ATLAS/CMS Comparison (Bosonic Decays)

Greg Landsberg Brown University "Higgs Hunting" 2015

Higgs Boson Mass

 $19.7 \text{ fb}^{-1} (8 \text{ TeV}) + 5.1 \text{ fb}^{-1} (7 \text{ TeV})$

- Long-standing puzzle resolved; the mass is consistent (~2σ) between two high-precision channels and two experiments:
 - ATLAS: 125.36 ± 0.37 ± 0.18 GeV (3.3 per mil precision)
 - CMS: 125.02 ± 0.27 ± 0.15 GeV (2.5 per mil precision)
- No evidence for two states



Higgs Boson Width

- Width from interference has been measured in both experiments
 - ATLAS: WW+ZZ not fixing the ratio of off-shells and on-shell couplings to one:
 - Γ < 23 MeV @ 95% CL
 - CMS: new ZZ analysis allowing for anomalous couplings



$$A(\text{HVV}) \propto \left[a_1 - e^{i\phi_{\Lambda Q}} \frac{(q_{V1} + q_{V2})^2}{(\Lambda_Q)^2} - e^{i\phi_{\Lambda 1}} \frac{(q_{V1}^2 + q_{V2}^2)}{(\Lambda_1)^2} \right] m_V^2 \epsilon_{V1}^* \epsilon_V^*$$

- Γ < 46 MeV (unconstrained) or 26 MeV (f_{Λ}=0) @ 95% CL
- Direct measurements only give Γ < 2-3 GeV
- CMS: direct lower limit on Γ from lifetime: Γ > 3.5 x 10⁻⁹ MeV
- Q: what's the ultimate precision of this method?

Signal Strength

- Theory is good to N³LO on the cross section!
- ATLAS and CMS are consistent with $\mu = 1$
 - ATLAS is consistently ~1 σ high
 - $H(\gamma\gamma)$ is slightly higher in both experiments
- Clear proof of the fact that the new boson is the agent of EWSB
- Q: How well do we need to probe custodial symmetry?
- Q: Can H(γγ) still be above unity?

Channel	ATLAS	CMS
γγ	1.17 ± 0.27	1.14 ^{+0.26} -0.23
ZZ	1.44 ^{+0.40} -0.33	0.93 ^{+0.29} -0.25
WW	1.16 +0.24 -0.21	0.72 ^{+0.20} -0.18

Differential Cross Section

- Known to NNLO
- Small discrepancy in the $p_T(\gamma\gamma)$ spectrum in ATLAS not confirmed by CMS (also in the ZZ channel)
- Q: what other variables are important to differentiate over?

