

ATLAS Anomaly Trigger Calibration

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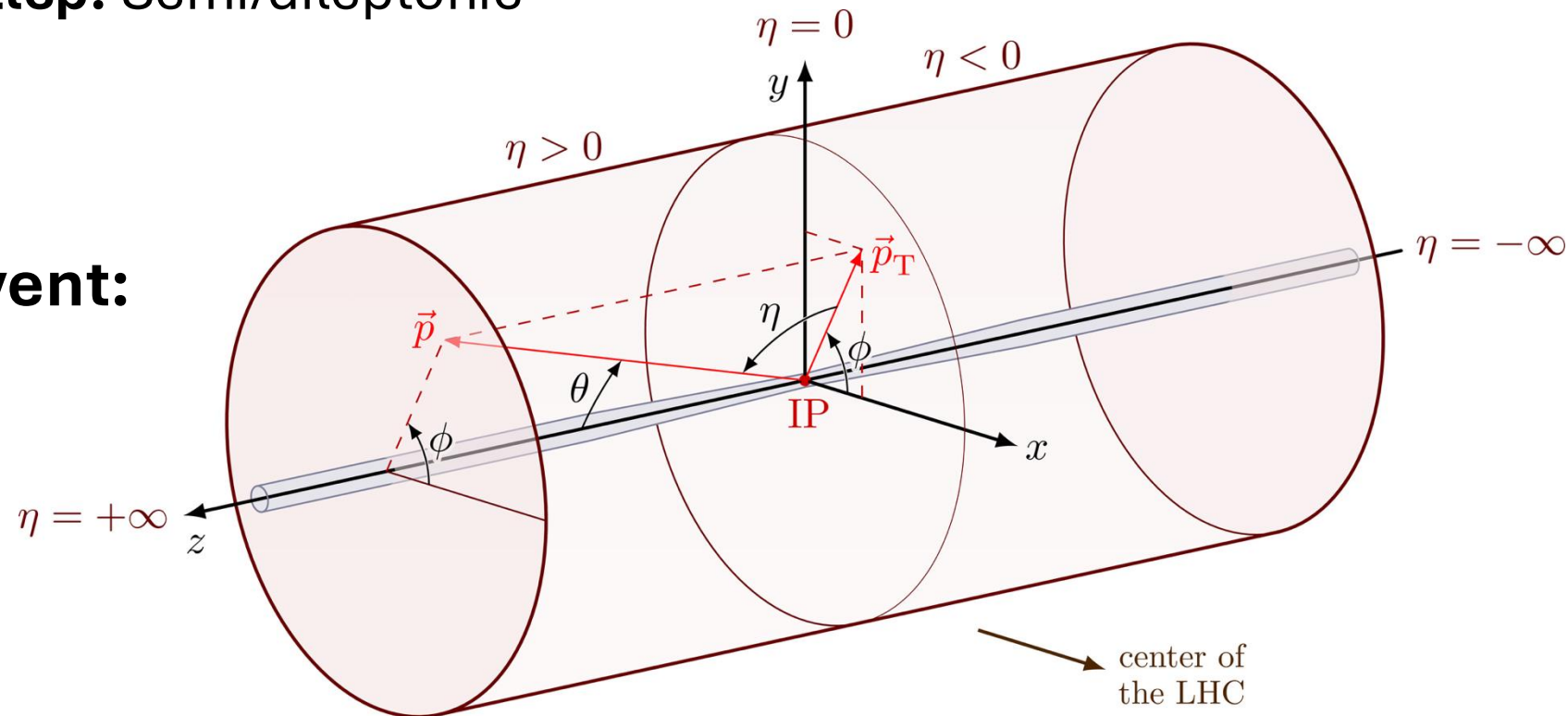
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Scope of This Work

- 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

- $/ (256 * 256 * 3)$

Scaling factors

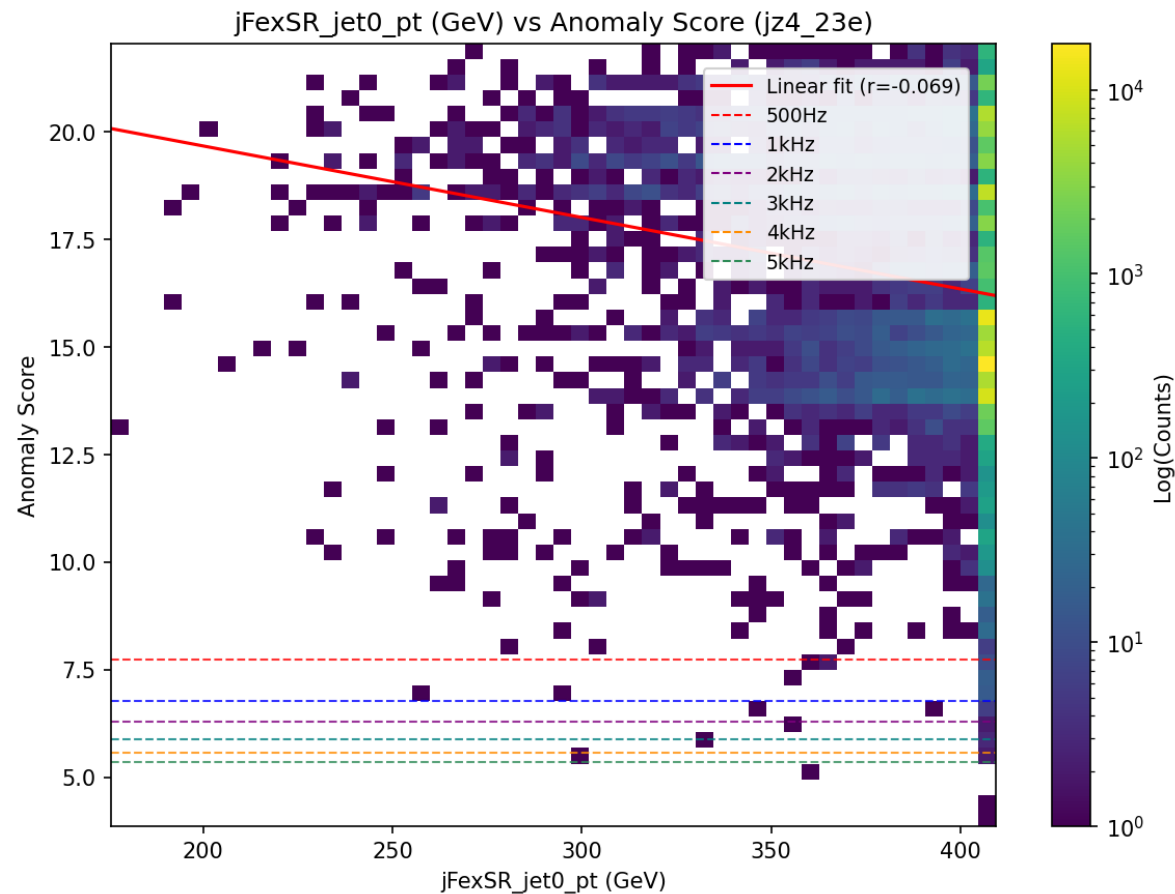
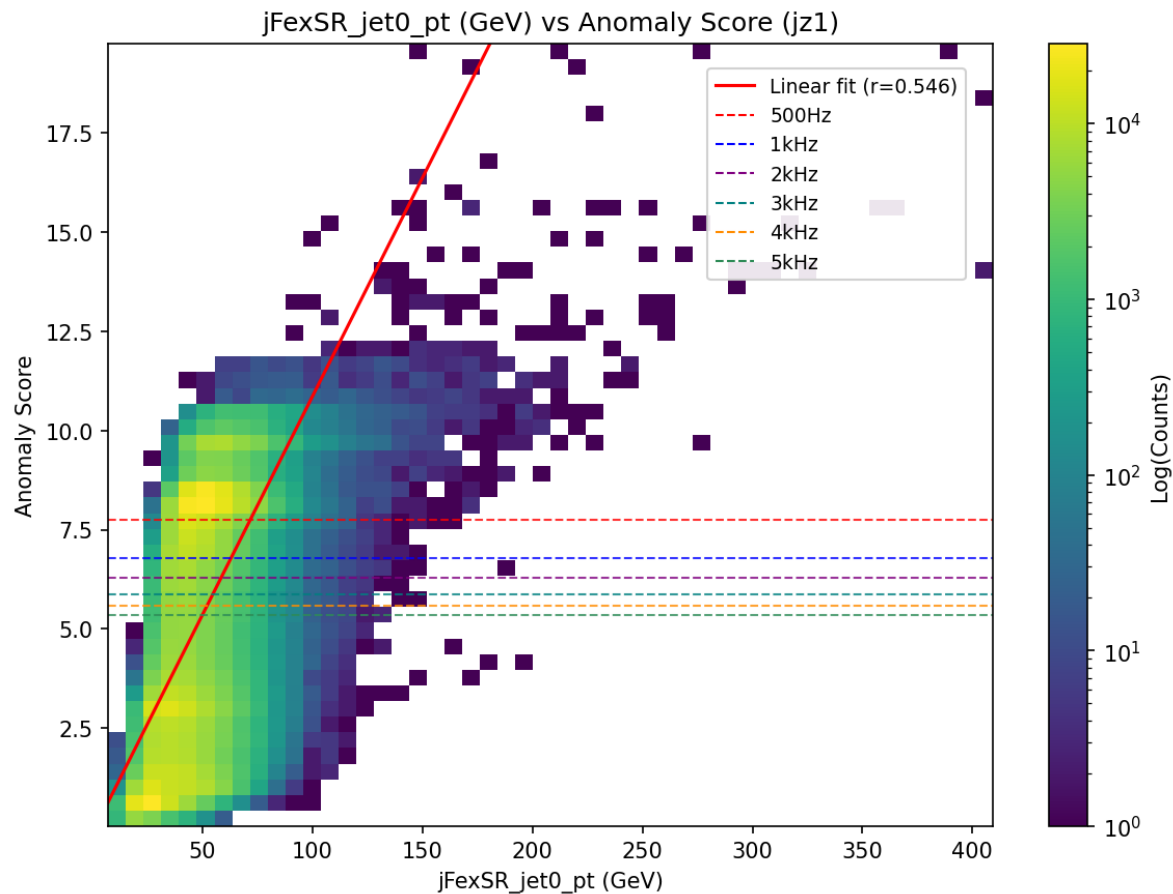
$$x_i^{\text{scaled}} = \frac{x_i}{2^{s_i}}$$

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

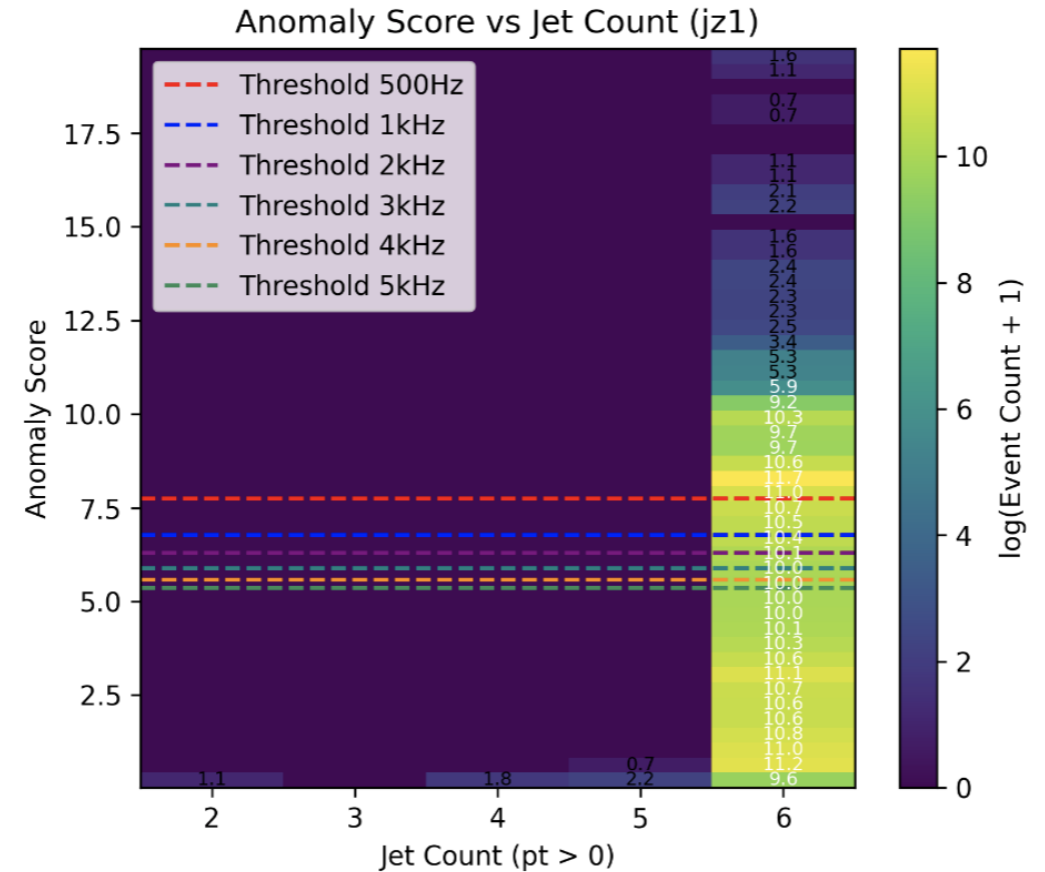
Category	Feature	s_i
Muons (4)	muon0_pt (GeV)	4
	muon0_eta	4
	muon0_phi (rad)	4
	muon1_pt (GeV)	2
	muon1_eta	3
	muon1_phi (rad)	3
	muon2_pt (GeV)	1
	muon2_eta	1
	muon2_phi (rad)	2
	muon3_pt (GeV)	-2
MET	muon3_eta	-1
	muon3_phi (rad)	-1
	MET_pt (GeV)	6
	MET_phi (rad)	5

Anomaly vs Jet p_T



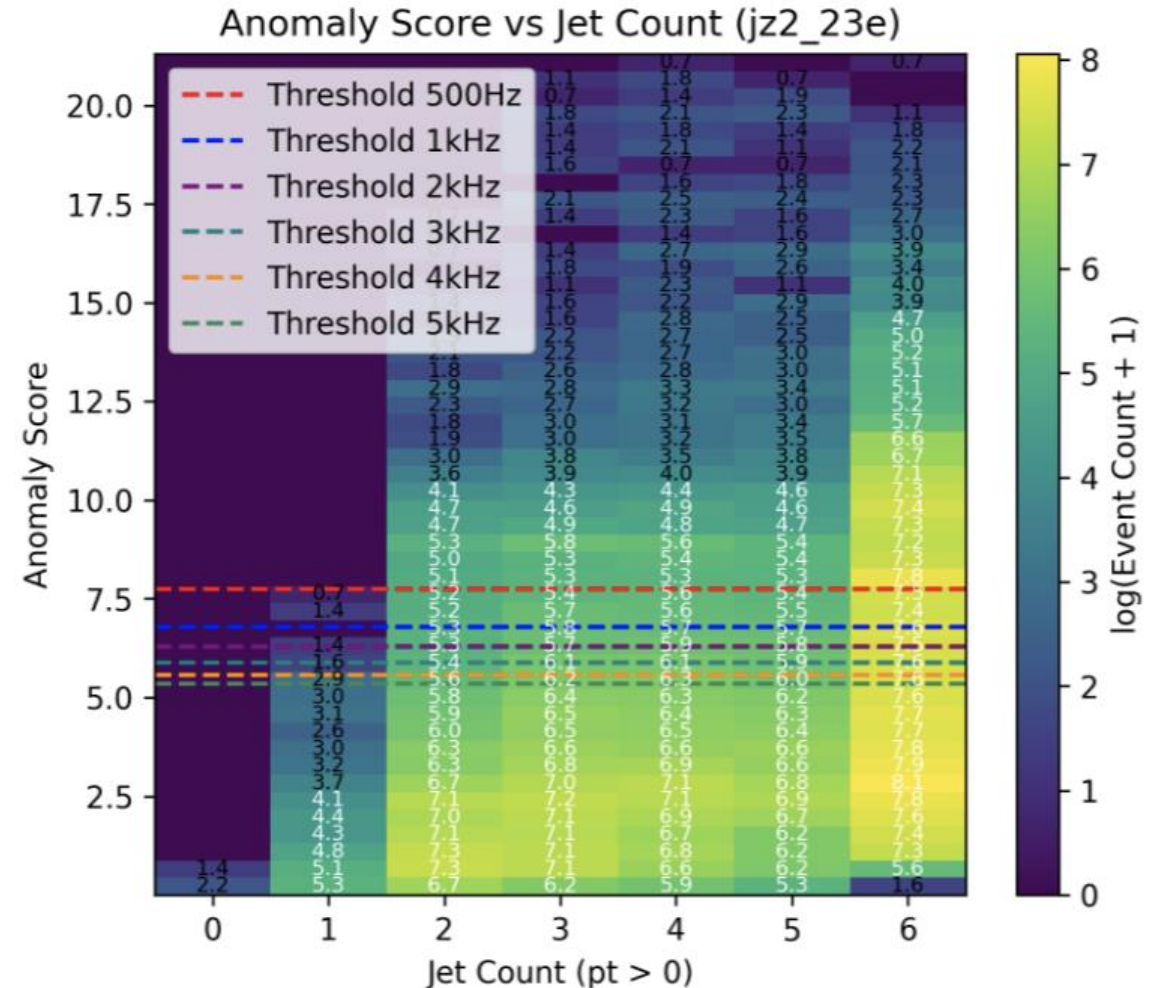
Anomaly Score vs. Jet Multiplicity

- For jz1, almost all events contain six jets
- 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

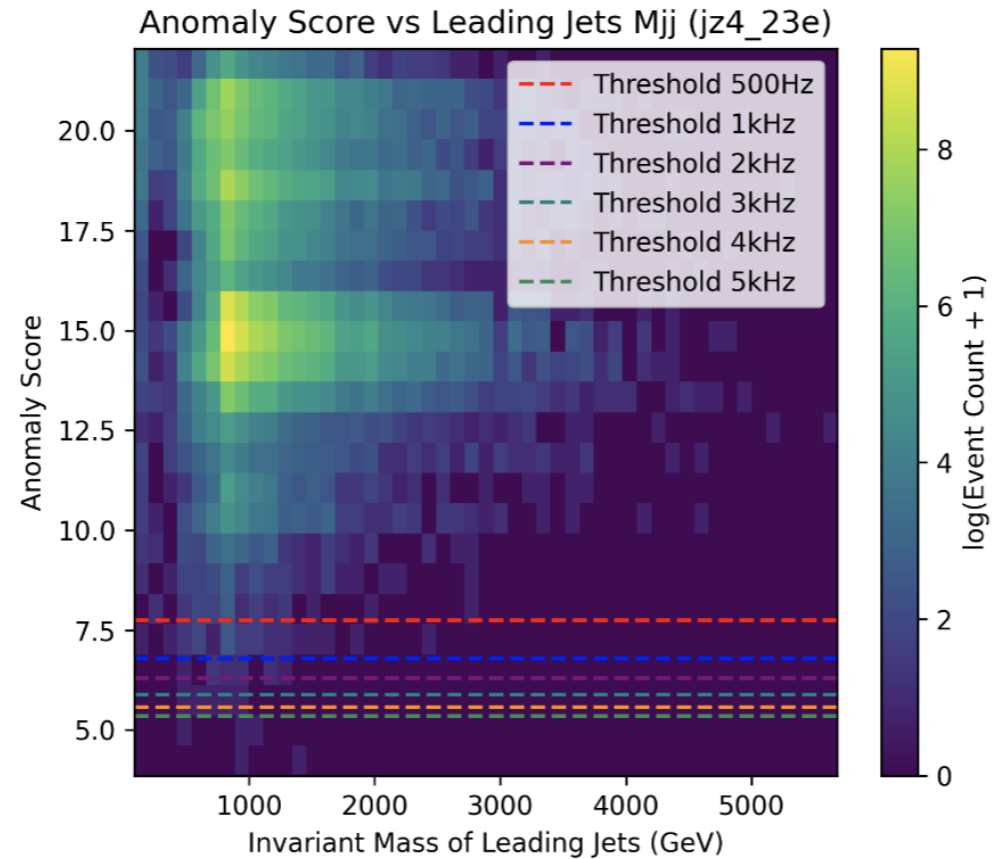
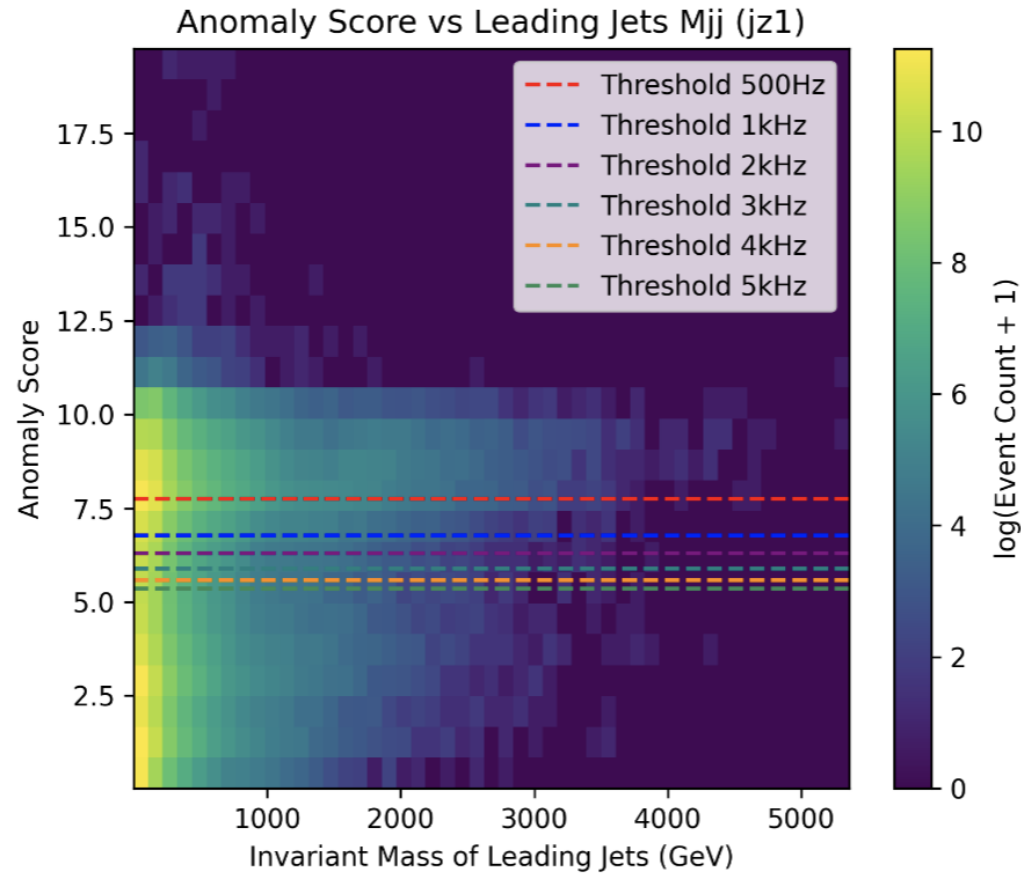


Anomaly Score vs. Jet Multiplicity

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

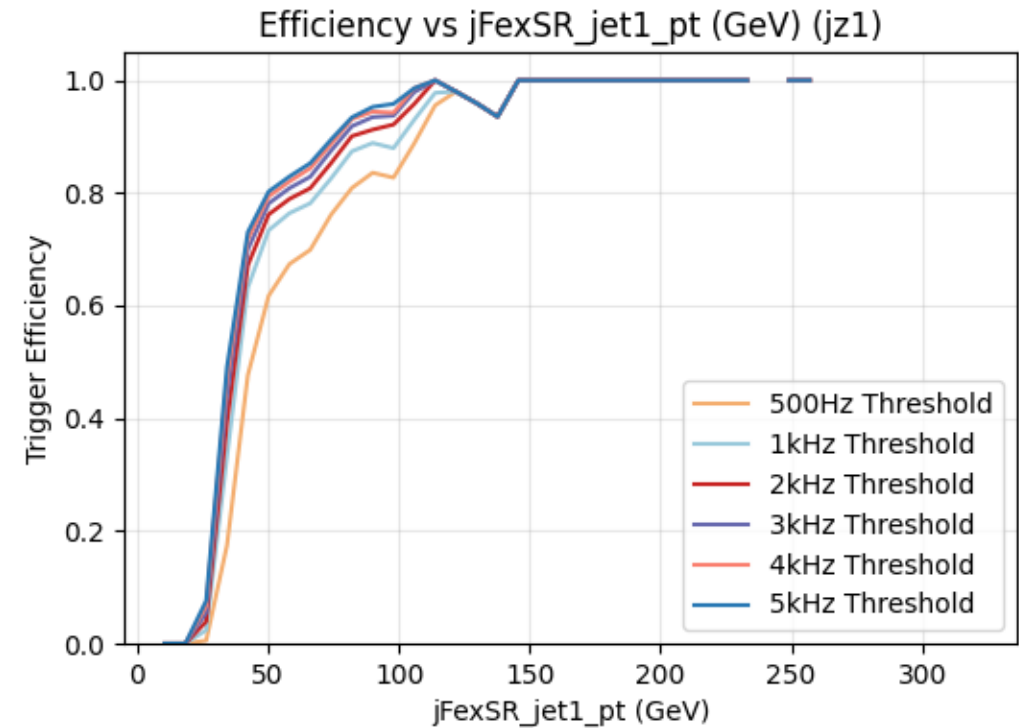
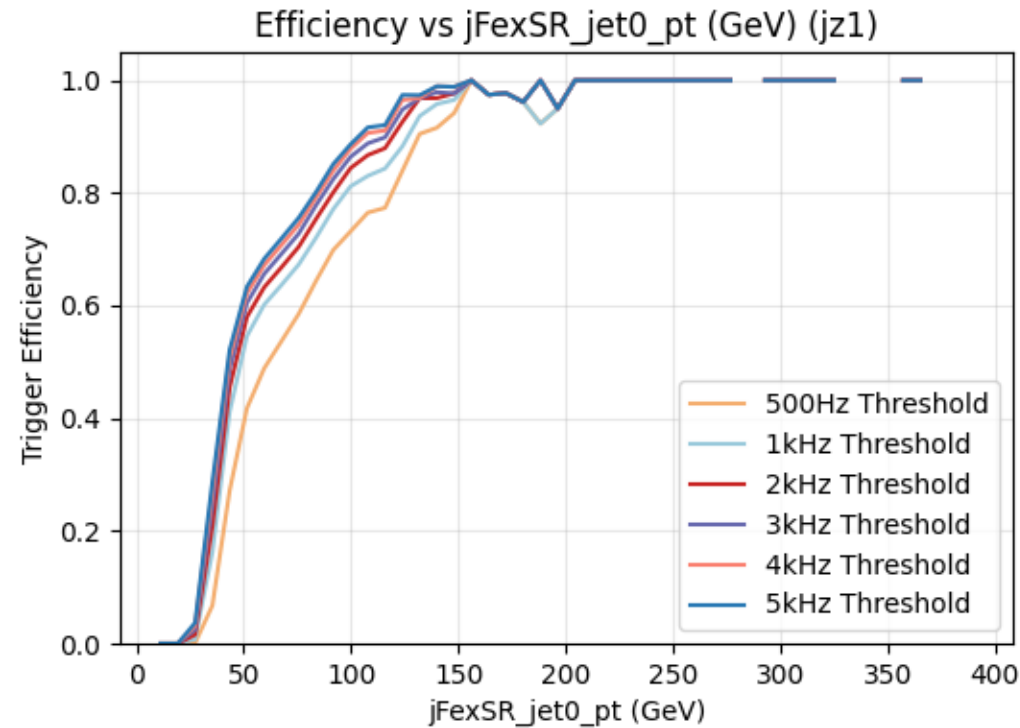


Invariant Mass of Two Leading Jets

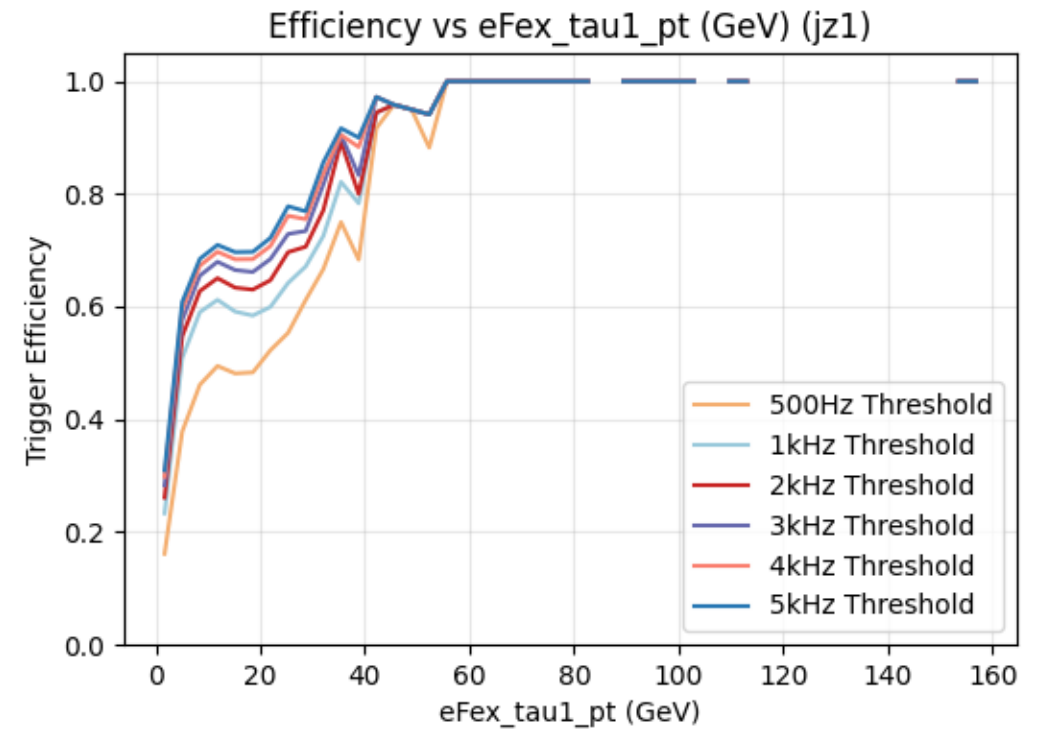
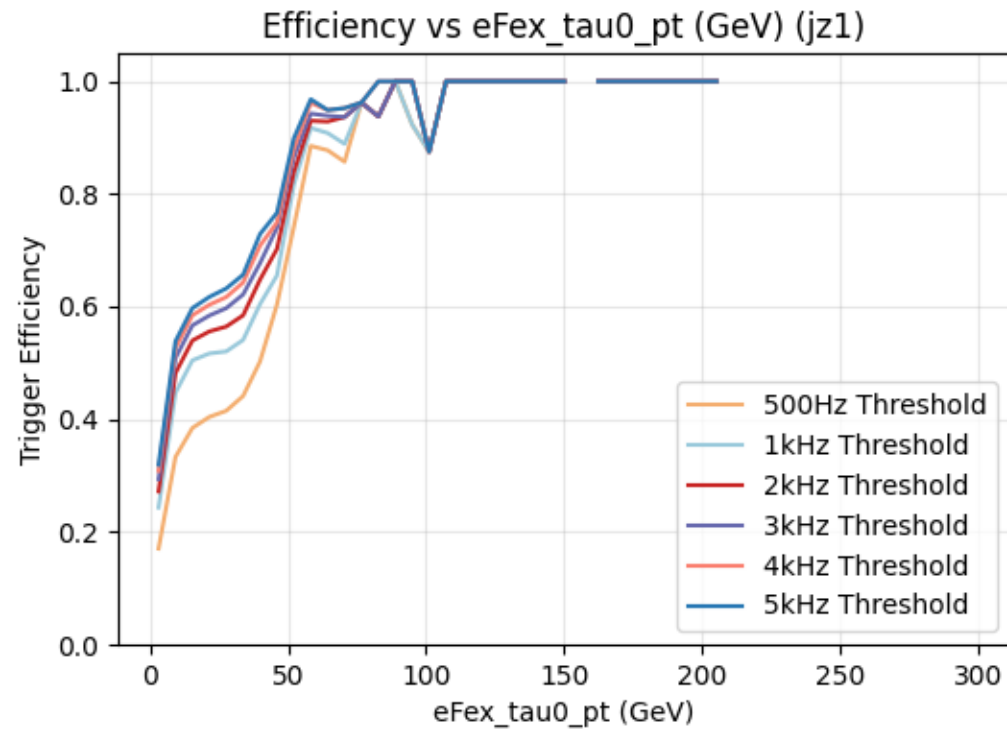


C-3: jz4 anomaly score vs invariant mass (GeV)

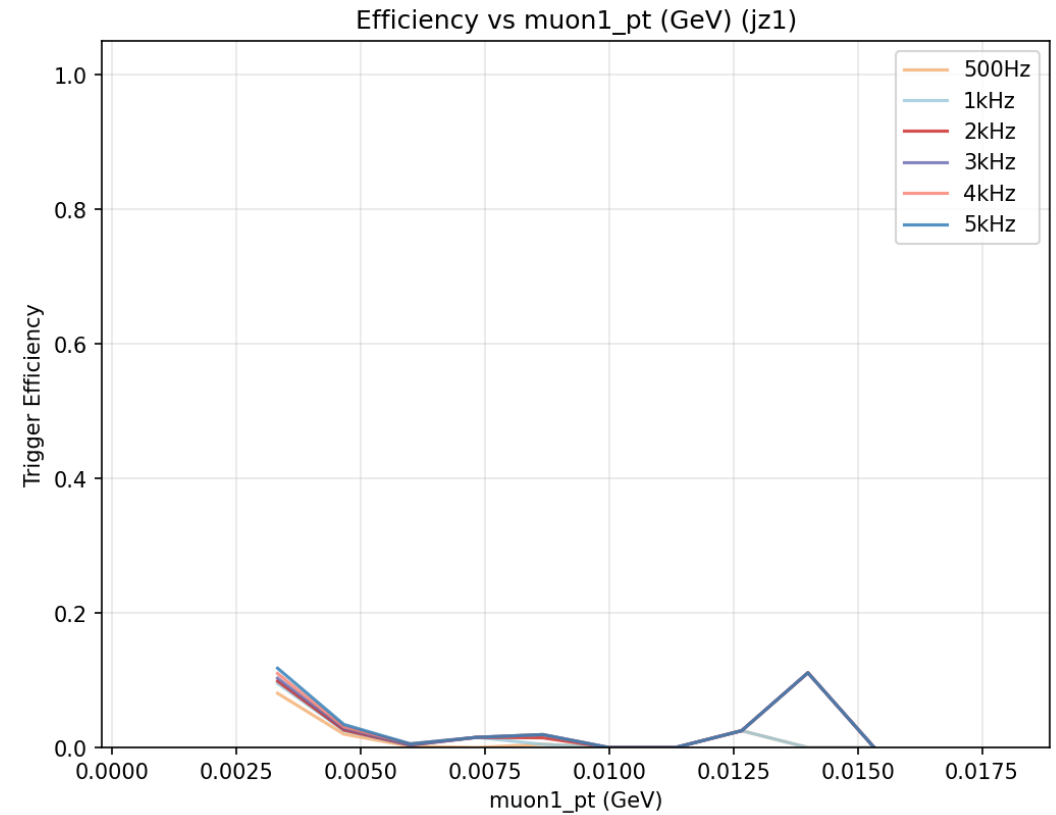
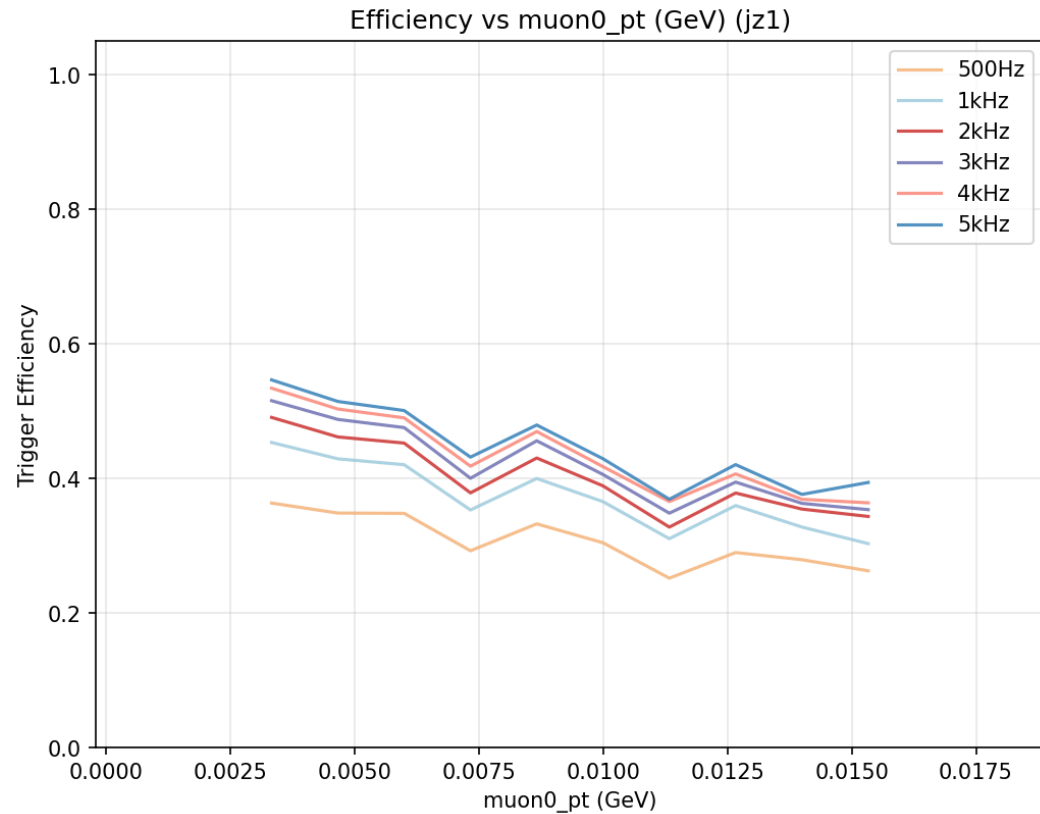
Efficiency Curves (jz1 jet)



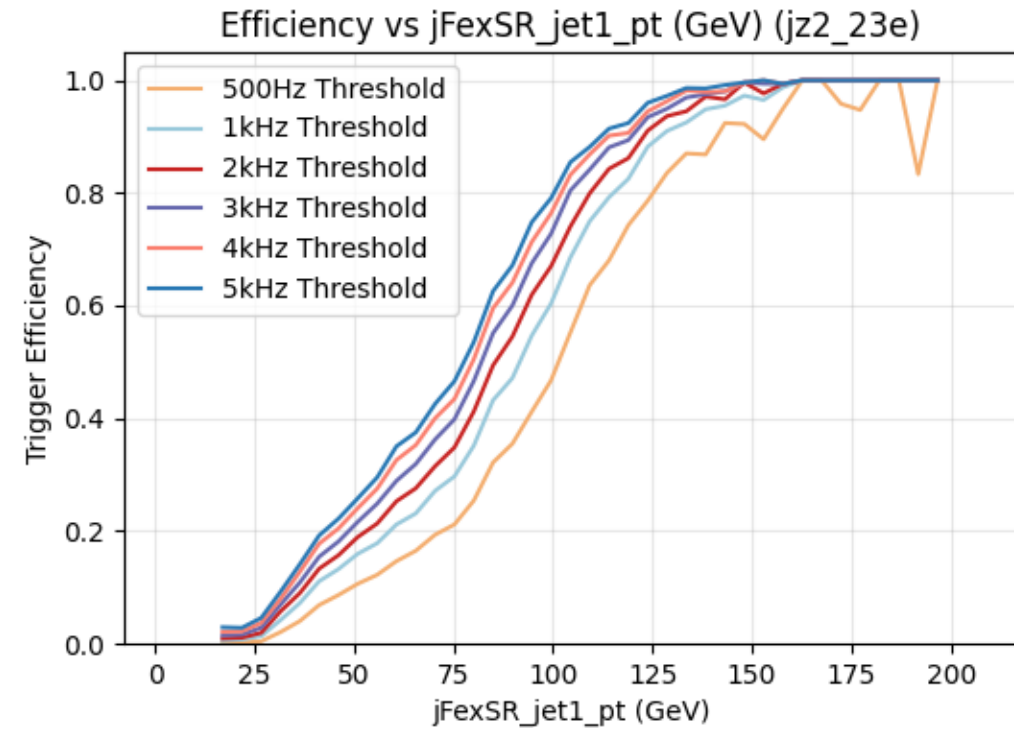
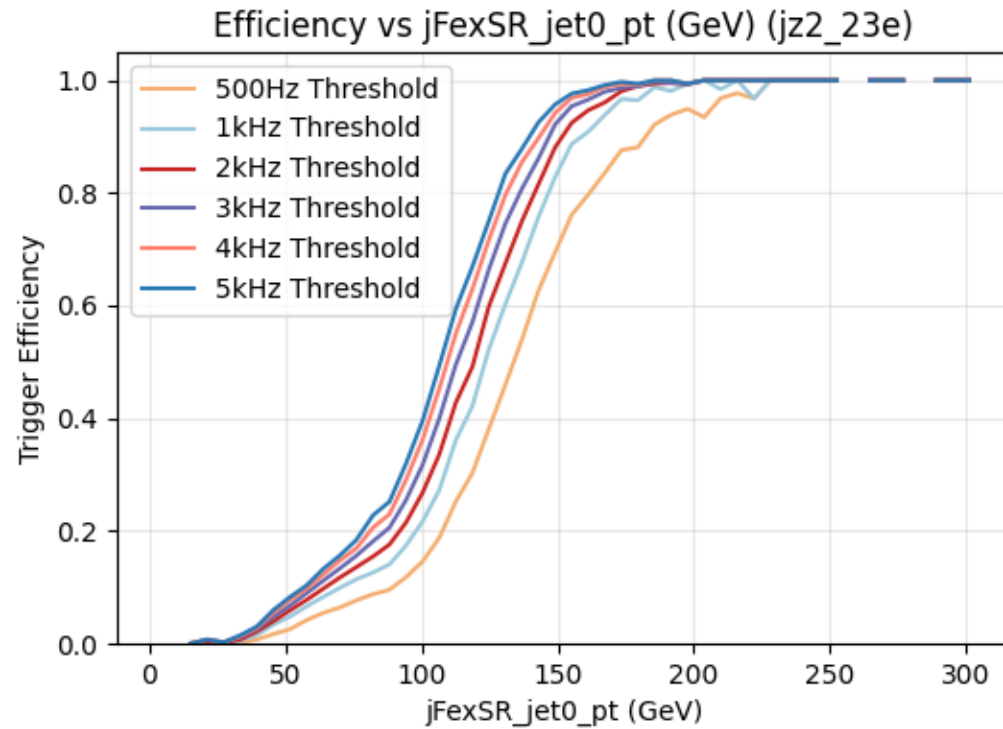
Efficiency Curves (jz1 tau)



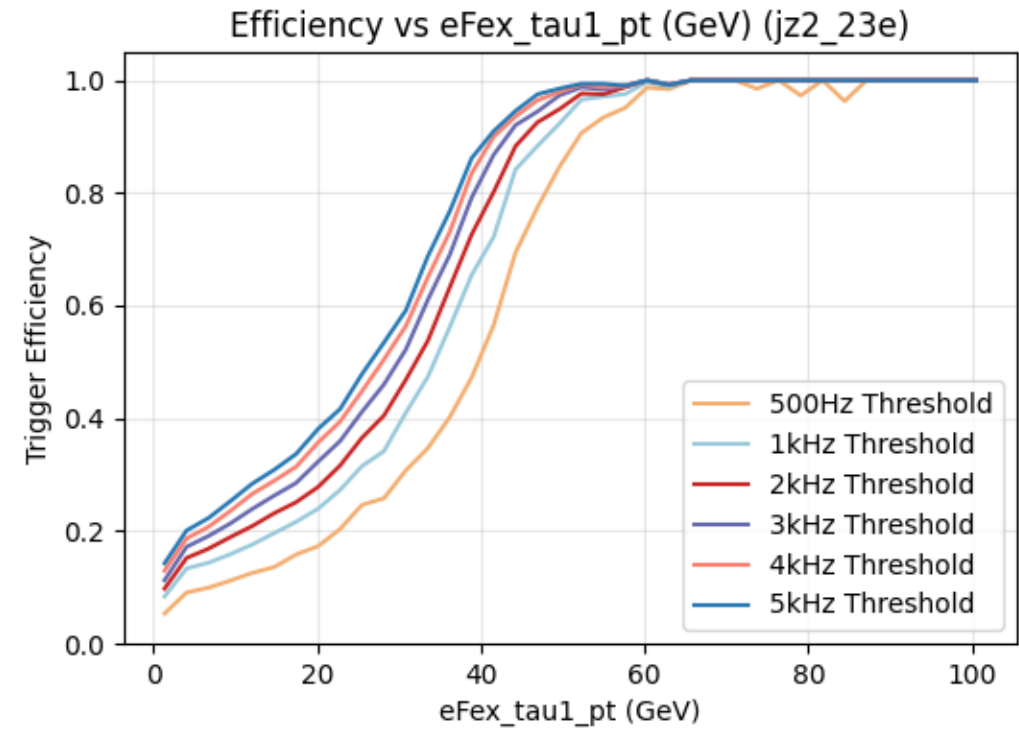
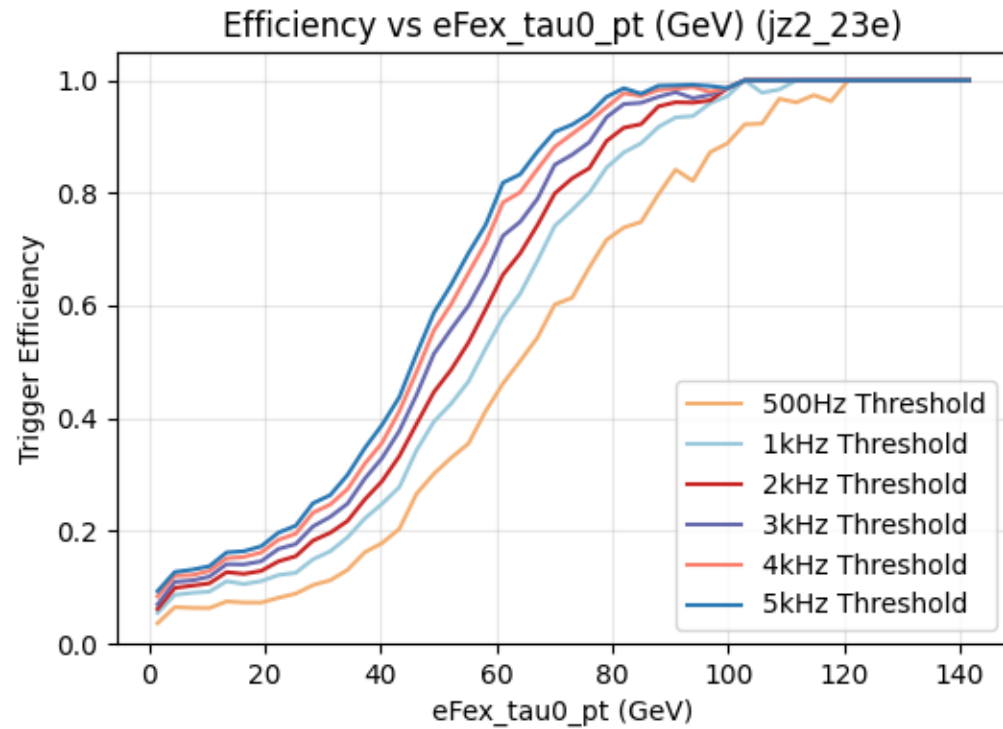
Efficiency Curves (jz1 muon)



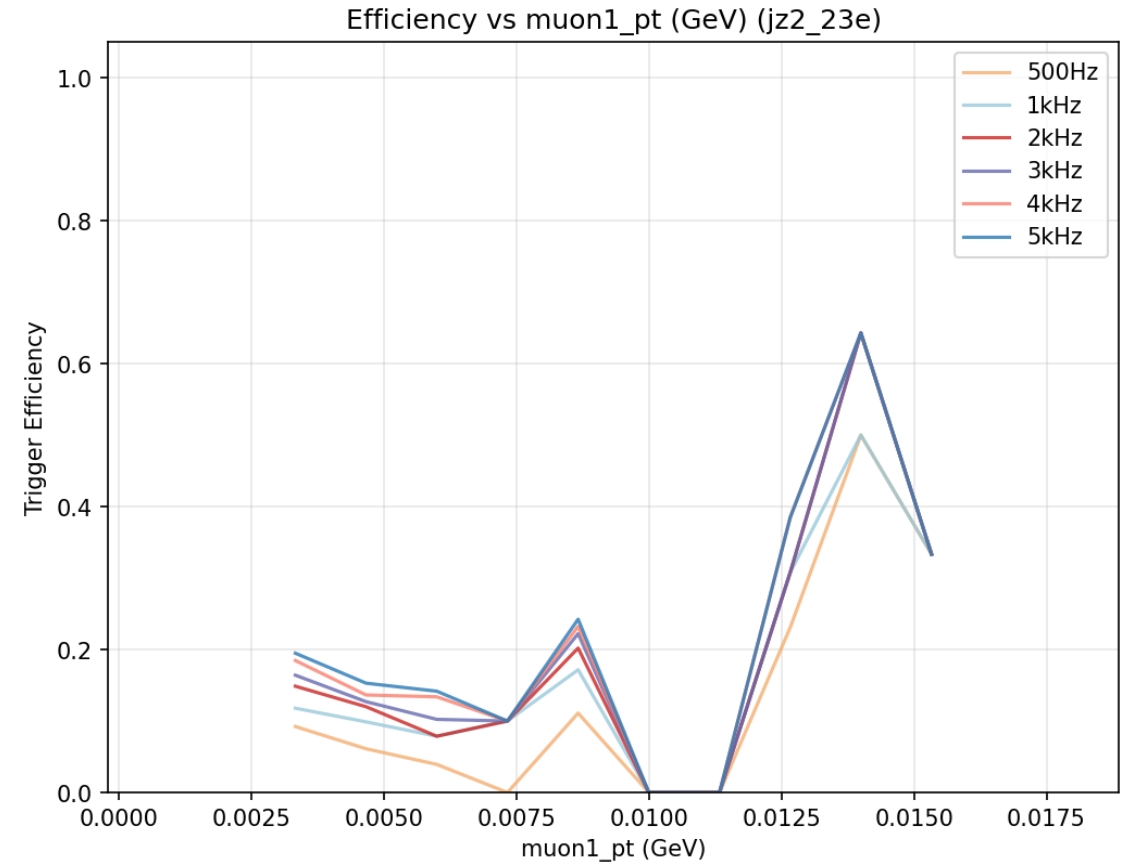
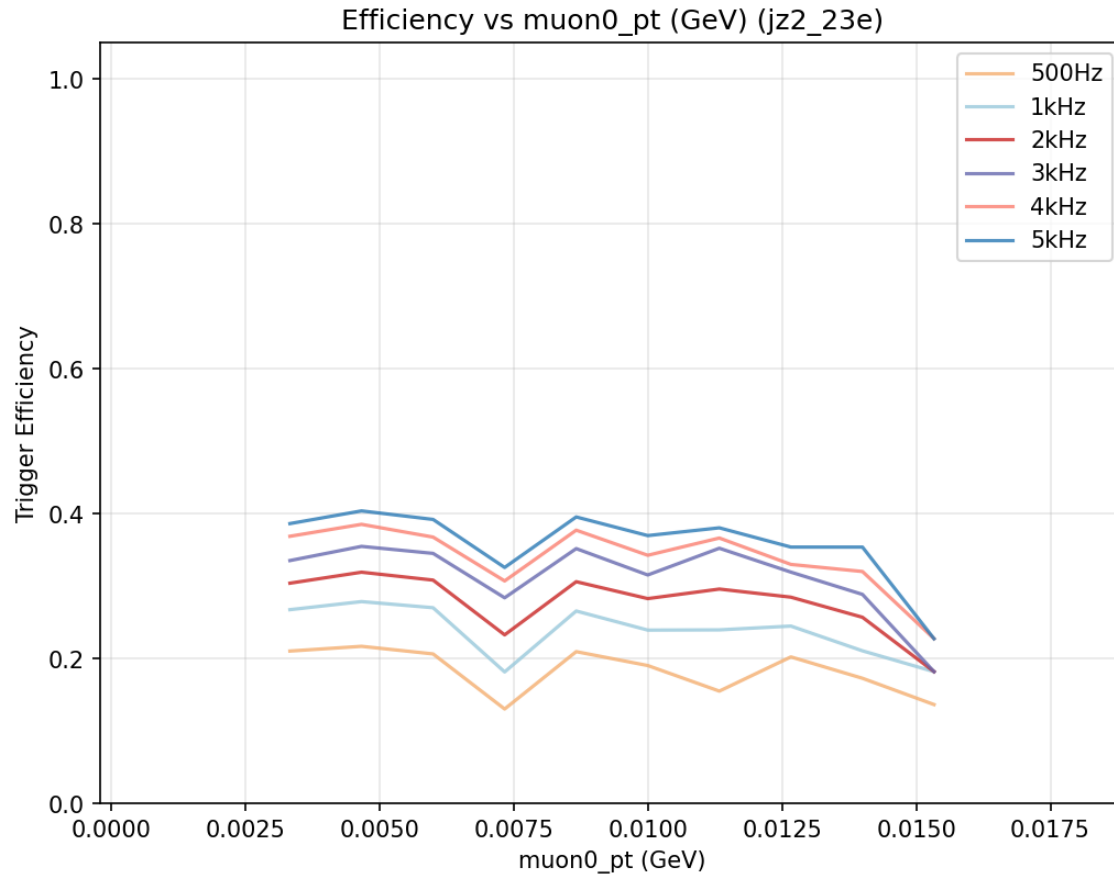
Efficiency Curves (jz2 jet)



Efficiency Curves (jz2 tau)

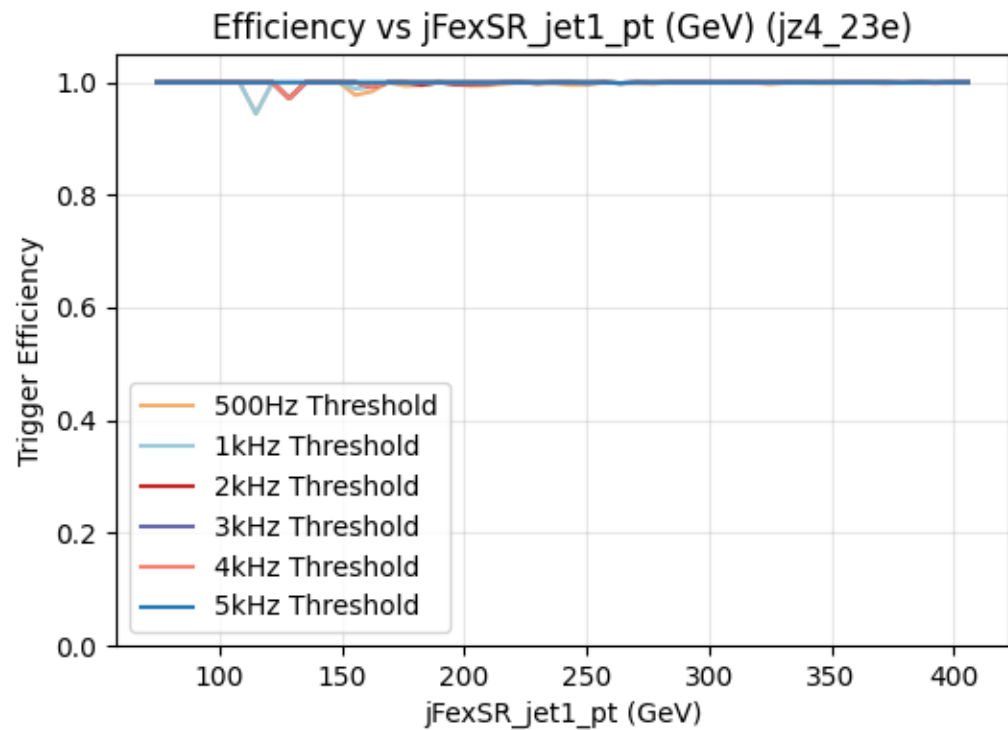
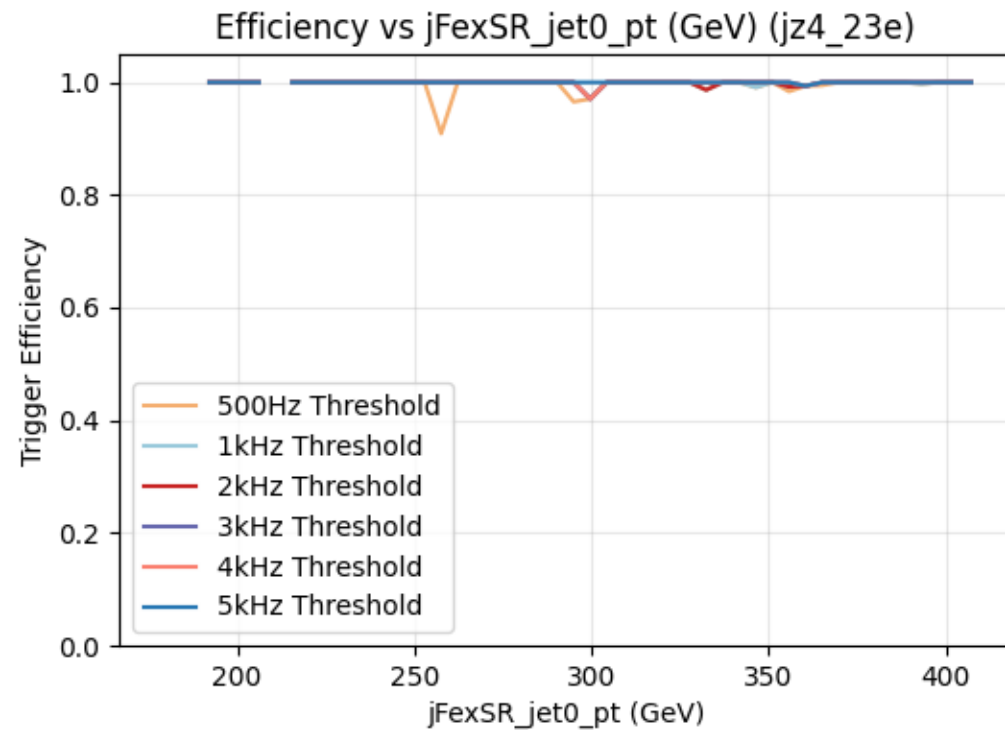


Efficiency Curves (jz2 muon)



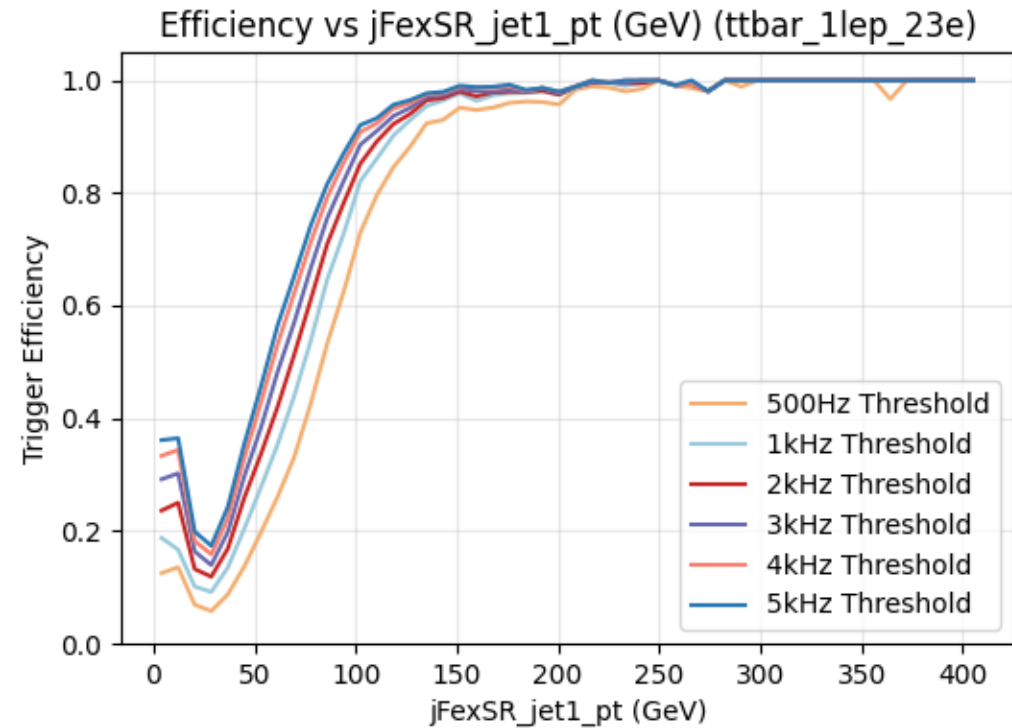
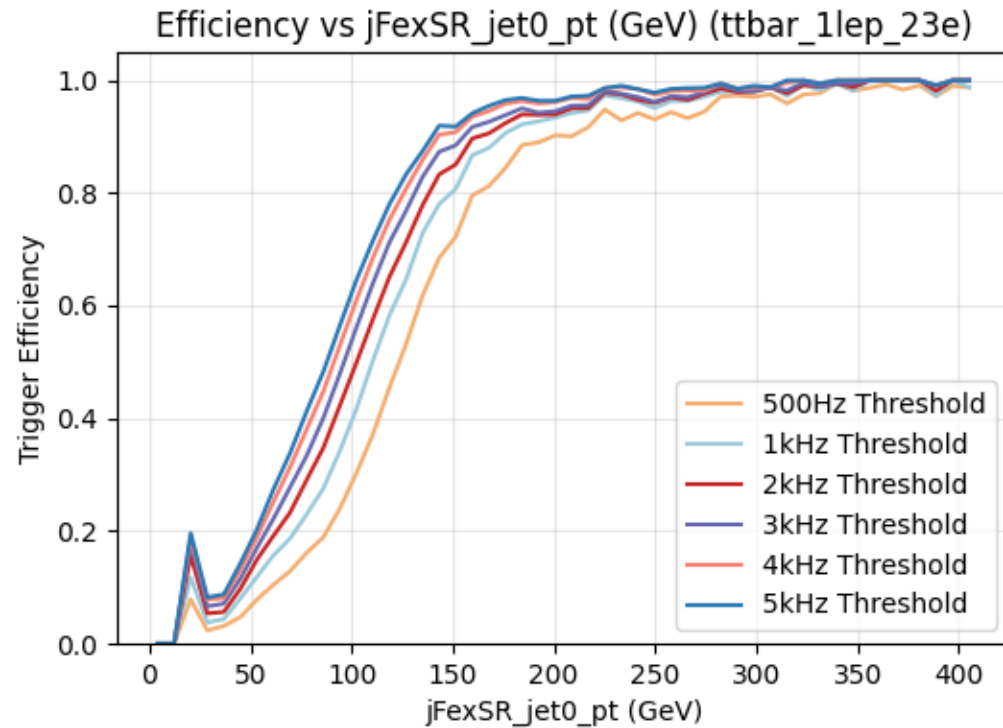
Efficiency Curves (jz4, 100% L1 pass rate)

- ~100%



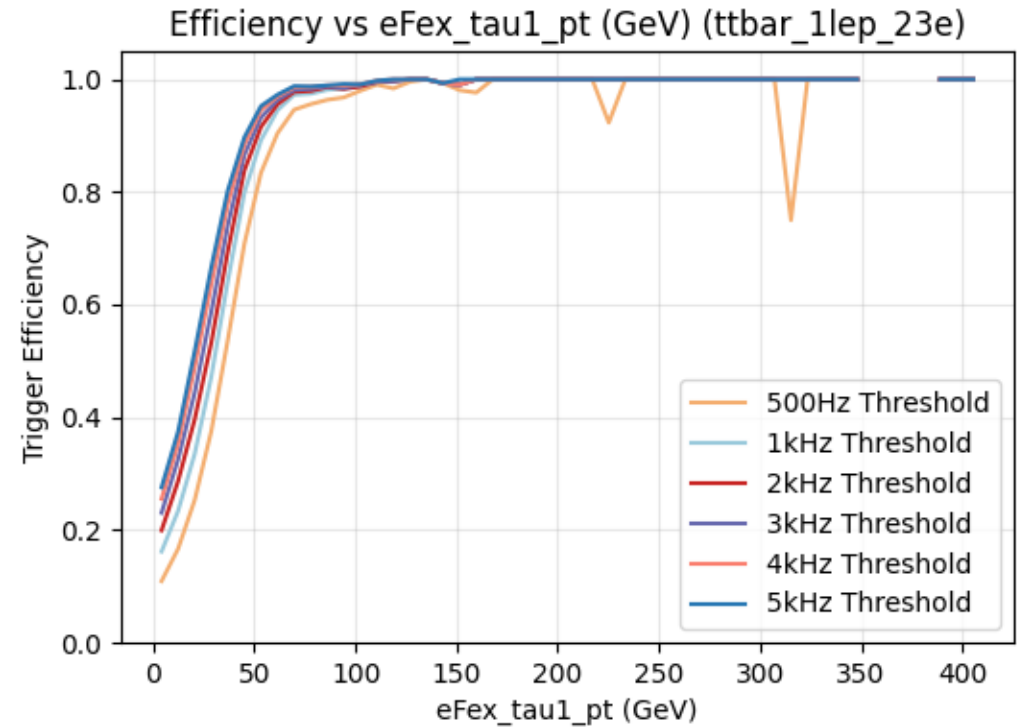
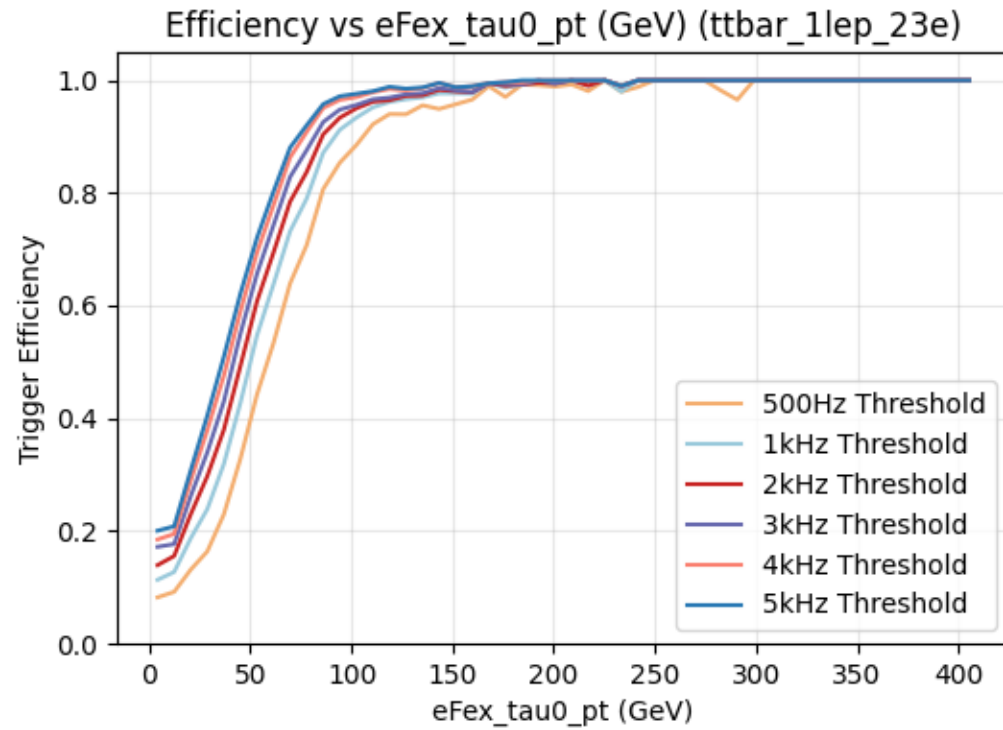
Efficiency Curves (ttbar1lep jet)

- Non-zero at low p_T

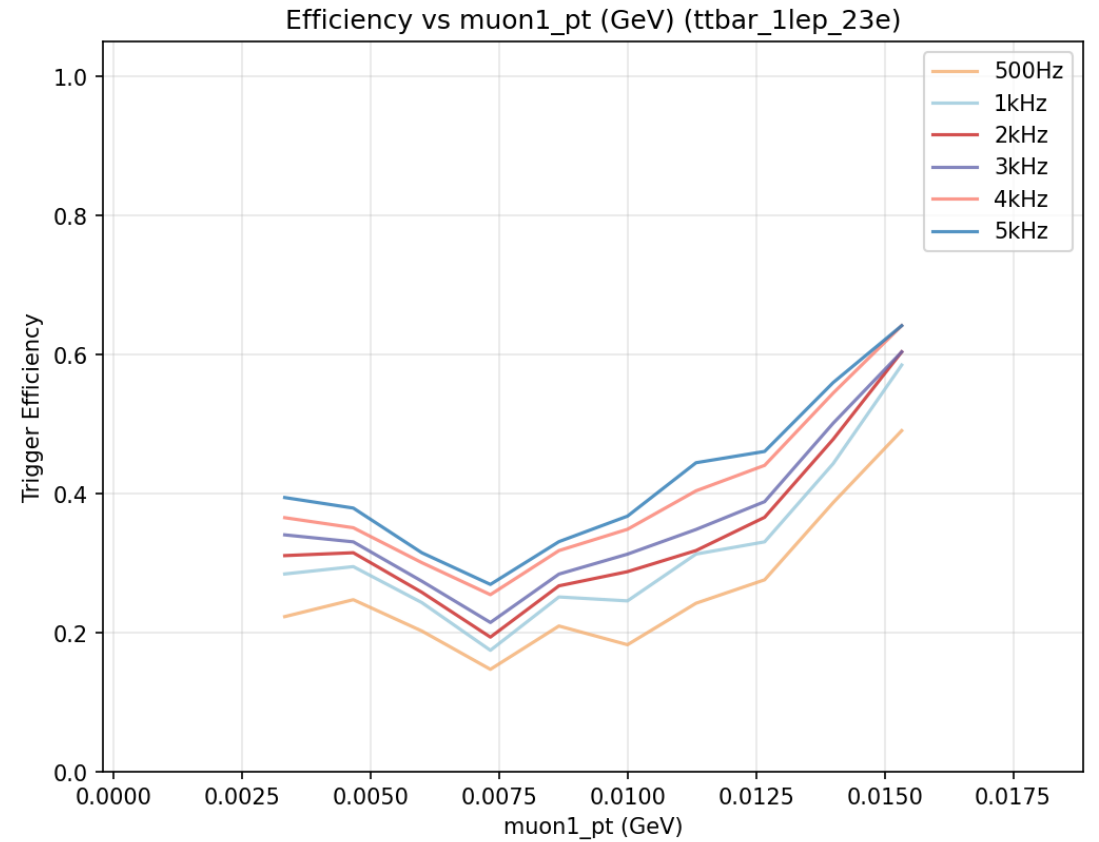
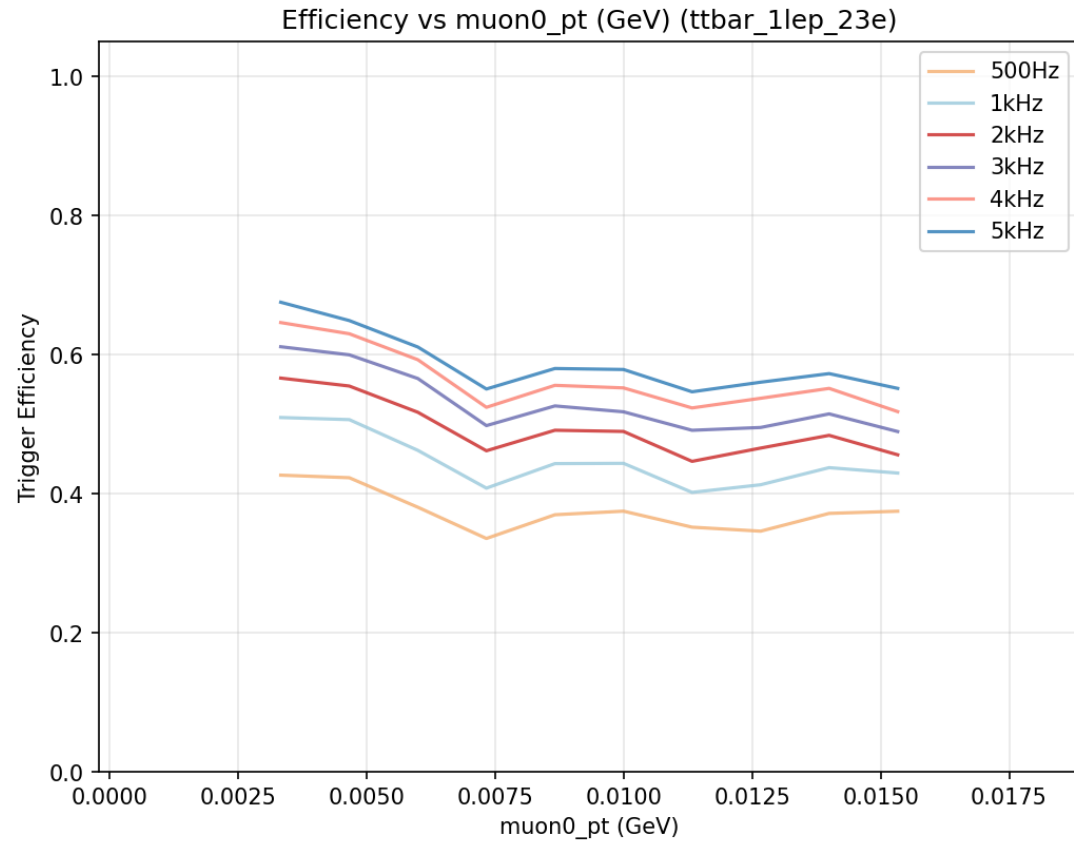


Efficiency Curves (ttbar1lep tau)

- Non-zero at low p_T

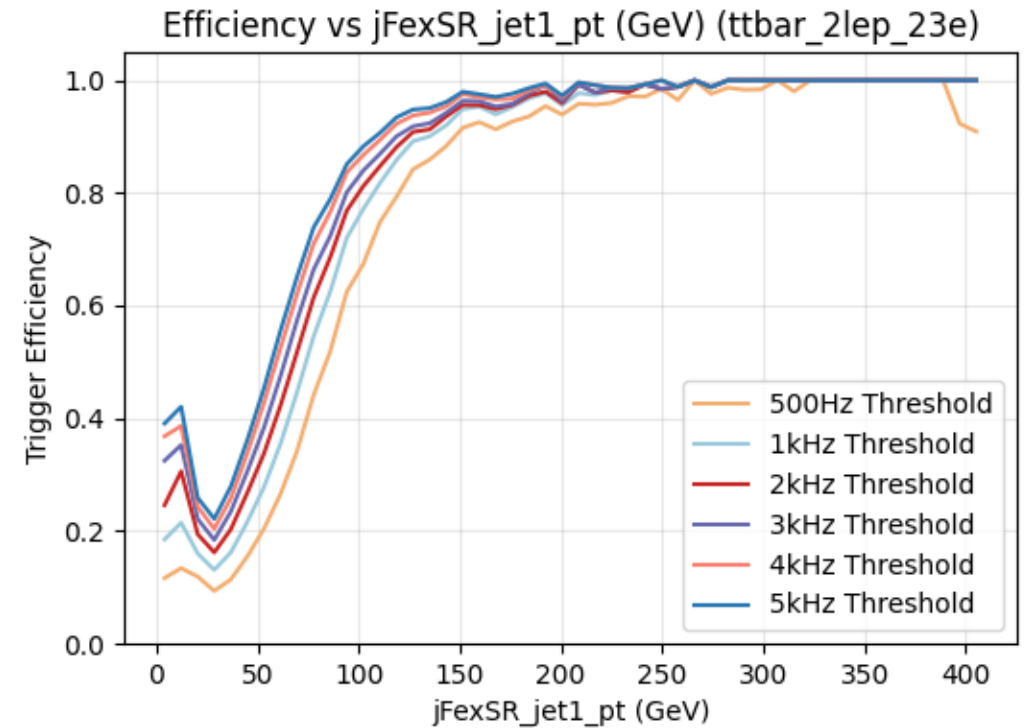
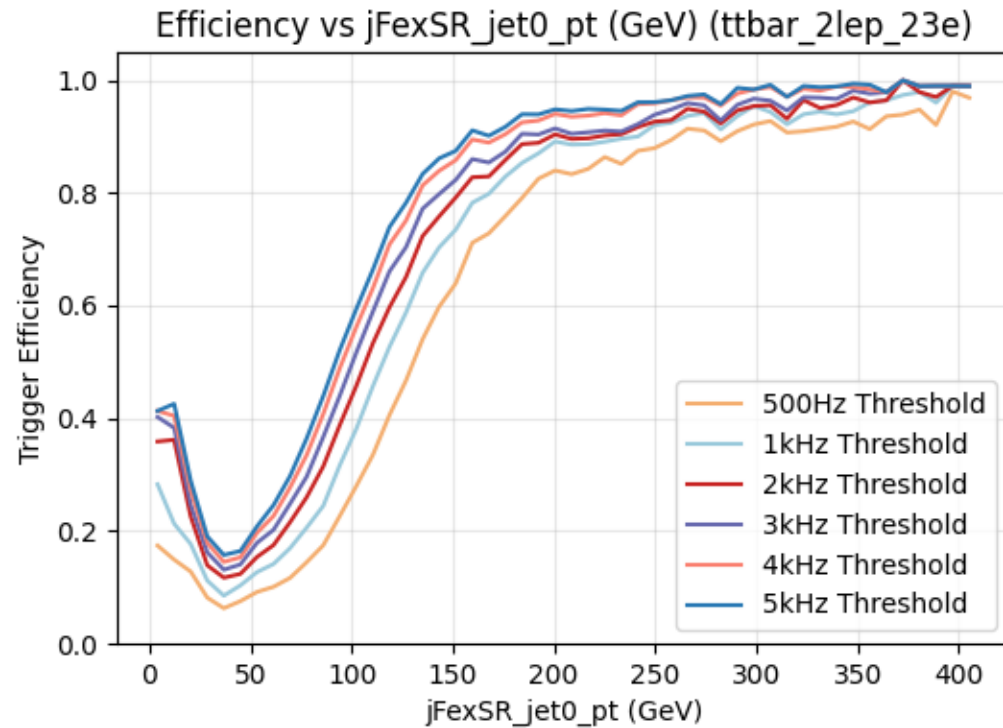


Efficiency Curves (ttbar1lep muon)

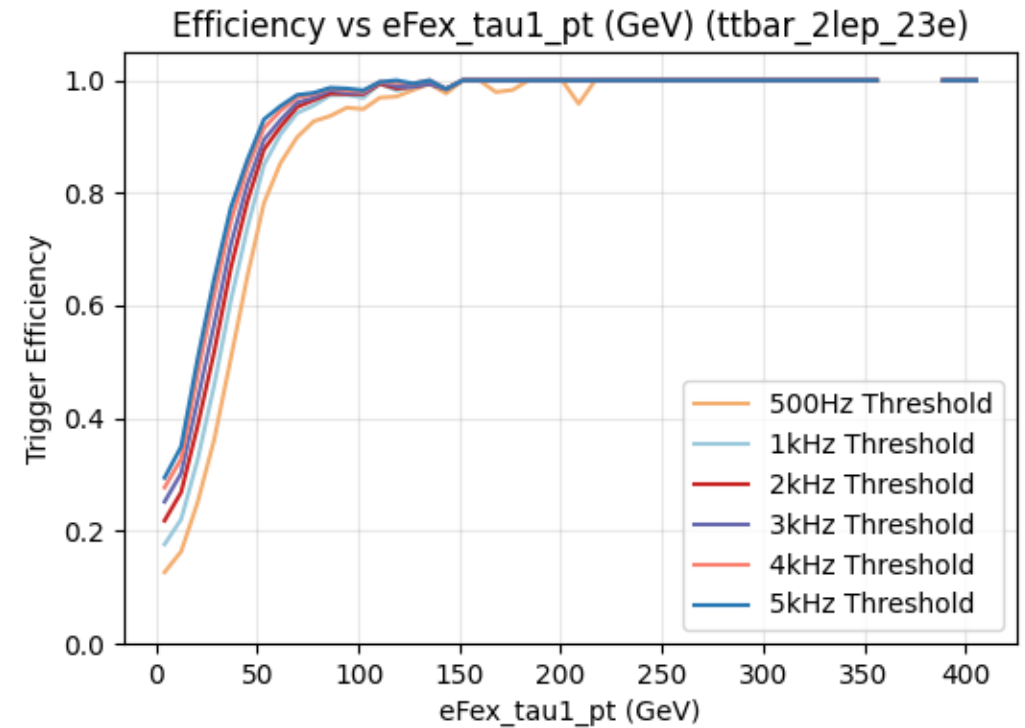
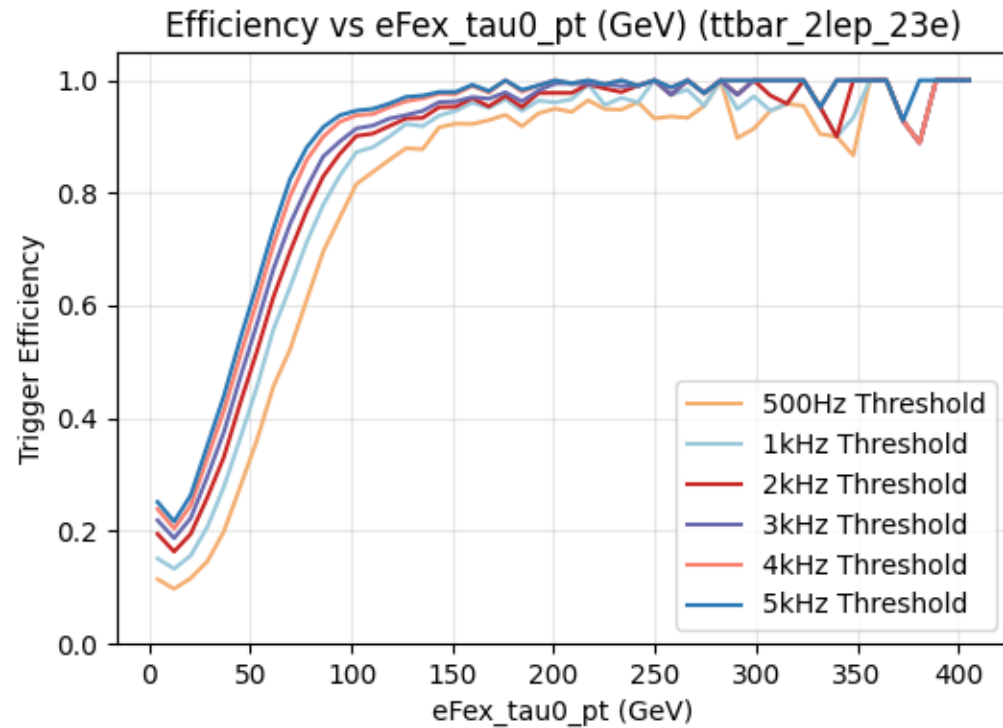


Efficiency Curves (ttbar2lep jet)

- Non-zero at low p_T for jet0-3

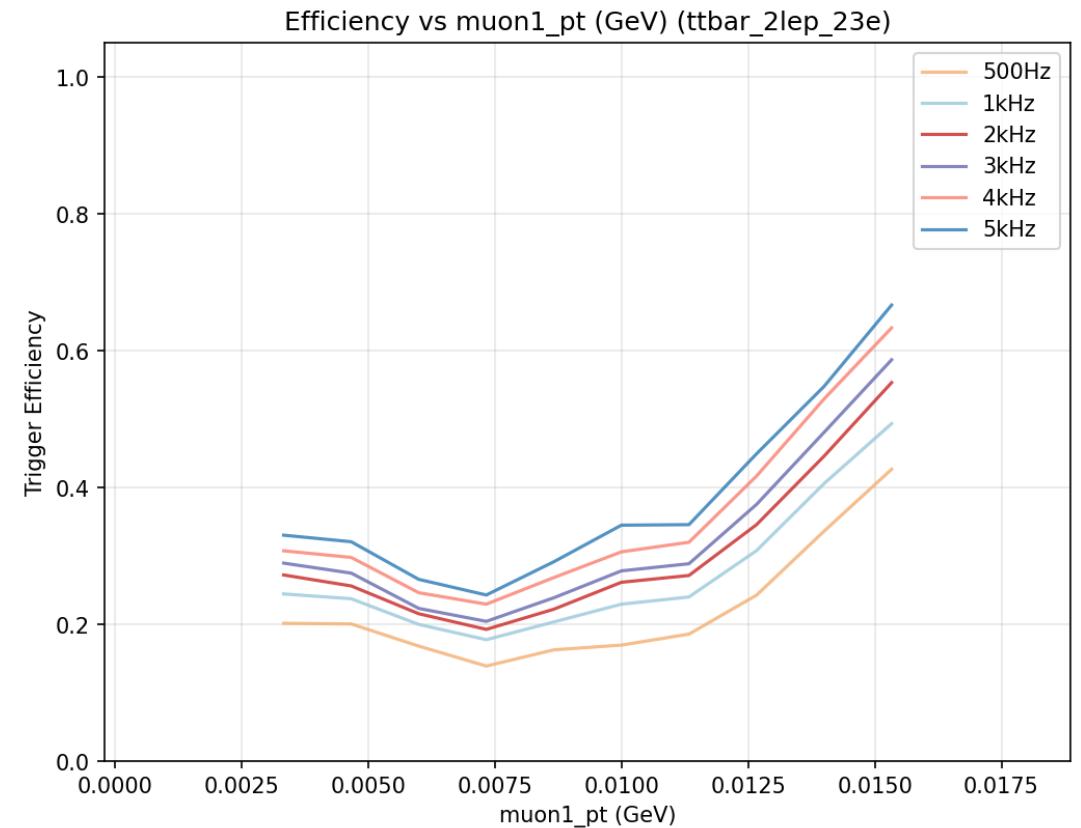
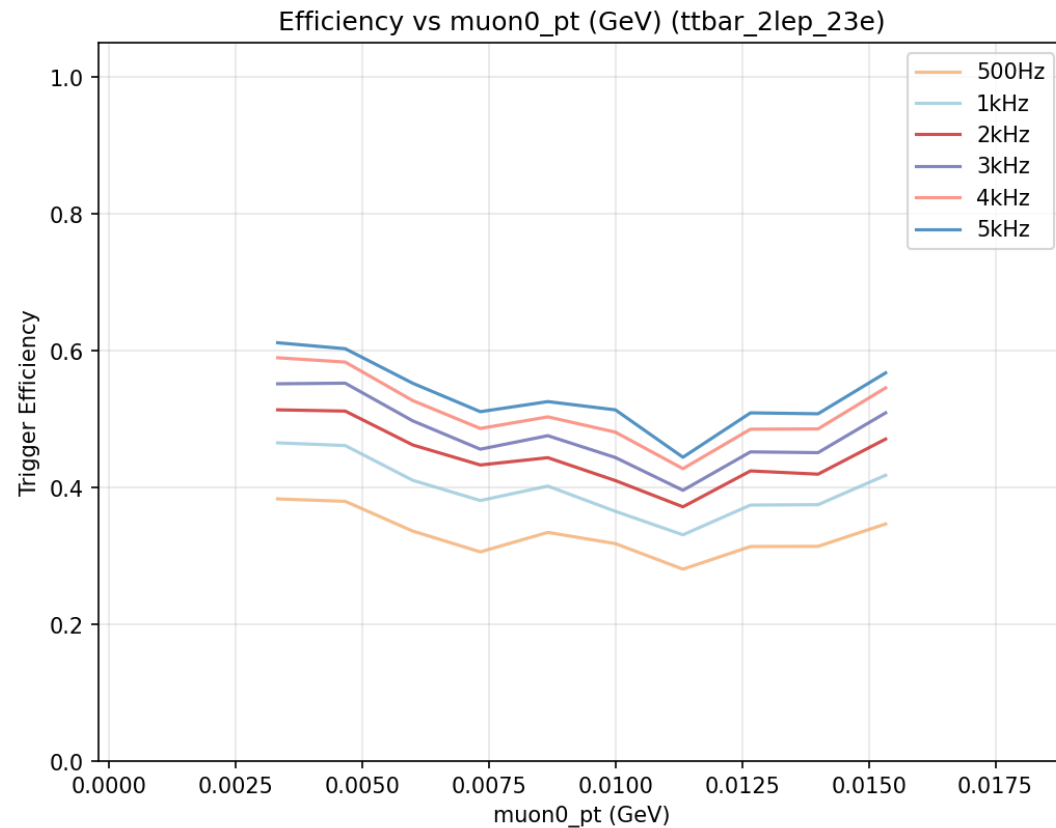


Efficiency Curves (ttbar2lep tau)



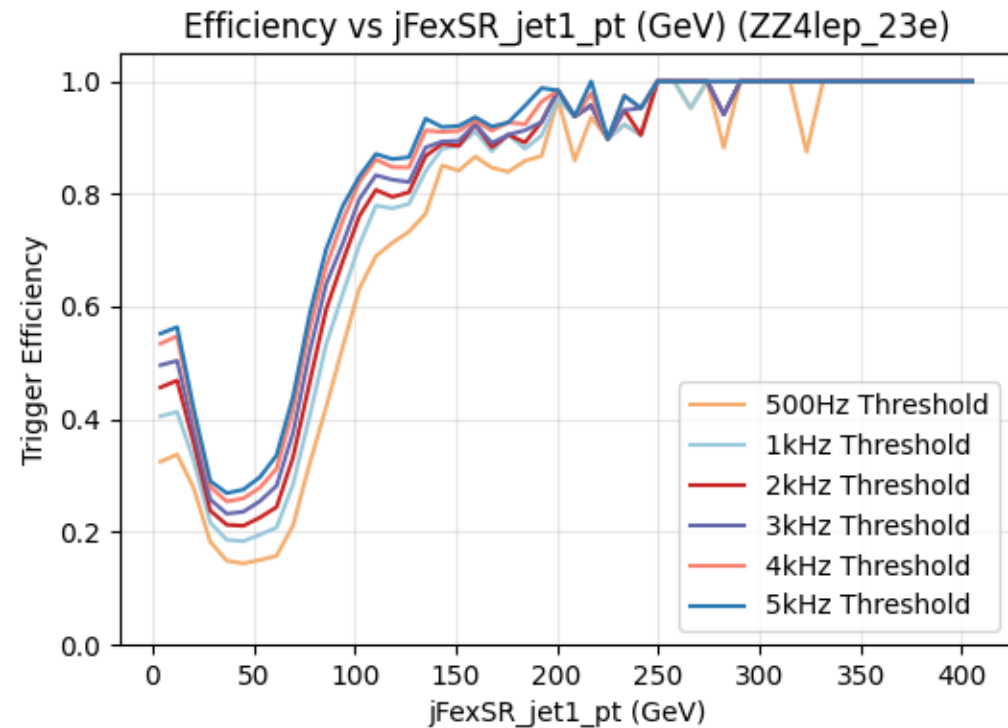
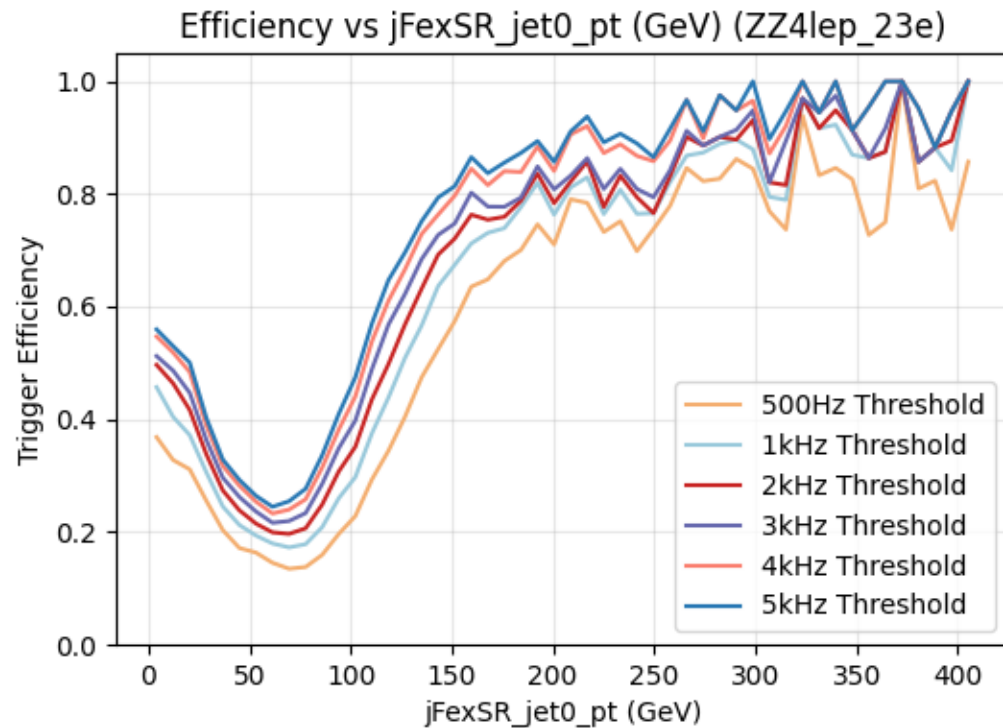
Efficiency Curves (ttbar2lep muon)

- Non-zero at low p_T



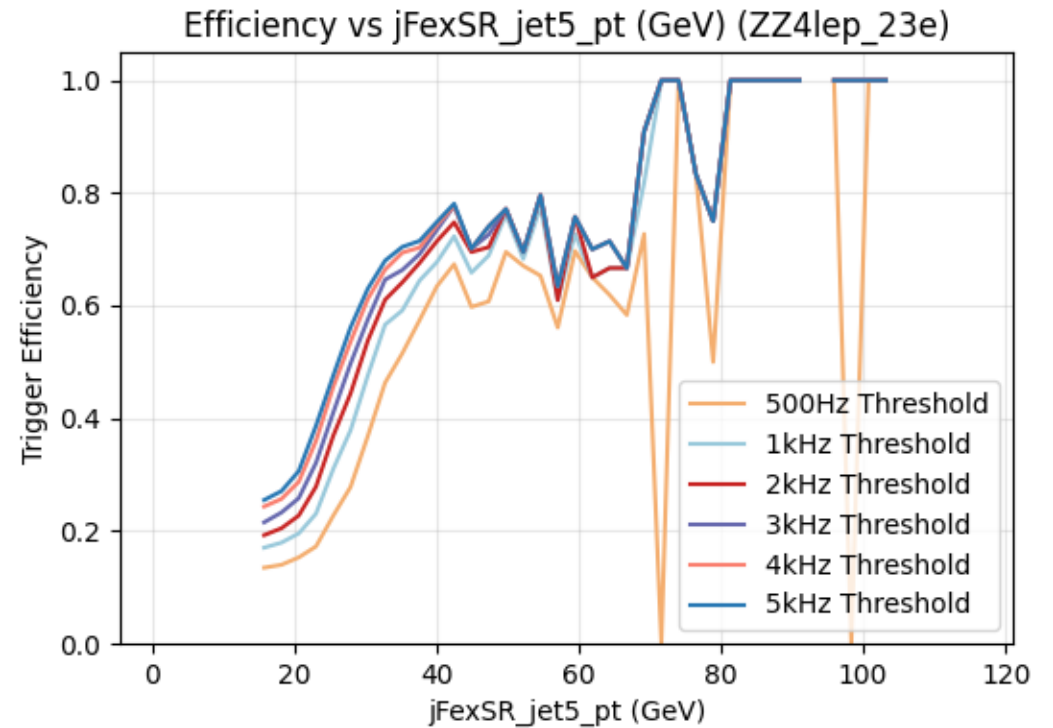
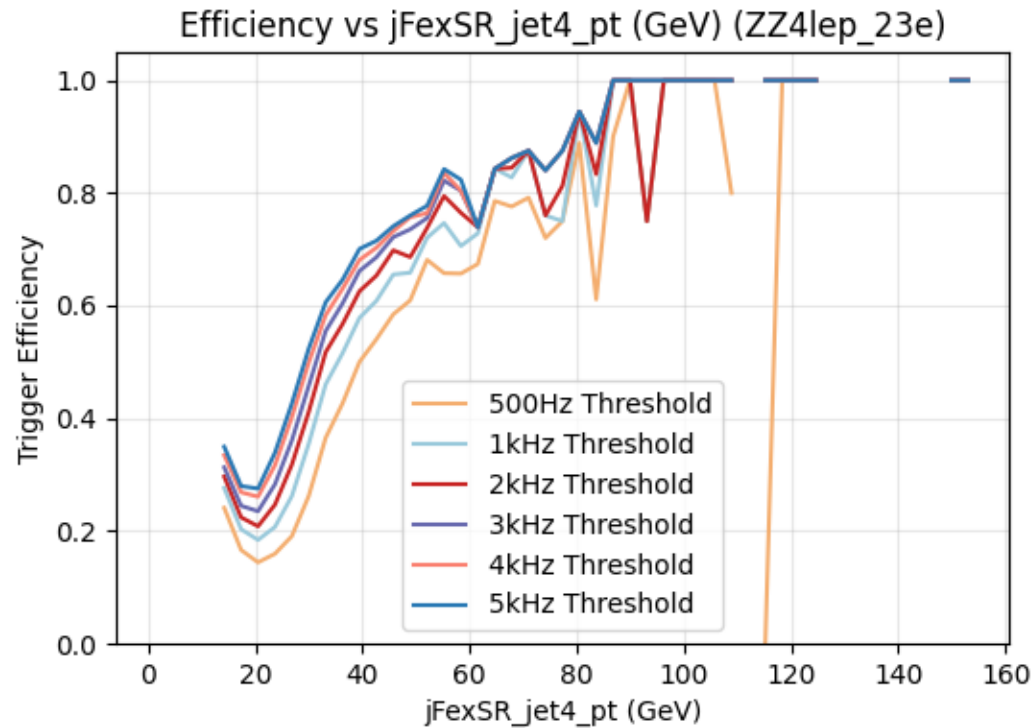
Efficiency Curves (ZZ4lep jet)

- Non-zero at low p_T

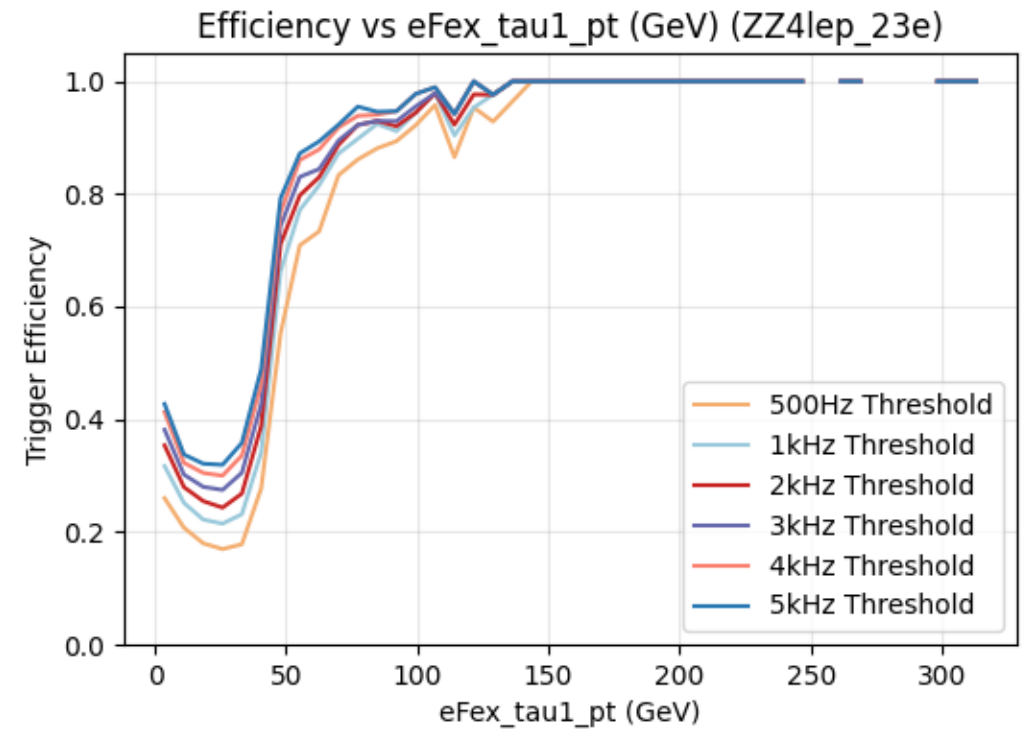
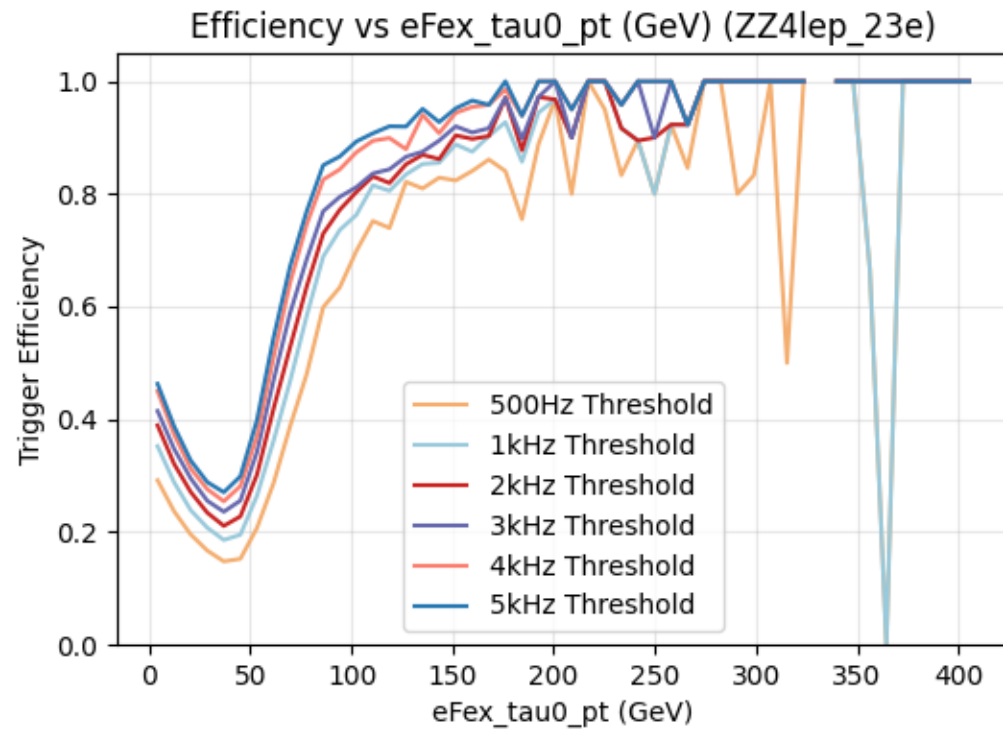


Efficiency Curves (ZZ4lep jet)

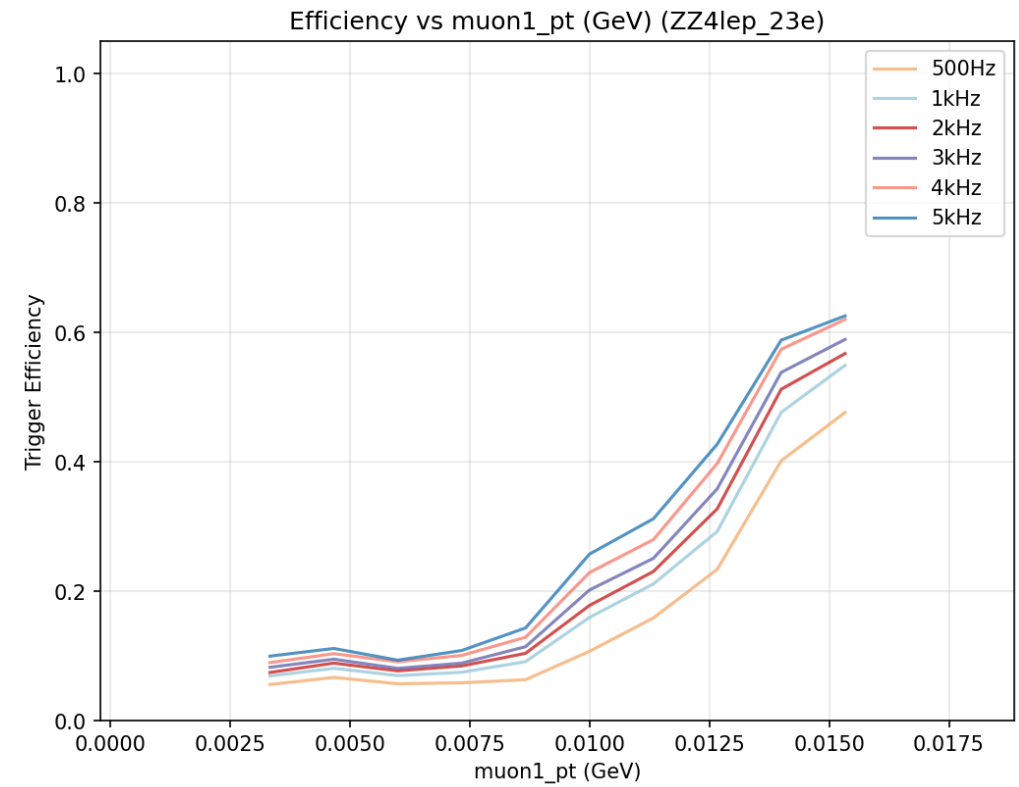
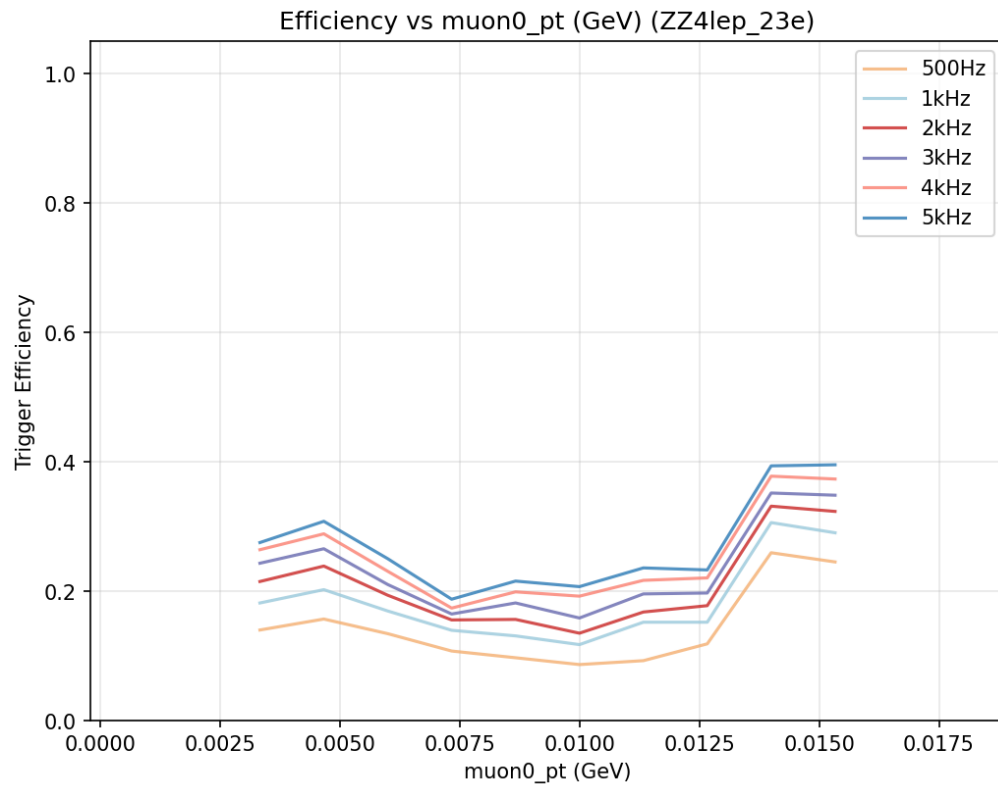
- lack data after $\sim 110\text{GeV}$
- Very low p_T sacrificed



Efficiency Curves (ZZ4lep tau)



Efficiency Curves (ZZ4lep muon)



Efficiency Curves (ZZ4lep muon)

