



**TECHNISCHE  
UNIVERSITÄT  
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# WG2 Summary

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# State of the art review by Narei

- Large set of VBS and aQGC results at LHC, all accessible final states studied
- VBS XS limited by statistical uncertainties, so far only one channel observed
- Starting analysing 13 TeV, will bring a lot of interesting results !
- Channels very complementary for the constraints on EFT operators -> stringent limits in all parameters so far

## ❖ Datasets

- ❖ ATLAS: 8 TeV (20.2 fb<sup>-1</sup>)
- ❖ CMS: 8 TeV (19.7 fb<sup>-1</sup>) and 13 TeV (35.9 fb<sup>-1</sup>)

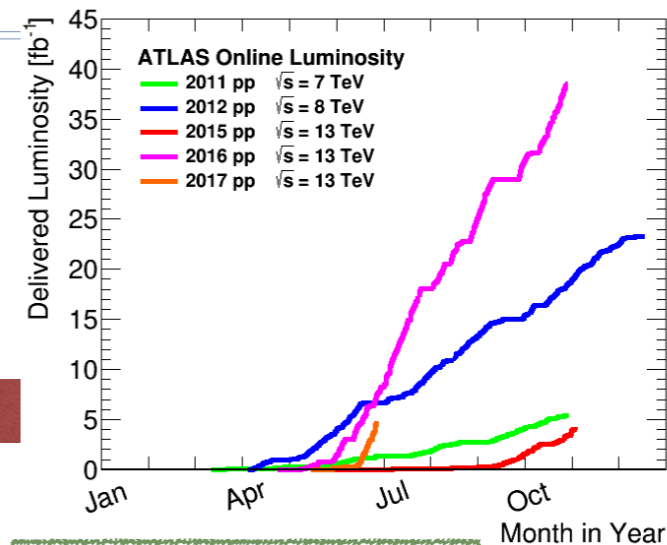
## ❖ Channels studied:

	ATLAS	CMS
W <sup>±</sup> W <sup>±</sup> <i>Best EW/QCD</i>	8 TeV	8, 13 TeV
W <sup>±</sup> Z	8 TeV	-
Wγ <i>Largest XS</i>	-	8 TeV
Zγ	8 TeV	8 TeV
ZZ <i>Low reduc. bkg</i>	-	13 TeV
WV semi-lept.	8 TeV	-

*Special, only access to aQGCs, very sensitive*

## ❖ All possible VBS final states studied @ LHC

- ❖ except  $\gamma\gamma$  and  $W^+W^-$ , too difficult due to huge bkg.
- ❖ **Can probe all operators of EFT !**



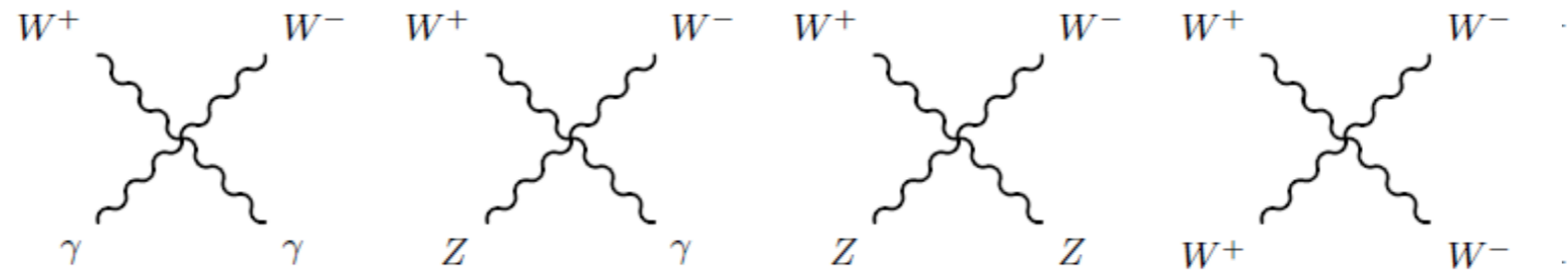
first (and unique to now)  
VBS process observed !

VVjj final state	ZZ	Zγ γγ	W <sup>+</sup> W <sup>-</sup> WZ	W <sup>±</sup> W <sup>±</sup>	Wγ
f <sub>S,0</sub> , f <sub>S,1</sub>	✓		✓	✓	
f <sub>M,0</sub> , f <sub>M,1</sub> , f <sub>M,6</sub> , f <sub>M,7</sub>	✓	✓	✓	✓	✓
f <sub>M,2</sub> , f <sub>M,3</sub> , f <sub>M,4</sub> , f <sub>M,5</sub>	✓	✓	✓		✓
f <sub>T,0</sub> , f <sub>T,1</sub> , f <sub>T,2</sub>	✓	✓	✓	✓	✓
f <sub>T,5</sub> , f <sub>T,6</sub> , f <sub>T,7</sub>	✓	✓	✓		✓
f <sub>T,8</sub> , f <sub>T,9</sub>	✓	✓			

# Our aims!

## ❖ Standard model:

- $\mathcal{L}_{WWVV}$  contains the quartic gauge self-couplings (QGC)



$$\mathcal{L}_{WWVV} = -\frac{g^2}{4} \left\{ [2W_\mu^+ W^{-\mu} + (A_\mu \sin \theta_W - Z_\mu \cos \theta_W)^2]^2 - [W_\mu^+ W_\nu^- + W_\nu^+ W_\mu^- + (A_\mu \sin \theta_W - Z_\mu \cos \theta_W)(A_\nu \sin \theta_W - Z_\nu \cos \theta_W)]^2 \right\}$$

- no neutral self-couplings in the SM

**1. Observe all SM QGC Processes with these vertices**

**2. Constrain or find BSM physics (in EFT or full models)**

**3. Test Eweak Symmetry breaking and Higgs properties**

- **One of the core reasons, why LHC has been built!**

# Common ground and possible studies with our data

- Xavier we discussed the common selection criteria → preliminary cuts for some channels already!



List of (unordered) topics



- ❖ Polarisation measurements (see also Ezio's talk)
  - Especially  $V_L V_L \rightarrow V_L V_L$
- ❖ Charge ratios  $W^+/W^-$ 
  - Examples, and influence of pdfs
- ❖ BSM (see also Ilaria's talk)
  - Validity of EFT tails, Explicit or Simplified Models?
- ❖ Best way to interpretation
  - Fit to complete distributions vs. extreme phase space regions ?
- ❖ Extend the reach (not in my talk)
  - Scattering channels, decay channels (see Narei's talk, WG2)
  - boosted topologies (see Christoph's and Andreas' talk, WG3)

# Final words

- MBI workshop (Karlsruhe, 28-30 August) might be the occasion to continue the discussions
  - ▶ Meetings for the different activities will be announced soon
  - ▶ Please subscribe to the WG2 mailing list! <https://groups.google.com/forum/#!forum/vbscan-wg2>