Benchmark of the event selection strategy for OO using HF particle flow candidates

Charged hadron RAA OO meeting Lynn Rong, Jing Wang (MIT) 05/29/2025

Introduction

corresponding contamination arising from EM events.

- HIJING (hadronic) OO collisions (cross section ~ 1.08 barn)
- STARLIGHT single-diffractive collisions (cross section ~ 0.3 barn)
- \rightarrow for this purpose, each sample was reweighed according to the estimated cross section
- using the Forest (Jing)
- 3) Detailed description of the dataset and the skim content can be found in Balazs' slides Validation of the slides can be found in Kyle's slides

1) We used the following two samples to estimate the efficiency of selection of hadronic OO events and the

2) The study was performed with the analysis skims we produced and fully validated against the results obtained





Selection strategy based on PF HF candidates

- HFE_{max} : HF leading tower energy from PF
- Selections with $(HFE_{max} + AND HFE_{max}) > X$ GeV where X is an arbitrary cuts are more central collisions Selections with $(HFE_{max} + OR HFE_{max} -) > X GeV$: Includes central and more ultra peripheral collisions
- We performed scans on multiple energy Xs (0-50) and calculated:
 - **Efficiency:** #Events that pass selection/nEvents in HIJING **Purity:** 1 - ((xsec_EM*Eff_bkg) / (xsec_EM *Eff_bkg) + (xsec_had * Eff_Signal)







Fraction of surviving events (Hijing hadronic)



HFE⁺_{max} > X AND HFE⁻_{max} > X HFE⁺_{max} > X OR HFE⁻_{max} > Cut value (X)

Blue: (HFE_{max} + AND HFE_{max} -) > X **Red:** (HFE_{max} + **OR** HFE_{max} -) > X **Scan range: 0 < X < 50 Efficiency:**

- (#of Events with all cuts)/(number of All events) Cuts:
- PV Filter, ClusterComp, abs(Vz) < 15

HF AND condition significantly reduces the event selection efficiency already at low thresholds





Fraction of surviving events (single-diffractive)

\rightarrow photonuclear (asymmetric events)





- **Blue:** (HFE_{max} + AND HFE_{max}) > X
- **Red:** (HFE_{max} + **OR** HFE_{max}) > X
- Scan range: 0 < X < 50
- **Efficiency:** (#of Events with all cuts)/(number of All events)
- Cuts: ullet
 - PV Filter, ClusterComp, abs(Vz) < 15

SD sample sees sharp drop for the **AND** condition as cuts tighten







ROC: efficiency (Hijing) vs contamination (SD)



Sample Cuts

- $(HFE_{max} + \text{ AND } HFE_{max}) > X \text{ for } 0 < X < 50$
- PVFilter, ClusterCompFilter, |Vz| < 15

Signal Sample: HIJING (xsecHadronic = 1.08b) **Background Sample:** StarlightSD (xsecEM = 0.3b) **Efficiency**: #Events that pass selection/nEvents in HIJING

- **Purity:** 1 ((xsecEM * EfficiencySD) / (xsecEM)
- *EfficiencySD) + (xsecHadronic * EfficiencyHIJING)

Each point corresponds to a given setup



Efficiency and Purity for 1/2 HFtower condition

1 Tower



 HFE_{max} + **AND** HFE_{max} - > X in blue HFE_{max} + **OR** HFE_{max} - > X condition in red Comparison between selection on **only highest energy** PF candidate and the **top 2** highest candidate





Efficiency and Purity of selection on 1 HFtower vs 2 HFtowers (zoomed in)





Comparison with the results obtained with the Forest

Efficiency/contamination: numerical comparison

Coinc	HFE_max Threshold	Forest Efficiency	Skim Efficiency	Forest Purity	Skim Purity
1	3	96.5%	96.5%	98.1%	98.1%
1	4	95.8%	95.8%	99.4%	99.4%
1	5	95.4%	95.4%	99.7%	99.7%
1	6	94.9%	94.9%	99.7%	99.7%
1	7	94.4%	94.4%	99.8%	99.8%
1	8	93.7%	93.7%	99.8%	99.8%
1	9	92.8%	92.8%	99.9%	99.9%
2	3	95.6%	95.6%	99.5%	99.5%
2	4	94.9%	94.9%	99.8%	99.8%
2	5	94.0%	94.0%	99.9%	99.9%
2	6	92.9%	92.9%	99.9%	99.9%

Very good agreement between Forest and Skim-based results!



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Efficiency plots cross check



- X scanned from 1-10GeV on left plot and 1-50GeV on right
- Cross check results match

Purity vs Efficiency (HFE_{max} + and HFE_{max} - > X) (SD and Hijing)



- Efficiency vs Purity of different selections on HFE_{max} + and HFE_{max} - > X for highest energy pfflow candidate

Summary and outlook

- only SD STARLIGHT)
- •Benchmarked and extended the results obtained with the forest-based code (Jing)
- •Trying the same with Double Diffractive Starlight

•Tested efficiency and contamination for signal (Hijing) and EM background (for the moment

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BACKUP slides





Updated centrality distribution





