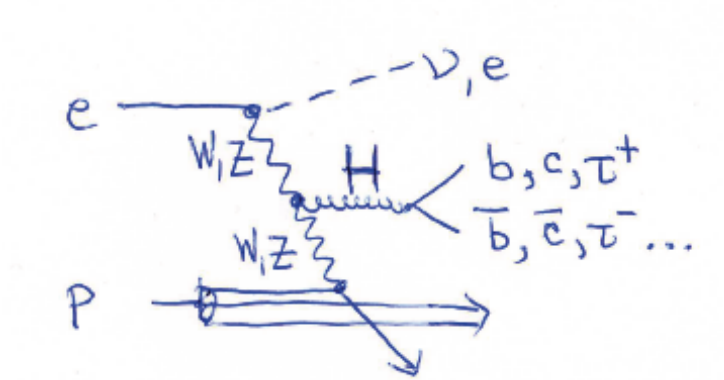
# A forward look to H in ep




A contribution to our discussion
For the HL HE LHC Workshop and the LHeC CDR Update we have to have a 'complete' answer to the question how well LHeC (and FCCeh) determine the Higgs properties

Max Klein
University of Liverpool

Tall at the LHeC/FCCeh Higgs Meeting, 8 January, 2018

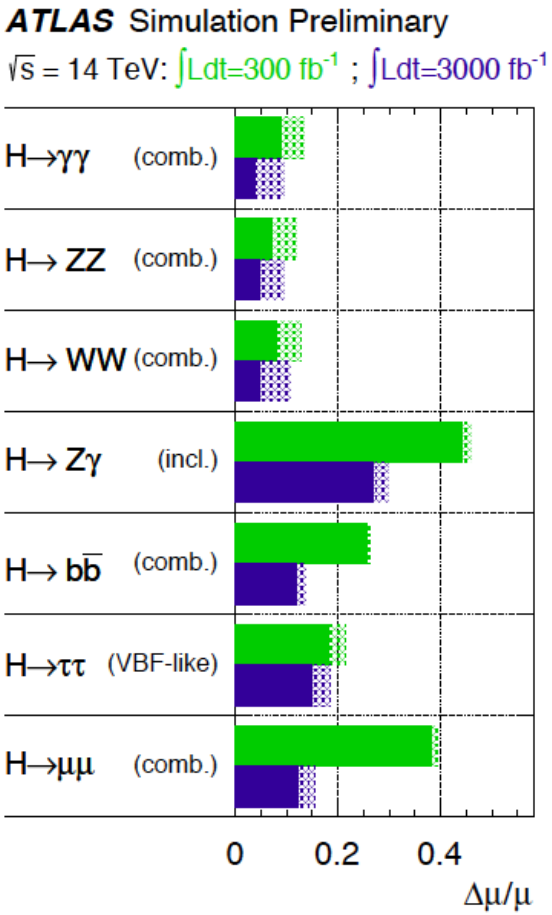
# Branching $br_i$ and Rates

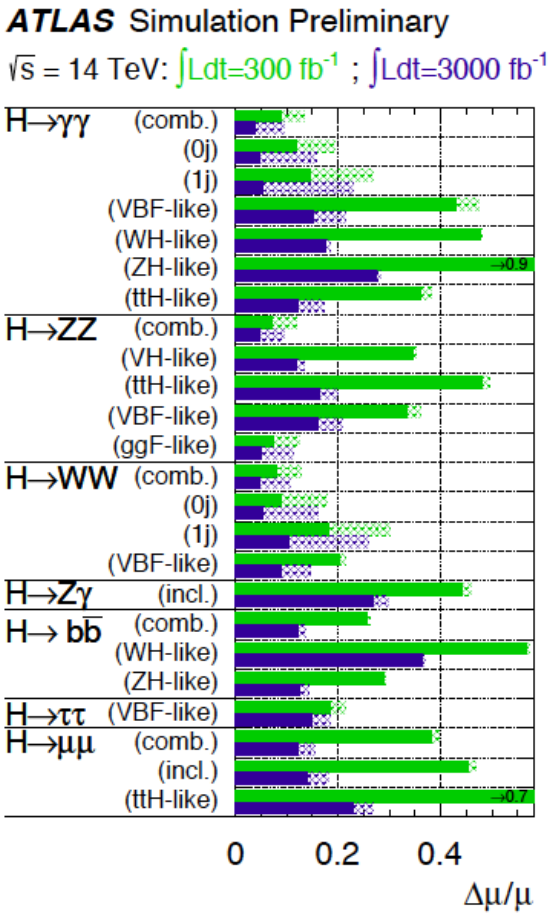
| Higgs in $e^-p$ | | CC - LHeC | NC - LHeC | CC - FHeC |
|---|---|---|---|---|
| Polarisation | | -0.8 | -0.8 | -0.8 |
| Luminosity [$ab^{-1}$] | | 1 | 1 | 5 |
| Cross Section [fb] | | 196 | 25 | 850 |
| Decay | BrFraction | $N^H_{CC}$ | $N^H_{NC}$ | $N^H_{CC}$ |
| $H \to b\bar{b}$ | 0.577 | 113 100 | 13 900 | 2 450 000 |
| $H \to c\bar{c}$ | 0.029 | 5 700 | 700 | 123 000 |
| $H \to \tau^+\tau^-$ | 0.063 | 12 350 | 1 600 | 270 000 |
| $H \to \mu\mu$ | 0.00022 | 50 | 5 | 1 000 |
| $H \to 4l$ | 0.00013 | 30 | 3 | 550 |
| $H \to 2l2\nu$ | 0.0106 | 2 080 | 250 | 45 000 |
| $H \to gg$ | 0.086 | 16 850 | 2 050 | 365 000 |
| $H \to WW$ | 0.215 | 42 100 | 5 150 | 915 000 |
| $H \to ZZ$ | 0.0264 | 5 200 | 600 | 110 000 |
| $H \to \gamma\gamma$ | 0.00228 | 450 | 60 | 10 000 |
| $H \to Z\gamma$ | 0.00154 | 300 | 40 | 6 500 |

In their order of br, the 6 most abundant decays are: bb, WW, gg, ττ, cc, ZZ: B= $\Sigma br_i$=1 (0.996)

# ATLAS and LHC Prospect

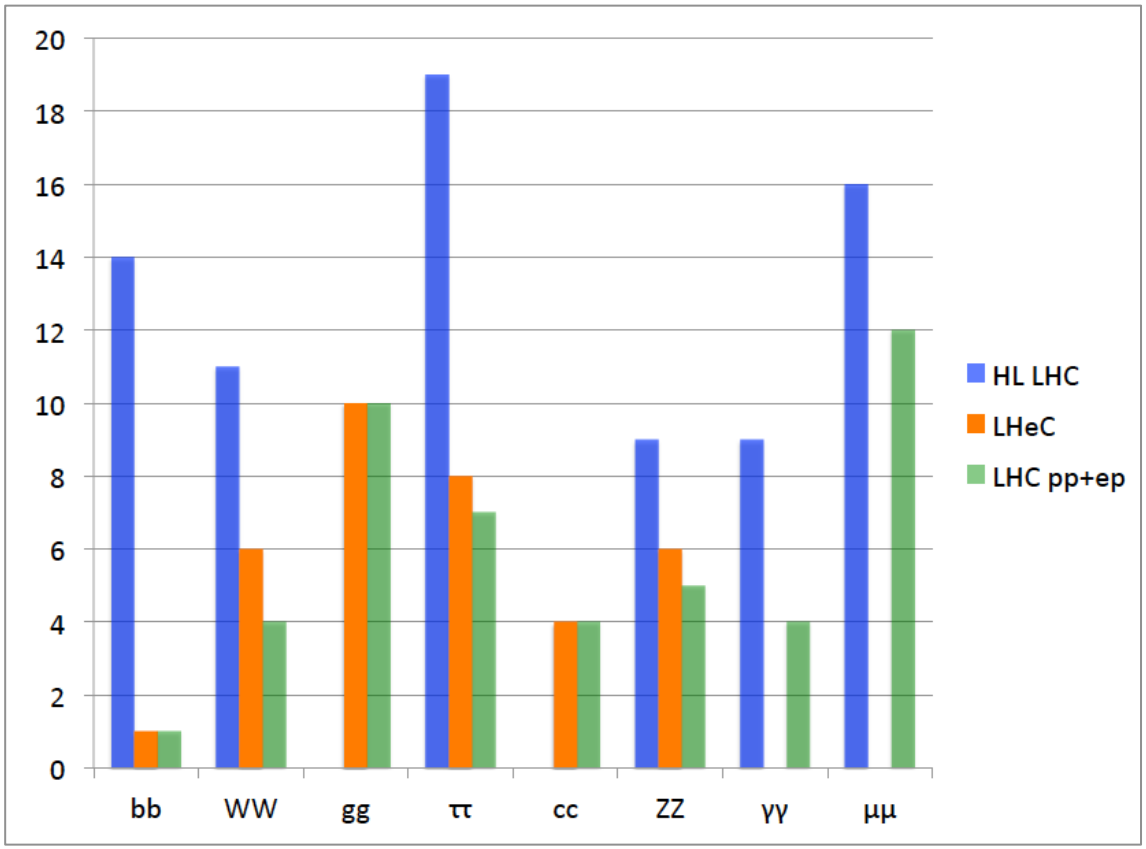
ATLAS-PHYS-PUB-2014-16




These results/estimates will almost certainly improve. HL-HE LHC Workshop ATLAS analyses: eg H-bb: recent paper 1708.03299: μ=0.9 +- 0.18 +0.21-0.19= 0.90 →30% with 36 fb-1. can expect this becomes sth like O(5)%, not 14% as ATLAS predicted. Furthermore, LHC will be the ATLAS+CMS average. → maybe the LHC result will be green/2

# Future LHC




Considered 3 cases: ATLAS 2014 prospect (“HL LHC”), LHeC (bb, cc from Uta et al, others guessed from rates and decay peculiarities, gg assumed to work..), LHC (ep+pp) a tentative combination of LHeC + LHC with no theory if they are similar, or just the best ( as bb from ep)

**B=0.89 +- 0.12** **B=1.00+-0.02** **B=1.00+-0.01**

# Questions

Can we do H → gg in ep (pp)?

We expect 400 H→ γγ events in ep. Is that hopeless?

Can we get estimates for all extra 4 channels (gg,ττ,WW,ZZ) by summer/fall 18?

Can we determine the full width from an inclusive NC study?

How do we estimate the theory gain through ep  for pp?

Can/shall we do an EFT coupling fit? eg. a la Peskin et al:  1708.0912
(couplings sound twice better than signal strength. Their fit does a magic boost for iLC..

It is crucial for the LHeC to converge on this and I want to thank cordially all involved

A Happy New Year