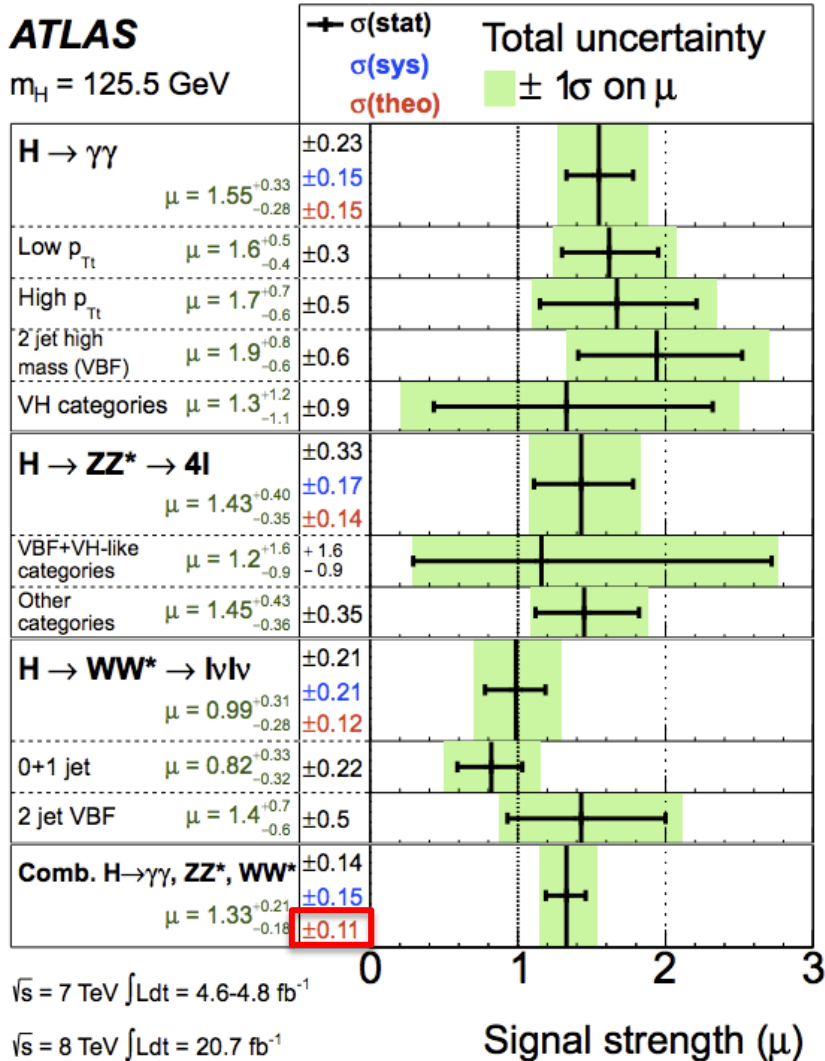


The experimentalists point of view

Contributions from André, Reisaburo,
Pierre, Marumi ...

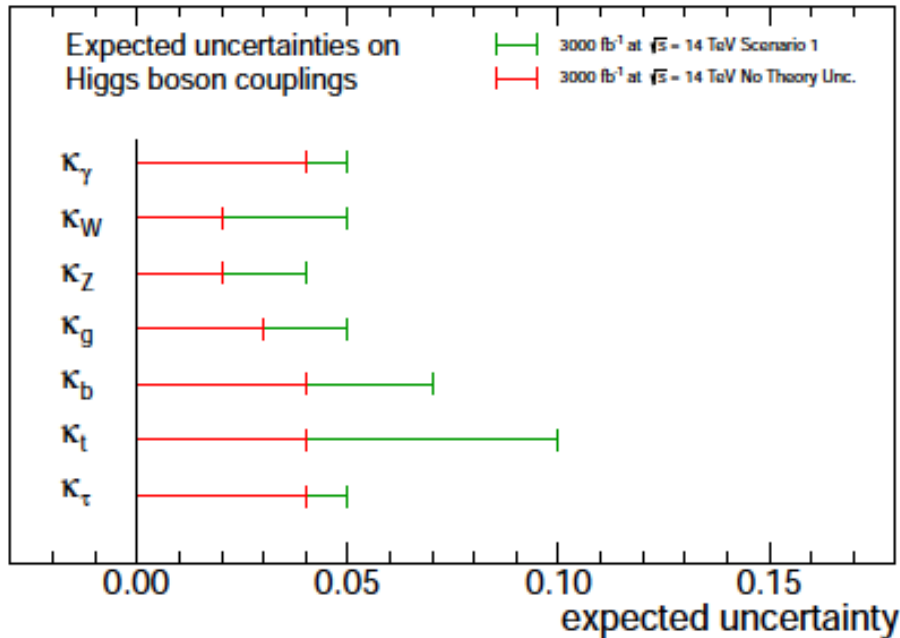
Yields/Rates/Couplings



- **Theory Error** on $\sigma(\text{ggH})$ already visible on combined μ
 - **Scale + PDF** -> Improvements: See slide by C. Anastasiou at this EFT2013 who discussed N3LO ggH
 - Impact also **VBF extraction**: non negligible **ggH contamination**
- How to implement theory errors in our **fit model**:
 - Gaussian, log-normal, Flat, ...
- **Jet bin** uncertainties **0/1 Jet VBF** selections:
 - experiments moving to **VBF tag MVA techniques**
 - How to go beyond (conservative) **Stewart & Tackmann prescription**

Yields/Rates/Couplings

CMS Projection



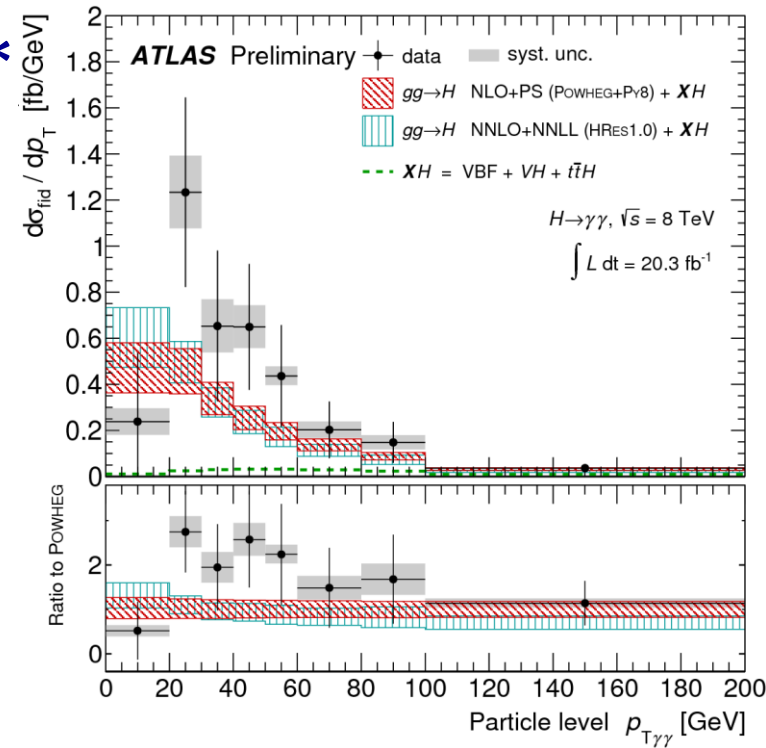
- Precision issues:

- Final goal is to go below 5% accuracy on couplings (most of BSM models predict deviation below 10%)
- inclusions of NLO EW
- Top Yukawa coupling reduce theory errors on $t\bar{t}H$

- Modeling of $Pt(H)$ in ggH :
 - already used by several analysis to enhance sensitivity (reduce bkg)
 - Review procedure to assess systematics and improve prediction: effect of finite quark masses t/b
 - Important also in BSM (POWHEG MSSM implemented, now work under progress for 2HDM by A. Vicini et al.)
- How to go beyond current “LO-inspired” parameterization “*a la* LHC Higgs XS WG”

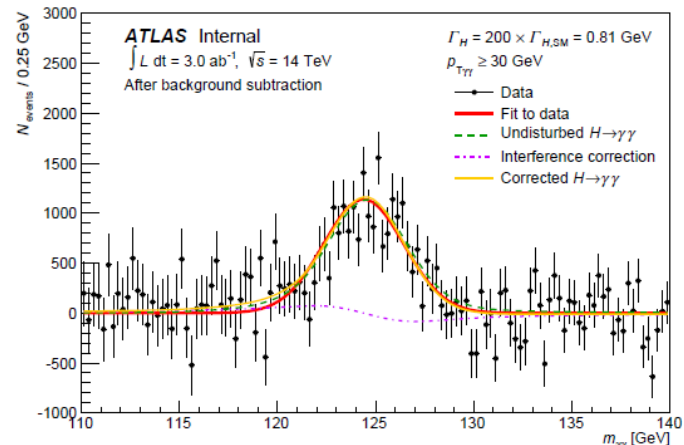
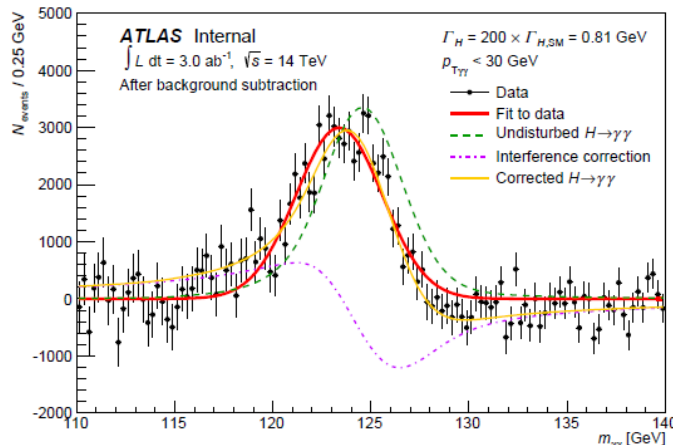
Differential Cross-sections

- Work started: $\gamma\gamma$ and soon ZZ^*
- ...
- Theory systematic clear when cuts are applied to **physics objects** (γ Pt and Y η) but difficult to **combine channels**
- Guidance from theory community on which variables: now focusing on **Pt**, **Y**, **N-jets** .. (M_{34} ...) ?



Mass and Width

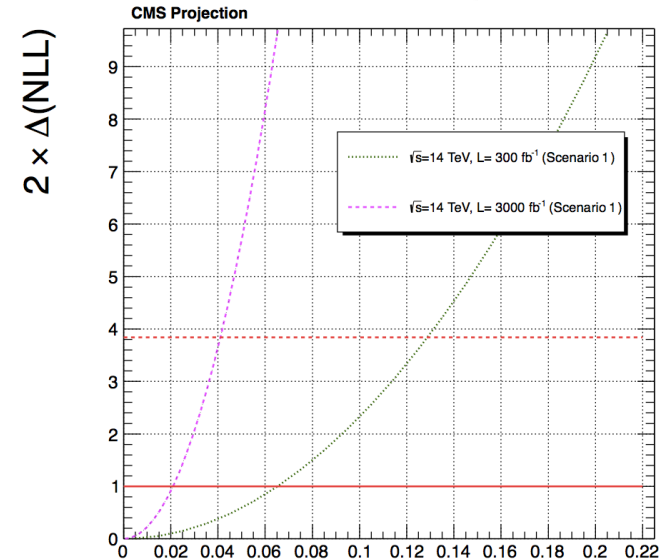
- Mass: **Interference effects** (with SM bkg) on mass small for $\gamma\gamma$ (and negligible in ZZ^*) with respect to current statistical error (to be considered at HL-LHC)
- Width:
 - Direct constraint from mass spectrum CMS (and ATLAS also coming soon) of \sim **few GeV**
 - Using **Interferometry** $\gamma\gamma$ and ZZ^* (Kauer-Passarino + Melnikov-Caola) may lead to better experimental constraints : work started for HL-LHC $\Gamma_H < \sim 100$ MeV ?



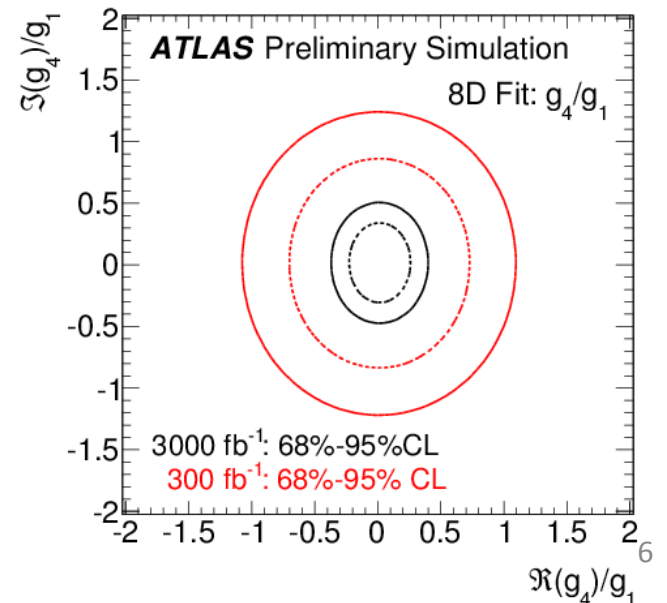
CP

$$A = v^{-1} \epsilon_1^{*\mu} \epsilon_2^{*\nu} \left(\underbrace{a_1 g_{\mu\nu} m_H^2}_{A_1} + a_2 q_\mu q_\nu + \underbrace{a_3 \epsilon_{\mu\nu\alpha\beta} q_1^\alpha q_2^\beta}_{A_3} \right) = \underbrace{A_1}_{A_1} + \underbrace{A_2}_{A_2} + \underbrace{A_3}_{A_3}$$

- Several MC/Parameterizations under consideration:
 - Current results with JHU(LO) – cross-checks with MG5
 - Moving to NLO MC: JHU+Powheg, MG5/aMC@NLO
 - Need to understand differences
 - ... addressed in Fabio's talk
- What about complex (CP violating) couplings:
 - present in JHU not in MG5 ?
- To do → investigate CP with:
 - VBF production
 - Fermion sector: $H \rightarrow \tau\tau$?



$$f_{a3} = |A_3|^2 / (|A_1|^2 + |A_3|^2) \quad f_{a3}$$



Additional General Remarks

- **Tools:** Experimental collaborations need tools (MC, ME, reweighting, etc.) for **Higgs property measurements** and **BSM Higgs searches**
 - Tool developments are important aspects
 - ex. (N)NLO MC for both Higgs signal ggF, VBF, WH/ZH, ttH, HH(most important in HL-LHC) and SM background

Additional General Remarks

Direction:

- Interplay with, and constraints from, the rest of the EWK sector. HEFT NLO EWK fit?
- Taxonomy/hierarchy of operators. Based on observability of effects ?

Correctness:

- Inclusion of NnLO QCD
- Inclusion of NLO EWK. Takers ?

Sensitivity: most BSM effects $<10\%$:

- LO EWK not enough
- Beyond zero-width effects should be built-in.

Physical sense:

Rosetta stone between Wilson coefficients and κ is needed.

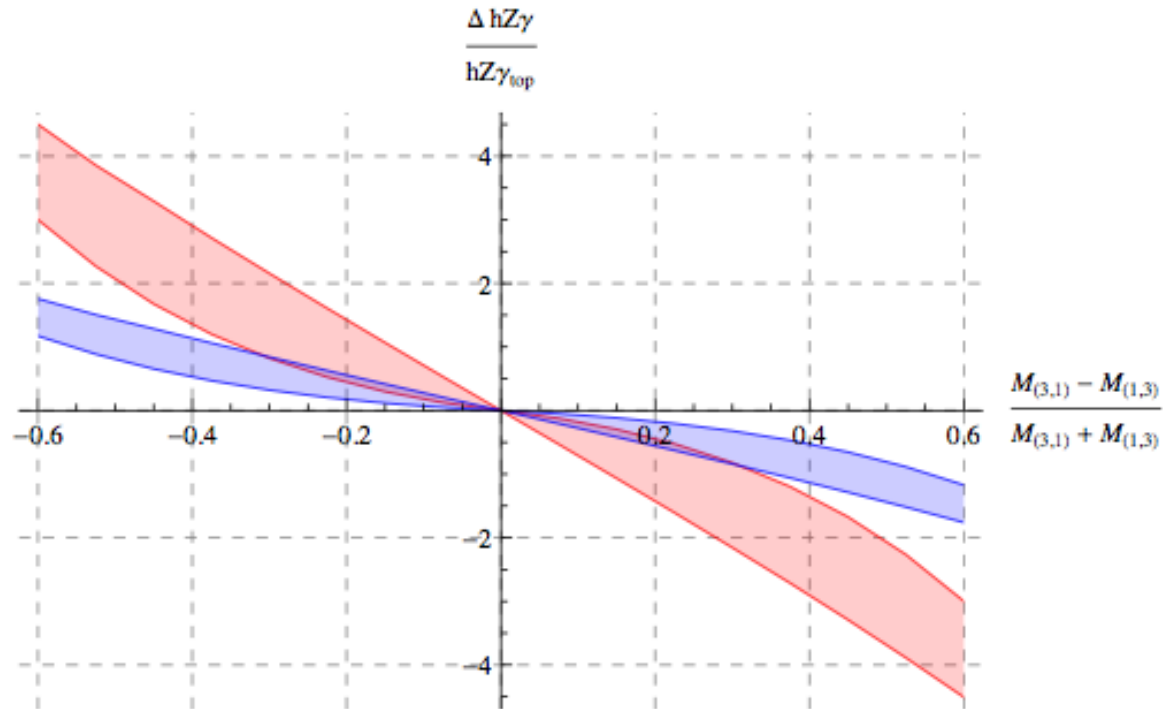
Practicality:

Automatic implementation in existing (or new) codes.

Backup

Guidelines for **Exotic** and **Rare Decay** Searches

- Mono-photon beyond $Z\gamma$ and mono Z and W



- Four photons / Four (tau) leptons
- **Lepton-Flavor Violating** decays
 - We are on track for the $\tau\mu$ channel

Guidelines for Exotic and Rare Decay Searches

- Cornering the **charm coupling** (interesting when decoupling Yukawa and Mass of charm)
 - Inclusive search very difficult
 - Possible use of $J/\Psi \gamma$ not particularly simpler
 - Other channels?

- More exotic decays
 - Many possible channels (See G. Isidori's talk)
 - Other ideas?

