



Update on direct photon simulations at NICA energies

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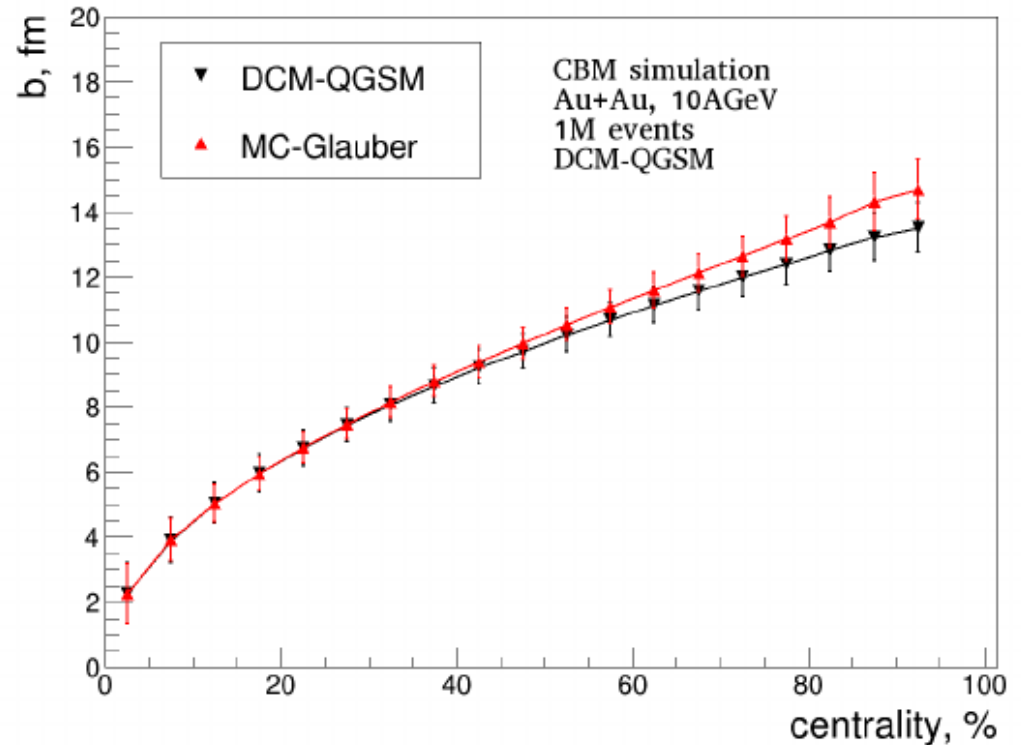
MPD ECAL Meeting
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What's new

- Code optimization: simulations now work faster
- Code fixes:
 - Previously: calculate photon emission from each volume until freeze-out (Urqmd default criteria – $e(i,j,k) > 5\epsilon_0$ in each volume!). Now: calculate photon emission only for volumes having $e(i,j,k) > 5\epsilon_0$). Total yield decreases by 30%, but it makes it consistent with WA98 simulations by B.Bauhle and M.Bleicher (PHYSICAL REVIEW C 81, 044904, 2010)
- Simulate wide distribution of impact parameter
- Look at final hadrons distribution after hydro phase
 - Problem: hydro stops for many events for 11 GeV with entropy difference greater than 10% error. No final hadrons file (f14) output. Currently this exit switched off – but we will need to tune grid size carefully.

Centrality

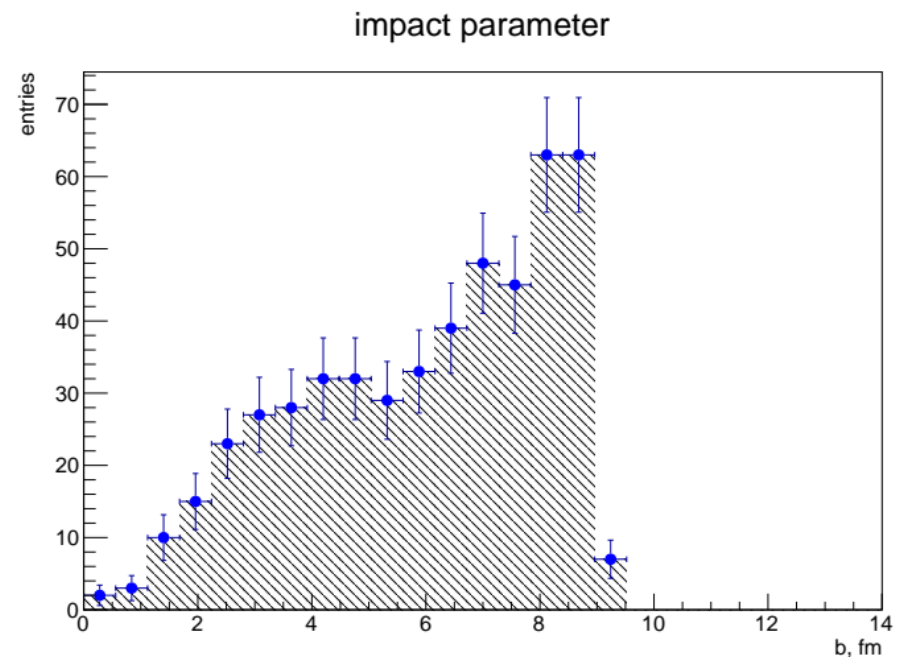
- Centrality intervals approximately taken as in CBM studies. Do we have similar for NICA?
- $b < 4.5$ fm \rightarrow 0-10% centrality
- $6 < b < 9$ fm \rightarrow 20-40% centrality



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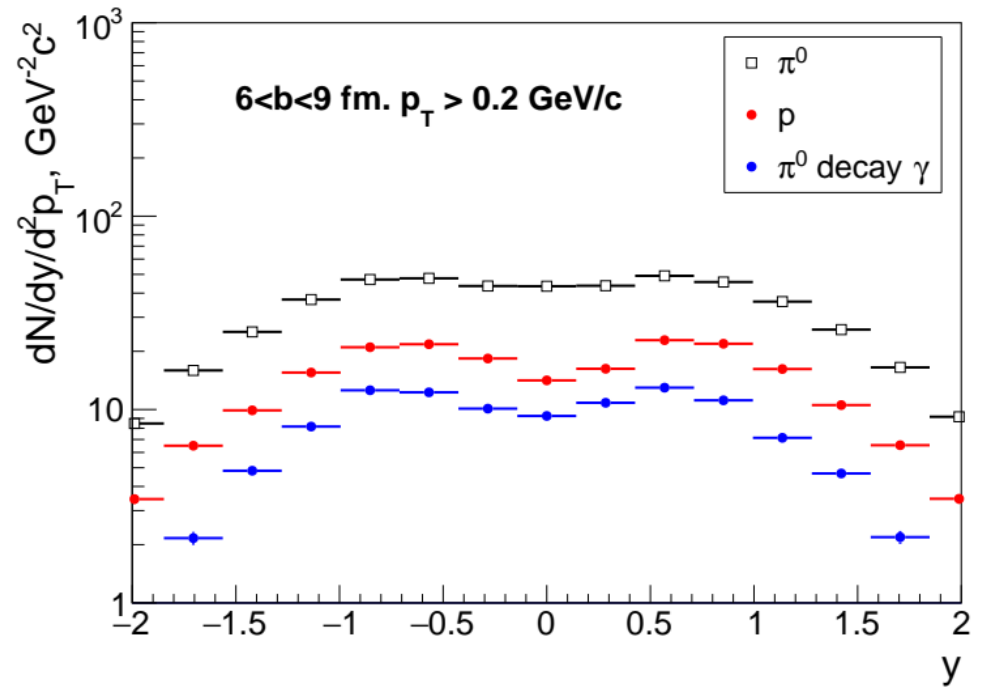
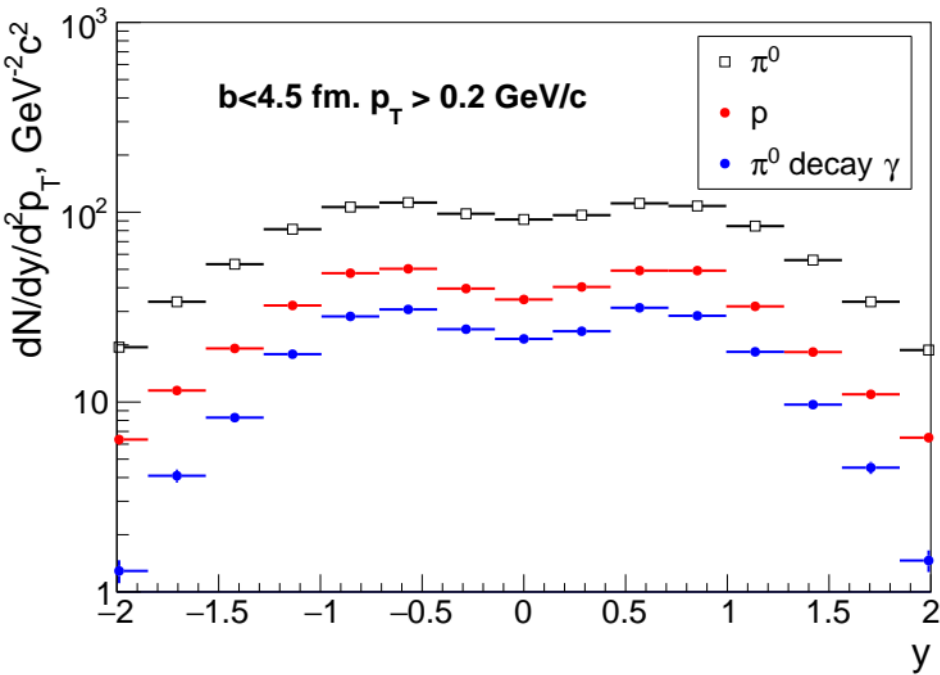
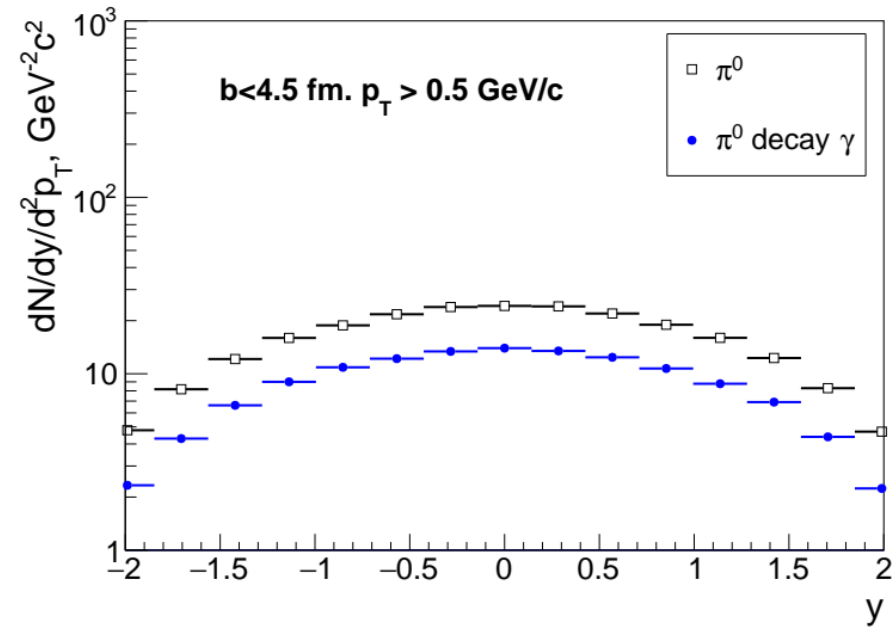
Simulation setup

- 500 events now per energy (**11 GeV**, 5 GeV). Mass production needed but after more tests.
- **Imp -9**
- Tim 30 30 (to exit if simulation takes too long, maybe can increase)
- 1 event per job
- Bag model EOS
- Each job produce final particles (f14 file) and hydro output (modified fort.21). Can compare them event by event!



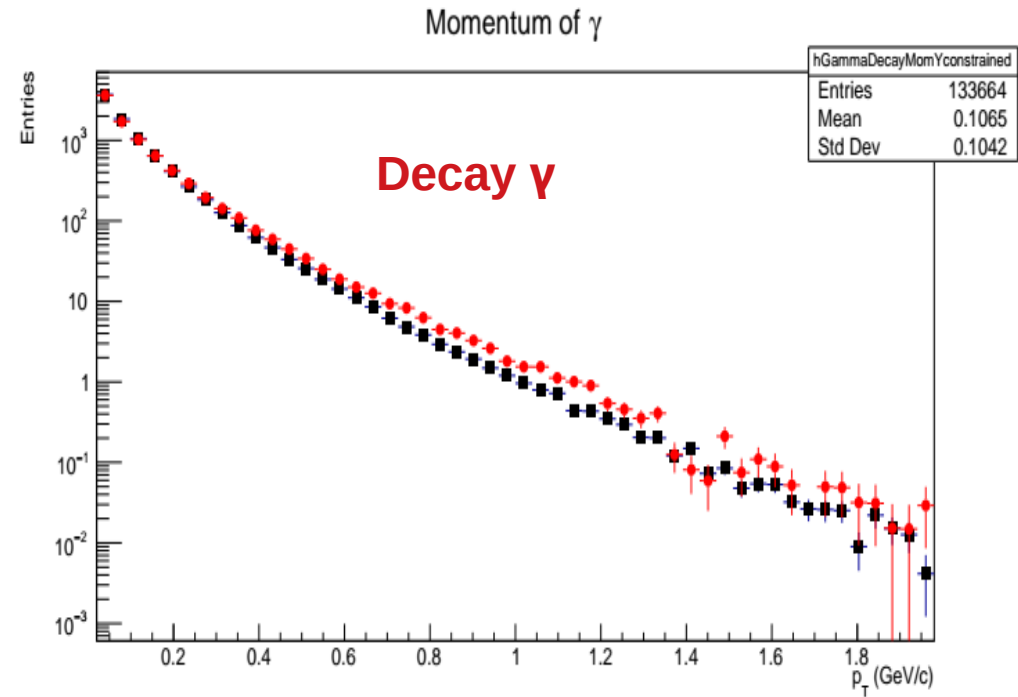
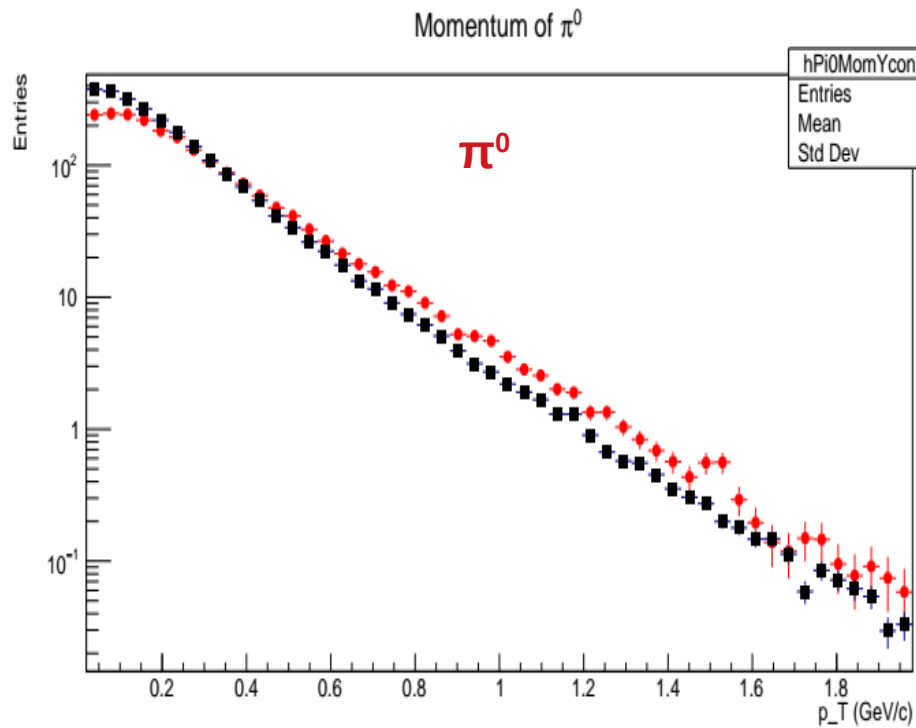
Final hadrons spectra

- $b < 4.5$ fm \rightarrow 0-10% centrality
- $6 < b < 9$ fm \rightarrow 20-40% centrality
- Drop in midrapidity (was not observed with hydro mode off)



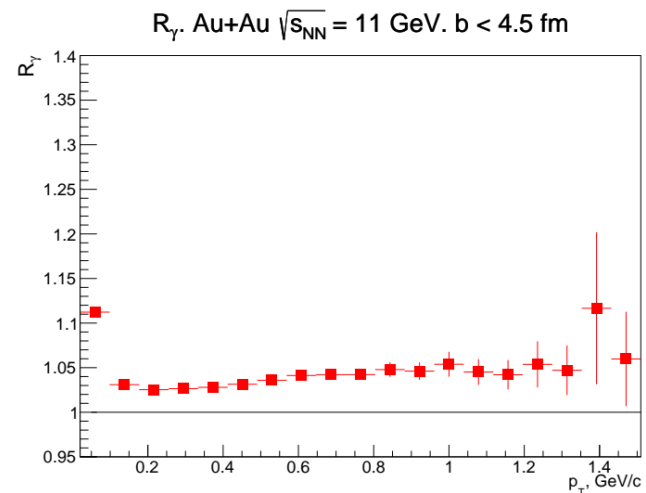
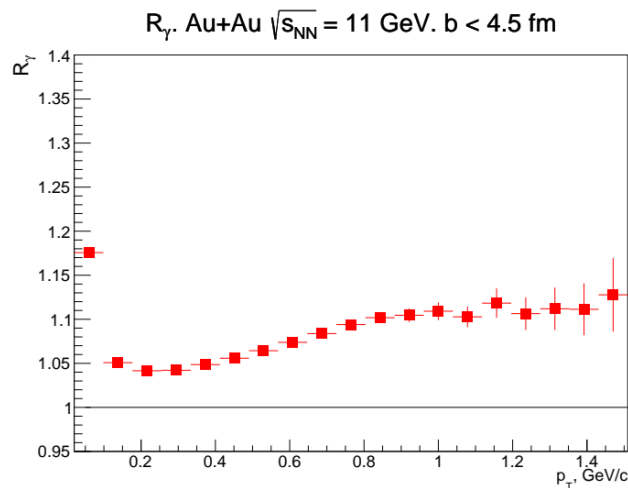
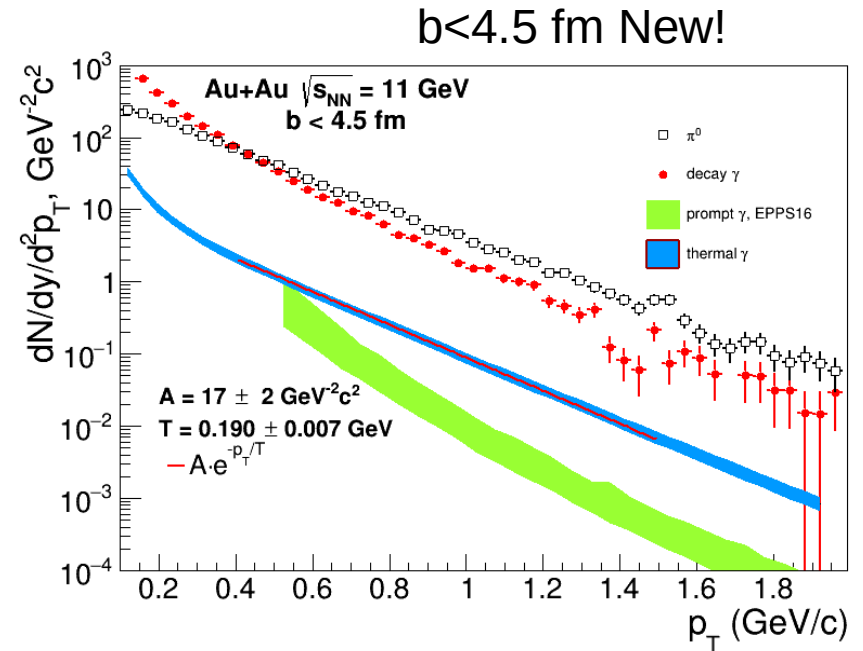
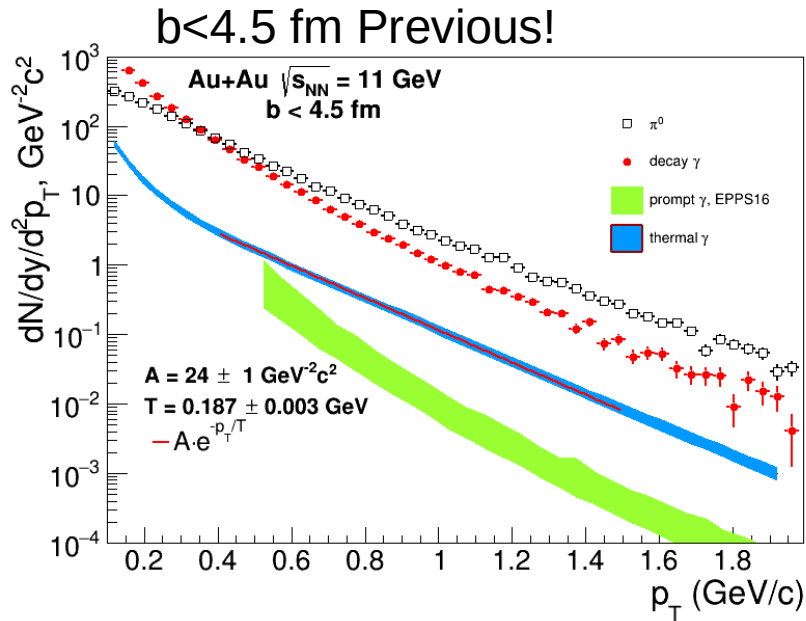
Final hadrons spectra

- $b < 4.5$ fm. Black markers – hydro off (previous calculations), red – hydro on (new). Harder spectra now!



Calculations at $\sqrt{s_{NN}} = 11$ GeV

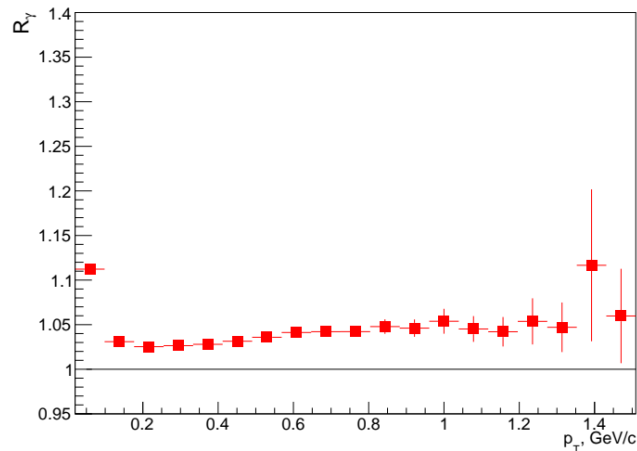
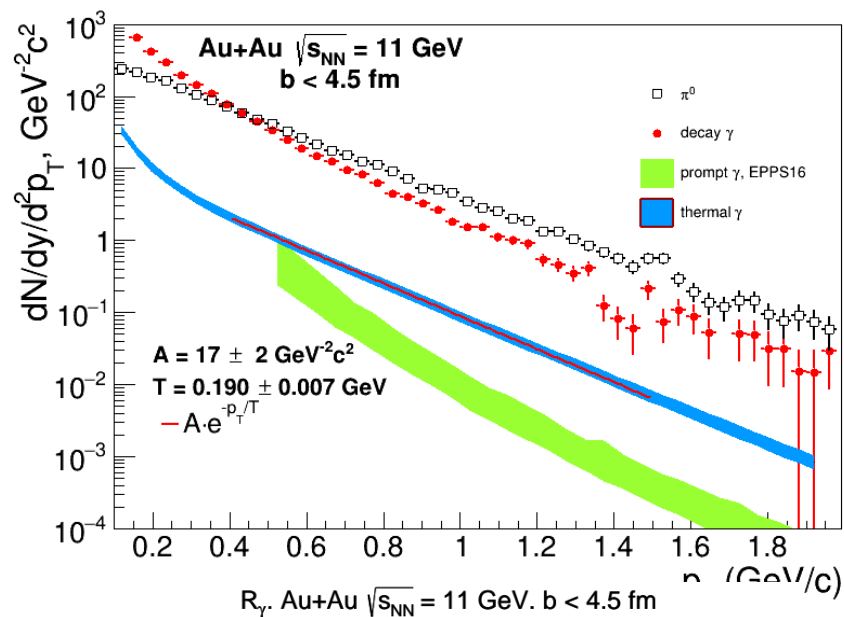
- π^0 and decay gamma spectra harder. Direct gamma due to change in calculation drops 30%.
- This results in R_γ now $\sim 5\%$ at 1 GeV/c (for $b < 4.5$).



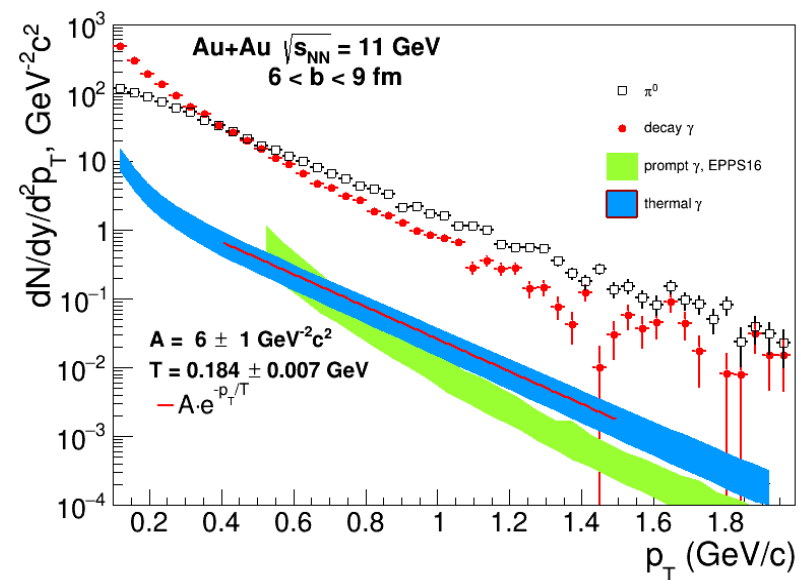
Centrality dependence

- Compare 0-10% and 20-40%
- Yield smaller by ~ 3 times.
- But similar R_γ . Much larger event-by-event fluctuations

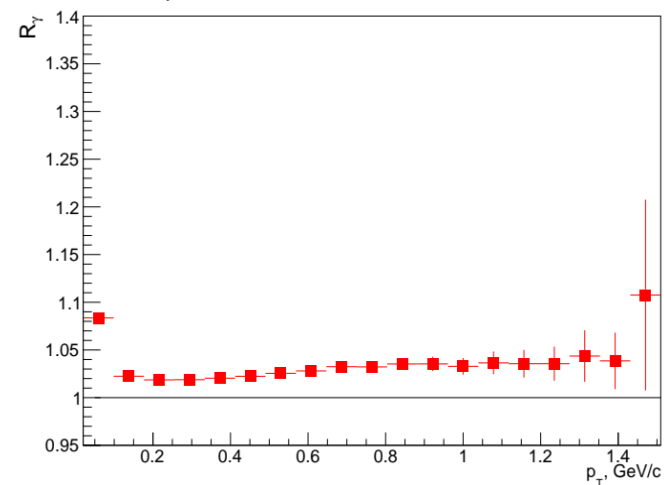
$b < 4.5$ fm



$6 < b < 9$ fm

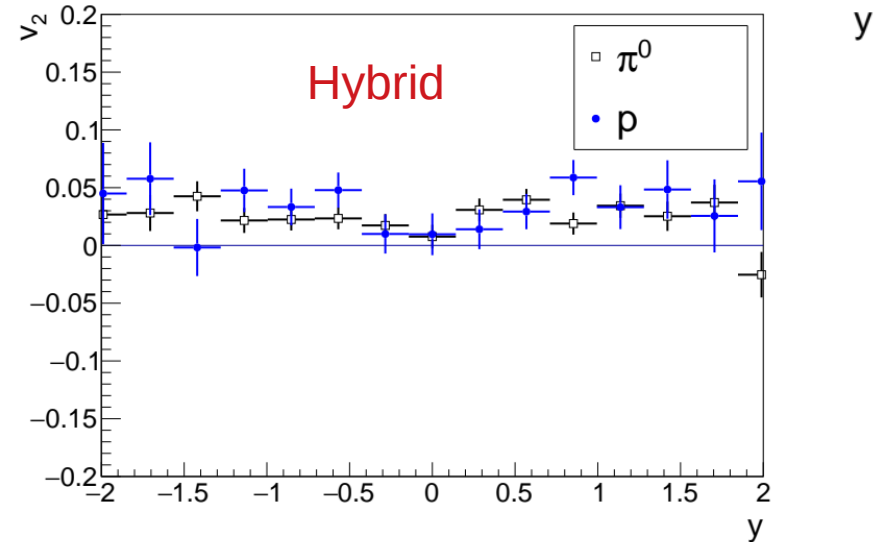
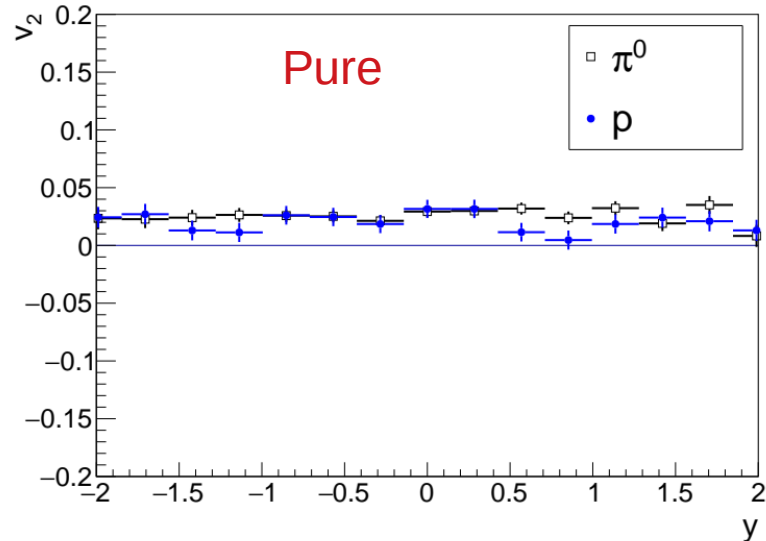
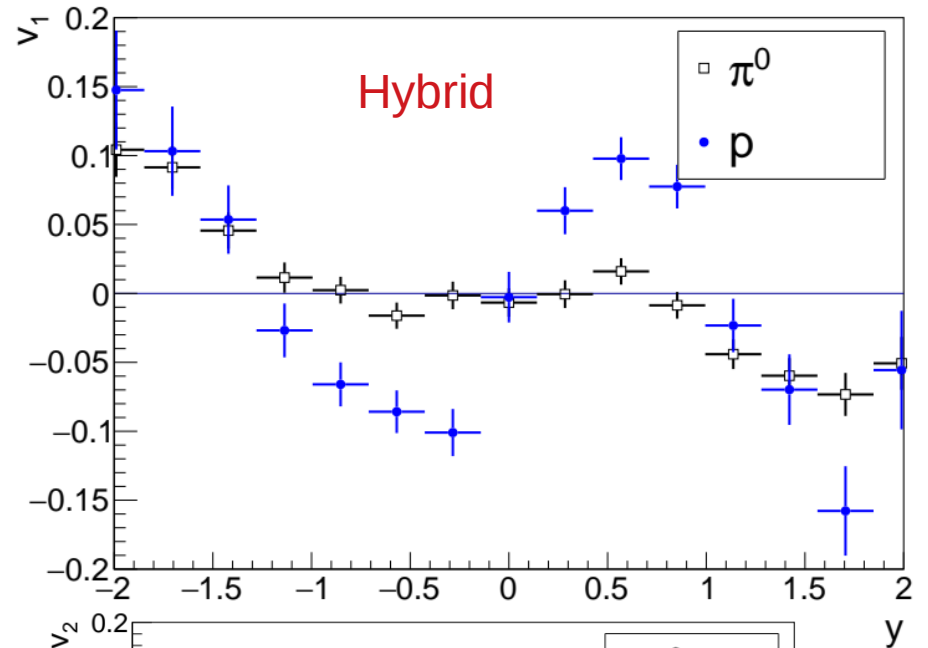
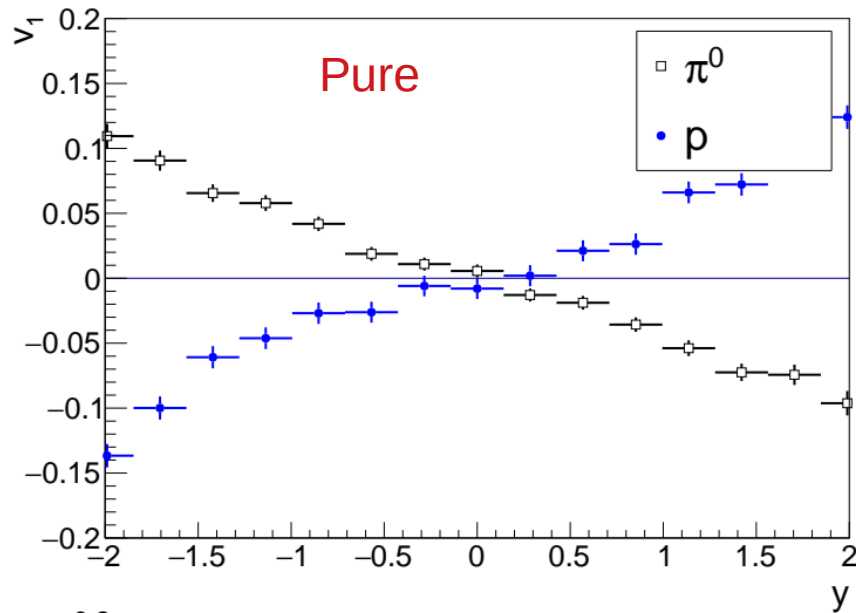


R_γ , Au+Au $\sqrt{s_{NN}} = 11$ GeV. $6 < b < 9$ fm



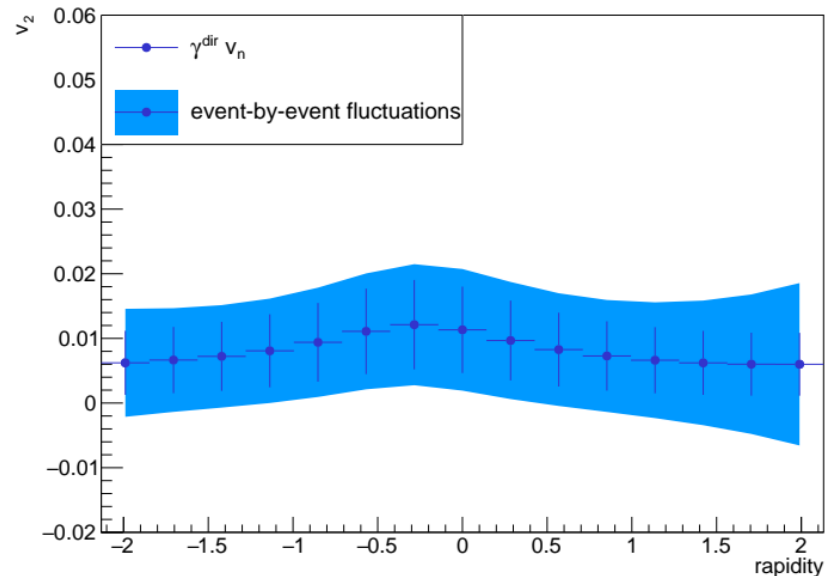
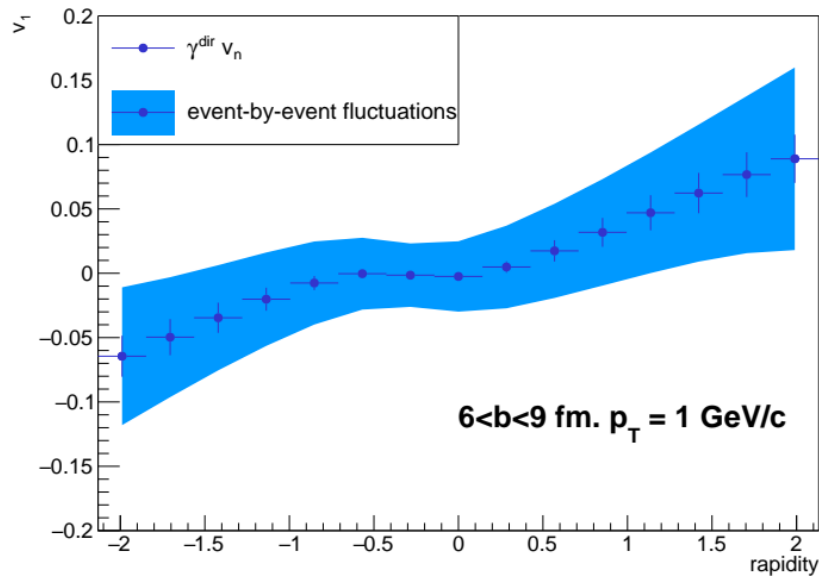
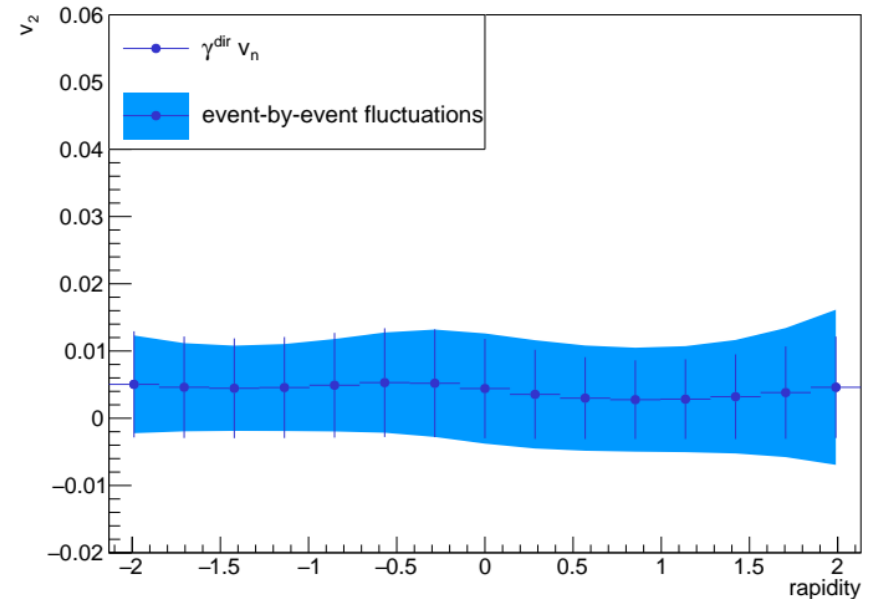
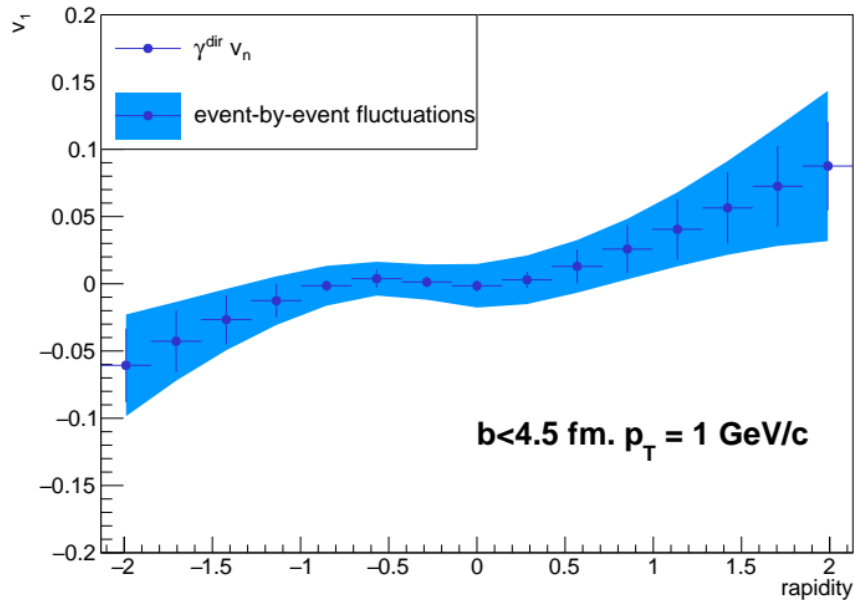
Flow of hardons

- $v_n = \langle \text{Cos}(n\phi_i) \rangle$
- $p_T > 0.2 \text{ GeV}/c$
- Compare pure UrQMD with hybrid UrQMD. 11 GeV, $b < 4.5 \text{ fm}$.



Flow of direct gamma

- Results for $p_T = 1$ GeV/c.
- v_1 slope positive – like for protons
- Magnitude increased for semi-central compared to central.



Conclusions

- Direct photon studies are ongoing. New calculations:
 - Added final hadron data after hydro mode;
 - Change in thermal photon emission leads to decrease of yield by $\sim 30\%$
 - Dependence on impact parameter add.

- Collective flow studies ongoing (model data).

- Todo:
 - More tests
 - Add events
 - Produce results for 5 GeV
 - Calculate dir gamma vn with the same p_T cuts as hadrons
 - Look at correlations with final hadrons

Backup