Tau Trigger Menu

Olya Igonkina (Nikhef) for tau trigger group

- Conclusions from Beatenberg workshop

    - current trigger menu for taus

- Modifications to tau+MET chains

- Removal of L1 EM isolation for tau items

Lowest unprescaled items

Signature	10TeV, 10^{31}	14 TeV, 10^{31}	Motivation
tau50_loose	0.89 ± 0.44	5.45 ± 0.75	Heavy resonance, Exotics
tau16i_loose_EFxe30	5.8 ± 0.70	6.7 ± 0.85	W->$\tau\nu$, Higgs, Z->$\tau\tau$
2tau20i_loose	1.1 ± 0.5	5.25 ± 0.73	Z, Higgs->$\tau\tau$->2hX
tau12_loose_e10_loose	0.89 ± 0.45	3.2 ± 0.57	Z,Higgs ->$\tau\tau$->lhX
tau16i_loose_mu6	0.11 ± 0.03	2.57 ± 0.51	Z,Higgs ->$\tau\tau$->lhX
tau16i_loose_j120	0.22 ± 0.22	1.54 ± 0.40	SUSY
tau16i_loose_2j70	0.44 ± 0.3	0.82 ± 0.29	SUSY, Higgs
tau16i_loose_3j23	0.44 ± 0.3	1.44 ± 0.38	ttbar, SUSY, Charged Higgs
e10_medium	15 ± 1.8	26 ± 1.6	Z,Higgs ->$\tau\tau$->ehX
mu10	11 ± 1.6	22 ± 1.5	Z,Higgs ->$\tau\tau$->μhX

Not enough MC for low rate items

link to trigger rate table

Changes in menu (release 15.1.0)

- New L1 menu – plan to keep it though complete first run, from cosmics data taking through end of first physics run (2010) :

  HA5, HA6, HA9, HA9I, HA16, HA16I, HA25, HA40

- L1 EM isolation is removed for trk9_id, trk16_id items (hadronic calibration)

- tau16, tau20, tau29 (no L1 EM isolation) are added to test/MC menu.

- no tau+X or 2tau without L1 EM isolation are added yet

  - topic of discussion at this workshop

- tauNoCut_SiTrk, tauNoCut_TRT are added to main menu (prescaled)

- all items have explicit "loose/medium/tight" tag in the name (was missing for loose items before). Mostly loose items are used at 10^{31}

- a number of old items removed from menu – see

  https://savannah.cern.ch/bugs/index.php?47875 for full list

L1 EM isolation

- Suggestion to remove L1 EM isolation (*fixed* 6GeV cut) for the low pT items:

  - The L1 rate changes insignificantly
  - The EF rate of single tau or tau+MET increases by **1.5**
  - The EF rate of double taus increase by 3-**4**
  - W->τν, Z–>ττ efficiencies increase by **2%**,
  - A->ττ efficiency increases by **10%** -
    - but can be collected with higher thresholds

- Looking into using isolation cut (*relative* to the total energy) at L2 but so far not promising.

- Plan to introduce unisolated 2tau signature with higher pT *2tau29*

Until the usefulness of removing the L1 EM isolation is shown, will keep L1 EM isolation in
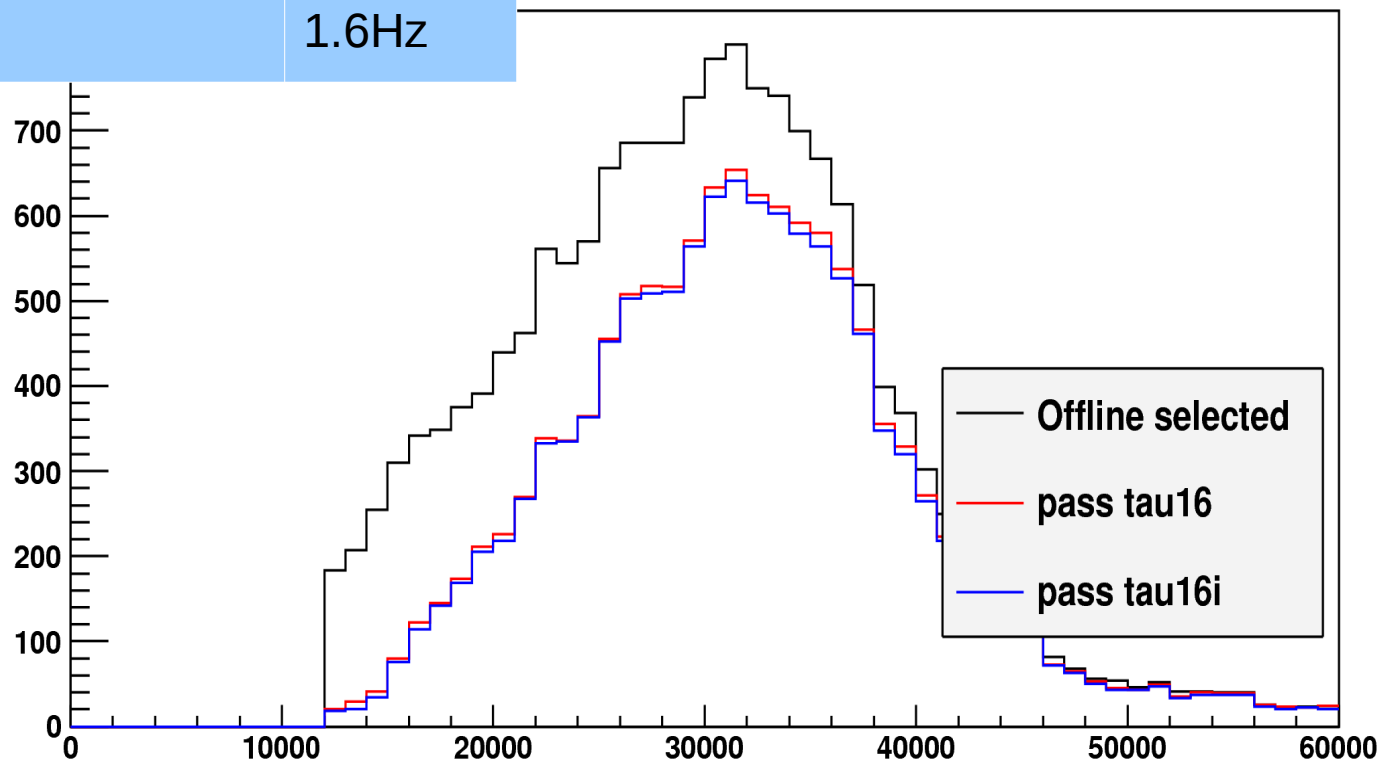
L1 EM isolation effect

14TeV, 10³¹	tau	tau+EFxe30	2tau
tau16	650Hz	11.5Hz	16.4Hz
tau16i	590 Hz	9Hzh	8Hz
tau29	150Hz		4.7Hz
tau29i	115Hz		1.6Hz

W->$\tau\nu$ (106023 DS)
offline MET>30GeV
true tau matched to
either tauRec or tau1p3p

L1 EM isolation is not
important for low pt
taus(W/Z). It is very important
for high pt taus (heavy
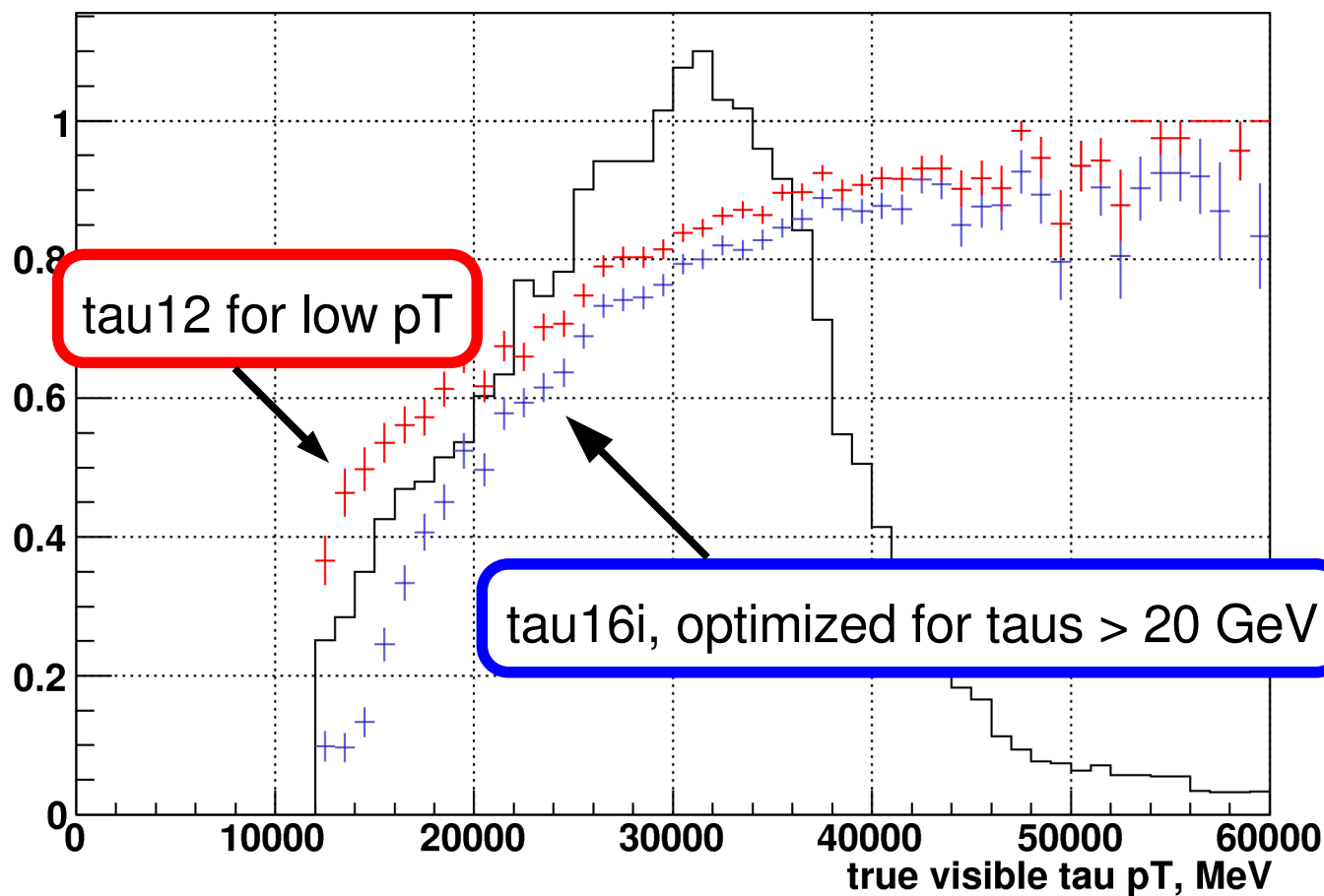Higgs), but there a higher
threshold can be used

Offline selected
pass tau16
pass tau16i

W->τν trigger

- So far we concentrated on *tau16i_loose_EFxe30* (XE: 0,0,30) – much better efficiency than old *tau16i_loose_xe30* (XE: 30,30,30).

  - *tau16i_EFxe30* has too high rate at L2 (600Hz). Alternatives investigated :

    - new *tau16i_loose_xe30_loose* (XE: 15,15,30) looks OK
    - *tau16i_EFxe30_njXX* – not useful

  - EF rate of *tau16i_loose_xe30_loose* is low, 2.3Hz at 10TeV,10^{31}:

    - should we reduce EF xe threshold?
    - should we reduce tau pt threshold?
    - should we go for completely different trigger (e.g. single xe40)?

- <u>New developments in MET triggers</u> :

  - will have lower threshold at L1/L2 vs EF. New **xe30** : (20,20,30)
  - will have "loose" selection **xe30_loose** : (15,15,30)
  - lowest unprescaled item is now xe40 :(30,30,40)

DS 106023, 10TeV,
offline MET>**30GeV**,
offline matched taus

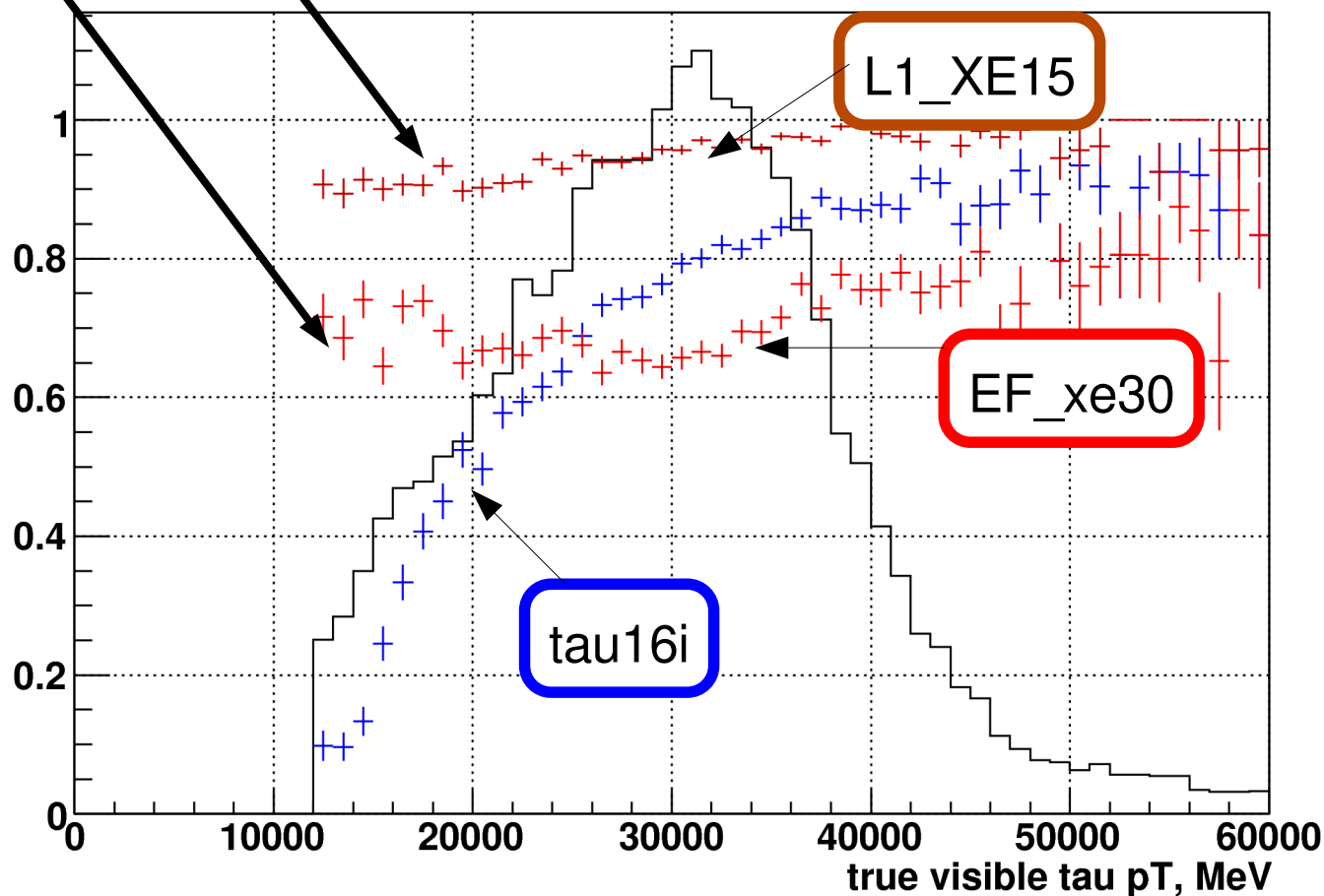tau12 for low pT

tau16i, optimized for taus > 20 GeV

true visible tau pT, MeV

W->τν, visible tau pT

DS 106023, 10TeV, offline MET**>30Ge**V, offline matched taus

Flat XE efficiency (for high offline MET values only)

L1_XE15

EF_xe30

tau16i

true visible tau pT, MeV
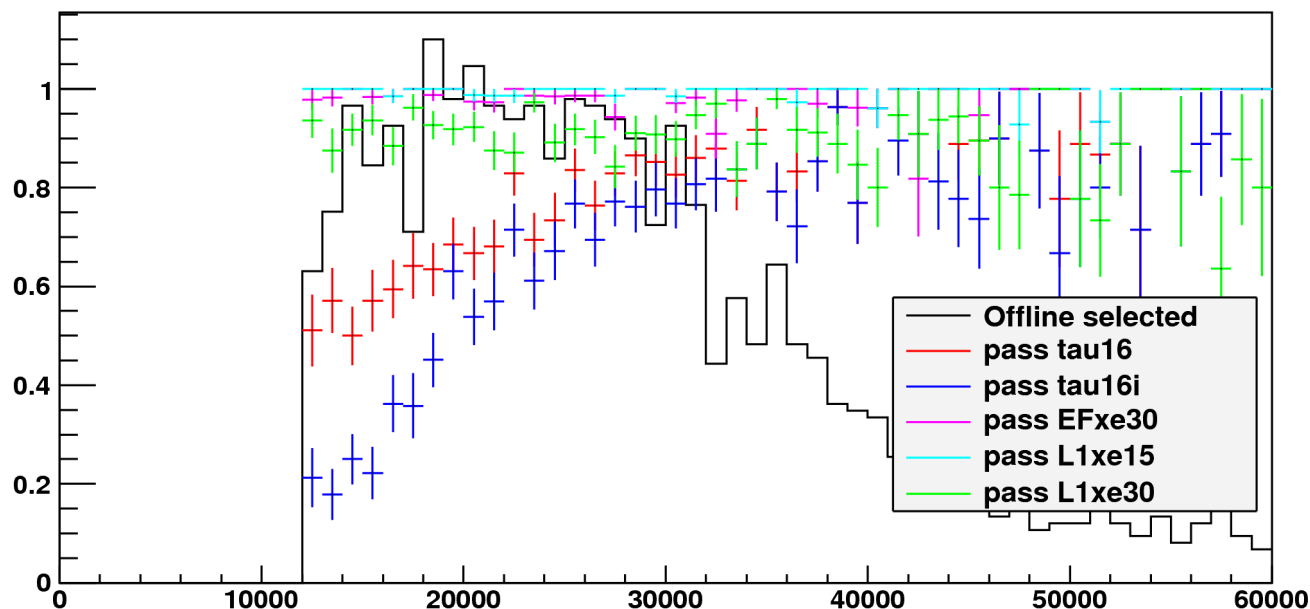
- It matters which offline MET cut is applied. If offline MET cut is high (e.g. 50 GeV), then xe30 is qiute safe. Unprescaled xe40 might be an interesting alternative.

offline MET>**50GeV,**
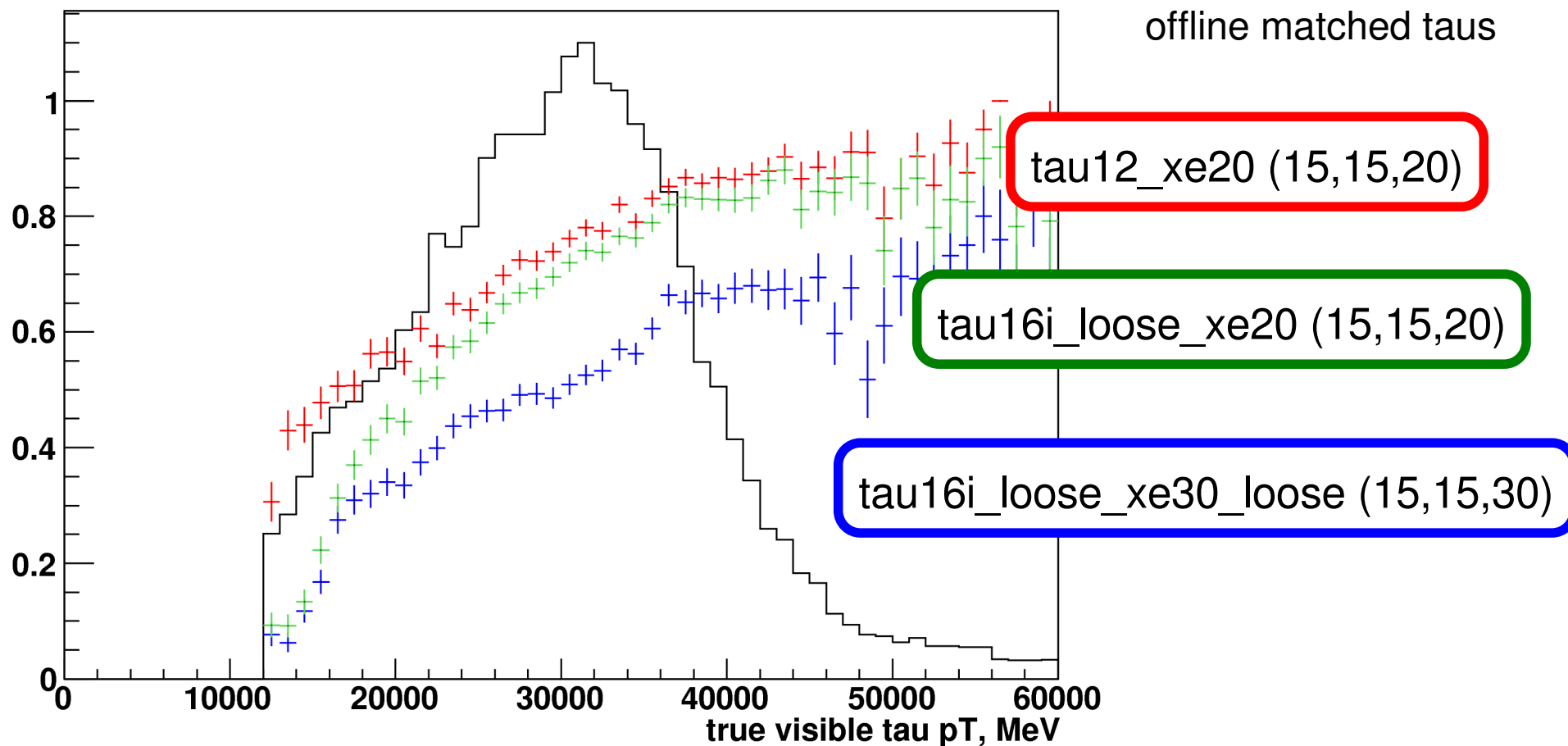
offline matched taus

offline matched

──	Offline selected
──	pass tau16
──	pass tau16i
──	pass EFxe30
──	pass L1xe15
──	pass L1xe30

W->τν, tau+MET combinations

DS 106023, 10TeV
offline MET>30GeV,
offline matched taus

offline matched

tau12_xe20 (15,15,20)

tau16i_loose_xe20 (15,15,20)

tau16i_loose_xe30_loose (15,15,30)

true visible tau pT, MeV

Use OR with xe40 to gain some of low pt taus?

W->τν trigger

Signature	L1,L2,EF XE cuts in GeV	Rate @ 10TeV,10^{31}	W->τν efficiency (106023)
tau16i_loose_xe25	(15,15,25)	5.4Hz	60%
tau16i_loose_xe30EF	(0,0,30)	2.3Hz	50.3%
tau16i_loose_xe30_loose	(15,15,30)	2Hz	49.7%
tau16_loose_xe30_loose	(15,15,30)	2.3Hz	50%
tau12_xe20	(15,15,20)	19Hz	72%
tau12_xe25	(15,15,25)	8 Hz	66%
tau12_xe30_loose	(15,15,30)	3Hz	55%
L1TAU6_xe30_loose	(15,15,30)	20Hz	68%
L1TAU9I_xe30	(20,20,30)	7.4Hz	60%
xe30_loose	(15,15,30)	38Hz	64%
xe40	(30,30,40)	0.6Hz	25%

2 →

0 →

1 →

1a? →

Proposal for tau+MET

- At 10TeV, 10^{30} use *tau12_xe20*

- If rate is too high, use *tau12_xe25*

- Then introduce tau L1 EM isolation if rate is still too high (*tau12i_xe30*?)

- At 10^{31} use *tau16i_xe25 OR xe40*

- Could introduce *L1_TAU9(I)+xe30* (no tau HLT)

  – gives very high efficiency, but L2 output rate might be a problem.

Many options are possible,
but only few will be implemented and commissioned.
Please provide feedback soon.

Above options are not necessarily best for SM Higgs searches

Conclusions

- Most of the changes discussed in Beatenberg are implemented

- Current (release 15.1.0) menu looks simpler

- L1 EM isolation cut helps to reduce rate for low pt items. Keep it. (may be remove it for tau+e/mu signatures)

- Modification of MET chains – standard new MET chains are good for tau+MET no need for loose MET signatures

    - use xe30 (20,20,30) instead of (0,0,30) or (15,15,30)

- Should consider tau12_xe20 and tau16i_xe20(25) combinations for W->$\tau\nu$.

- Need to think what are the needs for SM Higgs searches in terms of tau+MET – assume high lumi items and harder offline pT cut for taus (tau29_xe30 (20,20,30))