A. Nikitenko Imperial College, UK / ITEP Moscow

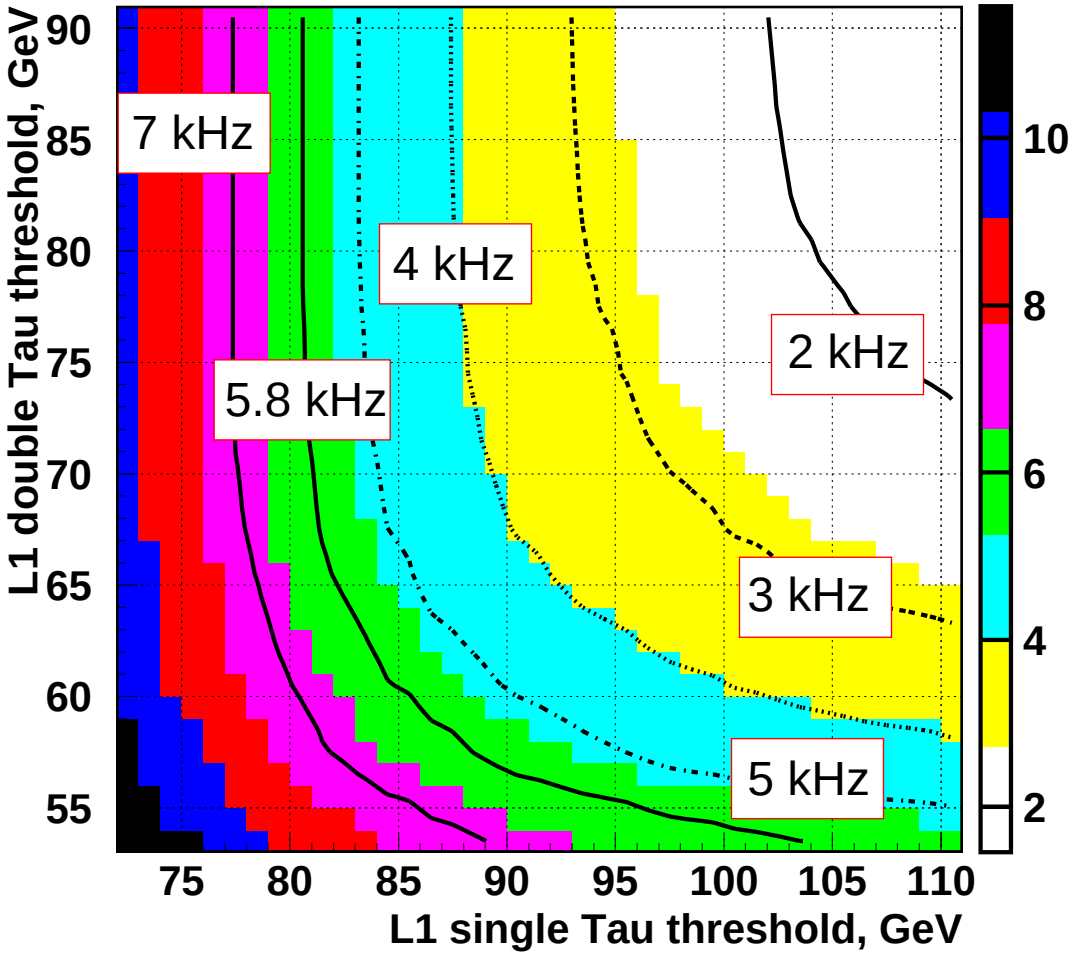
L1 and HLT on “jetmet” channels

results obtained by R. Kinnunen, S. Abdullin , A. Nikitenko

- MSSM Higgs in gg->bbH, H ->2τ ->2 jet
  M_H=200, 500 GeV
- MSSM H^+ in gb->t H^+->τ ν -> τ-jet + b + 2 q-jets
  M_{H^+}=200, 400 GeV
- invisible Higgs in qq->qqH, M_H=120 GeV
- SUSY multi jets + MET. 6 points in mSUGRA

L1 for MSSM H->2τ->2jet

L1 iso-rate curves for 1Tau or 2Tau

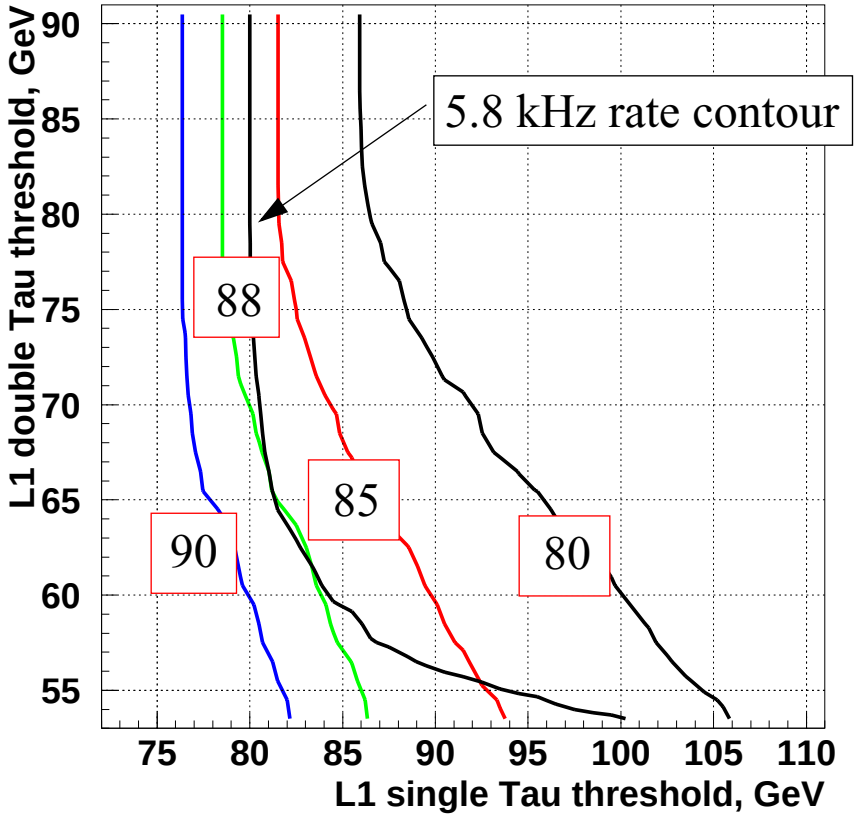


optimal thresholds for the same rate

efficiency of tau signals at 5.8 kHz L1 rate of 1T or 2T trg.

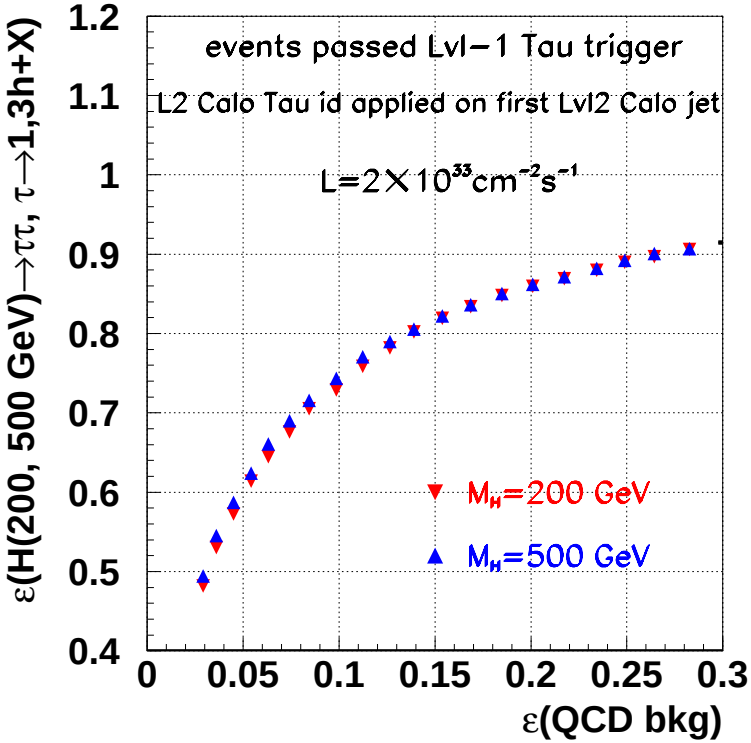
L1 threshold, GeV		efficiency	
1Tau	2 Tau	H->2τ-jets M=200 GeV	H^+->τ-jet M=200 GeV
100	54	0.82	0.82
94	55	0.84	0.84
88	57	0.86	0.85
84	60	0.88	0.86
82	64	0.88	0.87
81	65	0.88	0.87
80	80	0.86	0.87

efficiency (%) for H->2τ-jet M_H = 200 GeV



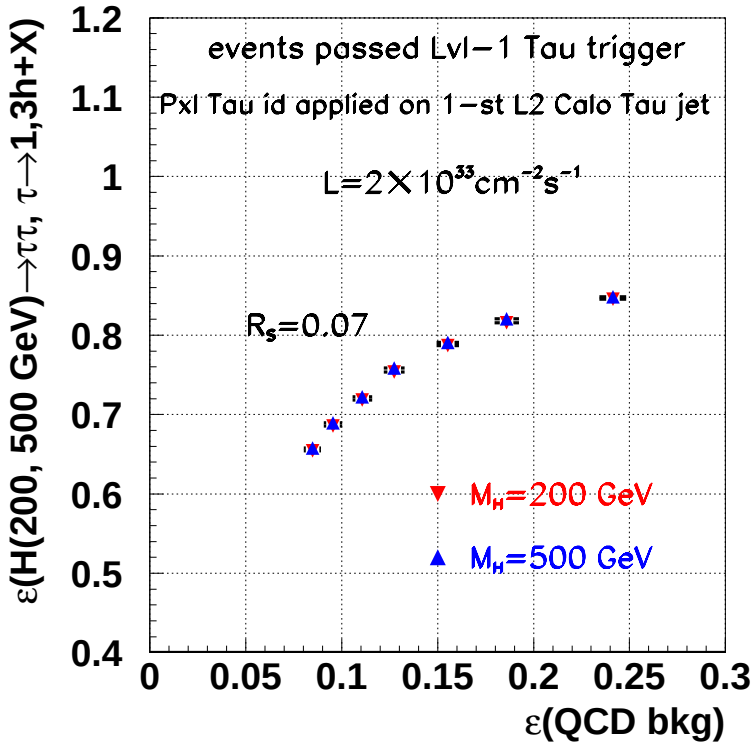
HLT : 1-st way for H -> 2τ -> 2-jets (I) : L2 calo + L3 Pxl

first apply calo id for 1-st L2 Calo Jet



and suppress rate by factor 5

then apply Pxl id for 1- st L2 Calo Tau Jet



and suppress rate by factor ~10

HLT : 1-st way for H -> 2τ -> 2-jets (II) : L2 calo + L3 Pxl

in 22 % 2-nd L1 Tau catches not real tau

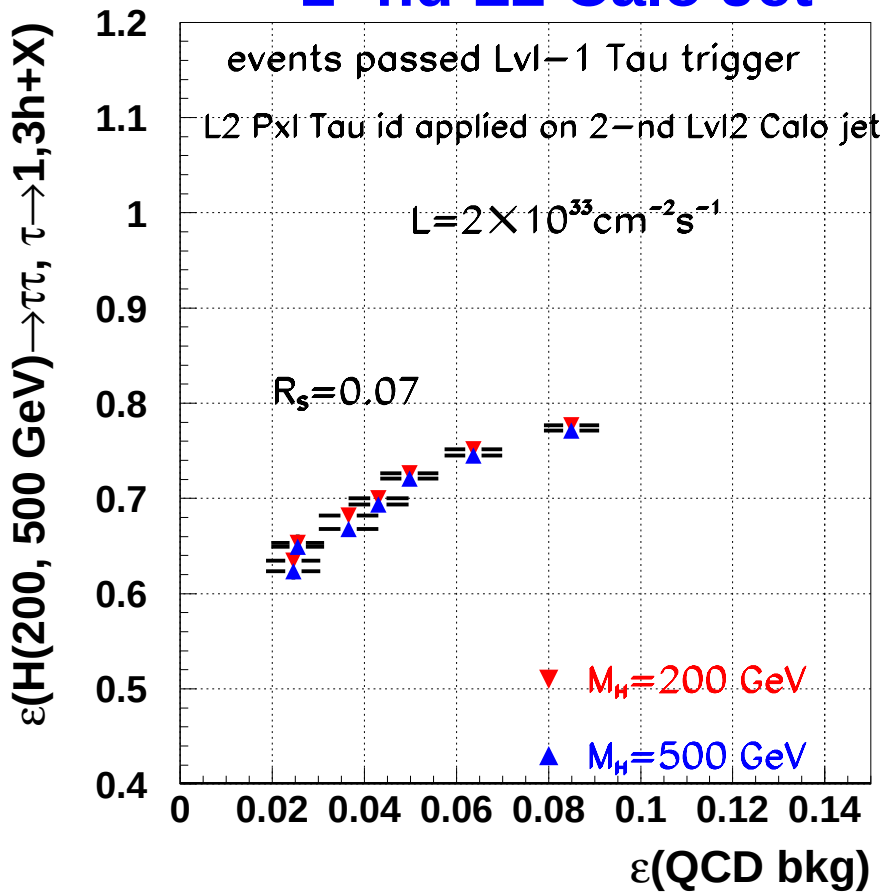
in 14 % there is no 2-nd L1 Tau at all.

in that case tau is picked up by 1-st Central Jet.

Strategy for 2-nd tau seach at Lvl 2 is :

if there is no 2-nd L1 Tau or E_T < 35 GeV at Lvl-2 analyse 1-st L1 Central Jet

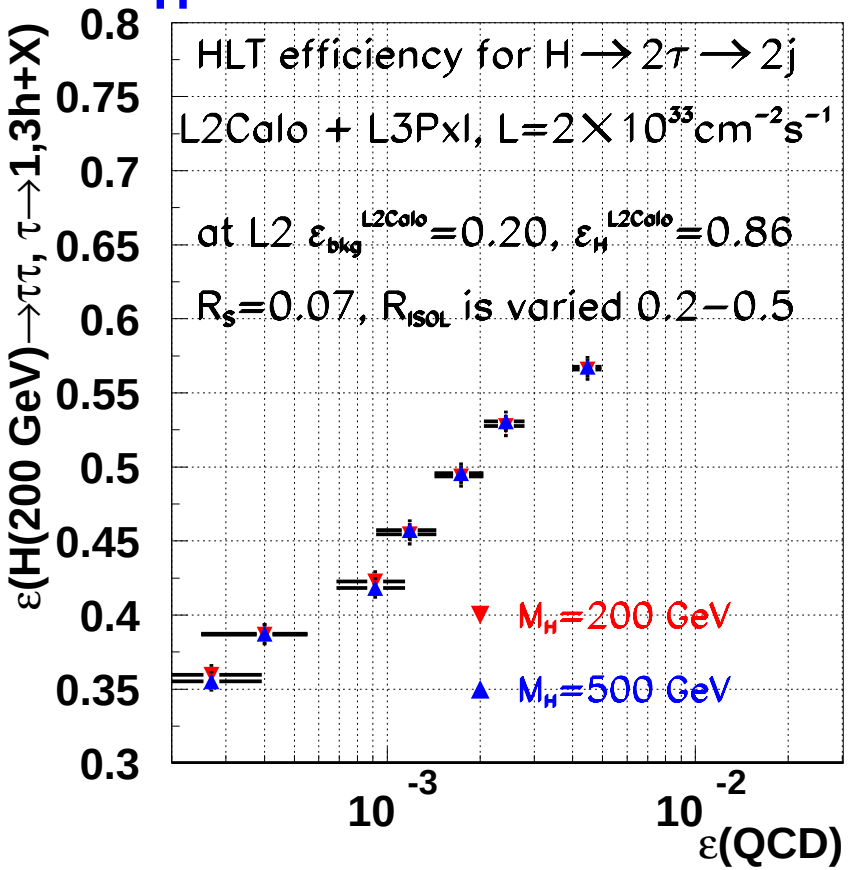
apply Pxl id for 2- nd L2 Calo Jet



and suppress rate by factor 25

Result on HLT with Calo + Pixel for H -> 2τ -> 2-jets

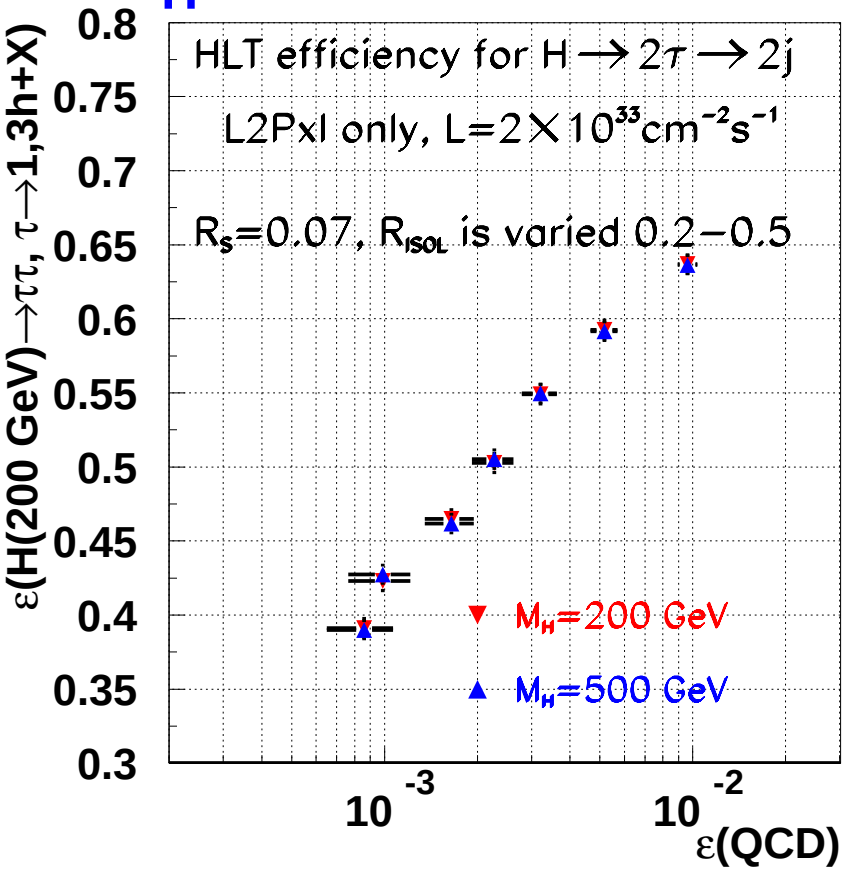
supression factor 10^{-3} for ε(H->2τ-jets) = 0.42 for M_H = 200 and 500 GeV



for R_{isol} = 0.40, R_s = 0.07, R_m = 0.1, p_t^m > 3 GeV, p_t^{isol} > 1 GeV

HLT : 2-nd way for H -> 2τ -> 2-jets with Pixels only

supression factor 10^{-3} for ε(H->2τ-jets) = 0.42 for M_H = 200 and 500 GeV



for R_{isol} = 0.45, R_s = 0.07, R_m = 0.1, p_t^m > 3 GeV, p_t^{isol} > 1 GeV

Charged Higgs : strategy at Lvl 2

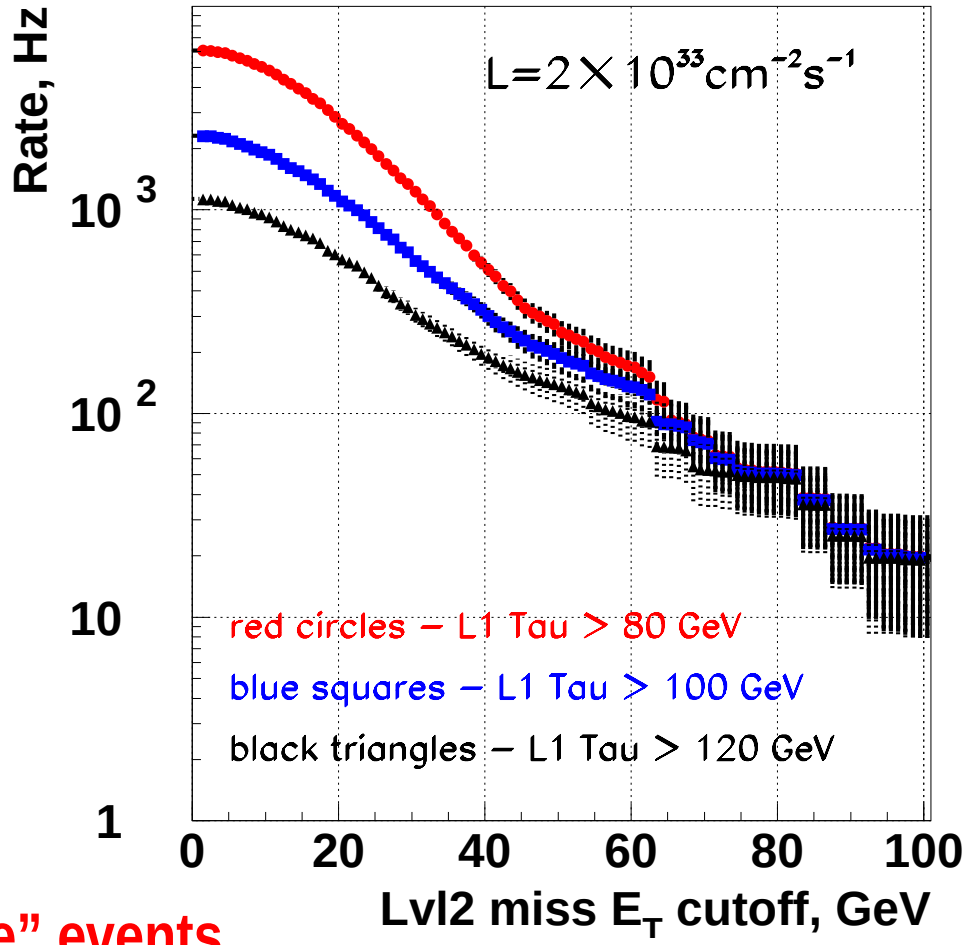
off-line analysis uses cut on miss E_T > 100 GeV, so let's do it at Lvl 2

1. Use at Lvl 1 single Tau trigger

L1 cut-off	rate	eff.
80 GeV	~6 kHz	0.87
100 GeV	2.3 kHz	0.82
120 GeV	1.1 kHz	0.68

2. cut at Lvl 2 on MET:

MET > 90 GeV
rate ~ 30 Hz

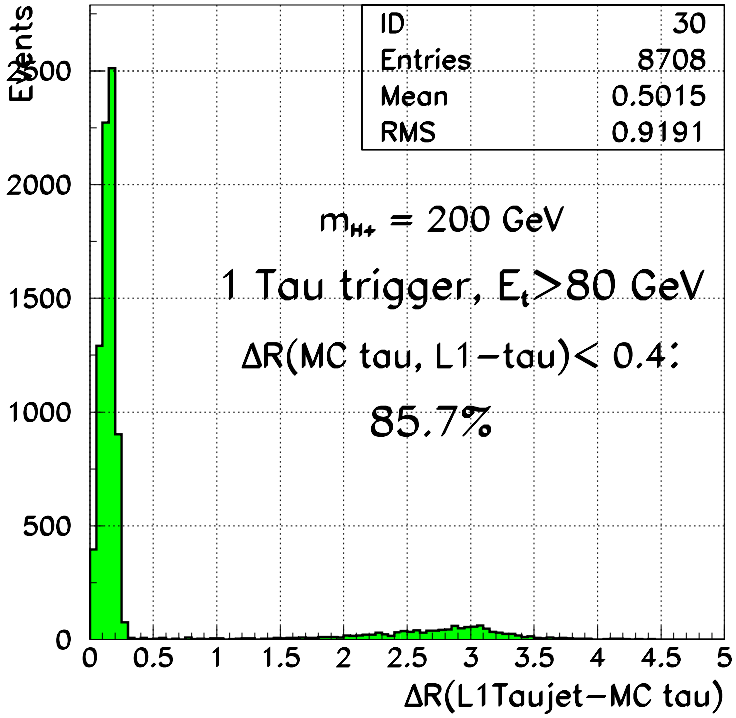


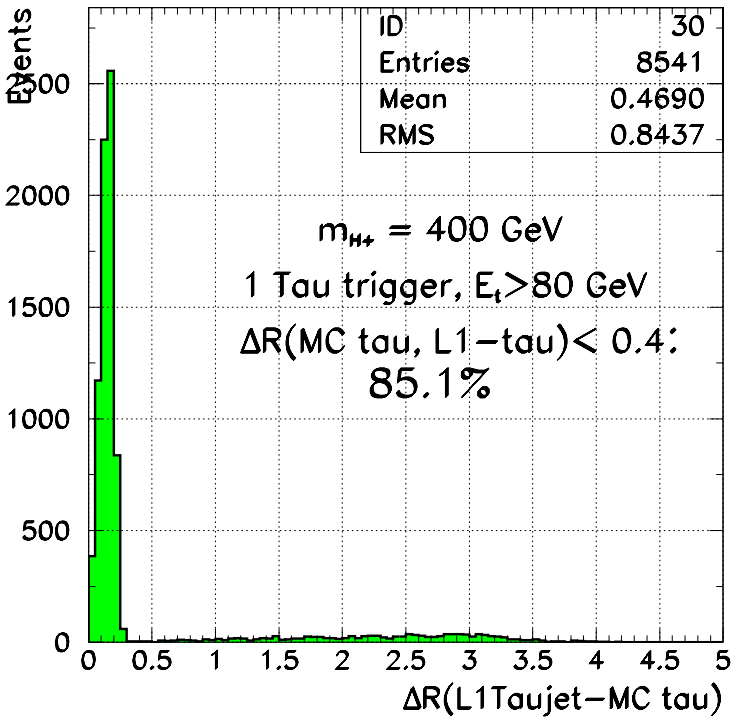
no loss at Lvl-2 of "off-line" events

Strategy for charged Higgs at Lvl 3

need suppression factor ~ 1/30. Can be achieved with Pxl or full Tracker isolation (see H->2τ-jet results)

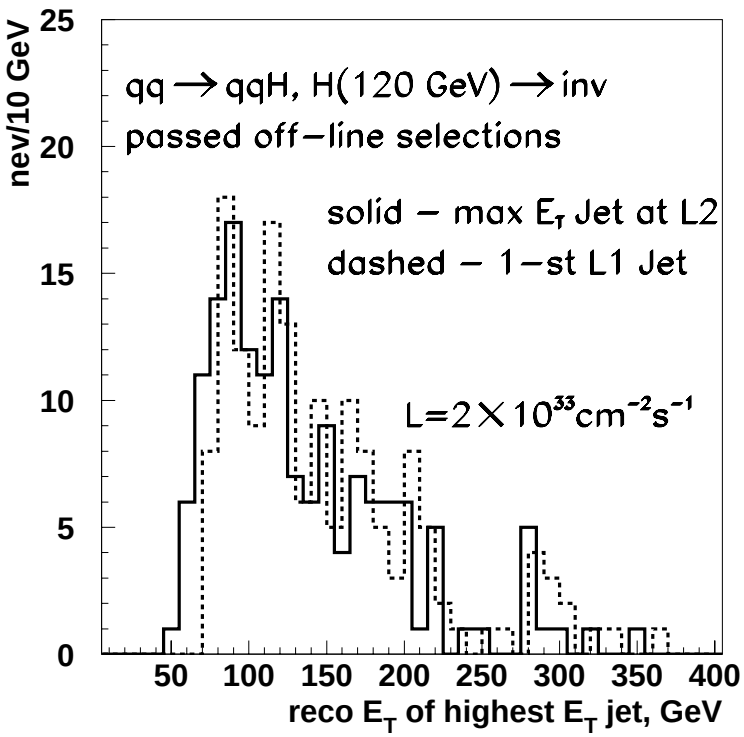
In 15% 1-st L1 Tau catches something else but not τ-jet. Final state is H^+t -> τ-jet + b jet + 2q jets

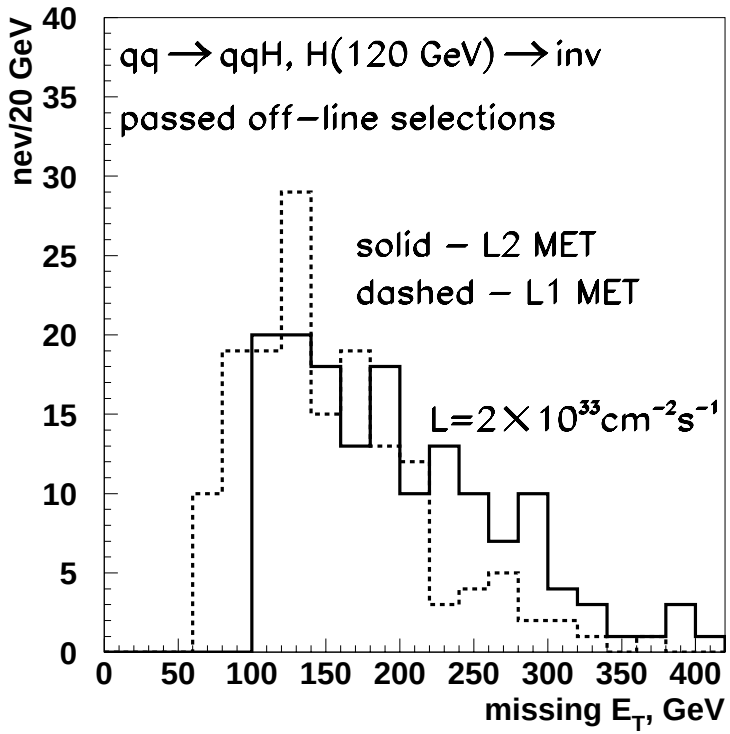




L1 for invisible Higgs in qq->qqH

off-line selections : $E_{Tj1,j2}$ > 40 GeV, $|\Delta\eta_{j1j2}|$ > 4.4,
$\eta_{j1}\eta_{j2}$ < 0, M_{j1j2} > 1200 GeV, miss E_T > 100 GeV, ϕ_{j1j2}<1rad





L1 J+MET 50-50 GeV is 100% efficient for events passed off-line cuts

HLT for invisible Higgs in qq->qqH

After cuts :

$E_{Tj1,j2} > 40$ GeV,

$|\Delta\eta_{j1j2}| > 4.4$,

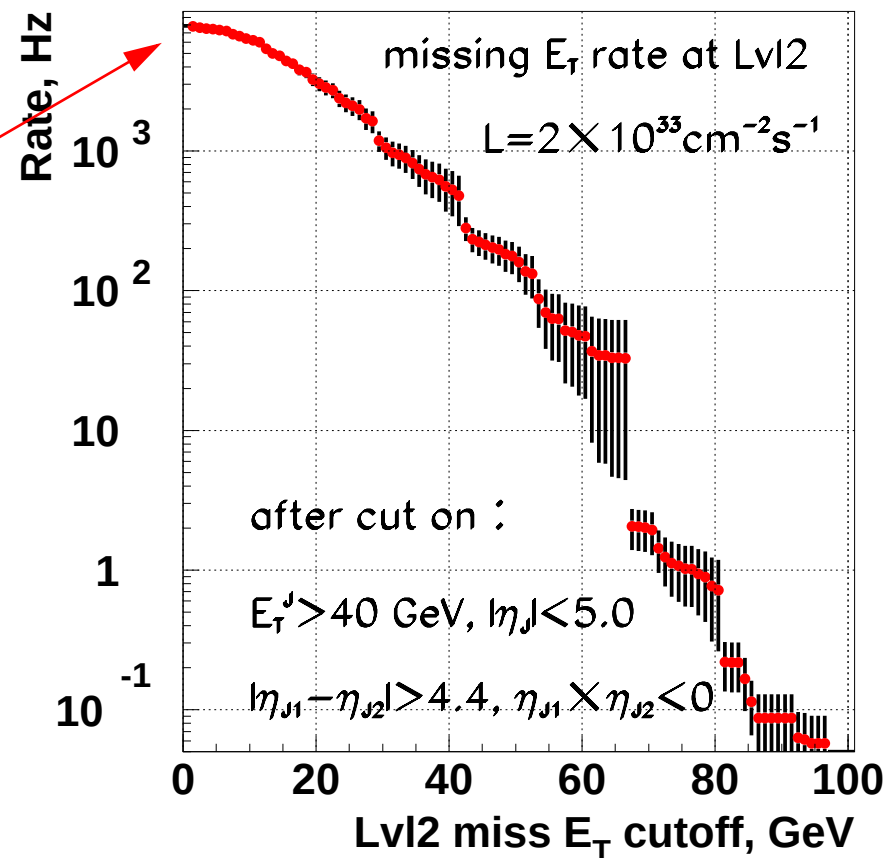
$\eta_{j1}\eta_{j2} < 0$

rate is 7.9 kHz

With additional cut

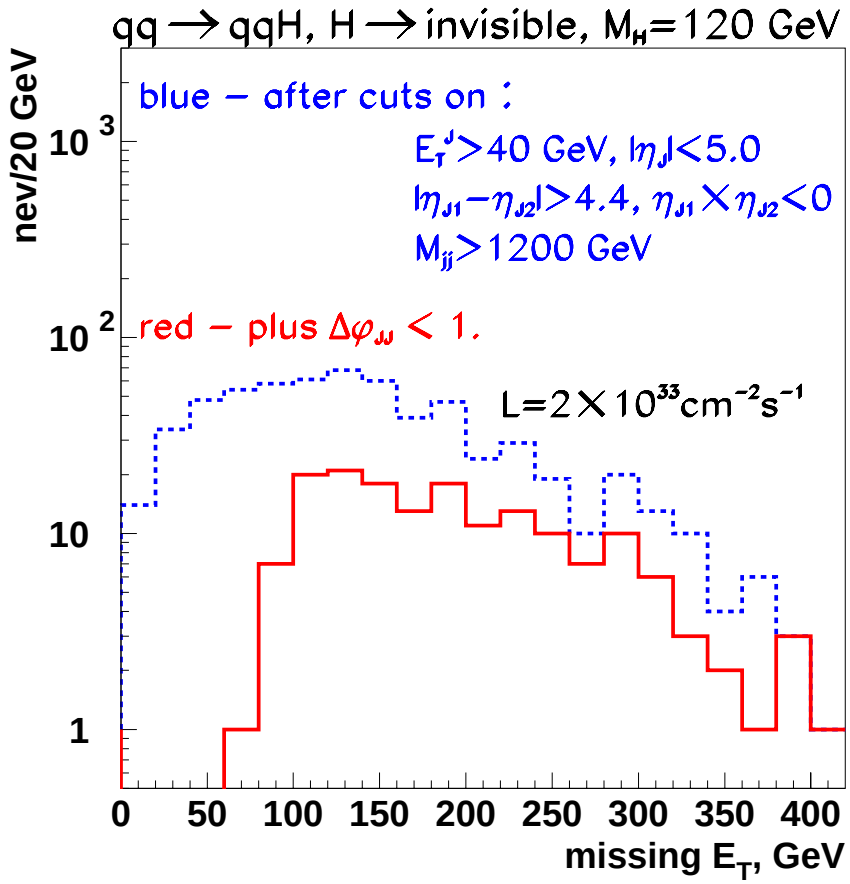
MET > 80 GeV

rate is ~ 1 Hz

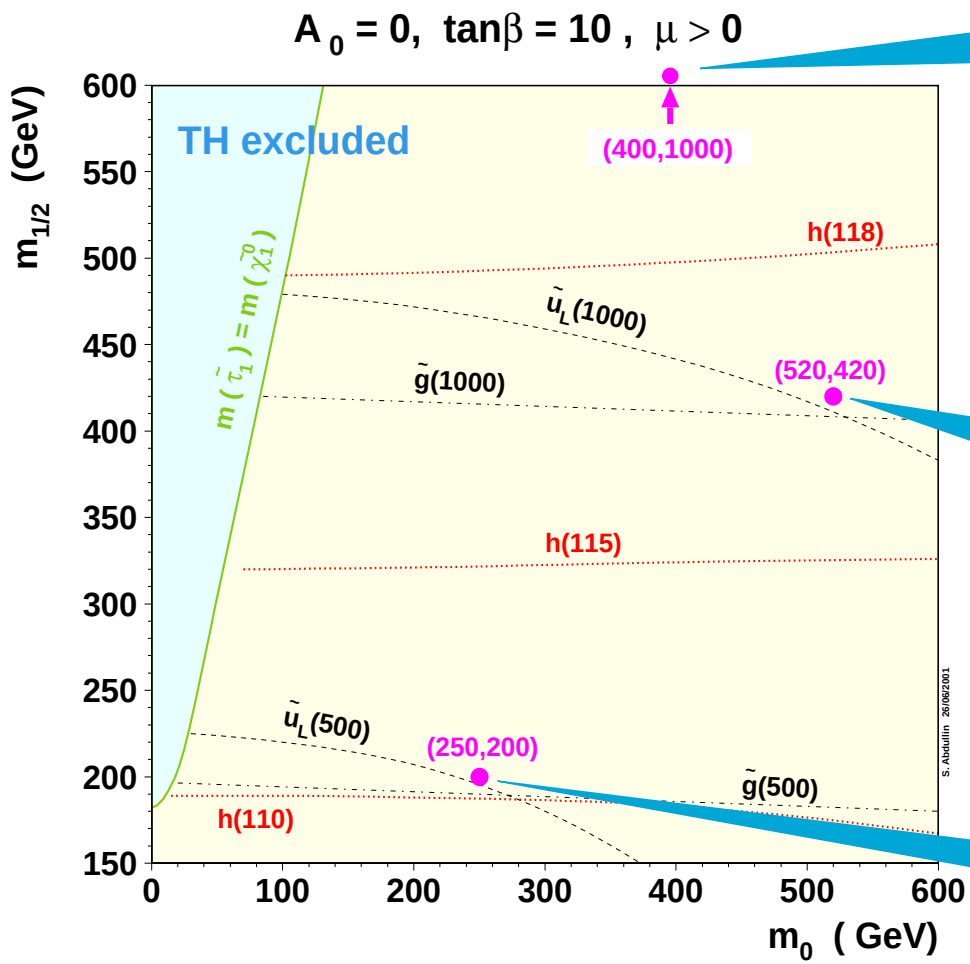


MET for off-line invisible Higgs

off-line cuts select invisible Higgs events with large MET



PROBING POINTS



$m(\tilde{\chi}_1^0) = 423$ GeV $m(h) = 121.9$ GeV

$m(\tilde{g}) = 2154$ GeV $m(\tilde{u}_L) = 1993$ GeV

$\sigma \sim 18$ fb, requires $\int Ldt \sim 20\text{-}25\ fb^{-1}$

typical cuts : $\not{E}_T > 800$ GeV, $N_j \geq 2$

3 $E_T^j > 300, 150$ GeV

$m(\tilde{\chi}_1^0) = 177.5$ GeV $m(h) = 116.8$ GeV

$m(\tilde{t}_1) = 726$ GeV

$\sigma = 2.24$ pb, requires $\int Ldt < 100\ pb^{-1}$

typical cuts : $\not{E}_T > 300$ GeV, $N_j \geq 3$

2 $E_T^j > 200, 100, 50$ GeV

$m(\tilde{\chi}_1^0) = 79.0$ GeV $m(h) = 110.7$ GeV

$m(\tilde{t}_1) = 352$ GeV

$\sigma = 115$ pb, requires $\int Ldt < 10\ pb^{-1}$

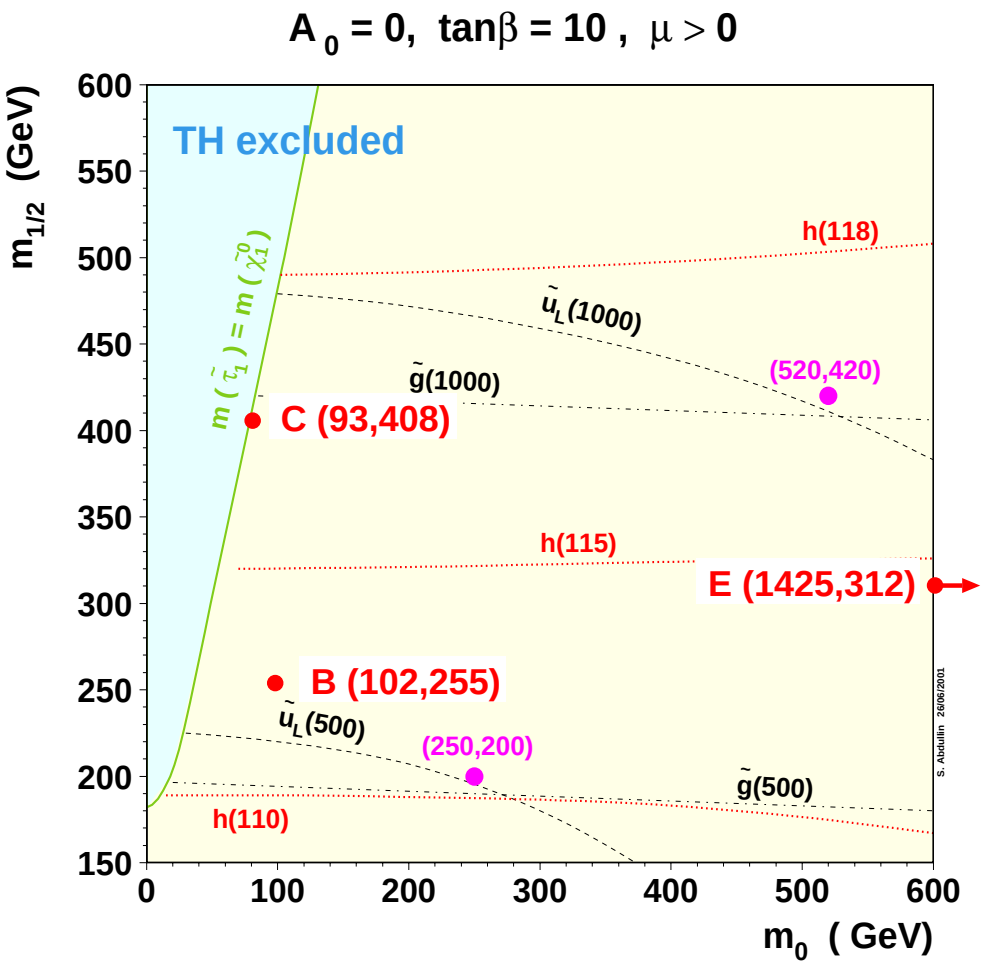
typical cuts : $\not{E}_T > 200$ GeV, $N_j \geq 2$

1 $E_T^j > 100, 50, 50$ GeV

- **Typical off-line signal efficiency : 20 - 70 % (@ 0.5 - 2 TeV)**

MORE PROBING POINTS ...

taken from paper hep-ph/0106204 by J.Ellis et al.



☞ **All 3 points are within cosmologically interesting region ...**

☞ **Point B :**

m_h = 113 GeV
$m_{\tilde{g}}$ = 606 GeV
$m_{\tilde{q}}$ = 500-550 GeV (400 for $\tilde{t}_1$)
close to g_μ - 2 limit
tau-enriched, quite enough sleptons

☞ **Point C :**

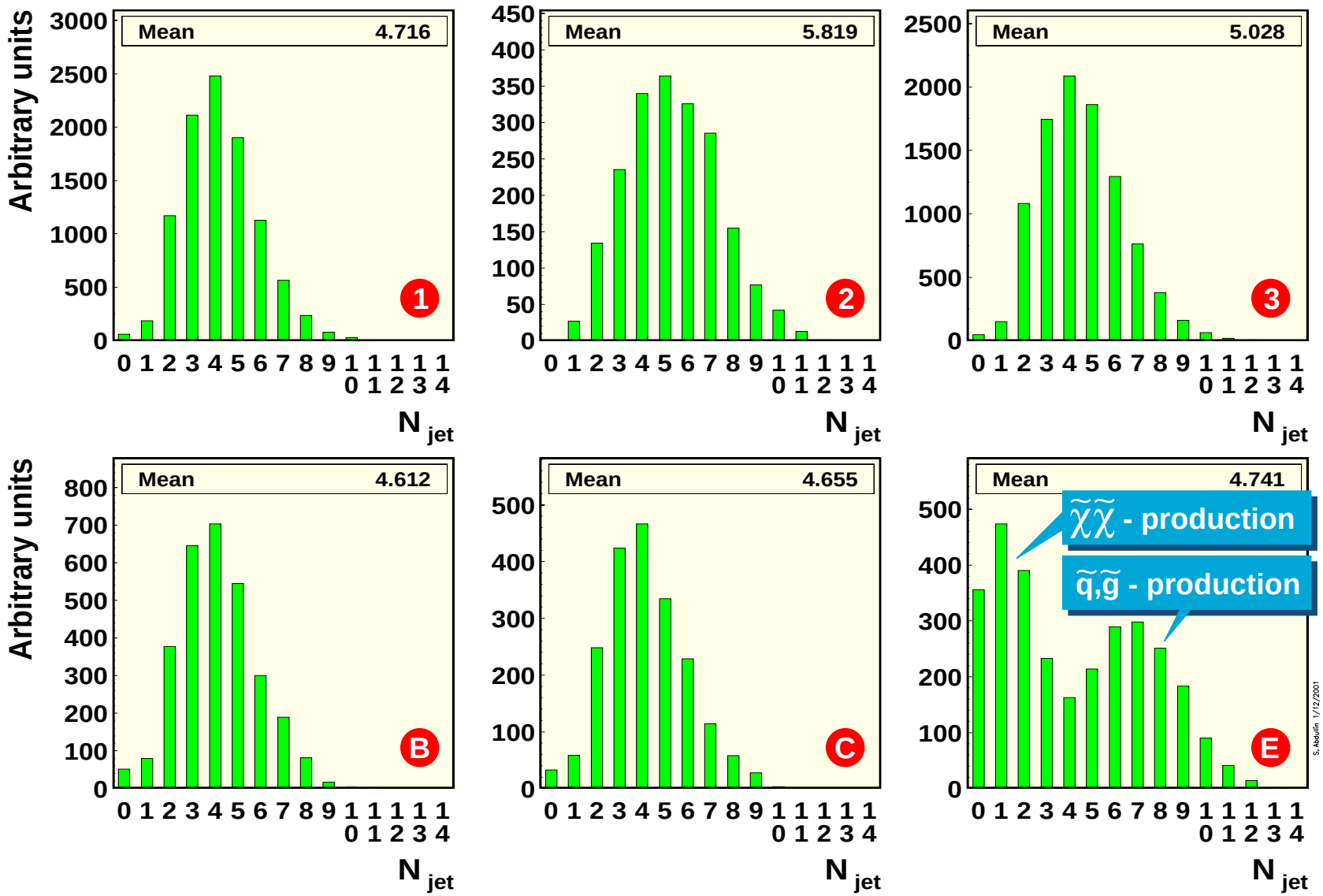
m_h = 117 GeV
$m_{\tilde{g}}$ = 932 GeV
$m_{\tilde{q}}$ = 800-830 GeV (635 for $\tilde{t}_1$)
in the coannihilation "tail"
lower jet multiplicity, higher MET

☞ **Point E (big $\tilde{\chi}\tilde{\chi}$ fraction ~ 40 %) :**

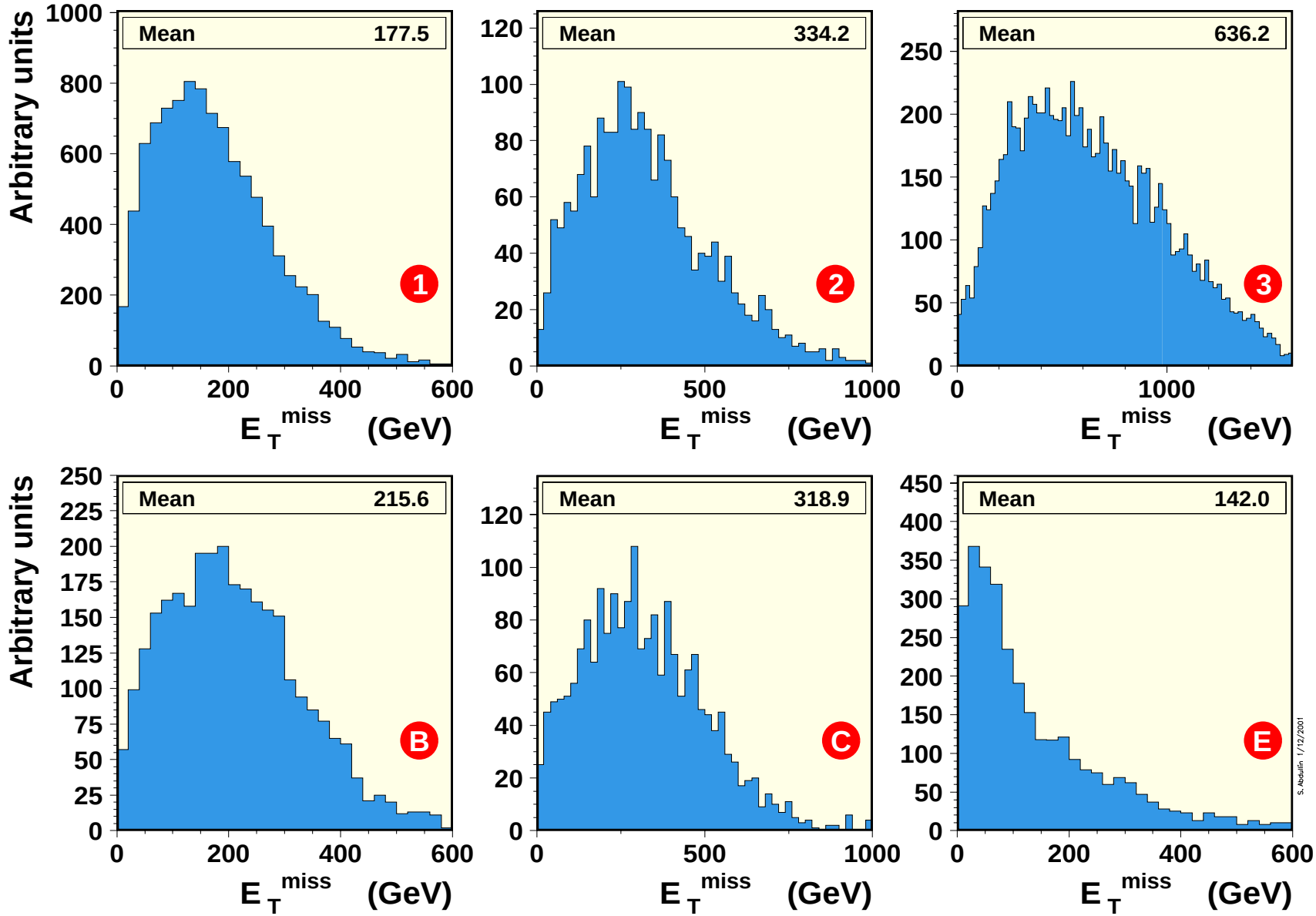
m_h = 116 GeV
$m_{\tilde{g}}$ = 804 GeV, 3-body decays (softer)
$m_{\tilde{q}}$ = ~1500 GeV (987 for $\tilde{t}_1$) → gluino "focused point"
high jet multiplicity (incl. b's), lower MET

NUMBER OF L2 JETS

$E_T^{jet} > 40$ GeV



PROBING POINTS DISTRIBUTIONS : L2 MET



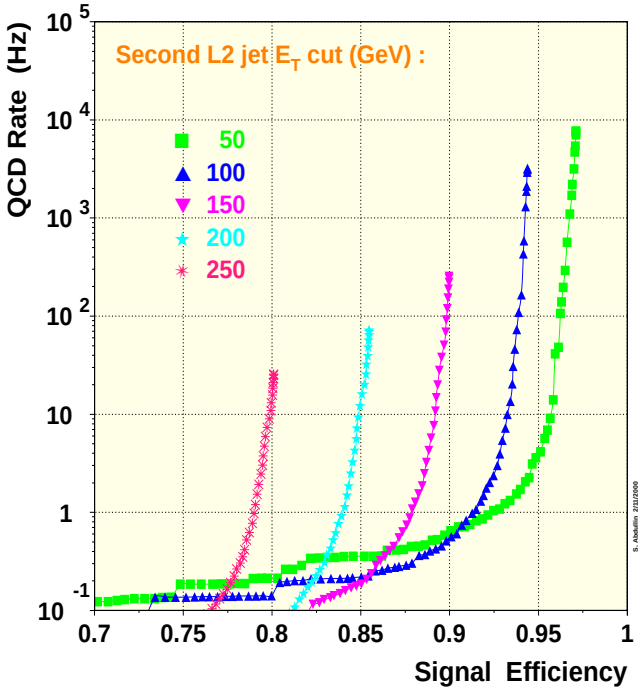
L1 SIGNAL SELECTION

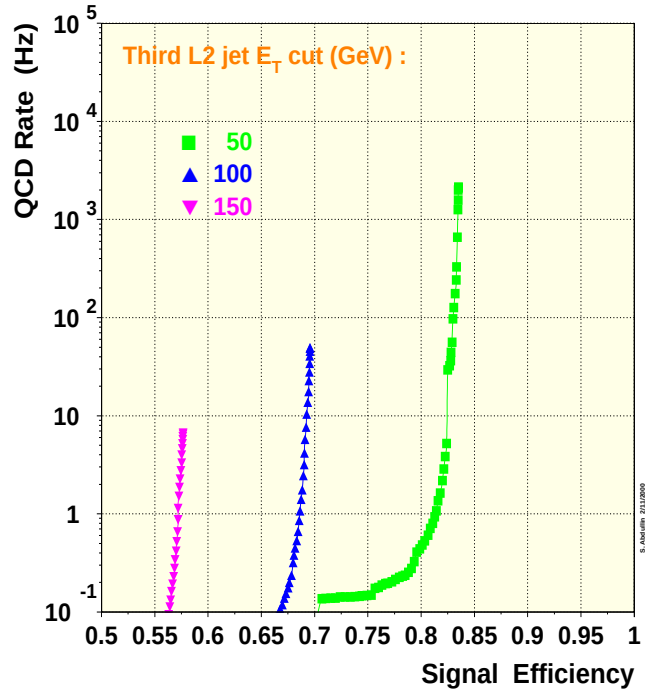
- L1 cuts taken from CMS IN 2001/42 (Wisconsin team)
  - nominal 12.5 kHz L1 Trigger rate limit is assumed
  - L1 jet cuts : 120, 90, 70, 50 GeV for (respectively)1, 2, 3, 4 jets
    L1 MET cut : 100 GeV (95 % at 275 GeV !)

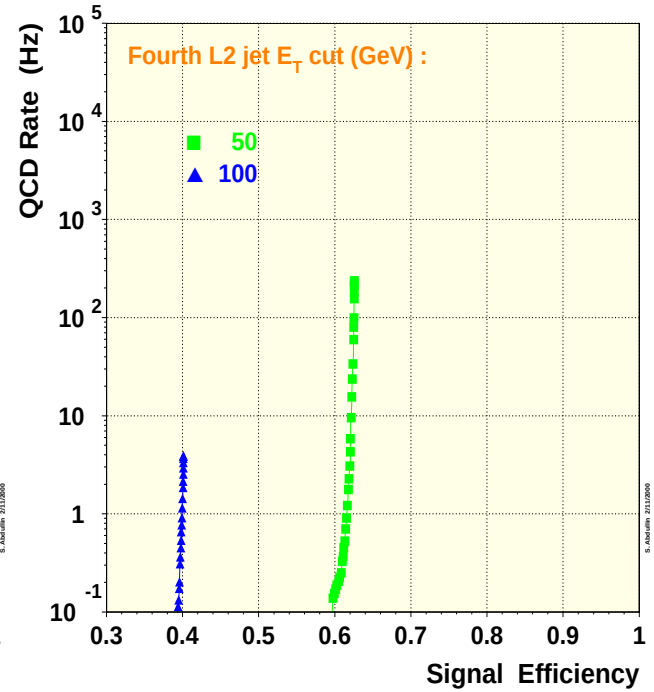
- Signal individual (cumulative) trigger efficiencies (%)

Point	E_T cut (GeV)				
	j (120)	jj (90)	jjj (70)	jjjj (50)	MET (100)
1	91.5 (91.5)	81.1 (93.3)	58.6 (93.3)	38.2 (94.3)	67.2 (94.5)
2	97.5 (97.5)	93.1 (97.7)	81.6 (98.2)	65.6 (98.2)	88.3 (98.2)
3	98.7 (98.7)	94.8 (98.8)	76.0 (98.8)	53.9 (98.8)	95.8 (98.9)
B	93.2 (93.2)	85.6 (94.4)	66.4 (94.7)	43.7 (97.7)	75.1 (94.9)
C	95.5 (95.5)	89.7 (95.6)	69.6 (95.7)	48.0 (95.8)	86.7 (95.9)
E	59.3 (59.3)	53.5 (60.9)	50.3 (61.1)	46.7 (61.3)	42.5 (61.6)

SIGNAL EFFICIENCY VS QCD RATE AT L2 (III)



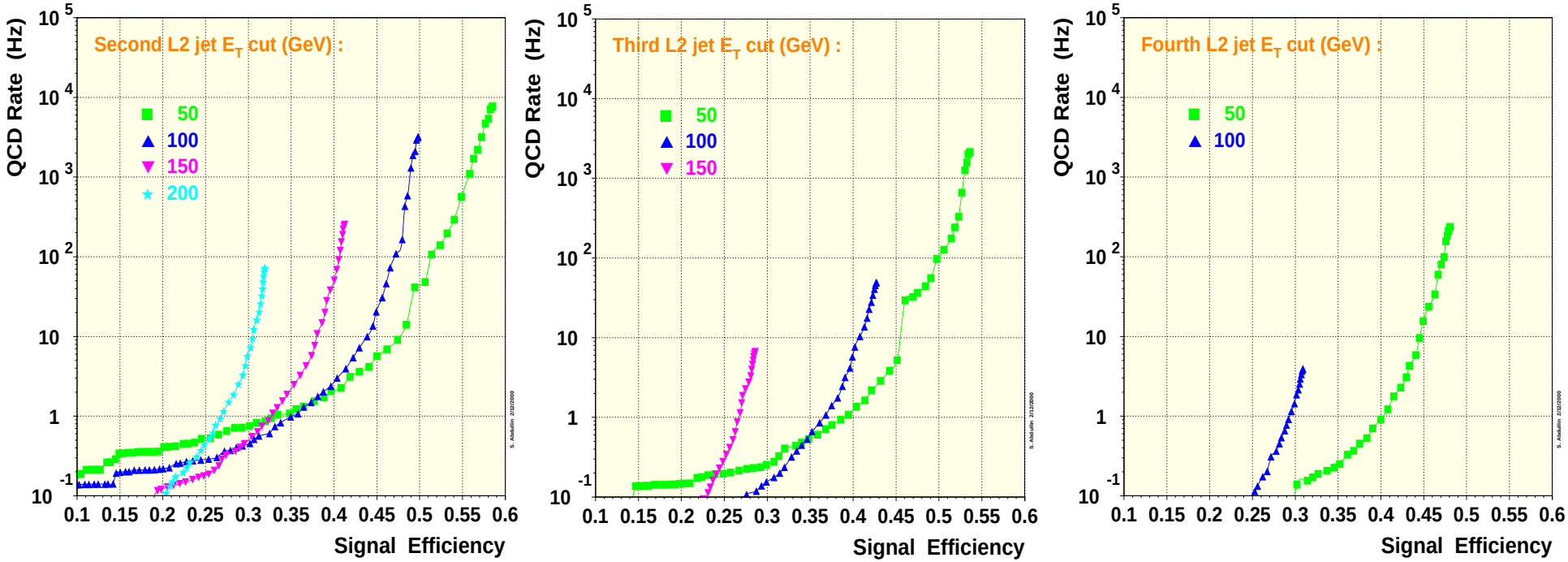




Point 3

- **92-93 % of the signal at ~ 1 Hz QCD rate with**
  - **2 jets with E_T > 50 GeV + MET > 180 GeV**
  - **2 jets with E_T > 100 GeV + MET > 130 GeV**
  - **3 jets with E_T > 50 GeV + MET > 125 GeV corresponds to ~ 82 % eff.**

SIGNAL EFFICIENCY VS QCD RATE AT L2 (III)



Point E

- ~ 40 % of the signal at ~ 1 Hz QCD rate with
  - 3 jets with E_T > 50 GeV + MET > 110 GeV
  - 4 jets with E_T > 50 GeV + MET > 85 GeV

- 5-6 jets requirement is quite typical for such a signal ($m_{\tilde{q}} >> m_{\tilde{g}}$) in the "off-line" analysis