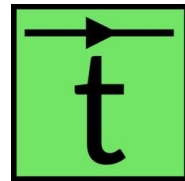


TOP tt cross section exercise

04.09.2025

Evan Ranken, Dominic Stafford, Beatriz Ribeiro Lopes



Overview

Exercise based on TOP-22-012, performed at DAS in 2023, 2024

- Measure inclusive top pair production cross section at 13.6 TeV
- 1/fb lumi collected at start of LHC Run 3 in Jul-Aug 2022

Exercise philosophy

- [Pepper framework](#): columnar, python+awkward-based
- Students inherit a **running NanoAOD-based framework**, but has missing pieces
 - Students tour the framework
 - Understand and fill in gaps in the event processing+plotting
- Includes **combine** component
 - Datacard writer script included to process their histogrammed data (again with gaps)
 - Learn standard combine commands, perform measurement, plot impacts

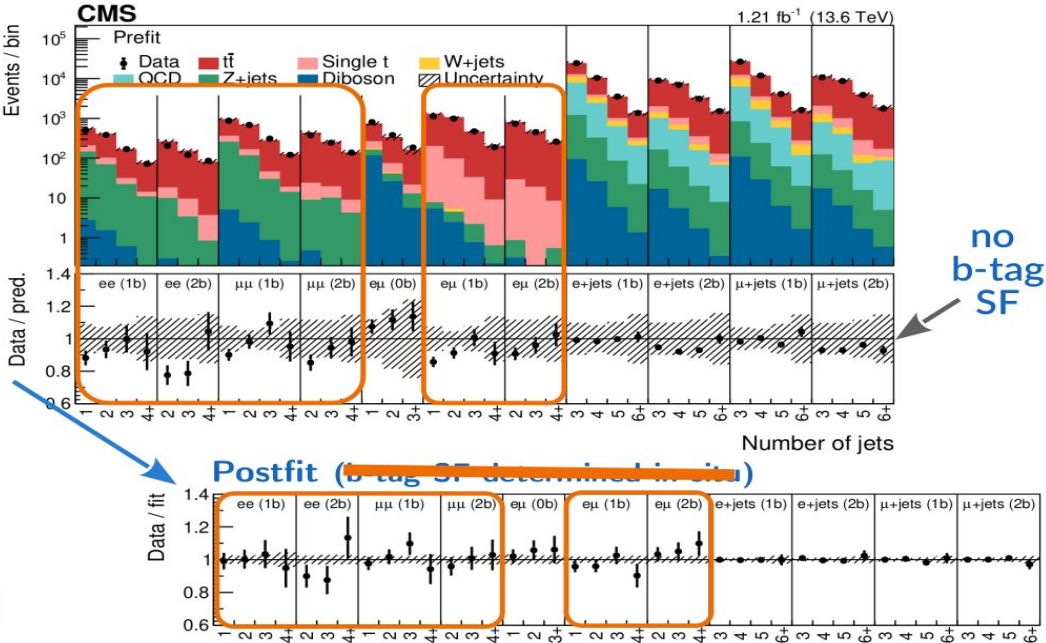
Measurement setup

Simplified version of TOP-22-012:

- Channel combination of l+jets and dilepton → **Dilepton channels only** (no QCD background)
- Simplified uncertainties → **no in-situ btag SF, reduced number of uncertainties**

Bins:

- Lepton flavor
 - b jet multiplicity
 - Jet multiplicity



History and resources

- Ran this exercise at 2023 PODAS (NAF) with Laurids Jeppe, as well as at 2024 DAS (Ixplus) with Dominic and Otto Hindrichs.
- Documentation cern pages: <https://cmsdas-2024-ttxs.docs.cern.ch/>
- Gitlab repo and separate repo with solutions:
<https://gitlab.cern.ch/cmsdas-cern-2024/long-ex-top-xsec>
<https://gitlab.cern.ch/eranken/pepper-ttxsec-das-exercise-2024/> (private, “solved” branch)
- MC sample skims with major backgrounds only, to keep runtime short

New documentation site for this and other long exercises:

- <https://gitlab.cern.ch/eranken/cmsdas2025-desy-longex-docs>
 - ◻ master branch deploys to <https://cmsdas-2025-desy-longex.docs.cern.ch/> (viewable to CMS member e-group)
 - ◻ README explains how to add your own exercise
 - ◻ Propose to collect all long exercise documentation here, even if it is just a few links to slides or a notebook.

The screenshot shows the web interface of the 'CMSDAS 2025 @ DESY - Long Exercises' documentation site. The top navigation bar is dark blue with a book icon, the title 'CMSDAS 2025 @ DESY - Long Exercises', a gear icon, a search bar with the text 'Search', and a 'src' link with a document icon. Below the navigation bar, there are three links: 'Home', 'Top cross section (2024)', and 'Demo exercise'. The main content area has a dark background. On the left, there is a sidebar with the following items: 'Top cross section (2024)' (highlighted in blue), 'Pre-exercise', 'Data analysis using Pepper', and a list of sections: '0. Introduction', '1. Histograms + plots', '2. Customize your analysis', and '3. Corrections + systematics'. The main content area displays the 'Introduction' section, which contains the text: 'In this exercise we will perform a measurement of the top quark pair production cross section using $\sim 1 \text{ fb}^{-1}$ of data collected during the early days of LHC Run 3.' and 'This exercise was adapted from the measurement [TOP-22-012](#).' There is a pencil icon in the top right corner of the main content area.

Documentation:

- 2024 version is up on the website, will start updating soon

Exercise:

- Beatriz Ribeiro Lopes** has agreed to join as co-facilitator

To-do

- Merge new pepper changes into repo (plotting update?)
- Test and finalize prescription for installing + running on afs/eos
- Check uncertainties and SF (last year, measurement results were low)
- Move data files to DAS 2025 directory?
- update solutions repo, student repo