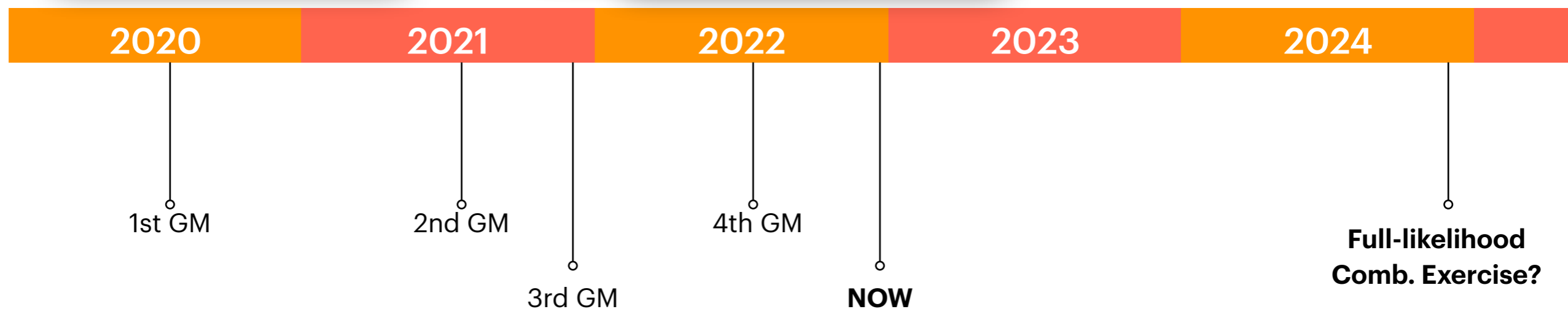
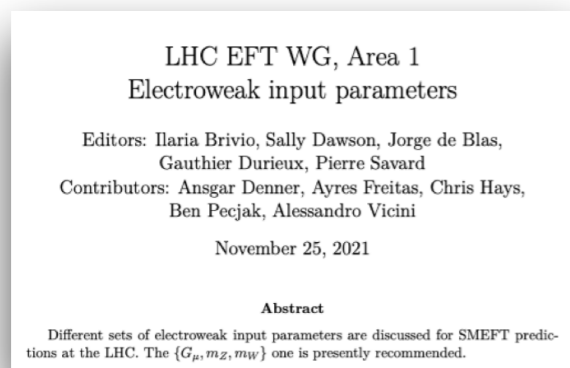


# Proposals from LHC EFT WG activities CMS SMP group proposals

Matteo Presilla, 2<sup>nd</sup> Dec. '22

# Future plans and intermediate steps

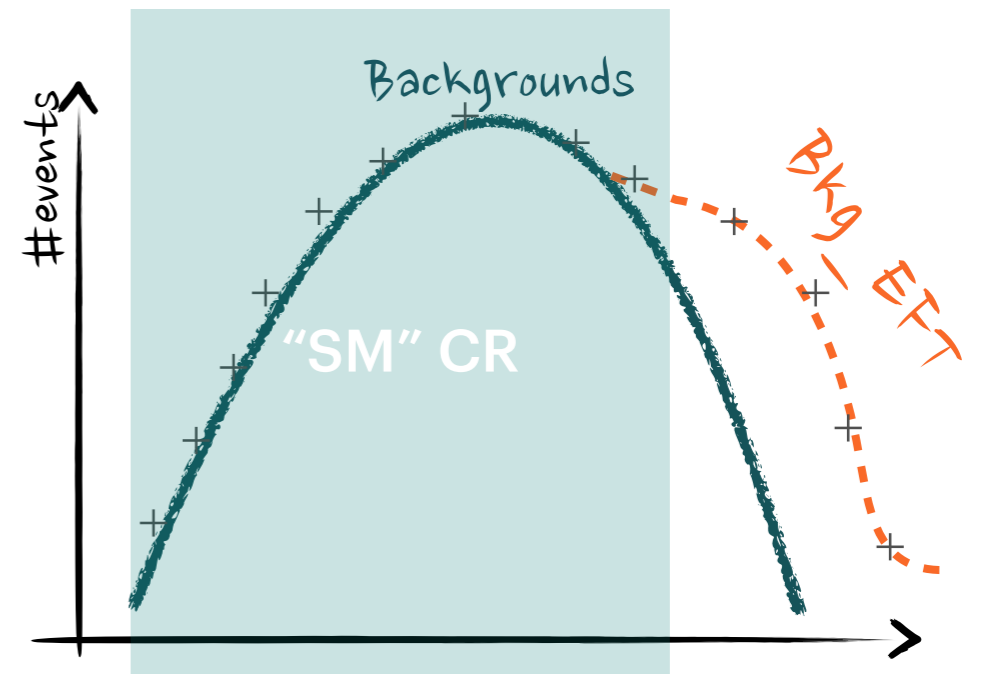
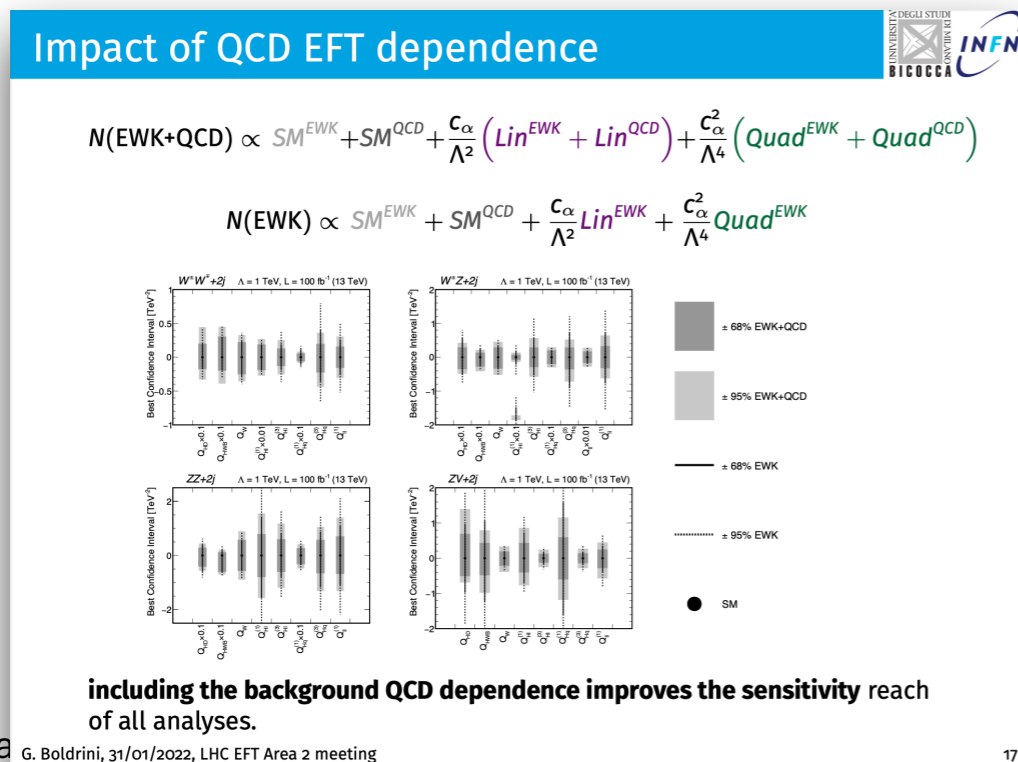
- Incredibly fast ramp-up of Area 4 techniques, thanks also to developments of tools and interaction with other Areas for conventions and studies
- In parallel more complex combination exercise could be defined: experimental full-likelihood combination
- Fundamental to compare fits: full-experimental vs.  $\chi^2$ -simplified fits and assess the feasibility for a subset of processes



# Full-likelihood combination

## Why might be crucial?

- A comparison of the obtained result with the outcome of the same combination performed with today's publicly-available information
- Useful discussion on how to improve results publications to let the two get closer
- Understand when full-likelihood information is necessary
- Heritage for future/under dev. analyses:
  - Developing tools and conventions now could help perfecting single measurements (and ease future combinations)
  - Bottlenecks of EFT full-reconstructed analysis: inclusion of EFT contribution for irreducible backgrounds => Definition of purely "SM control regions", where EFT contribution for certain operators may be negligible



# Identify input analyses

- What should we combine?
  - Provide unfolded differential cross sections in relevant distributions with Rivet routines so that comparison to different models and global EFT combinations are possible.
- Extensive documentation already started from Area 4 (Andrew et Al. gSheet)

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<a href="#">ATL-PHYS-PUB-2021-022</a>	ATLAS	EWK	WW (lep) WZ (lep) 4l Z+2j (lep)	pT(lead. lep.) [14 bins] mT(WZ) [6 bins] m4l x mZ2 [2 bins] dPhi(jj) [12 bins]	SMEFTsim 3.0	MW, MZ, GF	topU3l	33	AG: unable to find full param., only summarized in figs KL: Should be internally available	WZ: <a href="https://www.hepdata.net/record/ins1720438">https://www.hepdata.net/record/ins1720438</a> (tab 12&13) WW: <a href="https://www.hepdata.net/record/ins1734263">https://www.hepdata.net/record/ins1734263</a> (tab 4&5) VBFZ: <a href="https://www.hepdata.net/record/ins1803608">https://www.hepdata.net/record/ins1803608</a> (tab 8) 4l: <a href="https://www.hepdata.net/record/ins1849535">https://www.hepdata.net/record/ins1849535</a> (Cov_matrix_mZ2_Z)	WW: ATLAS_2019_11734263 WZ: internal exists, contacted team 4l: ATLAS_2024_11849535 Z+2j: ATLAS_2020_11803608	???
<a href="#">ATLAS-CONF-2019-029</a>	ATLAS	HIG	H->yy	pTH, Njets, mjj, Dphijj, pTj1	SMEFTsim2.1	MW, MZ, GF	U35	4 (cHC, cHW, cHB, cHWB)	Not public	Not public	???	???
<a href="#">ATLAS-CONF-2020-026</a>	ATLAS	HIG	(gg,qq,V,tt)H->yy	STXS 1.2 (w/ merging)				N/A				
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<a href="#">ATLAS-HIGG-2018-51</a>	ATLAS	HIG	(W,Z)H->bb	STXS 1.1 (w merging)	SMEFTsim2.1	MW, MZ, GF	U35	14	Not public?	Not public	No	???
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<a href="#">CMS-TOP-18-010</a>	CMS	TOP	tty (SL)	pT(y) [9 bins]	dim6top				2	RS: Can be obtained.	AG: no?	Available internally.
<a href="#">CMS-SMP-18-004</a>	CMS	EWK	WW (lep)	mll [11 bins] (AG: but diff. measurement uses different binning)	EWDim6 (AG: ?)	?	-	3 (cwww, cw, cb)	AG: no?	AG: no?	Yes	AG: no?
<a href="#">CMS-PAS-SMP-20-014</a>	CMS	EWK	WZ (lep)	mWZ [7 bins] (AG: but diff. measurement uses different binning)	EWDim6 (AG: ?)	?	-	3 (cwww, cw, cb) + 2 CP-odd	AG: no?	Yes	AG: not public yet	???

## CAVEAT FOR SUCCESSFULL COMBINATION:

- We need to make sure that analyses are orthogonal and take correctly into account correlations in the systematic uncertainties
- Correlation scheme for some physics objects across years not trivial anymore
- Make sure the formats and inputs are compatible

Rivet routine available

# Identify input analyses

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<a href="#">ATLAS-CONF-2019-029</a>	ATLAS	HIG	H->yy	...	...	...	...	...	...	Not public	???	???
<a href="#">ATLAS-CONF-2020-026</a>	ATLAS	HIG	(gg,qq)	...	...	...	...	...	...	Not public	No	???
<a href="#">ATLAS-HIGG-2018-28</a>	ATLAS	HIG	(gg,qq)	...	...	...	...	...	...	Not public	No	???
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<a href="#">CMS-TOP-18-010</a>	CMS	TOP	tty (SL)	...	...	...	...	...	...	AG: no?	Yes	AG: no?
<a href="#">CMS-SMP-18-004</a>	CMS	EWK	WW (lep)	...	...	...	...	...	...	AG: no?	Yes	AG: no?
<a href="#">CMS-PAS-SMP-20-014</a>	CMS	EWK	WZ (lep)	...	...	...	...	...	...	Yes	AG: not public yet	???

## Consider additional selection criteria (VBS EXAMPLE)

Summary of the sensitivity of each process to the operator subset. Empty cells = impossible to insert EFT vertices in diagrams.

proc / op	$Q_{HD}$	$Q_{H\Box}$	$Q_{HWB}$	$Q_{Hq}^{(1)}$	$Q_{Hq}^{(3)}$	$Q_{HW}$	$Q_W$	$Q_{Hl}^{(1)}$	$Q_{Hl}^{(3)}$	$Q_{ll}^{(1)}$	$Q_{qq}^{(3)}$	$Q_{qq}^{(3,1)}$	$Q_{qq}^{(1,1)}$	$Q_{qq}^{(1)}$	$Q_{ll}$
SSWW-EW	✓	✓	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓	✓	✓	(✓)
OSWW-EW	✓	✓	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓	✓	✓	(✓)
WZ-EW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	(✓)
ZZ-EW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	(✓)
ZV-EW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
WW	✓		✓	✓	✓	✓	✓	(✓)	✓	✓					
ZV-QCD	✓		✓	✓	✓	✓	✓	✓	✓	✓					
OSWW-QCD	✓		✓	✓	✓	✓	✓	✓	✓	✓					
WZ-QCD	✓		✓	✓	✓	✓	✓	✓	✓	✓					(✓)
ZZ-QCD	✓		✓	✓	✓	✓	✓	✓	✓	✓					(✓)

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Rivet routine available

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Choose additional selection criteria: selecting measurements less sensitive to quadratic component  $O(\Lambda^{-4})$

Rivet routine available



# Where to start

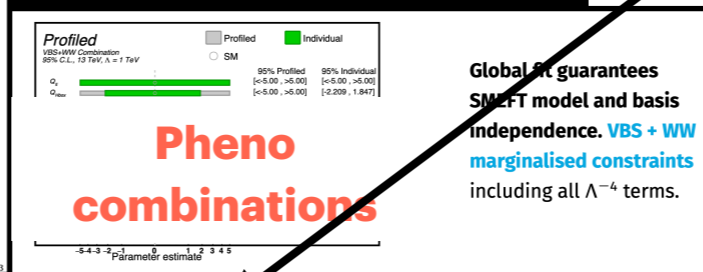
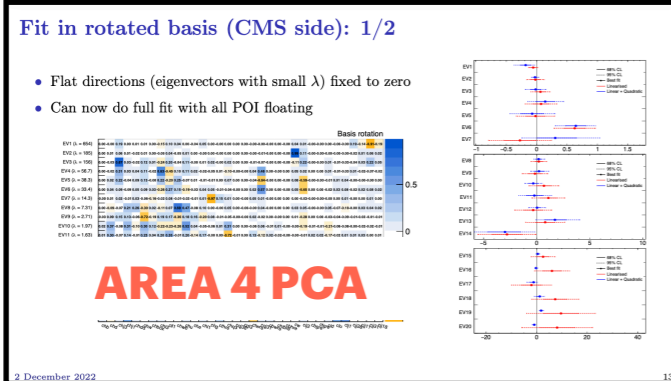
Try to build on top of existing efforts (single experimental combinations, other working groups, ...)

- Agree on a set on conventions on the final states to be tested
- Define technical statistical procedure and consequently data format
- Collect all AREA 4 studies and existing conventions in a single document (~1 year?)
- Find new solutions for reco-level analyses persistency:
  - Agree on a way to store information in experimental data-formats to ease recasting of signals in the event content

Where the LHC EFT WG comes to play

Reco-EFT signals persistency ?

Area 4 note?



All other WGs combinations



Exercises within experiments:

Extraction of linear and quadratic components for statistical analysis with reco-EFT signals