

ATLAS Anomaly Trigger Calibration

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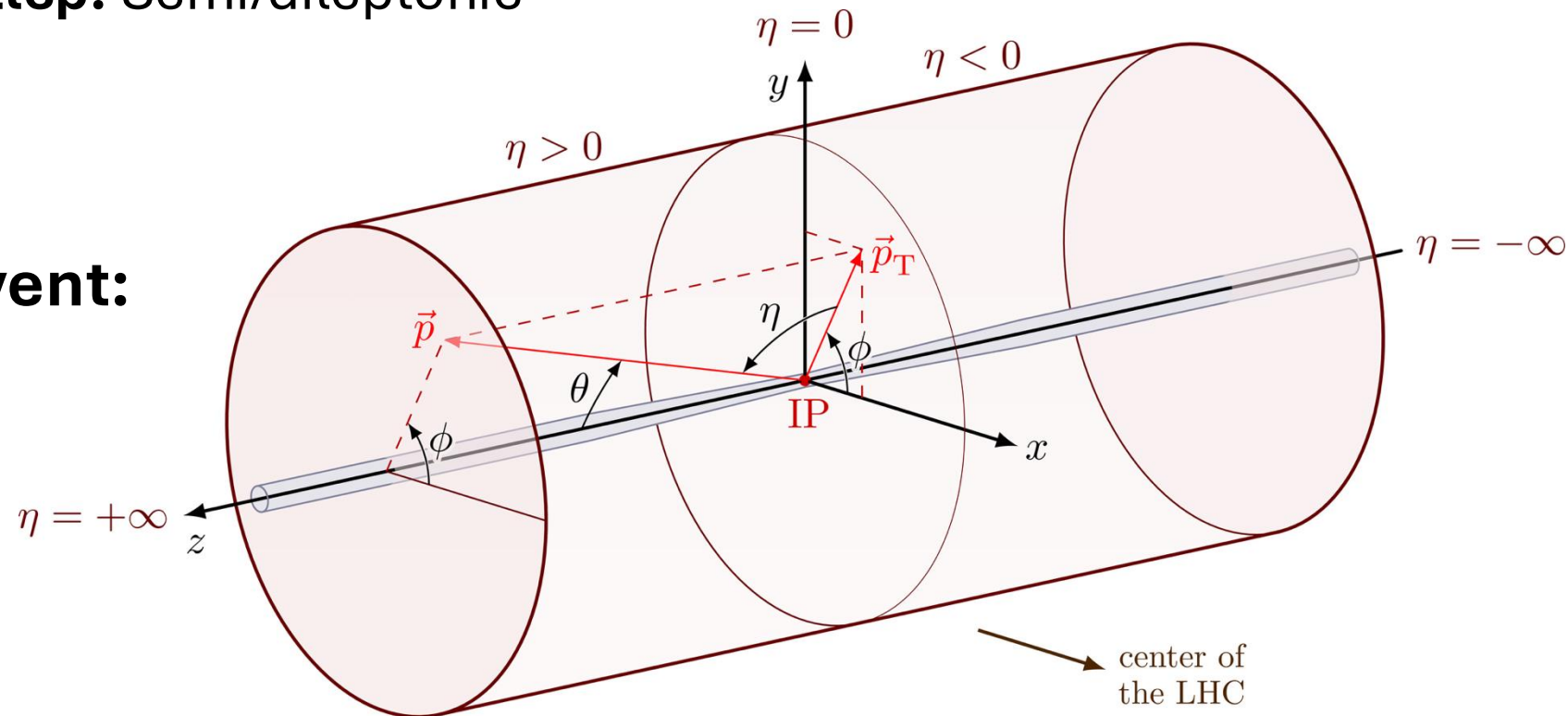
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Scope of This Work

- Initial **calibration** of the anomaly trigger.
- Focus areas:
 - Compute anomaly scores for six MC datasets.
 - Evaluate trigger efficiency for multiple thresholds.
 - Build reproducible workflows for future calibration.
- Code repository: <https://github.com/ryxie-24/Calibration>

Monte Carlo Datasets

- Six datasets (signal-like MC):
 - **jz1, jz2, jz4**: Inclusive QCD dijet events.
 - **ttbar 1lep, ttbar 2lep**: Semi/dileptonic top-antitop.
 - **ZZ4lep**: Clean SM benchmark.
- **44 features per event**:
jets, taus,
muons, MET.



Thresholds

- corresponding to intake rate:

At L1	Using 2460 bunch crossing * 11245 turn per second = 27662700 Hz	Using 2808 bunch crossing * 11245 turn per second = 31575960 Hz
250Hz	1722342	1819597
500Hz	1492475	1516309
1kHz	1308268	1329877
2kHz		1237997
3kHz		1156836
4kHz		1096728
5khz		1051755
11kHz	876531	899489

Scaling factors

$$x_i^{\text{scaled}} = \frac{x_i}{2^{s_i}}$$

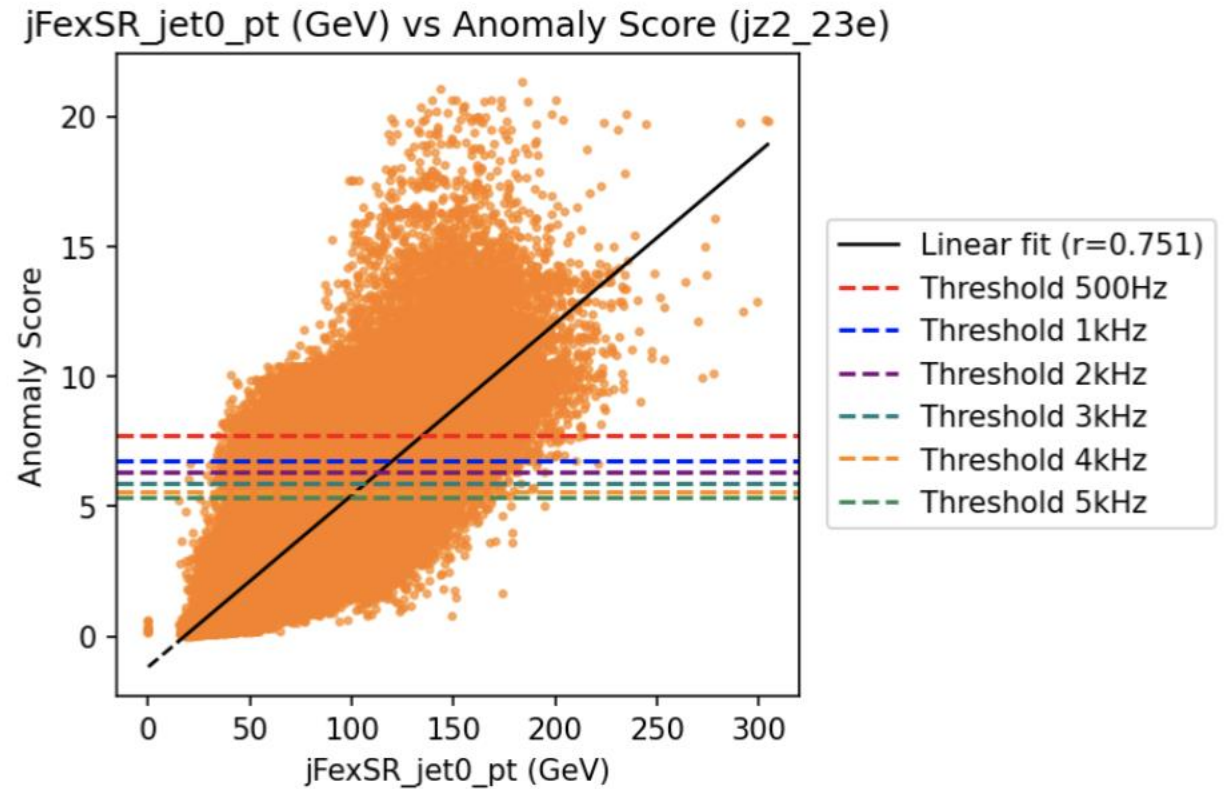
Category	Feature	s_i
jFexSR jets (6)	jFexSR_jet0_pt (GeV)	7
	jFexSR_jet0_eta	5
	jFexSR_jet0_phi (rad)	5
	jFexSR_jet1_pt (GeV)	7
	jFexSR_jet1_eta	5
	jFexSR_jet1_phi (rad)	5
	jFexSR_jet2_pt (GeV)	5
	jFexSR_jet2_eta	4
	jFexSR_jet2_phi (rad)	4
	jFexSR_jet3_pt (GeV)	5
	jFexSR_jet3_eta	4
	jFexSR_jet3_phi (rad)	3
	jFexSR_jet4_pt (GeV)	4
	jFexSR_jet4_eta	3
	jFexSR_jet4_phi (rad)	3
	jFexSR_jet5_pt (GeV)	3
	jFexSR_jet5_eta	3
	jFexSR_jet5_phi (rad)	2

Category	Feature	s_i
eFex taus (4)	eFex_tau0_pt (GeV)	6
	eFex_tau0_eta	5
	eFex_tau0_phi (rad)	5
	eFex_tau1_pt (GeV)	5
	eFex_tau1_eta	4
	eFex_tau1_phi (rad)	5
	eFex_tau2_pt (GeV)	4
	eFex_tau2_eta	3
	eFex_tau2_phi (rad)	4
	eFex_tau3_pt (GeV)	3
	eFex_tau3_eta	2
	eFex_tau3_phi (rad)	3

Category	Feature	s_i
Muons (4)	muon0_pt (GeV)	4
	muon0_eta	4
	muon0_phi (rad)	4
	muon1_pt (GeV)	2
	muon1_eta	3
	muon1_phi (rad)	3
	muon2_pt (GeV)	1
	muon2_eta	1
	muon2_phi (rad)	2
	muon3_pt (GeV)	-2
MET	muon3_eta	-1
	muon3_phi (rad)	-1
	MET_pt (GeV)	6
	MET_phi (rad)	5

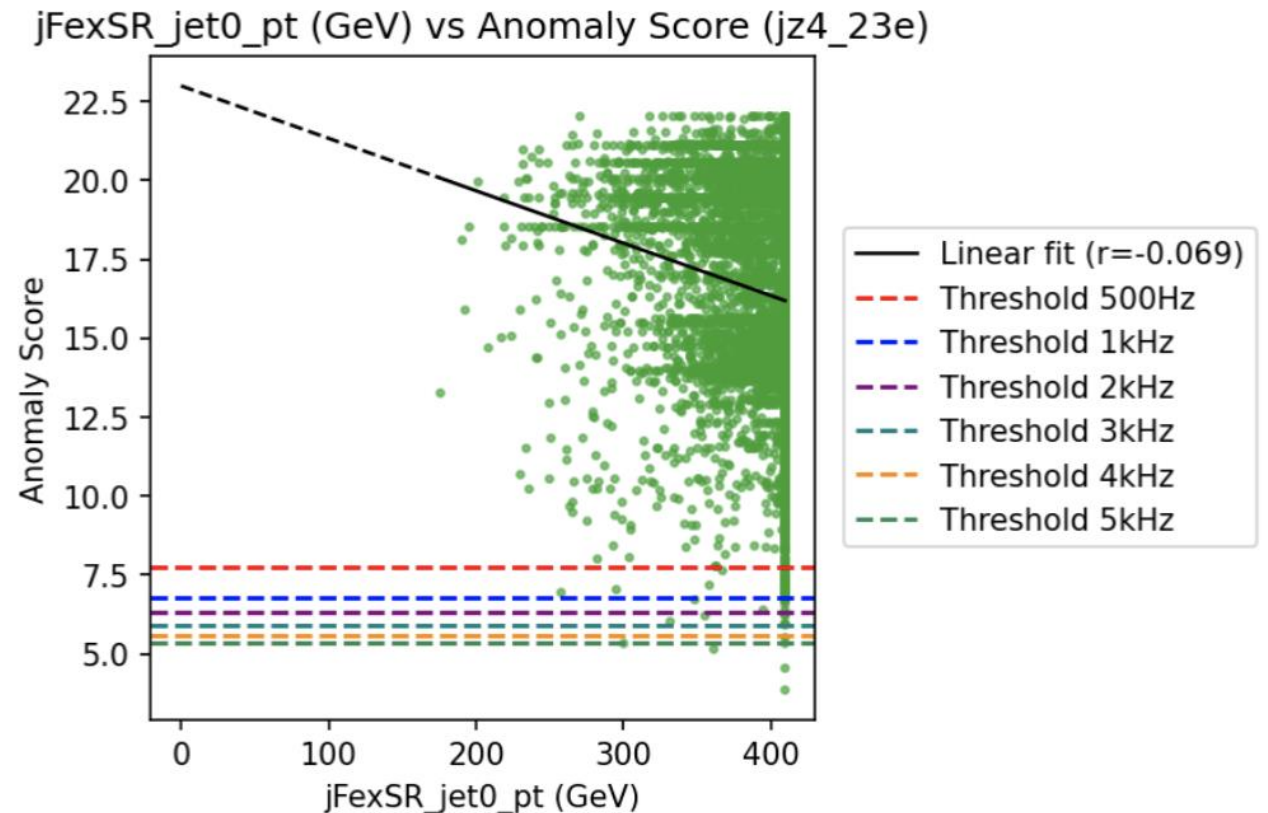
Anomaly vs Jet p_T

- Anomaly score shows an approximately positive correlation with jet p_T
- Independent of the jet rank



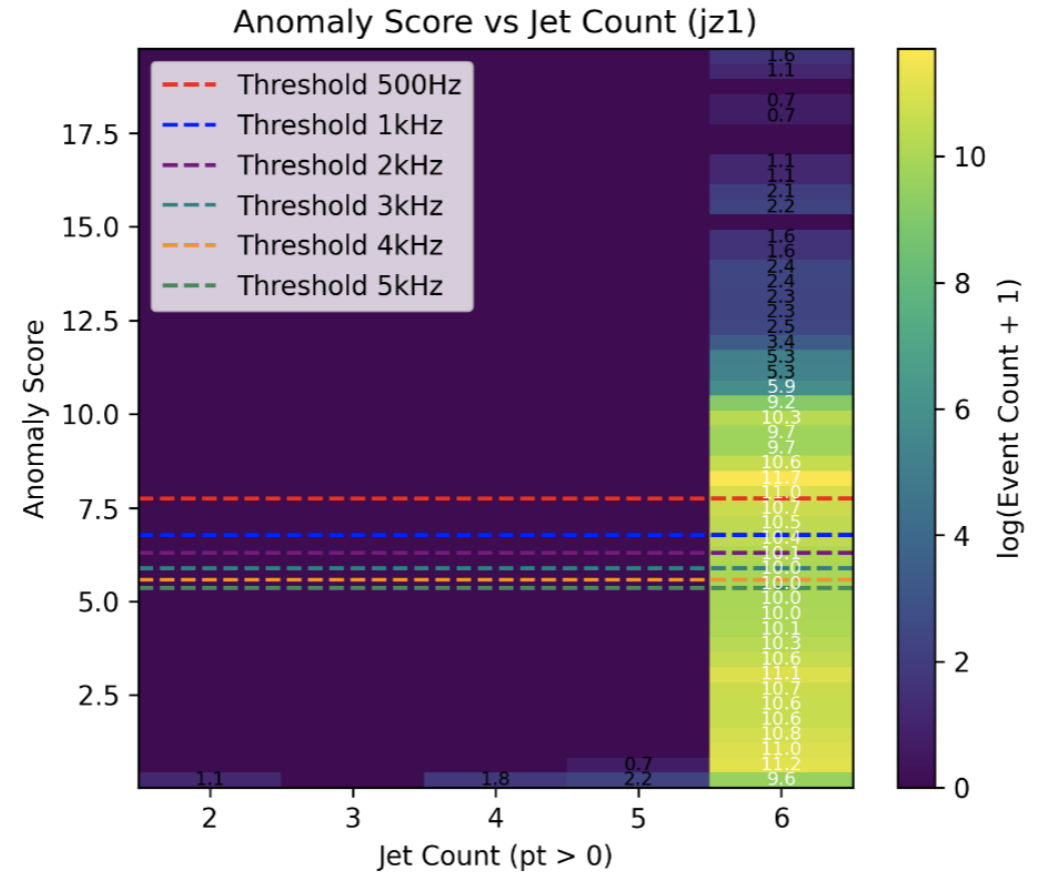
Anomaly vs Jet p_T

- jz4: anomaly score does not rise monotonically with increasing jet p_T
- This shows our trigger's algorithm does not simply take p_T , its calculation is based on a more complex topology



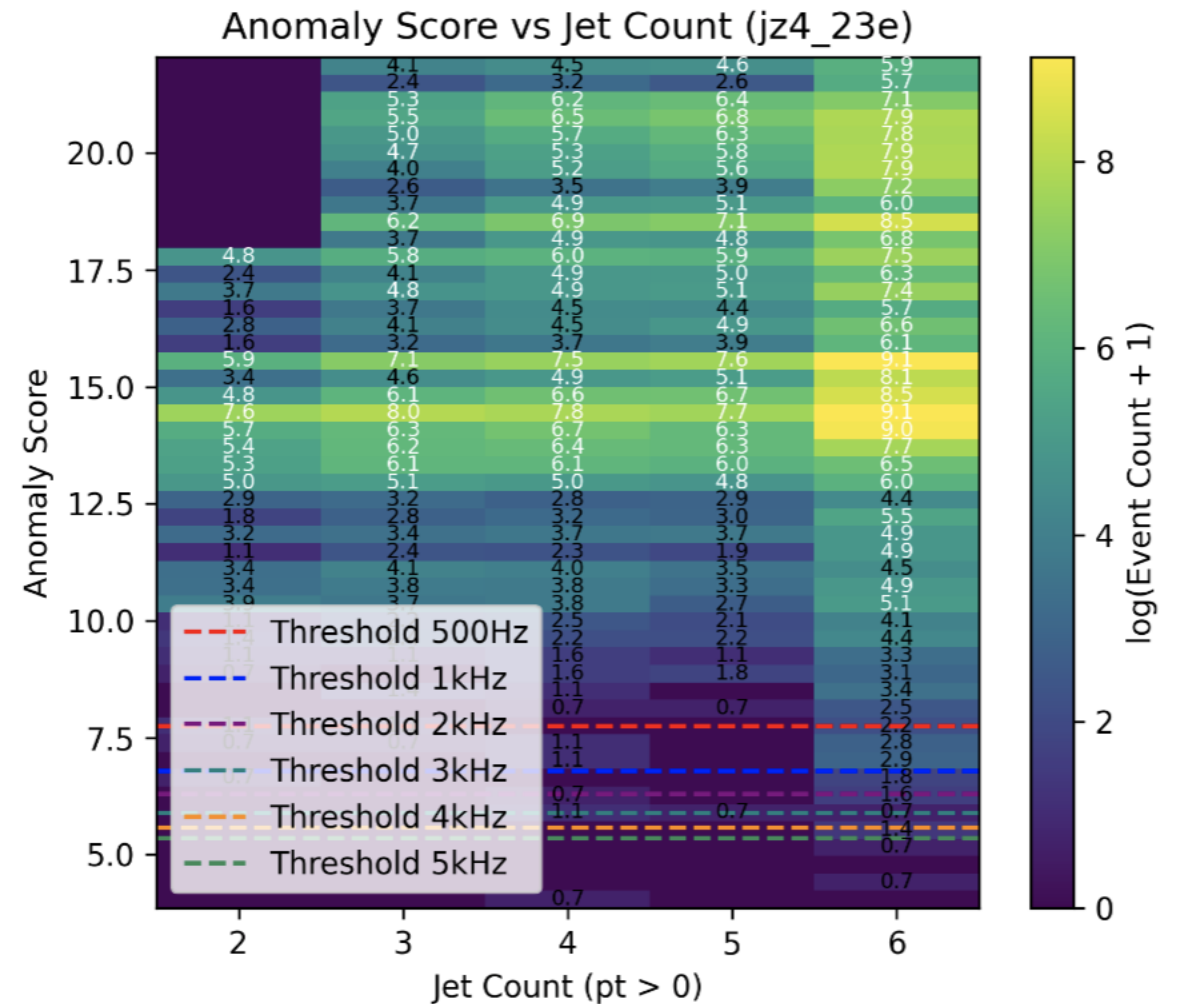
Anomaly Score vs. Jet Multiplicity

- For jz1, almost all events contain six jet
- Difficult to identify a clear correlation between jet multiplicity and the anomaly score
- Events with fewer than six jets consistently show anomaly scores below 1, which indicates low jet multiplicity rarely coincides with high anomaly scores



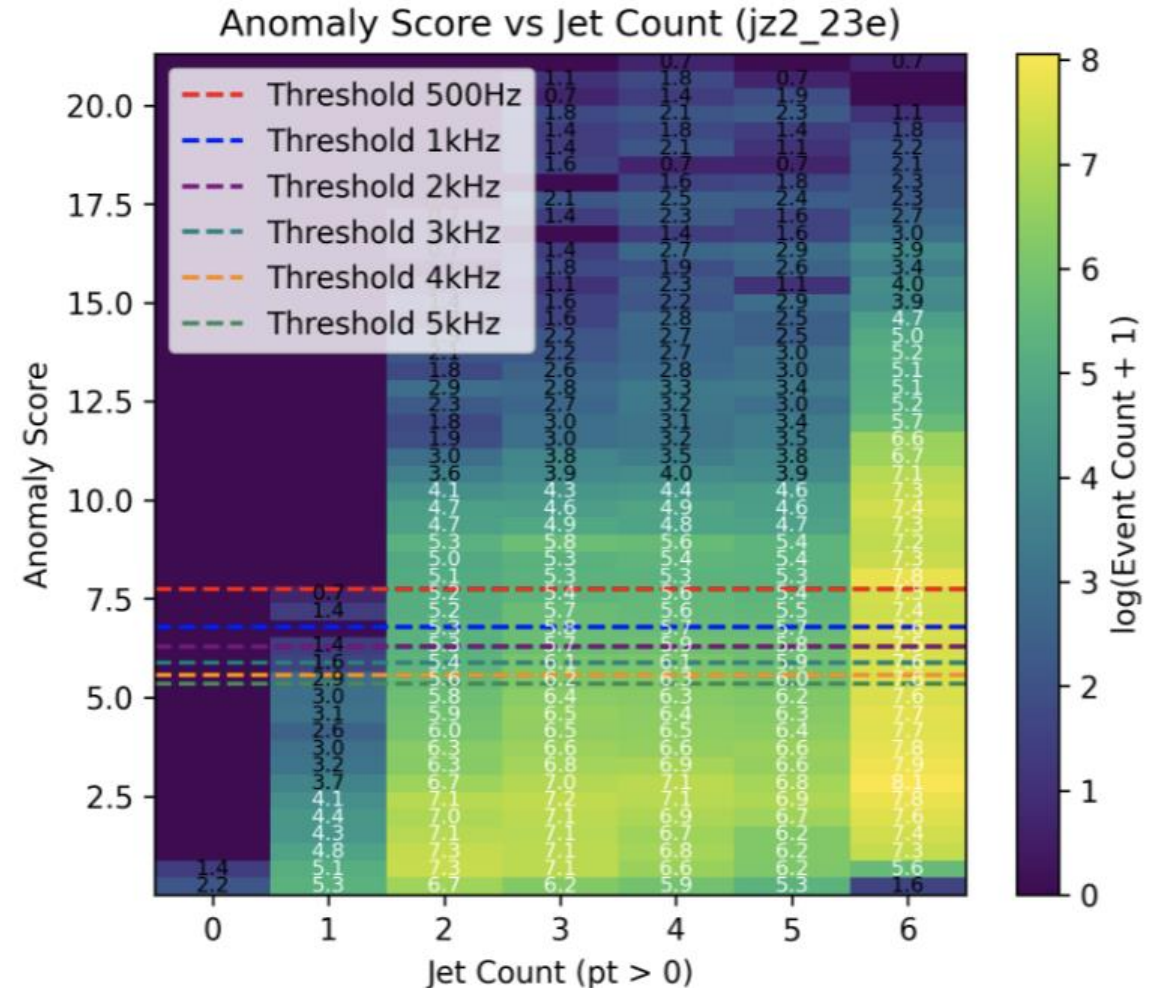
Anomaly Score vs. Jet Multiplicity

- jz4 events predominantly occupy the high-score region (above 13) with six jets

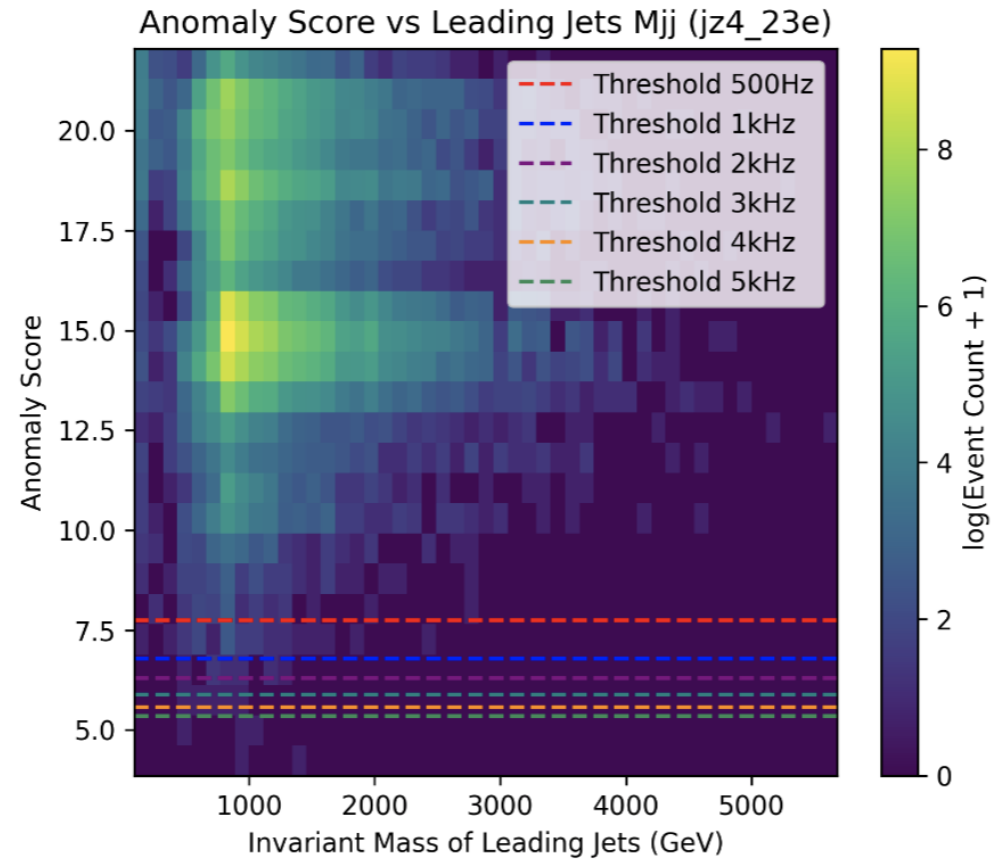
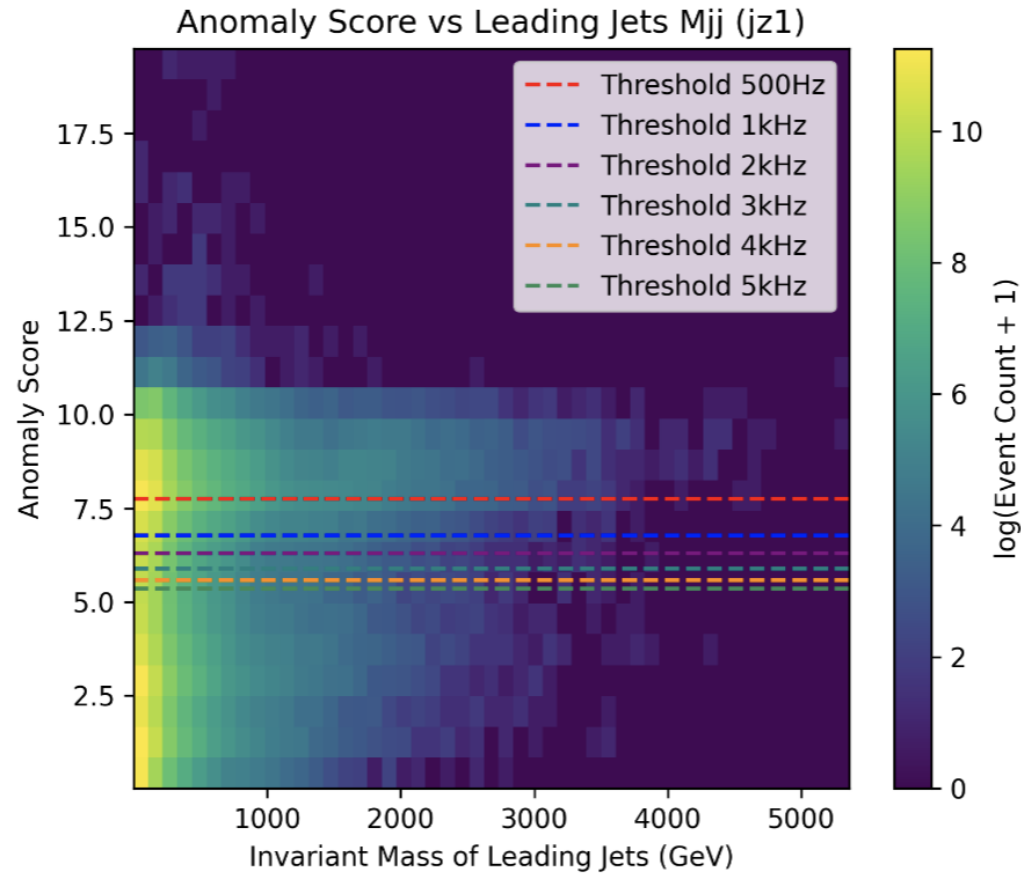


Anomaly Score vs. Jet Multiplicity

- For other processes, high anomaly score events tend to cluster at higher jet multiplicities



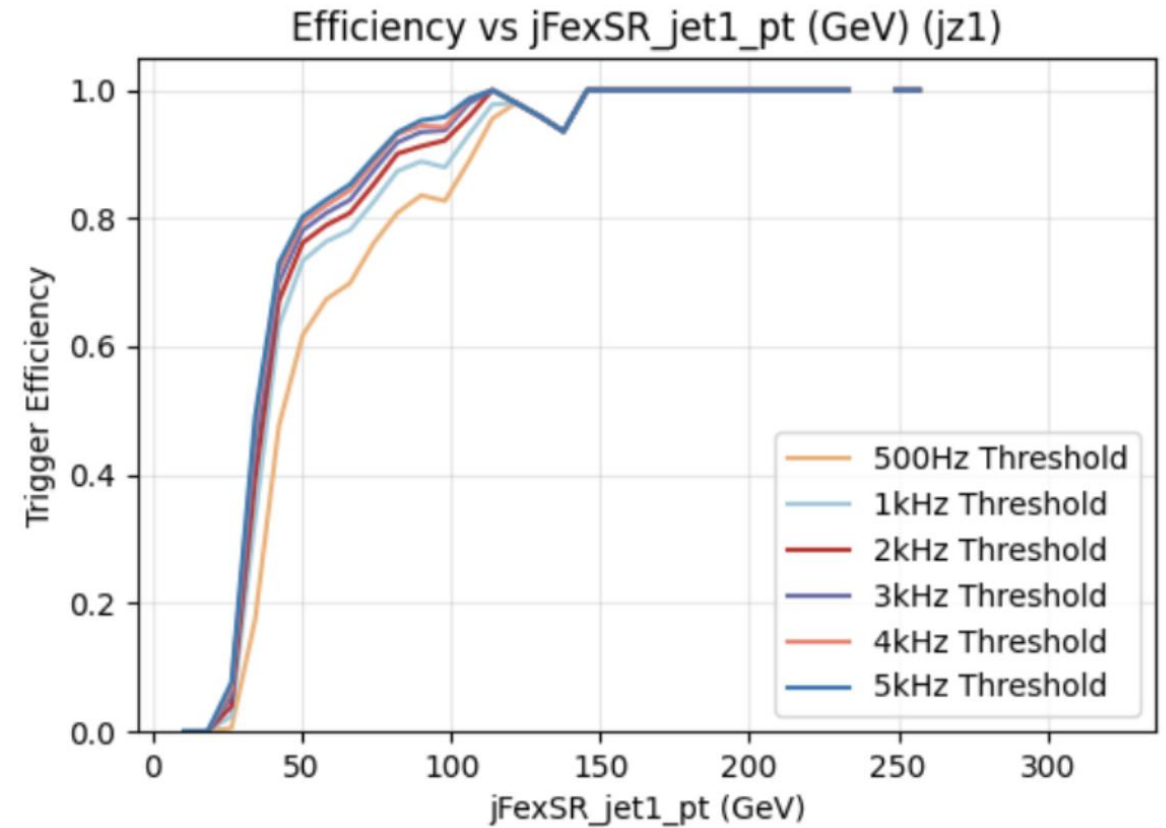
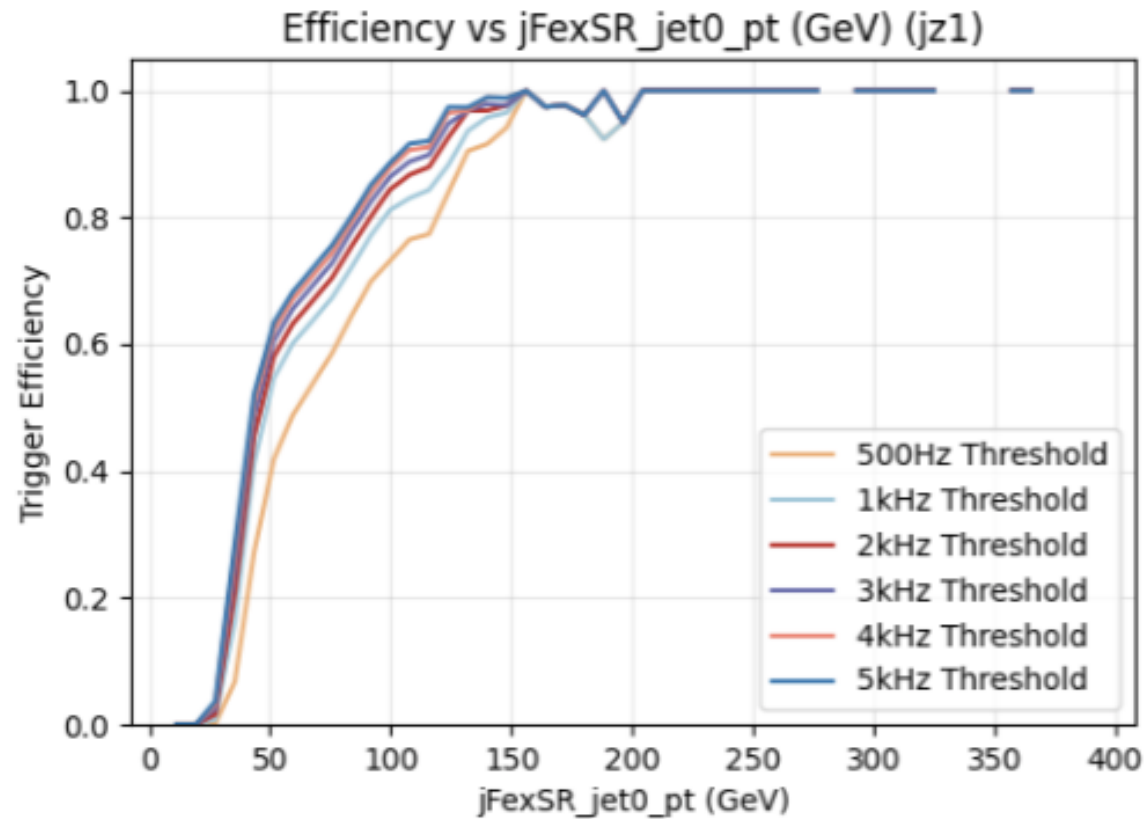
Invariant Mass of Two Leading Jets



C-3: jz4 anomaly score vs invariant mass (GeV)

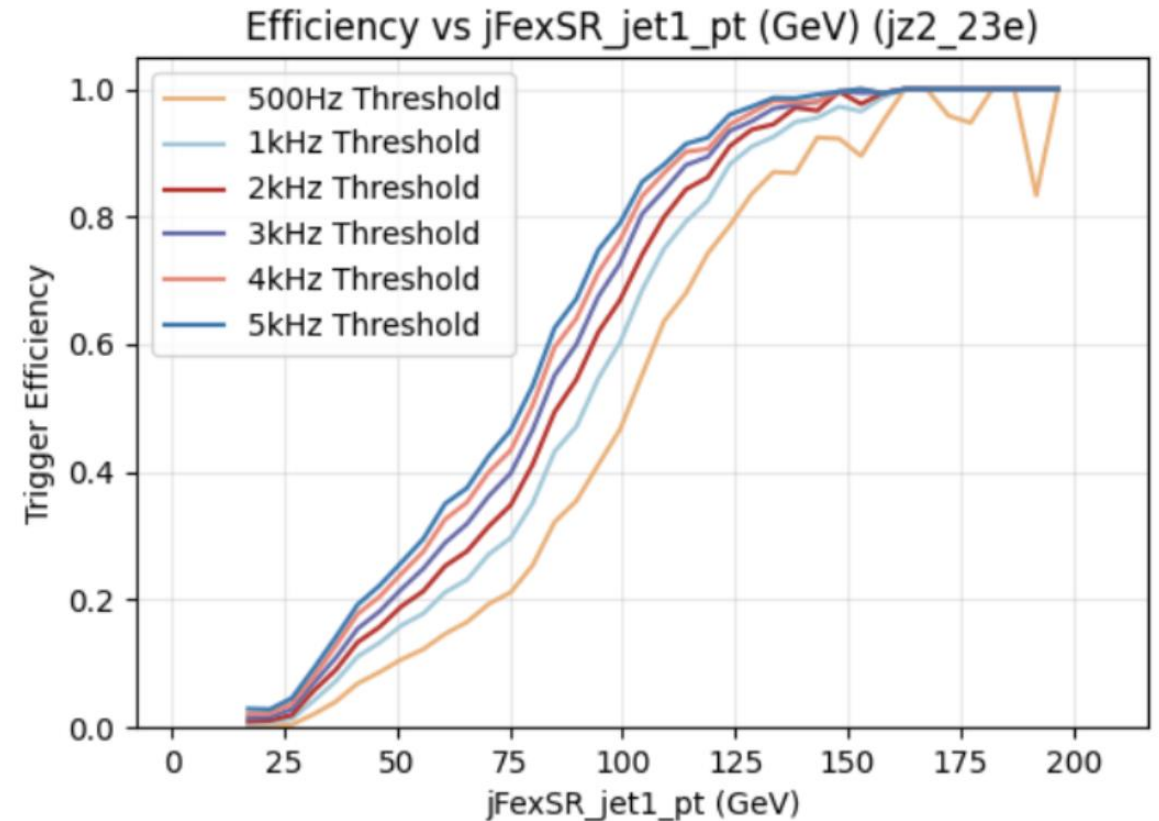
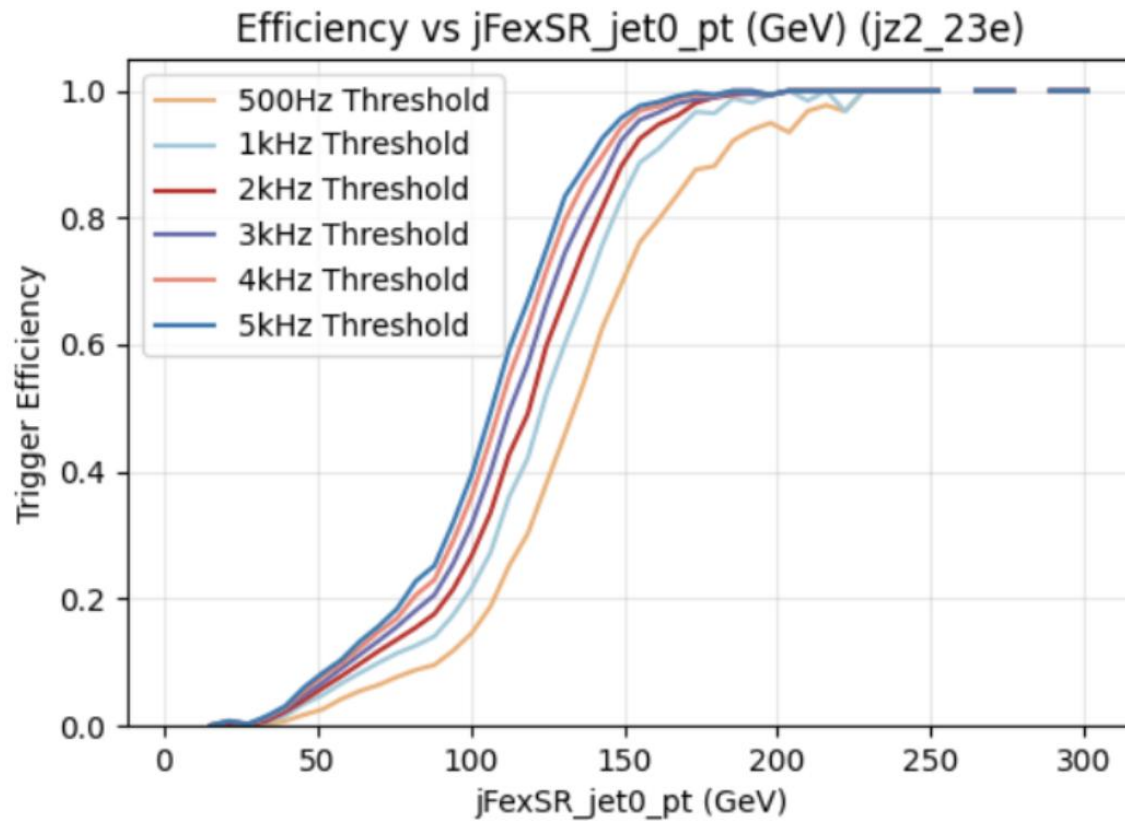
Efficiency Curves (jz1)

- turn-on behavior



Efficiency Curves (jz2)

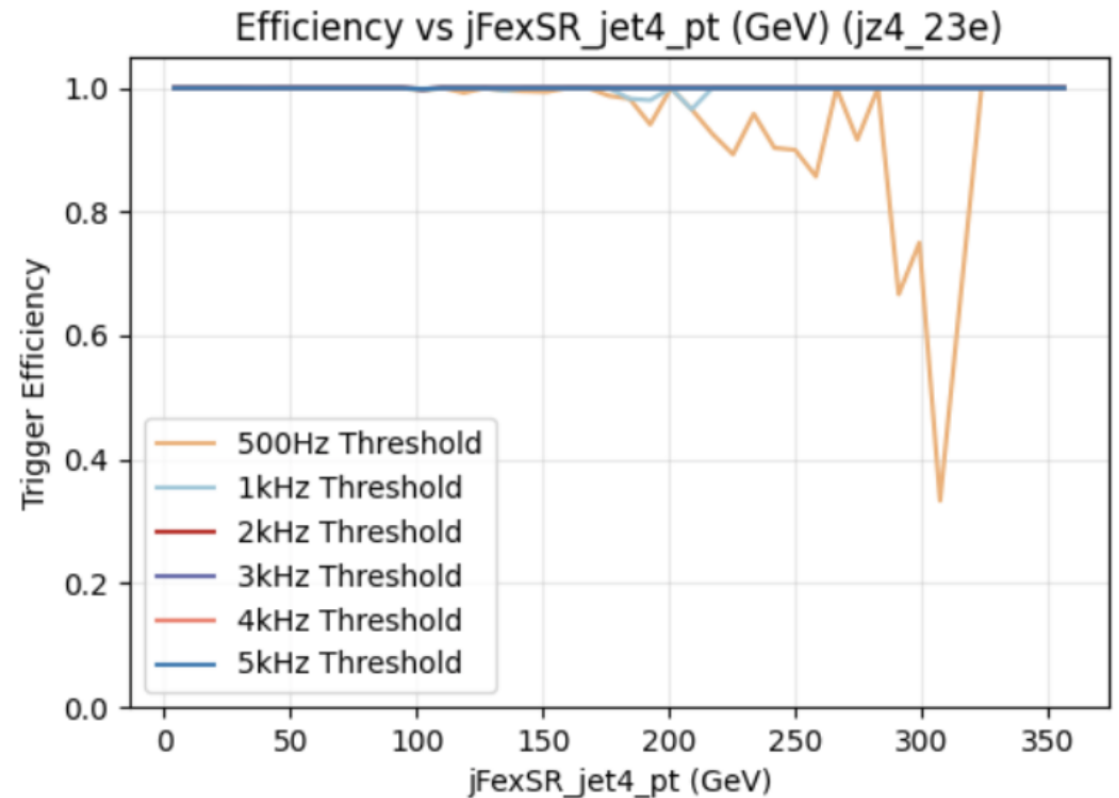
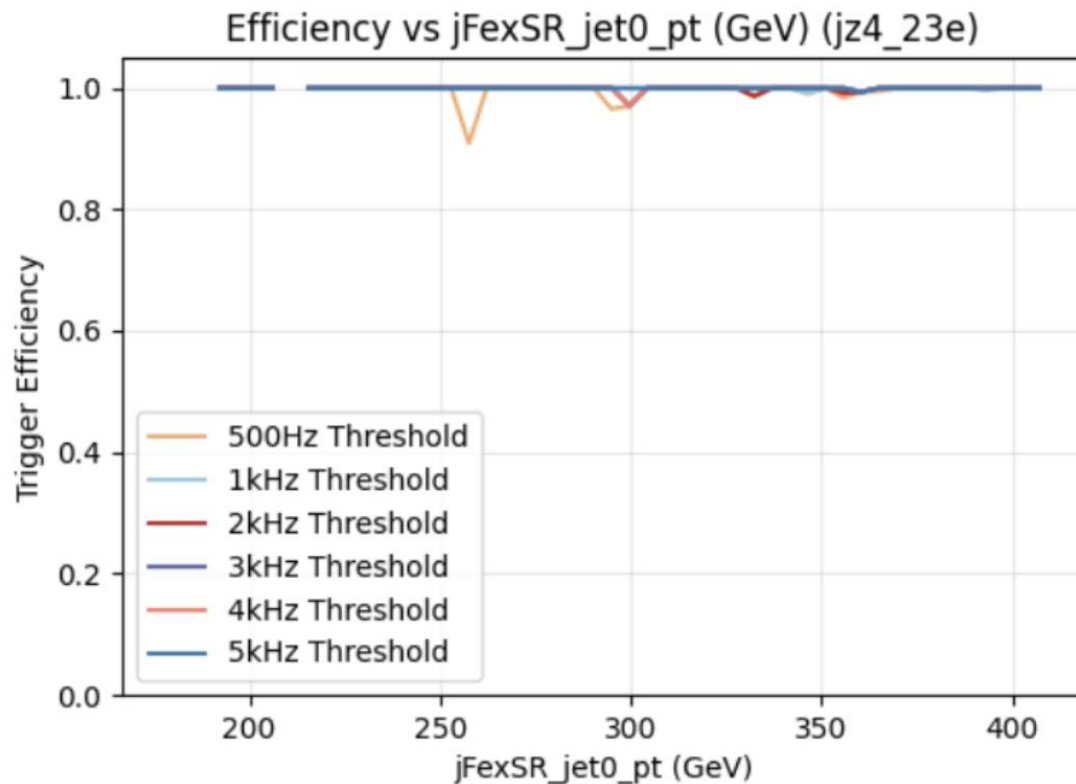
- turn-on behavior



Efficiency Curves (jz4, 100% L1 pass rate)

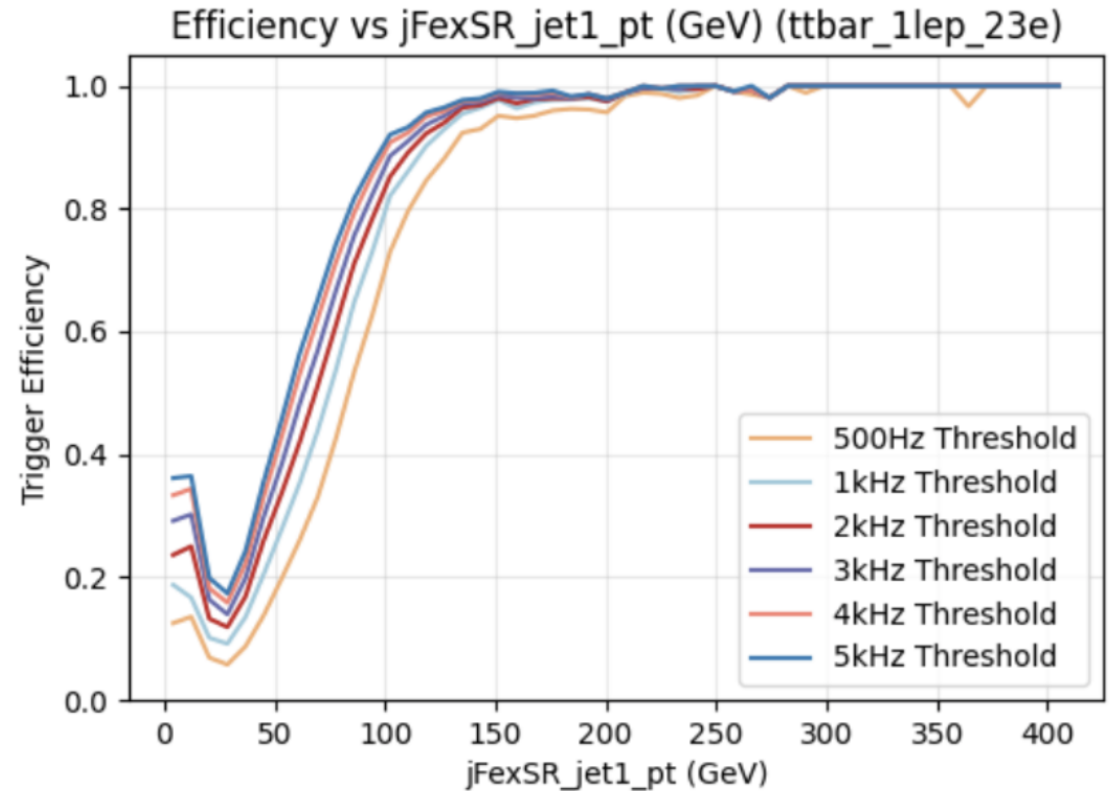
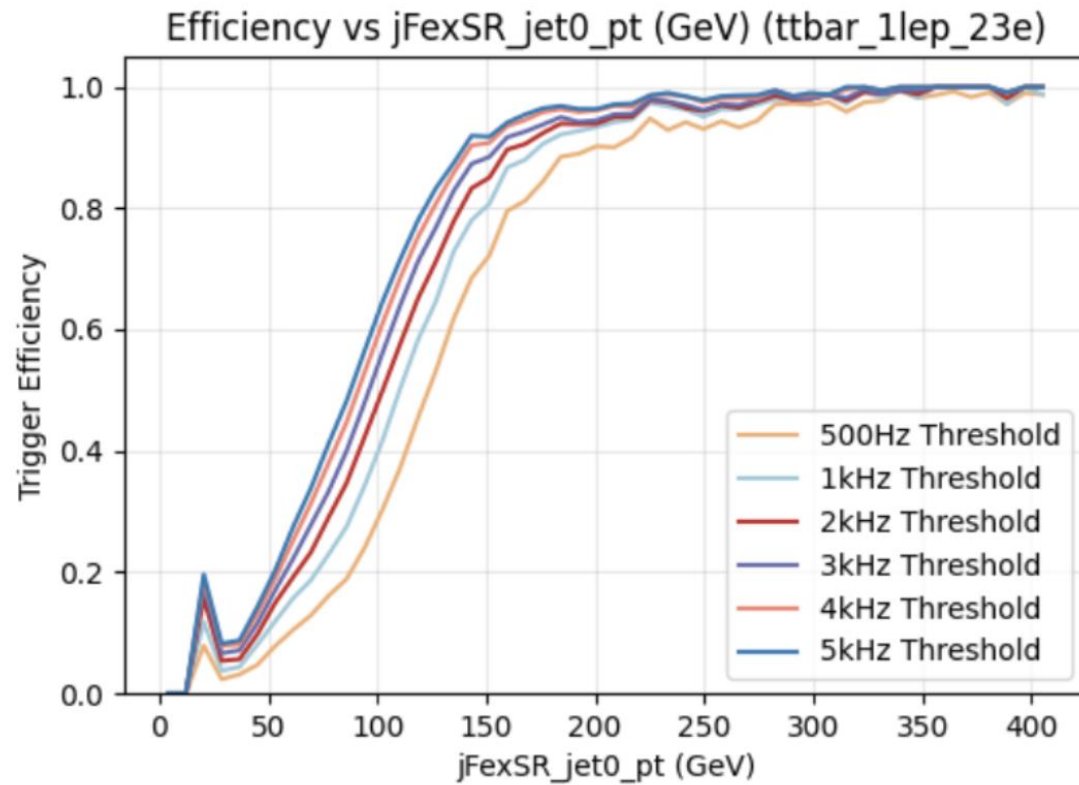
- ~100%

- Drop after 200GeV at 500Hz for jet4, after 150GeV for jet5



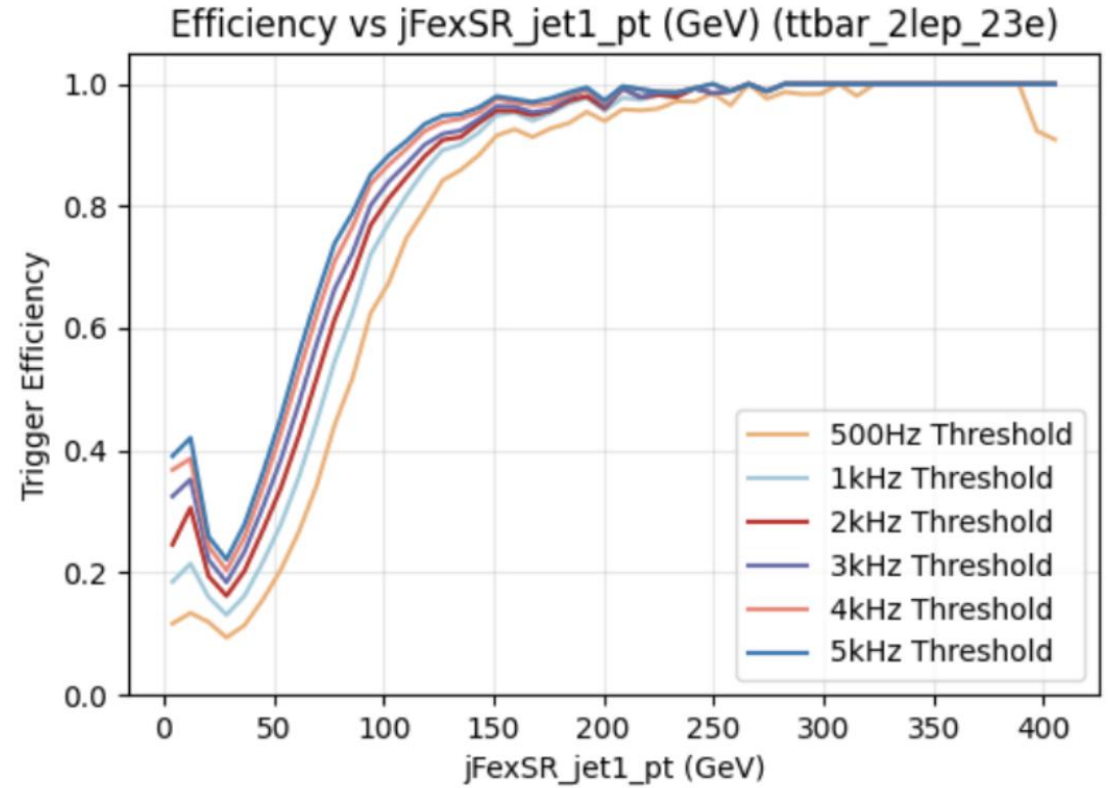
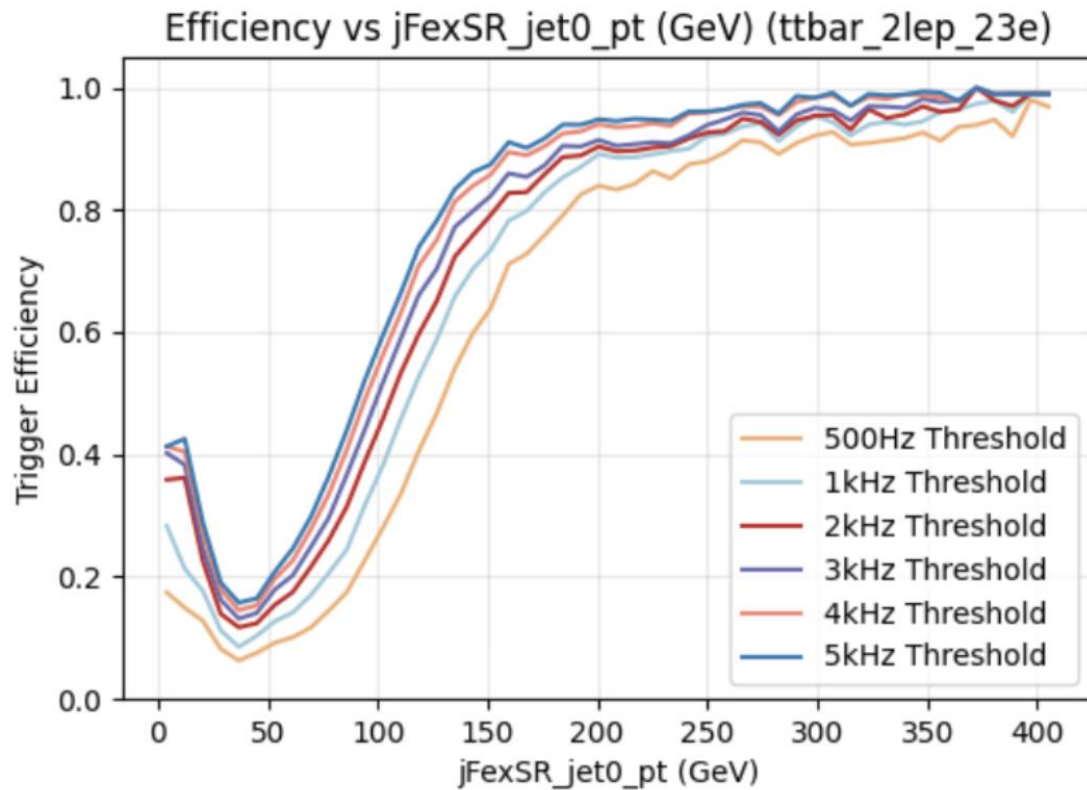
Efficiency Curves (ttbar1lep)

- Non-zero at low p_T



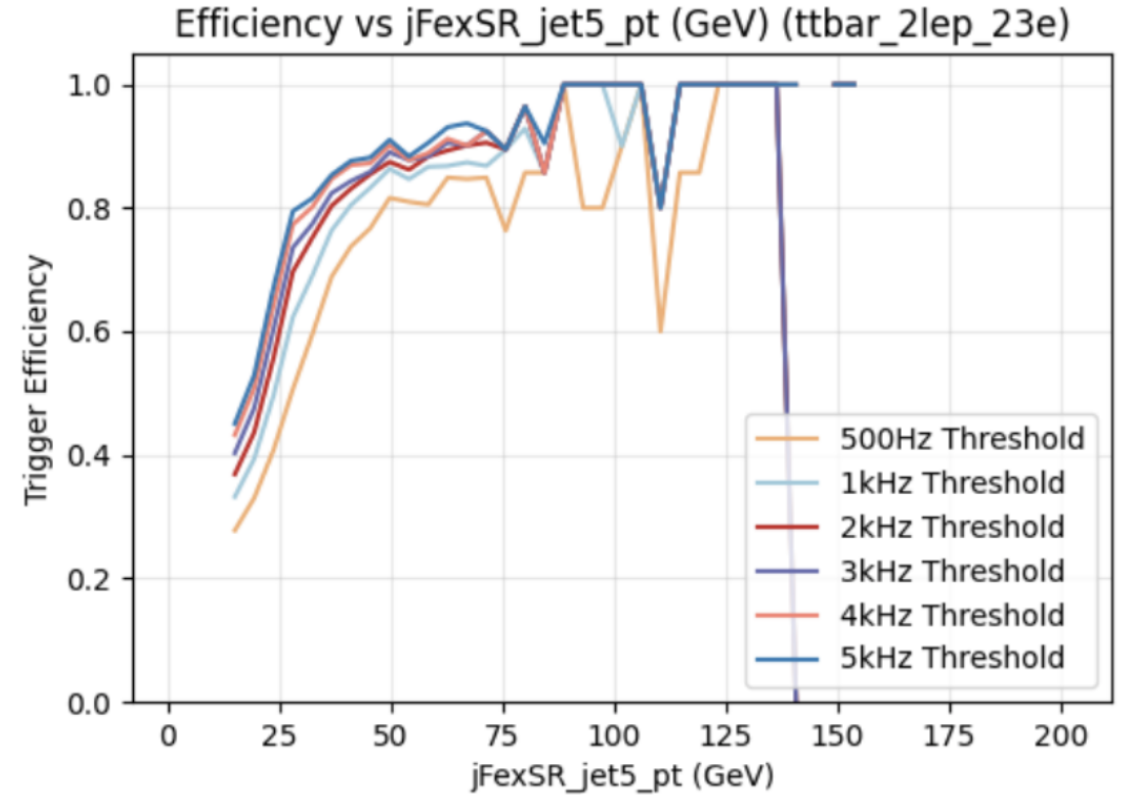
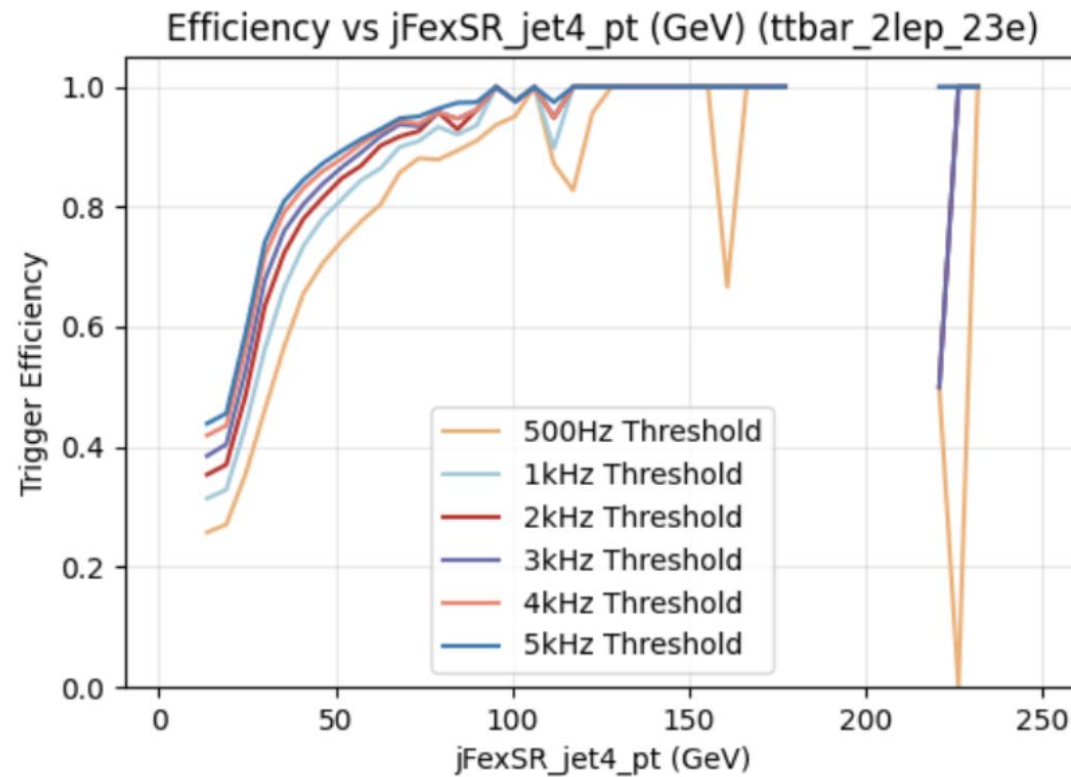
Efficiency Curves (ttbar2lep)

- Non-zero at low p_T for jet0-3



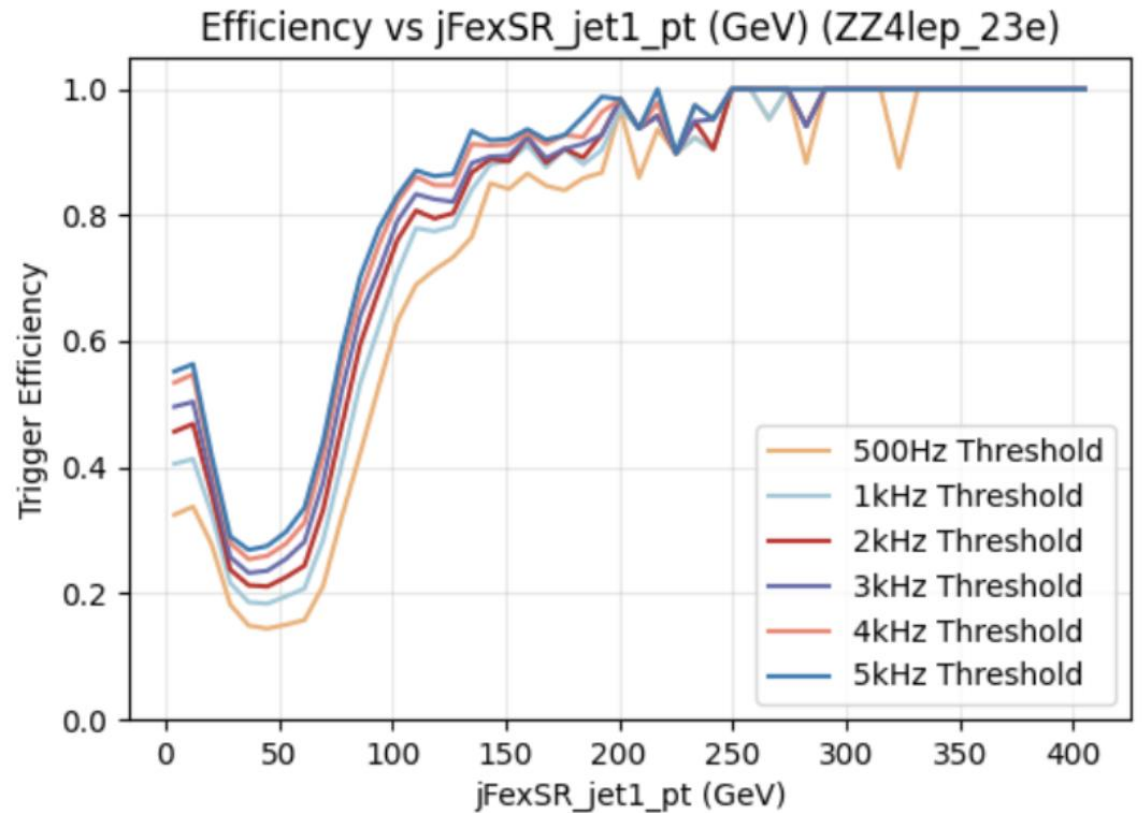
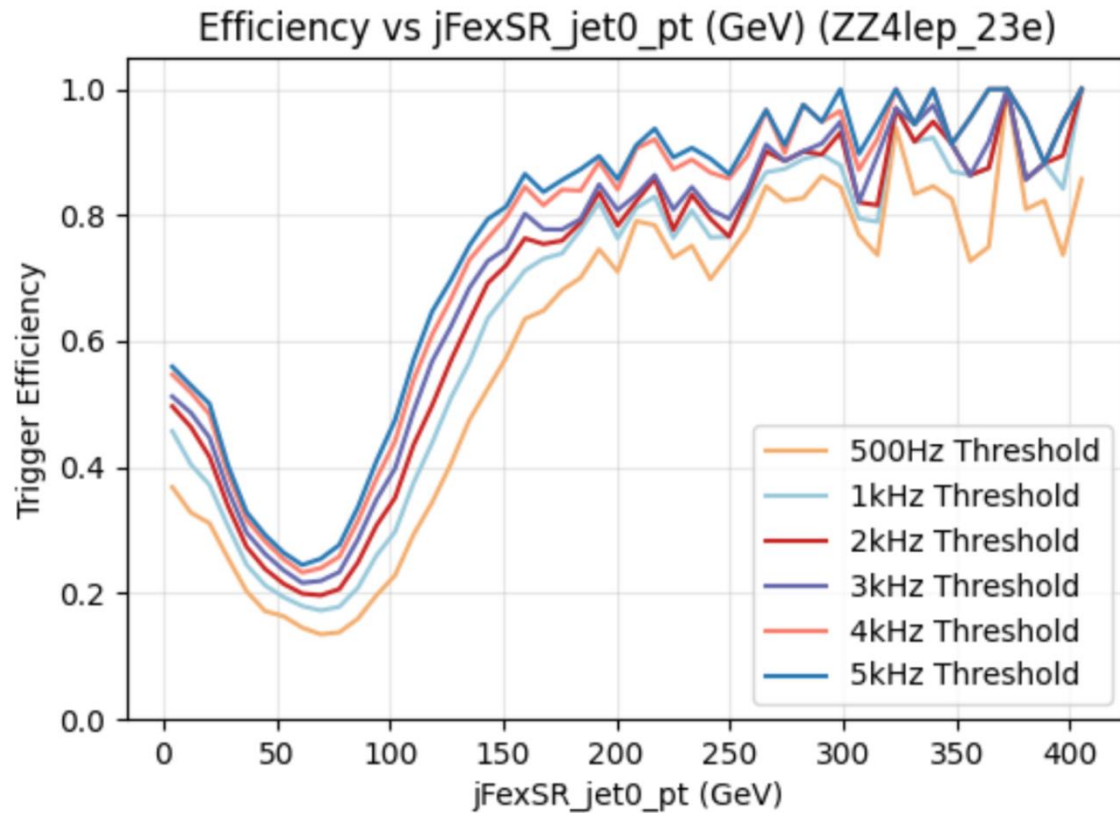
Efficiency Curves (ttbar2lep)

- Chaotic for jet4 and 5 (very low p_T sacrificed for noise)



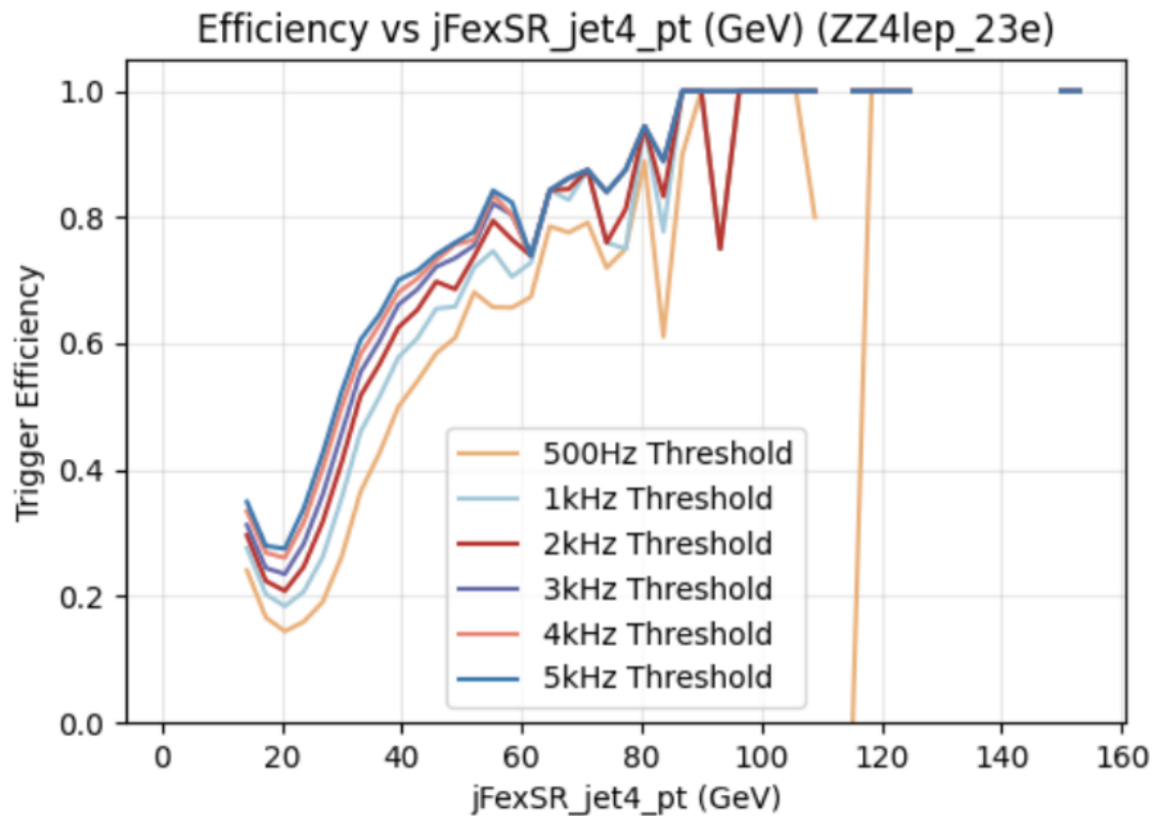
Efficiency Curves (ZZ4lep)

- Non-zero at low p_T



Efficiency Curves (ZZ4lep)

- Non-zero at low p_T , lack data after $\sim 110\text{GeV}$



- Very low p_T sacrificed

