branching ratio study of $\mathrm{H} \to \gamma\gamma$, $\mathrm{H} \to \mu\mu$

C. Calancha

General Meeting

November 1st, 2014

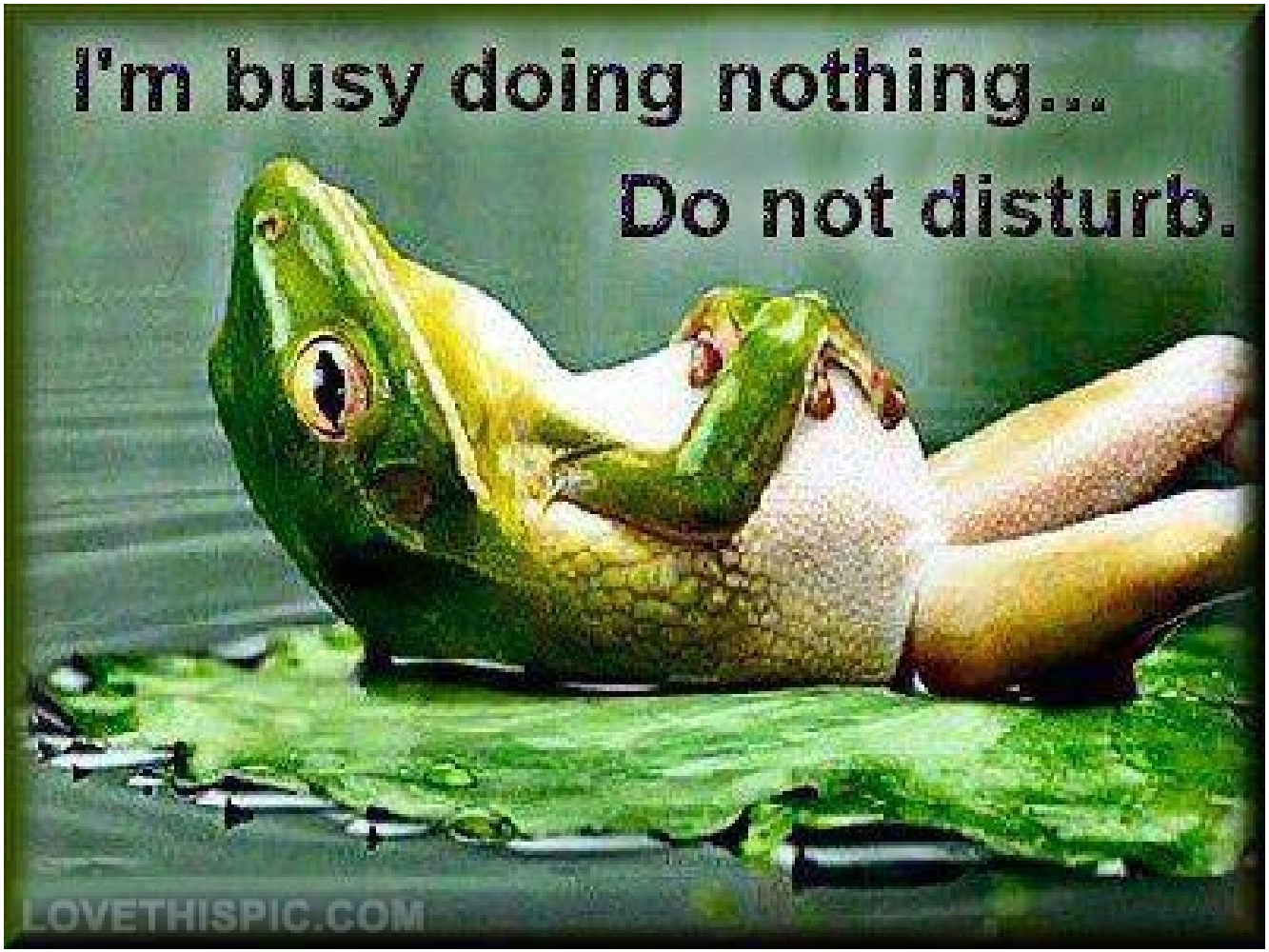
Outline

- Introduction.
- Status Rare Decays.
- Conclusion.

- Hope you enjoyed a nice Halloween night.
- I was very busy writting slides for you.

Not Active in Analysis in a While

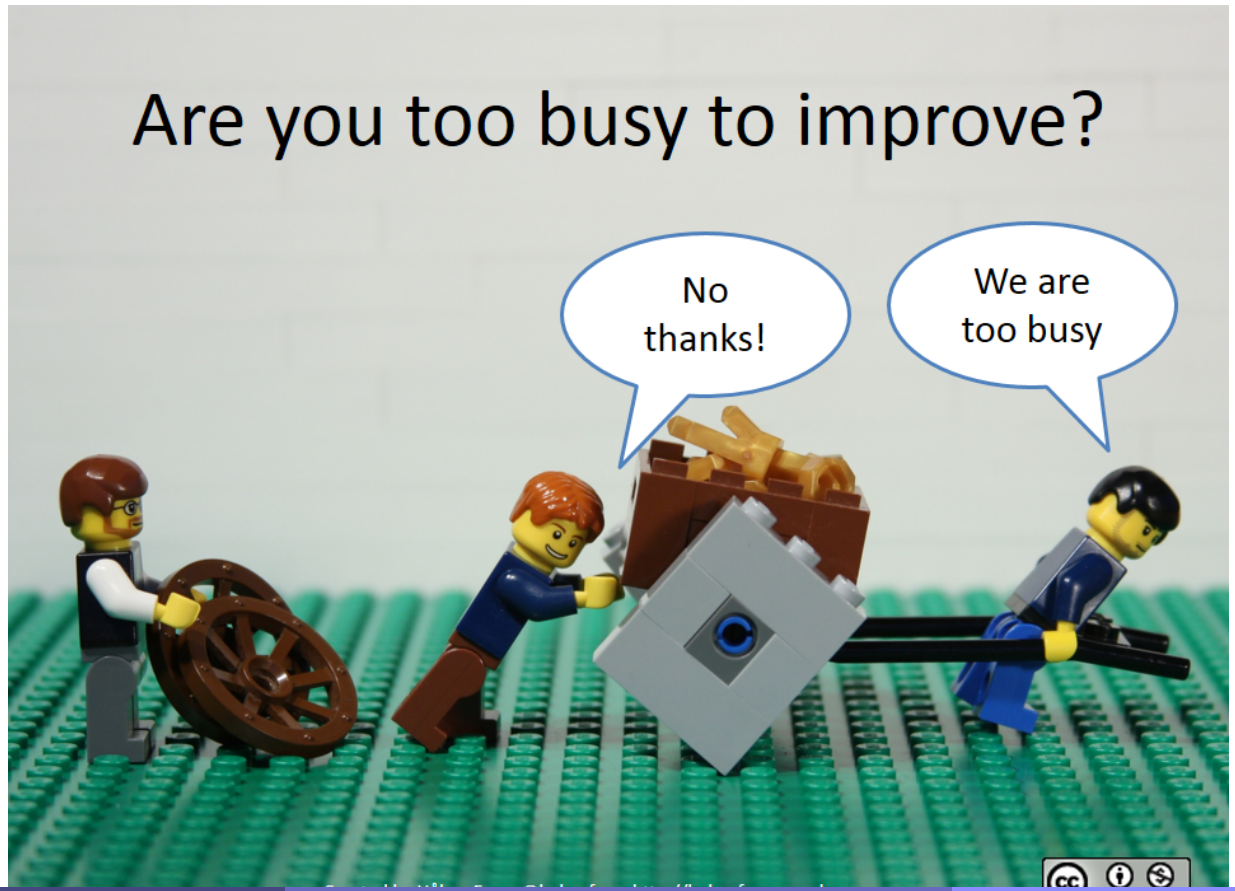
- Other Activities took 100% of my time.



- Well, not exactly like in the picture...

Very Busy as to Improve Previous Results

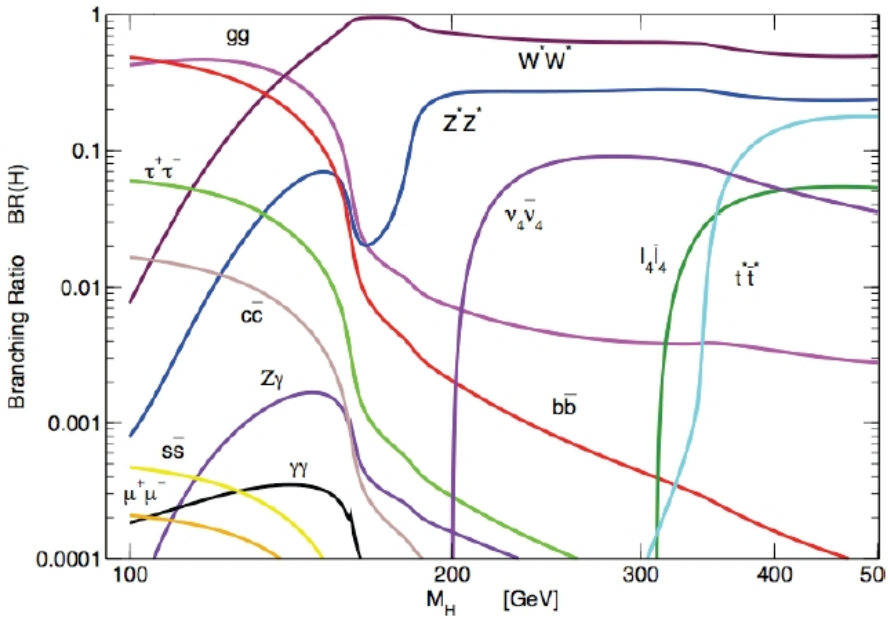
- Other Activities took 100% of my time.
  - hardware: FPCCD, beam test.
  - software: cut table tools, `ilc-xsec-db`.
  - detector optimization: single γ resolution impact on BR.

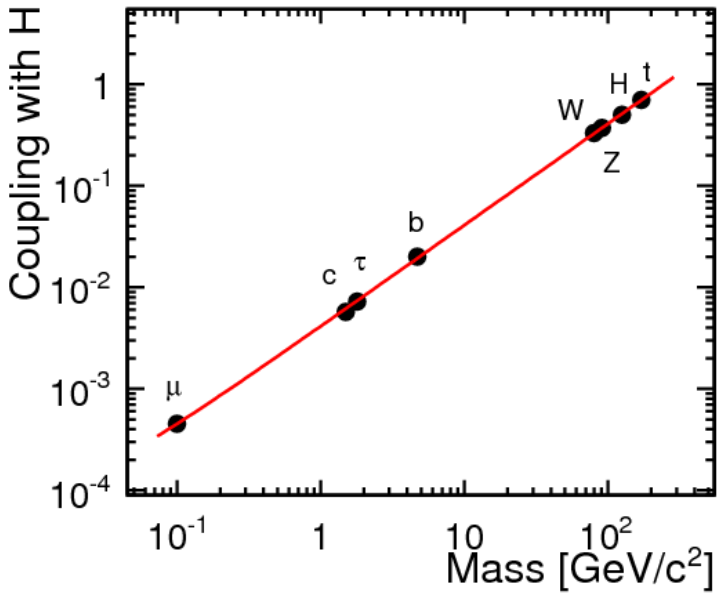


- Instead of present new result its time to summarize what has been done.

Branching Ratio Measurements

- Studying the Higgs properties important part of the ILC physics programme.
- Mass of $\approx 125\ \mathrm{GeV}/c^2$ $\rightarrow$ we are sensitive to many H decays.
  - Makes possible to test the linear coupling mass relation.
  - Makes possible to study rare Higgs decays via loop.
    - Even if no new heavy particles are observed, they will affect the branching fraction of these rare decays.

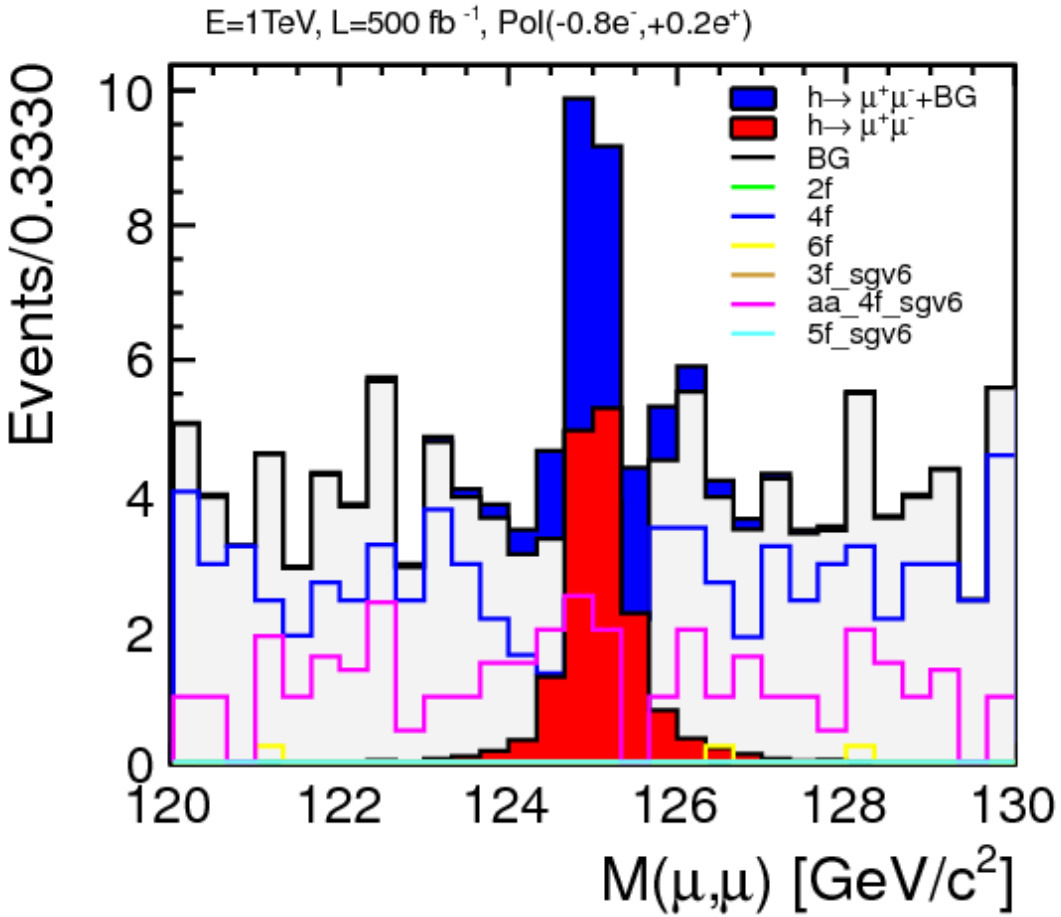




$\mathrm{H} \to \mu\mu$

- My first Analysis at linear colliders.

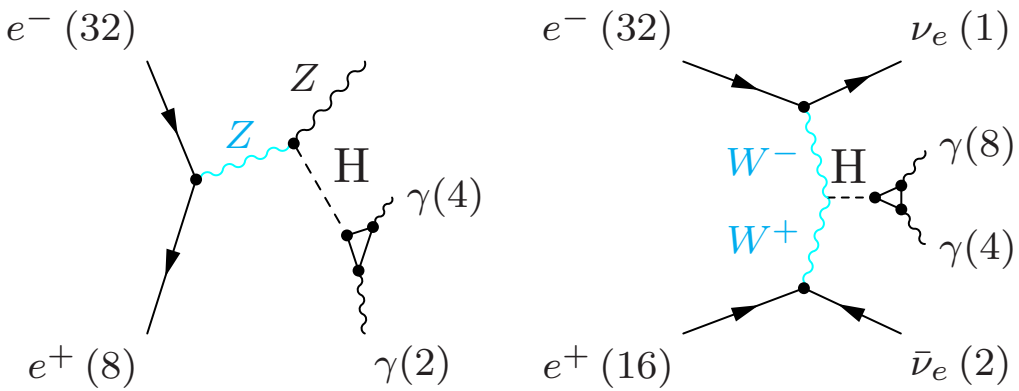
- ECM: 1000 GeV.
- (P_{e^-}, P_{e^+})=(-0.8,+0.2),
- $\int L = 500\ \mathrm{fb}^{-1}$.
- $S/\sqrt{S+B}$: 44 %
  (31 % at 1000 fb^{-1}).



LC-REP-2013-006

$\mathrm{H} \to \gamma\gamma$

$H \to \gamma\gamma$



external Z in the left hand plot decaying to: $Z \to l^+l^-$, $Z \to \nu\bar{\nu}$, $Z \to q\bar{q}$

Br($H \to \gamma\gamma$) = 0.228 %

- Main Background: qq$\gamma\gamma$, $\nu\nu\gamma\gamma$
  - High statistics samples generated, simulated, reconstructed with same tools as DBD samples.
- $\sigma(mainback)/\sigma(signal)$
  - 1000 GeV: $\approx 50 (= 44/0.9)$ ($\nu\bar{\nu}$H).
  - 500 GeV: $\approx 110 (= 42/0.39)$ ($\nu\bar{\nu}$H).

Presented at LCWS13 (*)

- $\frac{\Delta(\sigma \cdot Br)}{\sigma \cdot Br}$: 18.9 % at 500 GeV (500 fb^{-1})
- $\frac{\Delta(\sigma \cdot Br)}{\sigma \cdot Br}$: 7.4 % at 1000 GeV (1000 fb^{-1}).
- Both numbers refers to $\nu\bar{\nu}\mathrm{H}$. (**)

(*) See slides here

(**) Although preliminary results for other energies exists, only listed analysis presented out of our group.

- Results not as impressive as these (room for improve):

Next Step

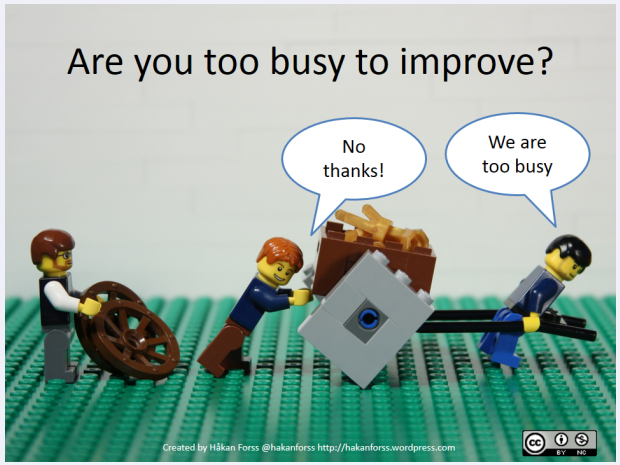
Next Step

Constraints

- Currently i can work $\lesssim$ 30 on analysis.
  - It could be less if i join systematics task force.
- No time to cover all energies with all Z modes.
- Write documentation of analysis also very important and time consuming.

A realistic goal

- The most important is cover machine design scenario: 500 GeV.
- 500 GeV with $\mathrm{q\bar{q}H}$, $\nu\bar{\nu}\mathrm{H}$.
  - Analyze these channels.
    - Improving $\nu\bar{\nu}\mathrm{H}$.
    - $\mathrm{q\bar{q}H}$ new.
  - prepare detailed documentation.



- What about $\mathrm{H} \to \mu\mu$ at 500 GeV?
  (considering staging C-500 slides 8-9 on Fujii-san todays report).
  - If would considered if people really interested.

Conclusion

Rare Decays Analyzed

- $H \to \mu\mu$ at 1000 GeV.
  - LC note and DBD.
- $\nu\bar{\nu}H$, $(H \to \gamma\gamma)$ at 500 and 1000 GeV.
  - Presented at LCWS13.
  - Comprehensible documentation desirable: just slides not easy to follow.

Outlook

- Considering other duties the best way to proceed is focus on 500 GeV.
- $\nu\bar{\nu}H$ and $q\bar{q}H(H \to \gamma\gamma)$ the priority.
  - With proper documentation.
- $H \to \mu\mu$ at 500 GeV could be done (if requested).
  - It would certainly rise the limit considering my other task/duties.


That's all Folks!
CULTURE WAR
SANTORUM CAMPAIGN
A LOONEY TUNE PRODUCTION
Chattanooga Times Free Press
Bennett