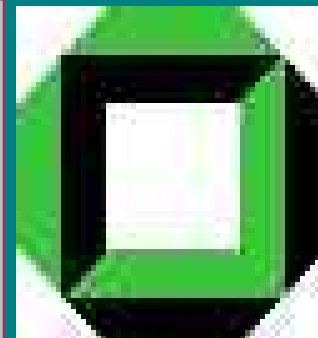




Selections and triggers for SUSY trilepton *(intermediate status)*



V.Zhukov

University Karlsruhe

Status:

CMS internal note CMS IN 2005/039 is available

PTDR preliminary draft is written

status at :

www-ekp.physik.uni.karlsruhe/~zhukov/Trileptons/Trileptons.html

Introduction

Signal signature SUSY 3 leptons (3body):

$$pp \rightarrow \chi_1^\pm \chi_2^0 \rightarrow \begin{cases} \chi_1^0 + l^\pm l^\mp \\ \chi_1^0 + l^\pm \end{cases}$$

Selections used sofar:

- **3 isolated leptons with 2 OSSE**
- μ : $Pt > 10 \text{ GeV}/c$ $|\eta| < 2.4$
- e : $Pt > 15 \text{ GeV}/c$ $|\eta| < 2.4$
- **No Jets** $E_T > 20 \text{ GeV}$ $|\eta| < 2.4$

Summary of Previous study:

Samples (30fb⁻¹): W,Z, χ leptonic decays

	N_{NLO}	$N_{2\mu+l}$
ZZ_4l	4800	56
ZW_3l	$5 \cdot 10^4$	223
ttbar_2l	$2.6 \cdot 10^6$	396
Zbbar_2l	$4.4 \cdot 10^6$	171
Wtj_1l	$3 \cdot 10^5$	58
LM9_2l	$4 \cdot 10^5$	42
lm9_3l	$3.7 \cdot 10^3$	265

Update:

- Revisit selection cuts
- Trigger performance (*first look*)

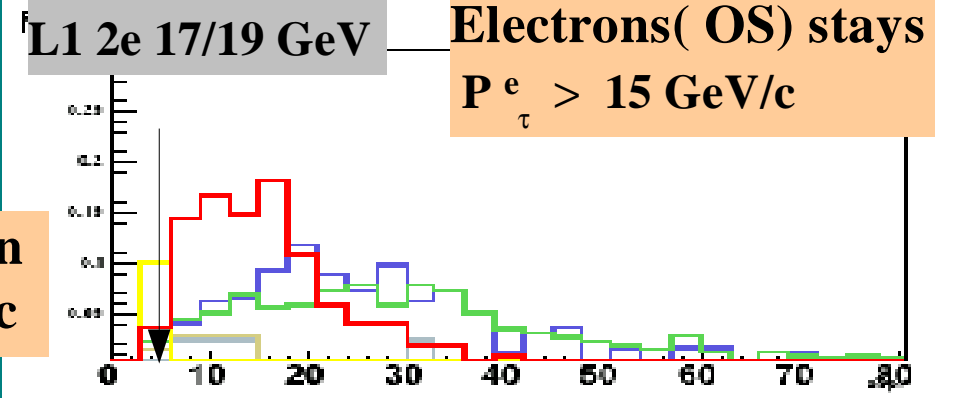
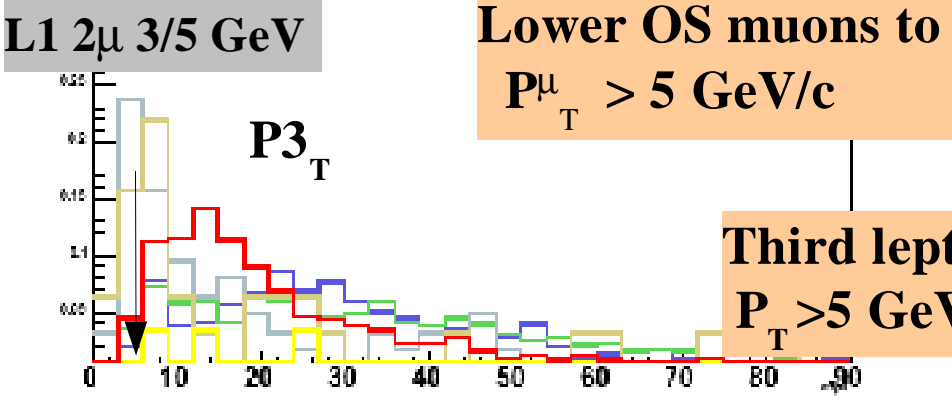
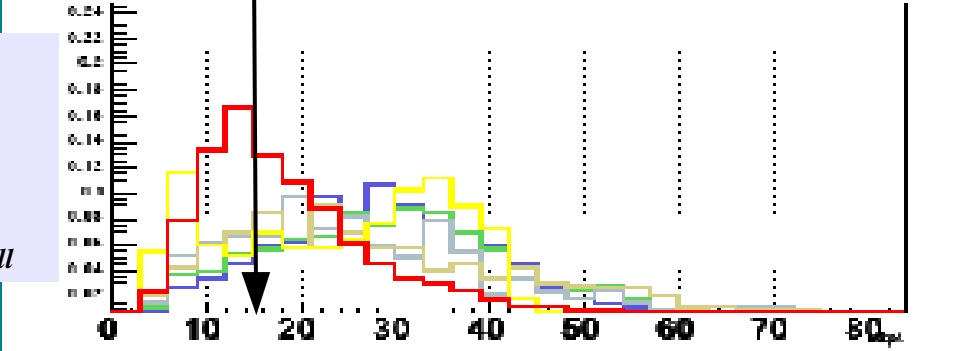
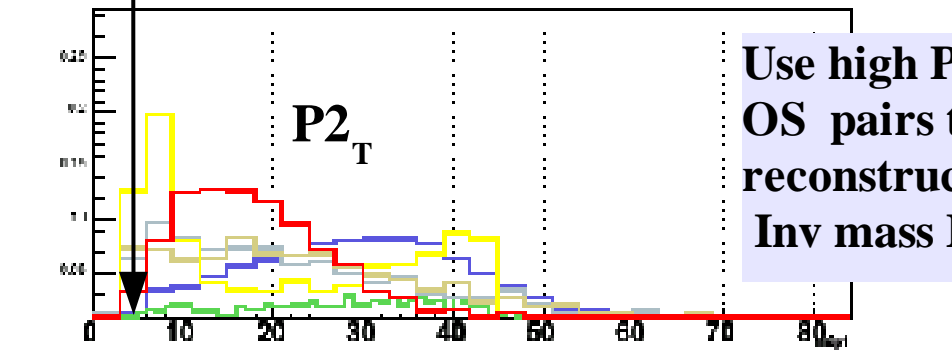
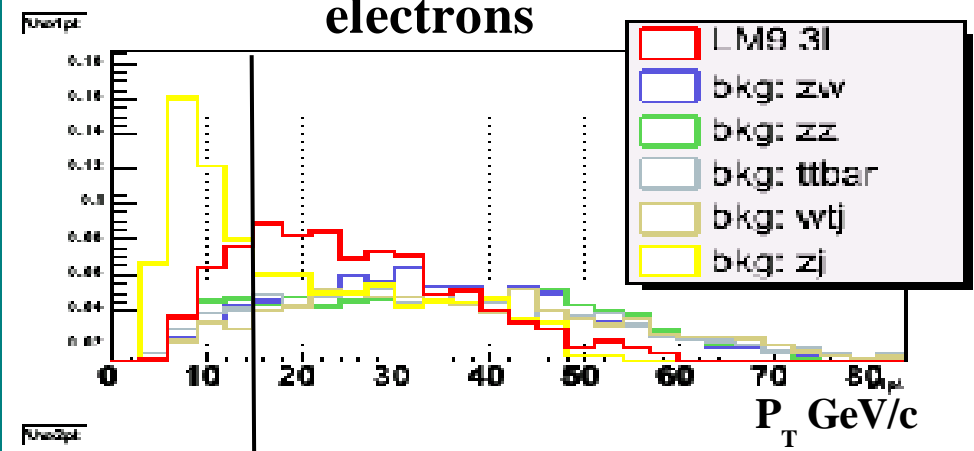
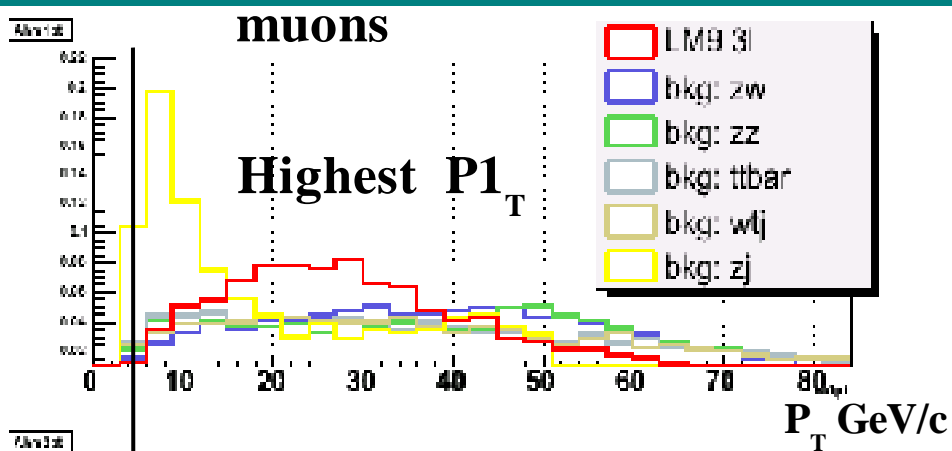
Data samples used:

10^4 ev DST (Karlsruhe produced)
for the signal and each backgr.
Analyzed with ORCA_8_7_3

Significance LM9 $2\mu+l$: $S_L \sim 8.3$
 $2e+l$: ~ 5

Selection cuts: leptons

Normalized P_T distribution (no selection) of the ordered by P_T signal and backgrounds

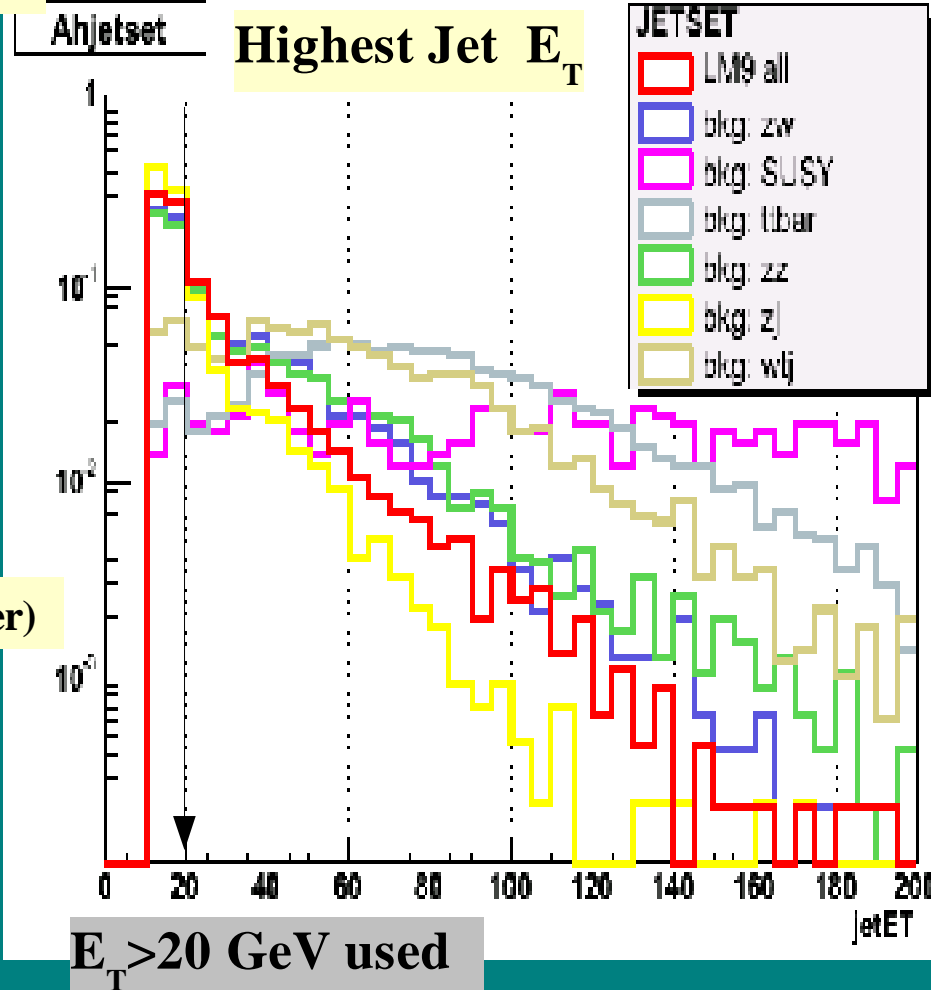
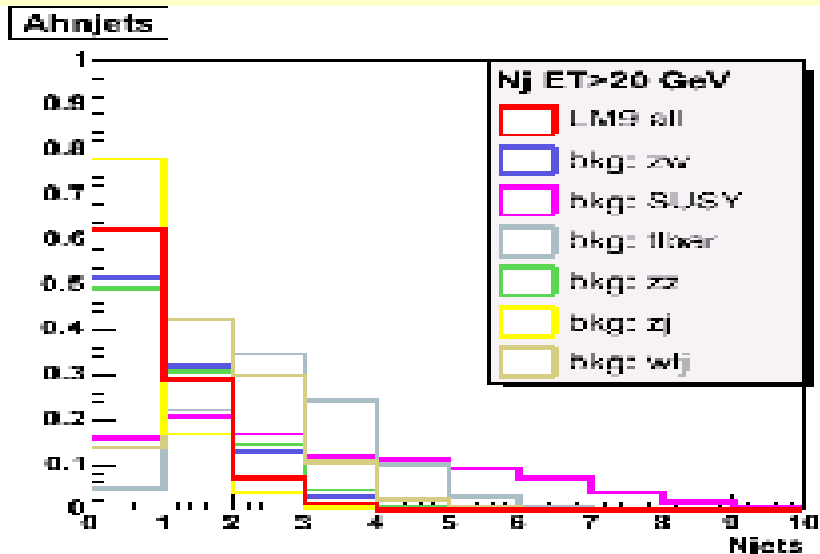


Third lepton $P_T > 5$ GeV/c

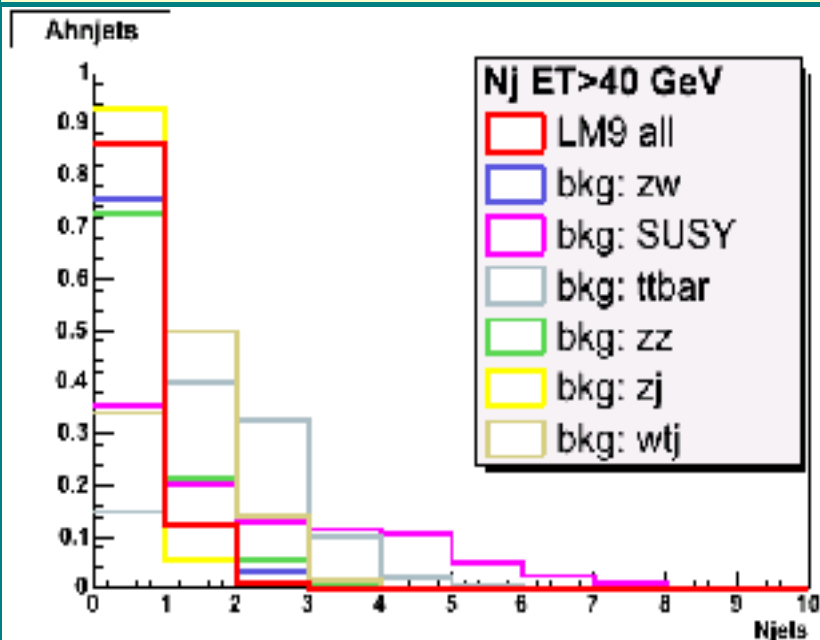
Selection cuts : Jets

Njets : ~63% of signal Nj=0 at ET>20 GeV

EcalPlusEcalTower



Njets: ~85% Nj=0 at ET>40GeV (ttbar x3 larger)

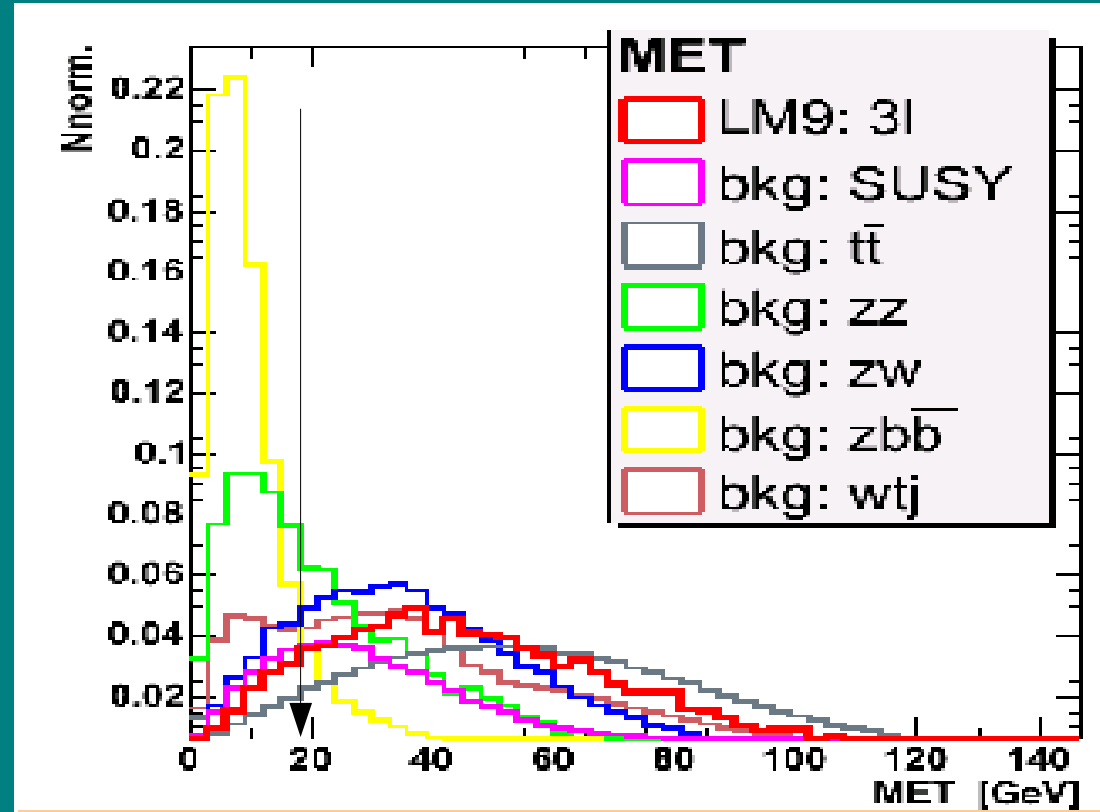
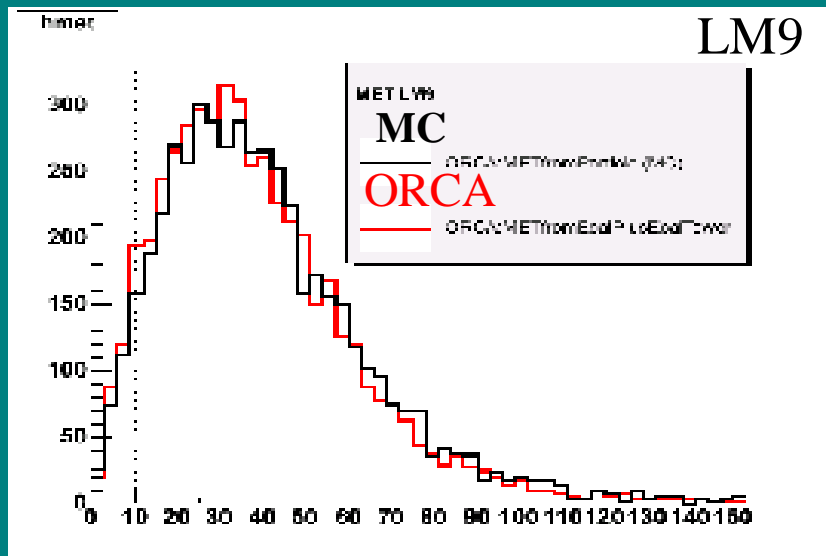


The Significance almost the same:
ET>20 GeV ~8.3
ET>40 GeV ~8.0
keep the lowest threshold 20 GeV

Selection cuts: MET

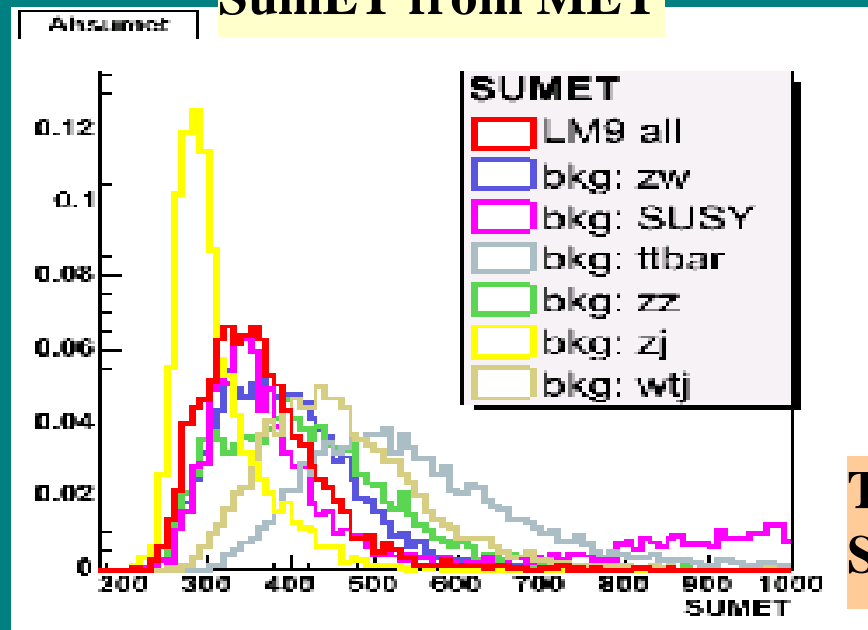
MET is effective for z/wjets (and probably QCD)
 ~10% significance increase for MET > 18 GeV

METFromEcalPlusHcalTower



No upper MET cut since for large $m_{1/2}$ (LM1,2)
 MET (SumET) is increasing

SumET from MET



The SumET can be used
 SumET > 500 GeV ~10% significance increase

Selection cuts: Invariant mass

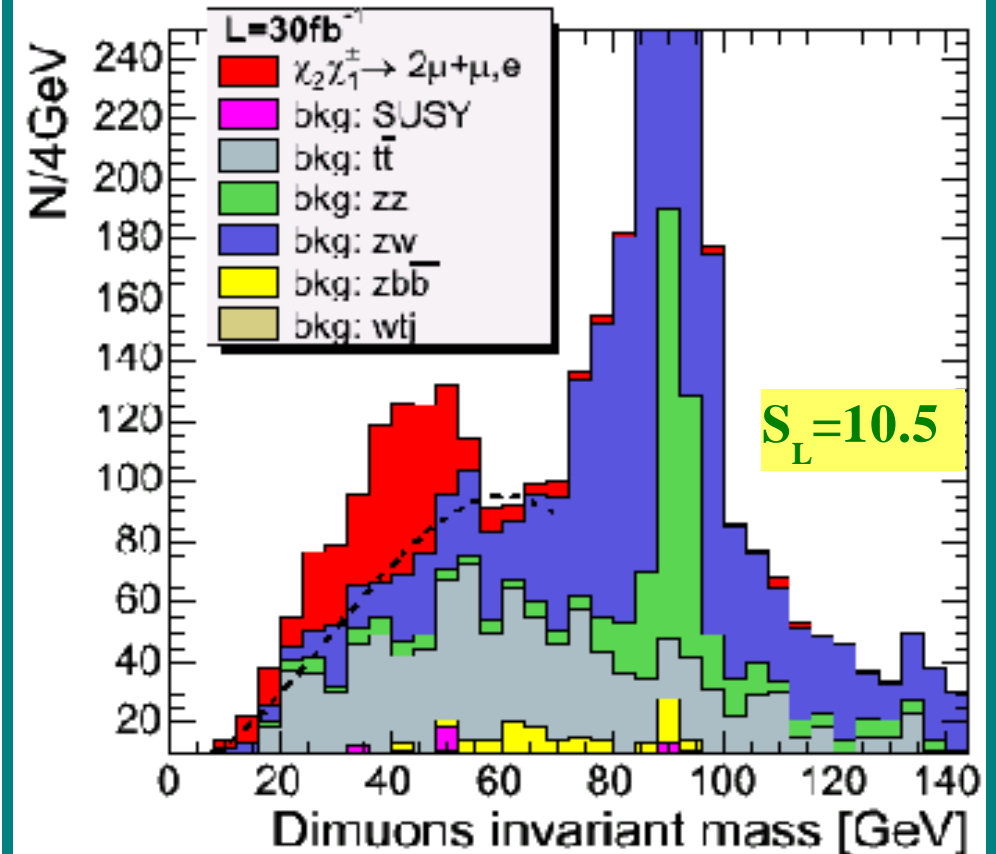
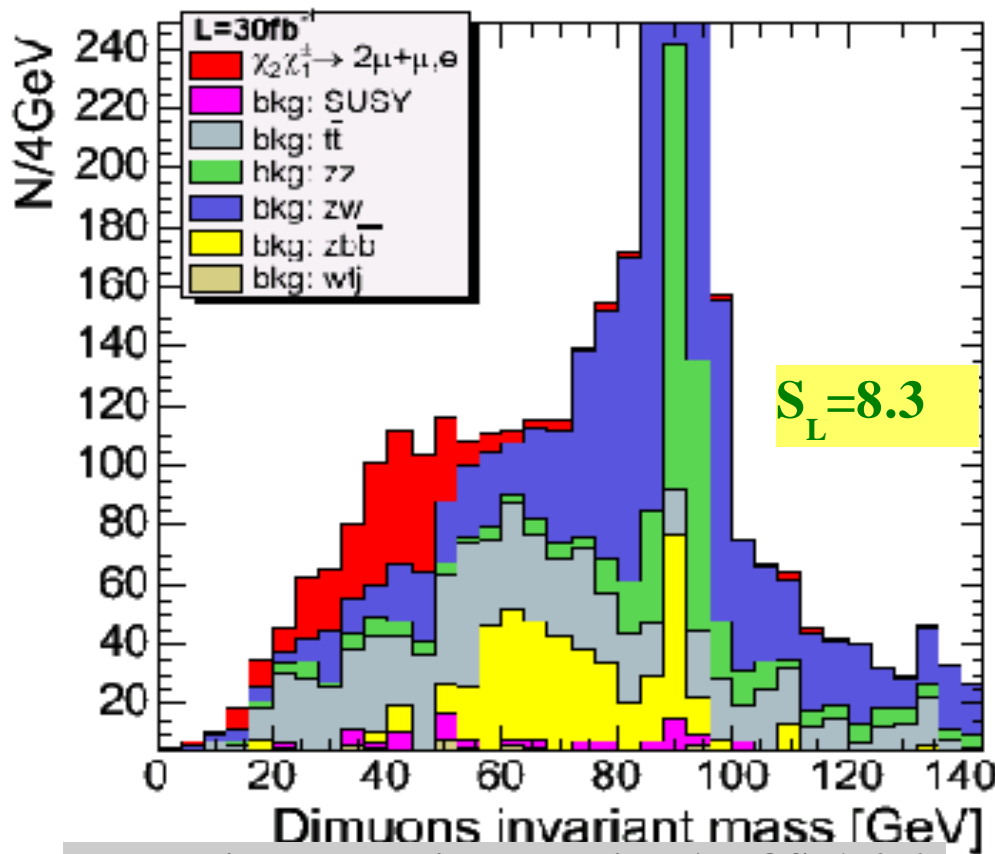
Dimuons invariant mass $2\mu + e, \mu$

Previous:

No Jets $ET > 20$ GeV
 No MET cut
 $P_t^\mu > 10$ GeV/c
 $P_t^e > 15$ GeV/c

Now:

No Jets $ET > 20$ GeV No sumET cut yet
 $MET > 18$ GeV
 $P_t^\mu > 5$ GeV/c
 $P_t^e > 5$ GeV/c (if is the third lepton)



$t\bar{t}$ bar, zw , susy are simulated in FAMOS_1_2_0

Trigger: L1

Max cumulative L1 rate

(LL/HL)~16/30 kHz

Most of bandwidth is associated to the single μ , e streams

30 bits trigger pattern

defined in the L1tGlobalTrigger

All channels are inclusive!

Electrons can be identified as a tau or as a jet.

What is important?

→ efficiency in respect to the offline selection

→ distribution of the L1 streams

Study with Low Lumi, no PU

L1 items relevant for the trilepton

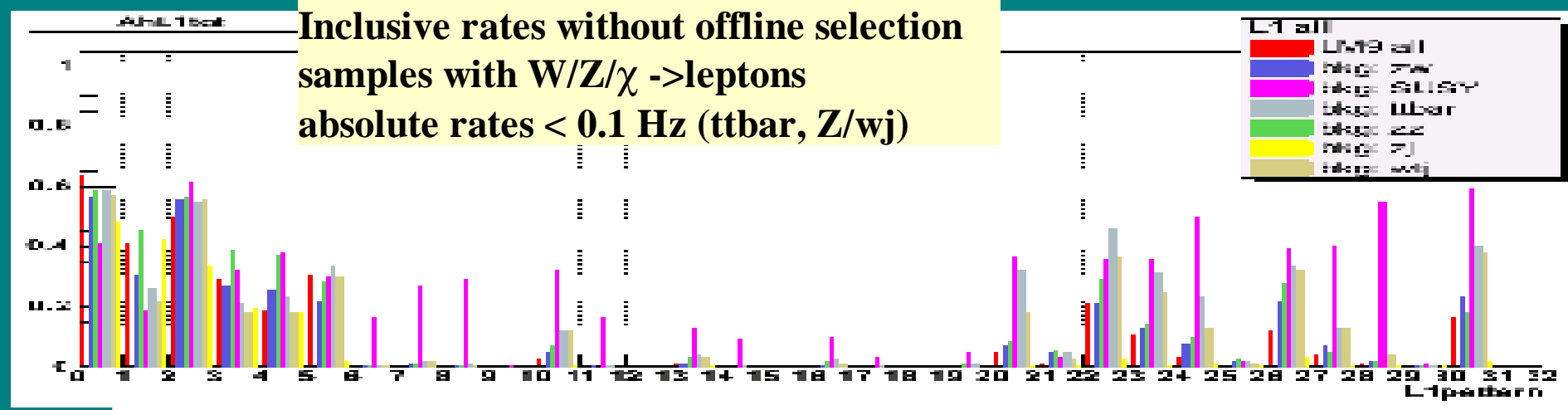
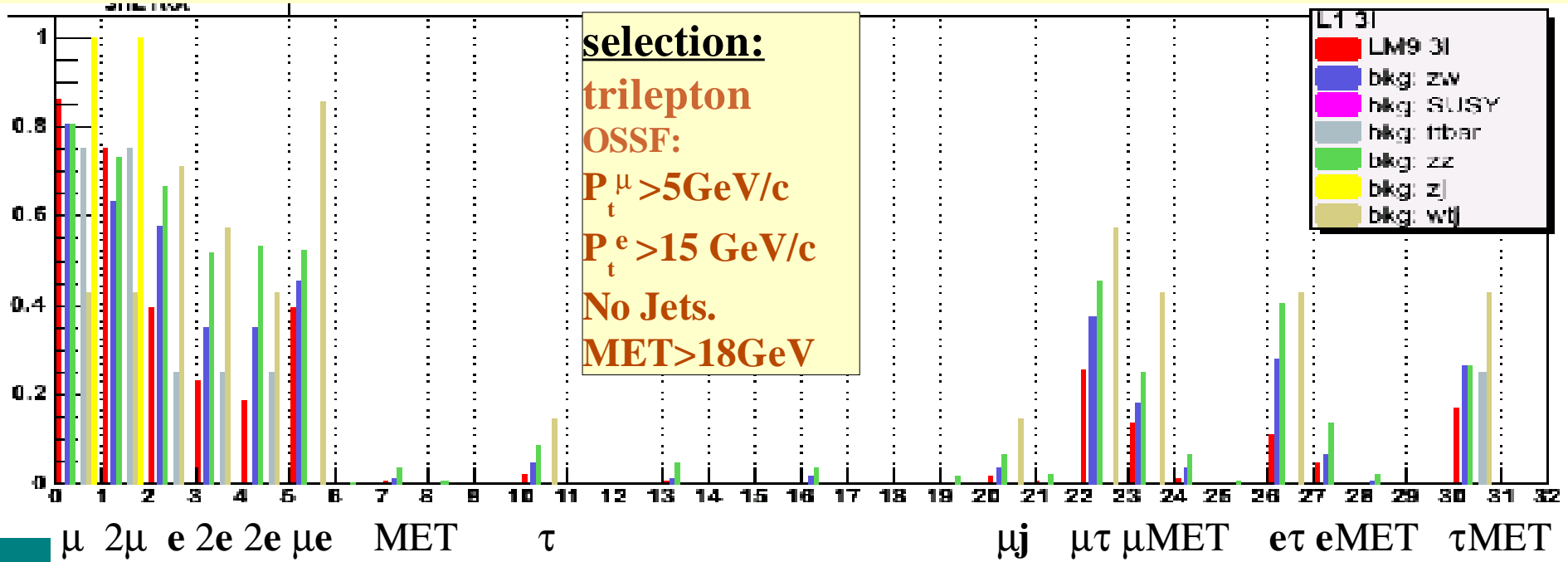
DAQ TDR

bit	item	thr, GeV(LL HL)		Rates (LL,HL) kHz	
0	μ	14	20	2.7	6.2
1	2μ	3	5	0.9	1.7
2	e/ γ (all)	29	34	3.3	6.5
3,4	$2e/2\gamma$	17	19	1.3	3.3
5	$\mu+e/\gamma$ isol	5,15	7,17		
20,21	$\mu+cj,fj$	5,30	14,40		
22	$\mu+\tau$	5,25	12,30		
23	$\mu+MET$	5,45	16,80		
24,25	e/ γ +cj,fj	21,45	25,52		
26	e/ γ + τ	14,52	25,52		
27	e/ γ +MET	21,74	25,150		
10, 13,16	1,2,3 τ	86,59,40	101,67,70		
30	τ +MET	35,40/60,60			

New table is proposed for the PTDR!

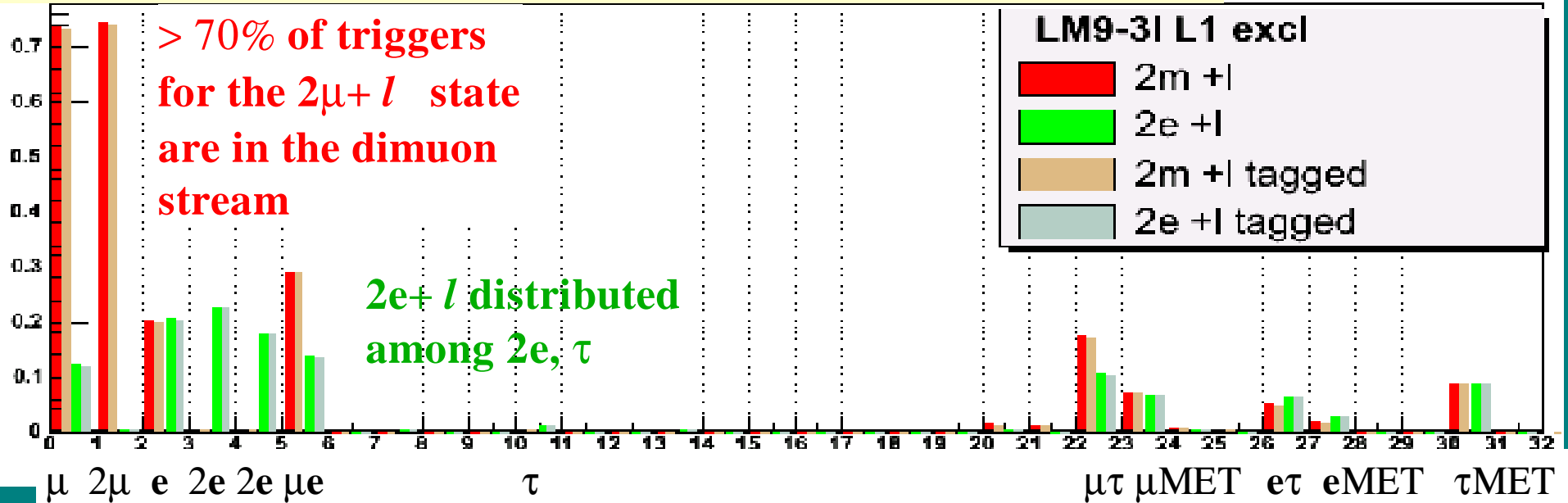
Trigger: L1 rates

Inclusive rates of different L1 items for signal and backgrounds offline selected
(probability to populate the L1 streams)

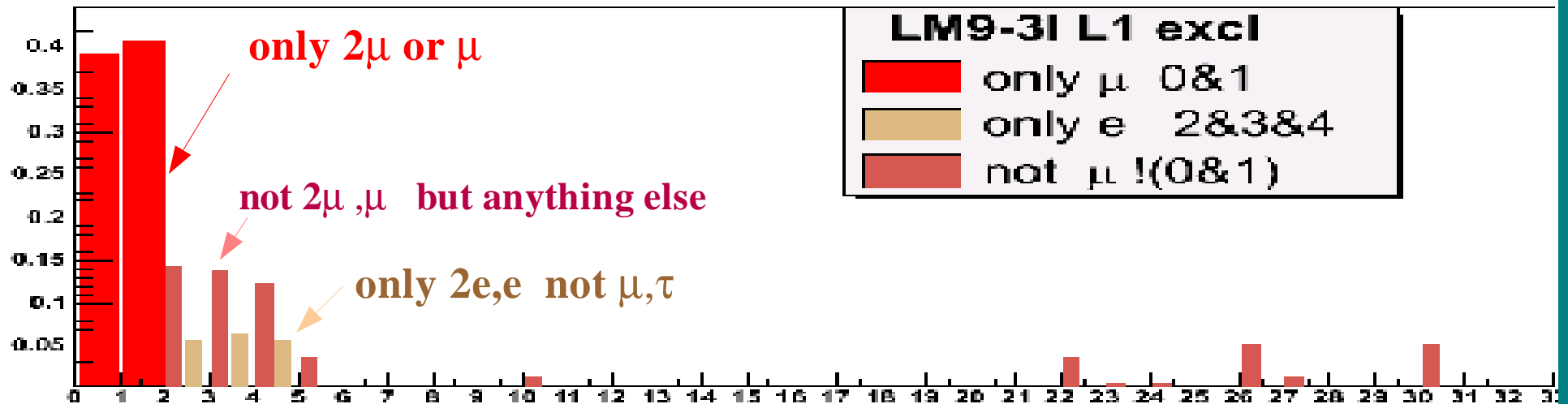


Trigger: L1 streams

Inclusive L1 rates with the different offline trilepton patterns



'Exclusive' rates for the offline selected trileptons



Trigger: HLT

Starts from L1.
Max cumulative rate <100Hz.

Many reconstruction algorithms
in each step of reconstruction
L2, L2.5, L3 and final HLT
still under developments.
Which menu to use for the
PTDR ?

Lack of documentation!

ORCA_8_7_3 2x1033HLT.xml
(not compatible with ORCA_8_7_1)

Some relevant bits.

Bits	item	thr(LL HL), GeV	Rate(LL), Hz
2	e	26 31	33
6	2e	14.5 16.9	
13	2e relaxed	21.8 21.8	1
43	μ	19 31	25
54	2 μ	7 10	4
88	e+ τ	16, 52 20,62	2
102	μ + τ	15, 40	
116,119	τ +MET	20,67	
.....?			

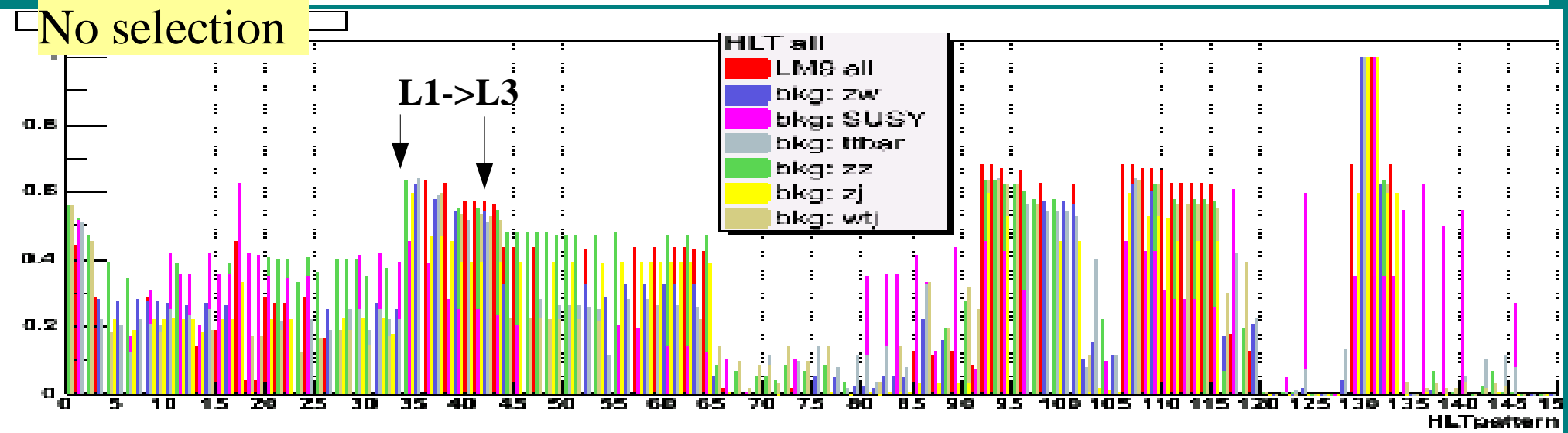
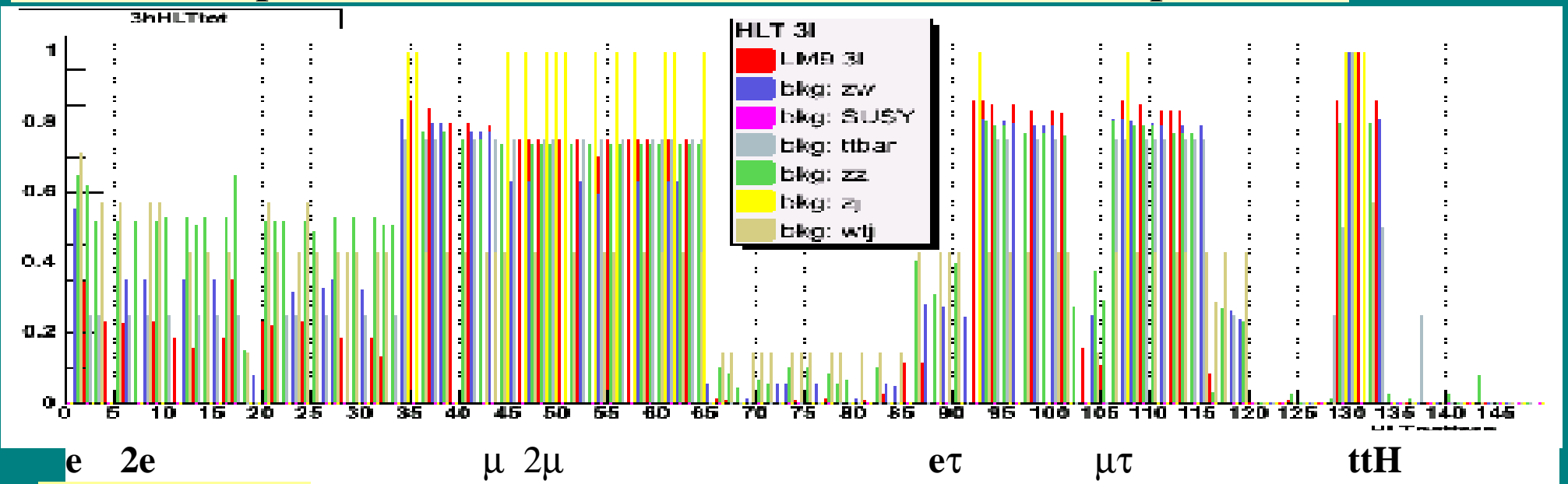
Not approved for
PTDR!

(μ + μ -) , No Jets(30GeV)
(e+e-)....

HLT Potentially can be used to
construct the Trileptons trigger
(needs to lower jets threshold)

Trigger: HLT rates

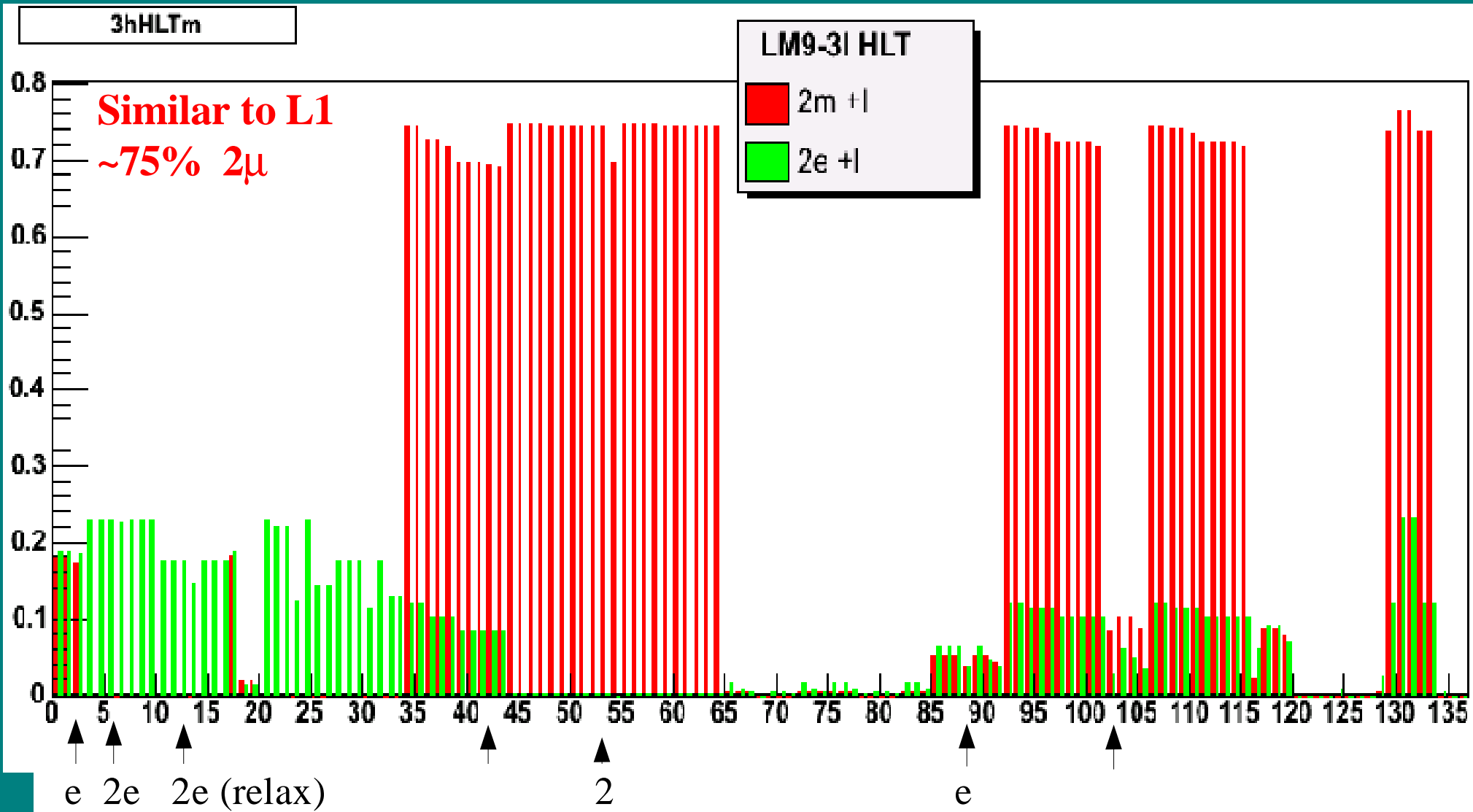
Cumulative pattern, all bits with offline selection of trileptons.



Trigger: HLT streams

HLT rates for the different offline combinations

Efficiency for offline selected: 99.7%



preliminary

Triggers: LM9 streams

Off line selected	L1	HLT
2μ+l 77%	73% 2μ +X 29% μ+e +X 18% μ+τ+X 8% μ+MET+X 0.8% μ+forward jet+X 9% MET+τ+X 0.2% only 1μ 0.8% only 2μ 0% only τ....	70% 2μ +X 10% μ+τ+X
2e+l 23%	22% 2e(isol)+X 18% 2e(all)+X 14% e+μ+X 10% τ +μ +X 6% e+τ +X 9% MET+τ+X 0.2% only 1e 5% only 2e (isol. or relax)....	22% 2e(isol)+X 14% 2e(rel)+X 4% e+τ+X
Efficiency	100%	99.7%

Summary

**Significance improvement ~20% for dimuon + lepton can be achieved with optimized cuts ($S_L \sim 10$) (More optimization using LL,NN..)
The dielectron is much worse due to higher L1 thresholds.**

**L1 trigger is 100% efficient for the offline selected events.
~73% of the $2\mu+l$ events are in the dimuon stream.**

HLT is ~99.7% efficient (will be studied). ~70% of the $2\mu+l$ is in the dimuons stream

Plans for PTDR:

- optimize cuts(methods) , consider different mSUGRA parameters.**
- uncertainty (physics and reconstruction), significance estimator**
- the full Z/Wj and QCD bkg are still missing**
- HLT algorithms evaluation**