
Analysis projects in AG Biebel

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Analysis Meeting
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Outlook

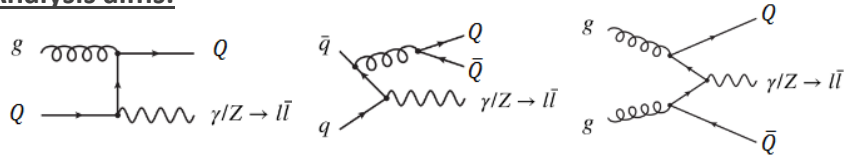
- **Z+c(c)** production cross section measurements using run2 (+run3) data (Stefanie)
- Employing matrix elements in the search for Higgs self-coupling (Edis)
- Qualification and analysis tasks (Lars)
- Performance of standalone muons in run3 (Celine)

Z+c(c) production cross section measurements using run2 (+run3) data

Background:

- Ongoing ATLAS analysis
- ≥ 10 analysis members with associated institutes located in the United Kingdom, Italy, Germany, China and at CERN

Analysis aims:



- Measurement of the Z+c and Z+c(c) production using a **c-tagger** with high efficiency for c-jets using run2 (+ run3) data
- Publication of the results on Z+c and Z+c(c) for end of 2025

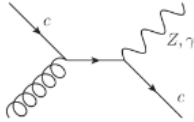
Up to now, no ATLAS publication on this topic !!!

- First measurements done by D0 detector at the Fermilab Tevatron Collider and by CMS and LHCb at the LHC

DO Collaboration, Phys. Rev. Lett. **112** (2014) 042001; CMS Collaboration, Eur. Phys. J. C **78** (2018) 278; CMS Collaboration, Phys. Rev. D **102** (2020) 032007; CMS Collaboration, J. High Energy Phys. **04** (2021) 109; LHCb Collaboration, Phys. Rev. Lett. **128** (2022) 082001

Physics motivations:

- Test for pQCD and the proton structure
- The analysis is sensitive to testing the intrinsic charm hypothesis, in which a valence-like c quark contributes to the proton PDF (BHPS model)



Brodsky et al., Phys. Lett. B **93** (1980) 451-455;
Beauchemin et al., Phys. Rev. D **92** (2015) 034014

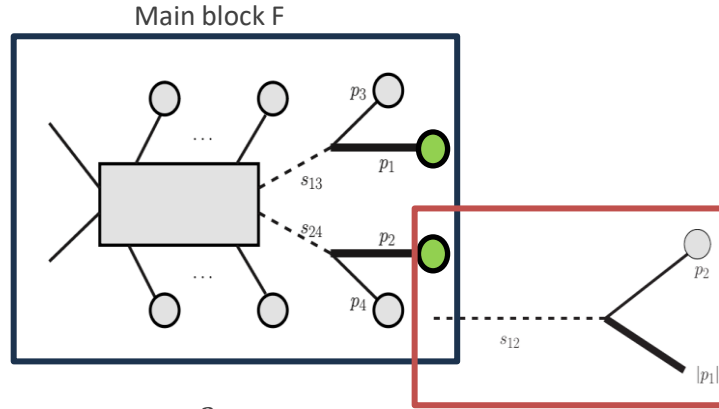
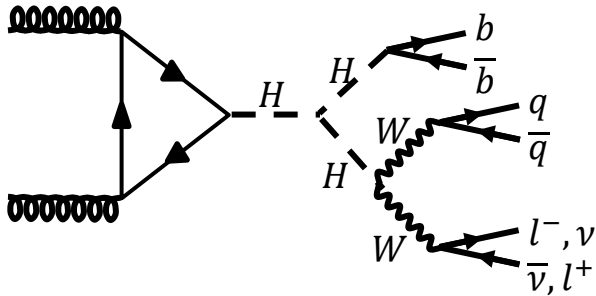
- Testing of 3 and 4 flavour number schemes (FNS)

no contribution of c quarks to the proton PDF
=> Only g->cc (QCD)
c-quark PDF in initial state

- Z+HF jets is background to the Higgs boson production (HZ events, H->cc)
- BSM physics motivations: dark Higgs bosons, dark sector in general

Ferber, Grohsjean and Kahlhoefer, arXiv:2305.16169v1 (2023); Jung et al., Phys. Rev. D **105** (2022) 035008; Knapen, Shelton and Xu, Phys. Rev. D **103** (2021) 115013; Lu et al., arXiv:2304.03237v03

Employing Matrix Elements in the Search for Higgs Self-coupling



Blocks:

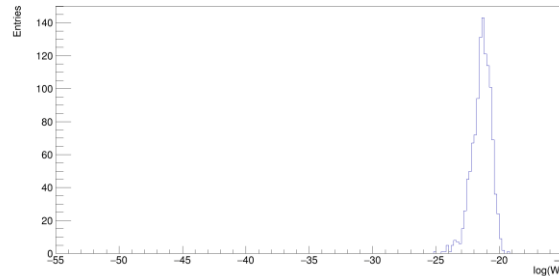
- Dashed lines: Decaying particles
- Lines with blob: Input particles for MoMEMta
- Lines without blob: Reconstructed particles by MoMEMta

• Matrix Element Method: $W(x|\alpha) = \int |\langle \psi_f | H_\alpha | \psi_i \rangle|^2 d\phi(f)$

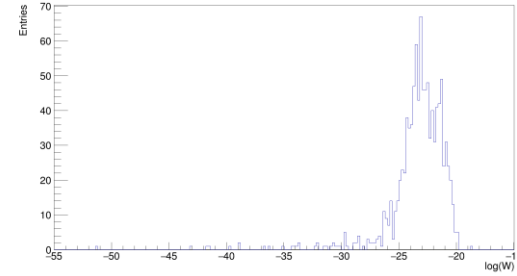
→ **Weight** represents a measure of likelihood

- Calculate weights with MoMEMta
- Compare weights of $H \rightarrow HH$ with $Z \rightarrow HZ$

ttbar(ttbar) Weights

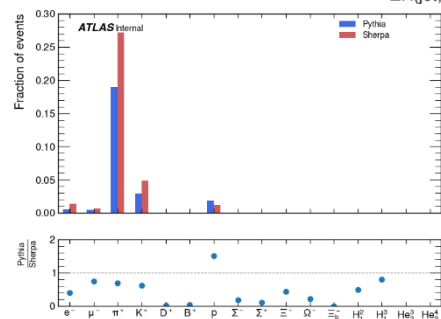
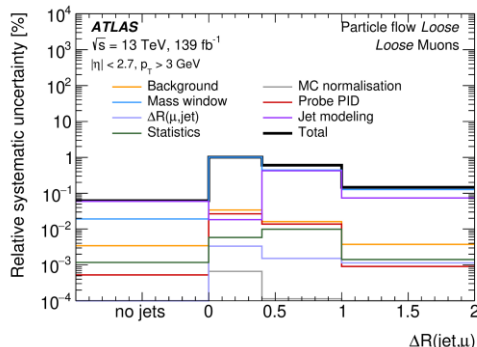
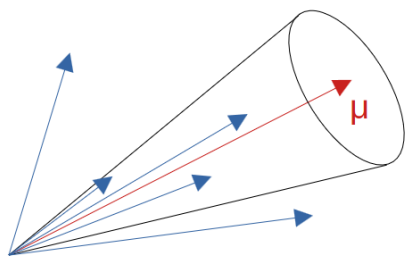
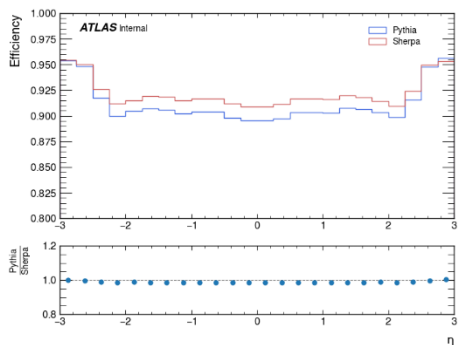


ttbar(HH) Weights

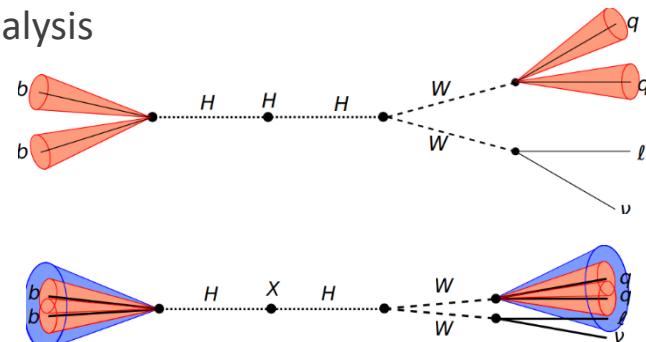


Qualification and analysis tasks

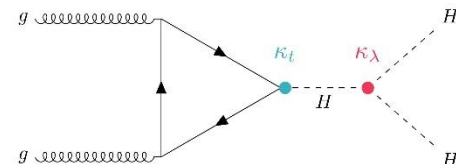
- Muon Isolation Efficiency Generator Dependence



- Run 3 DiHiggs to bbVV Non-resonant Boosted Analysis

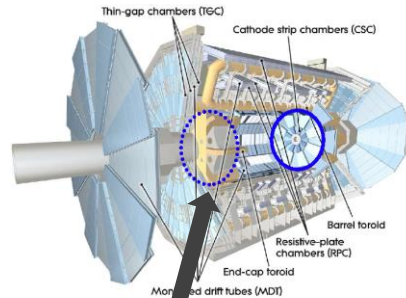


	bb	WW	$\tau\tau$	ZZ	YY
bb	34%				
WW	25%	4.6%			
$\tau\tau$	7.3%	2.7%	0.39%		
ZZ	3.1%	1.1%	0.33%	0.069%	
YY	0.26%	0.10%	0.028%	0.012%	0.0005%

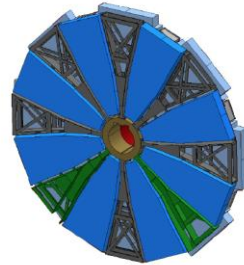


Performance of Standalone Muons in Run3

- Muon Combined Performance Group
- ATLAS Qualification Task



(a) Cut-away view of the ATLAS muon system. The locations of the small wheels are indicated by the blue circles.



(b) Structure of the new small wheel of the ATLAS muon system.

Standalone Muons:

- $|\eta| > 2.5$
- Reconstructed only by Muon Spectrometer

New Small Wheel

Welcome to AG Biebel !

Any questions ?