

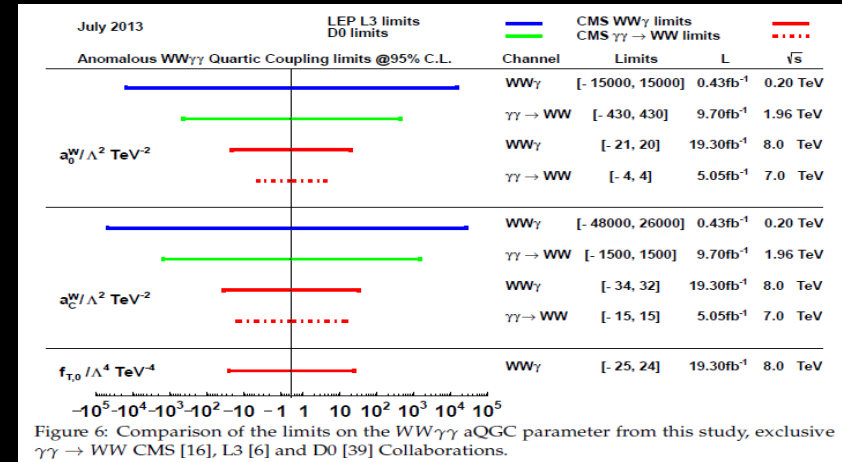
High Lumi

Introduction

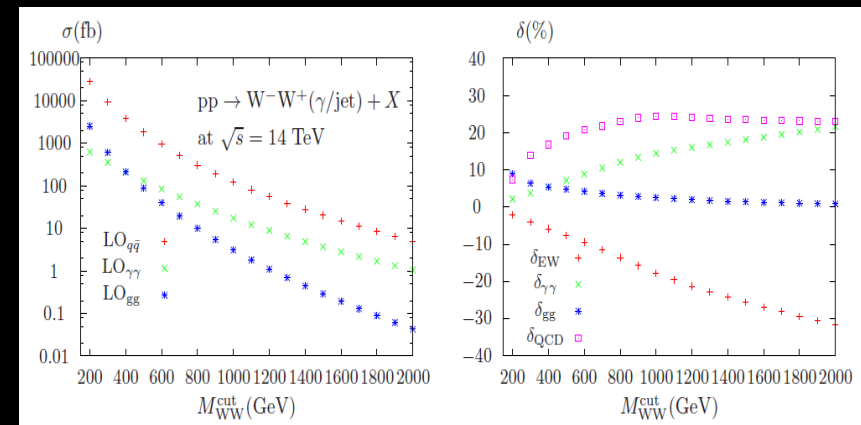
- Disclaimer: proposal (subject to modification) based on a short discussion between Antoni + myself
- Try to focus on a small number ($\sim 1-3$) of measurements that:
 - 1 Are not otherwise covered by low-lumi/medium-lumi working groups (= low-cross section SM or BSM processes)
 - 2 Are experimentally “easy” (=maybe not impossible) with high pileup and forward proton tracking+timing
 - 3 Still have interesting sensitivity in light of current/projected LHC results using central detectors only
 - 4 Can be significantly improved using forward proton information
- The short list:
 - $pp \rightarrow pWWp$ (and $pp \rightarrow pZZp$ by extension)
 - high-mass $pp \rightarrow p\gamma\gamma p$
 - high-mass $pp \rightarrow pj\bar{j}p$

$pp \rightarrow pWWp$ physics case

- Dominated by $\gamma\gamma \rightarrow WW$, sensitive to anomalous quartic (and triple depending on treatment of unitarity bounds/form factors) gauge couplings
 - Current sensitivity with 7TeV untagged $\gamma\gamma \rightarrow WW$ is already beyond CMS 8TeV $\gamma \rightarrow WW\gamma$
 - Generic AQGC limits are close to TeV scale
- $\gamma\gamma \rightarrow WW$ (including p-dissociation) is a large fraction of the total WW cross section at high mass
 - Interesting in light of small but persistent excess over SM in the ATLAS+CMS WW cross section measurements



CMS PAS SMP-13-009



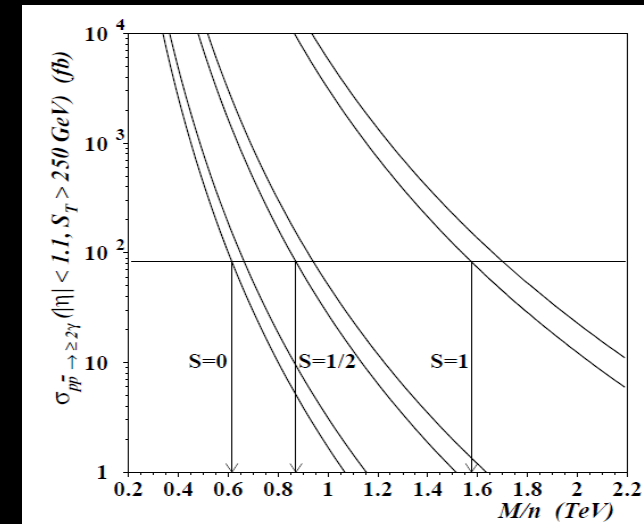
JHEP 1211 (2012) 093

$pp \rightarrow pWWp$ specific issues

- Central detectors: Trigger bandwidth and simulation of large backgrounds mostly “borrowed” from Higgs analyses
- Advantages of proton tagging:
 - 1 Remove proton-dissociation: tradeoff of statistics for smaller systematic/theoretical uncertainties
 - 2 Backgrounds: limits current untagged analyses to $e\mu$ final state (CMS) or high-mass tails (D0)
 - Attempt to recover SM-like same-flavor ($\mu\mu$ and ee) and semileptonic ($lvjj$) final states
 - 3 Kinematic constraints: differential measurements vs. $W_{\gamma\gamma}$, etc.

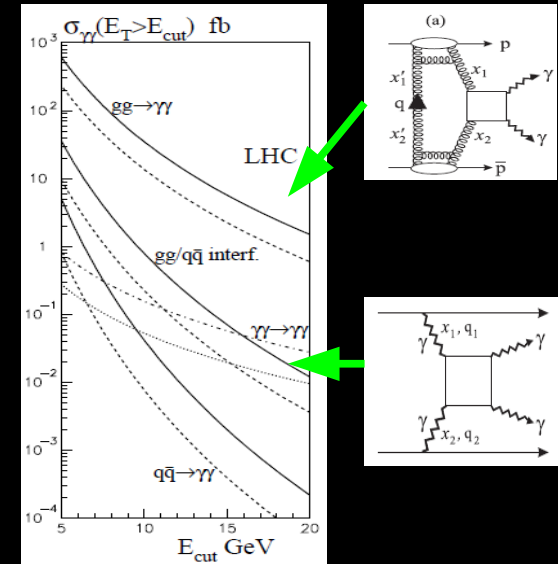
$pp \rightarrow p\gamma\gamma p$ physics case

- At high mass, expect to be dominated by $\gamma\gamma \rightarrow \gamma\gamma$
- Small in the SM for pp (arXiv:1305.7142), but shows up as a high-mass excess in a wide variety of exotic BSM scenarios
 - Anomalous $\gamma\gamma\gamma$ couplings (generically – Christophe's talk)
 - Not-yet-excluded-by-LHC technipions (Antoni's talk yesterday)
 - Magnetic monopoles and variations: Phys.Rev. D57 (1998) 6599-6603, arXiv:1107.3684, Eur.Phys.J. C62 (2009) 587-592...
 - Prehistoric Run 1 D0 limits are still competitive with direct searches at LHC: Phys.Rev.Lett. 81 (1998) 524-529
 - Extra dimensions: JHEP 1009 (2010) 042, Phys.Rev. D85 (2012) 014006
 - SUSY: Eur.Phys.J. C9 (1999) 673-686
 - Unparticles: JHEP 0909 (2009) 069
 - Non-commutative QED (don't ask...): Eur.Phys.J. C35 (2004) 137-143



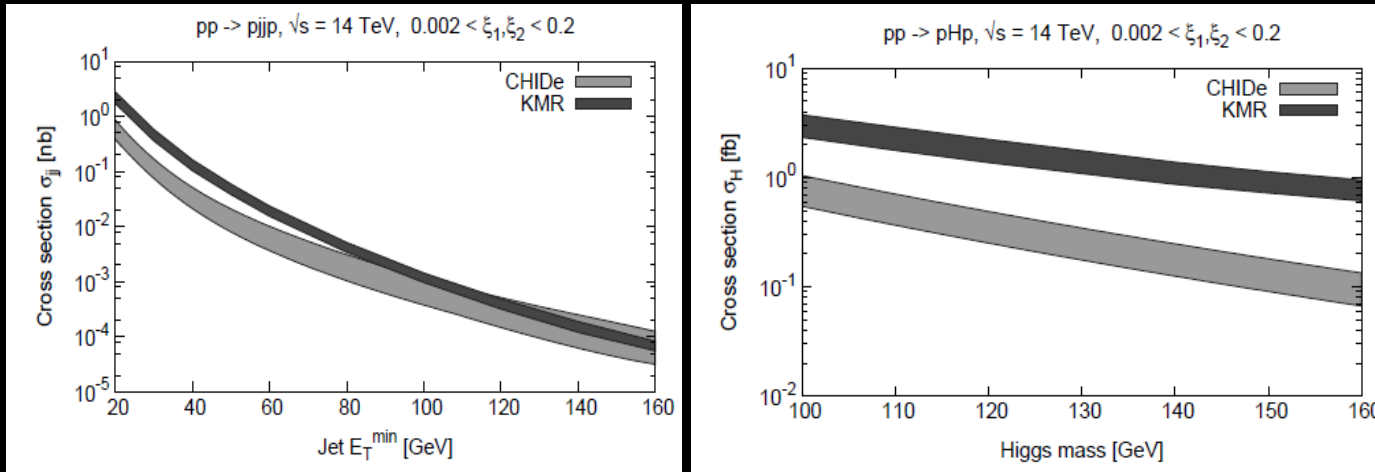
$pp \rightarrow p\gamma\gamma p$ specific issues

- Trigger thresholds (again) mostly driven by $H \rightarrow \gamma\gamma$
- Vertexing – how well does $\gamma\gamma$ vertex position need to be known (could be significantly different between CMS/ATLAS)?
- Backgrounds:
 - Pre-LHC prediction: $\gamma\gamma \rightarrow \gamma\gamma \gg$ “irreducible” strong CEP $gg \rightarrow \gamma\gamma$ only for $ET(\gamma) > 110 \text{ GeV}$ (or $m_{\gamma\gamma} \sim 220 \text{ GeV}$ at mid-rapidity)
 - Can this be better constrained by existing LHC/Tevatron measurements (or better – directly from 13 TeV data)?



Eur.Phys.J. C38 (2005) 475-482

$pp \rightarrow pjjp$ physics case



Phys.Rev. D83 (2011) 054013

- Benchmark for testing pQCD predictions in high-mass strong CEP processes beyond Tevatron energies
- Can have a large impact on exclusive Higgs predictions

$pp \rightarrow pj\bar{j}p$ specific issues

- Backgrounds/vertex efficiency issues (cf. Maciej's talk):
 - Large pileup/overlay backgrounds from SD/DD dijets with $\mu \gg 1$
- From the previous slide, would need to reduce measure down to low mass to discriminate between models...
 - Acceptance issues: Not really compatible with acceptance for nominal high-lumi optics
 - Trigger issues: With central triggers only jet pT thresholds for strawman 1E34 menu in CMS are ~ 360 GeV ($m_{jj} \sim 720$ GeV at central rapidity)

(Some) issues for all channels

- Realistic estimates/extrapolations/simulations of forward detector backgrounds
 - Pileup overlay
 - Beam backgrounds
- Volunteers :-)
- Other channels or suggestions?