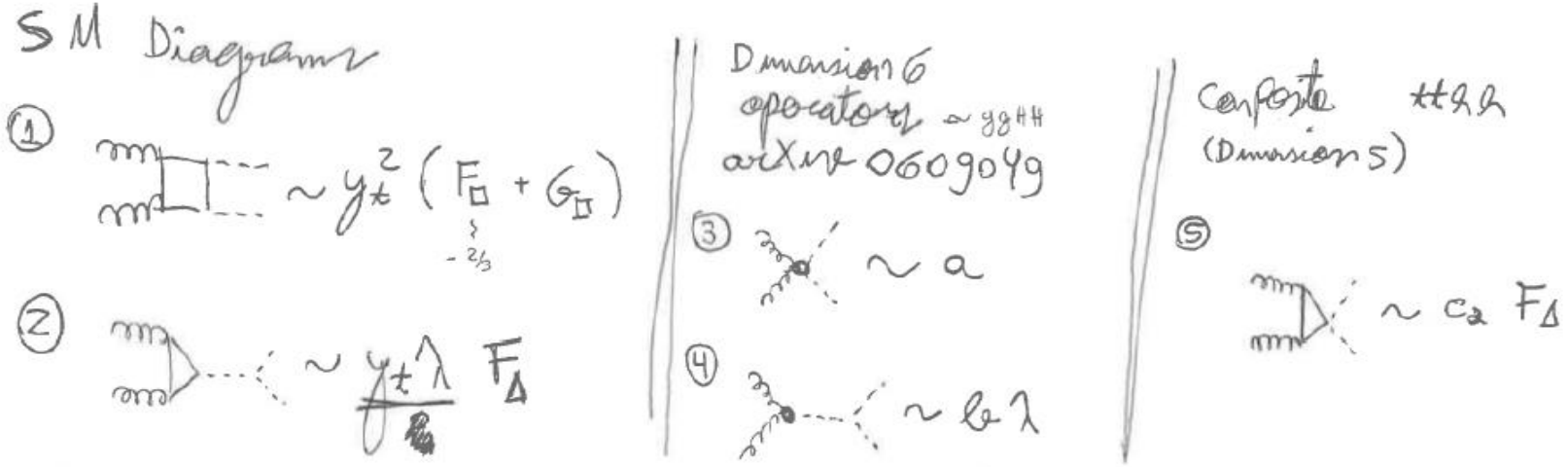
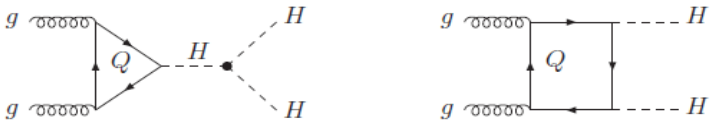
HH task force : ideas of the problematics



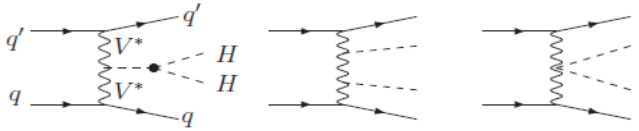
Maxime Gouzevitch (for CMS)
Magdalena Slawinska (for Atlas)
(both experiment contacts didn't yet discussed:))

0.1) HH decay and production channels

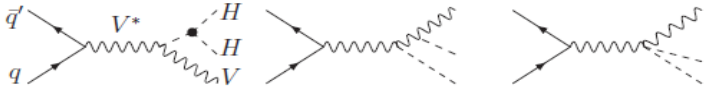
(a) gg double-Higgs fusion: $gg \to HH$



(b) WW/ZZ double-Higgs fusion: $qq' \to HHqq'$



(c) Double Higgs-strahlung: $q\bar{q}' \to ZHH/WHH$



(d) Associated production with top-quarks: $q\bar{q}/gg \to t\bar{t}HH$

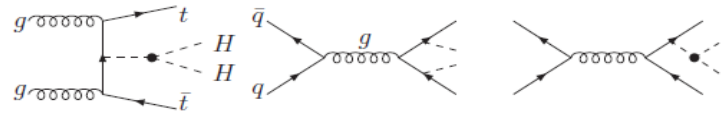
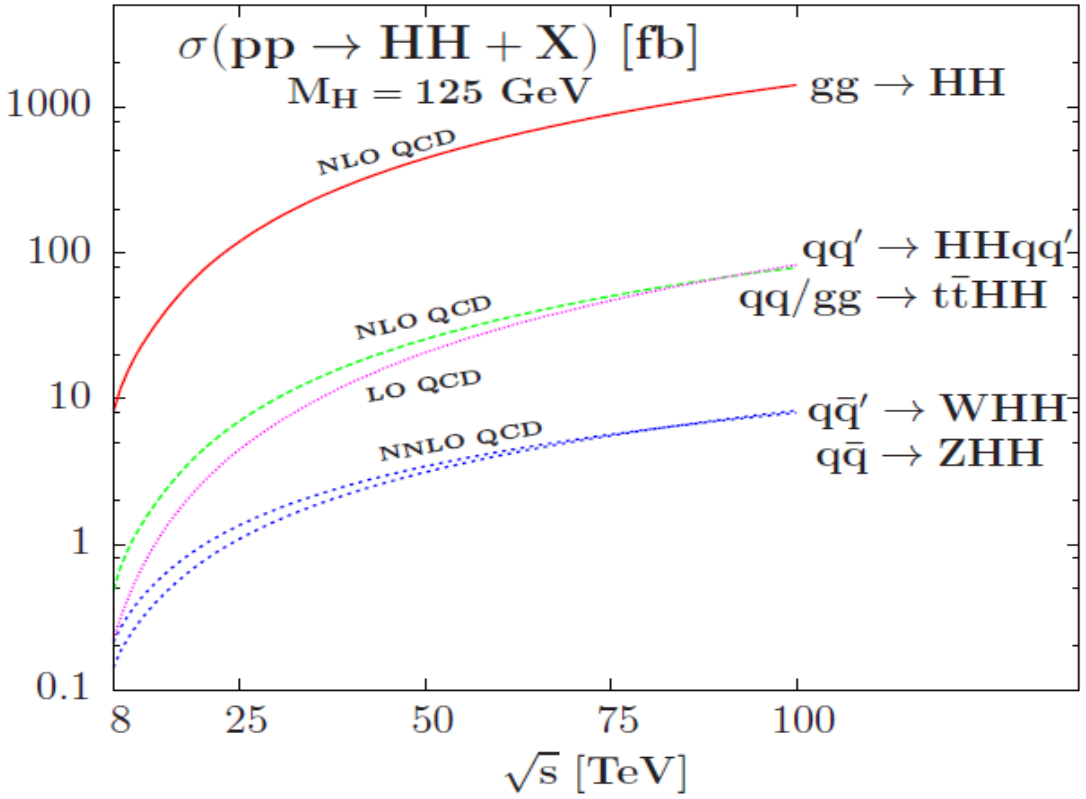


Figure 1: Some generic Feynman diagrams contributing to Higgs pair production at hac colliders.



0.2) HH decay and production channels

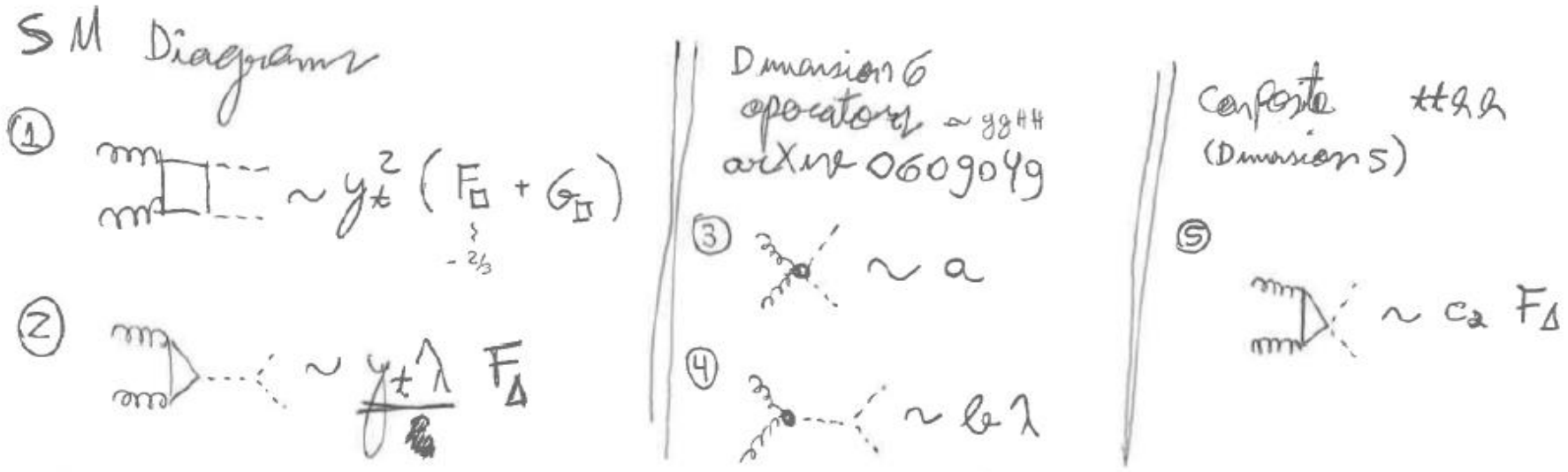
channel	frequency(%)
$h(b\bar{b}, c\bar{c}, gg)h(b\bar{b}, c\bar{c}, gg)$	47.86
$h(b\bar{b})h(b\bar{b})$	33.30
$h(b\bar{b}, c\bar{c}, gg)h(VV^*)$	33.40
$h(b\bar{b}, c\bar{c}, gg)h(\tau^+\tau^-)$	8.77
$h(VV^*)h(VV^*)$	5.83
$h(l^+l^-)h(VV^*)$	3.06
$h(l^+l^-)h(l^+l^-)$	0.40
$h(b\bar{b}, c\bar{c}, gg)h(\gamma\gamma)$	0.32
$h(b\bar{b})h(\gamma\gamma)$	0.26
$h(b\bar{b}, c\bar{c}, gg)h(\mu^+\mu^-)$	0.03
$h(l^+l^-)h(\gamma\gamma)$	0.03

1.1) HH non-resonant parametrization

1) SM HH is a far away story (3 ab-1 at least).
2) The way to SM HH goes through anomalious couplings.
We need to :

- Parametrize them at LO
- Consider the interplay with SM H production and Higgs coupling properties
- Consider the impoct on NLO and NNLO

1.2) HH non-resonant parametrization

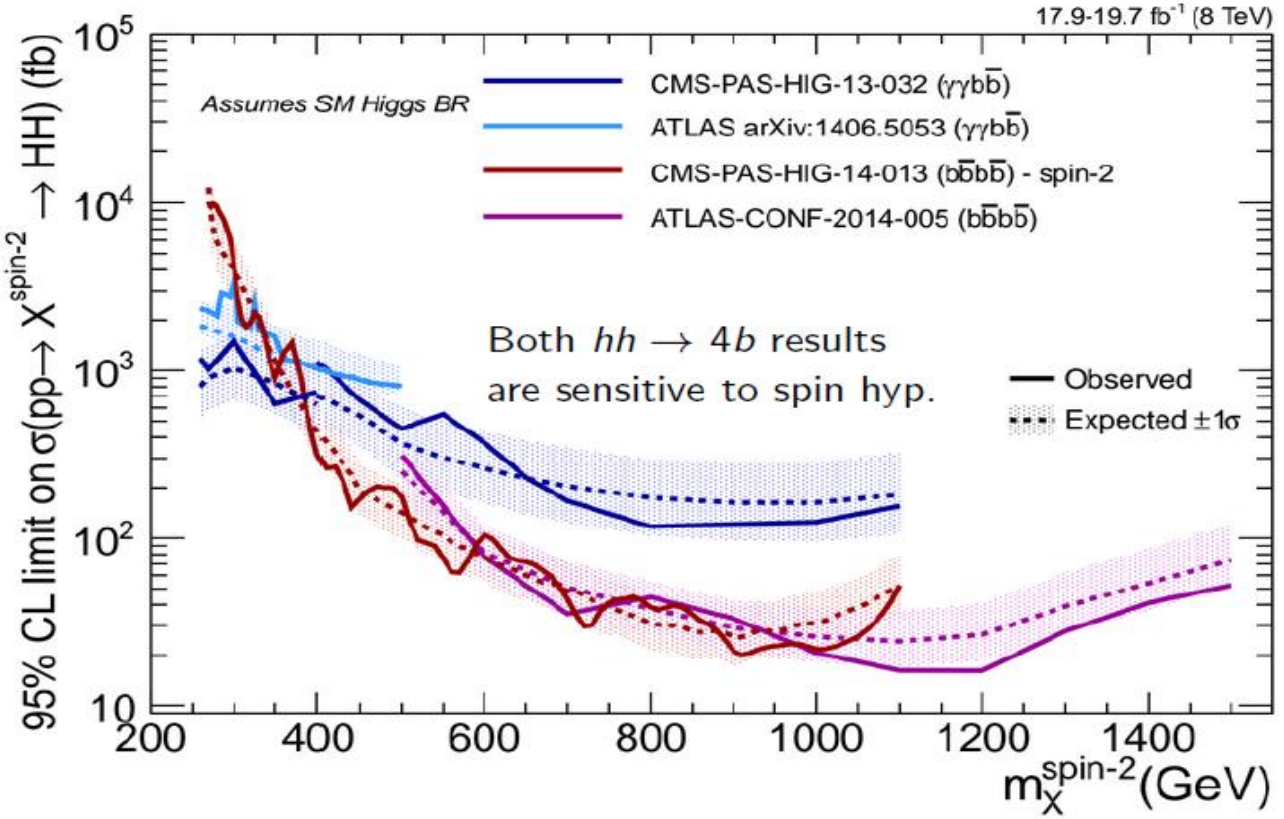


Free parameters: $\kappa_t \equiv y_t/y_{tSM}$, λ, a, b and c_2
(and for us the $h\gamma\gamma$ coupling $(= \kappa_\gamma)$)
$\Rightarrow$ The completely unconstrained parameters: c_2, a
(the c_2 is more motivated to study)

2) X->HH resonant searches

1) This is a associated analysis going along with HH non resonant :

- 250 < MX < 350 : 2HDM, (N)MSSM interest
- MX > 350 GeV : WED models



https://indico.cern.ch/event/302395/session/12/contribution/24/material/slides/0.pdf

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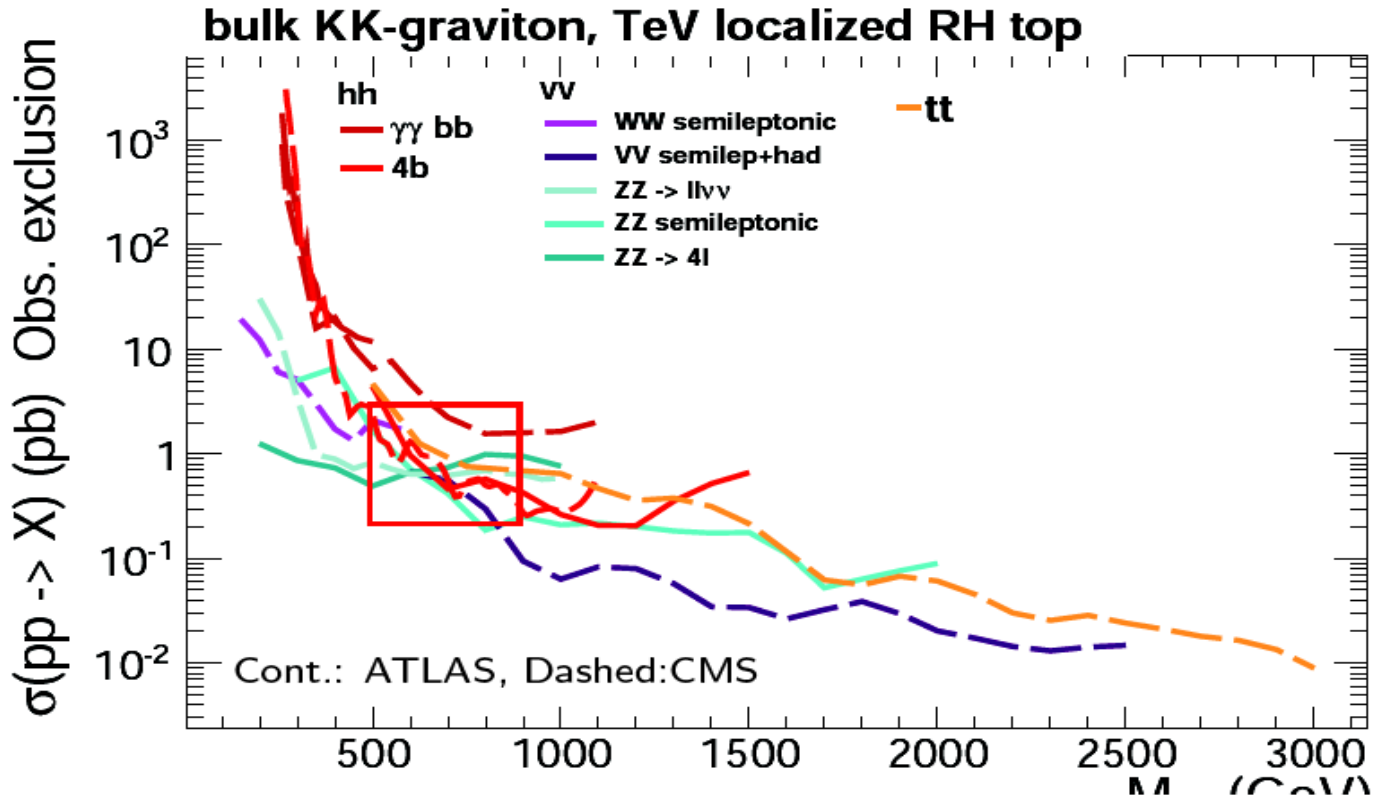
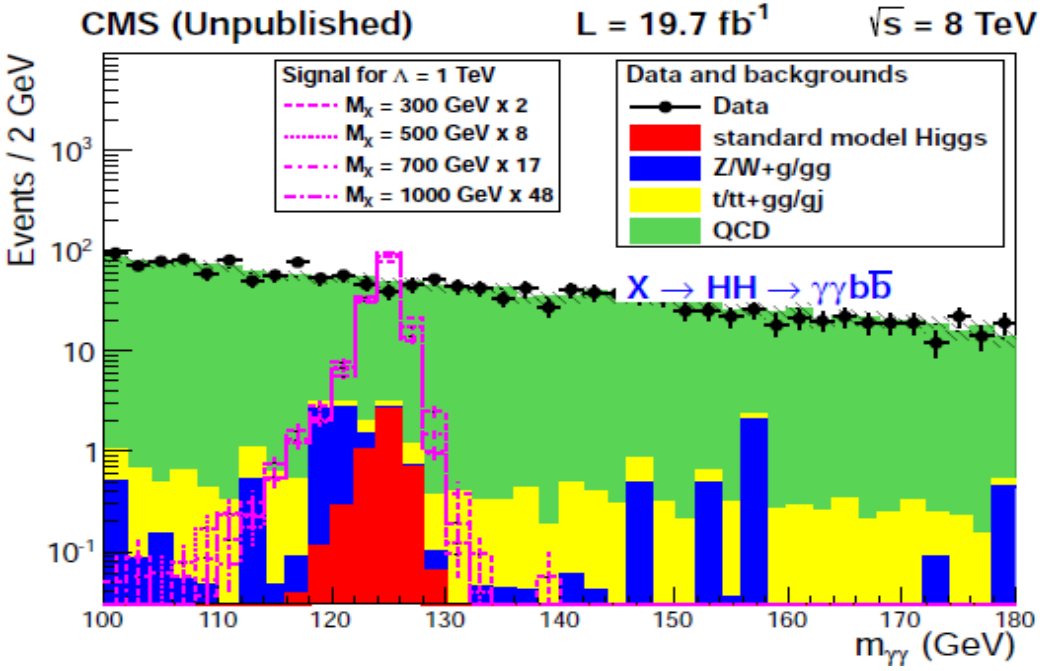


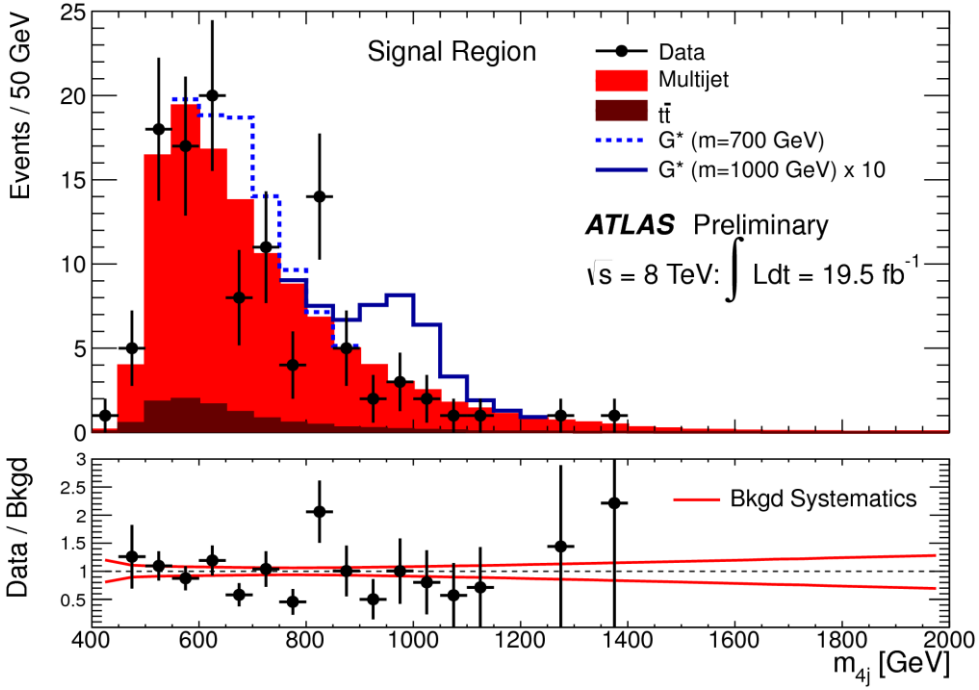
Di-higgs channel is competitive with VV if $M_{Gr} \subset\sim$[500,900] GeV.

3) Backgrounds

1) Understand backgrounds and agree on relevant ones:
   - QCD : gg+2jets, g+3jets
   - BbH, VHJ, ttH, ggH+2jets production

2) Guarantee (N)NLO predictions for background processes that cannot be extracted from data.





Other tasks

1) Study VBF HH production (resonant and non-resonant) :
   - New physics operators in non-resonant HH
   - Potential also for H self coupling observation

2) Coordinate prospects for future colliders (strong sensitivity to detector assumptions)