Tau Trigger Performance in 15.0.0

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Outline

- Overview of TTP Ntuple Production
- Performance of TTP trigger simulation
- Efficiencies for different levels and menus
  - Turn-on Curves
- Background Rates
- Turn-on curves for 10 TeV
- Conclusion

- **Overview over TrigTauPerformance (TTP)**

- package that can read TriggerBits and simulate trigger decisions using ESD files.
- saves tau trigger related information in TTP ntuple.
- for more information:

https://twiki.cern.ch/twiki/bin/view/Atlas/TrigTauPerformNtuple

Available Validation tools for TTP ntuples

Trigger/TrigAnalysis/TrigTauAnalysis/TrigTauPerformValidation

TTPValCutStudy	- plots abs. and rel. efficiency curves for each cut
TTPValEffTableMaker	- prints efficiency tables
TTPValRateTable	- print overall efficiencies and rates
TTPValDistributions	- prints distribution of cut variable for each cut
TTPValMultiPlots	- plots turn on curves for all menus and all levels
TTPValVariables	- prints values of variables

Reference files are available here:

https://twiki.cern.ch/twiki/bin/view/Atlas/TapmTauReference

TTP ntuple Production

- All plots/tables based on following datasets:
  - Signal sample:

    5107 (W->taunu, 46,000 events)

    5188 (Z->tautau, 86,500 events)
  - Background sample:

    J0 (5009, 199,250 events)

    J1 (5010, 98,161 events)

    J2 (5011, 90,250 events)

    J3 (5012, 93,700 events)

    J4 (5013, 95,060 events)

    J5 (5014, 94,750 events)
- All ntuples produced with 15.0.0
- All comparisons done with respect to 14.2.25.2
- Truth matching and offline matching required for all signal plots
- 15.2.0 and 15.3.0 probably used for data taking -> it's becoming more important to have stable code

TTP Ntuple Production

- Tags used to create and read 15.0.0 TTPs:
  - Trigger/TrigAnalsyis/TrigTauAnalysis/TrigTauPerformNtuple
    TrigTauPerformNtuple-00-04-23
  - Trigger/TrigAnalsyis/TrigTauAnalysis/TrigTauPerformAthena
    TrigTauPerformAthena-00-05-35
  - Trigger/TrigAnalsyis/TrigTauAnalysis/TrigTauPerformAnalysis
    TrigTauPerformAnalysis-00-04-17
  - Trigger/TrigAnalsyis/TrigTauAnalysis/TrigTauPerformValidation
    TrigTauPerformValidation-00-00-25

Simulation quality

- Comparison between Trigger Code decision and decision from TTP trigger simulation:

- For Signal (5188):

TAU16I_LOOSE	L1	L2	EF
HLT TriggerBit	55865	51068	48644
TTP decision	55865	51037	48593
Difference	0.00%	0.06%	0.10%

TAU50_LOOSE	L1	L2	EF
HLT TriggerBit	3692	2918	2592
TTP decision	3692	2916	2599
Difference	0.00%	0.07%	0.27%

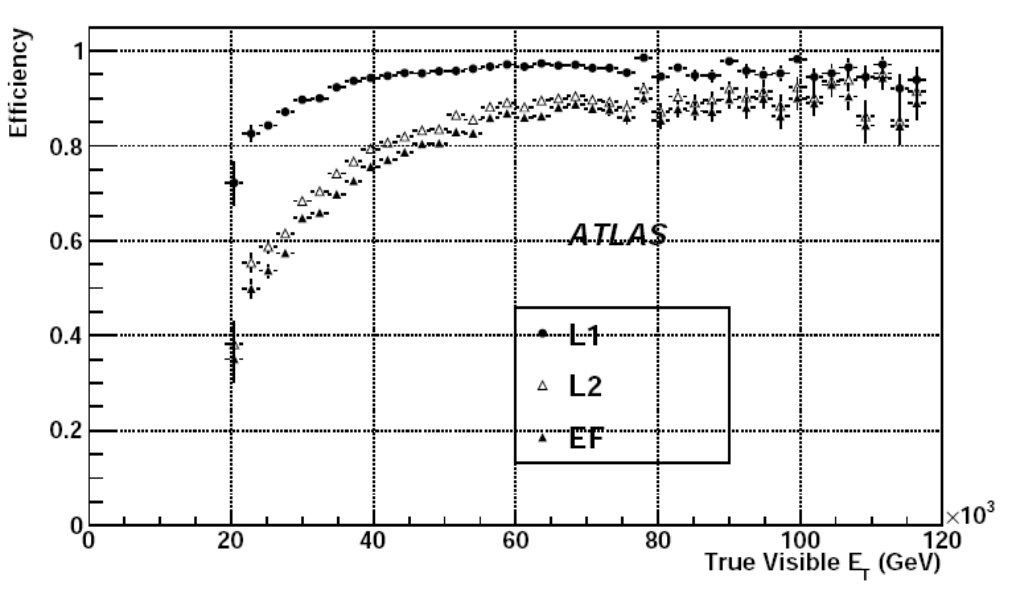
- For Background (5009):

TAU16I_LOOSE	L1	L2	EF
HLT TriggerBit	2729	422	258
TTP decision	2729	421	255
Difference	0.00%	0.24%	1.16%

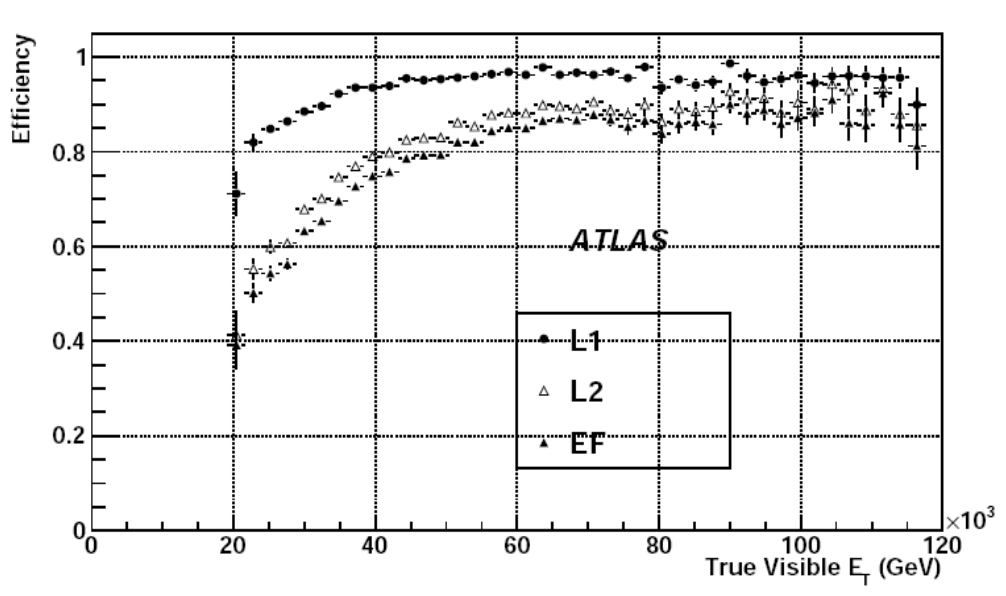
TAU50_LOOSE	L1	L2	EF
HLT TriggerBit	35	5	3
TTP decision	35	5	4
Difference	0.00%	0.00%	33.33%

15.0.0 performance - efficiencies

- Comparison of turn-on curves for different levels for tau16i
  - No significant changes seen



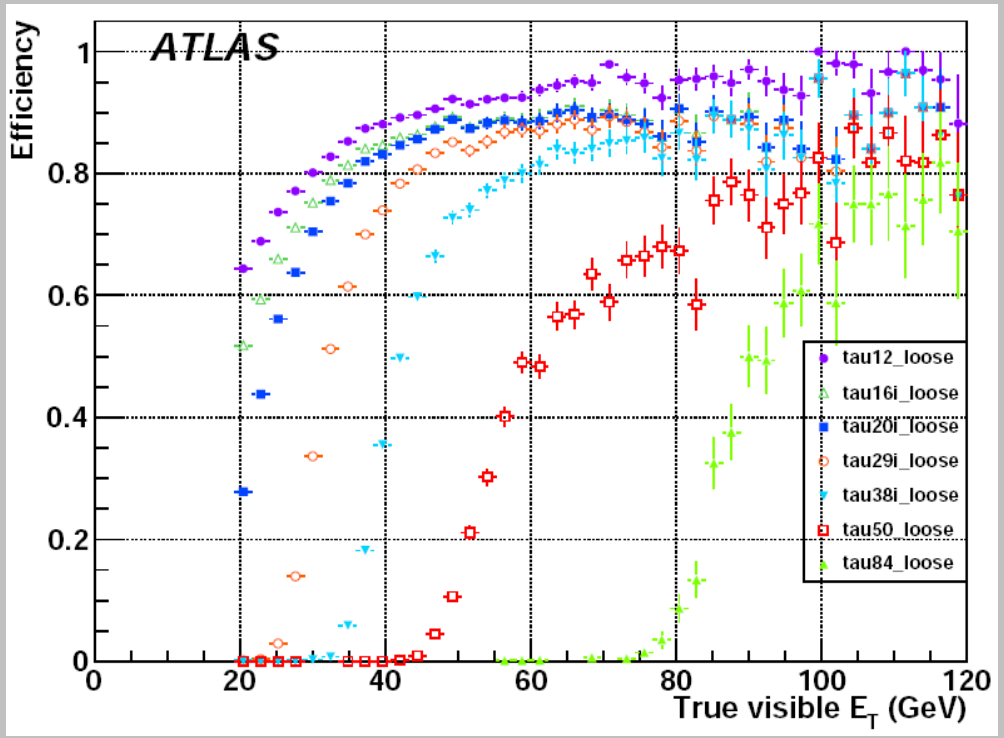
14.2.25.2



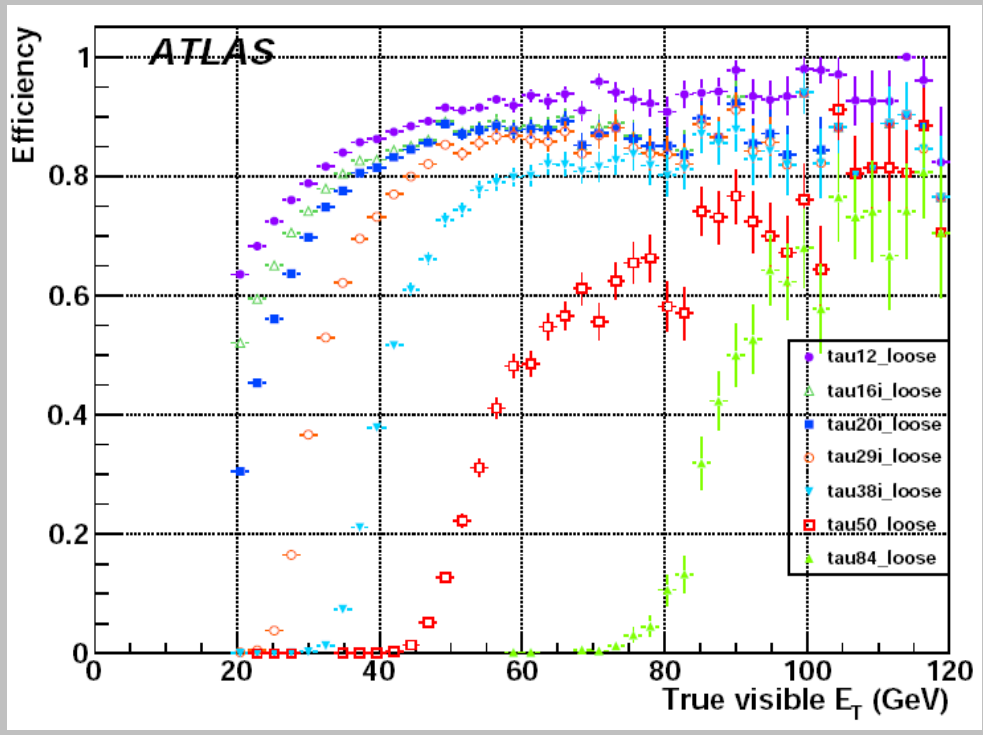
15.0.0

15.0.0 performance - efficiencies

- Comparison for turn-on curves different menus at EF



TTP12a, 14.2.25.2



TTP12, 15.0.0

15.0.0 performance - efficiencies

- Comparison efficiency numbers - TAU16I
- EITHERTAU offline matching and ALL decay types (1-Prong and 3-Prong)
- For 5188 (Z->tautau):

	L1	L2Calo	L2Trk	EF
14.2.25.2				
Relative Efficiency	94.1%	88.9%	96.4%	95.9%
Absolute Efficiency	94.1%	83.7%	80.7%	77.5%
15.0.0				
Relative Efficiency	93.8%	89.2%	96.2%	95.2%
Absolute Efficiency	93.8%	83.7%	80.5%	76.6%

As reference (for sample 5107):	
EF Absolute Efficiency for 15.0.0:	72%
EF Absolute Efficiency for 14.2.20:	73%
EF Absolute Efficiency for 13.0.30.3:	74%

Keep in mind: Not exactly the same sample!

(About 5% of the events in one sample are not in other sample)

15.0.0 performance - efficiencies

- Comparison efficiency numbers - TAU50
- EITHERTAU offline matching and ALL decay types (1-Prong and 3-Prong)
- For 5188 (Z->tautau):

	L1	L2Calo	L2Trk	EF
14.2.25.2				
Relative Efficiency	91.4%	77.9%	99.0%	93.0%
Absolute Efficiency	91.4%	71.2%	70.5%	65.5%
15.0.0				
Relative Efficiency	90.9%	78.1%	98.5%	91.8%
Absolute Efficiency	90.9%	71.0%	69.9%	64.2%

As reference (for sample 5107):

EF Absolute Efficiency for 15.0.0:	63%
EF Absolute Efficiency for 14.2.20:	75%
EF Absolute Efficiency for 13.0.30.3:	64%

Higher efficiencies at all Levels (not understood)

Keep in mind: Not exactly the same sample!

(About 5% of the events in one sample are not in other samples)

15.0.0 performance - Rates

- QCD Background rates:

TAU16I

Sample	J0	J1	J2	J3	J4	J5	Sum J0, J1
X-section [nb]	1.76E+07	1.38E+06	9.33E+04	5.88E+03	3.08E+02	1.25E+01	
Rate 15.0.0 [Hz]	225	265	87	9.2	0.45	0.013	490
Rate 14.2.20 [Hz]	208	263	88.9	-	-	-	471
Rate 14.2.25.2 [Hz]	228	263	-	9.2	0.45	-	491
Differences to 15.0.0:							
14.2.20	8.2%	0.8%	-2.1%	-	-	-	4.0%
14.2.25.2	-1.3%	0.8%	-	-0.4%	0.0%	-	-0.2%

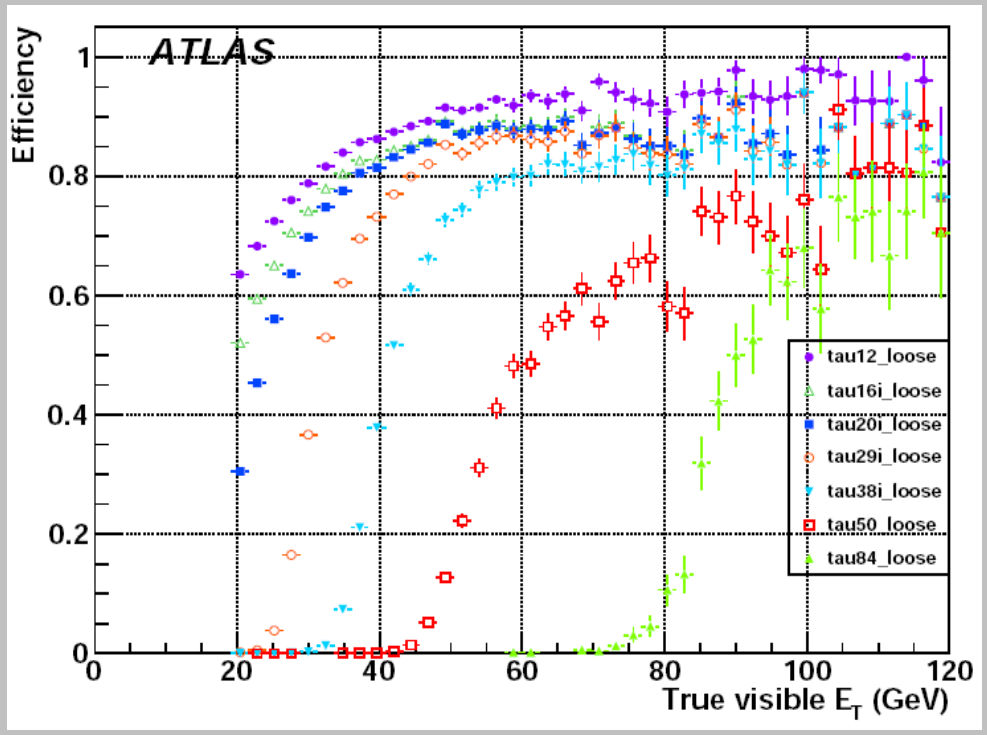
TAU50

Sample	J0	J1	J2	J3	J4	J5	Sum J0, J1
X-section [nb]	1.76E+07	1.38E+06	9.33E+04	5.88E+03	3.08E+02	1.25E+01	
Rate 15.0.0 [Hz]	3.5	1.3	2.1	2.2	0.36	0.026	4.8
Rate 14.2.20 [Hz]	1.8	1.3	1.6	-	-	-	3.1
Rate 14.2.25.2 [Hz]	2.7	1.26	-	2.1	0.36	-	3.9
Differences to 15.0.0:							
14.2.20	96.1%	-0.4%	27.0%	-	-	-	56.2%
14.2.25.2	32.9%	0.3%	-	0.8%	0.1%	-	22.4%

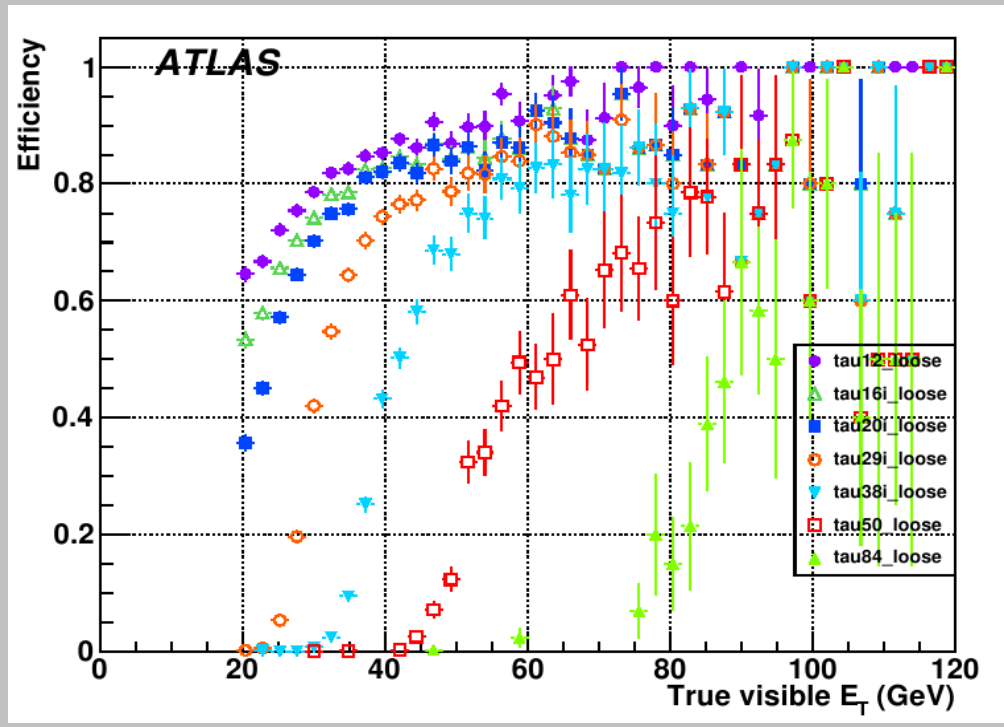
Large error (~50%)

15.0.0 performance – 10 TeV

- Comparison to 10 TeV efficiencies for TTP12, 15.0.0
  - Problem: lack of statistics



14 TeV



10 TeV

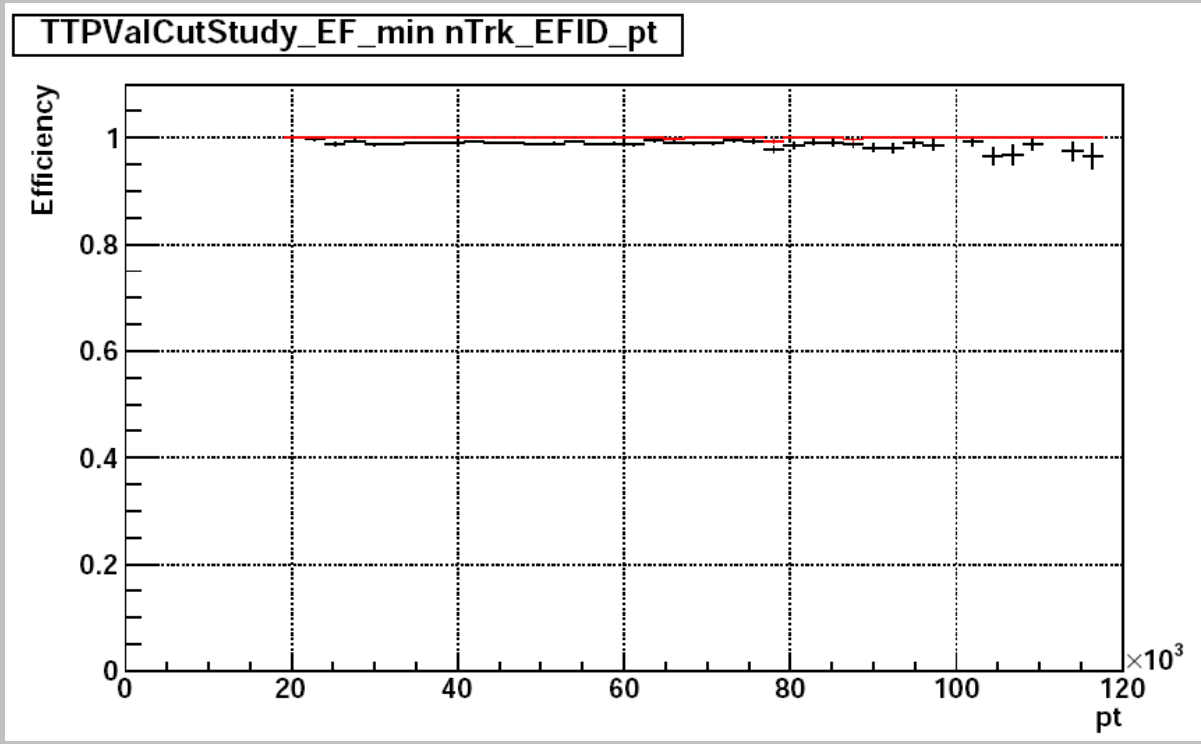
Conclusion

- TTP simulation gives good results compared to TriggerBits
- Turn-on curves and efficiencies look very good
- Background rates have not changed much
  - Except: J2 background for tau50 has increased compared to 14.2.20
- 15.0.0 looks like a very good release for the tau trigger
  - Need to pay attention to long-term trend of slowly increasing rates for higher pt menus

Backup slides

15.0.0 performance – efficiency decrease

- Explanation: lower efficiency for EF ID Min nTrks cut
- Remainder: problem with EF Min nTrks cut in the past (due to increase in number of ROIs in zero bin)
  - Was repaired, but didn't go back to original efficiency in 14.2.25.2
  - Not shown here, but only problem in 1Prong decays and only with offline matching



14.2.25.2 – red
15.0.0 - black

L2 vs EF for eta and phi

- Similar phi problem as in cosmics
- No problems seen in eta distribution
- Might be solved with Olya's fix for cosmics