

A multijet path in the HLT
e.g. for R_p -Violating
SUSY

So far: HLT selection has 1-4 jet requirements.
Can the signal efficiency be increased using
>4 Jets in the analysis?

- Only the R_p -Violating scenario considered for the SUSY signal
 - The contribution of the MET cuts is \sim negligible
- 3 background channels used in the analysis: QCD, tt and W+jet
 - Clearly, multijet QCD rate underestimated; in the future one should use NJET or other ME Monte Carlo
- Ntuples used for both background and signal data:
jma206_orca534_19Dec2001

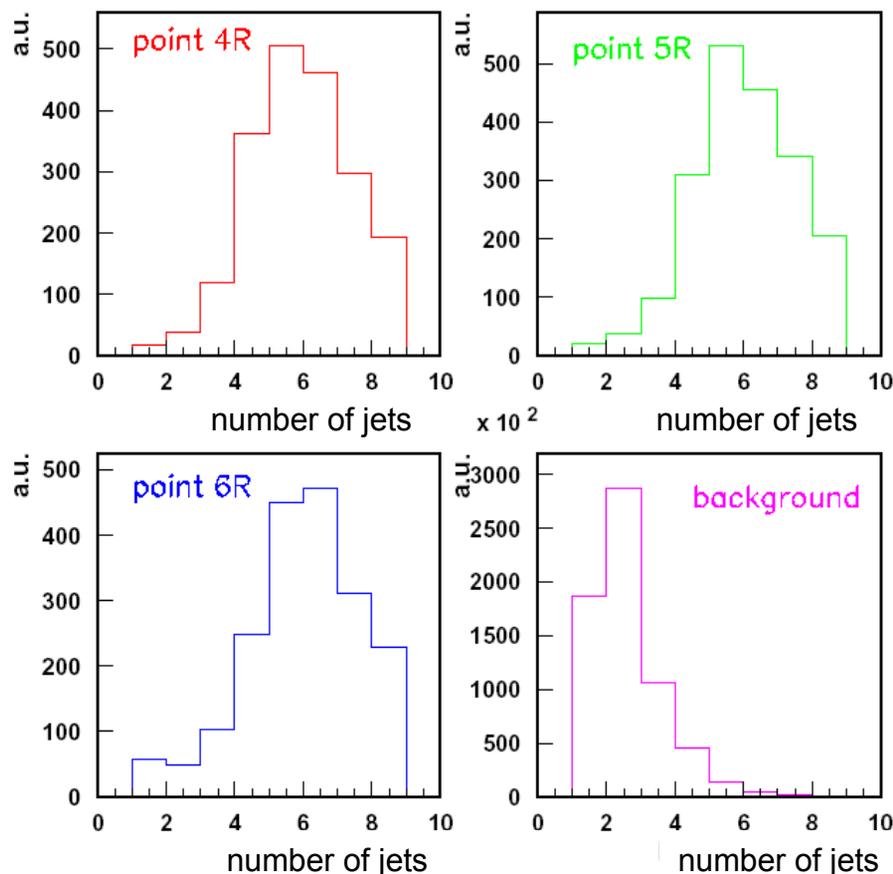
Efficiency calculation using the 4 highest E_T Jets

Cuts for L1T & HLT - Efficiencies for the R-Parity-Violating case

	EtCut (GeV)				Efficiency ($\times 1000$)			Background Eff. ($\times 1000$)
	1st jet	2nd jet	3rd jet	4th jet	4R	5R	6R	
L1T	145	110	60	47	929	942	866	163
HLT	550	400	190	120	190	211	92	22

The efficiency for the L1T is already high enough, but not the efficiency for HLT!

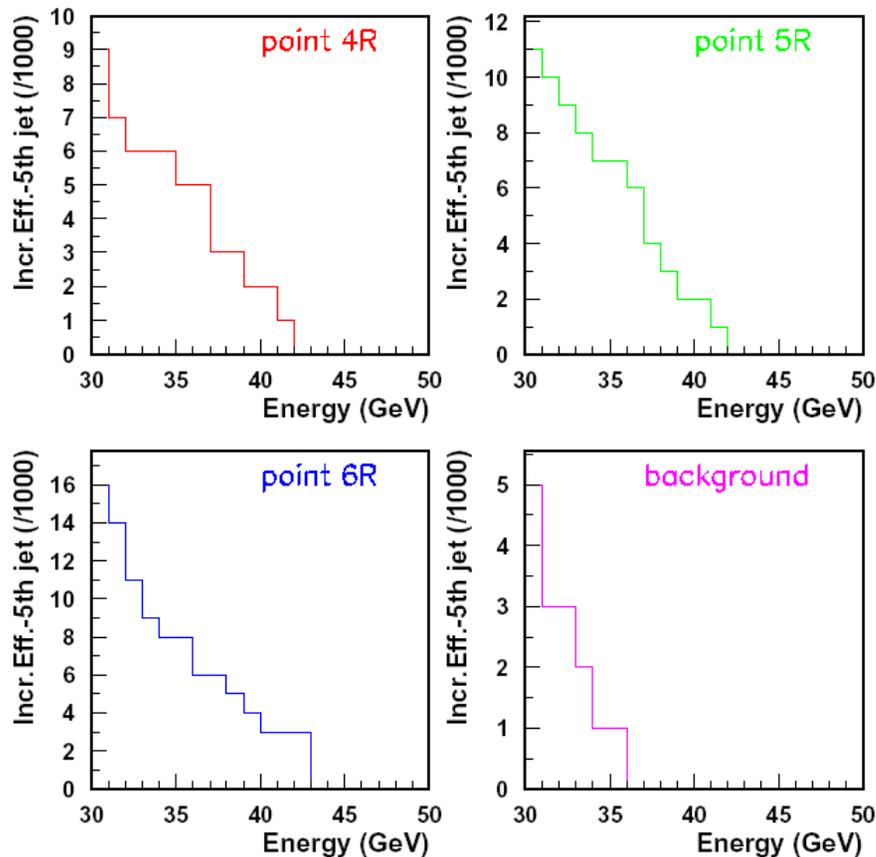
Including the Jets beyond the 4th highest E_T one, the signal efficiency increases without significantly increasing background efficiency, as most of the SUSY events have more than 4 jets, contrary to the background.



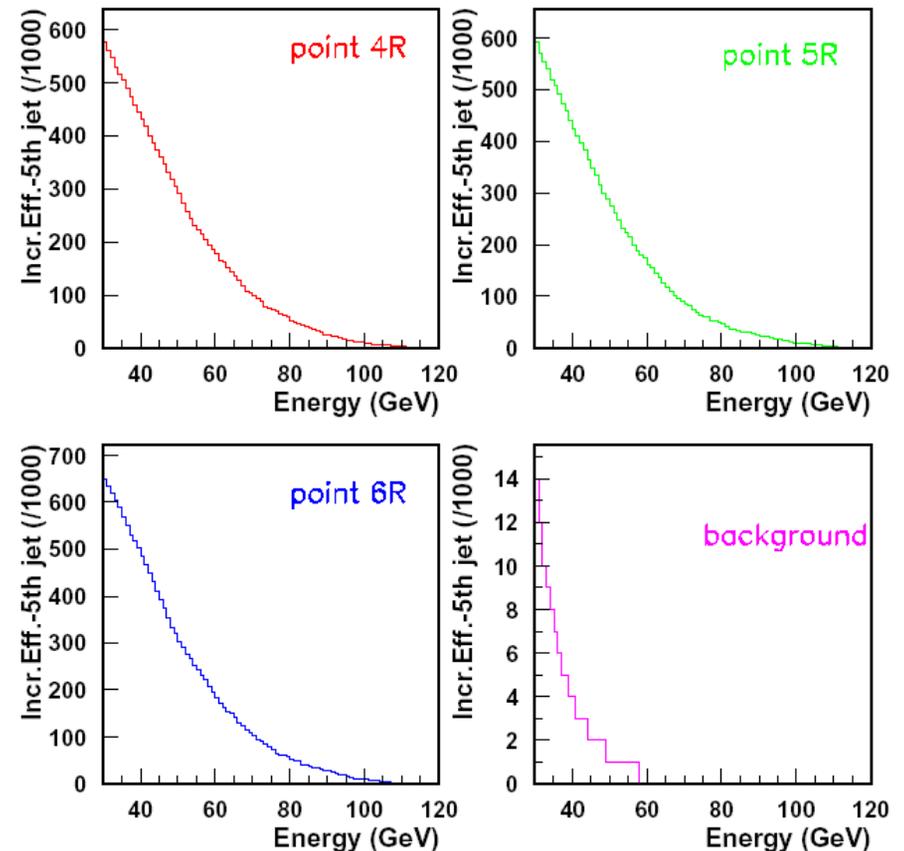
5th Jet Analysis

Calculation of the efficiencies with a step of 1 GeV to Cut on fifth jet

Increasing efficiency for the 5th Jet
@ L1 Trigger \rightarrow negligible ($<1\%$)

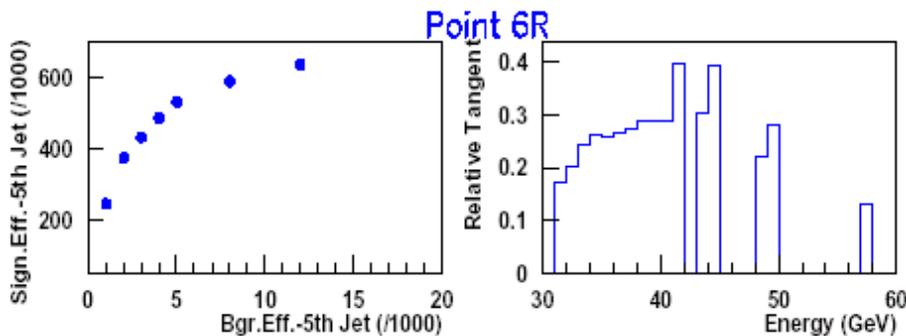
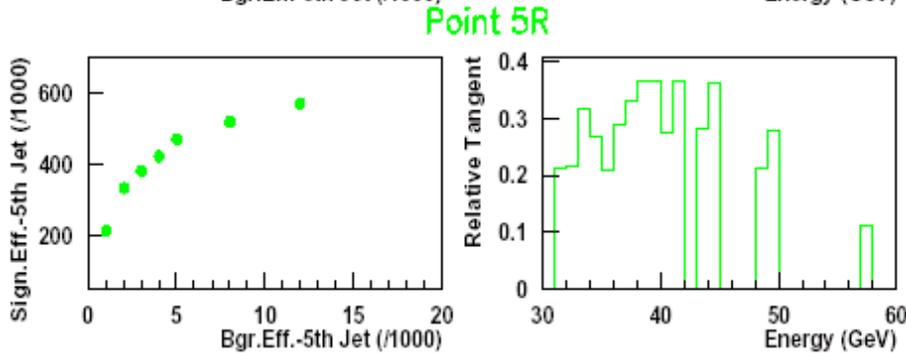
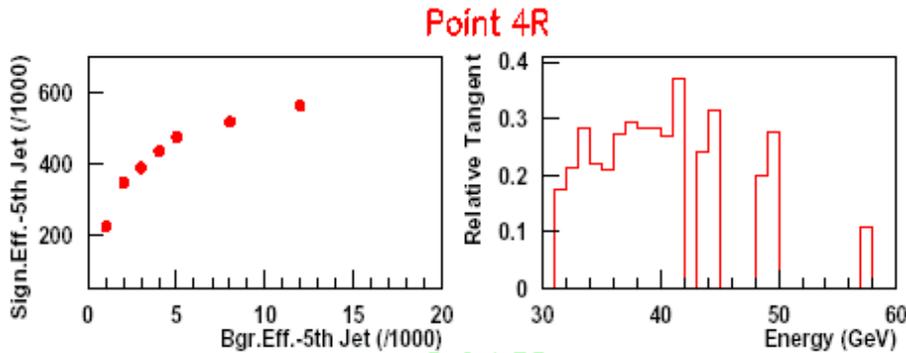


Increasing efficiency for the 5th Jet
@ HLT \rightarrow considerable (up to 60%)



\therefore We continue the analysis for the HLT case

Next step: determine optimal cut on 5th jet (Et-Cut5)



Plotted: ADDITIONAL eff for signal (y-axis) .vs. ADDITIONAL eff for bkg (x-axis)

ADDITIONAL: with respect to the 1-4 jet cuts

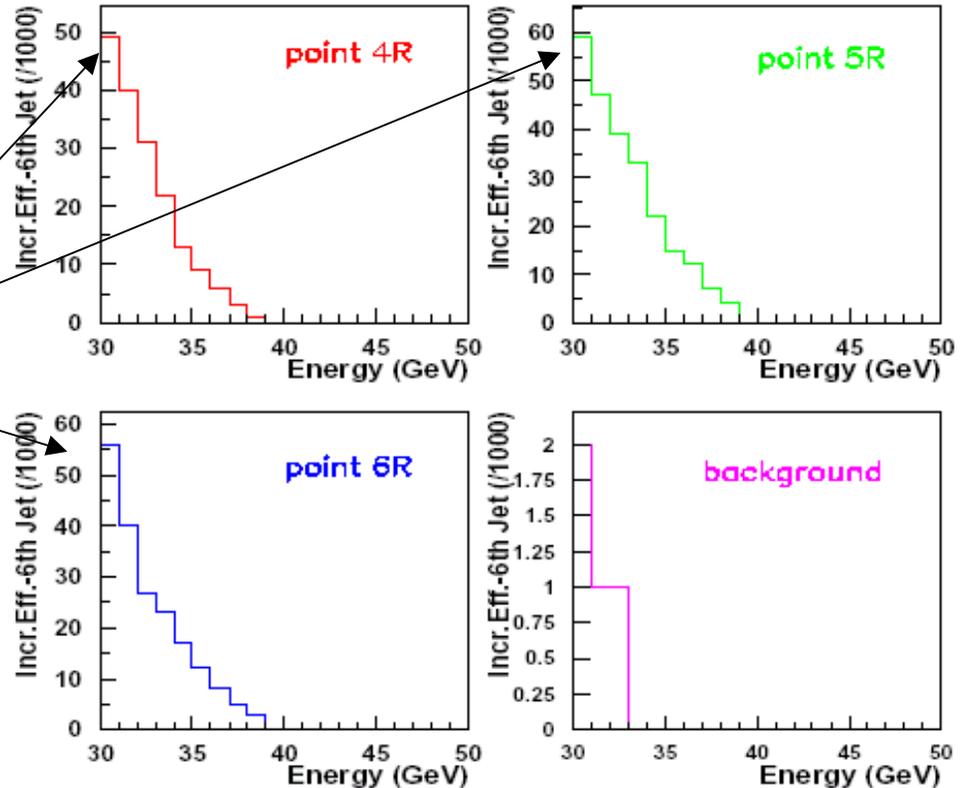
Appropriate range of energies: region where the background efficiency is reduced with at a rate greater than the rate of reduction in the signal efficiency.

∴ Allowed region of energies: 35–50 GeV

6th Jet Analysis

Setting $E_{t\text{-Cut}5} = 40$ GeV, repeat the process adding one more Jet in the analysis.

Potential improvement of up to 5-6% in signal efficiency



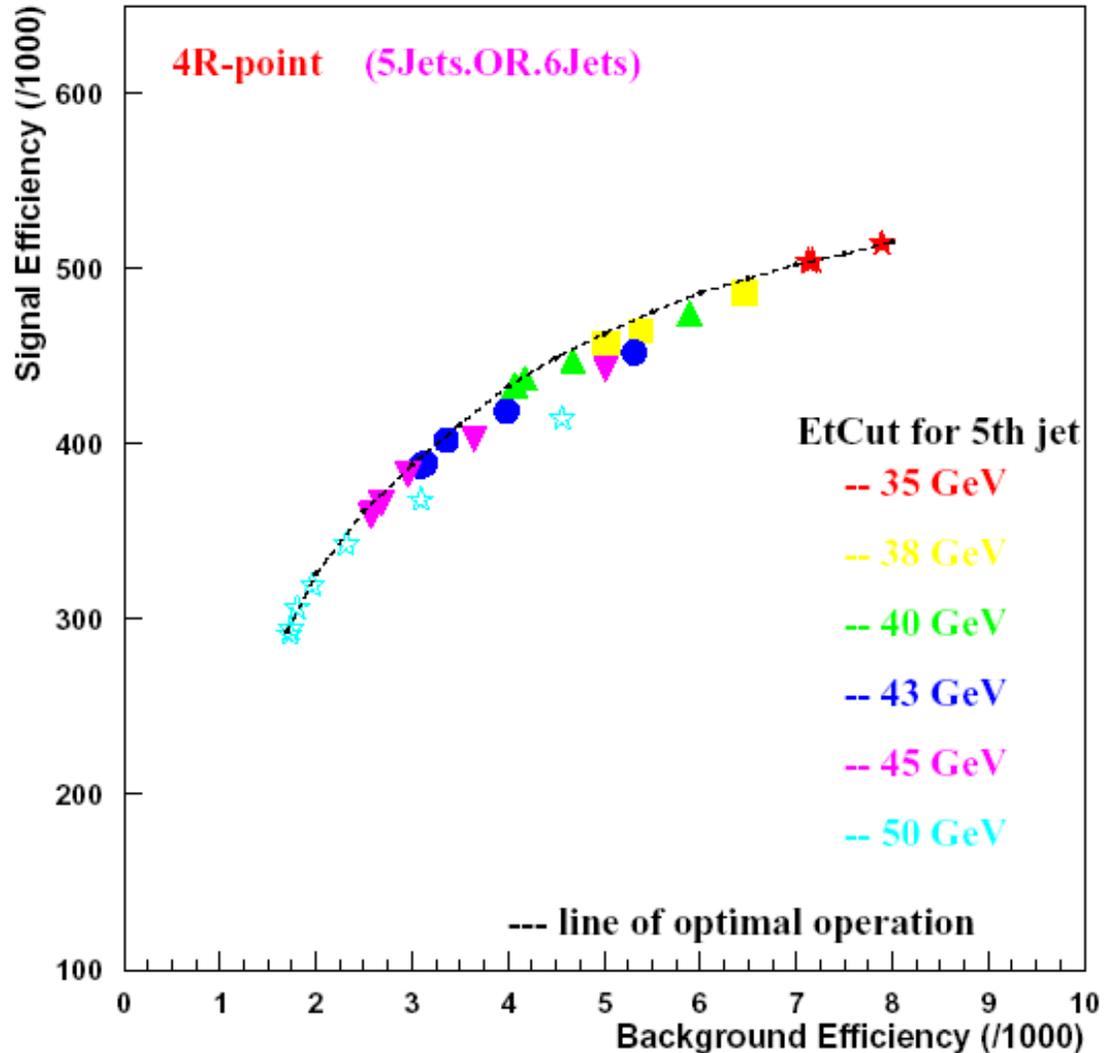
- Repeating the process for the 7th Jet: there is little more to gain.

Optimal Operation

Step through Et-Cut5 (in range 35 – 50 GeV) and through Et-Cut6
plot *Signal.Efficiency .VS. Background.Efficiency*.

The envelop of the lines
creates the line of
optimal operation →

→for a given cost
(background efficiency)
obtain maximum signal
efficiency, i.e. point on
the envelope.



Cost “improvement”

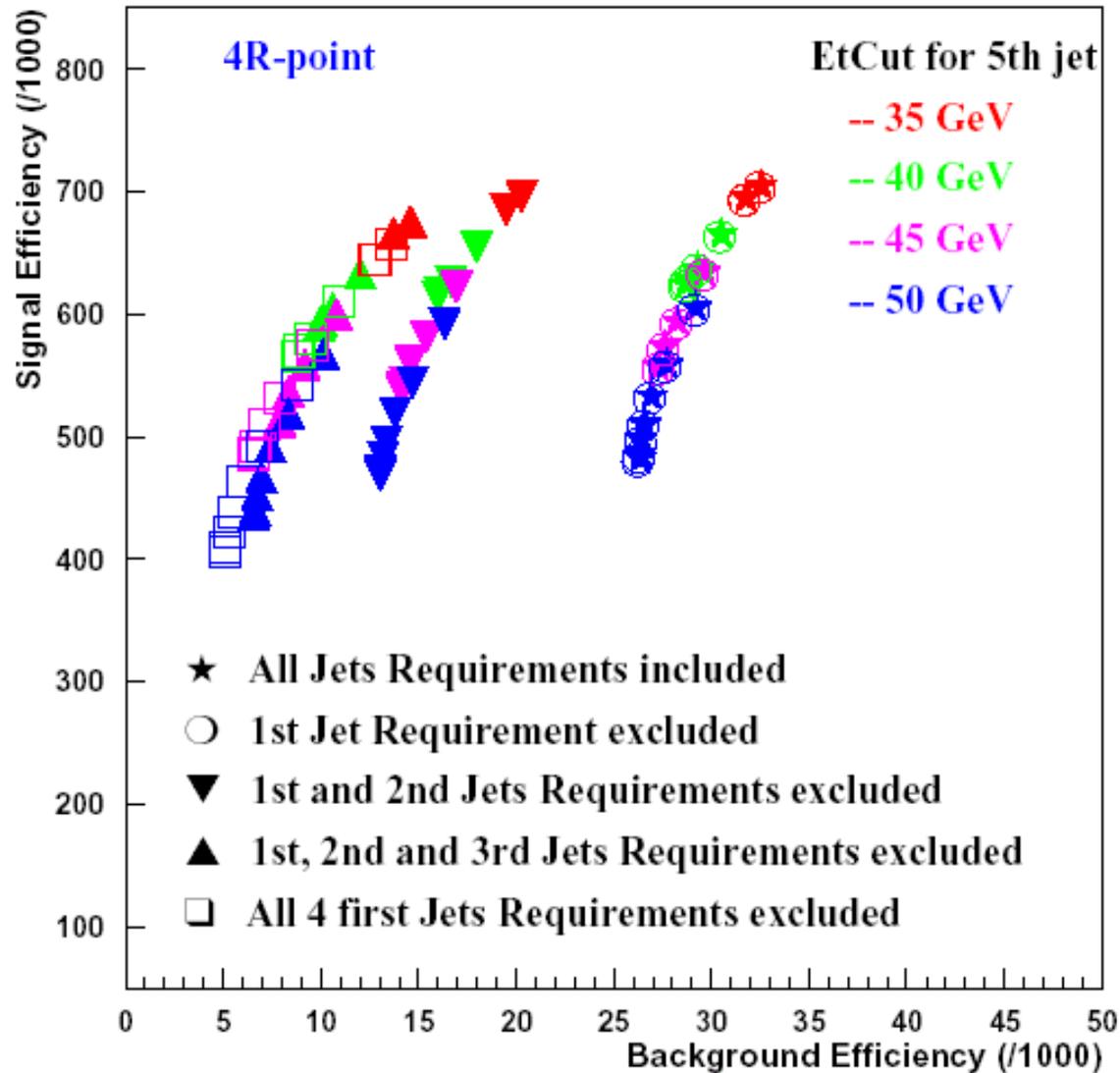
Calculating the increase in and the absolute efficiencies for the 5 highest Et Jets for both signal and background:

1. Most of background rate (bkg efficiency) from 1-jet and 2-jet path
 2. Signal efficiency increased from the 4th jet onwards
- Excluding some of the first jets requirements the background cost might decrease with no considerable decrease of the corresponding signal efficiency.

1-5 Jets Cuts – Efficiencies Calculated (in %)

N of Jet	Et-Cut (GeV)	Point 4R	Point 5R	Point 6R	Background
1	550	2.8 (2.8)	2.4 (2.4)	0.8 (0.8)	1.7 (1.7)
2	400	4.3 (3.3)	4.1 (3.6)	1.3 (1.0)	1.9 (1.9)
3	190	12.6 (10.6)	12.7 (10.6)	5.5 (4.9)	2.2 (0.9)
4	120	19.0 (11.7)	21.1 (13.5)	9.2 (6.4)	2.2 (0.3)
5	40	62.3 (56.6)	63.5 (57.5)	57.8 (55.8)	2.6 (0.8)

Signal Efficiency .VS. Background Efficiency excluding one by one the <4 jets requirements



Summary

As expected, a multi-jet requirement can increase efficiency for jet-rich signatures (e.g. R_p -violating SUSY) at relatively small “cost” (additional QCD rate)

For DAQ TDR: propose to add 5 and 6-jet requirement, tuned to absolute efficiency (i.e. redo signal vs bkg plots, excluding 1-4 jet contribution); describe only this as R_p -violating scenario.