EMCal Jet Trigger in Run 2 Pb-Pb

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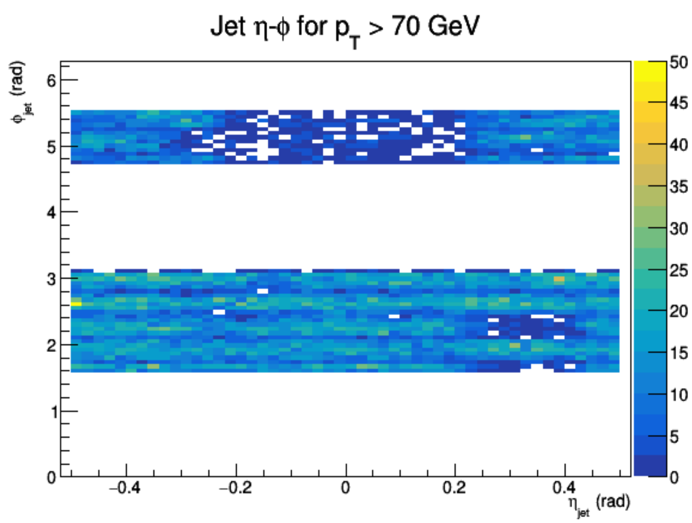
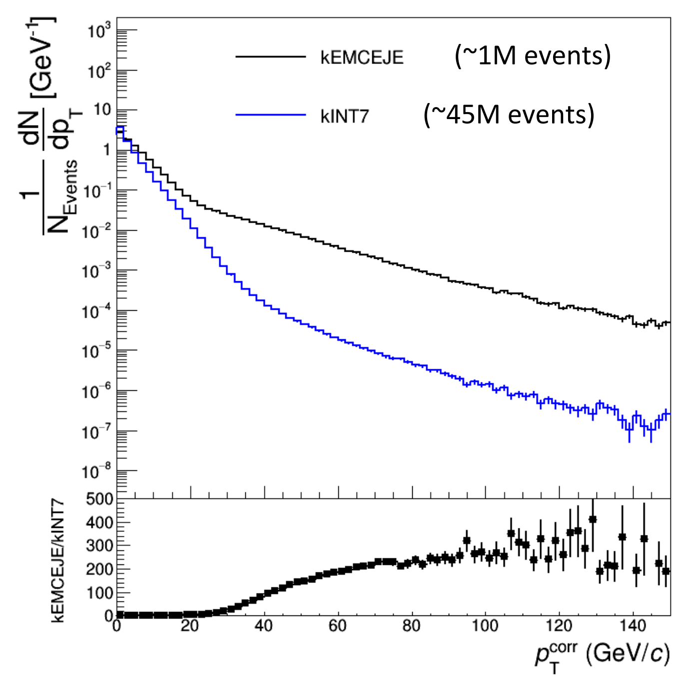
LHC15o EMCal Jet trigger

- Trigger algorithm:
  - 16x16 cell sliding jet patches (equivalent area to R≈0.13)
  - Median subtraction algorithm: Estimate background as median patch in opposite calorimeter of fixed "background" patches
  - 20 GeV threshold (after median background subtraction)

- Performance studied using R=0.2 full jets



Approximately uniform η-ϕ at high-p_T
Note: No PHOS jet trigger for this period

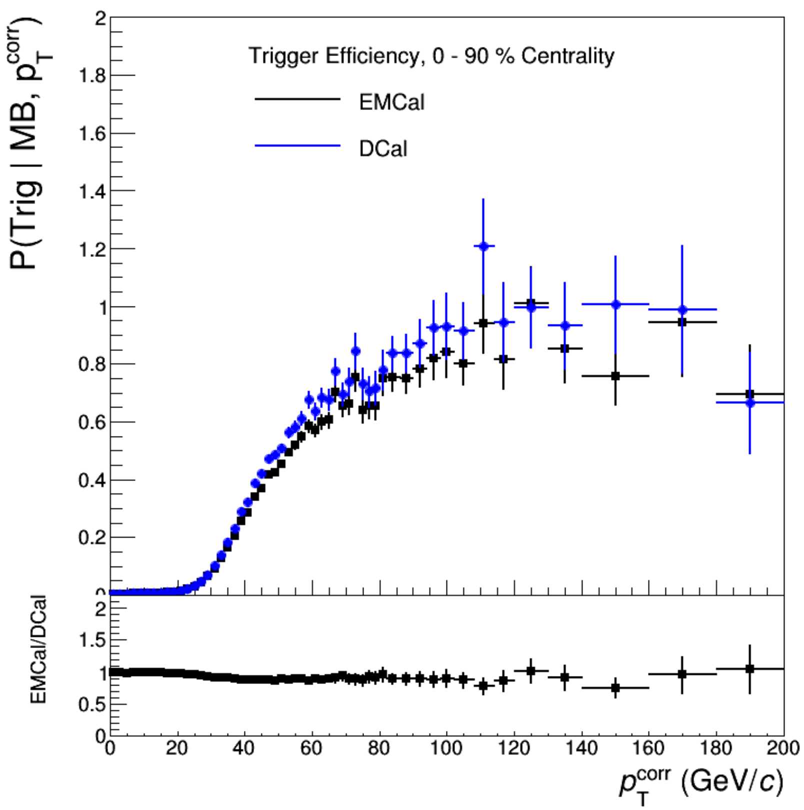


Enhancement in statistics by factor ~5 over MB at high-p_T

Trigger Efficiency

Trigger efficiency: $\varepsilon\left(p_T\right) = P\left(\mathrm{Trig}\,\middle|\,\mathrm{MB}, p_T^{jet}\right)$

- Since kEMCEJE requires the kINT7 condition as a prerequisite, we can estimate the total MB sample examined by the jet trigger by scaling up the recorded MB events by the MB downscaling factors
- The trigger efficiency can then be estimated by the ratio of the triggered jet spectrum to this scaled MB jet spectrum



Trigger becomes unbiased near ≈ 100 GeV

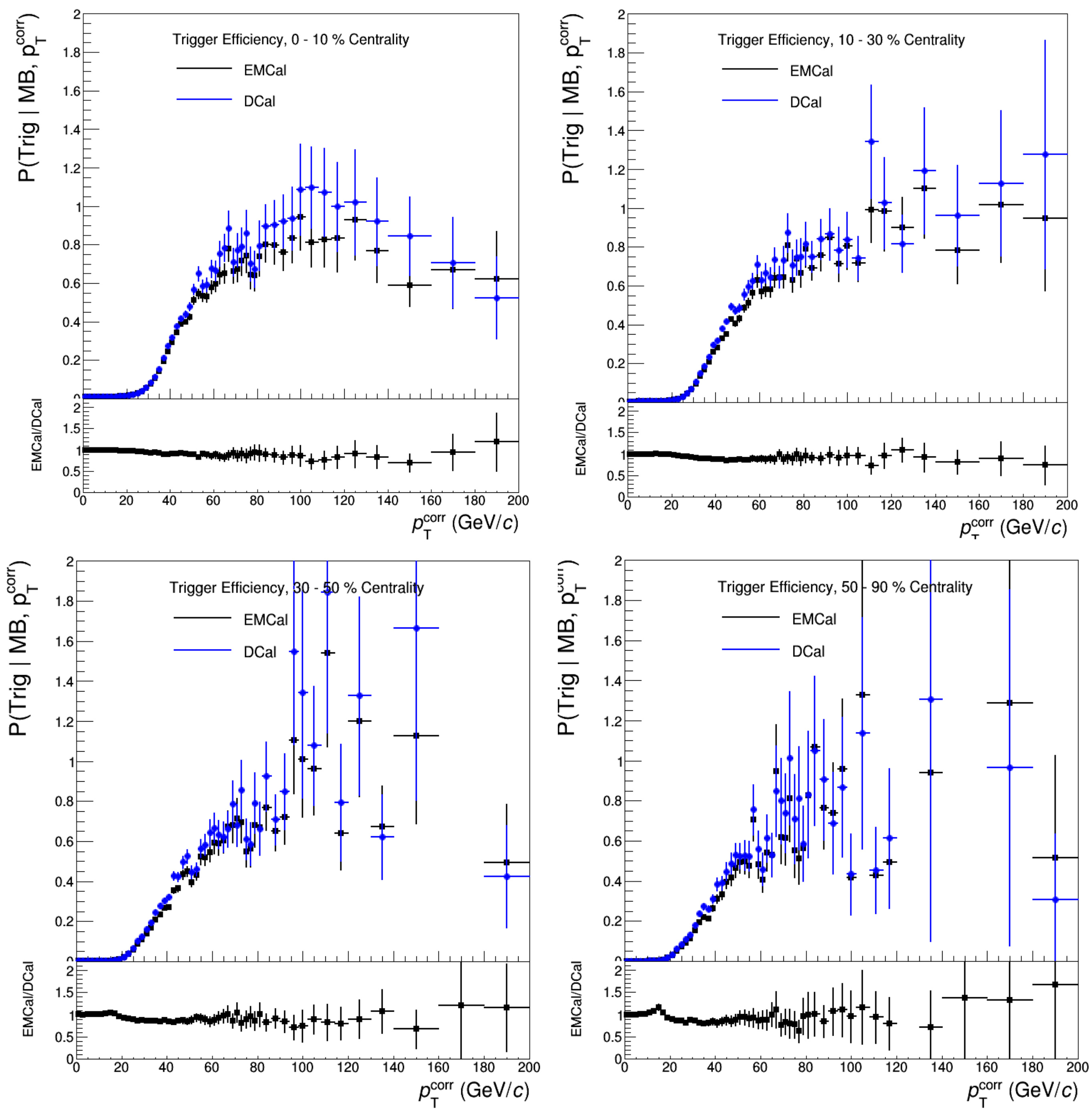
MB statistics are small above ≈ 100 GeV

DCal efficiency slightly higher than EMCal

- Dead/masked TRU in EMCal?

Trigger Efficiency

Efficiency does not depend strongly on centrality

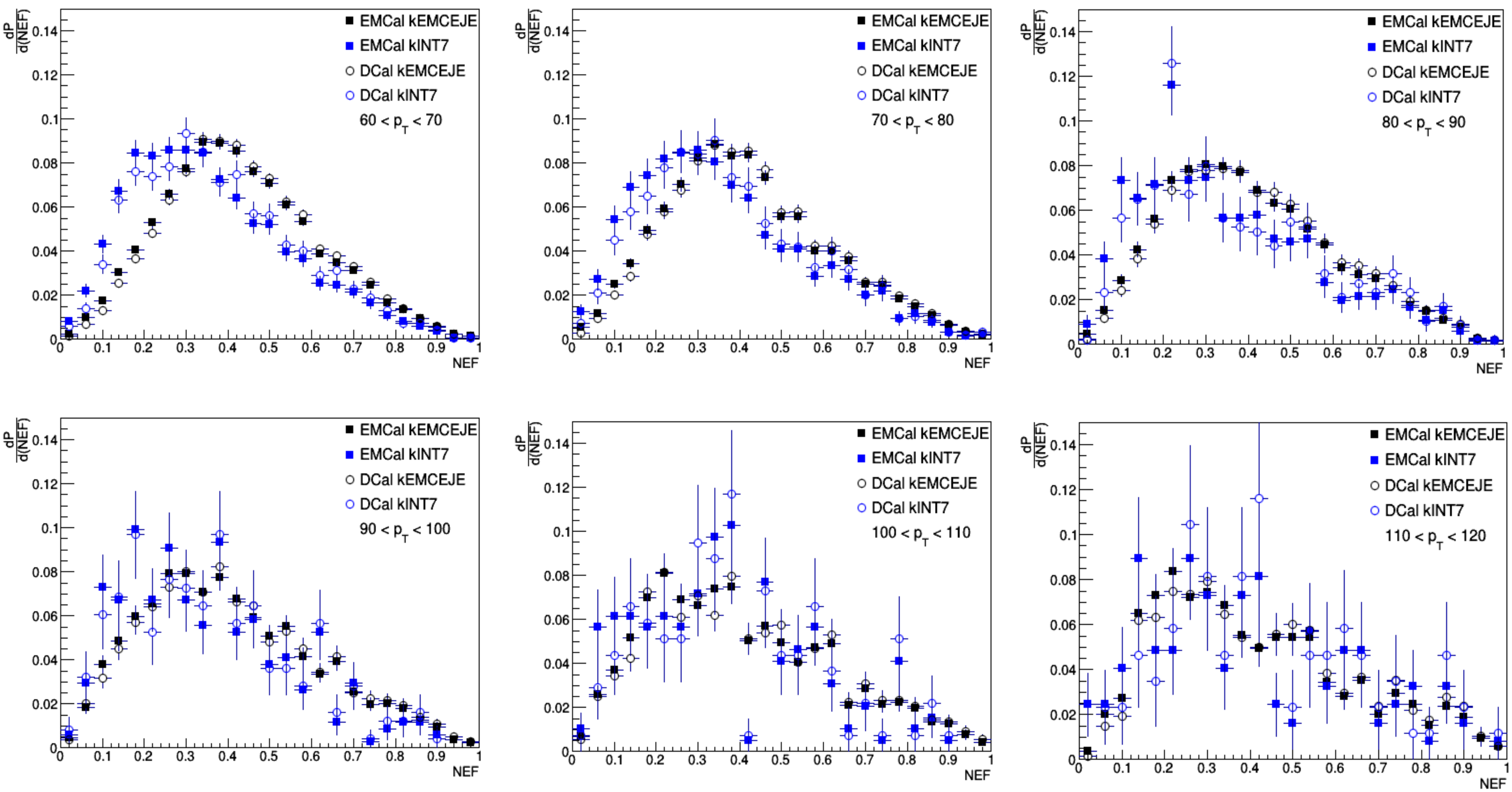


Trigger bias

- When trigger efficiency is less than 100%, the triggered sample of jets may be systematically biased
- One should compare observables of reconstructed full jets in kEMCEJE and kINT7 data, as a function of p_T:
  - Neutral energy fraction (NEF)
  - Z of leading charged jet constituent
  - Centrality
  - Number of jet constituents

Trigger bias: NEF

Triggered jets have enhanced neutral energy fraction at lower p_T, as expected
Trigger bias persists up to > 90 GeV

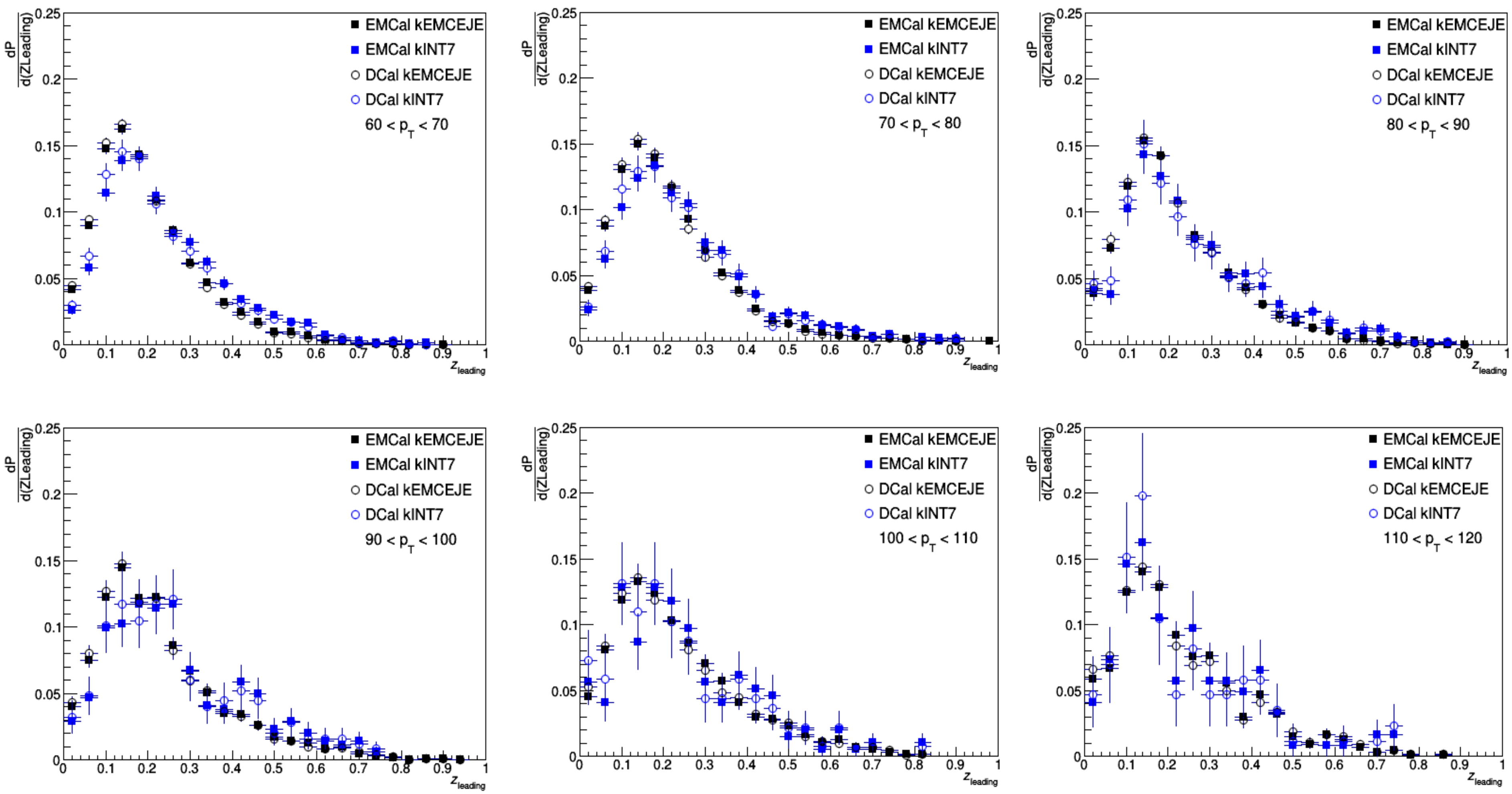


No obvious difference in trigger bias between EMCal and DCal
DCal systematically has slightly higher NEF than EMCal…

Trigger bias: $Z_{leading, ch}$

Triggered jets have suppressed $z_{leading, ch}$ up to > 90 GeV

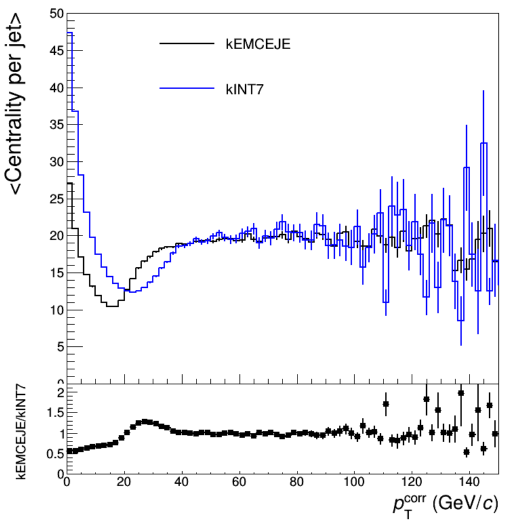
This is troublesome for jet quenching measurements

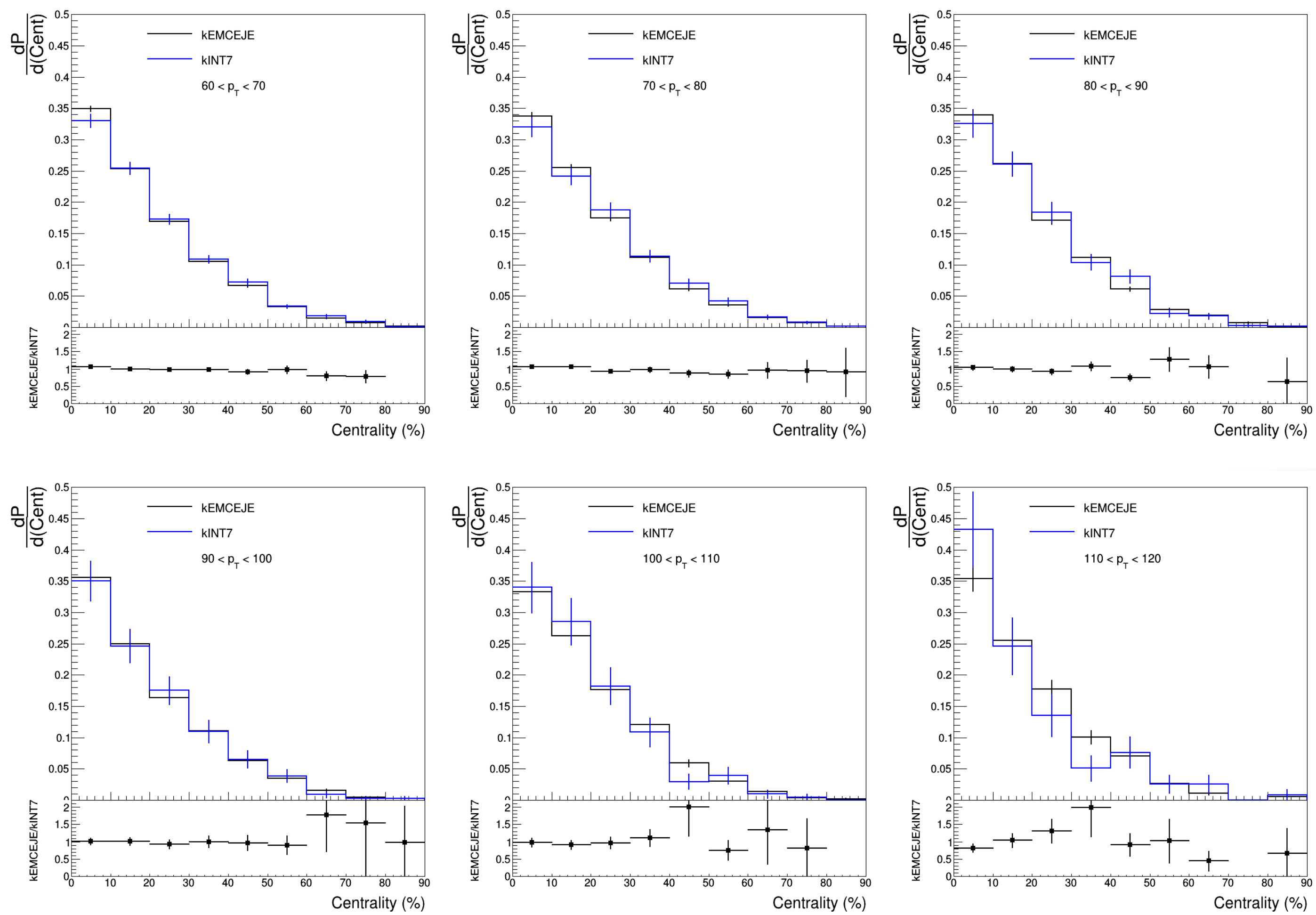


No obvious difference in trigger bias between EMCal and DCal

DCal systematically has slightly lower $Z_{leading,ch}$ than EMCal…

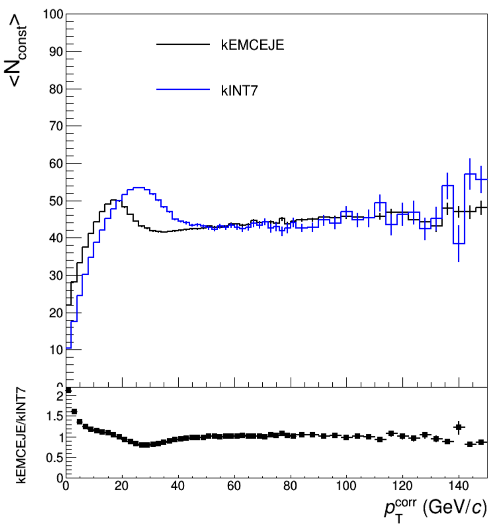
Trigger bias: Centrality

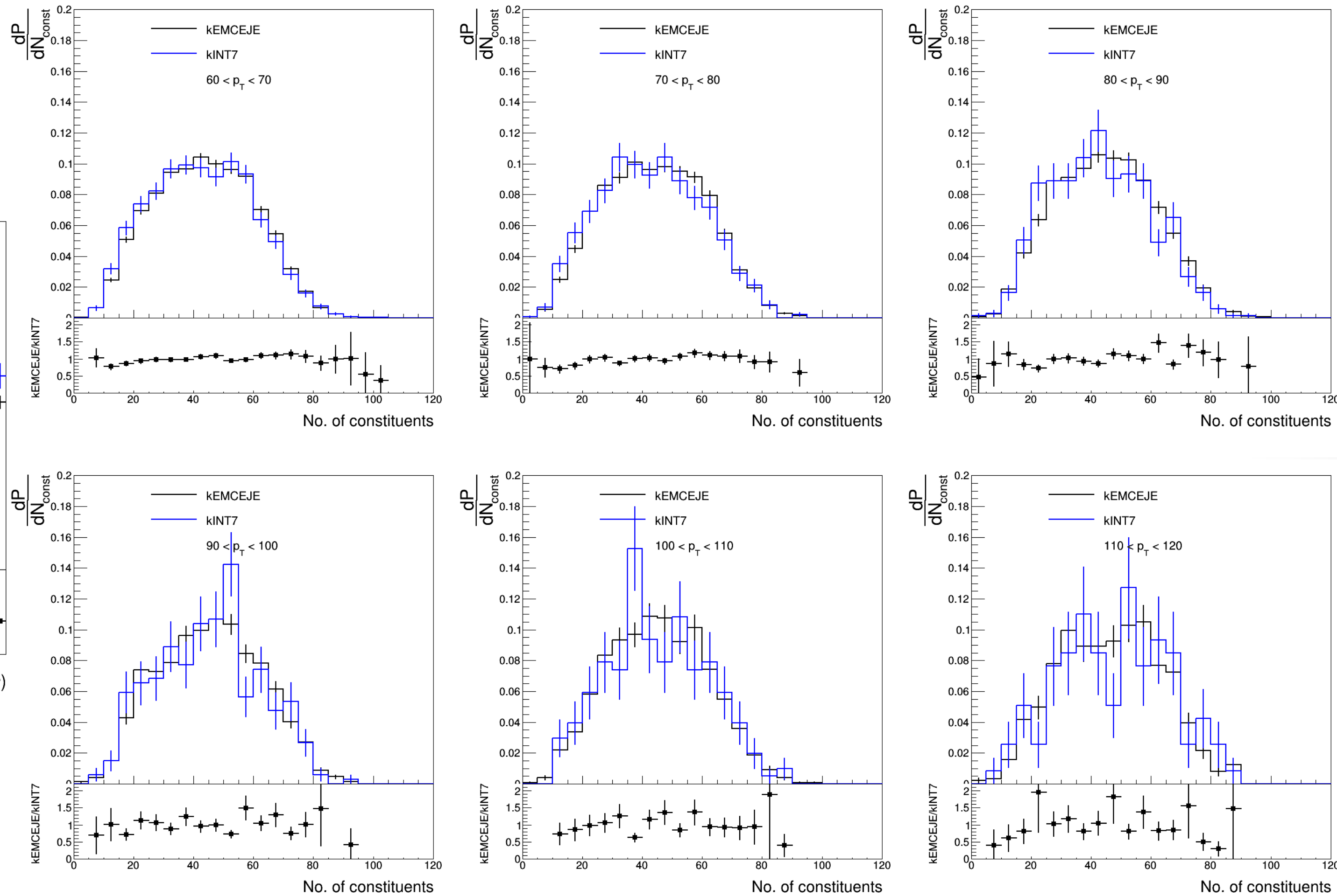




No centrality bias appears in mean jet centrality (top left) or centrality distributions (right panels) at high-p_T

Trigger bias: Multiplicity

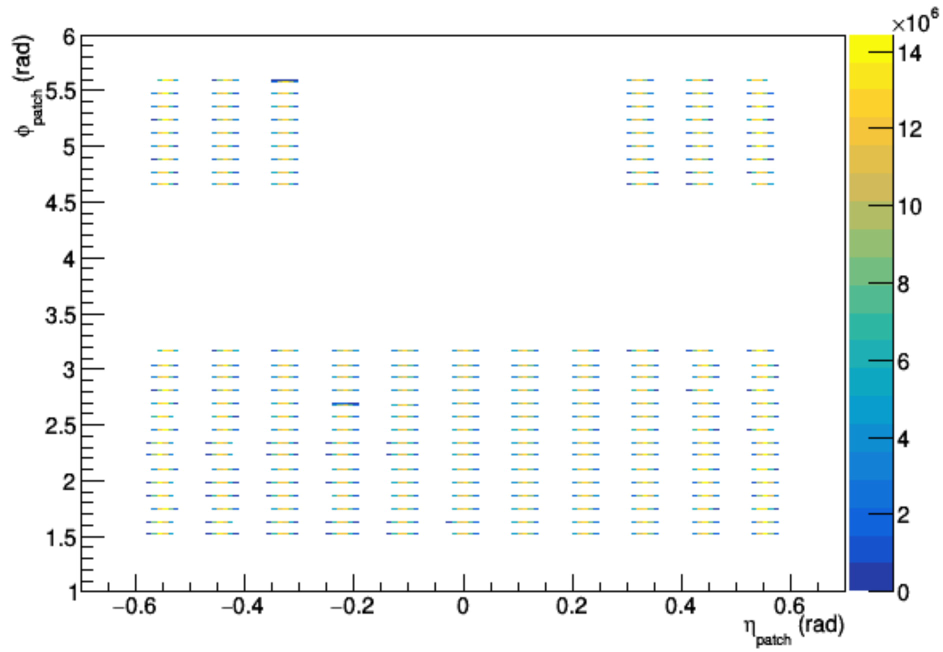




- No significant trigger bias in number of jet constituents

Trigger Simulation

- Using cell amplitudes in LHC15o min bias data, I "simulated" the jet trigger's median subtraction algorithm
  - TriggerMaker used to construct patches
  - Sliding jet patches used for median calculation (as opposed to the fixed background patches used in reality)

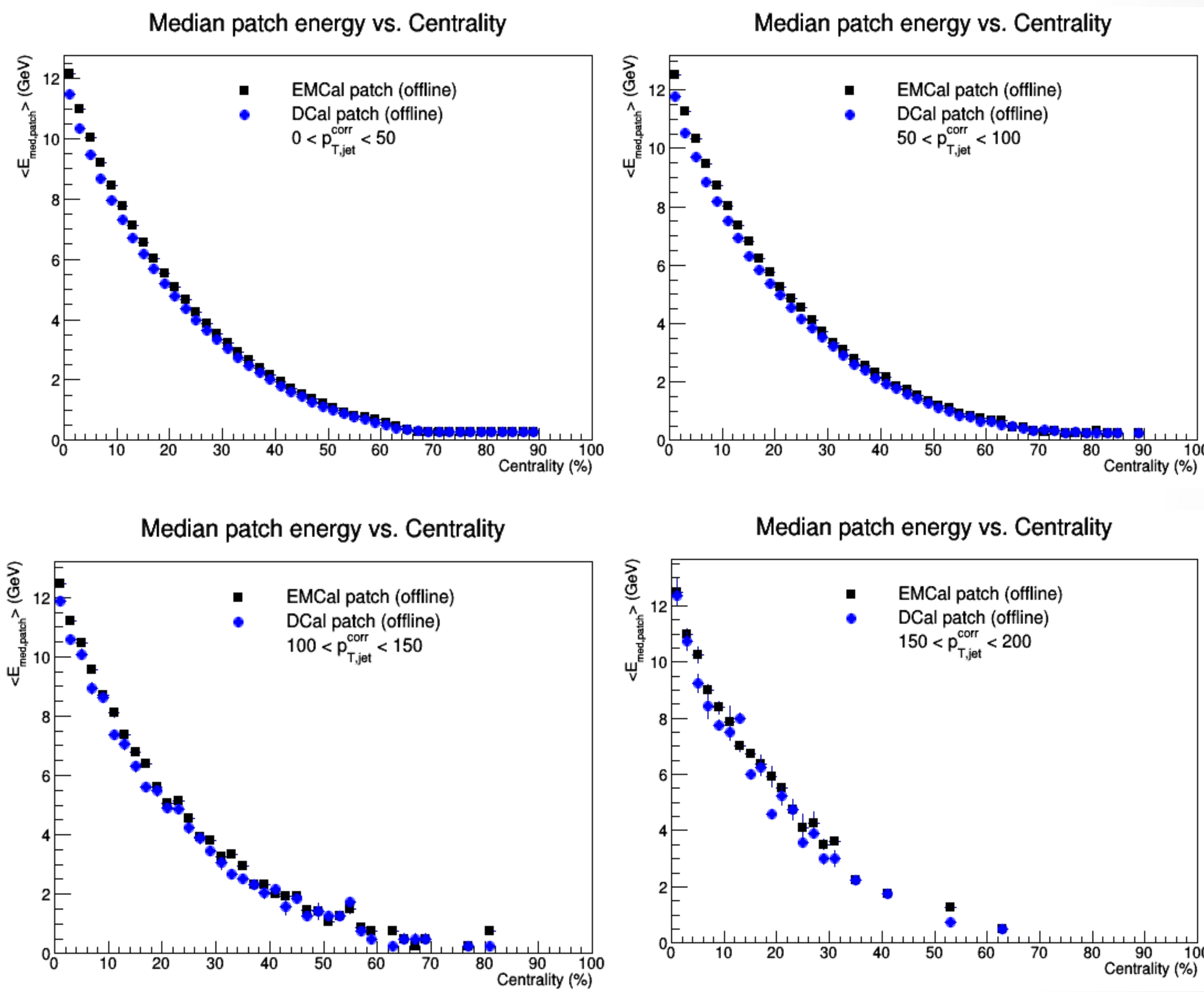


Trigger Simulation

Median patch energy is roughly unaffected by the presence of a jet

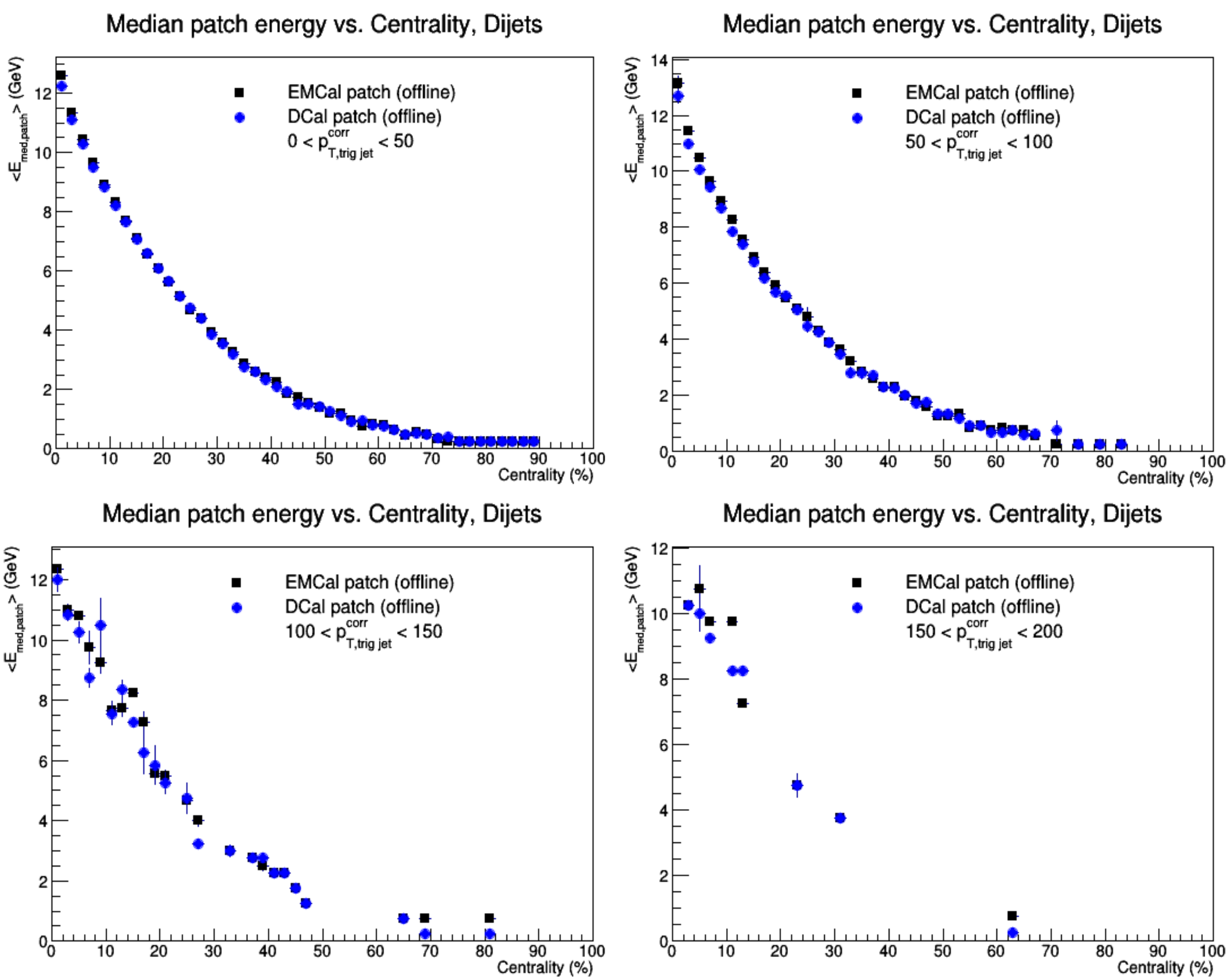
Median is slightly higher for EMCal

- Due to fewer bad cells?



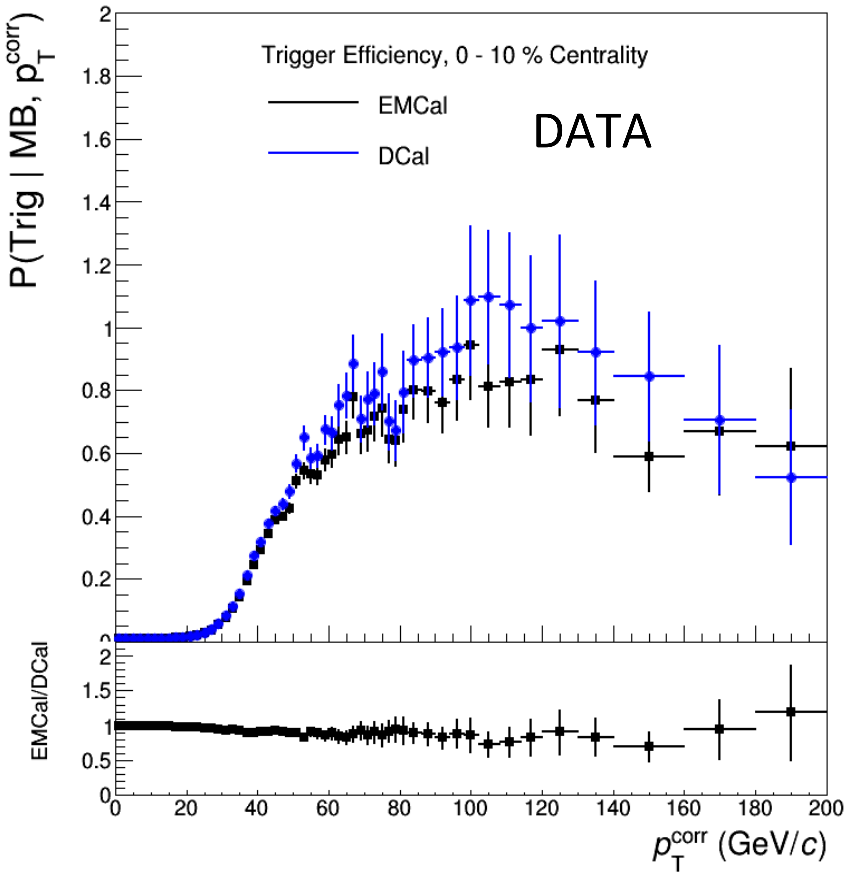
Trigger Simulation

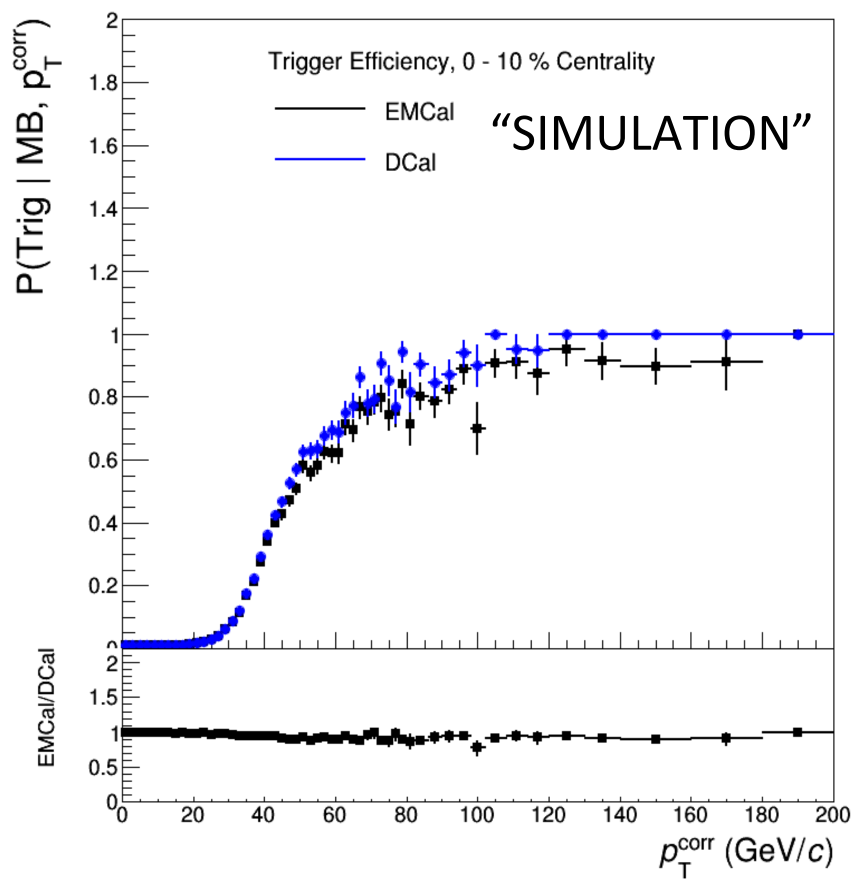
- Is the median patch energy enhanced in dijet events?
  - This would reduce the dijet trigger efficiency relative to the single jet trigger efficiency



It seems there is no significant bias!

Trigger Simulation



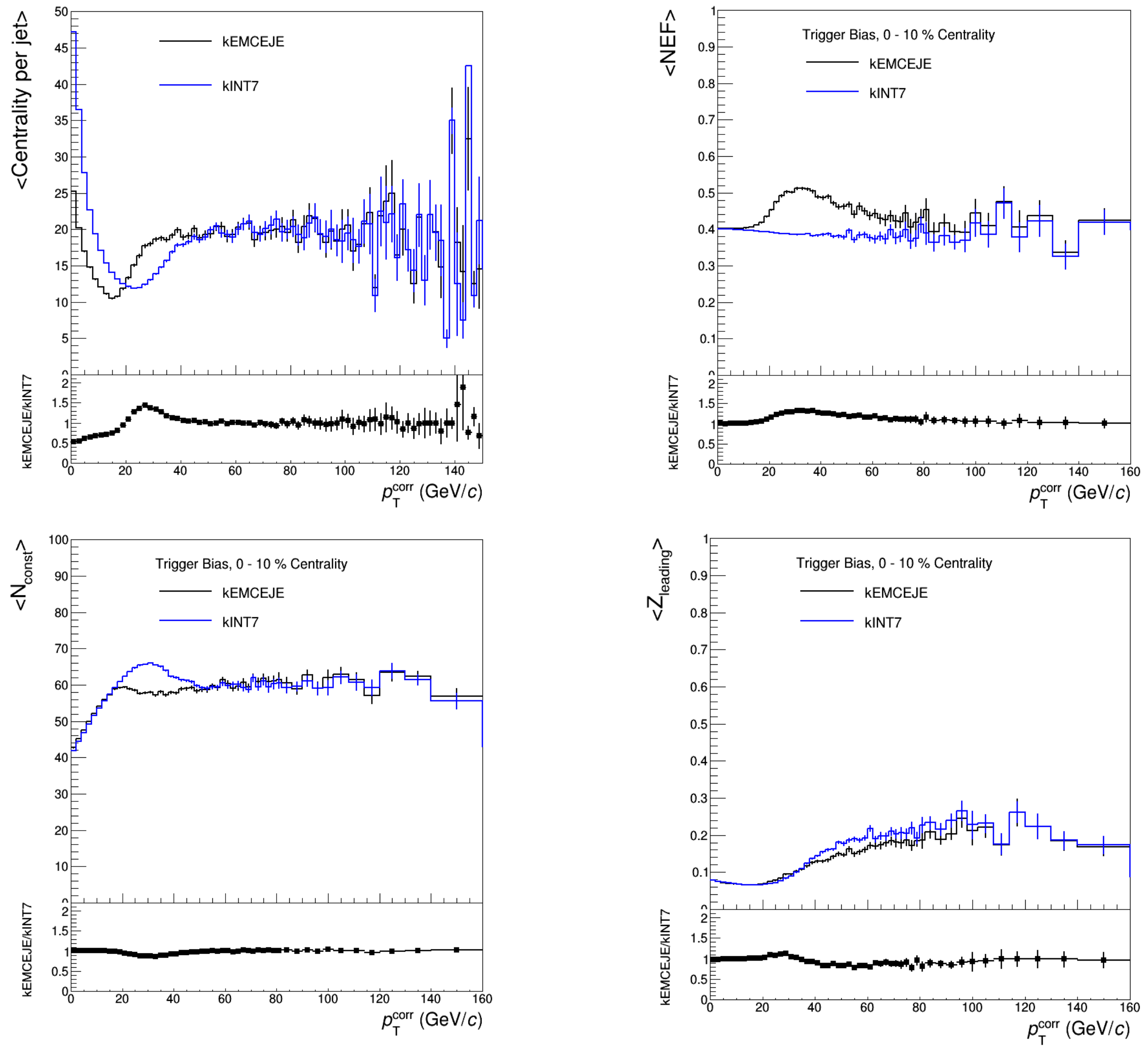


Efficiency is reasonably well-reproduced in "simulation"!
Including the fact that DCal is slightly more efficient

Note: Don't take error bars (binomial) too seriously

Trigger Simulation

- Trigger bias observables show similar behavior as in data



Conclusion

- The EMCal Jet Trigger performed well in LHC15o
- Trigger bias in NEF, $z_{leading}$ is present up to ≈ 100 GeV
- Trigger efficiency and bias are reproduced reasonably well by “simulation”
  - Limited statistics in trigger/MB overlap region make precise comparison difficult
- Next steps are to check in detail the effects of these observations on physics observables…

Thank you!

Backup

Analysis details

- LHC15o: 5.02 TeV Pb-Pb
- Full Jet QA presented here: https://indico.cern.ch/event/623447/contributions/2515038/attachments/1427034/2189872/qa_highIR_pass1.pdf
- Runlist: High-IR pass1, with good EMCal+PHOS
  - 246928 246846 246845 246844 246810 246809 246808 246807 246805 246804 246766 246765 246760 246759 246758 246757 246751 246750 246495 246493 246487 246434 246424 246271 246225 246222 246217 246115 246113 246089 246042 246037 246003 246001 245963 245954 245952 245949 245831 245829 245705 245702 245700 245683 246488 246087
- Triggers:
  - kINT7 (43M accepted events)
  - kEMCEJE (1.05M accepted events)
- Physics selection: Default (no pileup cuts)
- Event selection: AliEventCuts, automatic mode
  - Vertex position, vertex quality, centrality
- Track selection: LHC15o track cuts (hybrid tracks)
- EMCal corrections: AliEmcalCorrectionTask, all corrections enabled, default parameters used (exception: 50ns time cuts enabled)
- PHOS corrections: PHOS Tender (default settings), and exotic cluster cuts (M02 > 0.2, Ncells > 2)
- Jet Selection: Full jets, anti-kT, R=0.2, EMCal + DCal-region fiducial cut
  - Background subtracted using centrality-dependent scale factors