Results from investigations into the CMS physics channels PP→bbH(H→γγ)

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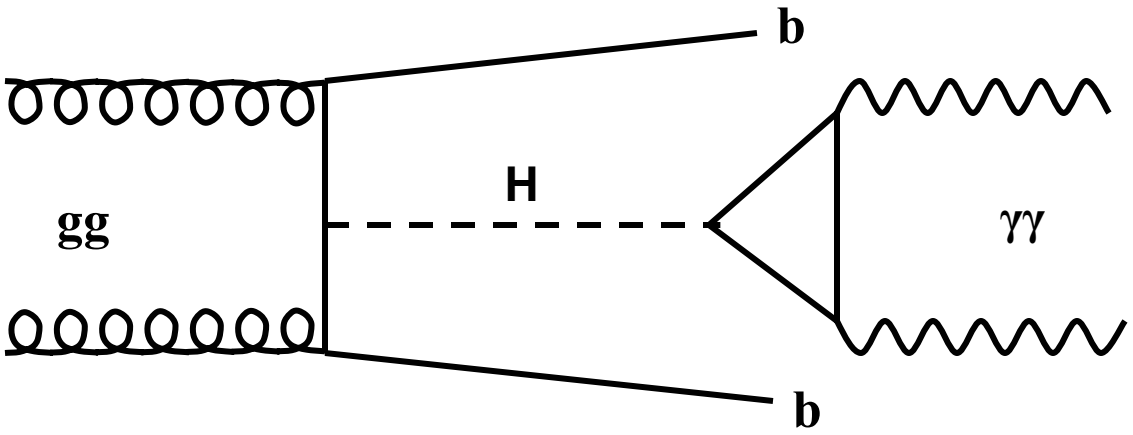
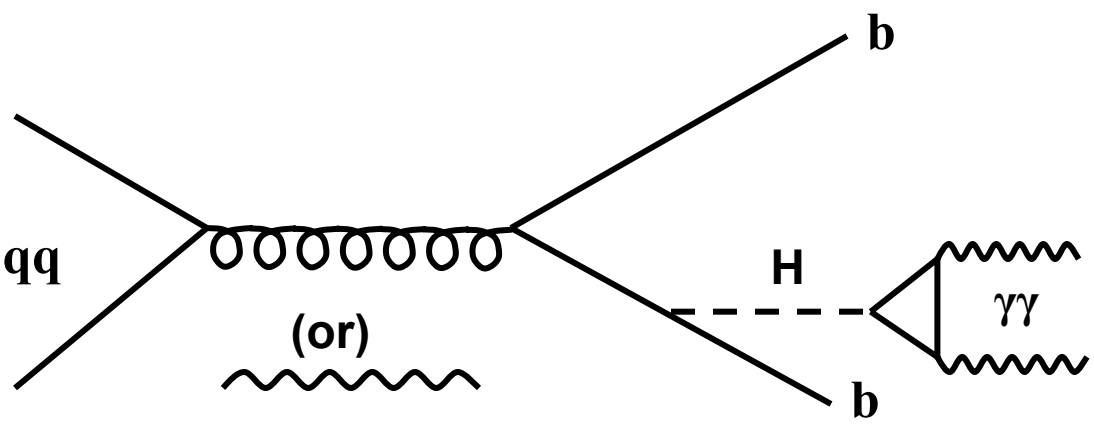
My Channels PP→bbH, H →γγ





2 Main sorts of diag:

gg →bbH(γγ) and

qq →bbH(γγ)

...contribution from gluon fusion about 1000X bigger than qq.

M_H and σ?

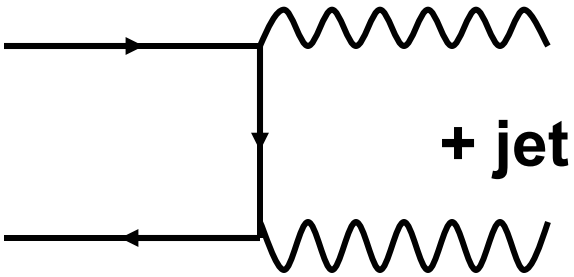
- Used Spira's HQQ(1.1) and HDECAY(3.0) with NLO/LO K=1.6.
- For all cases (SM, MSSM), v. small signal: order 0.09 to 0.15 fB passing basic CMS acceptance.
- Only regions worth looking at are:
  - SM: M_H~125GeV
  - MSSM (H): M_H~128, M_A~108, tanβ~30
  - MSSM (h): M_H~127, M_A~144, tanβ~30

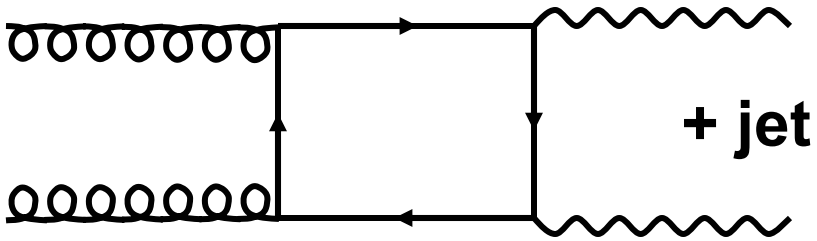
"acceptance": require: PT γ1>40, PTγ2>25, PT jet(s)>20 GeV, bTag>0,1: |η|s within fiducial regions.

Backgrounds

first two backgrounds: used PYTHIA 6.205:

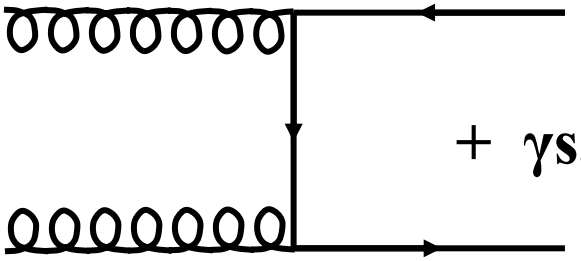
(1) PP→γγ+radiation/PU of a jet(s)





etc...

(2) PP→jet(s) + radiation/faking/PU of γγ



(1) order of 100 fB passing acceptance cuts (1000x signal!)

(2) can be kept to <<fB by simple b-tagging cuts.

Optimising vs Pythia back

Ran samples through CMSJET, added PU.

...using cuts on: P_T of γs, jet(s), P_T1-P_T2, M_H, P_TH, b-tagging efficiency as well as topological cuts: eta, phi, deltaEta, deltaPhi of γs, jet(s), this was the best i could do:

channel	"significance" in Gaussian sigmas (LEP style) For 100fB^{-1} data.	Probability of 3σ observation	Probability of 5σ observation
SM: 1-tag	2.87 (s=1.70,b<0.085)	41.8%	17.5%
SM: 2-tags	< 1evt per 100 fb-1 ..signal too small!!		
MSSM: h : 1-tag	3.68 (s=2.50,b<0.085)	63%	36.2%
MSSM: h : 2-tags	0.68 (s=1.00,b=2.56)	1.07%	0.0007%
MSSM: H : 1-tag	3.19 (s=2.00,b<0.085)	50.7%	24.4%
MSSM: H : 2-tag	0.40 (s=1.00,b=19.6)	0.28%	0.00006%

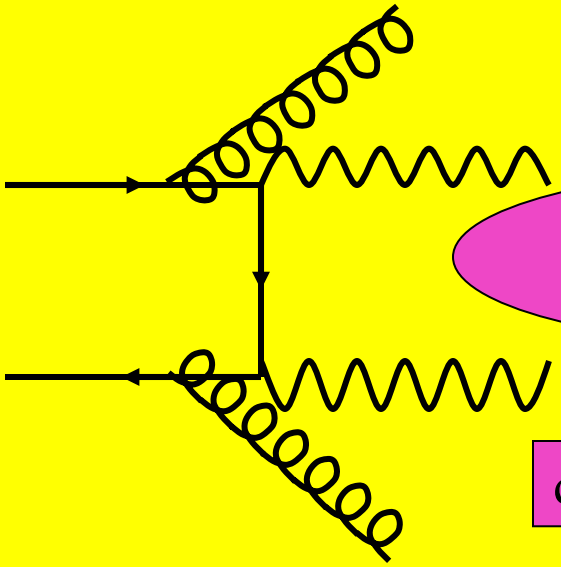
..so after looking at PYTHIA background, indication that there might be some chance of seeing 1-tag channels... ***..but...***

...uh oh.. MADEVENT backgrounds

PYTHIA: ff→γγ+X

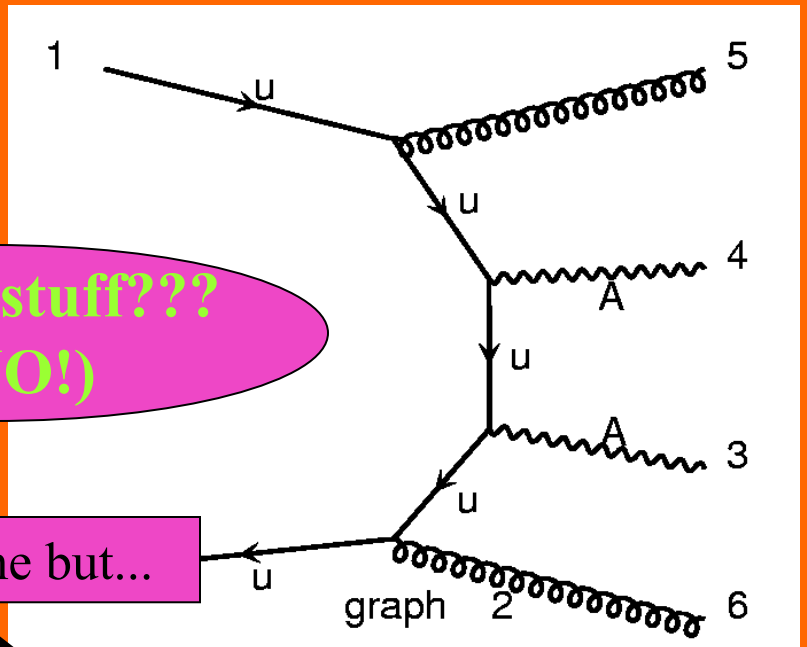
(X=2 jets ISR/FSR)

really is only:



MAD qq→γγgluglu

..all LO diags like:



~same stuff???
(NO!)

qq→γγ same but...

jets: ISR/FSR: soft & collinear approx

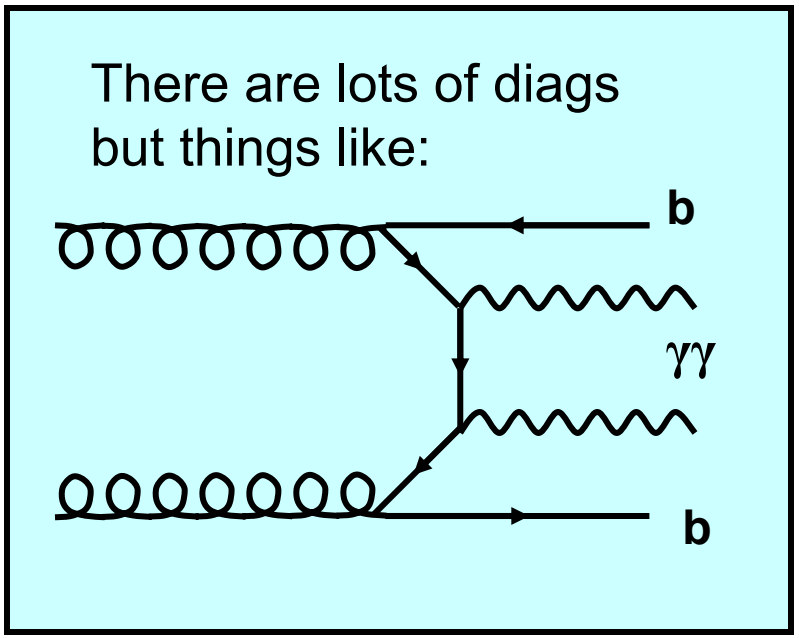
jets: exact matrix elements for hard scat.

MADGRAPH backgrounds

Made some more background (LO) processes using **MADEVENT**:

(1)"Irreducible background": processes where hard scattering really makes bbγγ. About 0.5 fB pass basic acceptance.

(2) "Light Jet background": where the hard scattering makes u's, d's etc. which then look like b jets. About 28 fB pass basic acceptance.

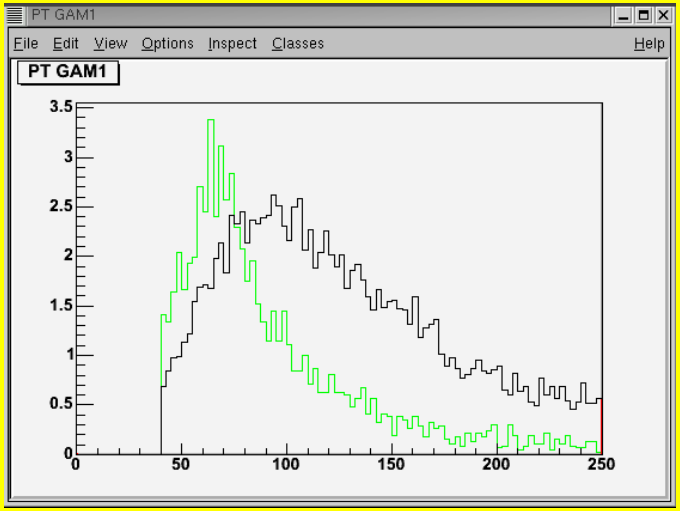


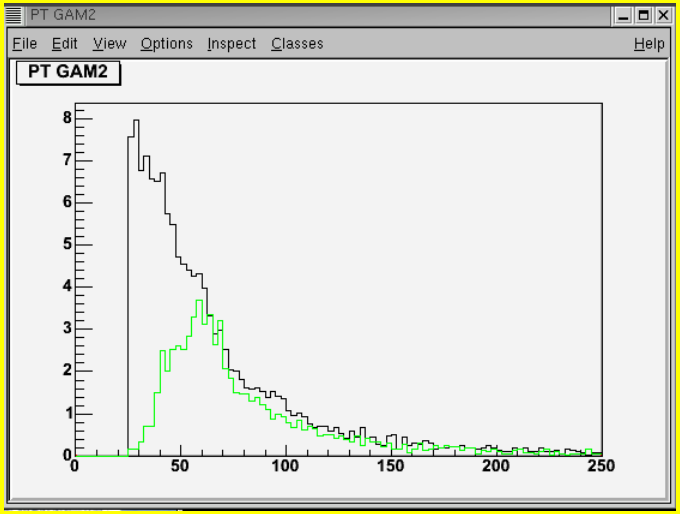
..but i can't find any signal significant regions !*##?*!

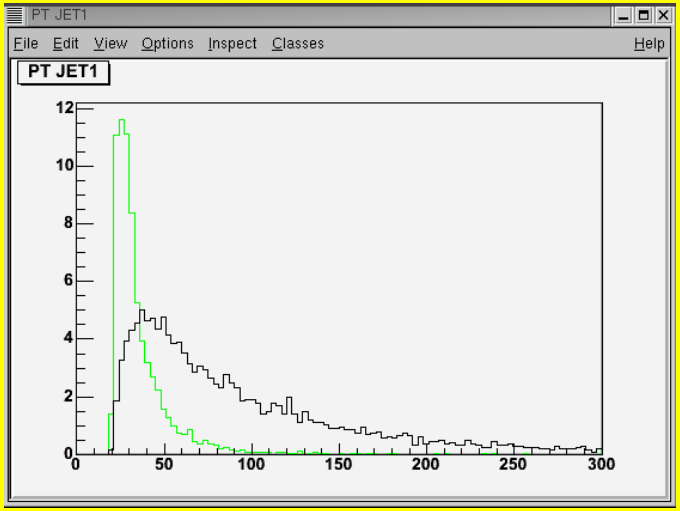
***acceptance (as before) require 2 γ, 1 jet with btag*

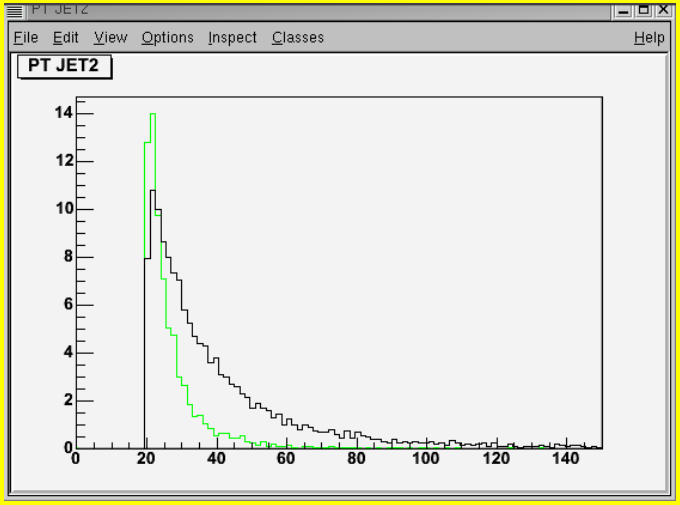
plots from a qq→γγgluglu PYT-MAD comparison

- PYT: 2 very similar PT γ (back to back) ...MAD shows PT ordering.
- MAD jj, much flatter PT spectrum.
- much harder to optimise against MAD topology.









..which all means...

- Using LO parton-lev gen, I can't find any regions of high signal significance anymore.. *(actually can only just about beat the bbγγ back..)*
- I also looked at the COMPHEP bbγγ and light jet+γγ samples *made by Misha Dubinin... also ALPGEN PhJet package ..both looked exactly the same as the MADEVENT ones.
- Did separate study of the γγ and γγjj backs produced buy PYTHIA and MADEVENT ..differences understood.

in summary...

- channel PP→bbH(γγ)
- signal of order 0.09 to 0.15fB
- backgrounds of order 100, (28 + 0.5) fB
- (Fast) simulated using CMSJET + PU.
- Maybe there is some cut combination that will give you a signal significant region but i have not found it..
- if you do a channel with a γγjj background, you'd better be careful how you make the background.