Three slides on Higgs decays to bosons

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Measurements of the Higgs boson decaying to bosons at CMS

Ed Scott, on behalf of the CMS Collaboration
Higgs Hunting, Paris, 23rd July 2018

Thanks to Toni and Ed for providing me well prepared draft talks in time!

Higgs Hunting workshop, Paris, July 2018
## Inclusive cross sections

<table>
<thead>
<tr>
<th>quantity</th>
<th>ATLAS</th>
<th>CMS (&quot;stage-0&quot;)</th>
<th>theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZZ</td>
<td>$\sigma=67.2\pm6.8\pm4.1\text{ fb}$ ($\delta=12%$, $L\approx80/\text{fb}$)</td>
<td>$\mu=1.06^{+0.15}_{-0.13}\text{ fb}$ ($\delta=13%$, $L\approx80/\text{fb}$)</td>
<td>$\sigma=55.7\pm2.5\text{ fb}$ ($\delta=4.4%$)</td>
</tr>
<tr>
<td>ZZ, fiducial</td>
<td>4.04$\pm0.41\pm0.22\text{ fb}$ ($\delta=12%$, $L\approx80/\text{fb}$)</td>
<td>3.35$\pm0.15\text{ fb}$ ($\delta=4.4%$)</td>
<td></td>
</tr>
<tr>
<td>$\gamma\gamma$, ggF</td>
<td>$\sigma=98^{+15}_{-14}\text{ fb}$ ($\delta=14%$, $L\approx80/\text{fb}$)</td>
<td>$\mu=1.02^{+0.19}_{-0.18}$ ($18.6%$, $L\approx36/\text{fb}$)</td>
<td>$\sigma=102^{+5}_{-7}$ ($\delta=6%$)</td>
</tr>
<tr>
<td>Sigma($\gamma$) fid</td>
<td>60.4$\pm6.1\pm0.3\text{ fb}$ ($10.1%$)</td>
<td>63.5$\pm3.3\text{ fb}$ ($5.2%$)</td>
<td></td>
</tr>
<tr>
<td>H$\rightarrow$WW, $\mu$(ggF)</td>
<td>$1.21^{+0.22}_{-0.21}$</td>
<td>$1.38^{+0.21}_{-0.24}$</td>
<td>1.0</td>
</tr>
<tr>
<td>H$\rightarrow$WW, $\mu$(VBF)</td>
<td>$0.62^{+0.37}_{-0.36}$</td>
<td>$0.29^{+0.66}_{-0.29}$</td>
<td>1.0</td>
</tr>
</tbody>
</table>

- ATLAS and CMS overall consistent in all three decay modes with each other and with theory
- Data precision will be <10% with full run-2 data for $\gamma\gamma$ and ZZ
  - Was 20—30% from ATLAS+CMS combination in run-1
- WW requires more hard work on systematics (partially limited by theor. systematics)
  - current precision similar to run-1 but larger systematics

**ZZ:**
- Similar trends in ATLAS+CMS
- Unc. approaching 10%

**$\gamma\gamma$:**
- Similar trends in ATLAS and CMS
- Perfect agreement with SM
- Unc. ~14% with 80/fb

**WW:**
- Similar trends in ATLAS and CMS
- ggF a bit high, VBF a bit low
- ggF syst. Limited (20%)
Differential and simplified template cross sections

- Wonderful progress in differential cross sections!
- State-of-the-art calculations describe data well
Higgs Boson properties

Mass measurements already starting to surpass run-1 precision
• No other property measurements in run-2 shown here
  • But some differential distributions very sensitive to certain properties

125.26 ± 0.21 GeV

In agreement and with a similar precision to the ATLAS+CMS Run-I combination:
\[ m_H = 125.09 \pm 0.24 \text{ GeV} \]