

Activities in LHC Electroweak Multiboson Group

Theory Contacts:

Celine Degrande (CERN)

Jonas Lindert (Durham)

CMS Contacts:

Senka Duric (Kansas State)

Chia-Ming Kuo (National Central)

Matthias Mozer (KIT)

ATLAS Contacts:

Kristin Lohwasser (Sheffield)

Yusheng Wu (USTC)

LHC Higgs XS WG Meeting, 27/03/2018

Multiboson Subgroup of LHC EW WG

□ LHC Electroweak WG re-established since last December

- ❖ Organization and plans discussed in last December's workshop:

<https://indico.cern.ch/event/678694>

- ❖ Subgroups defined:

- Precision Electroweak
- QCD jets and V+jets
- Multiboson

□ Multiboson Working Group

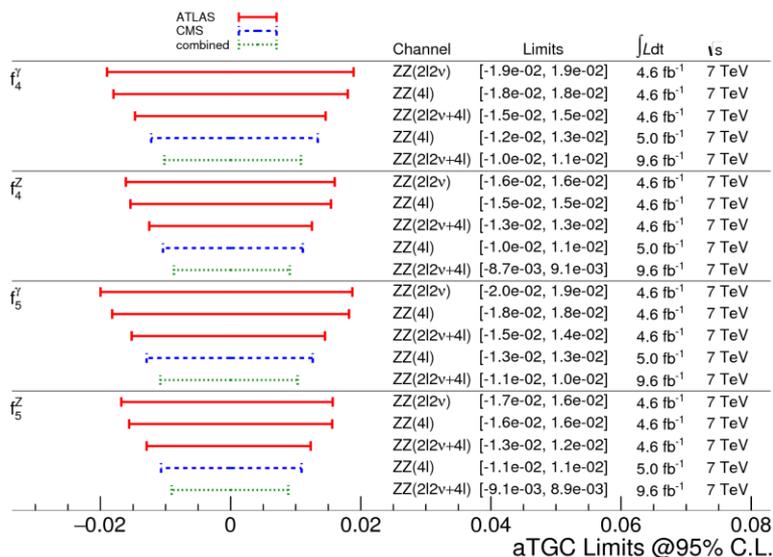
- ❖ Joint discussion among theorists and experimentalists (ATLAS, CMS, + potentially LHCb) on multiboson related topics
- ❖ To discuss and eventually give recommendations to common topics in
 - Multiboson measurements (theory treatments, MC modelling, phase space definitions, etc.)
 - Bosonic self couplings (aTGCs, aQGCs, EFT parametrizations, theory uncertainties, combination of multiple channels, etc.)

Past Activities

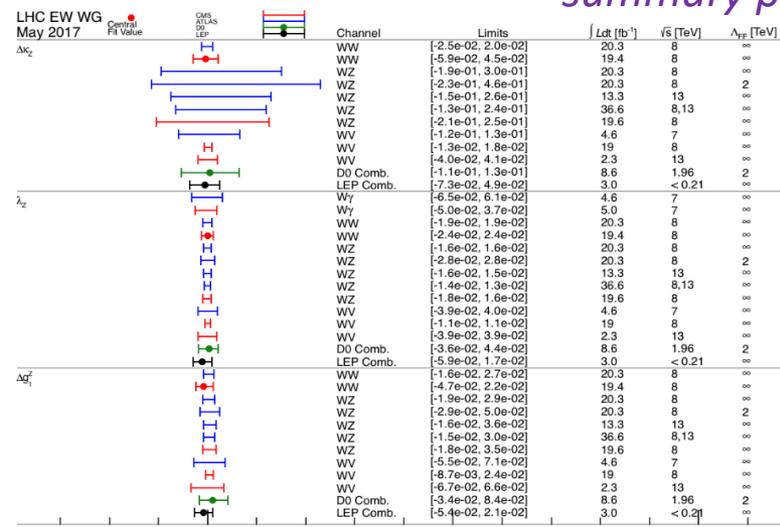
□ What we discussed in the past (listed recent ones, but prior to Dec. 2017)

- ❖ [about ATLAS+CMS summary plots](#)
- ❖ [about WW measurement](#)
- ❖ [about ZZ measurement](#)
- ❖ [neutral aTGCs EFT](#)
- ❖ discussions on charged aGCs: [1](#), [2](#), [3](#), [4](#), [5](#)
- ❖ discussion with LHC Higgs WG: [1](#) (global fit of aGCs?)

Demonstration of combination & summary plots



ATLAS-CONF-2016-036



C. Bittrich, M. Pleier (ATLAS) M. Herndon (CMS)

aTGC Limits @95% C.L.

Current Activities

- ❑ Agenda for topical meetings (1pm CERN time on Wednesdays)
 - ❖ <https://indico.cern.ch/category/3290/>
- ❑ Mailing list for meeting announcements and discussions
 - ❖ lhc-ewwg-multiboson@cern.ch
- ❑ What we are discussing now (from January 2018)
 - ❖ [21/2](#): about systematic uncertainties in MB measurements, plus correlation of theory uncertainties for ratio measurements of dibosons
 - ❖ [7/3](#): truth object definitions, and kick-off of MC studies
 - ❖ [14/3](#): phase space definitions in WZ and ZZ measurements
 - ❖ [4/4](#) (**Upcoming!**): EFT parametrization and constraints with multiboson
 - ❖ ...



meetings being organized to discuss and coordinate work to eventually converge on a **Yellow Report**

Plans for the Yellow Report

- ❑ *The Yellow Report*: Reviews of common topics concerning multiple bosons, and recommendations to future multiboson studies

- ❑ To include discussions on the following items (*chapters*)
 - ❖ Review of precision, main uncertainties, phase space definitions, and limitations
 - ❖ Sensitive processes / phases spaces / distributions to be further probed?
 - ❖ Theory and MC predictions: descriptions, comparisons and recommendations
 - ❖ Recommendations on anomalous couplings and EFT parametrization
 - ❖ Combination of different channels: input formats, methodology, and physics potentials

- ❑ Very preliminary timeline
 - ❖ Organizing meetings throughout this year to cover all the topics, plus offline efforts on collecting materials, conducting studies, and editing the document
 - ❖ To have the structure of the document ready by the end of May (to be presented in the upcoming LHC EW WG meeting, May 22-25th, in Orsay)
 - ❖ To have the report ready for review by Dec. 2018 (winter LHC EW WG meeting)
 - ❖ To make the report public in early 2019
 - ❖ To serve as a reference note for full Run-II multiboson analyses and for initial studies of Run-III data

Status of the Yellow Report Efforts

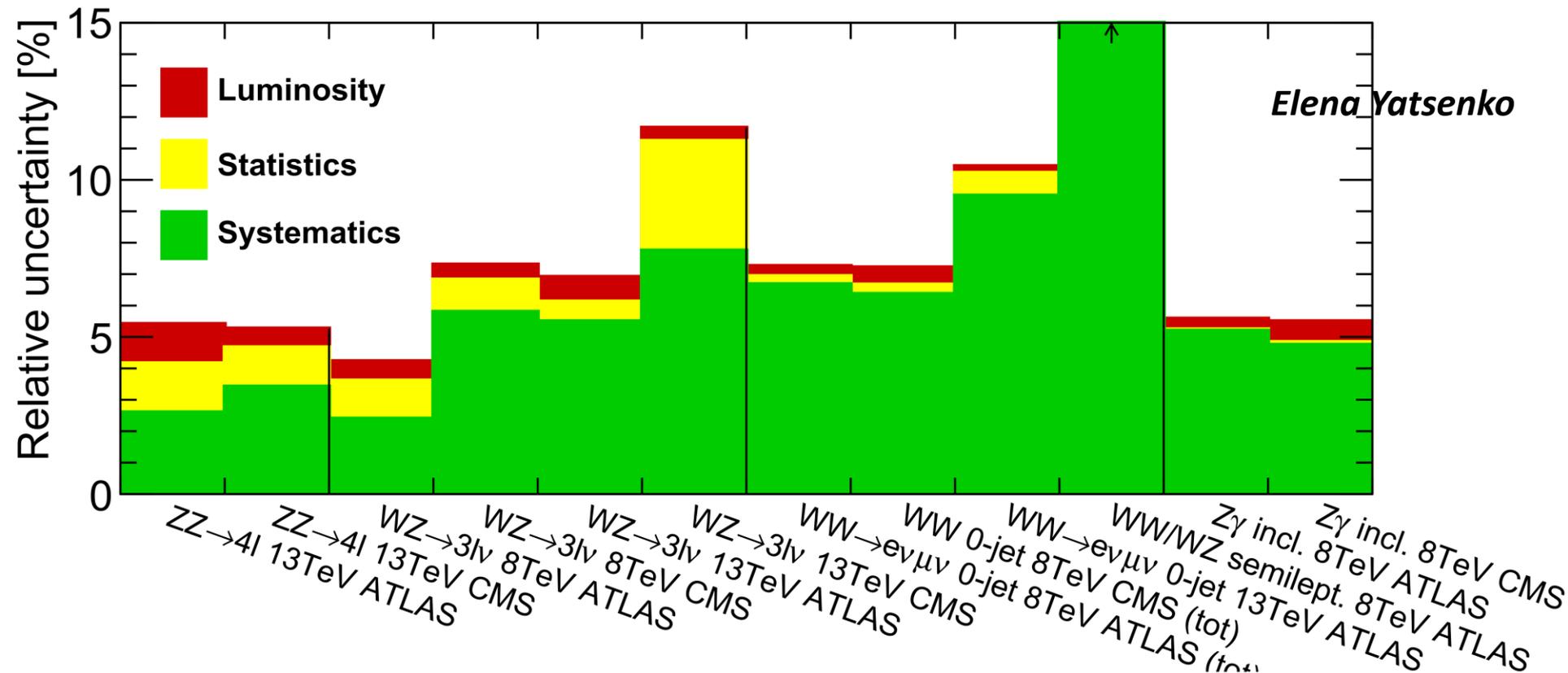
- ❑ At the beginning phase to define the structure of the report, find overall editors, and section editors

- ❑ Details already considered for some of the chapters
 - ❖ For the experimental reviews, to include discussions on all the diboson, triboson, and vector-boson-scattering channels
 - ❖ For the MC section, one part is to present plots comparing different MC predictions and fix-order calculations, given certain channels and fiducial definitions; inputs from both theory and experimental communities; for the ease of making such plots, plan to start from existing Rivert routines
 - ❖ ...

- ❑ Started to review measurement uncertainties, organize studies to give MC comparisons, and discuss EFT parametrizations
 - ❖ More to come

- ❑ Not large person-powers
 - ❖ Likely try to keep the report concise and effective, not as a mega-scale review
 - ❖ Please contact us if you are interested and motivated for certain topics!

Highlights of Recent Discussions

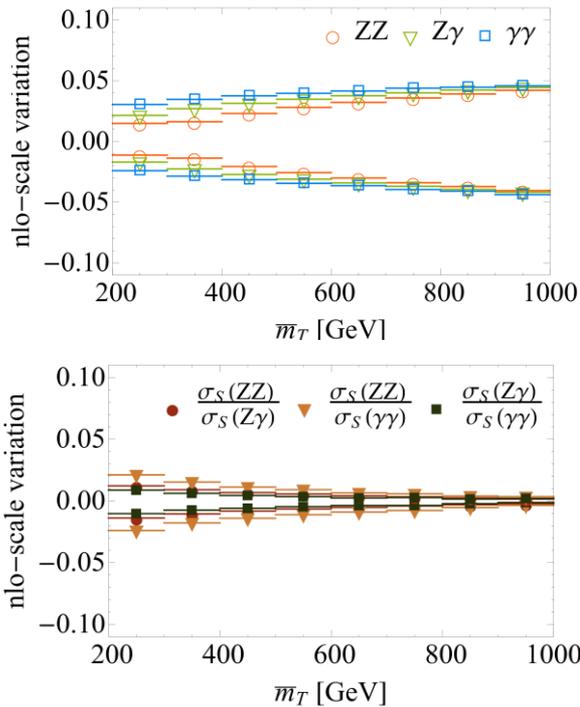


stack of uncertainties in quadrature: syst, $\sqrt{\text{syst}^2 + \text{stat}^2}$, ..

Measurements of integrated cross-sections: already limited by systematic unc.
 Differential measurements: further reduction of statistical unc. still important

Highlights of Recent Discussions

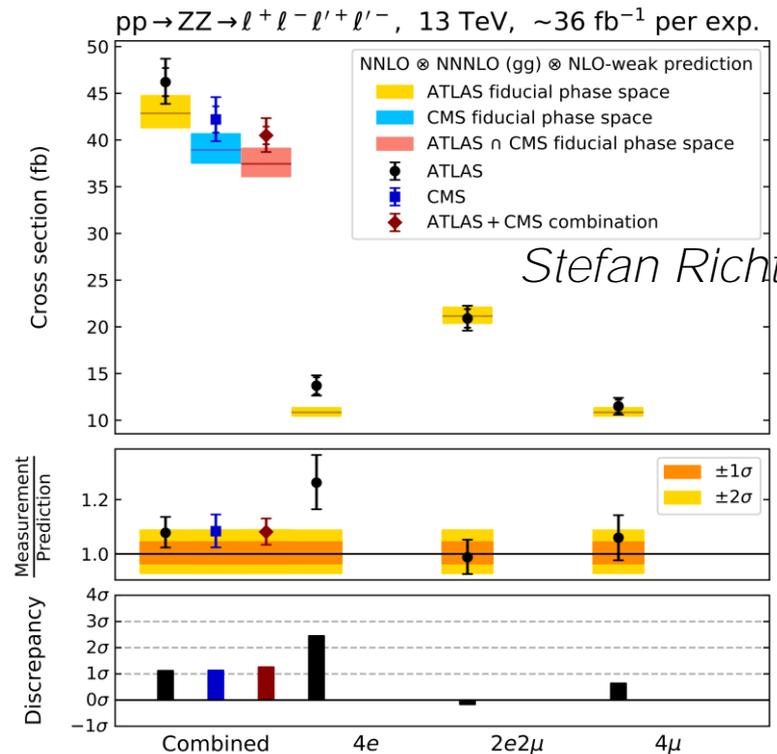
Jakub Scholtz



Ratios of diboson cross-sections could have good precision both experimentally and theoretically, but with further points to be clarified

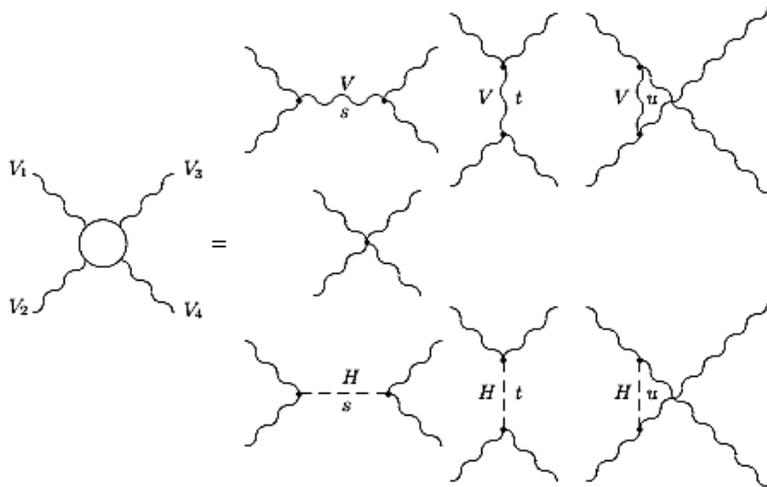
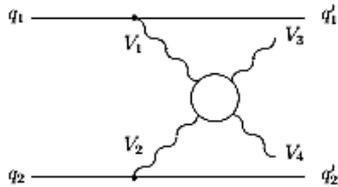
- 1) Certain theory assumptions under investigation (how to correlate theory unc. among channels!)
- 2) How to interpret the measured ratios

Combination of experimental results from a common fiducial region could give better constraints to SM predictions / BSM effects, with the strategy of defining such regions being discussed.



Stefan Richter

Common Topics w.r.t. LHC Higgs XS WG



For longer term:
Higgs and multiboson studies could be combined to give more thorough constraints to physics in the EW sector??

- ❑ How to avoid phase overlap between on-shell Higgs and on-shell diboson measurements
 - ❖ In most cases, straightforward
 - ❖ e.g. discussed before for WW v.s. $H \rightarrow WW$, cutting at $d\phi(\parallel)$ to remove Higgs contribution from WW
- ❑ Off-shell Higgs contribution usually included in diboson measurements, and especially important for VBS channels
- ❑ In terms of BSM: high-dimension (e.g. six) EFT parameters often affect boson self-interactions and Higgs-boson couplings at the same time, vice versa.