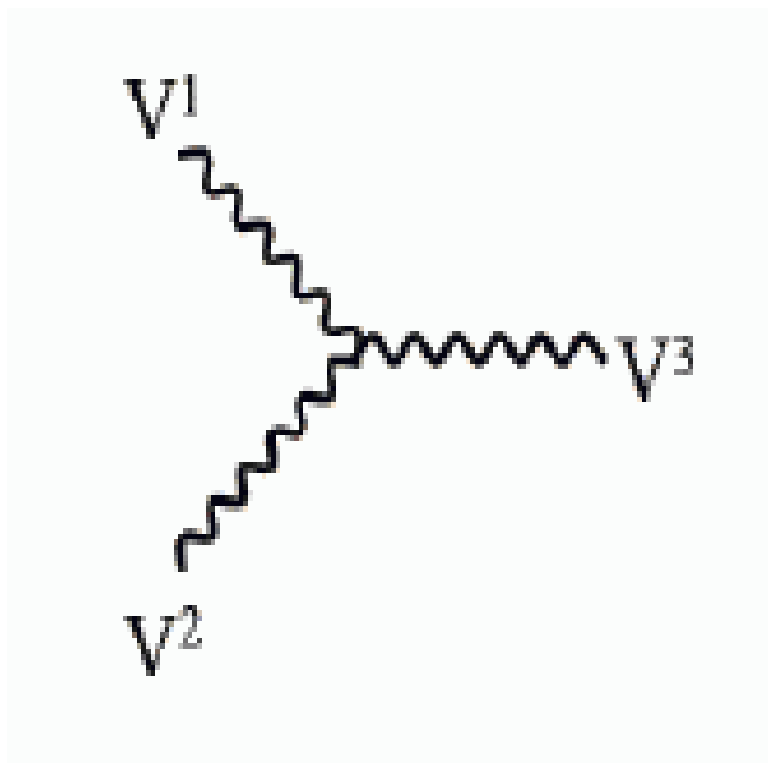




$Z(\nu\nu)\gamma$  trigger

**Pál Hidas**  
**György Vesztergombi**



## Triple Gauge Couplings (TGC)

charged (WWZ, WW $\gamma$ )

exist in SM

neutral (ZZZ, ZZ $\gamma$ , Z $\gamma\gamma$ ,  $\gamma\gamma\gamma$ )

does not exist in SM (“anomalous”)

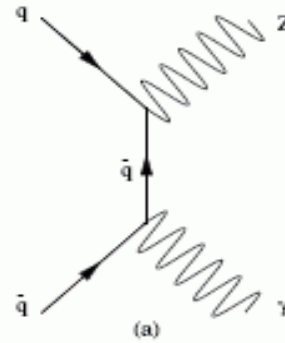
their observation indicates new physics beyond SM



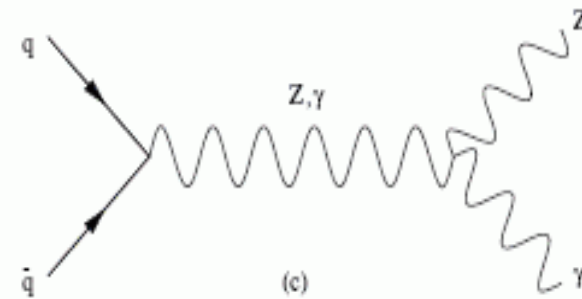
# pp $\rightarrow$ Z $\gamma$



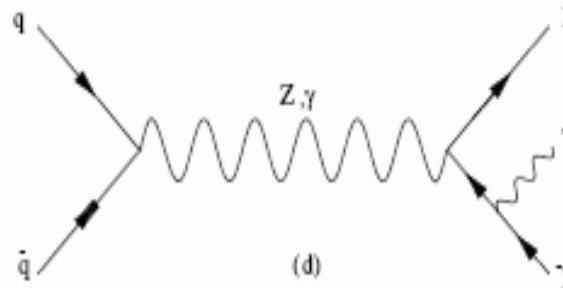
SM



anomalous

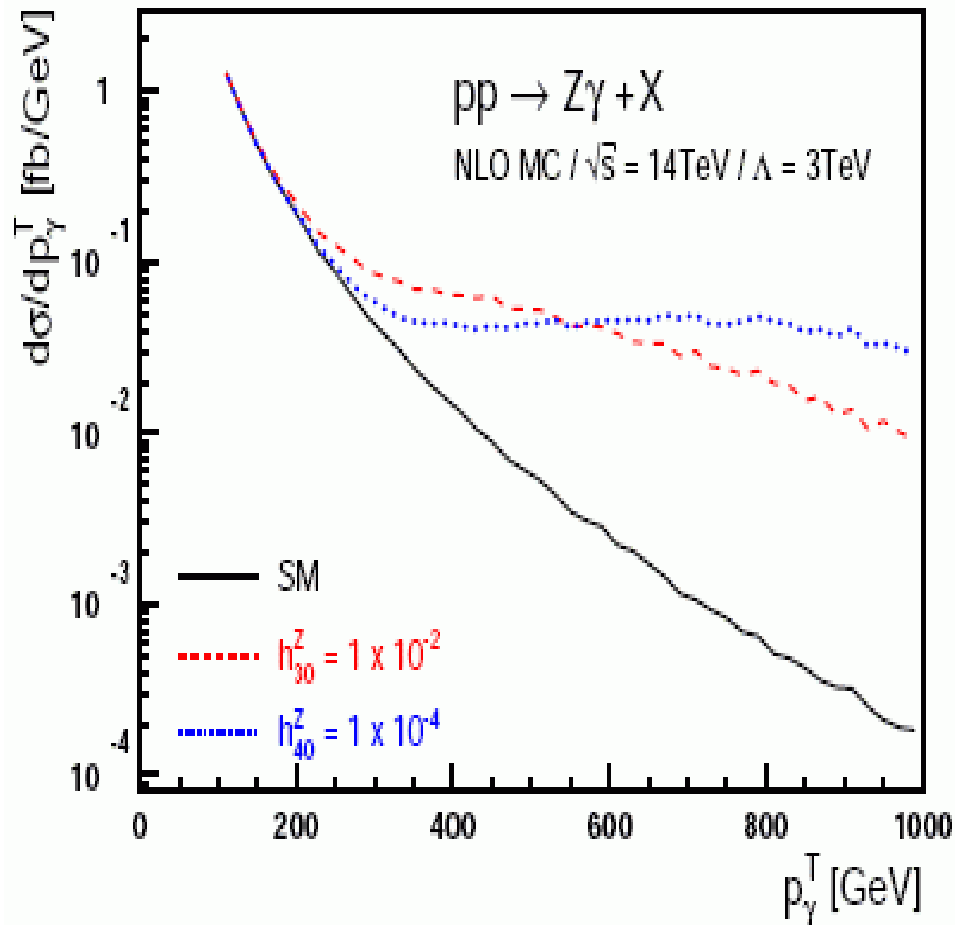


radiative BG





# Anomalous $Z\gamma$



CMS NOTE 2000/017

interesting  $\gamma$   $p_T > 400$  GeV/c



# $Z(-> \nu\nu) \gamma$ signal



## Signature

**high missing  $E_t$  (pt)**

no reconstruction of Z

**high pt isolated photon**

no radiative photons  $\rightarrow$  exactly 1 photon

**photon pt balanced with missing  $E_t$**

**no high pt electrons, muons, tracks, jets**



# MC study



See for details:

[http://grid.kfki.hu/twiki/pub/CMS/WeeklyBudapestDebrecenMeetings/100607\\_tgc.pdf](http://grid.kfki.hu/twiki/pub/CMS/WeeklyBudapestDebrecenMeetings/100607_tgc.pdf)

<http://indico.cern.ch/conferenceDisplay.py?confId=90714>

CMSSW\_3\_1\_4

Signal:  $Z\nu\nu\gamma$

Backgrounds: QCD80170, WW, WZ, Wjets, Zjets, Wgamma

To do: inclusive W background



# Real data



[/JetMET/Run2010A-Sep17ReReco\\_v2/RECO](#)

24 064 576 events,  $\sim 3 \text{ pb}^{-1}$

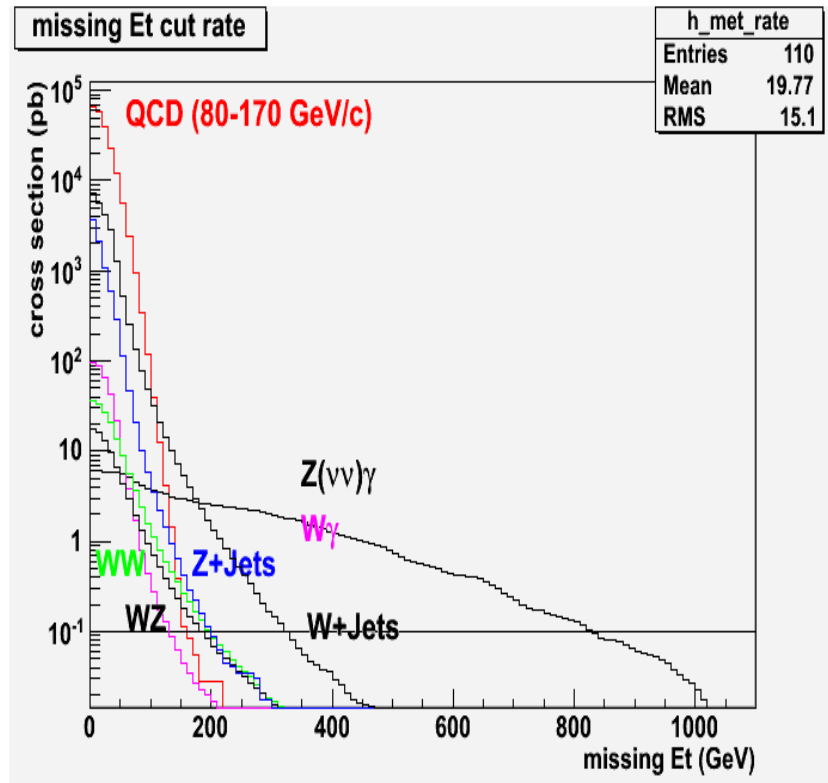
CMSSW\_3\_8\_4

Preselection:  $\text{MET (calo)} > 40 \text{ GeV}$ ,  $p_T^\gamma > 40 \text{ GeV}/c$

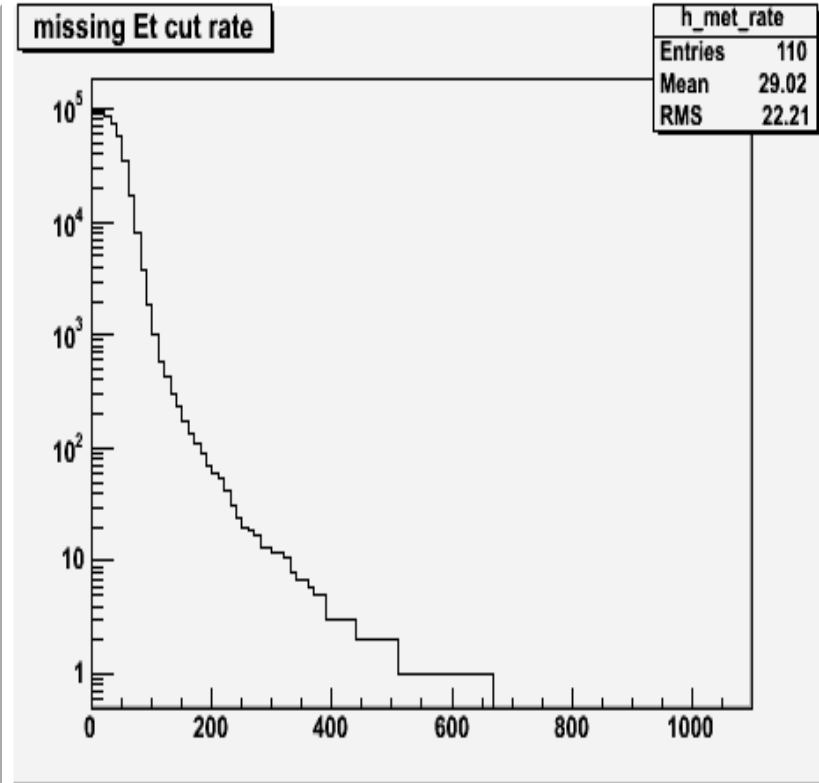
96 034 events



# Missing $E_T$ rate



MC

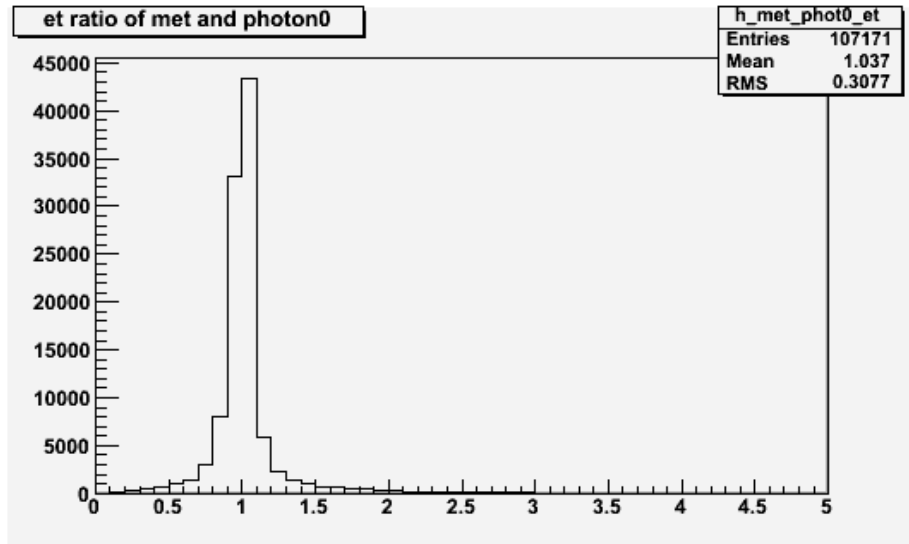


Preselected data



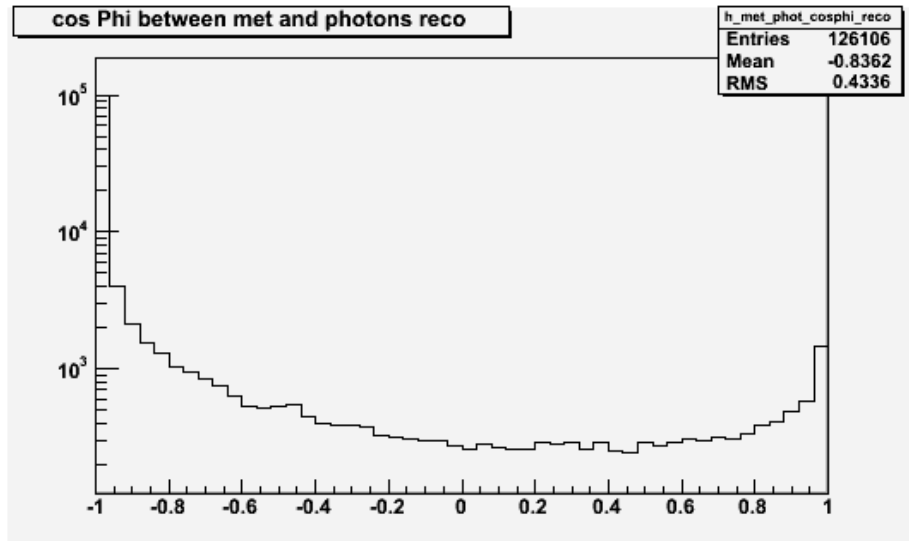


# MET $\gamma$ correlation



The signal has strong correlation between the missing Et and pt of the photon.

$$0.9 < \text{ratio} < 1.1$$



$$\cos \Phi < -0.98$$

MC



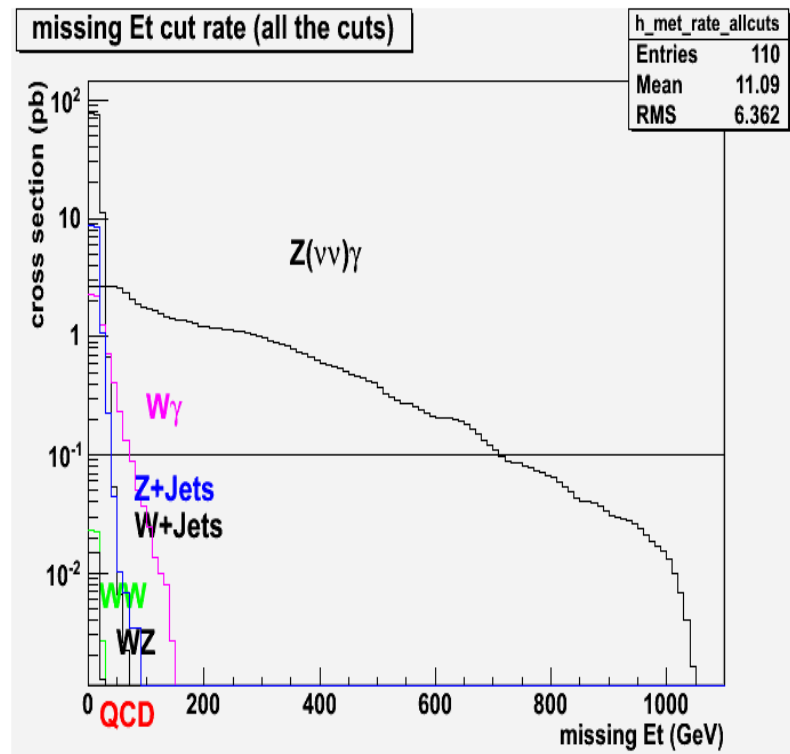
# Cut summary



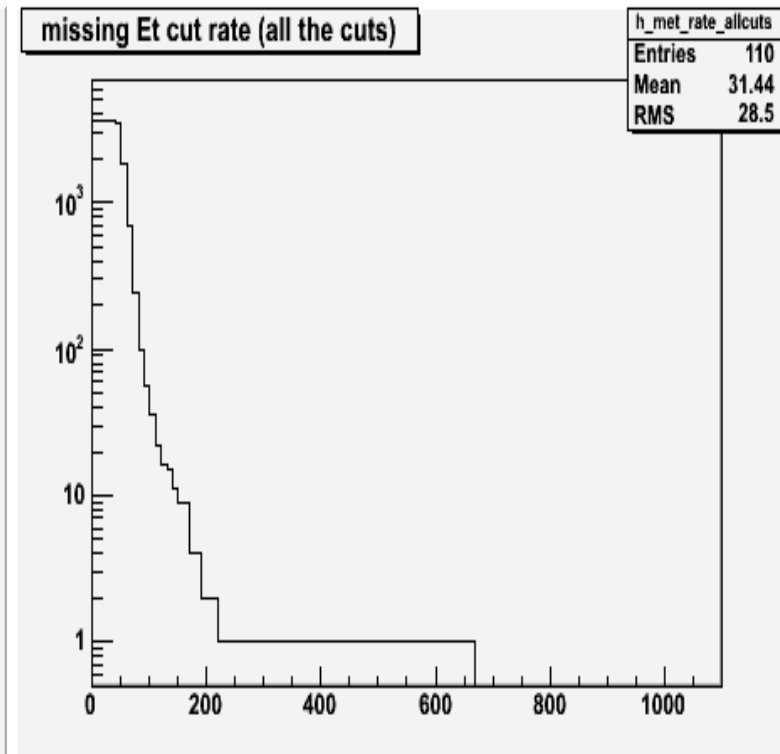
Cut	#Z(vv) $\gamma$	#W $\gamma$	#W+jet	#QCD 80-170 GeV/c
No cut	108907	106371	10004300	2375612
$p_T^{e,\mu} < 20 \text{ GeV}/c$	92992	55881	5839576	1525076
$p_T^{\text{track}} < 20 \text{ GeV}/c$	77490	57412	5965203	932378
$p_T^{\text{jet}} < 40 \text{ GeV}/c$	79286	64325	6281792	61
Lepton, track & jet veto	59773	38773	4227575	40
$N_\gamma = 1$	92279	56599	3586226	863320
MET & $\gamma$ balance	72782	4344	907576	29332
All the cuts above	48049	2494	103989	0
+ MET < 150 GeV	25308	1 (300GeV)	0	0



# Missing $E_T$ rate



MC



Preselected data



# Candidate



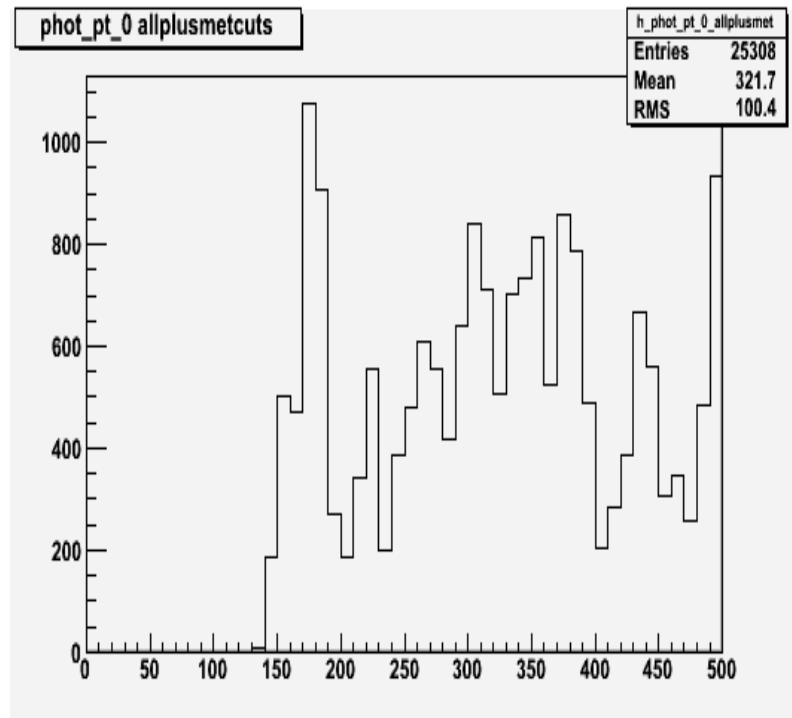
We seem to have at least one candidate

Run# = 143 181, Event# = 662 999 740

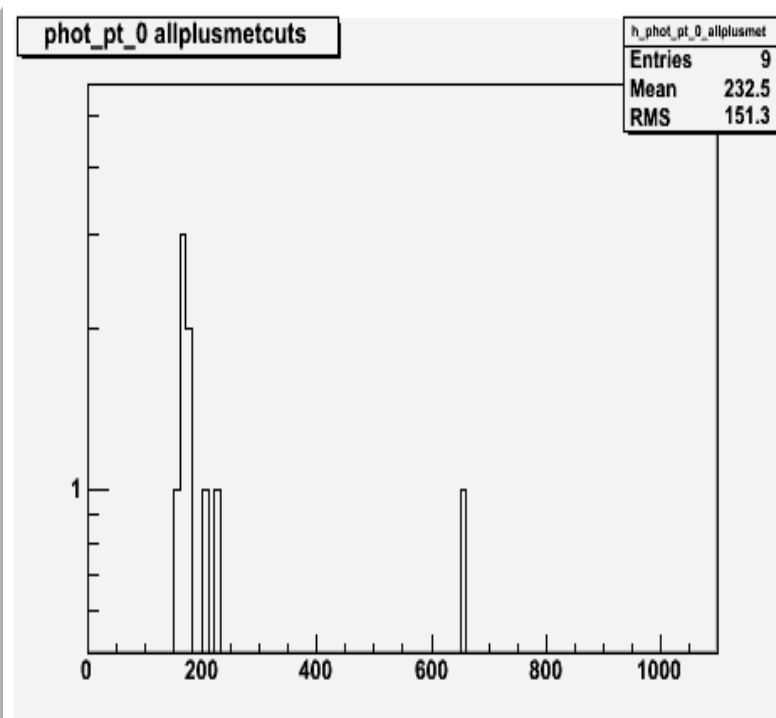
MET = 662 GeV,  $p_T^\gamma = 656 \text{ GeV}/c$



# Photon $p_T$



MC signal



Preselected data



# To do



Check inclusive W background

Better demonstrate need for Z(inv)gamma trigger