Matter and the Universe

Topic 1: *Fundamental Particles and Forces*

Properties of the Higgs boson in the two photon decay channel with the ATLAS detector

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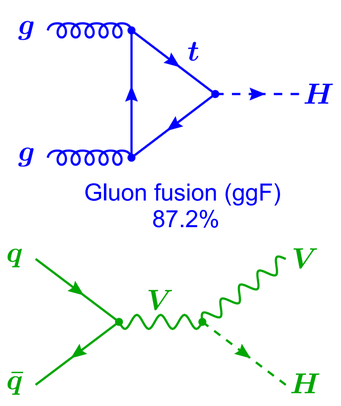
Properties of the SM Higgs boson

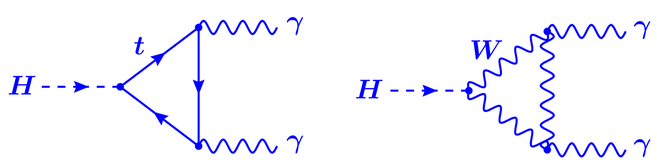
Standard Model predicts production cross sections and decay branching fractions (for a given Higgs mass)

Standard Model production modes



Higgs boson decay to two photons

- Through top-quark and W-boson loops
- BR(H→γγ) = 0.23% (m_H = 125 GeV)



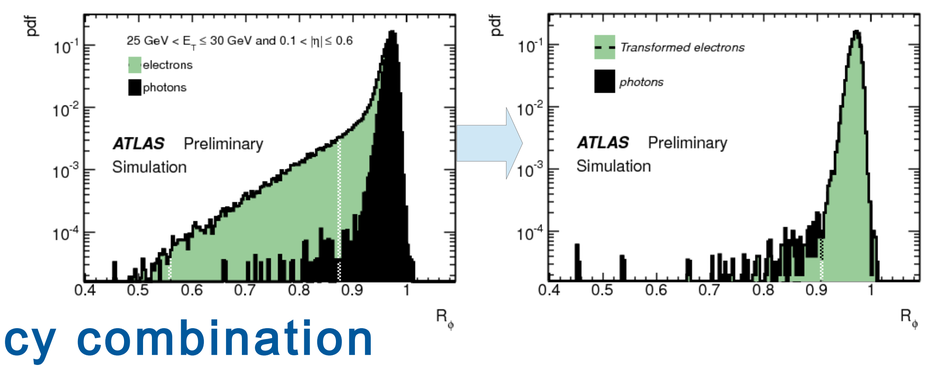
Photon identification

Discrimination from hadronic background based on shower shapes in EM calorimeter

- H→γγ needs jet rejection of ~10^4 to be dominated by γγ background
- Combines cuts sequentially (8 TeV) or with a neural network (7 TeV)

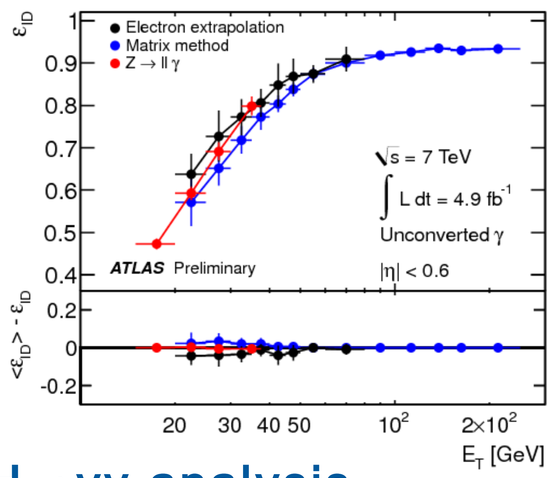
Efficiency extrapolation from Z→ee

- Very pure electron sample without biasing shower shapes
- Shower-shapes of photons and electrons very similar
- Remaining differences corrected for by dedicated transformations



Efficiency combination

Measurements in good agreement with results from two other methods and combined



Uncertainties range from ~5% at low E_T to ~1-2% at higher E_T

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Impact on H→γγ analysis

Composition of the selected sample

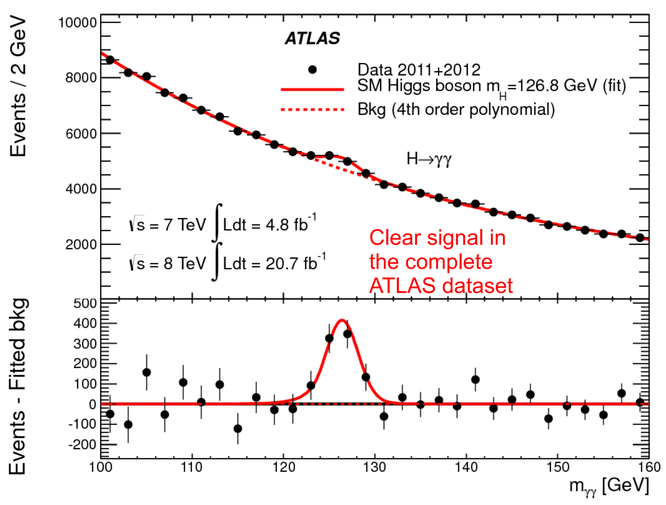
γγ	75±3%
γ+jet and jet+γ	22±2%
jet+jet	2.6±0.5%

Identification efficiency uncertainty on expected number of signal events

July 2012	10.8%
December 2012	5.3%
March 2013	2.4%

Second-largest experimental uncertainty on the measured inclusive signal strength

July 2012: Higgs boson discovery



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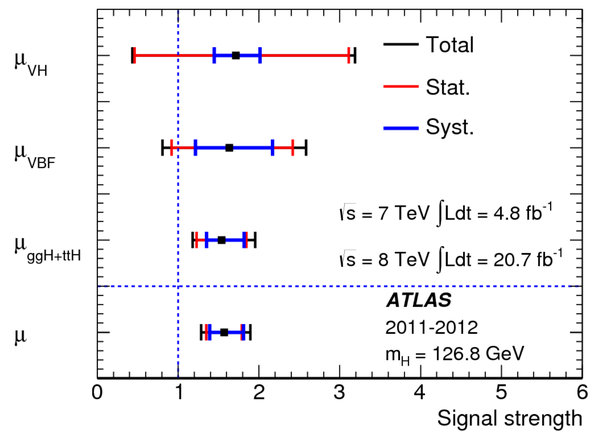
Production modes and couplings

Signal strength: $\mu = \frac{N_{observed}}{N_{SMHiggs}}$

Measurement in H → γγ consistent with SM prediction within 1.9σ:

μ=1.55 ± 0.23 (stat) ± 0.15 (syst) ± 0.15 (theo)

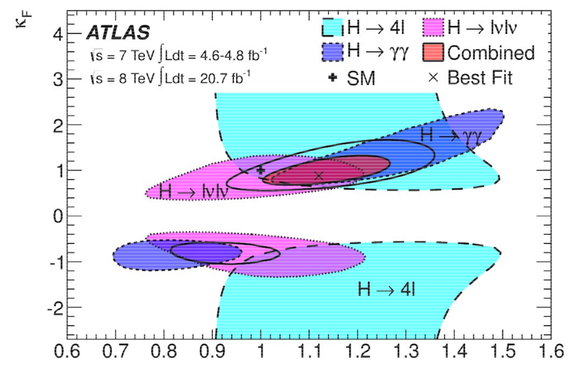
Signal strength for different production modes in H→γγ



In agreement with SM predictions

Coupling measurements: combination with other channels

Effective scale factors κ for the coupling to fermions (F) and vector bosons (V)



In agreement with SM prediction κ = 1

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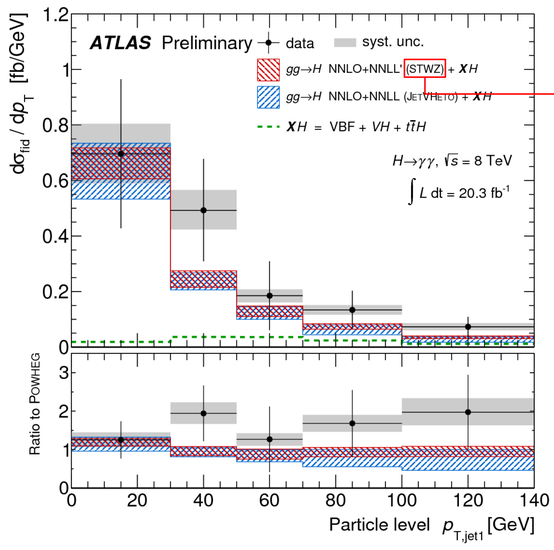
Differential cross-sections

First measurements of Higgs boson differential cross section: studying production and decay kinematics

High signal efficiency: H→γγ well suited for these measurements



Connection to DESY theory group

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