H->γγ : Update on γ Efficiency & γ/Jet Rejection/Separation

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OUTLINE

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- Cuts Applied
  - LVL1 & EM Calo
- Definitions
  - Photon Efficiency & Jet Rejection Rate
- Efficiency and Rejection vs. η
- Conclusions & Future Plans

MOTIVATION & GOALS

- Photon/Jet Rejection & Separation and future Isolation using
  - Pythia
  - MC@NLO
    - Conversion Block (not yet studied)
- To check our analysis with existing TDR.
- To uncover effects produced by new detector layout.
- To develop new methods to improve photon efficiency and photon/jet separation (ongoing).

DATA SETS USED

Higgs Events	Number of Events
Higgs->Gamma Gamma M_h = 120 GeV	
002329.lumi02.recon.009.*.hlt.pyt_h120...	10000
Higgs (->Gamma Gamma) + Jet M_h = 130 GeV	
higgs.002638.nlo_h130.dc1.simul...	66455
Di-Jet Events	
17 GeV	
002000.lumi02.recon.010.....hlt.pythia_jet17	251423
25 GeV (to be done)	
dc1.002001.lumi02.recon.009._....hlt.pythia_jet_25.root	116651
55 GeV (to be done)	
dc1.002002.lumi02.recon.009.....hlt.pythia_jet_55.eg9.603.root	237604

Luminosity:

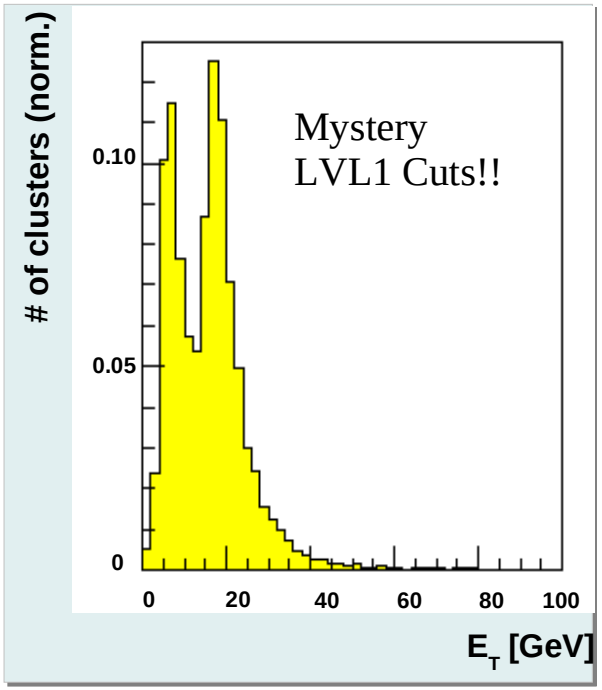
2×10^{33} $cm^{-2}s^{-1}$ (approximately 4.6 minimum bias events added per bunch crossing.)

PRESELECTION & OFFLINE CUTS(OK)

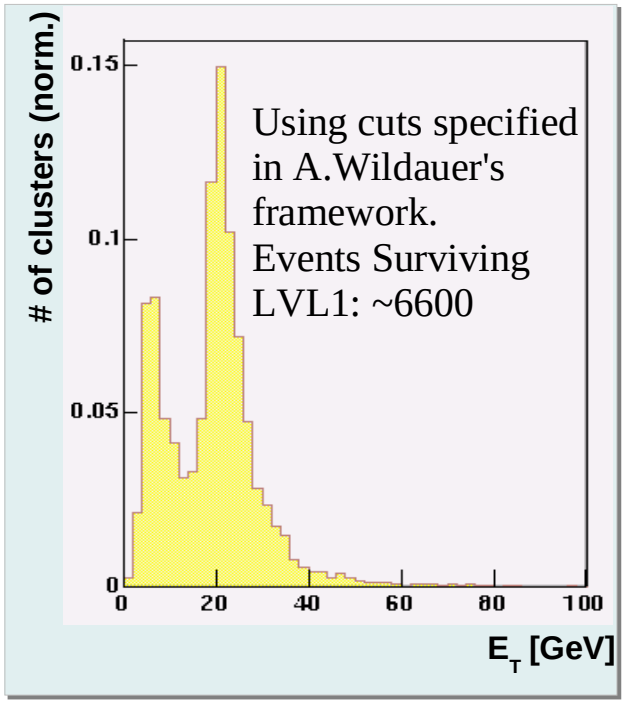
Preselection Cuts	Photons		E_{T1} > 40 GeV & E_{T2} > 25 GeV
	Jets		E_T > 17 GeV & LVL1
Offline Cuts	Hadronic	H	E_T(Had)/E_T(EM)
	Second Sampling	2S_a	E_2(3x7)/E_2(7x7)
		2S_b	Corrected shower width using 3x5 cells in η.
	First Sampling	1S_a	Energy of strip with maximal energy deposit scaled by fraction of Total E_T(EM)
		1S_b	Energy of strip where second maximum is found minus the energy of the valley between the two maxima.
		1S_c	Fraction of energy outside the shower core in η.
		1S_d	Corrected shower width using three strips.
		1S_e	Total width in first sampling using 20 strips.

JET DISTRIBUTIONS
(Jets Surviving LVL1)

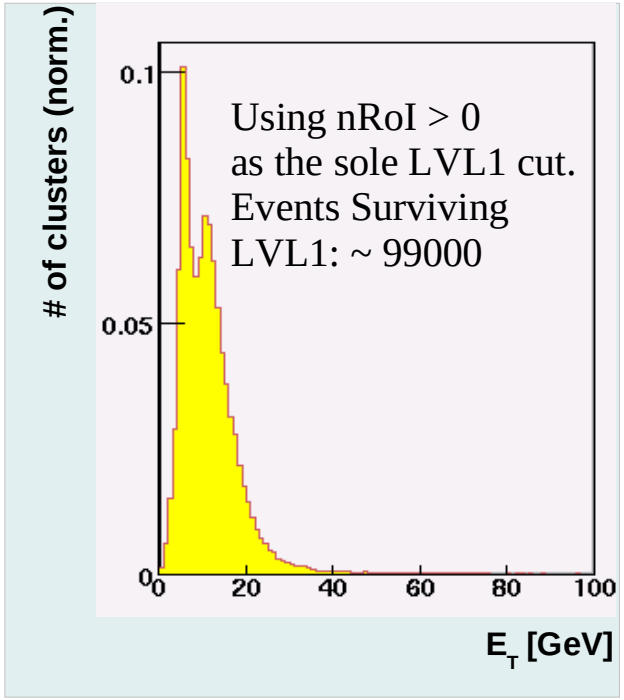
TDR



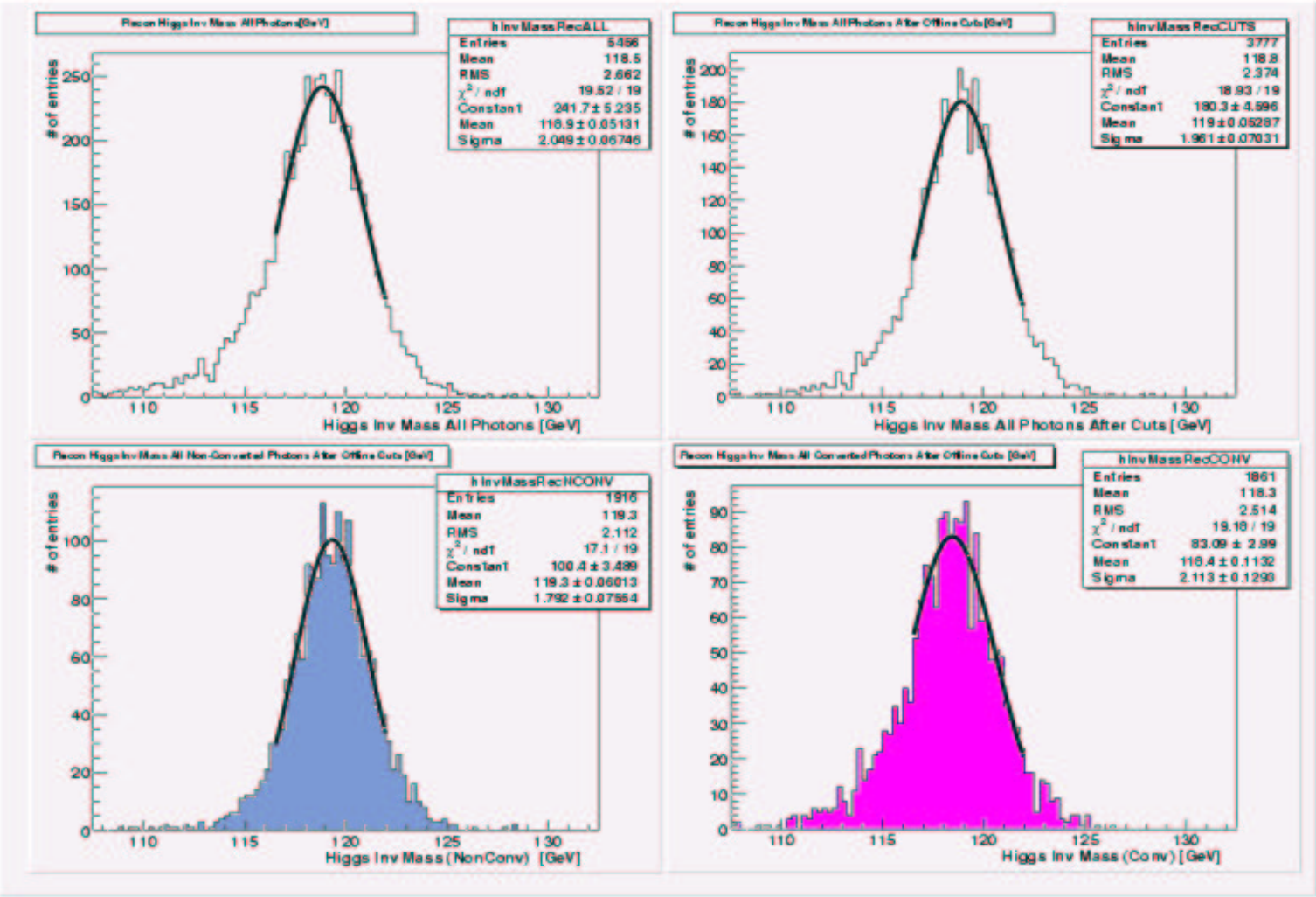
DC1
(previous analysis)



DC1
(updated analysis)



Invariant Mass of Rec Higgs (After Cuts)



DEFINITIONS

Photon Efficiency := $N_{\text{Accepted Photons}} / N_{\text{Total}}$

Jet Rejection** := $N_{\text{ATLFAST Jets}} / N_{\text{Accepted Jets}}$

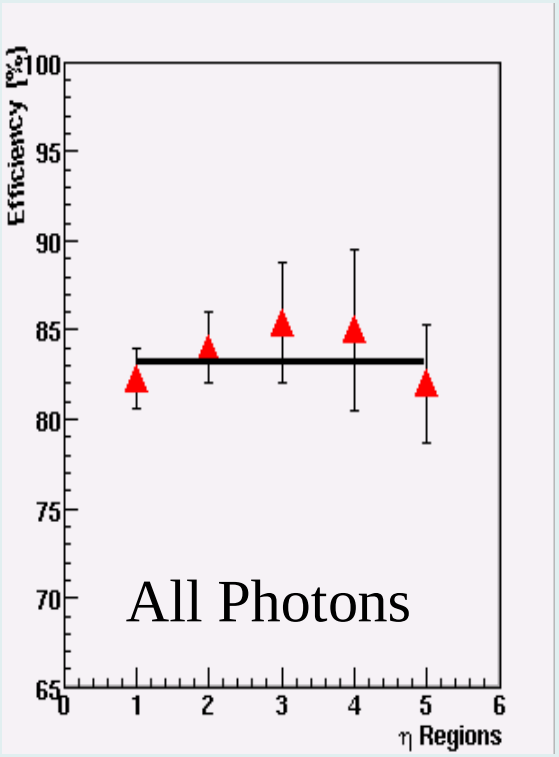
$N_{\text{ATLFASTJets}}$ is normalized to the number of events prior to the particle level filter. (These jets have been corrected using AtlFAST)

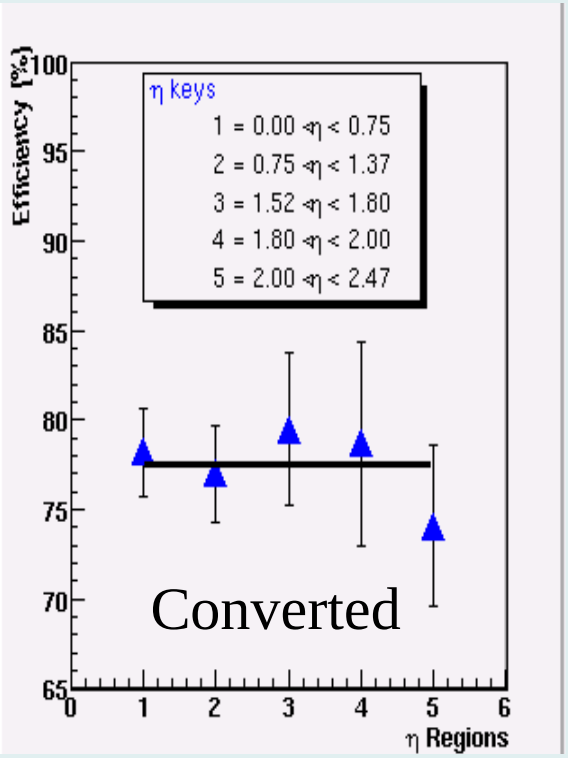
** Jet rejection with respect to jets observed in ATLFAST.

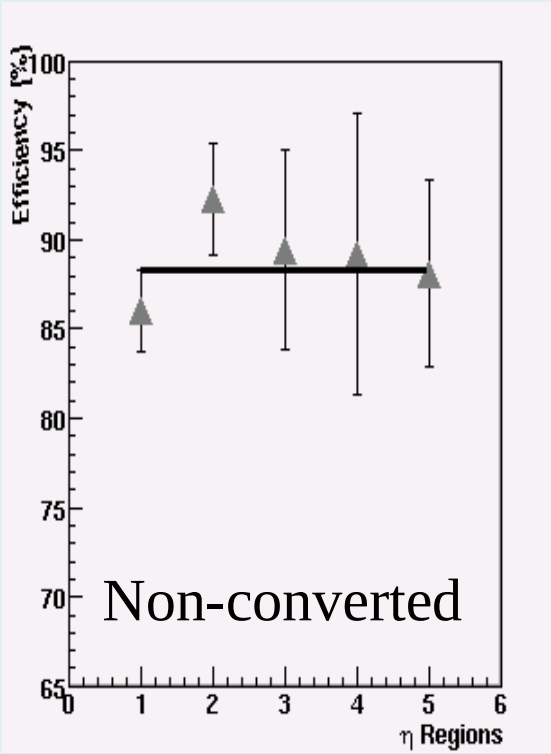
CUT VALUES

Cuts Applied									Photon Efficiency (Stat Error) in %
η Ranges	Hadronic	Second Sampling		First Sampling					
	h <	2S_a >	2S_b <	1S_a >	1S_b <	1S_c <	1S_d	1S_e	
$0.00 < \eta < 0.75$	0.042	0.96	0.0111	0.18	0.24	0.28	0.67	2.64	83.2 (1.8)
$0.75 < \eta < 1.37$	0.020	0.95	0.0111	0.28	0.28	0.27	0.80	2.90	83.7 (2.2)
$1.52 < \eta < 1.80$	0.041	0.94	0.0110	0.27	0.25	0.28	0.70	2.65	84.6 (3.7)
$1.80 < \eta < 2.00$	0.057	0.93	0.0112	0.25	0.20	0.17	0.67	2.64	84.3 (4.9)
$2.00 < \eta < 2.47$	0.059	0.94	0.0115	0.35	0.33	0.26	0.76	2.77	82.0 (3.5)
$0.00 < \eta < 2.47$	**0.042**	**0.94**	**0.0113**	**0.22**	**0.25**	**0.27**	**0.70**	**2.80**	**84.8 (1.2)**

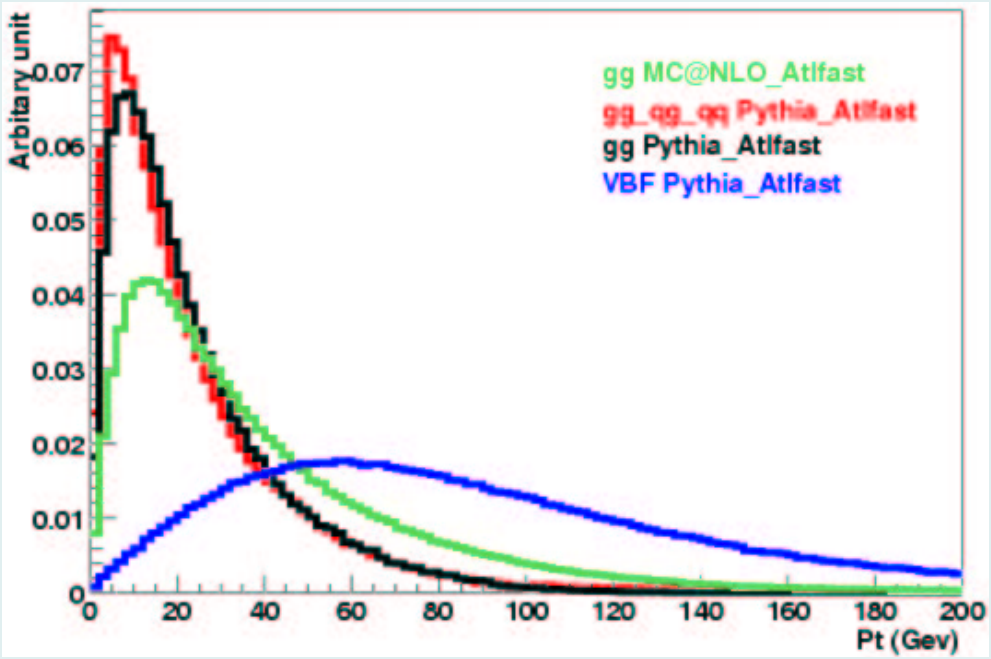
Photon Efficiency (ε) vs. η



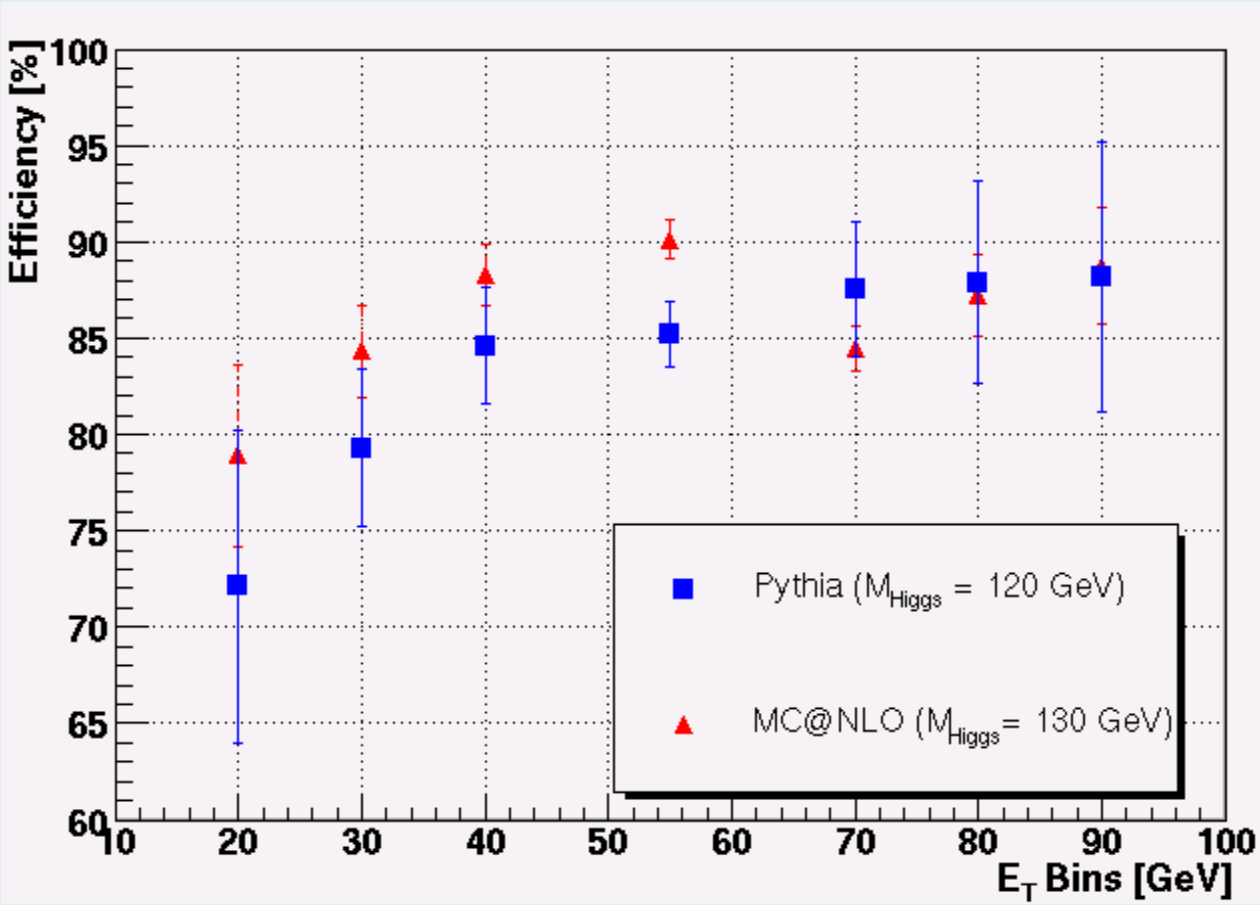




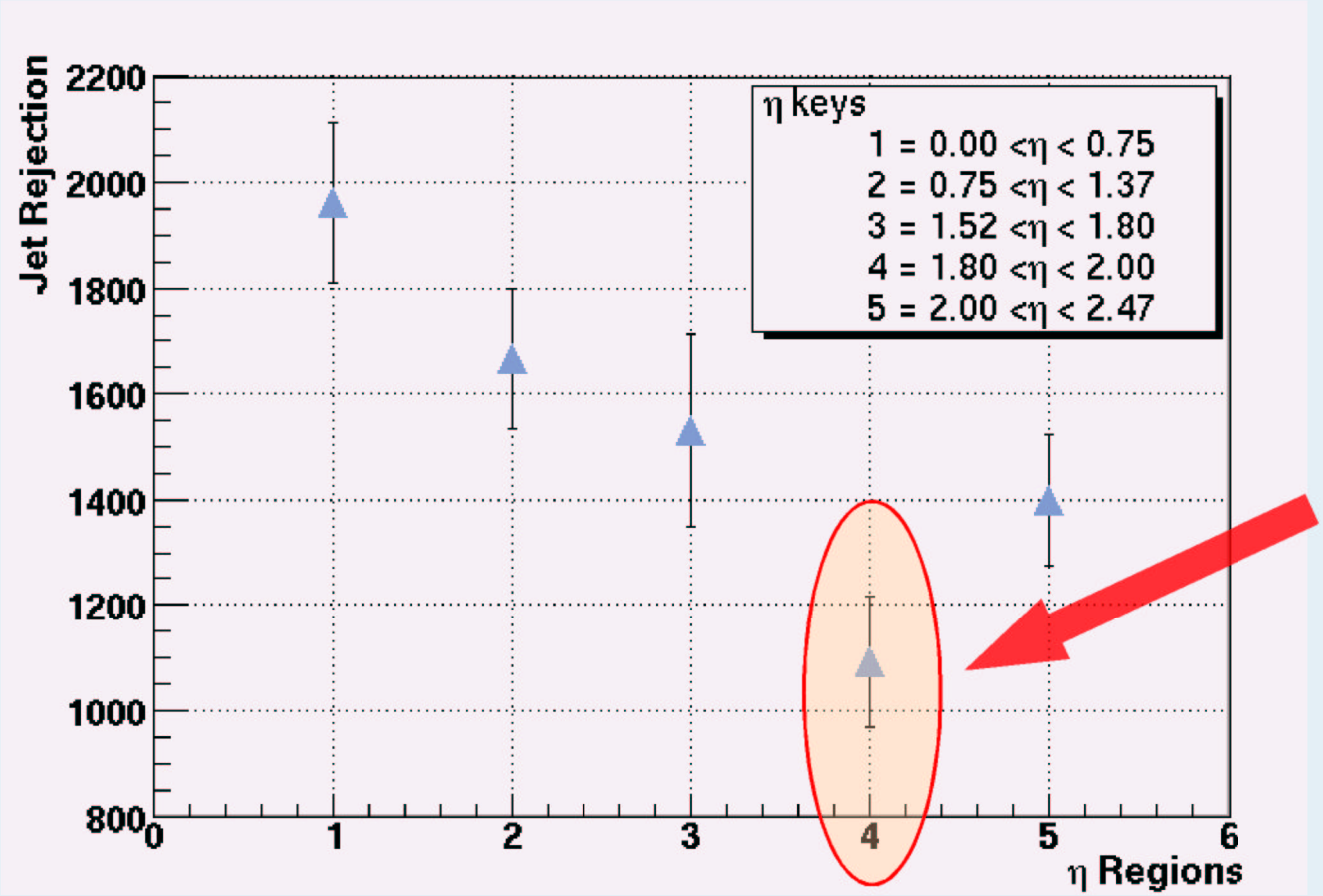
Higgs P_T with MC@NLO



Photon Efficiency vs. E_T



Jet Rejection vs. η



End of Barrel

Jet Composition

Jet Composition	Before Cuts	After Cuts				
		LVL1	Hadronic	2nd Sampling	1st Sampling	p_T/E_T
Prompt Photons (from hard interaction and from quark brem)	7.29%	7.32%	7.54%	8.54%	8.90%	8.80%
Π^0 events (10 GeV cut on energy)	46.40%	45.60%	45.70%	47.20%	48.70%	48.60%

RESULTS

Cuts for H->$\gamma\gamma$ at Low Lumi										
	Photon Efficiency (%)						Jet Rejection (Rate)			
	TDR	Relative Difference	DC1	Relative Difference	DC1 MC@NLO	Relative Difference	TDR	Relative Difference	DC1	Relative Difference
LVL1	100		100		100		76		**106**	
Hadronic Calo	95.7	95.7	98.8	98.8	99.6	99.6	130	1.8	183	1.7
EM Calorimeter										
2nd Sampling	90.2	94.3	93.3	94.4	93.2	93.6	390	2.9	486	2.7
1st Sampling	**85.7**	**95**	**84.8 ± 1.2**	**91**	**87.9 ± 0.6**	94.3	**1050**	**2.7**	**1254 ± 45.5**	**2.6**

Cuts for Photons: $E_{T1} > 40$ GeV and $E_{T2} > 25$ GeV

Jets : 17 GeV $< E_T <$ 23 GeV

CONCLUSIONS & FUTURE PLANS

- Before we had approximately 37 % higher jet rejection for present layout.
  - Due to LVL1 overkill.
- Now we have ~15% higher jet rejection for present layout w.r.t. TDR, consistent with Martina & Monika's results. Due mostly to LVL1.

- To use Neural Nets with uncorrelated variables.
- To incorporate and study the conversion block in Pythia and MC@NLO samples.
- To study jet rejection with higher energy di-jets.
- To introduce the corrections applied by INFN.