Ranking studies on ZH/ggH input workspaces

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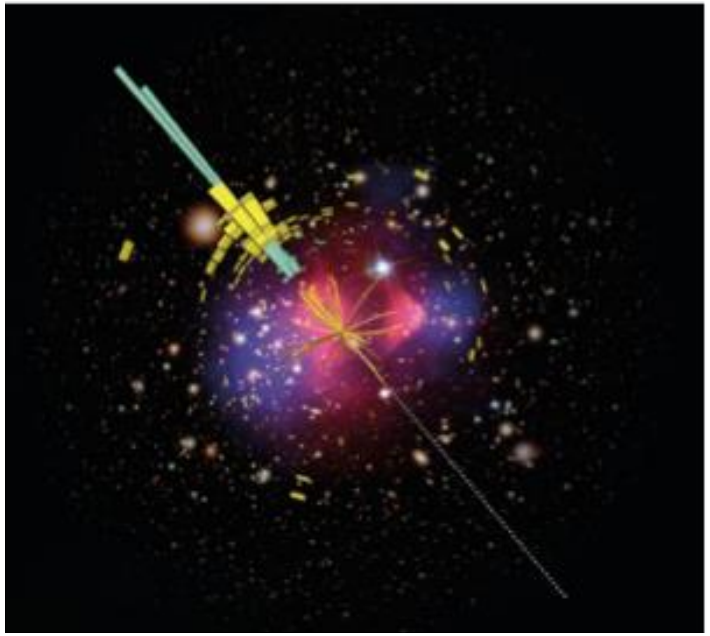
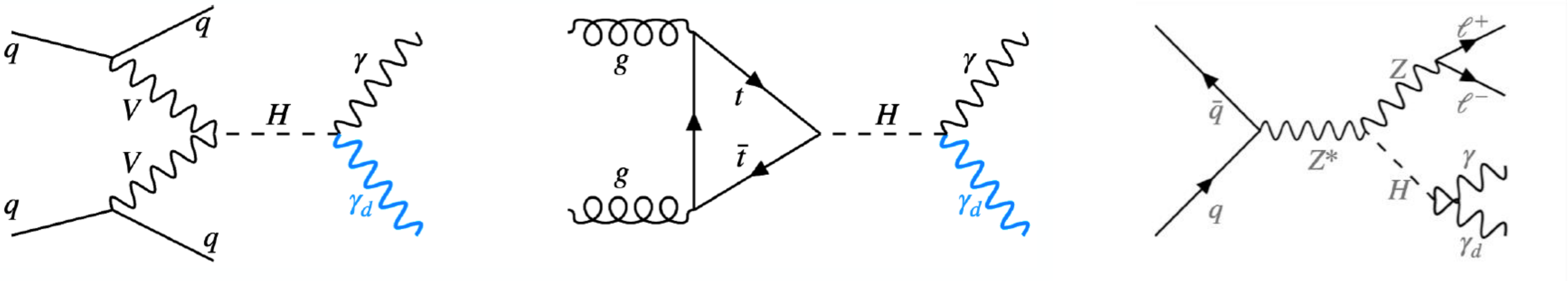
Introduction



- I’m working with the Dark Photon Combination Analysis team, which is a team in the ATLAS Common Dark Matter Subgroup (CDM)
- **Project goal:** Combine the results from different Higgs-boson to photon and dark photon searches to improve the decay rate sensitivity
- I’m working with Zirui Wang (University of Michigan), who is in the LHC Dark Matter Group, also working on Dark Photon Combination
- My role is to verify the systematic performance of each analysis and to build the correlation scheme. I’ll also work on RECAST to derive input likelihood models
- I am currently working on a ranking study as a precursor to combining the dark photon searches

Background

- There are several new physics scenarios of a Higgs-boson decay channel into a photon (γ) and dark-photon (γD)
- CMS has already conducted analyses on a combination of these scenarios
- Our aim is to combine ATLAS's most recent H→γγD searches to get the most precise constraint on the decay and study a wider range of masses

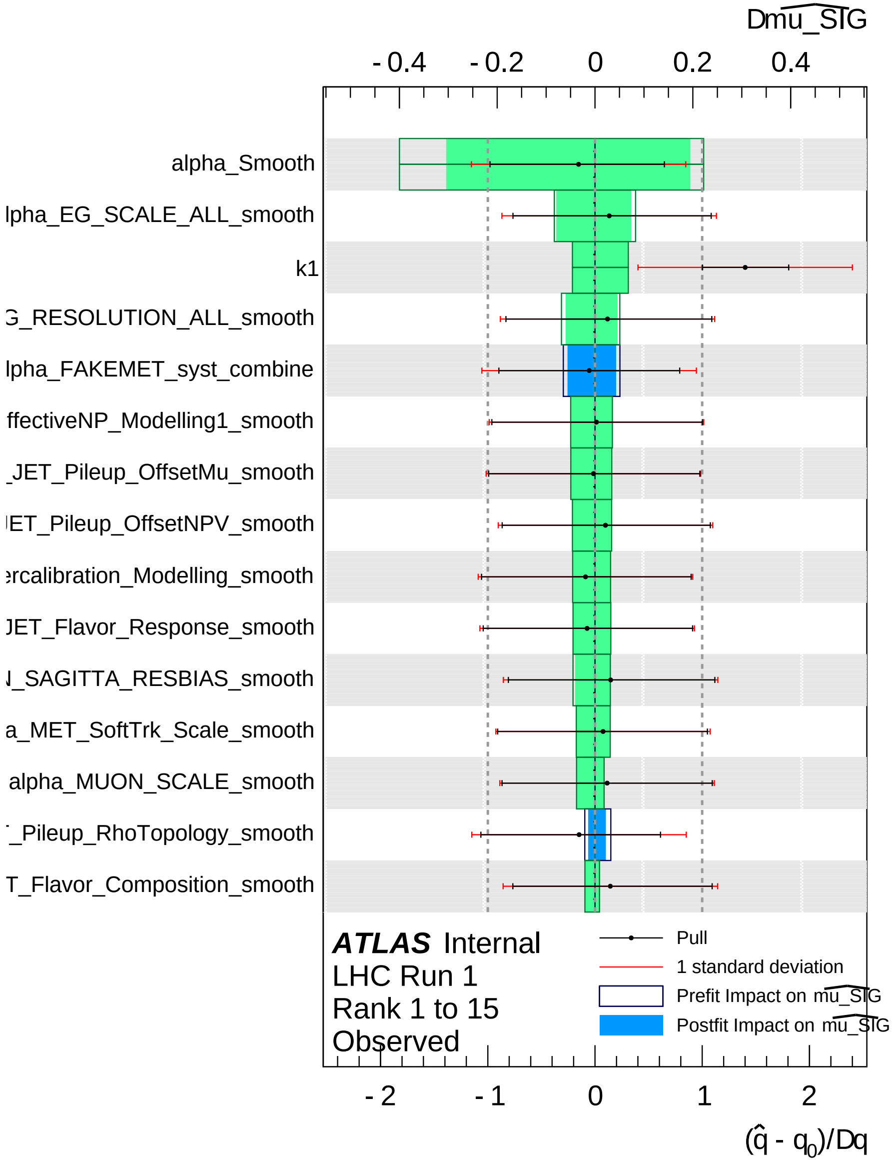


Different production modes of Higgs decaying into a photon and dark photon

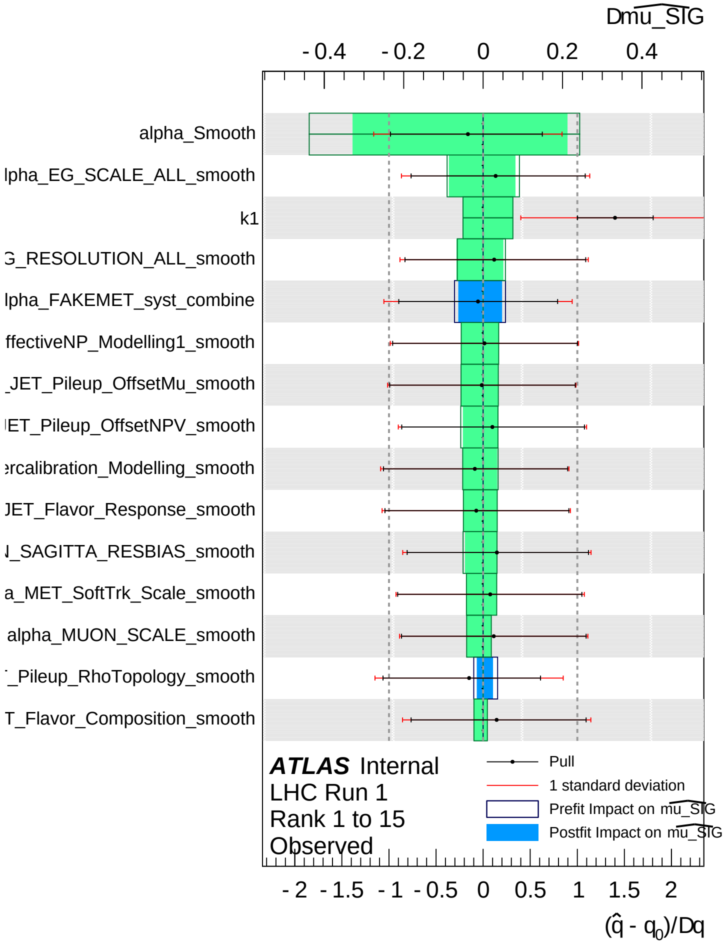
ZH: γD mass 0 GeV

- Impact bars are shown in blue and green, and corresponding to the top x-axis
- Blue indicates a positive impact on the signal strength from that NP, while negative-impact NPs are shown in green
- Pull lines correspond to the bottom x-axis
- Top 15 leading-impact NPs are shown

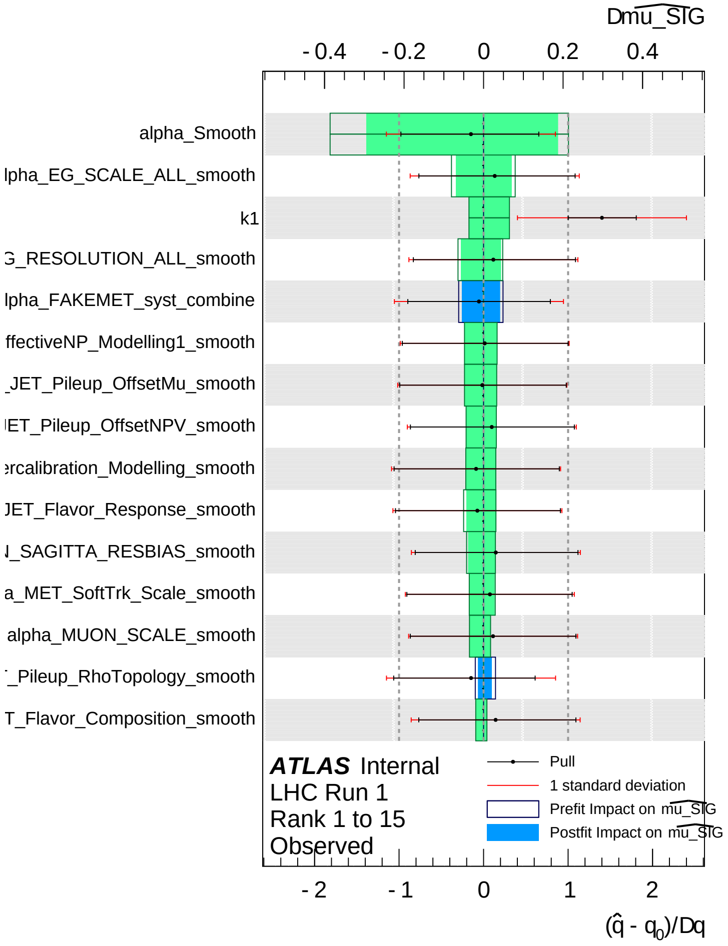
- **Smoothing uncertainty** has the leading impact and is much larger than other NPs
- Results dominated by experimental uncertainties (**EG, Fake, Jet, MET, MUON**). Modeling uncertainties are not in the leading 15 NPs
- The highest **modeling uncertainty** ranks 17 (SR-ScalUnc_Hyyd: see backup)
- Pulls are healthy for the leading 15 NPs



ZH: γD mass 1 GeV



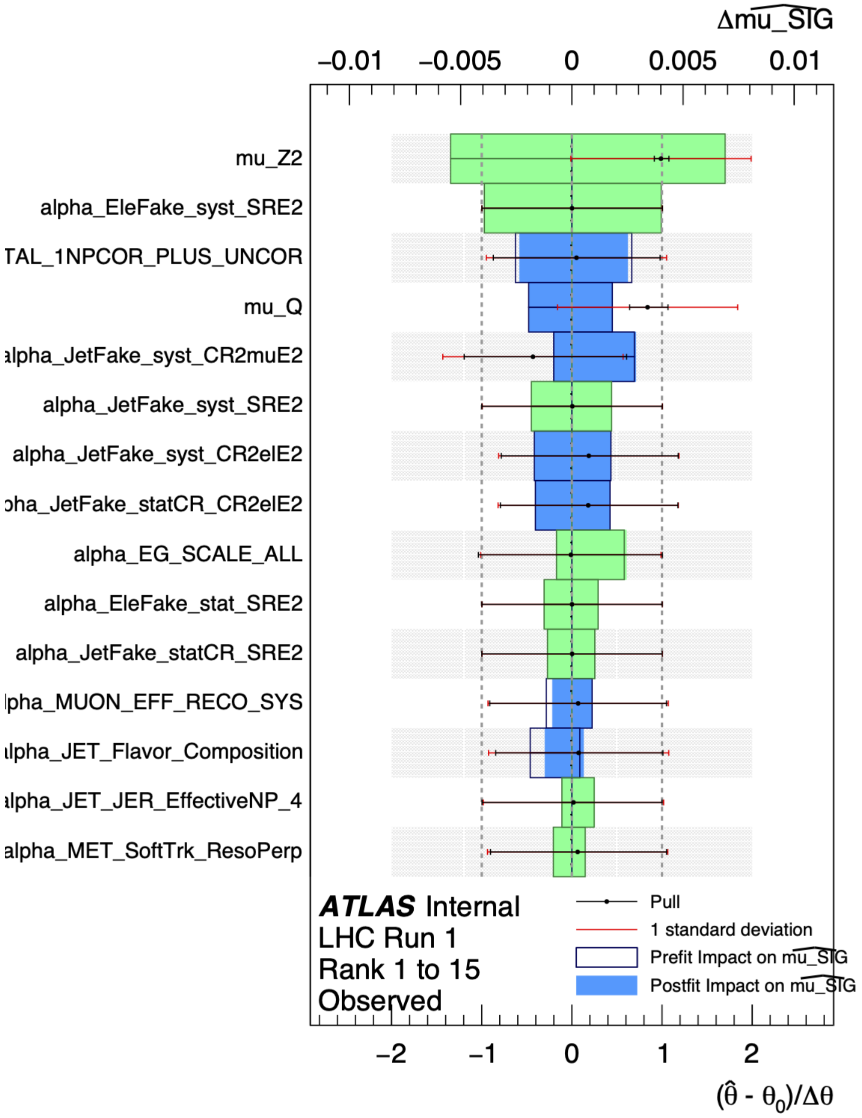
ZH: γD mass 40 GeV



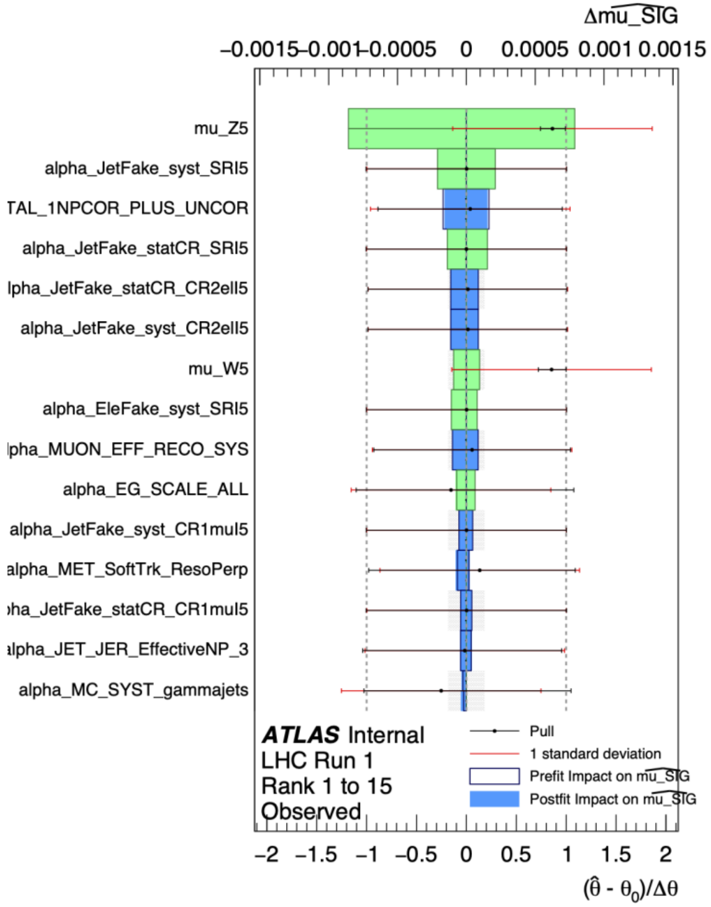
Ranking results stay consistent among different γD masses -> for observed results, **experimental uncertainties on background** are always giving leading impacts.

ggH: H mass 400 GeV

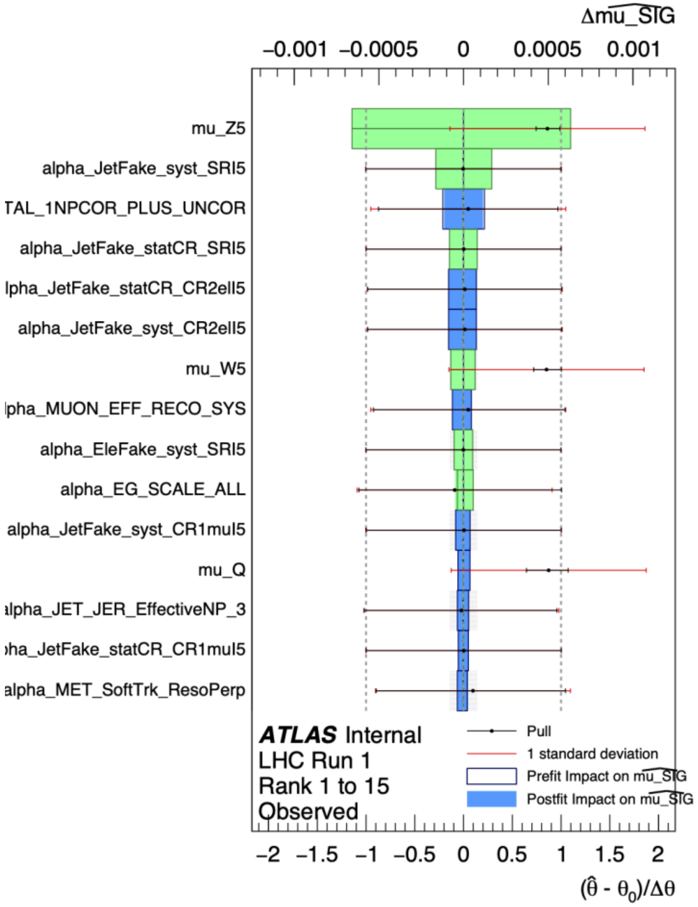
- **Background normalization** plays an important role in the ggH analysis, as well as **fake-related** NPs
- No modeling uncertainties in the top-15 NPs or top-30 (see backup)
- Pulls are generally healthy for the leading 15 NPs



ggH: H mass 1500 GeV



ggH: H mass 3000 GeV



- Rankings are generally consistent between 1500 and 3000 GeV mass points
- Comparing to 400 GeV, the impact from systematics on signal strength is much smaller → high mass results are more dominated by statistic uncertainties

Summary and To-do

Summary

- Derived ranking results on available ZH and ggH workspaces, with observed dataset and selected signal mass points
- Identified leading-impact systematics, both analyses are dominated by experimental uncertainties. Need to properly correlate those from common CP tools
- The impact from correlation on signal modeling uncertainties should not be large
- Leading systematics have healthy pulls

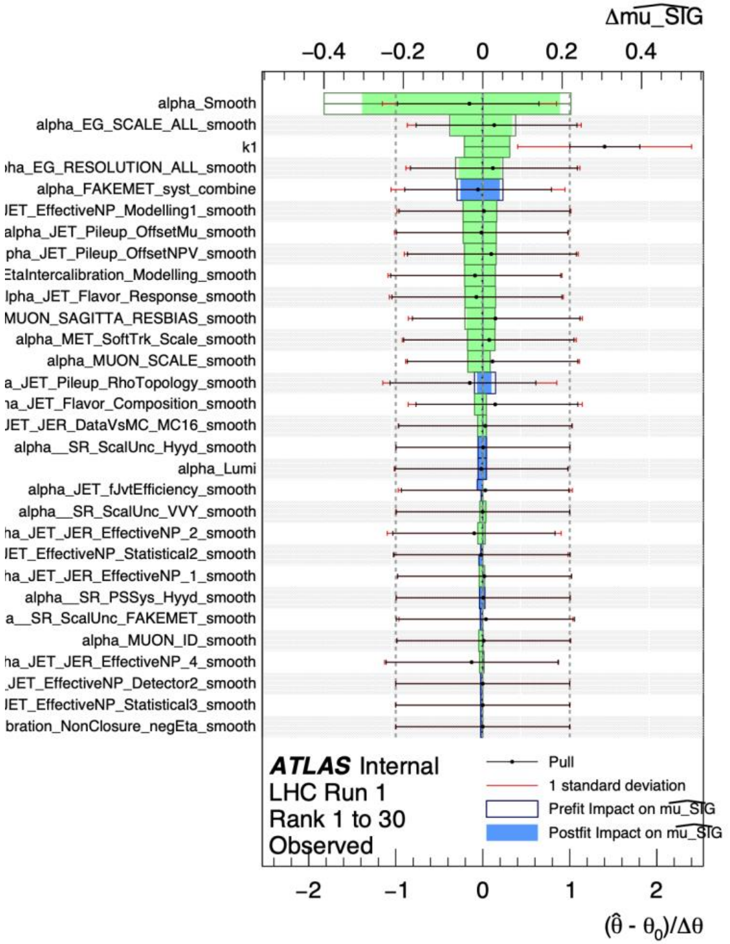
To-do

- Check expected results and compare with the observed one
- Loop all systematics and select over-constrained or pulled NPs
- Using those results as references to build the correlation scheme

Thanks!

Backup

ZH: γD mass 0 GeV



ggH: H mass 400 GeV