Treasure pipeline discussion

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27.5.26

Intro

* Last week, we agreed to create a PR for event-level tokenisation to ‘heptokens’ repo.
* Link to PR: https://github.com/Treasure-AmSC/heptokens/pull/5
* PR adds ATLAS event-object dataloading for per-object VQ-VAE tokenizer training (jets, electrons, muons, photons, taus), with configurable H5 feature paths and tokenizer diagnostics.

* Ran over the recent files from Viviana, next slides for the results

```
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electrons  events=3,558,000 objects=3,150,807
muons      events=3,558,000 objects=3,945,218
photons    events=3,558,000 objects=688,912
taus       events=3,558,000 objects=4,260,772
```

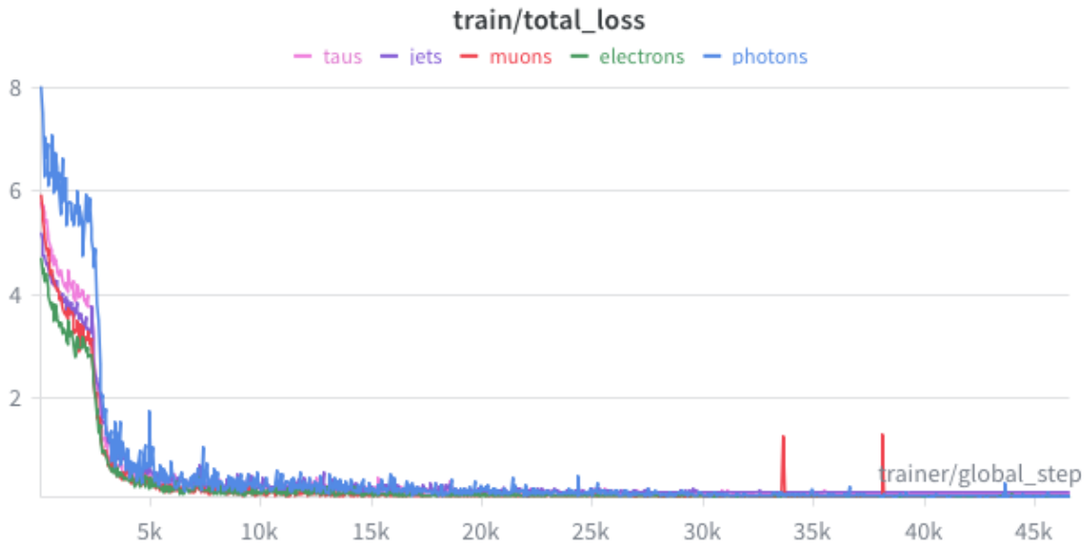
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taus
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muons
electrons
photons
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20k
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30k
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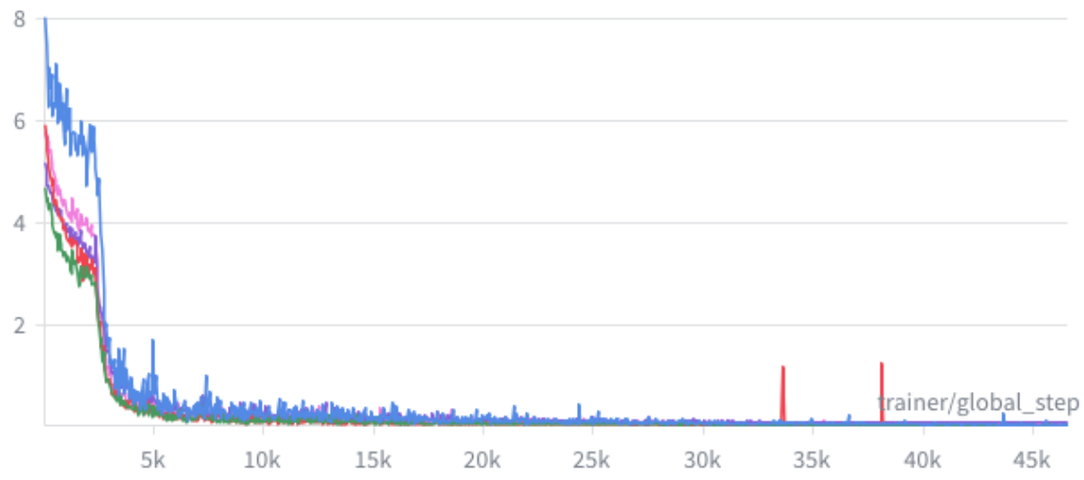
40k
45k
trainer/global_step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electrons
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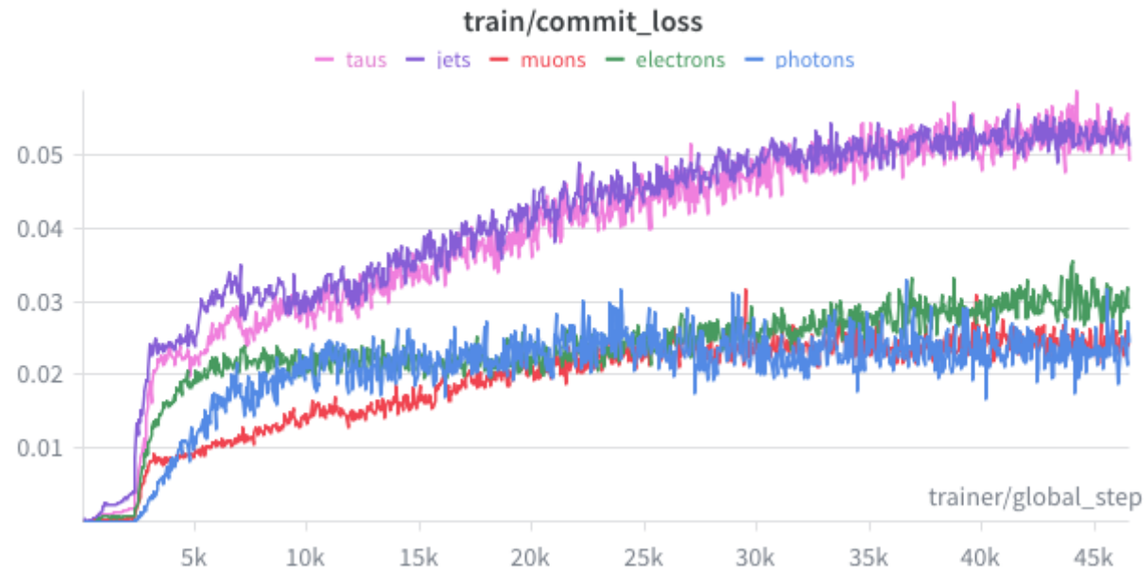
trainer/global_step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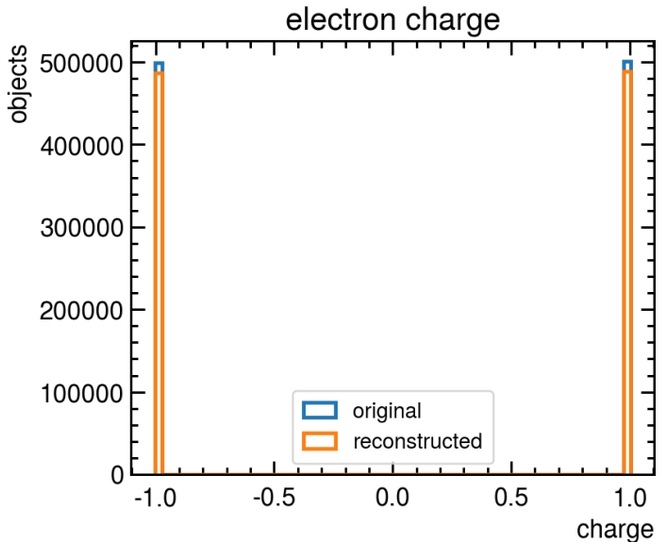
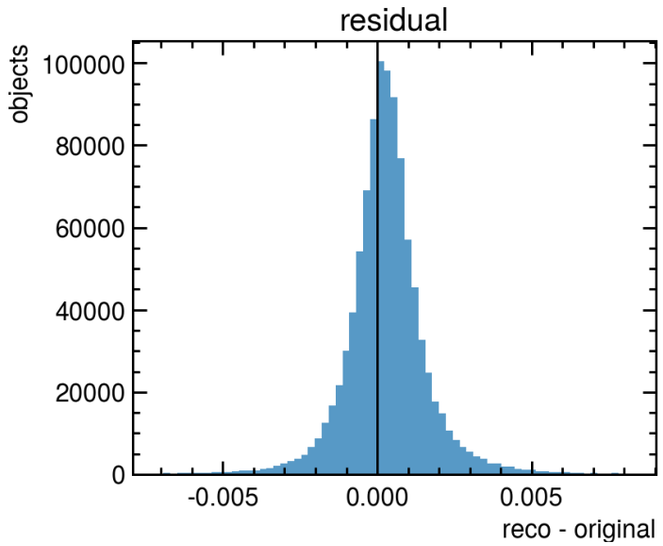
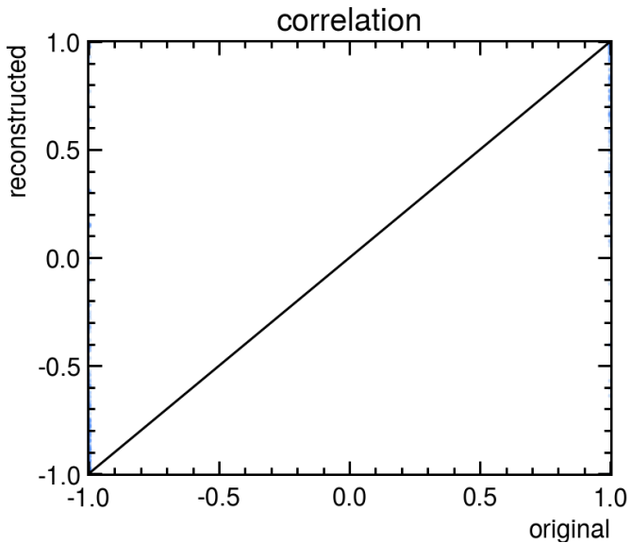
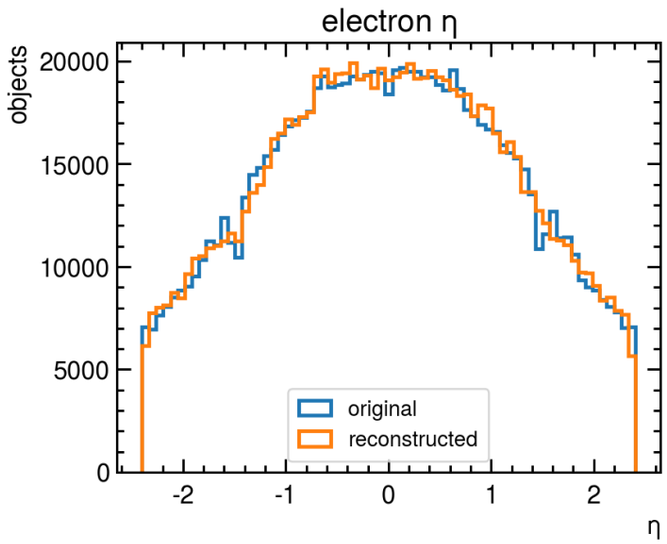
trainer/global_step

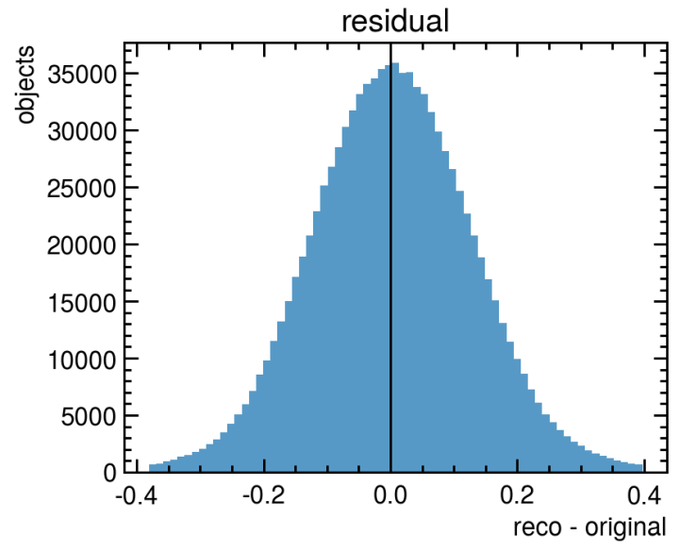
Diagnostics - electrons

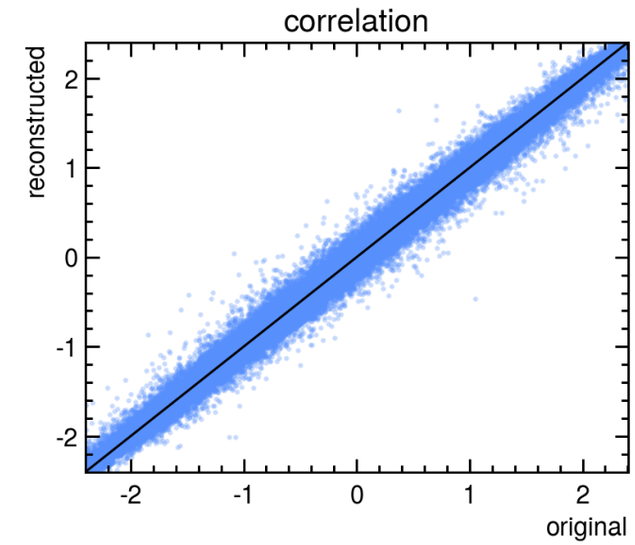


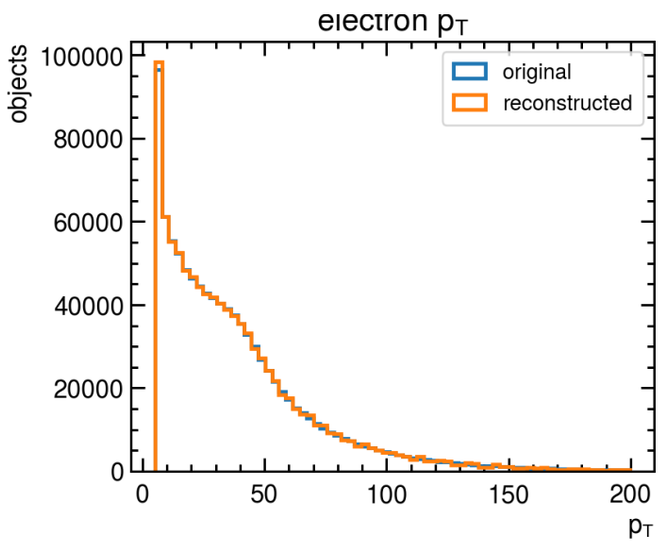


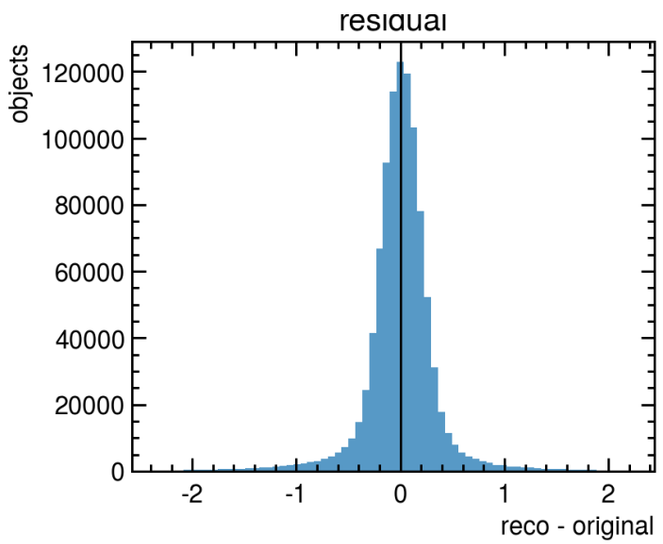


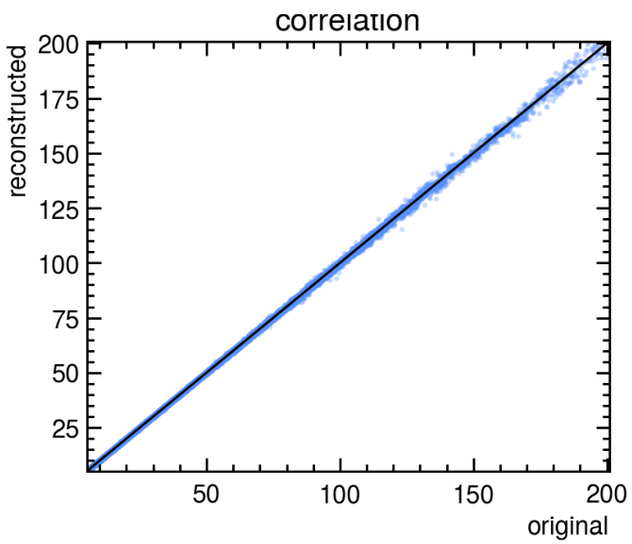




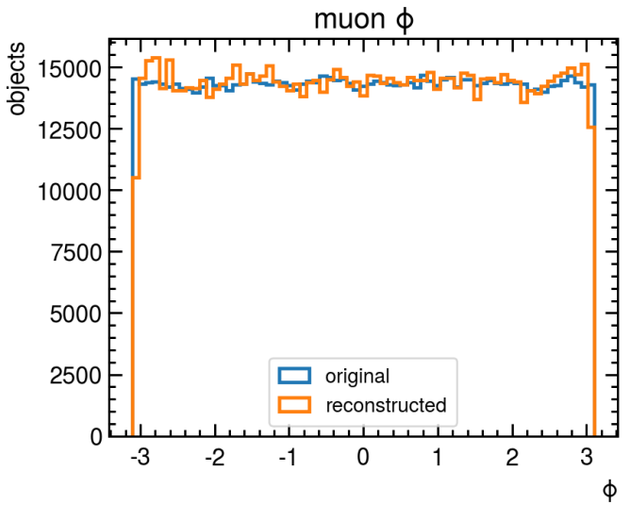


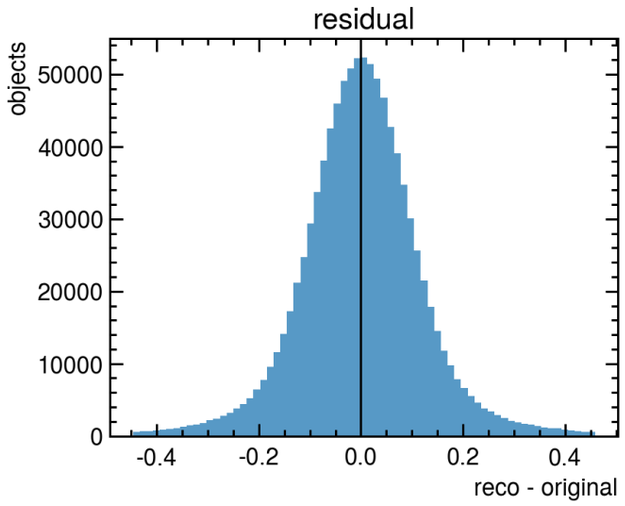


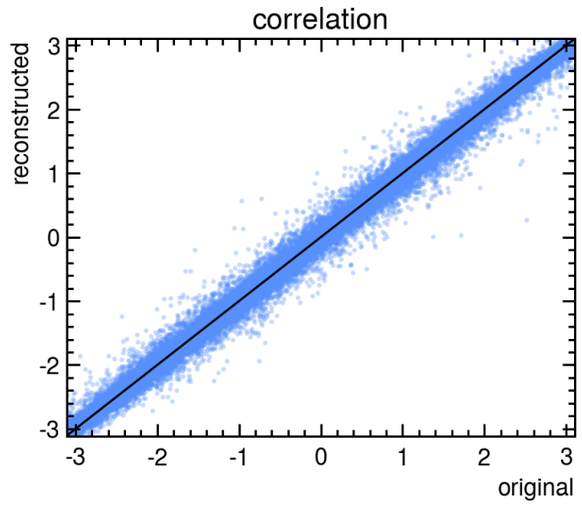


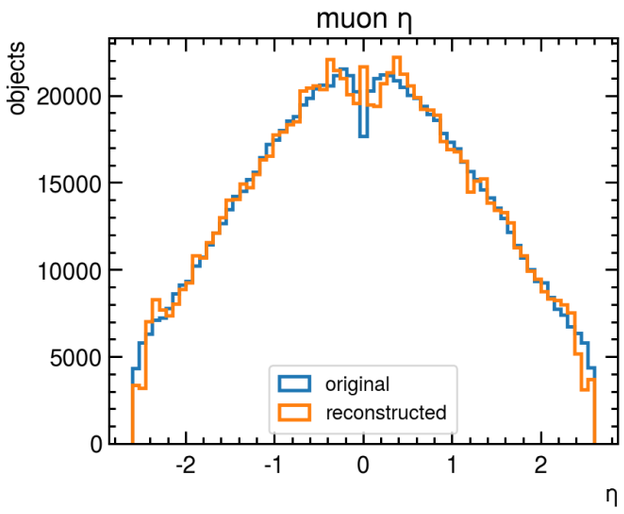


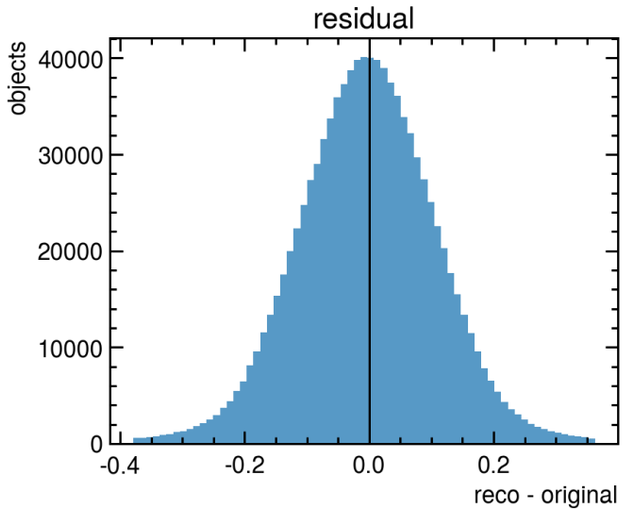
Diagnostics - muons

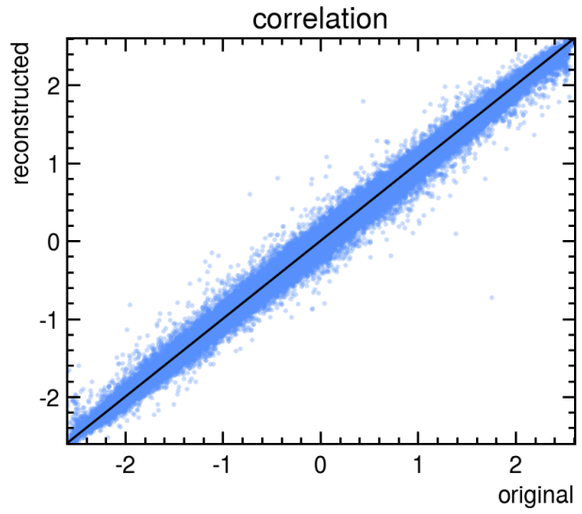


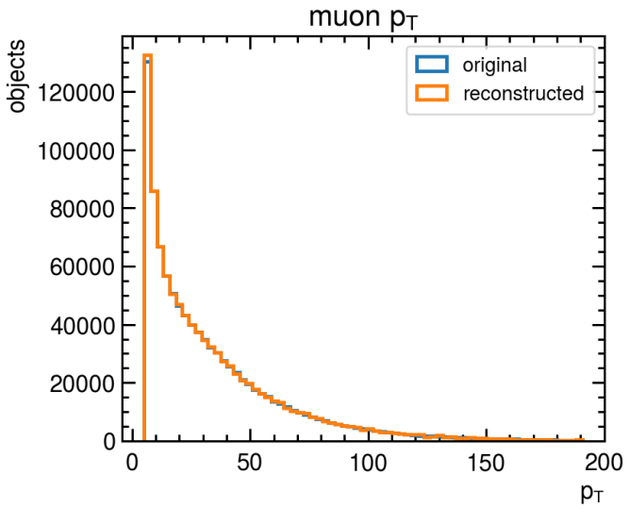


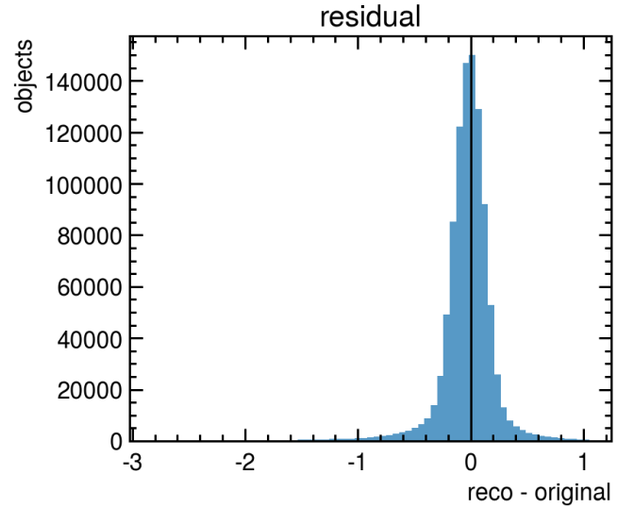


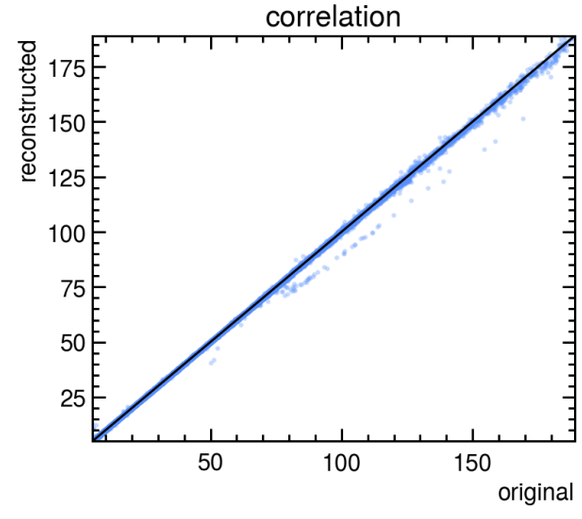




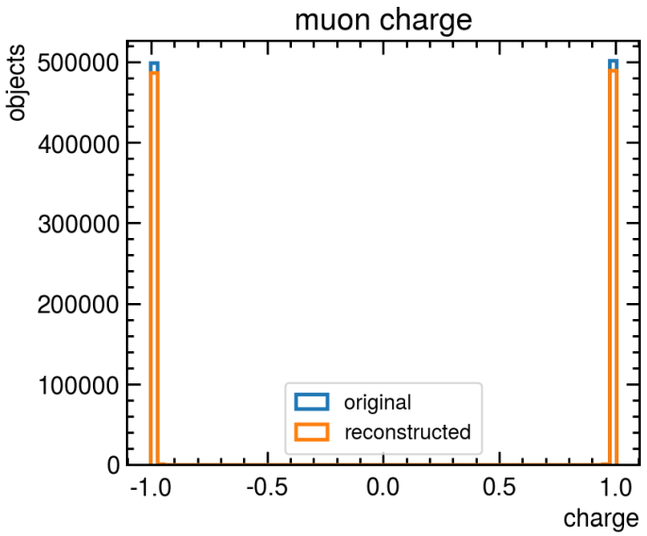


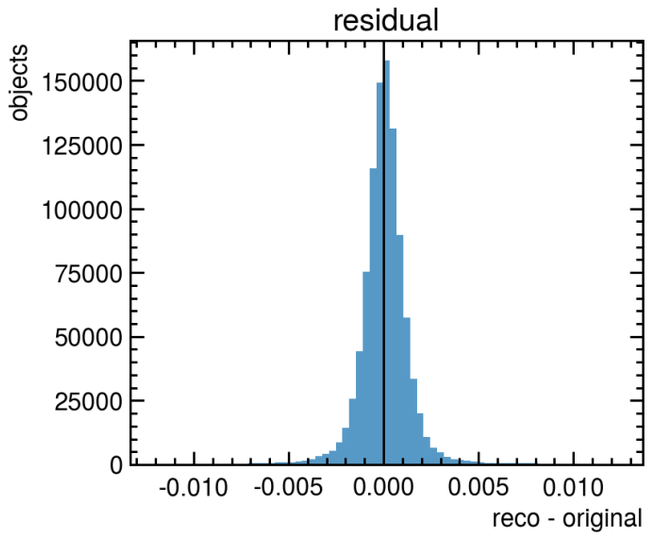


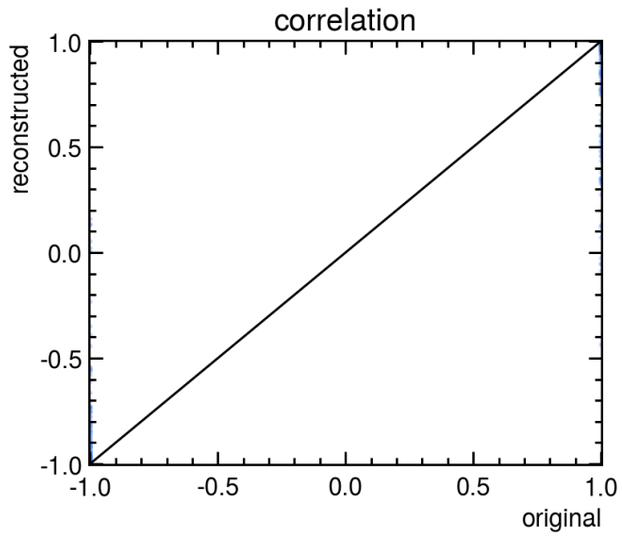


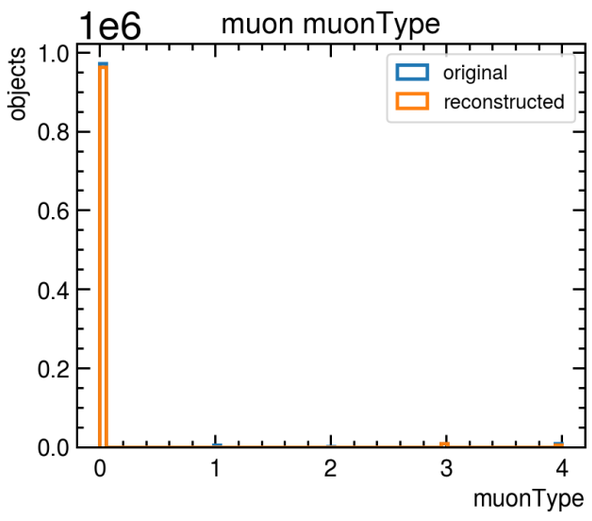


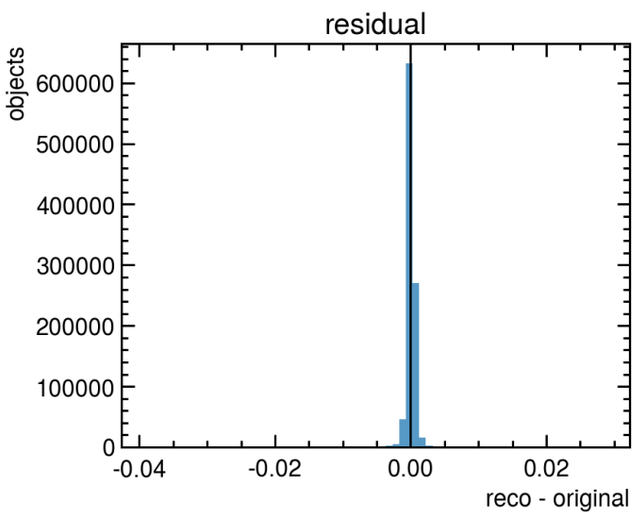
Diagnostics - muons

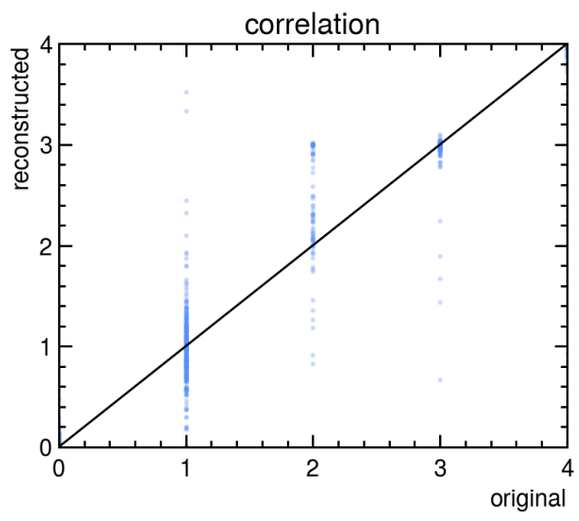


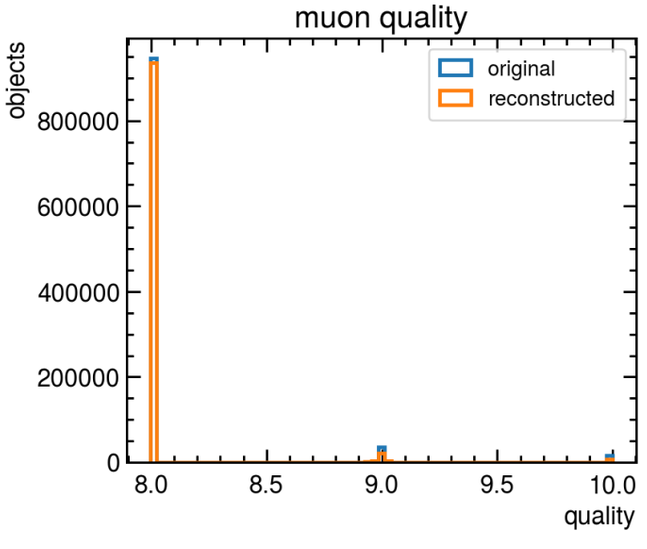


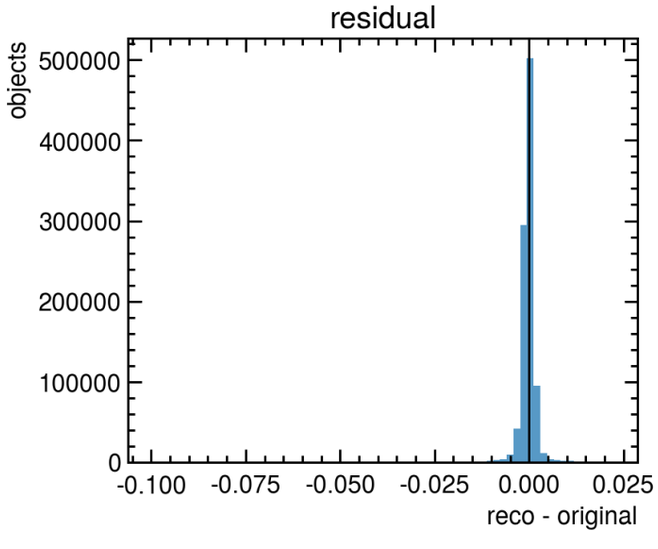


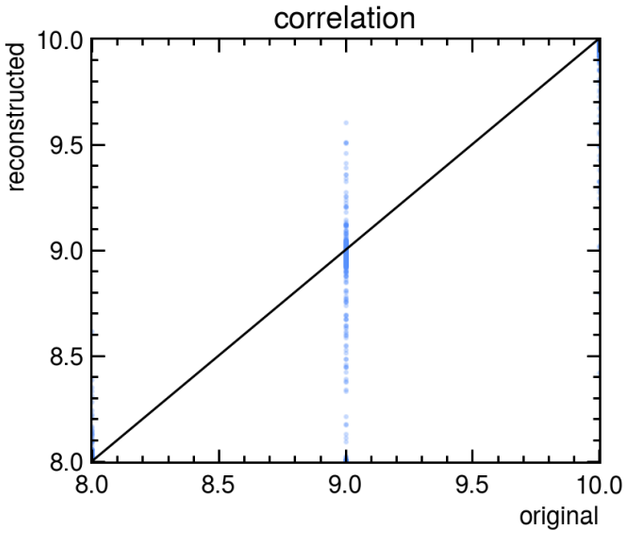




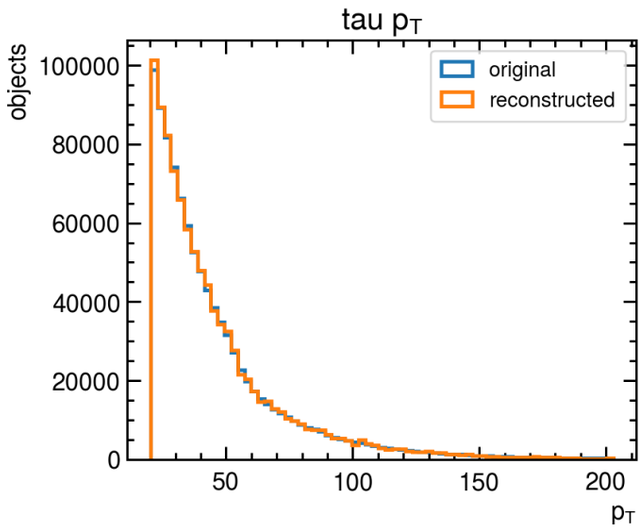


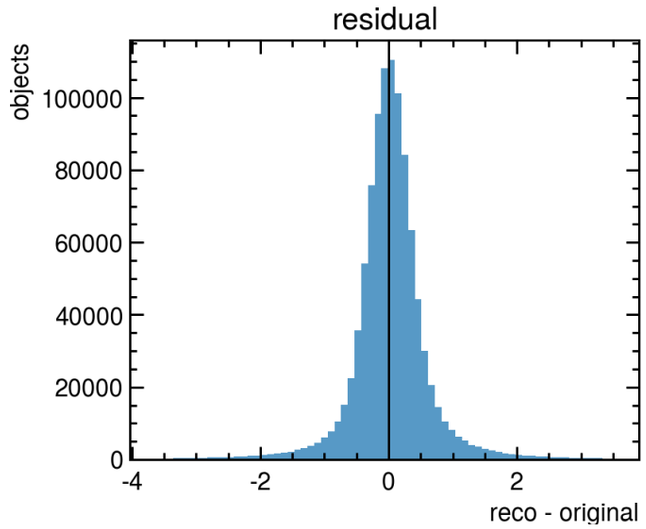


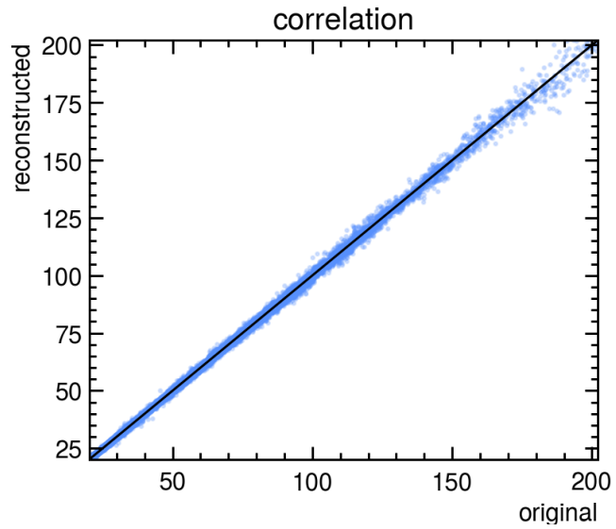


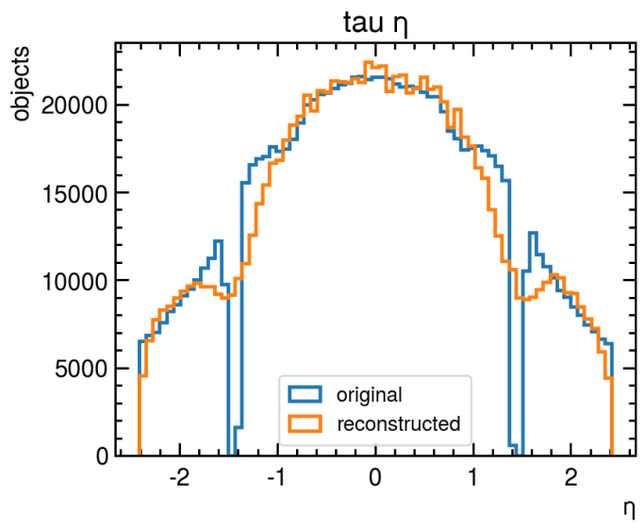


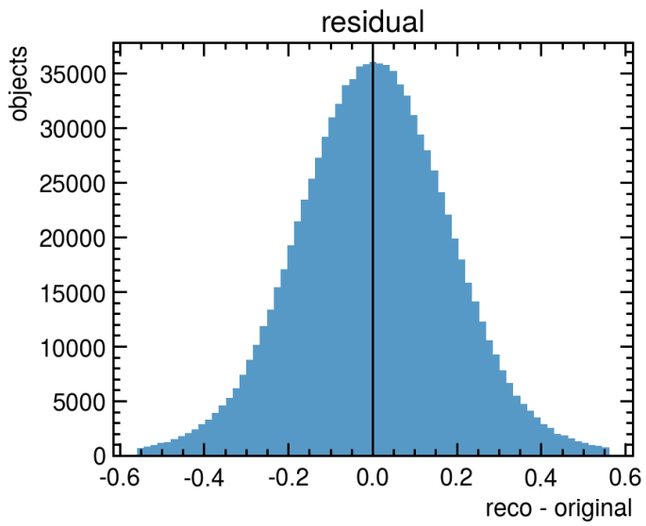
Diagnostics - taus

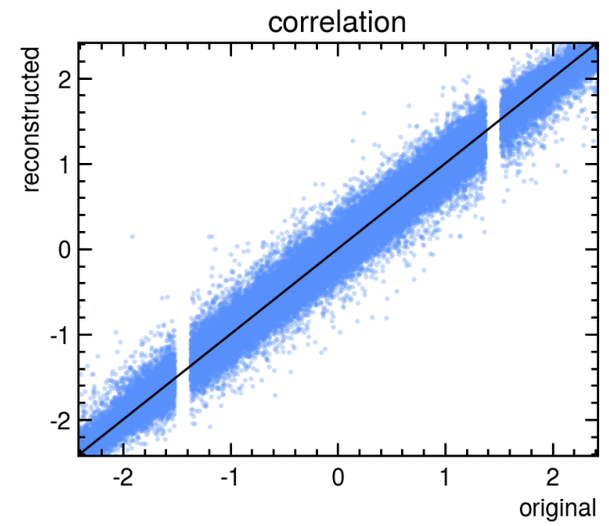


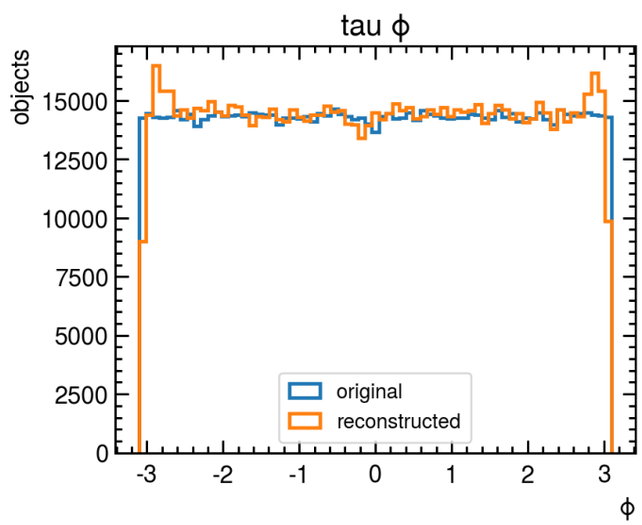


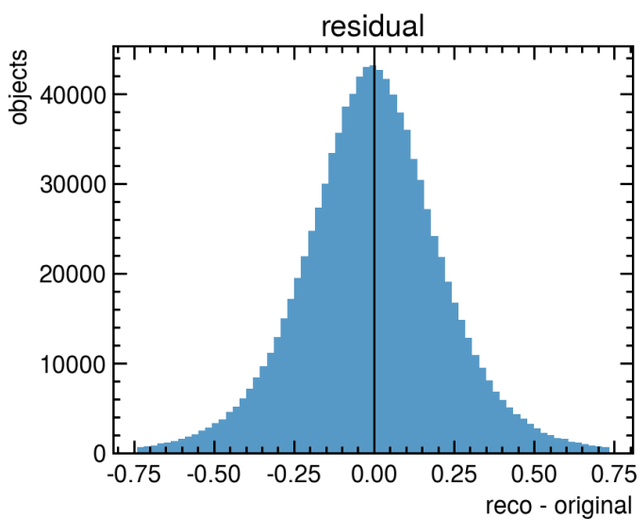


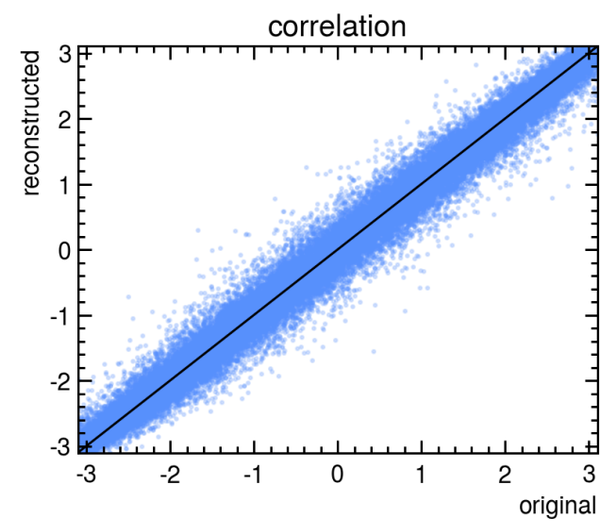












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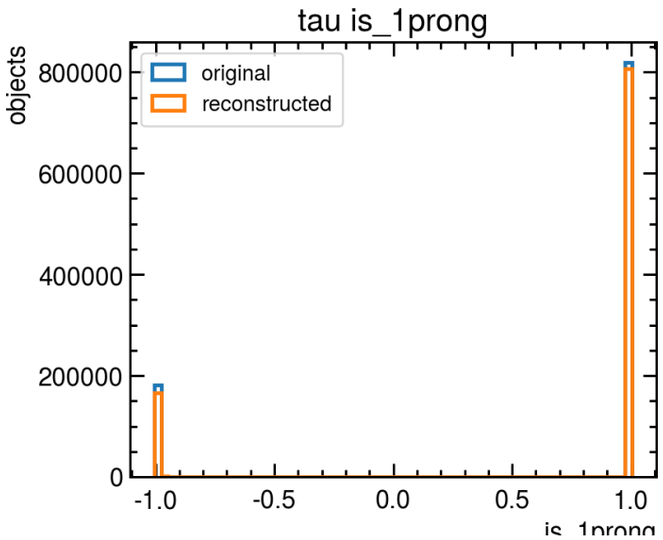
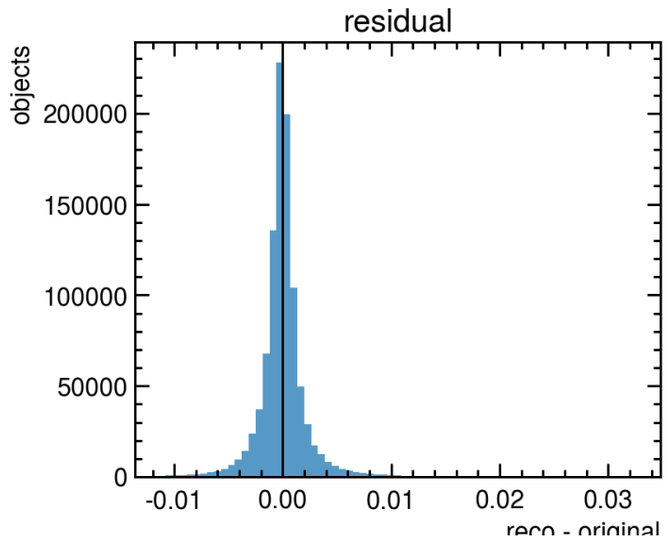
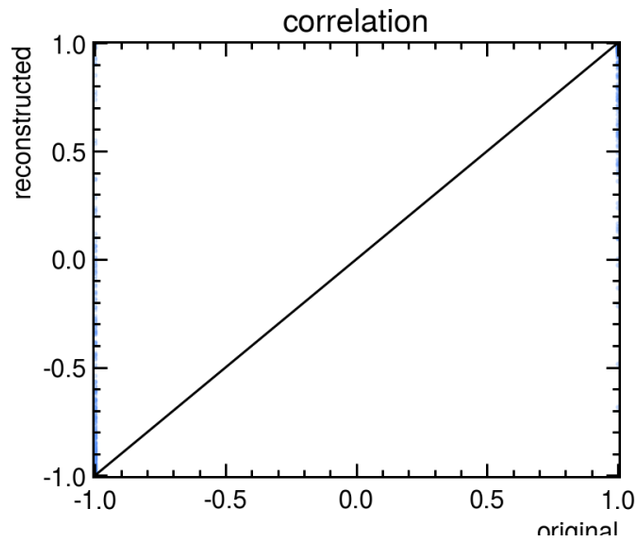
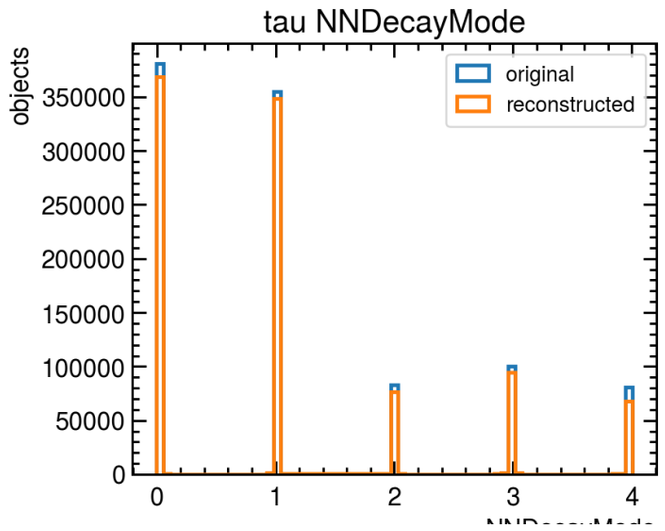
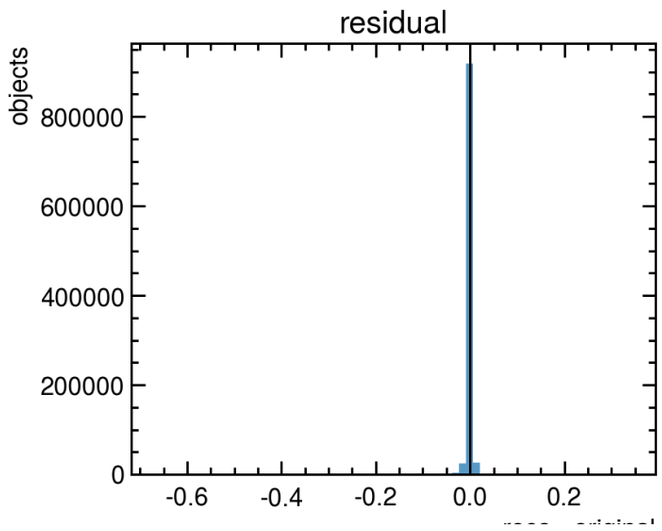
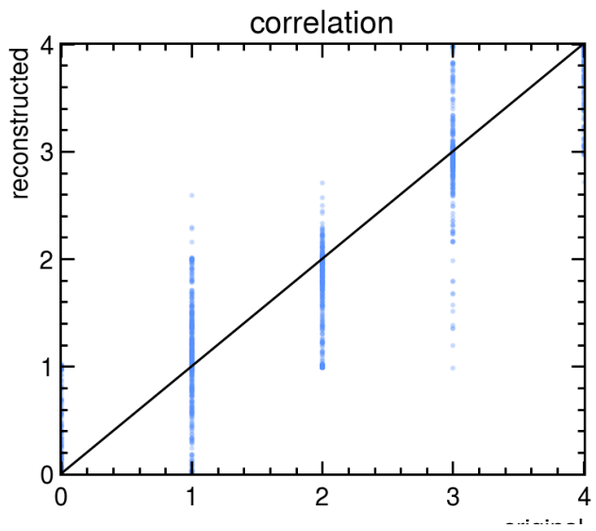


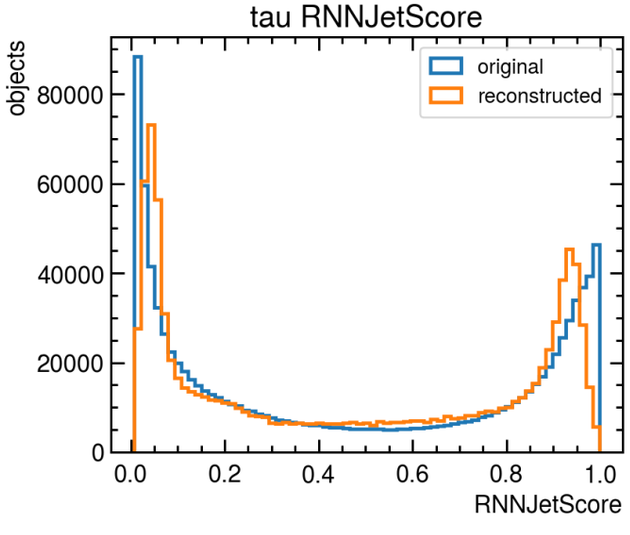


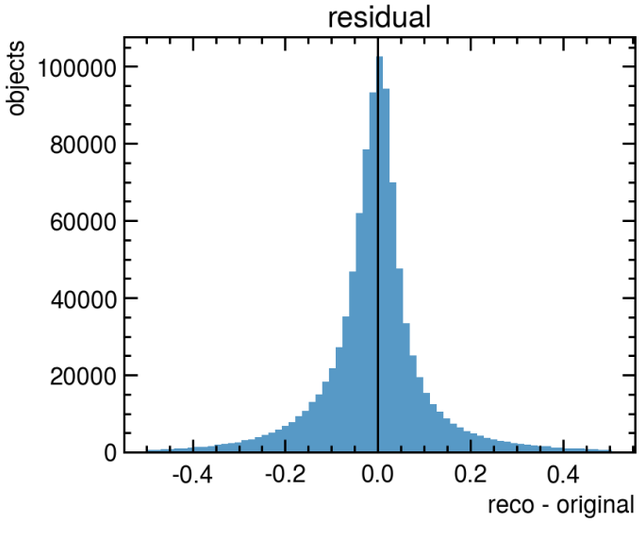


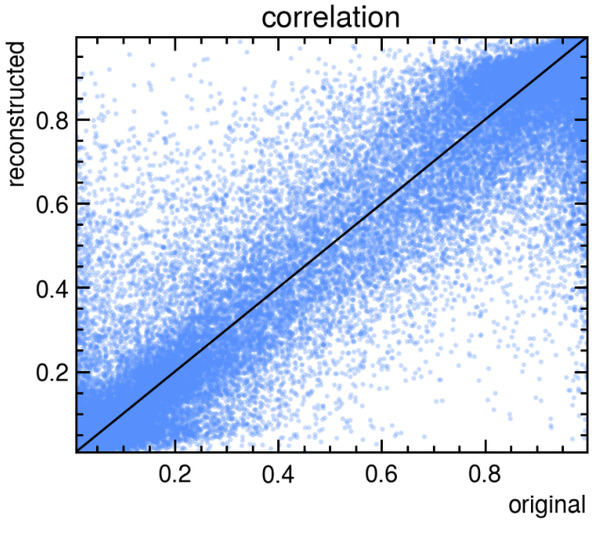




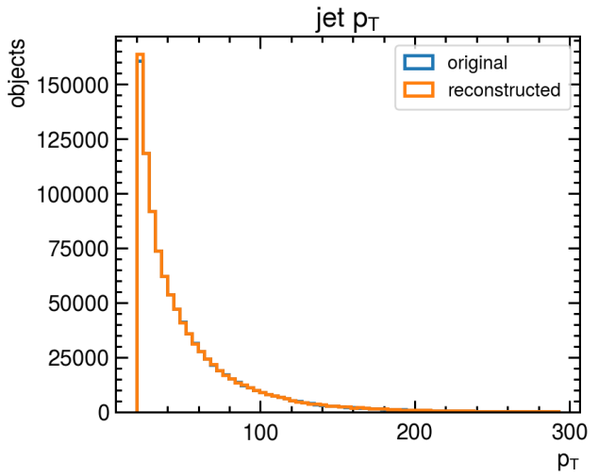


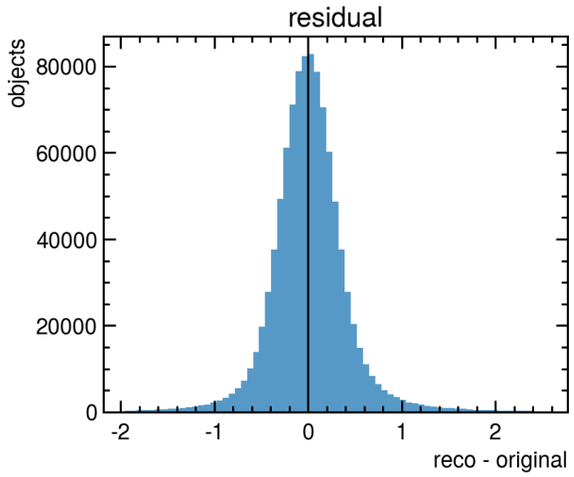


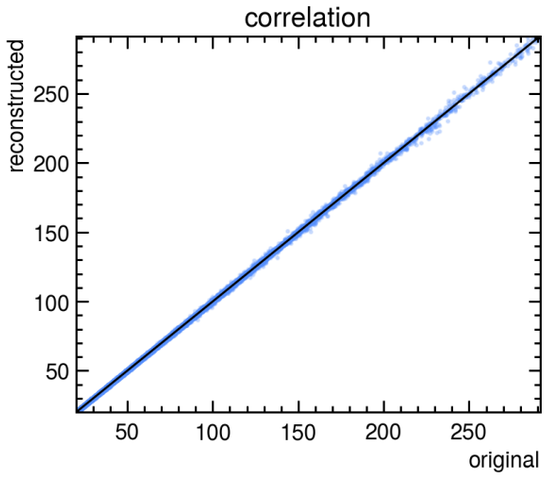


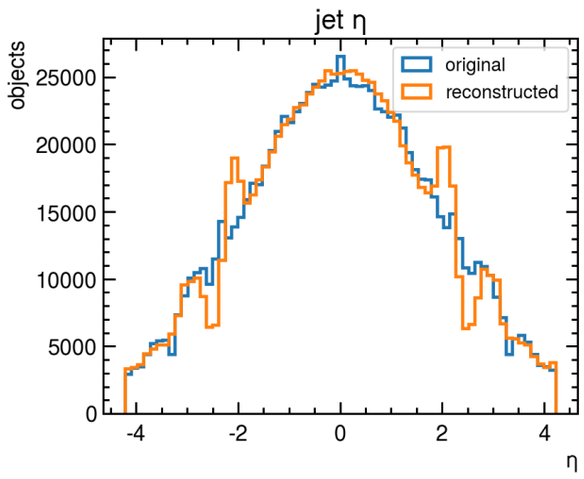


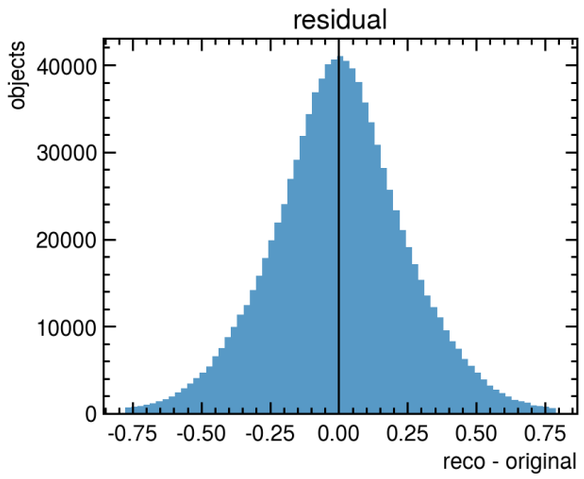
Diagnostics - jets

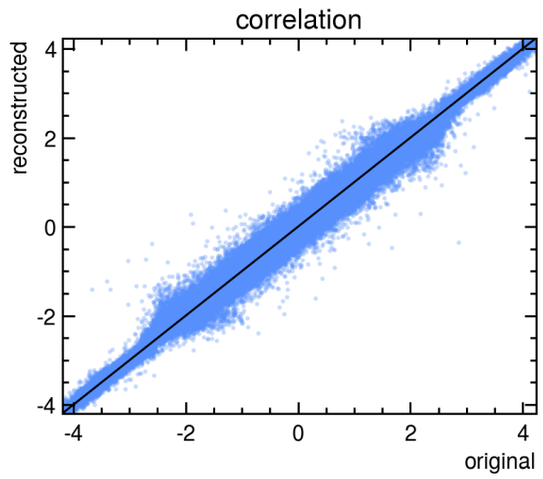


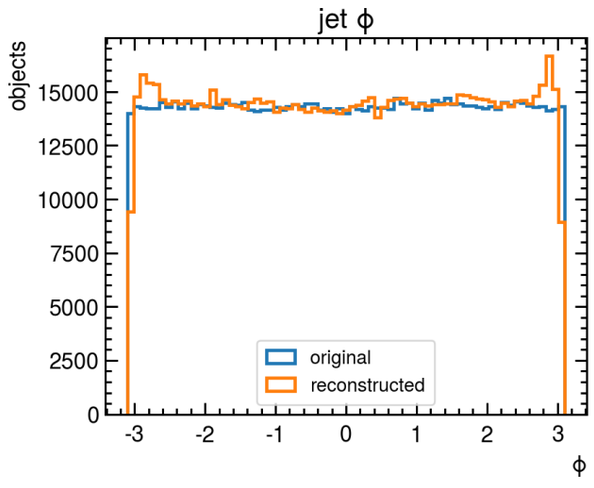


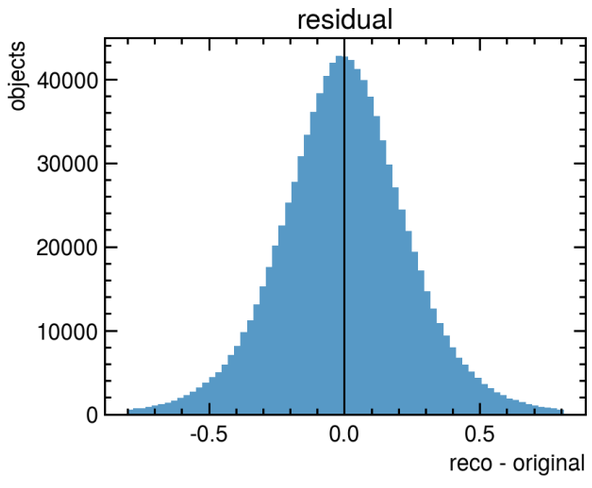


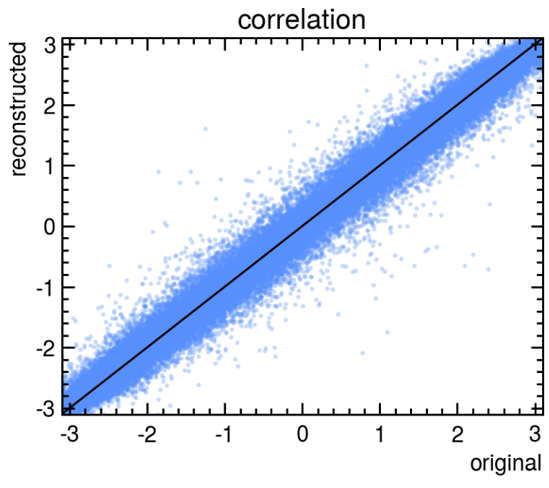




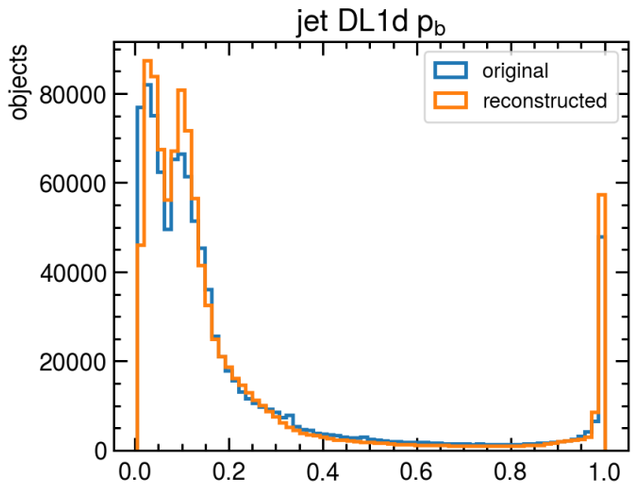


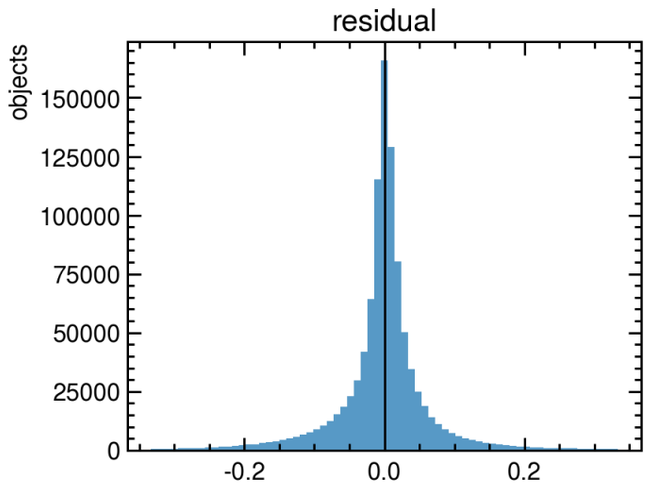


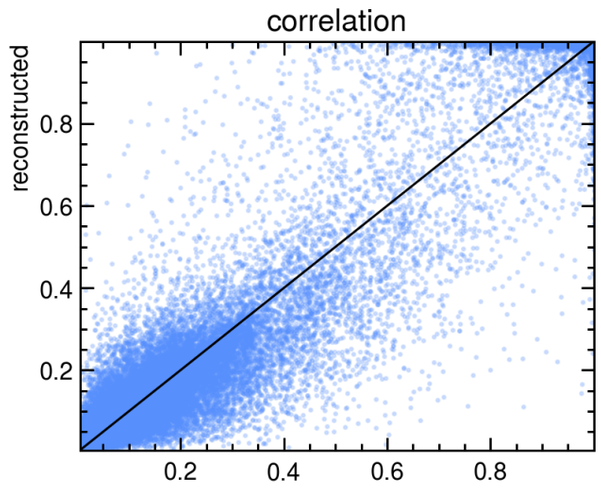


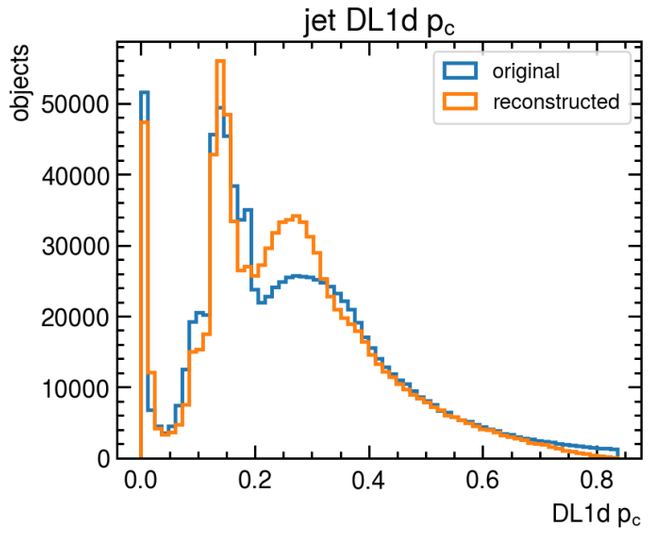


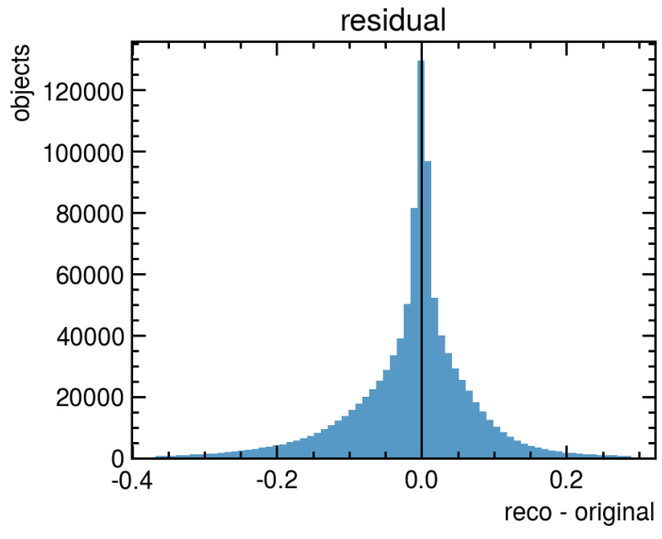
Diagnostics - jets

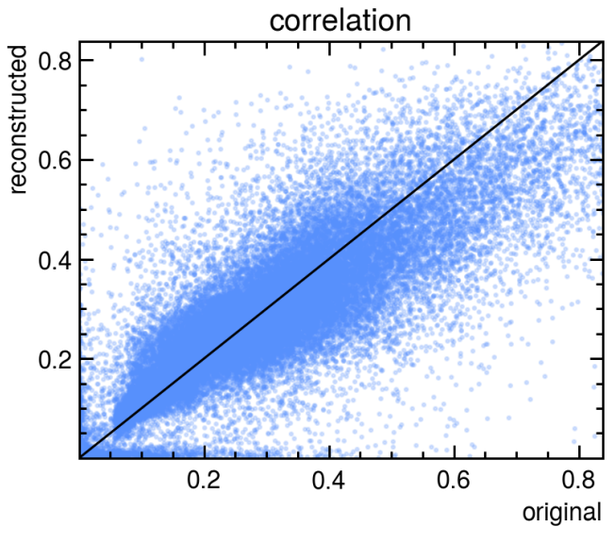


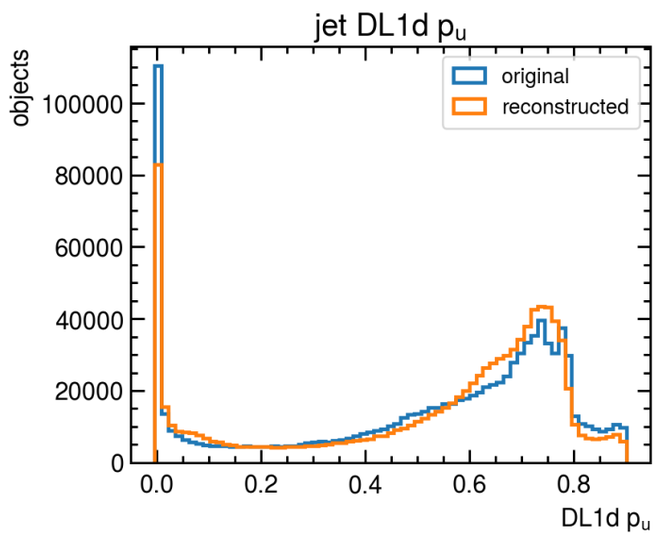


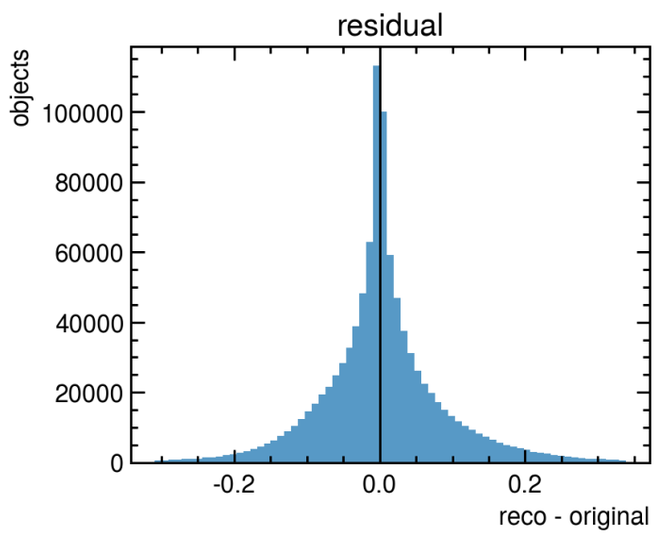


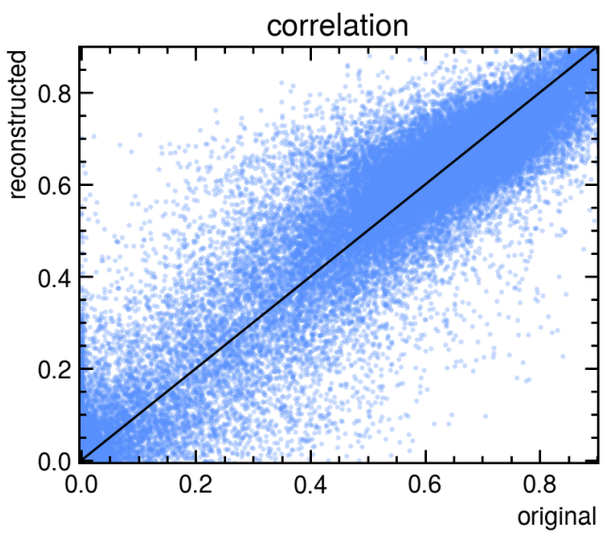












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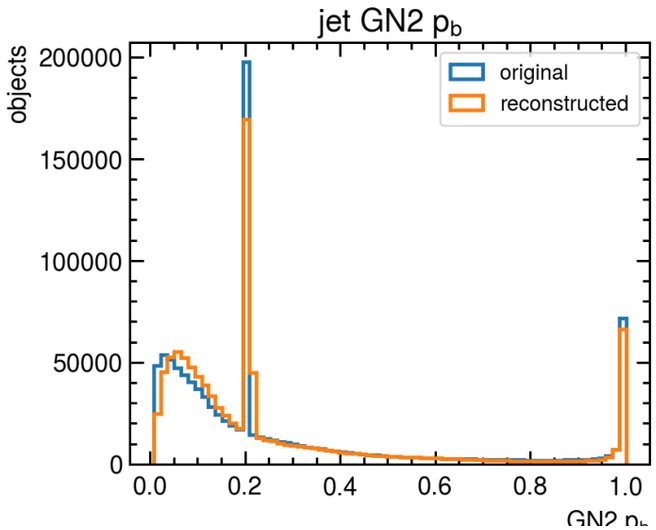

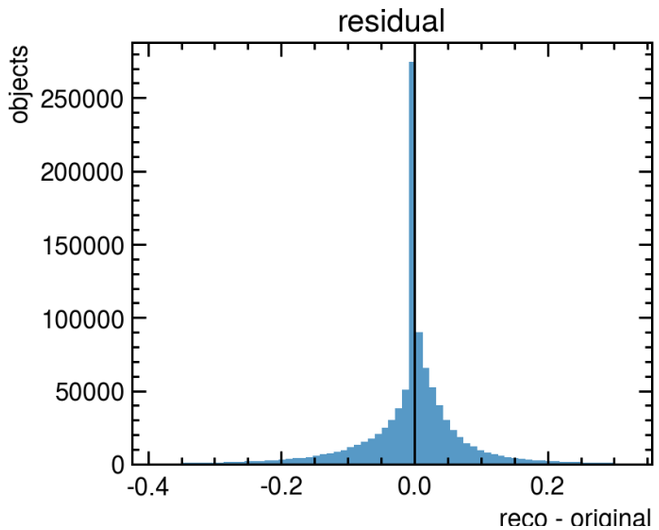

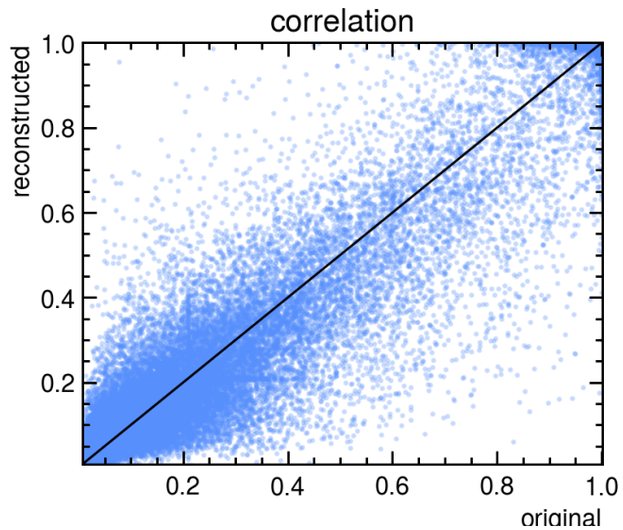

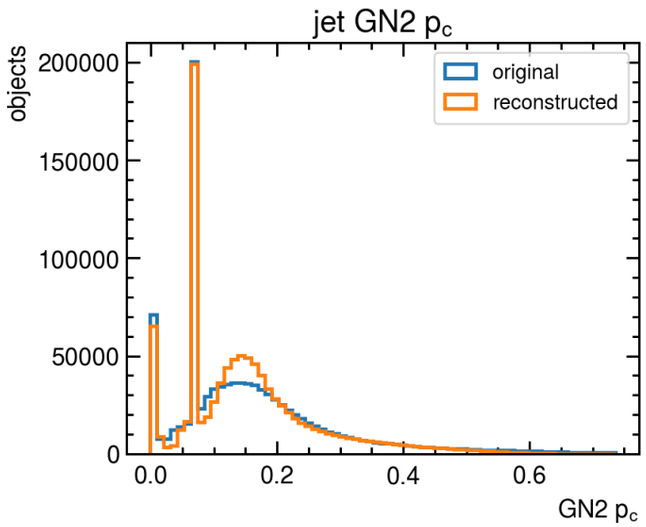

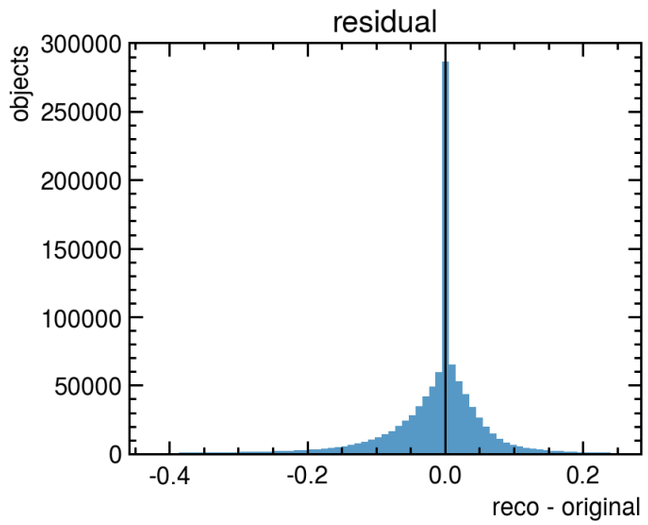

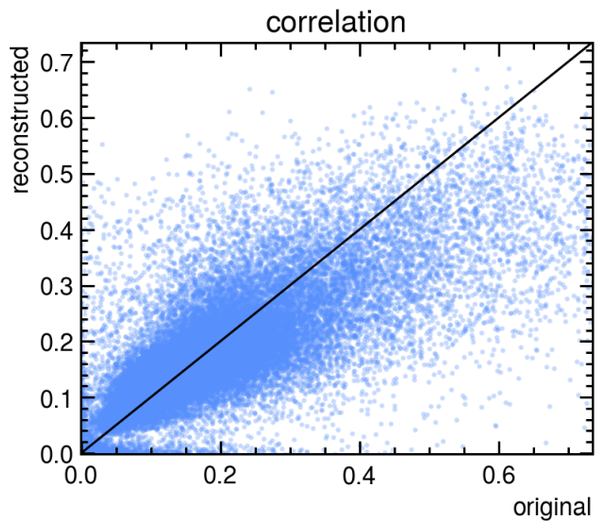

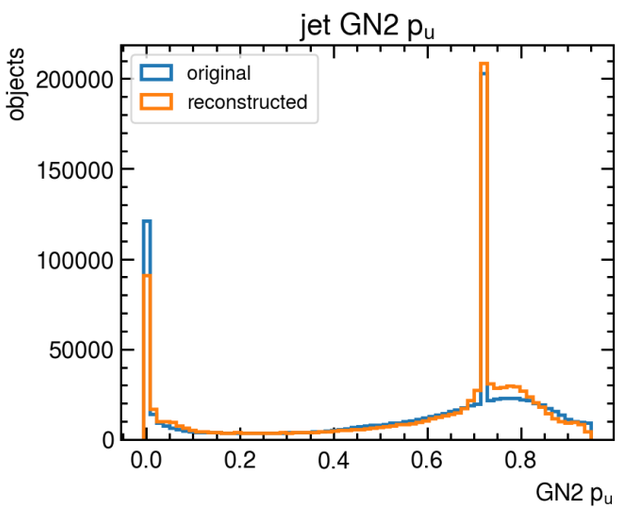

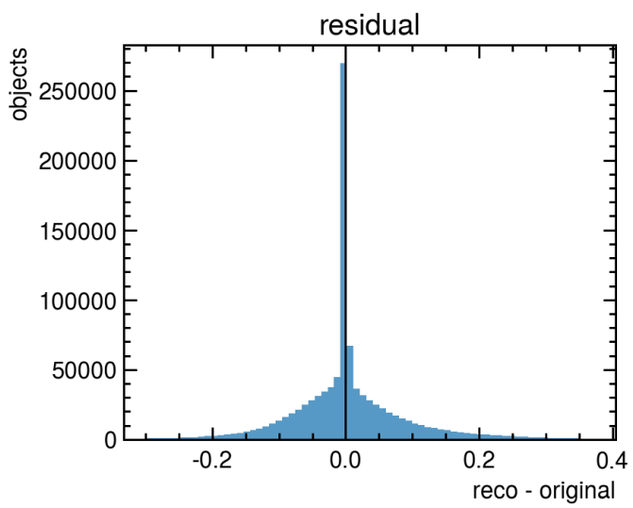

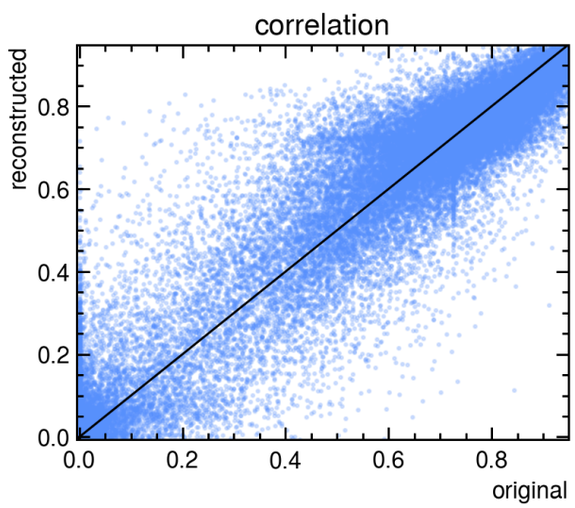

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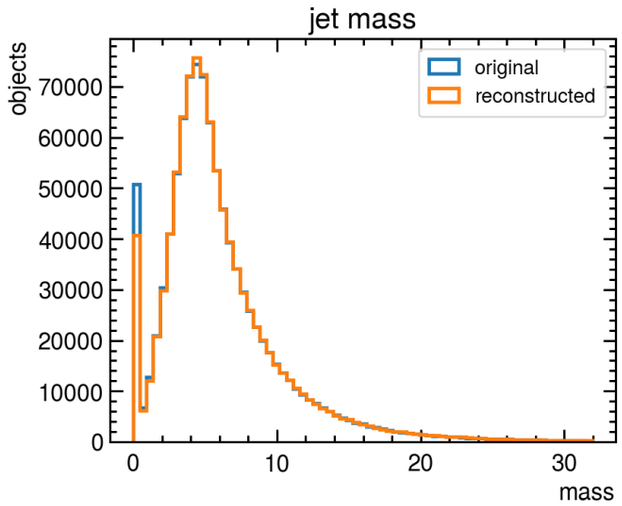
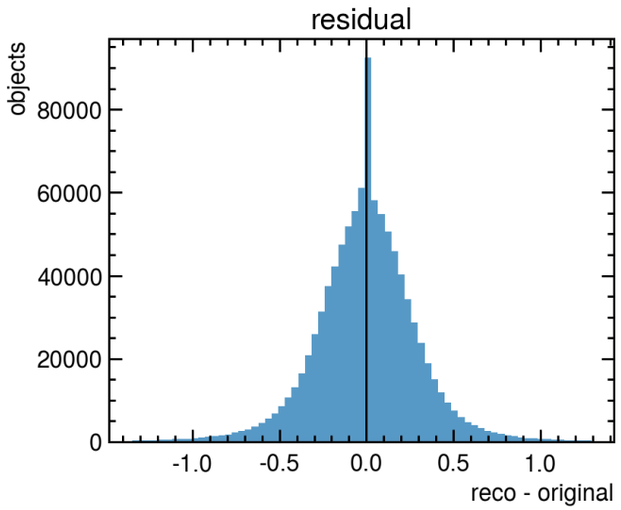
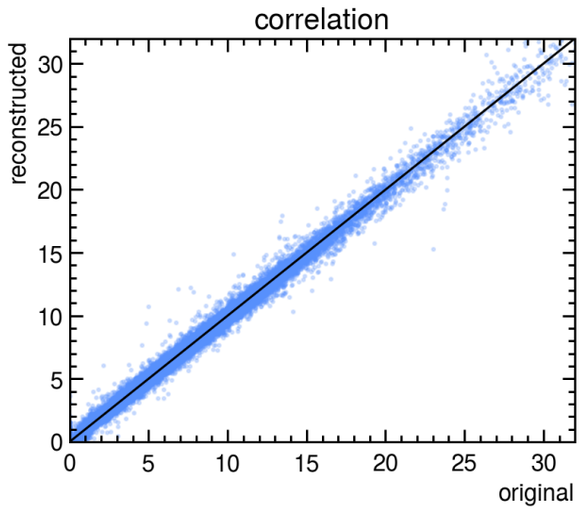
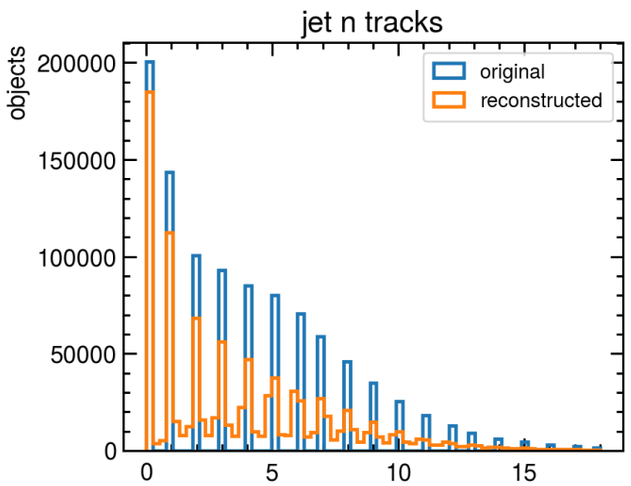
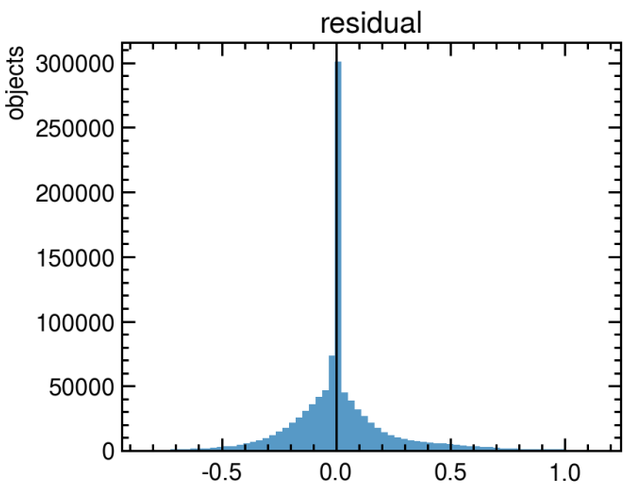
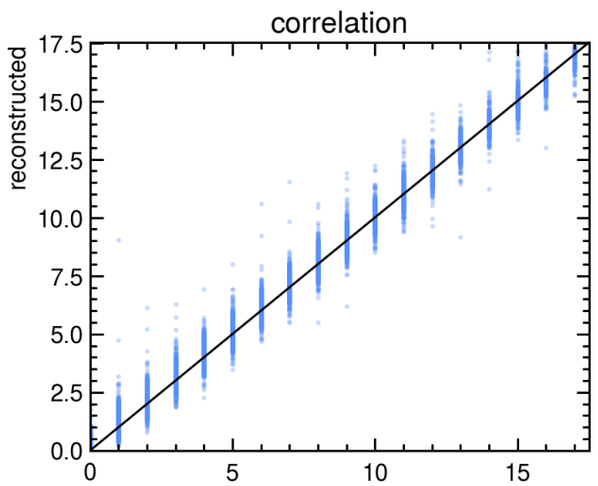


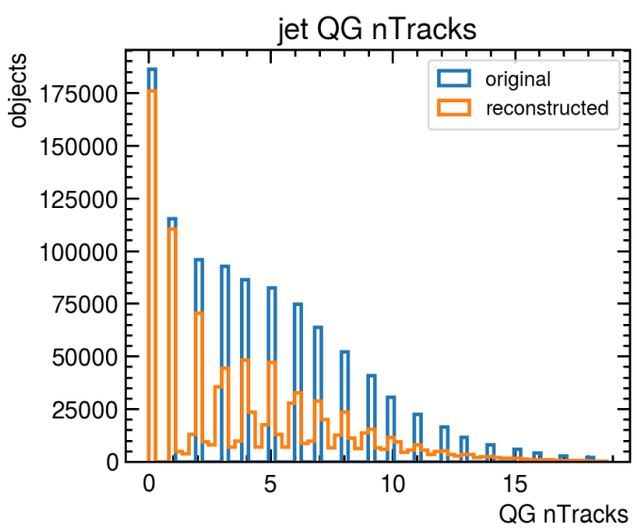


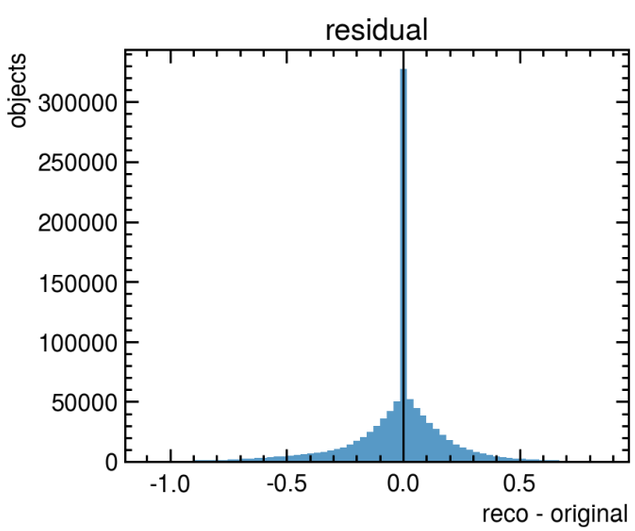


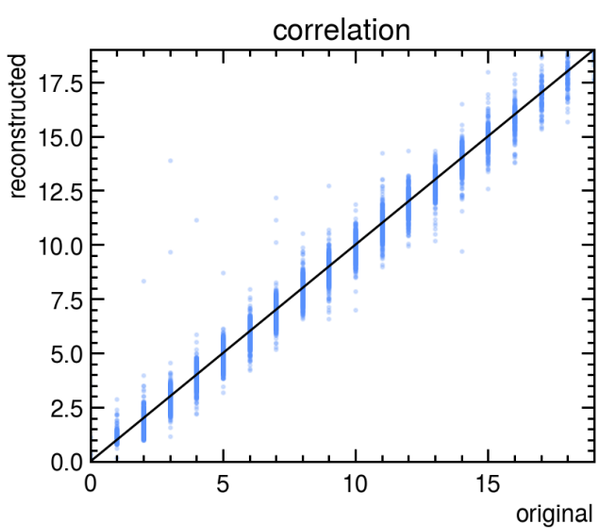




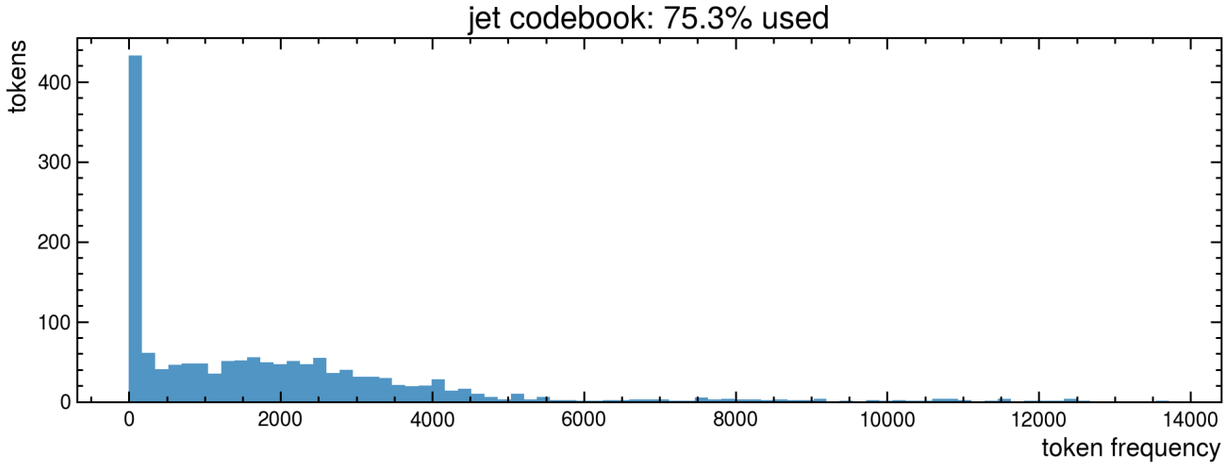








Diagnostics



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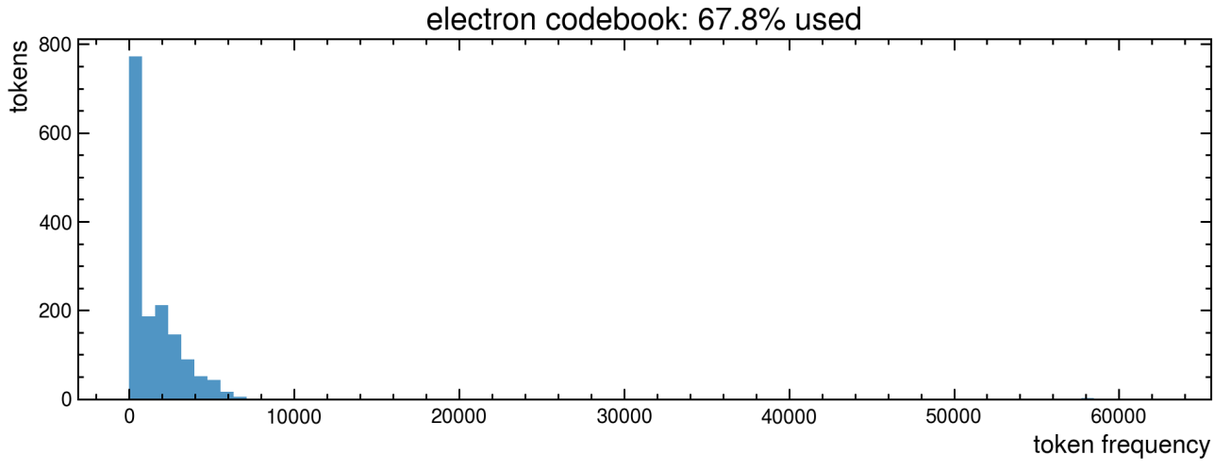

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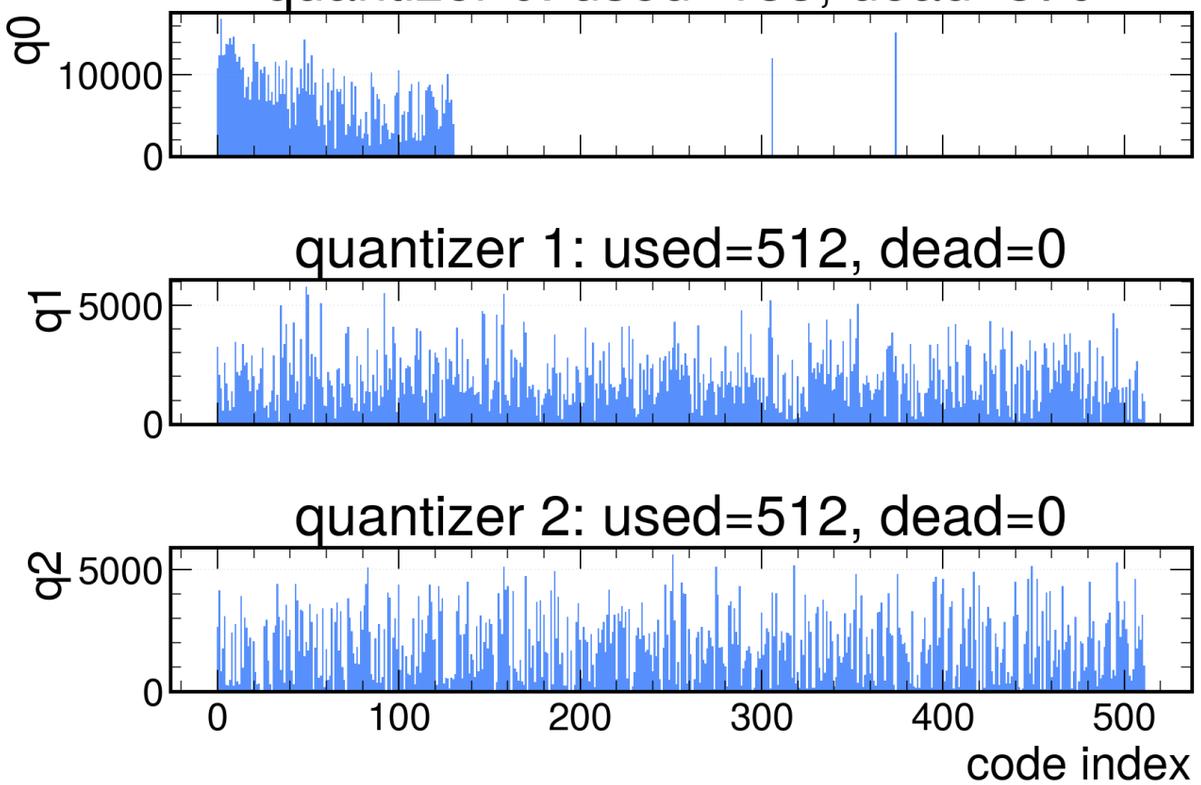

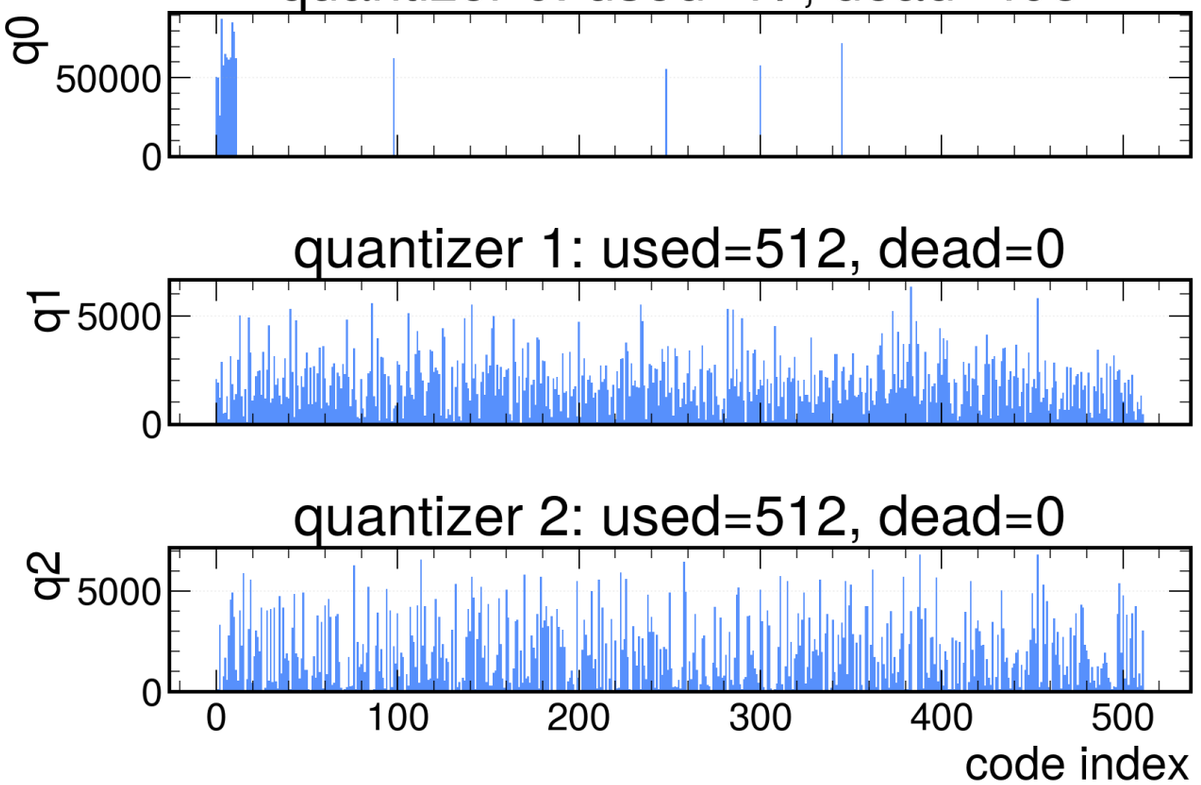

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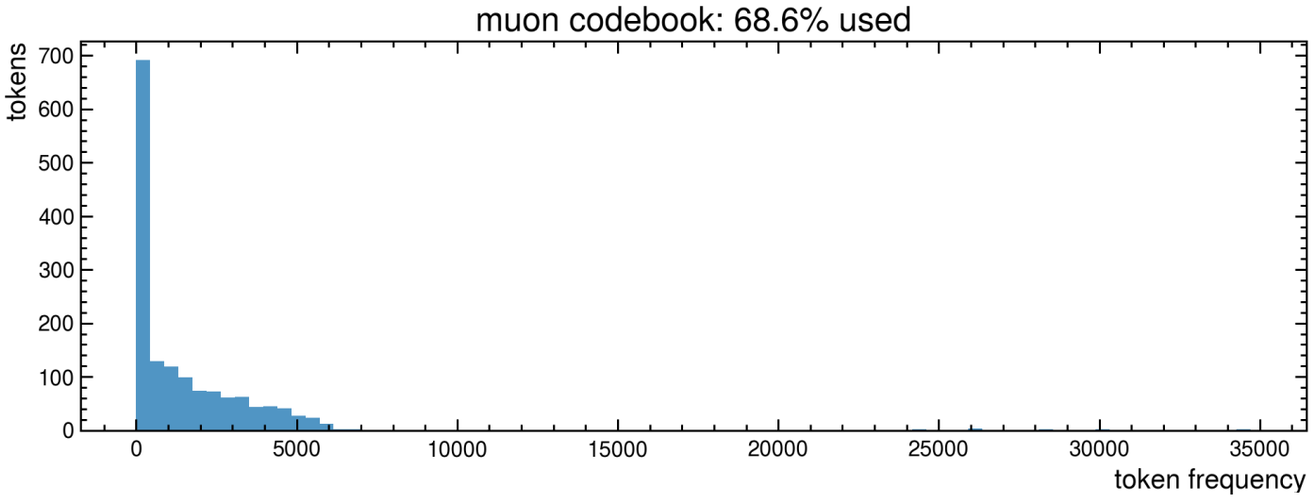

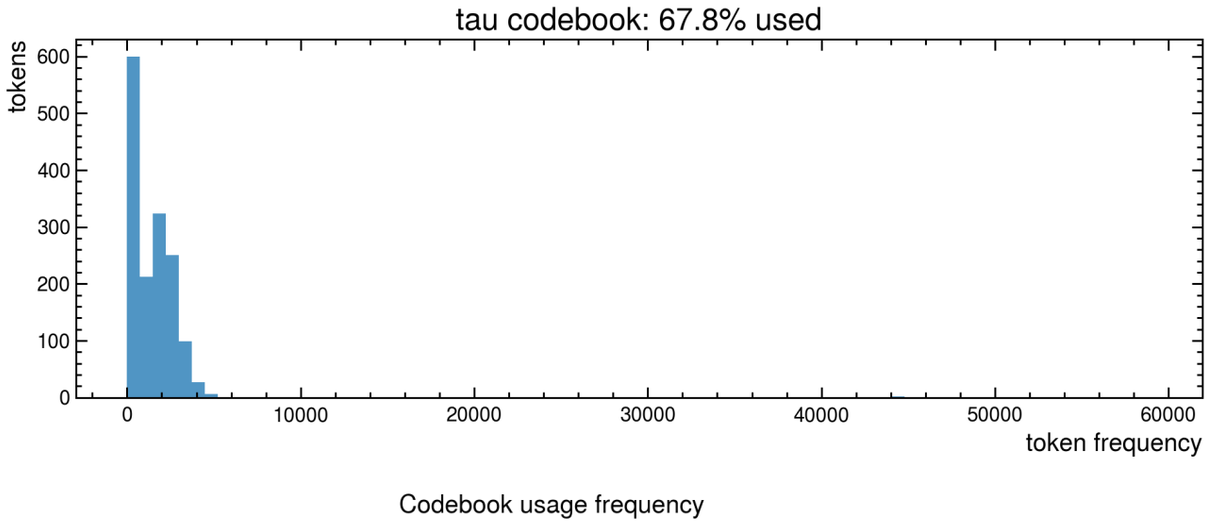

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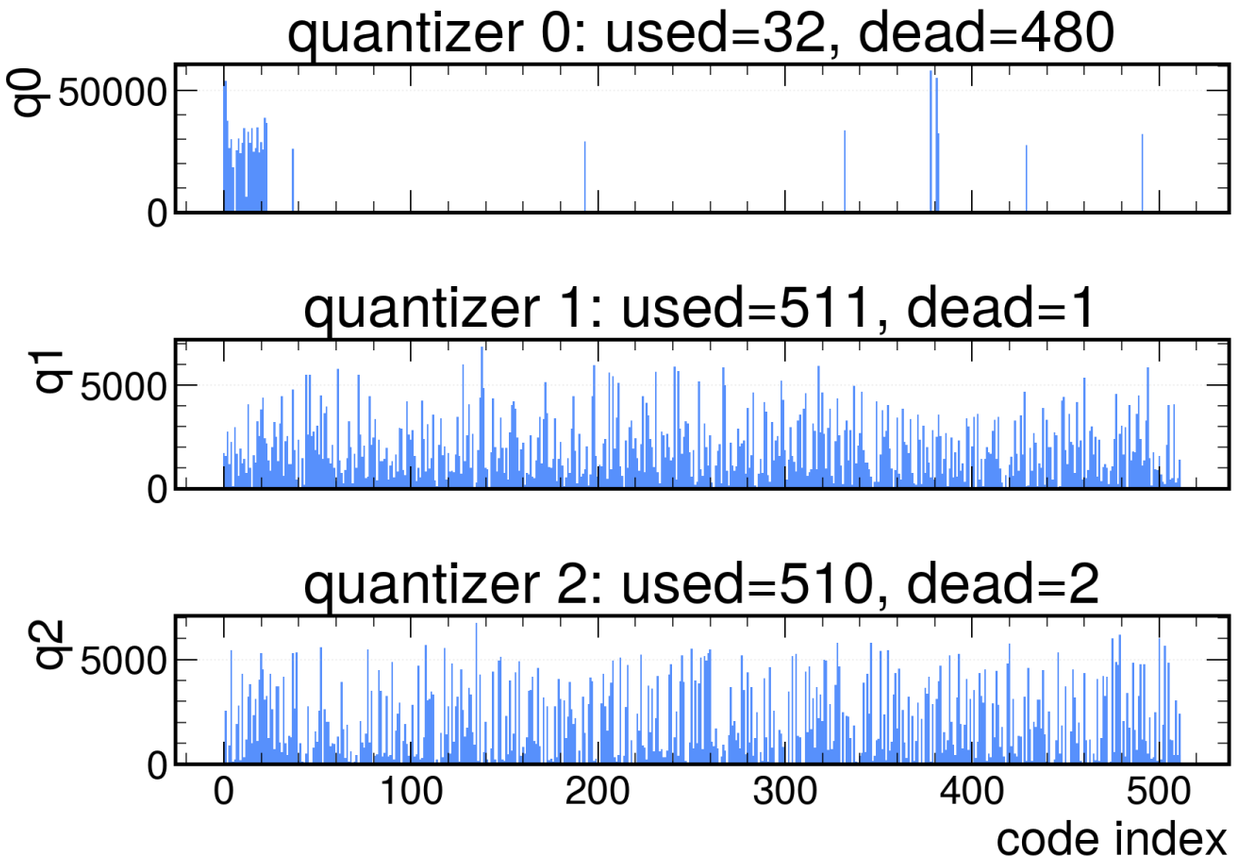

Discussion

* First full-feature object tokenizers are now trained and diagnostics are running for all object types.
* Basic kinematics are reconstructed well, but some higher-level/discriminant features are not yet well preserved.
  - The VQ-VAE appears to smooth bounded score-like features such as DL1d/GN2 probabilities.
* Next steps: Add data, separate continuous, discrete, and bounded score-like variables more carefully; test feature-wise preprocessing/normalisation; compare **single-codebook vs residual-codebook settings**; and evaluate whether these reconstruction differences matter for downstream model.