_{AA}

Fragmentation only



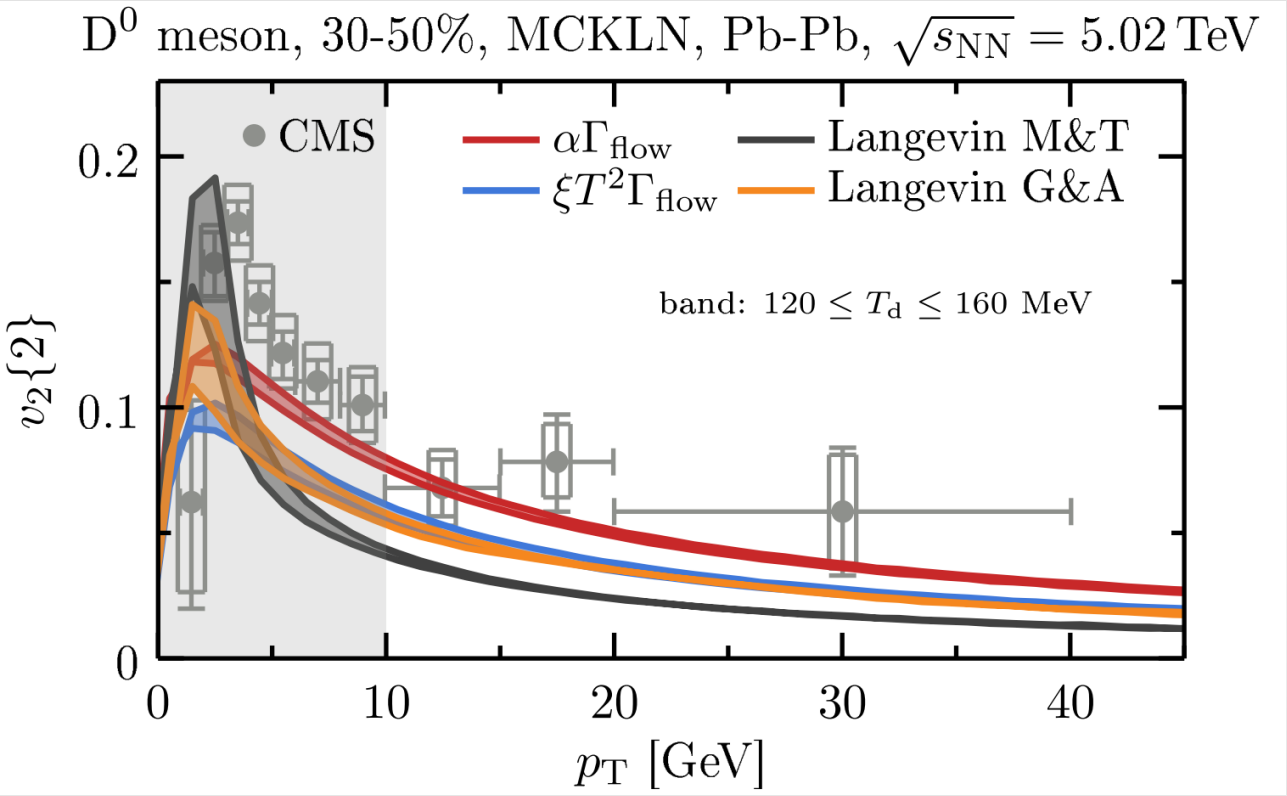
Energy loss:
very wrong at low p_T

Similar trends
at high p_T

Ref data: arXiv:1708.04962

Compare transport models: v_2

Fragmentation only

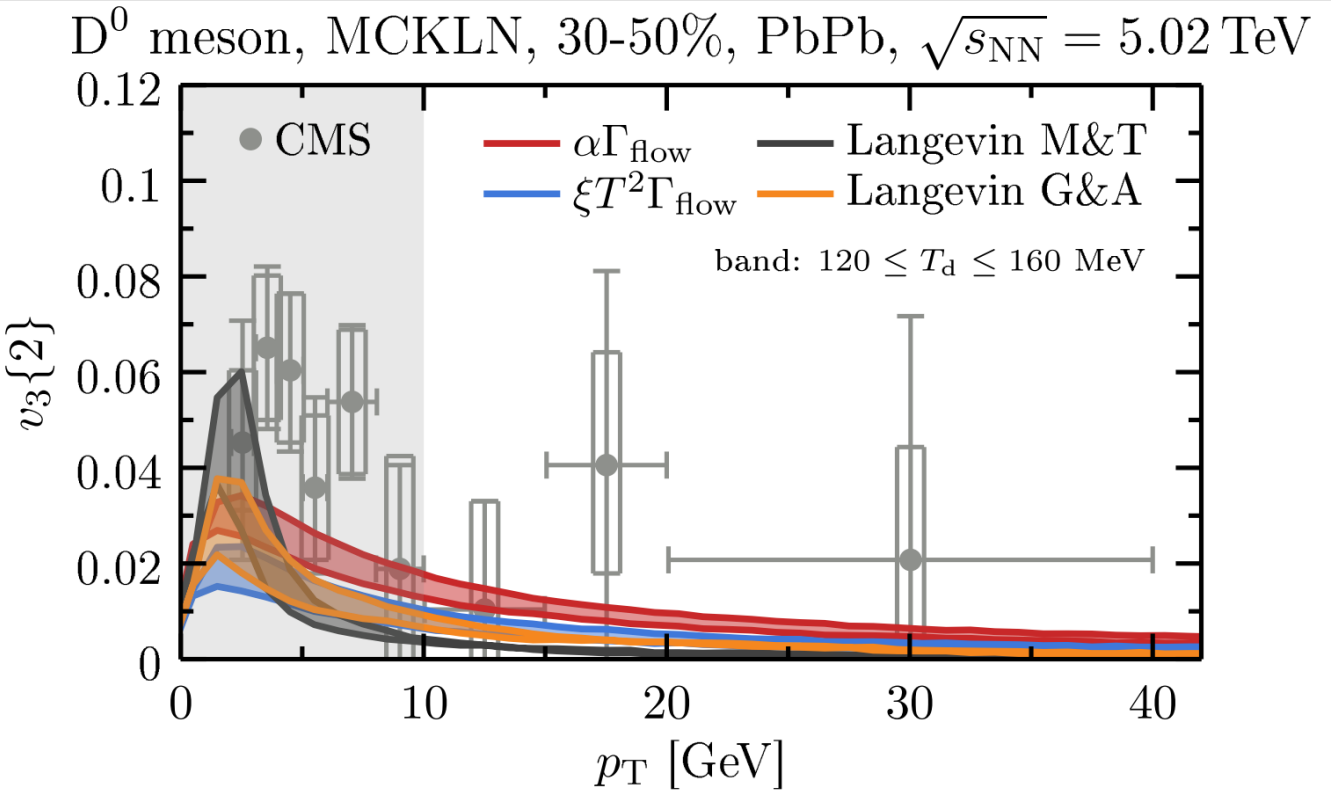


Langevin: better at low p_T ≠ Energy loss: better at high p_T
Globally underestimate the v_2

Ref data: arXiv:1708.03497

Compare transport models: v_3

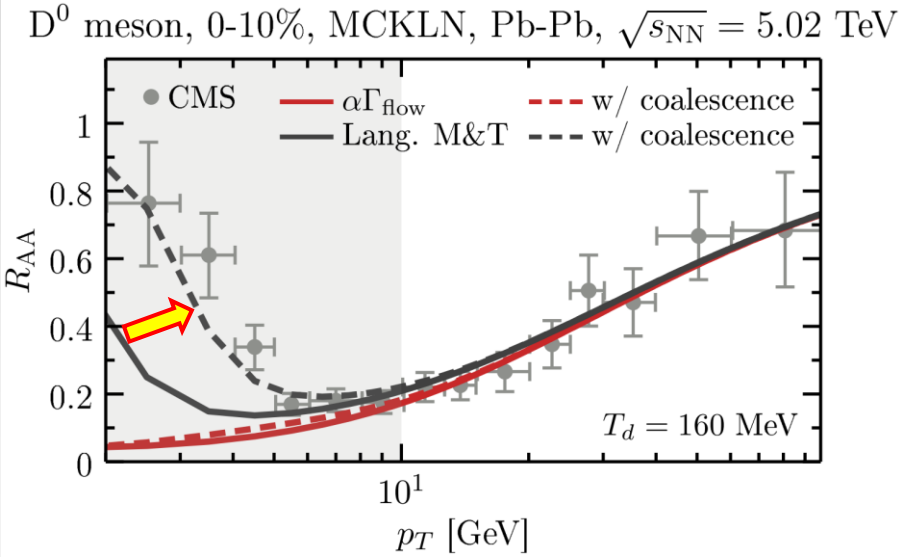
Fragmentation only

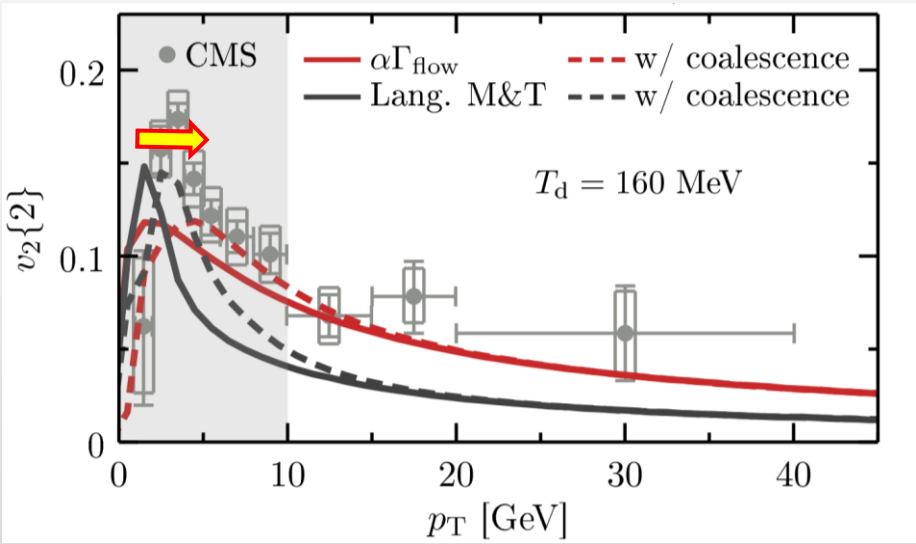


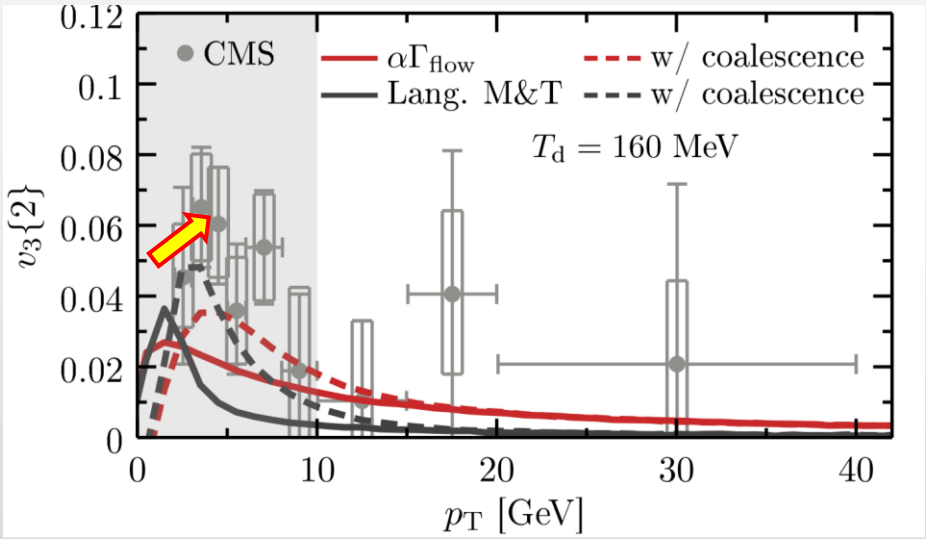
Same idea

Ref data: arXiv:1708.03497

With coalescence ?



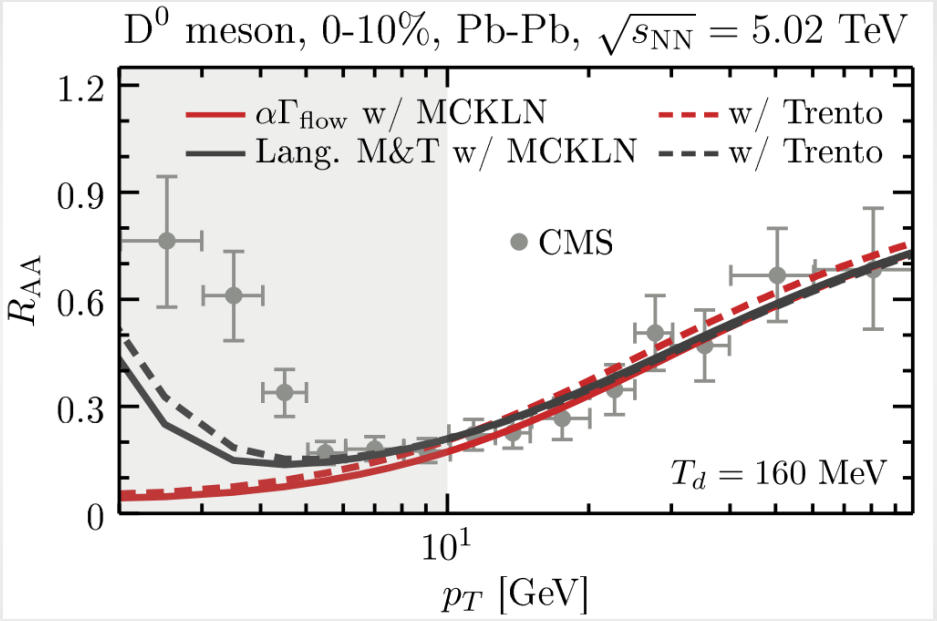


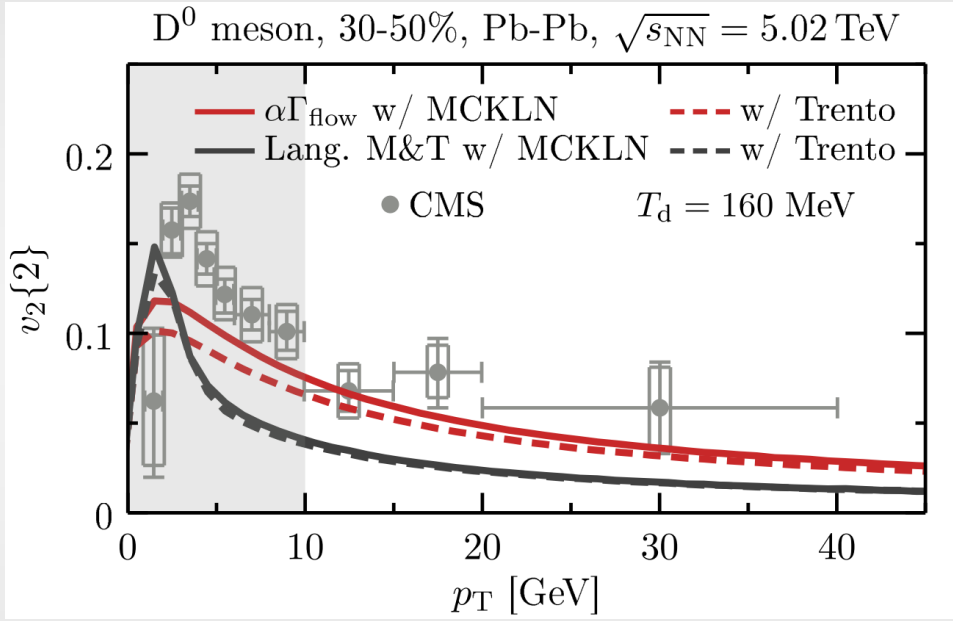


Lump shifts: very necessary !

MCKLN vs. T$_R$ENTo initial fluct. ?

Fragmentation only

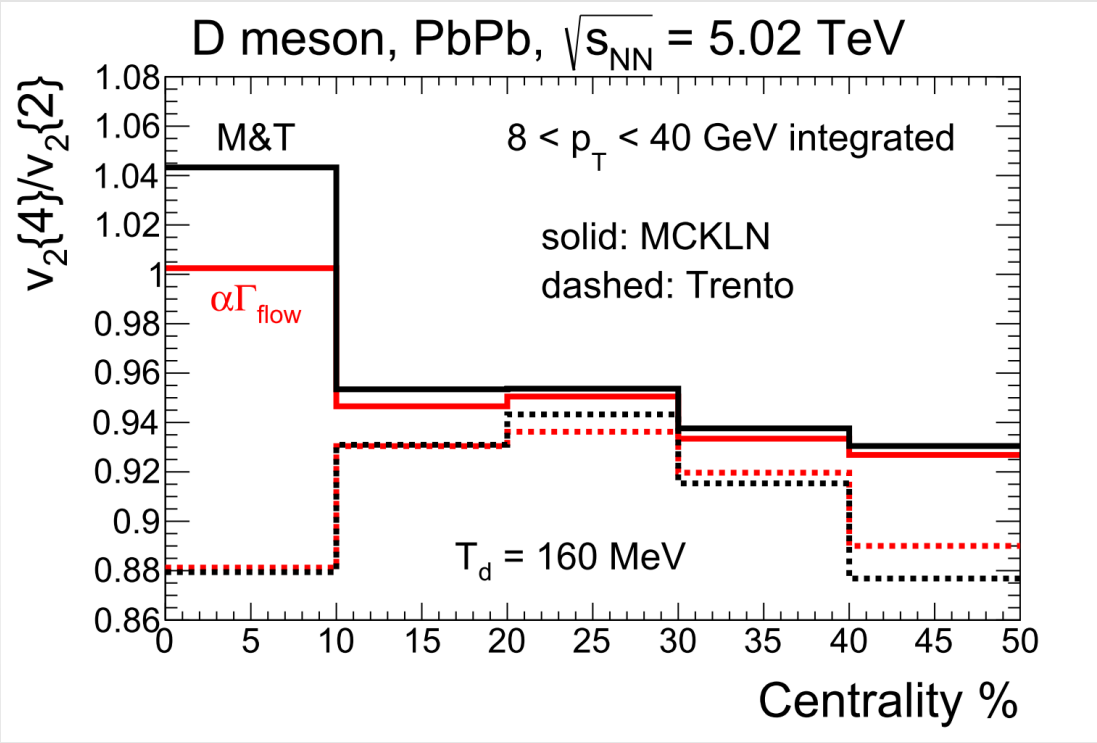


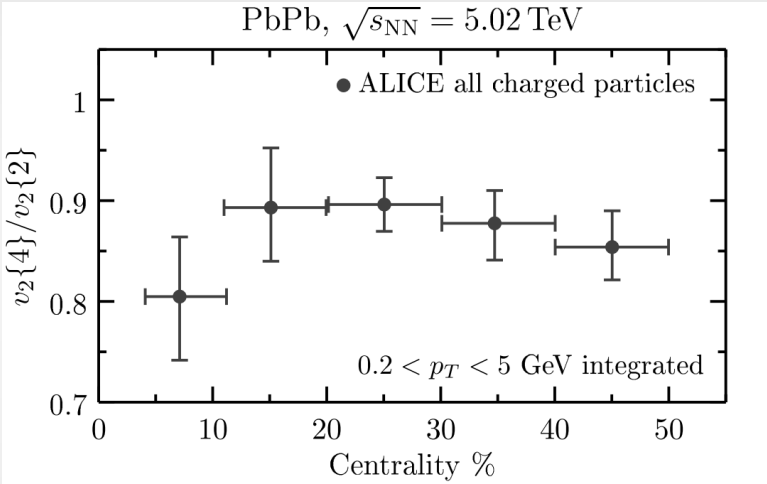


Small effect on R_{AA} and v_n

$v_2\{4\}/v_2\{2\}$

Fragmentation only



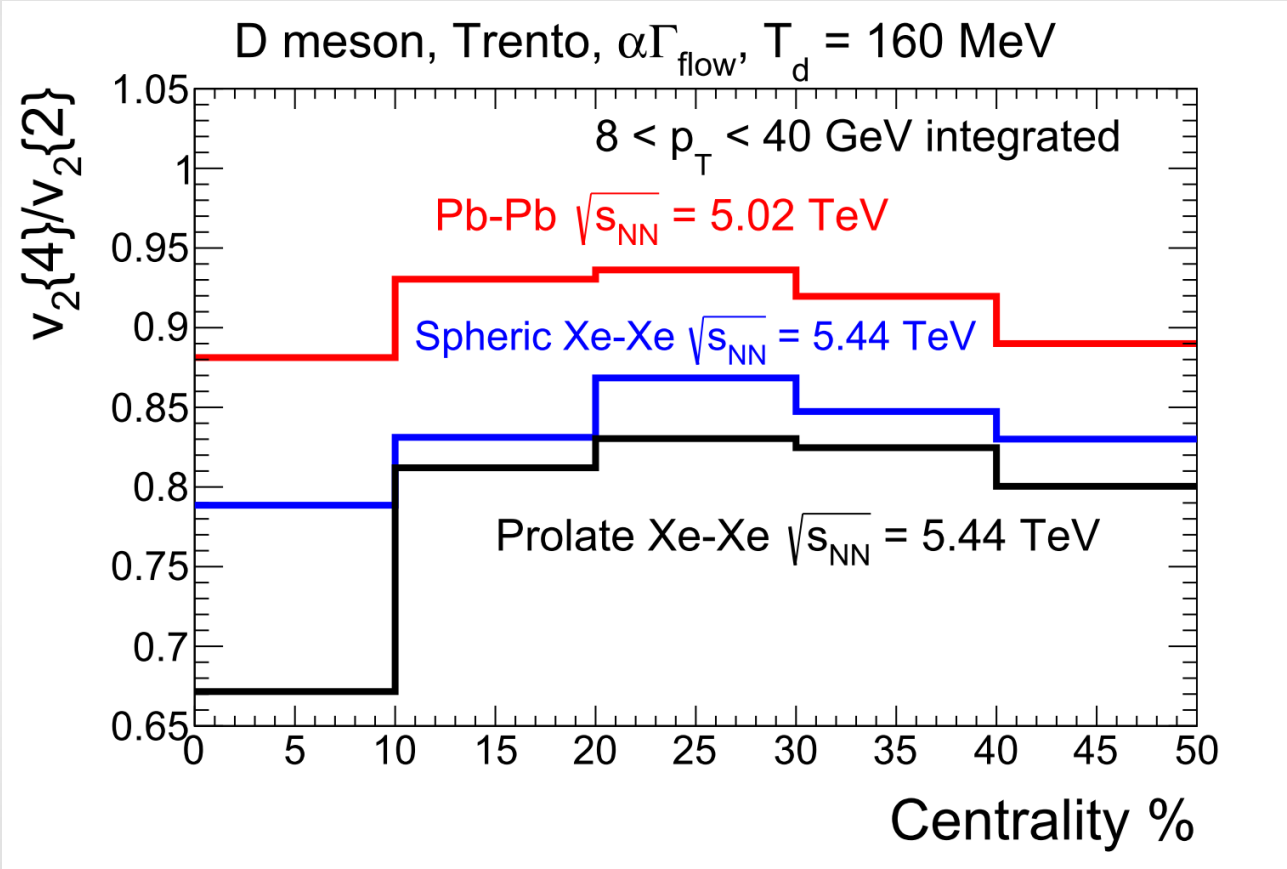


Trend depends on initial fluctuations

Ref data: arXiv:1602.01119

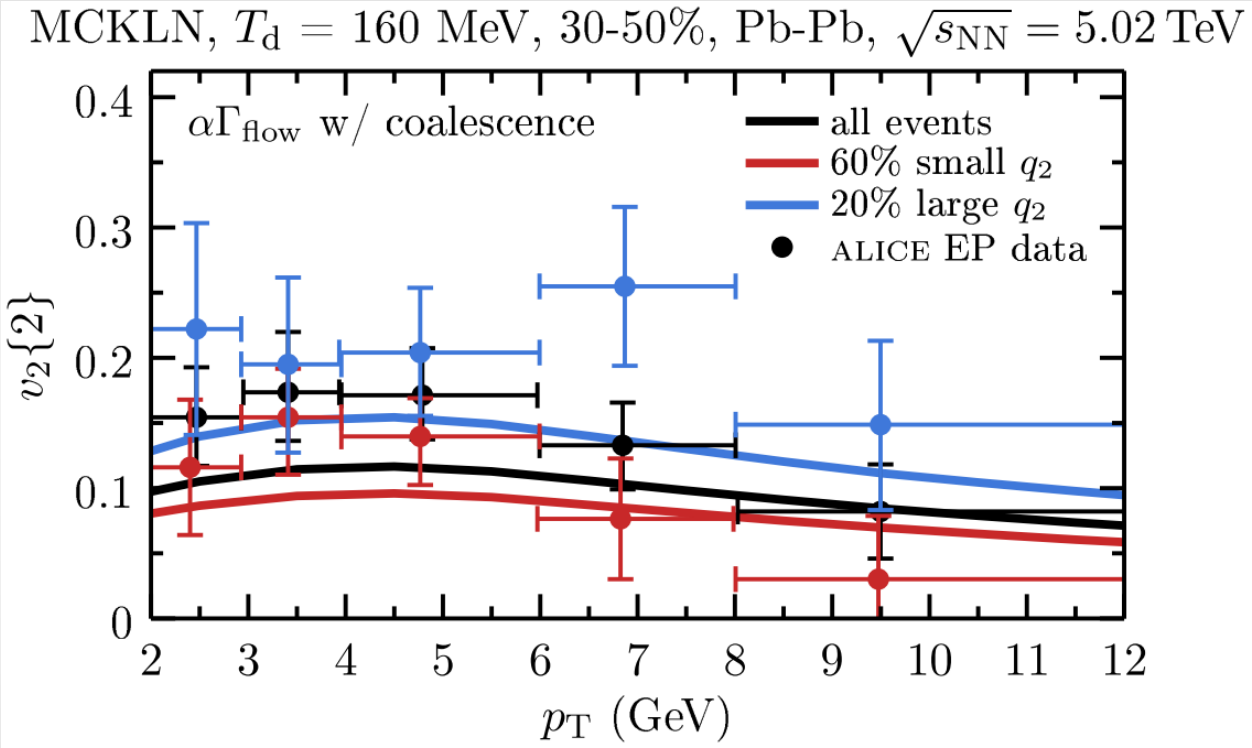
$v_2\{4\}/v_2\{2\}$

Fragmentation only



but average value depends on ion geometry (size & shape)

Soft-hard flow correlations: q2 analysis



Globally underestimate the data, though separations ~ ok

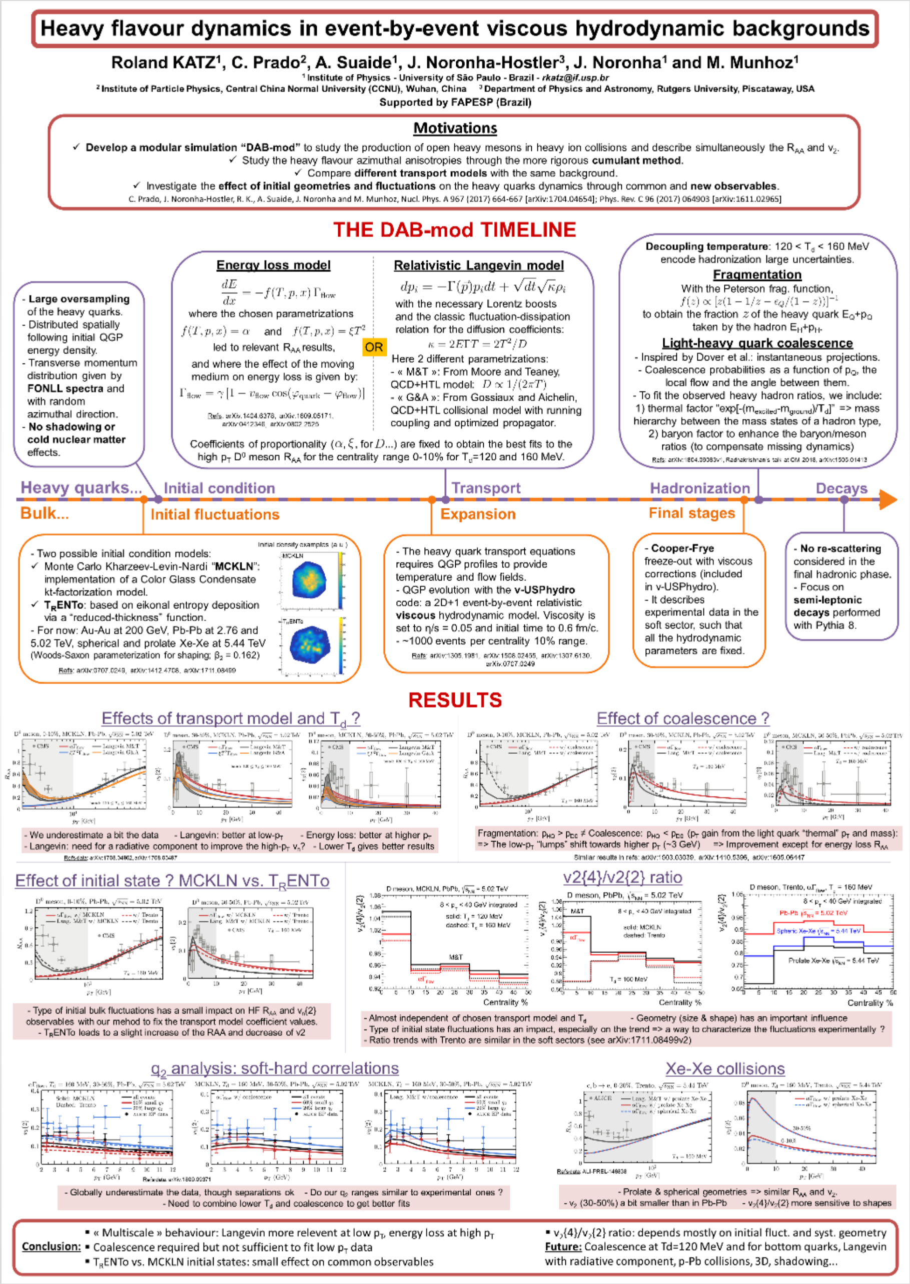
Conclusion

- « Multiscale » behaviour:
  Langevin better at low p_T, energy loss at high p_T
- Coalescence required but not sufficient to fit low p_T data
- T_RENTo vs. MCKLN: small effect on common observables
- $v_2\{4\}/v_2\{2\}$ ratio: mostly trend depends on initial fluctuations and average value on system geometry

Future:

Coalescence at Td=120 MeV and for bottom,
Langevin with radiative component,
p-Pb collisions, hadronic re-scattering, shadowing...

Thank you !



Roland Katz – 05/10/2018

Link to poster