

The new CC0pi data release

arXiv:1802.05078

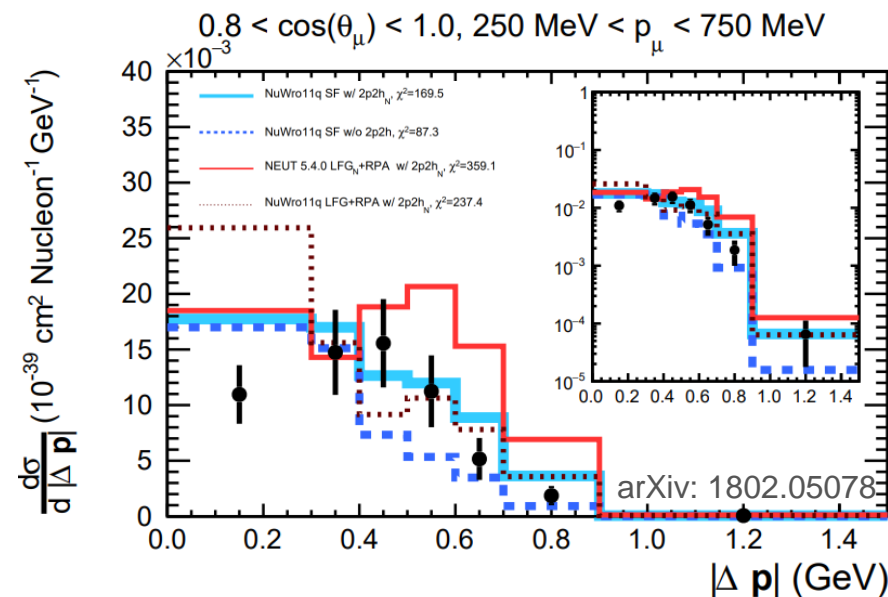
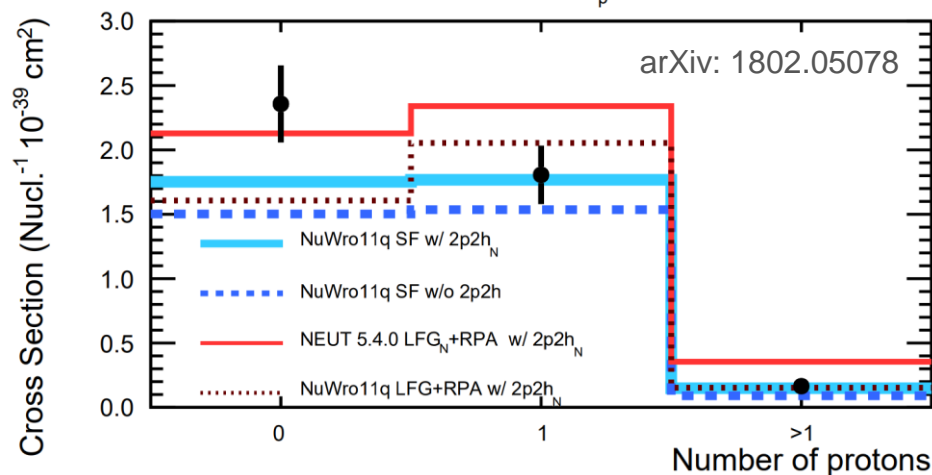
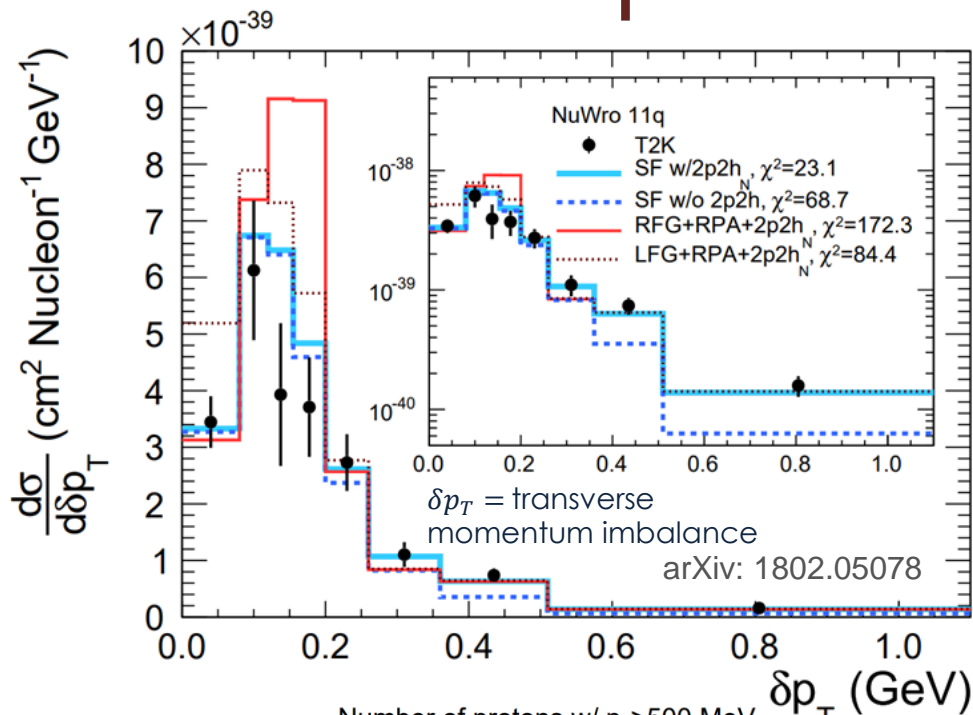
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New CC0pi data release

- Should be easy to reproduce plots like this from the paper



New CC0pi data release

README.pdf

Details all of this

cc0piWithProtonsDataRelease_v1p3.tar

datResults.root

datResults_noreg.root

dphitResults.root

dphitResults_noreg.root

dptResults.root

dptResults_noreg.root

infkResults.root

multidif_binMap.txt

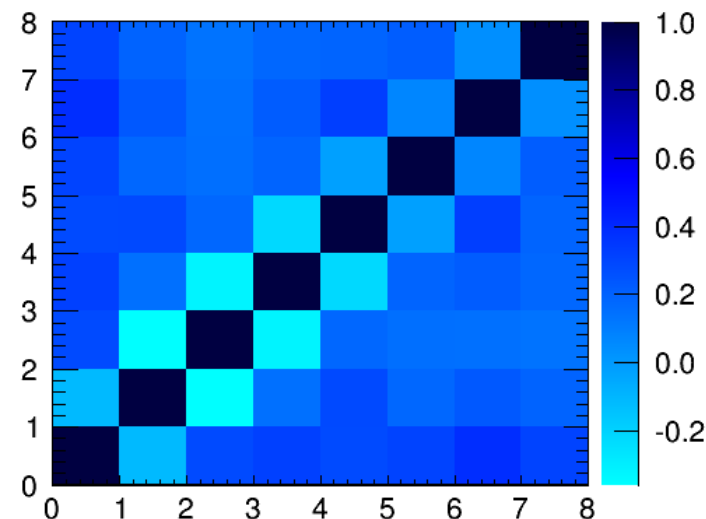
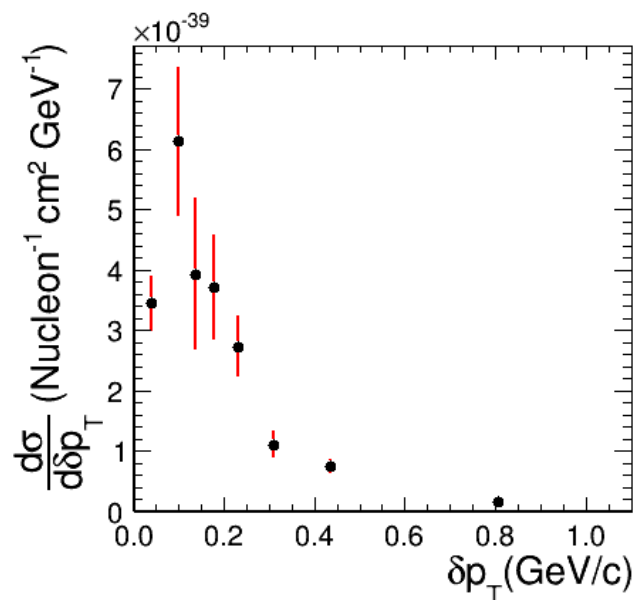
multidif_results.root

dptResults.root

Result;1

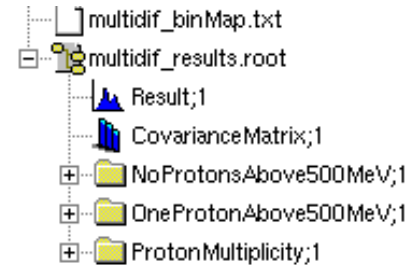
Correlation_Matrix;1

Covariance_Matrix;1



Multi differential result

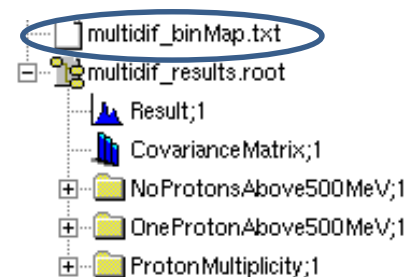
- 4-dimensional non-uniform binning:
 - Number of protons above 500 MeV/c
 - 0 – bin in $p_\mu, \cos \theta_\mu$
 - 1 – bin in $p_p, \cos \theta_p, \cos \theta_\mu$
 - More – just one bin



Multi differential result

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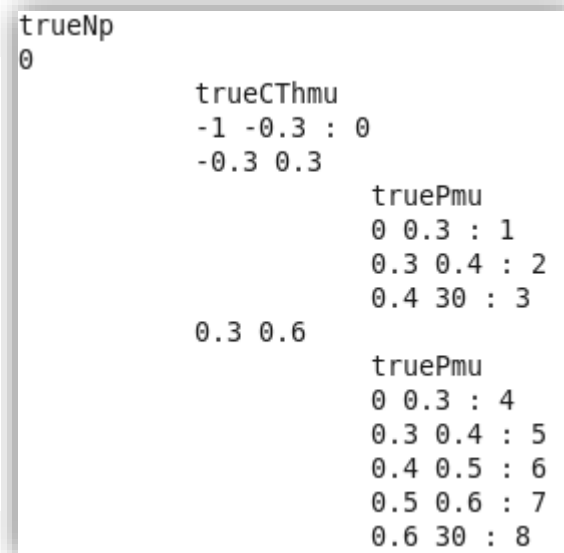
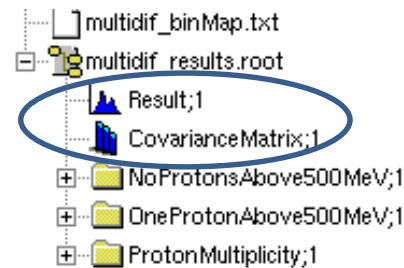
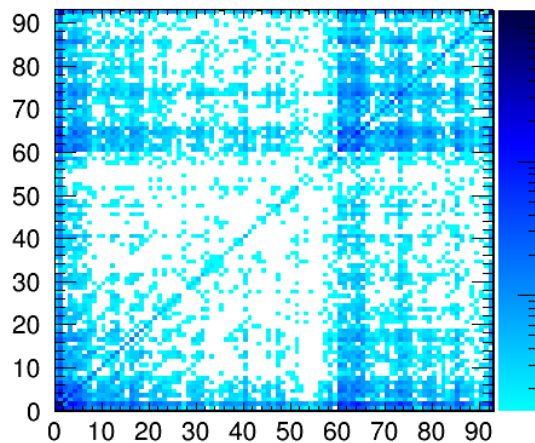
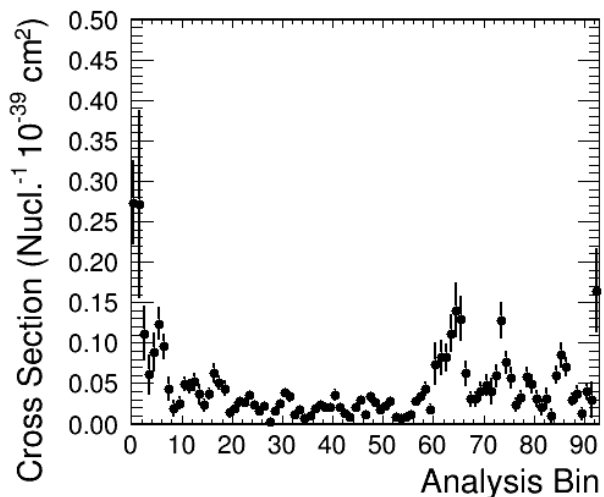
The bin mapping text file helps
keep track of all of this



```
trueNp
0
    trueCThmu
    -1 -0.3 : 0
    -0.3 0.3
        truePmu
        0 0.3 : 1
        0.3 0.4 : 2
        0.4 30 : 3
    0.3 0.6
        truePmu
        0 0.3 : 4
        0.3 0.4 : 5
        0.4 0.5 : 6
        0.5 0.6 : 7
        0.6 30 : 8
```

Multi differential result

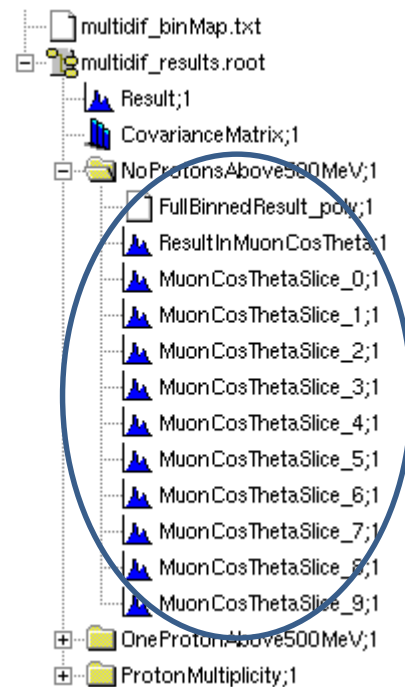
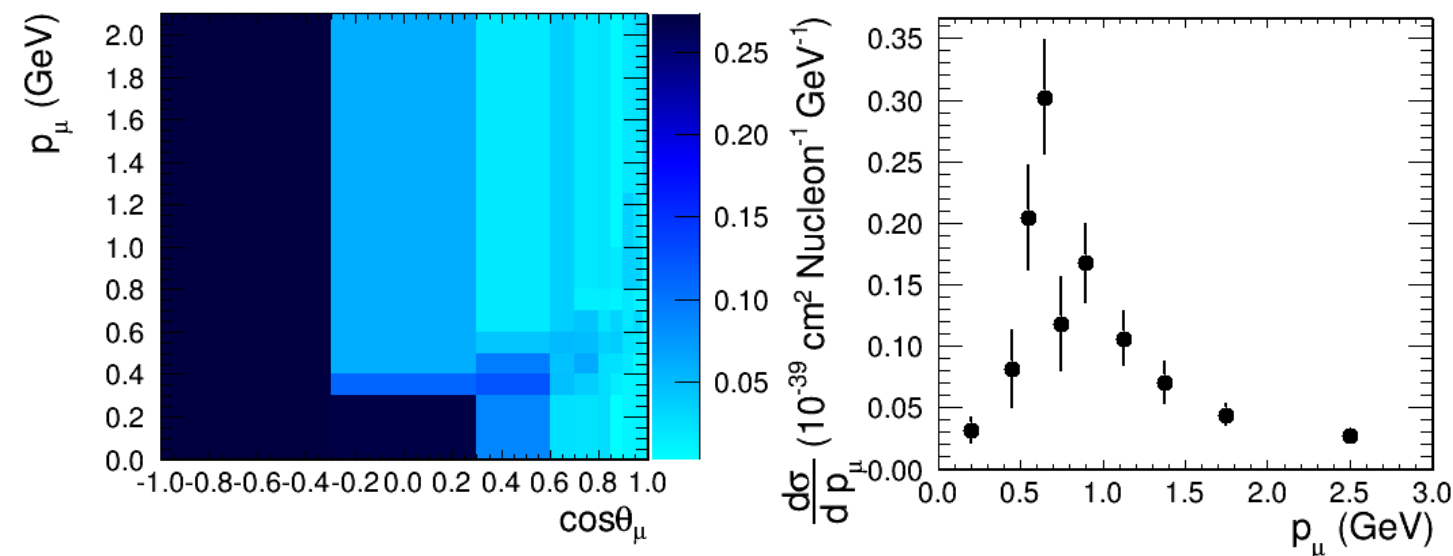
- 4-dimensional non-uniform binning:
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Provide a linearised result and full covariance matrix for easy χ^2 calculations

Multi differential result

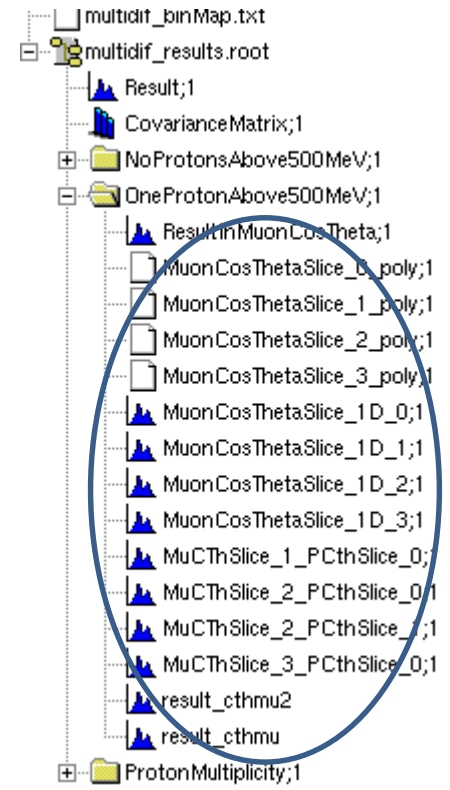
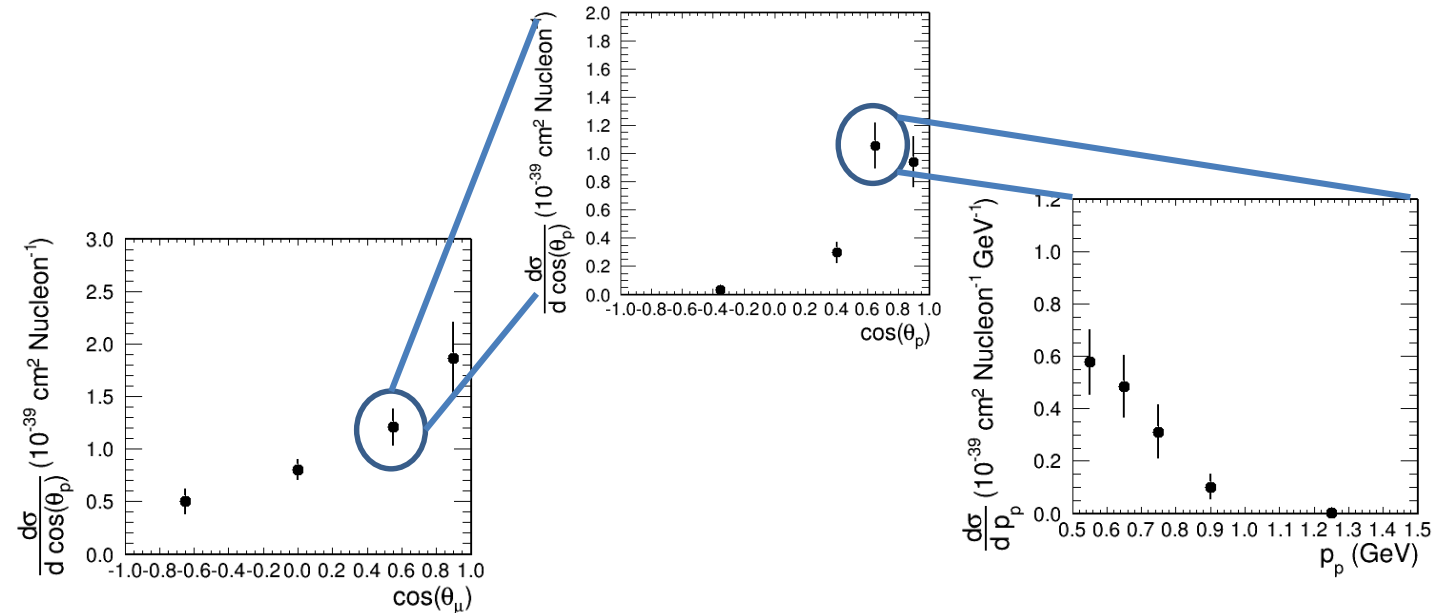
- 4-dimensional non-uniform binning:
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 - 1 – bin in $p_p, \cos \theta_p, \cos \theta_\mu$
 - More – just one bin



A TH2Poly can describe the entire result in the 0 protons above threshold bin, but individual slices are also provided as well as the result integrated over p_μ

Multi differential result

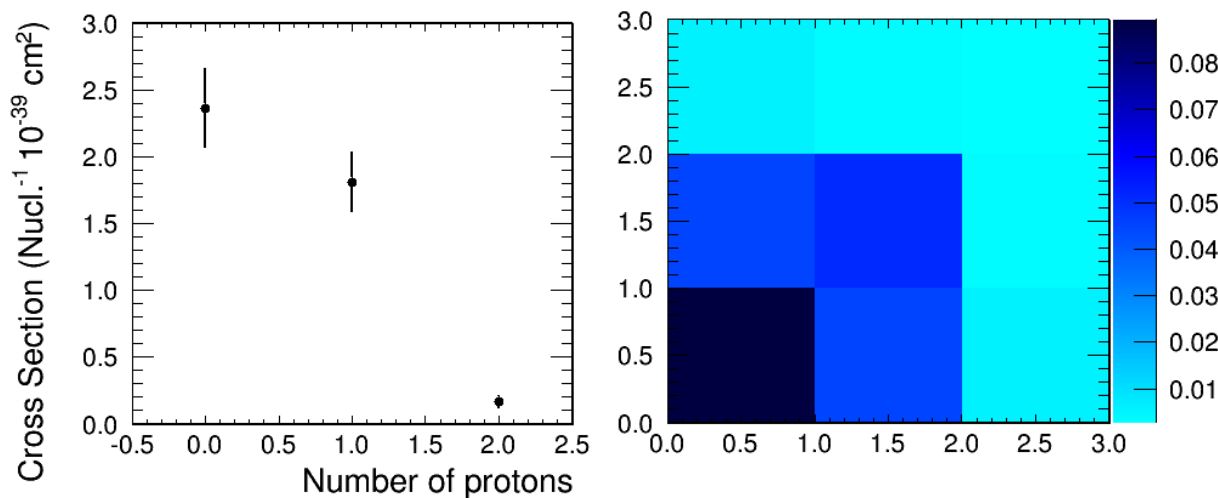
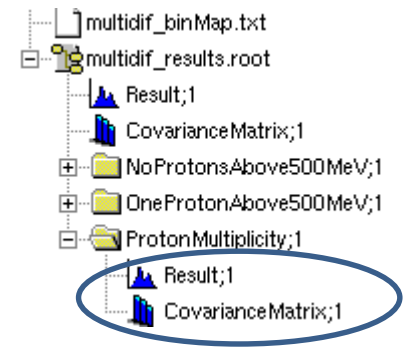
- 4-dimensional non-uniform binning:
 - Number of protons above 500 MeV/c
 - 0 – bin in $p_\mu, \cos \theta_\mu$
 - 1 – bin in $p_p, \cos \theta_p, \cos \theta_\mu$
 - More – just one bin



Need a TH2Poly in $p_p, \cos \theta_p$ for each slice of $\cos \theta_\mu$ to describe the result with one proton above threshold. Individual slices and integrated results are also provided

Multi differential result

- 4-dimensional non-uniform binning:
 - Number of protons above 500 MeV/c
 - 0 – bin in $p_\mu, \cos \theta_\mu$
 - 1 – bin in $p_p, \cos \theta_p, \cos \theta_\mu$
 - More – just one bin



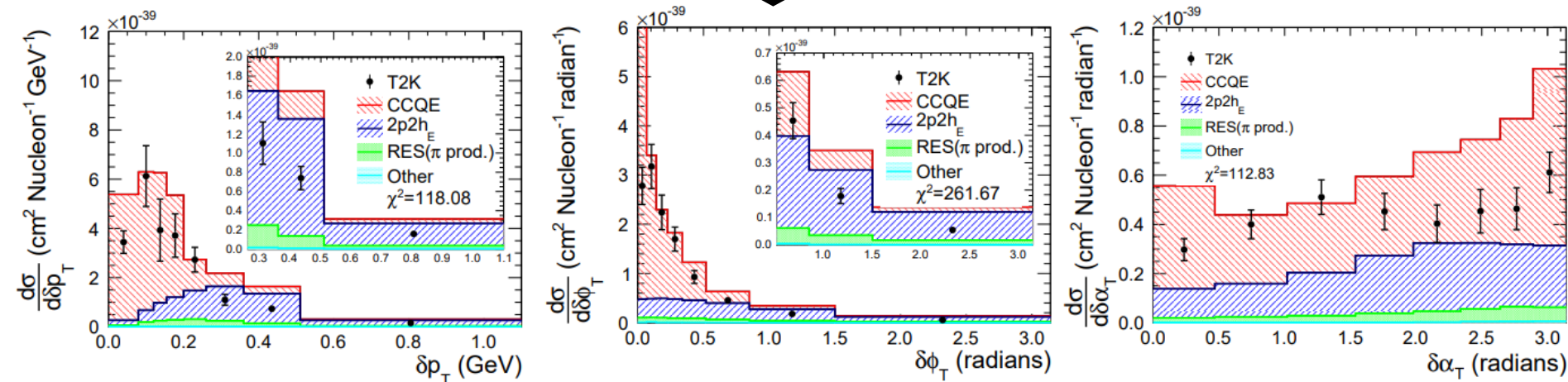
The first two bins are just the integral of the 0 and 1 proton bins. A covariance matrix is provided for easy comparison to the proton multiplicity result.

Playing the NUISANCE



- Also plan to release results as NUISANCE samples
- Makes generator comparisons and model tuning extremely simple

```
sample T2K_CC0pinp_STV_XSec_1Ddpt_nu GENIE:/data/t2k/dolan/generators/genie/mar17/R-2_12_4_defaultpMEC/gntp.0.ghep.root
sample T2K_CC0pinp_STV_XSec_1Ddphit_nu GENIE:/data/t2k/dolan/generators/genie/mar17/R-2_12_4_defaultpMEC/gntp.0.ghep.root
sample T2K_CC0pinp_STV_XSec_1Ddat_nu GENIE:/data/t2k/dolan/generators/genie/mar17/R-2_12_4_defaultpMEC/gntp.0.ghep.root
```



[2017 JINST 12 P01016](#), [arXiv:1612.07393](#), <https://nuisance.hepforge.org/>

To regularise or not to regularise

- The STV analysis provides both regularised and unregularised results. Which should you use?
- Significant discussion of this in the README, in brief:
 - Unregularised result has minimal bias, but is almost meaningless without the accompanying covarainces
 - Regularised result uses a prior to effectively smooth the result and push covarainces onto the diagonal
 - **Regulation used is much much weaker than D'Agostini 1!**
- **Use regularised result** when comparing to anything “by-eye” (this is almost always the result to use when showing any comparisons)
- **Use unregularised result** when looking for a quantitative conclusion, e.g. fitting model parameters.

To regularise or not to regularise

- **Use unregularised result** when looking for a quantitative conclusion, e.g. fitting model parameters.

- This is *really* easy to make and can be very useful when your result is being used in a likelihood fit to place external constraints for oscillation analyses (as T2K does).
- Please can we have it? (we don't care how bad it “looks”)

Using multiple T2K results

- **What if you want to use T2K CC0 π and CC1 π results at the same time?**
- The data forming the main result from one is used as a background constraint for the other.
- Need a way of providing the correlations between these results.
- In future could investigate ways of providing these.

Thoughts / concerns

What happens if the flux prediction changes?

- Not really possible to provide separate flux covariance – control samples correlate all systematics

What if we find out the background prediction was crazy?

- Mitigated through data-driven background subtraction, but no easy way to provide a way of altering background subtraction from unfolded result

What if my errors are really not Gaussian?

- Will become more of a problem as systematics dominate more
- Could release high dimensional likelihood surfaces?
- Would need to build a set of tools to use this

Thank you for listening