

VORKSPACE EVPLORER

LHC Reinterpretation Forum

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Historical Context

- Project started as part of combination effort for ATLAS analyses
- Combination SHOULD be straightforward, as all analyses already scrutinised by ATLAS, BUT ...
- Inputs to combination:
 - produced in various frameworks
 - converted into pyhf JSON format
 - need to be understood and validated
 - \rightarrow very time-consuming
- Idea: Streamline validation process to ensure correctness of workspace contents

Examples of issues we saw:



```
"data": {
    "hi": 1.017,
    "lo": 0.983
j,
"name": "luminosity",
"type": "normsys"
```

Additional normalisation systematic for luminosity

Fit parameters fixed when they should not be

But also cases of certain systematics missing completely!

Issues hard to spot when not familiar with workspace







Overview

- Provide easy-to-use interface for analysers to validate their pyhf JSON workspaces \rightarrow WorkspaceExplorer
- Runs in web browser, providing visualisations of workspace contents:
 - Bar charts, pie charts, data/MC comparisons, NP structure
- Connection to python-based backend allows retrieving fit results
- Load workspaces from local files or directly from HEPdata entries
- All plots can be downloaded as SVG



extend to 453 in the future + may be useful for combine cards as well?

SR





DOWNLOAD





Summary

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Processes

ttbar	?
Wjets	?
singletop	?
Diboson	?
ttZ	?
ttW	?
ttH	\bigcirc
Zjets	\odot
LQumum1800BR50	?

Regions

WjetsCR
singletopCR
lowNNoutCR
SR



Normalisation Factors



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mu_ttbar (floating)
mu_wjets (floating)
mu_singletop (floating)
SigXsecOverSM (floating)
signalnormalization (fixed)



Modifier Structure Chart



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Э...

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n		JET_JER_NP6
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2		singletop_FSR
3	_	JET_Flavour_Composition
4		singletop_hadronization
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singletop_muF









Application Structure

Frontend written in Typescript Accessible at

workspaceexplorer.app.cern.ch

"Business logic": VueJS framework

Pinia for state management



Quasar framework for UI elements

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QUASAR

Plots created from native SVG elements

Send workspaces to **RESTful API**



Code publicly available on Github

<u>WorkspaceExplorerFrontend</u> **WorkspaceExplorerBackend**

Python-based backend

Hosted on CERN Openshift instance



 \mathscr{L} ikelihoods

Simple RESTful API using Flask: - POST workspace

- GET fit results

Celery + Redis for asynchronous task handling



Profile likelihood fits using pyhf + cabinetry

Retrieve fit results from RESTful API





Usage Scenarios

- Validation of workspaces:
 - easy way for analysers to confirm contents of workspaces
 - avoid mistakes due to conversion between different statistical frameworks
 - confirm all necessary information is available
- Exploration of unfamiliar workspaces: aid understanding of analyses from outsider's perspective
- Education:
 - Introduce newcomers to key concepts







Advantages

- Parallels to RooBrowser, but:
 - focus on HistFactory schema
 - no need to setup ROOT
 - runs natively in web browser
 - \rightarrow low barrier to entry

Can tie in directly with HEPdata: Ioad via ID of HEPdata entry share via URL parameter, e.g. https://workspaceexplorer.app.cern.ch/?id=2077557

(only works if the raw workspace is directly attached to the HEPdata entry, but I will try to find time to implement unpacking of tarballs & applying signal patches soon)







Interactive Pulls

- New, experimental feature:
 "pulling the pulls"
- Change pulls directly in the UI
- Work in progress, but preview to play around with here
- Investigate impact of nuisance parameters
 - \rightarrow "Fitting by hand"

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Changing pulls in pull plot instantly reflected in post-fit plots



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Interactive Pulls

| < < 1/2 **> >|**

Systematic Uncertainty Chart

Filter by name







singletopCR



JET_JER_NP1





Signal Region





Conclusions & Outlook (I)

- Interactive visualisation of pyhf workspaces in the web browser
- Read in local files or load directly from HEPdata (maybe even link directly?)
- Connection to backend running pyhf + cabinetry for profilelikelihood fits
- Useful for understanding and validating statistical models, but also for sharing them



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Conclusions & Outlook (II)

In Progress:

- - -

- interactive pulls
- plots of systematic variations
- Ideas for the future:
 - Interfaces for HS3, combine
 - Cache workspaces and fit results on server to allow sharing via permalink
 - Customisable fit parameters (e.g. exclude certain NPs)



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