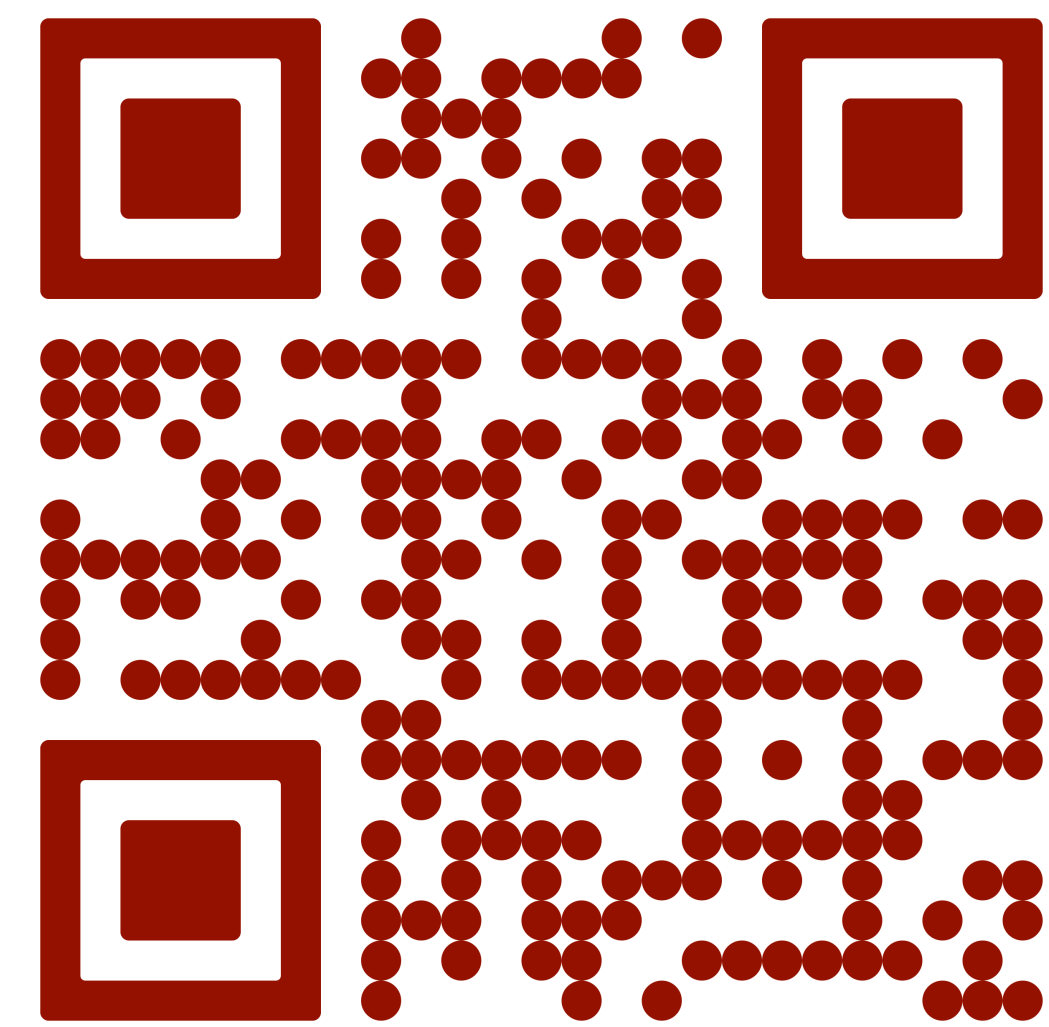


# The Landscape of Unfolding with Machine Learning

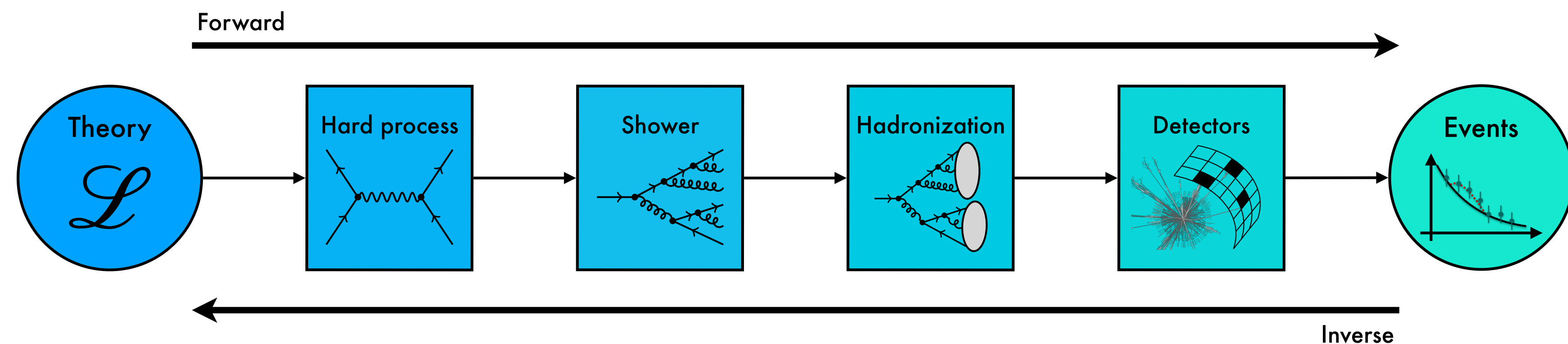
## Known, upgraded and new tools

arXiv: 2404.18807



### Physics Problem

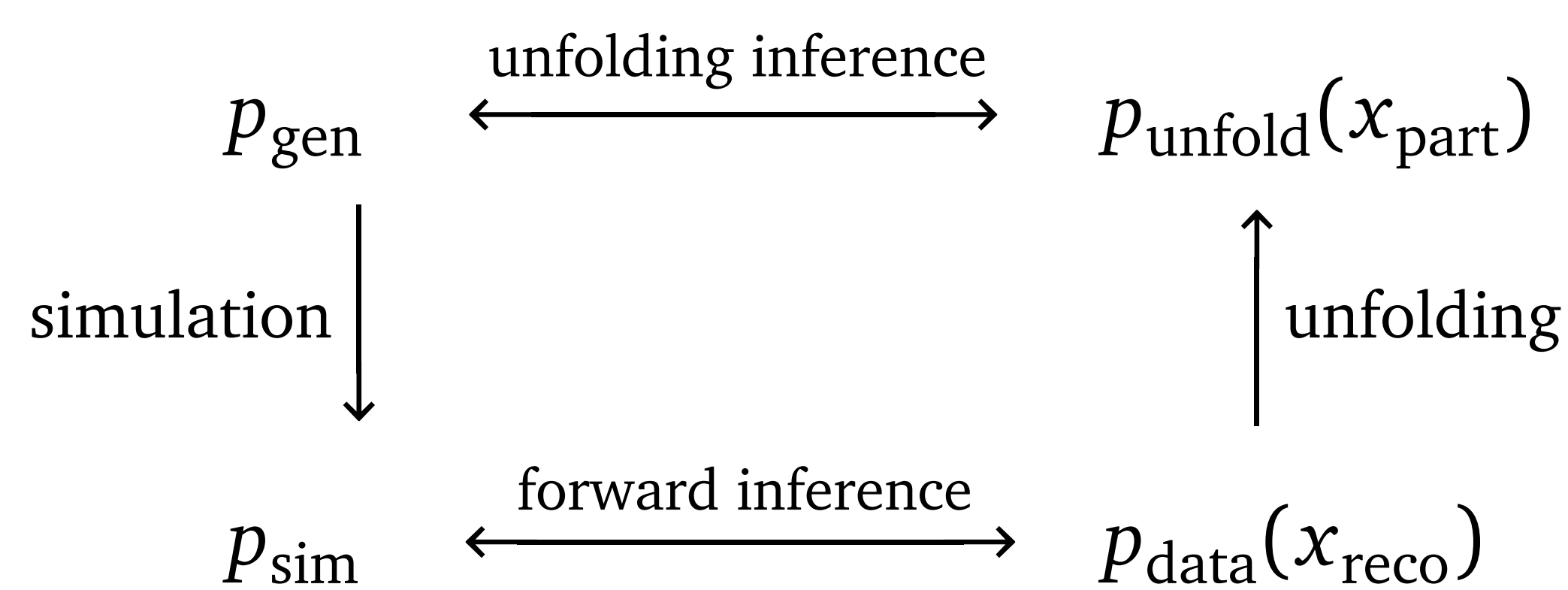
What is unfolding?



- Inversion of (parts of) the LHC simulation chain

Why unfolding?

- Efficient and optimal analyses: can easily test different or improved theories
- Public analyses: allows for combination of results

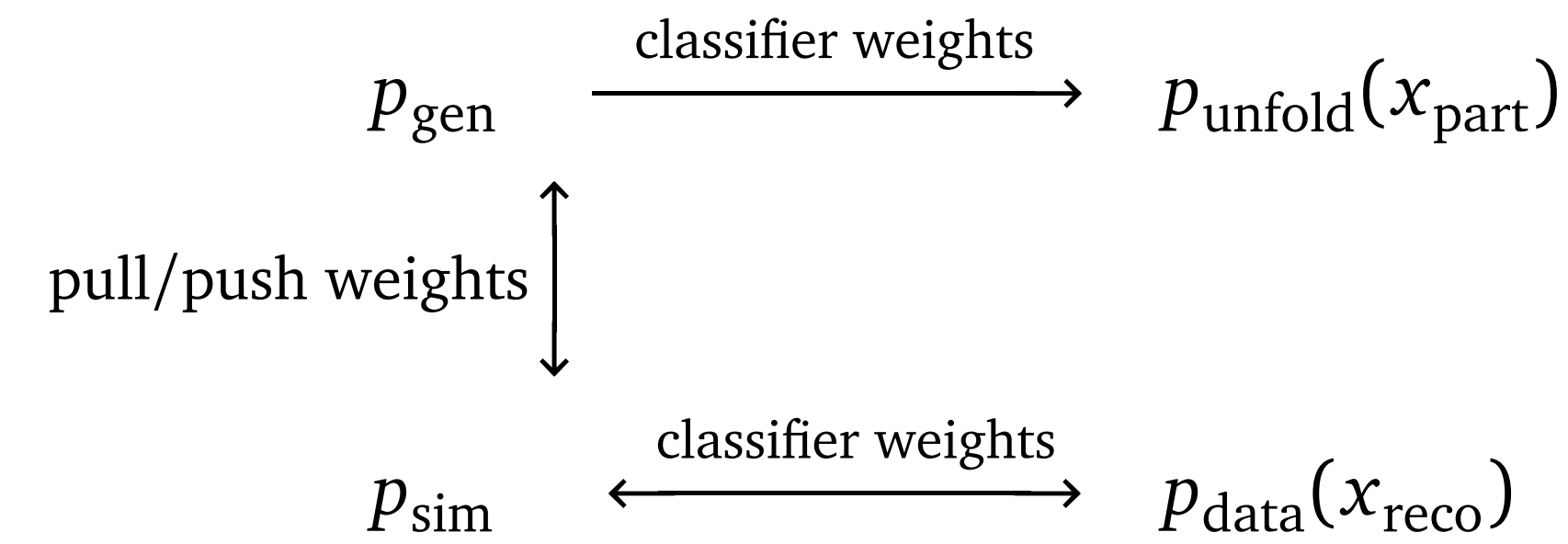


Why ML-based unfolding?

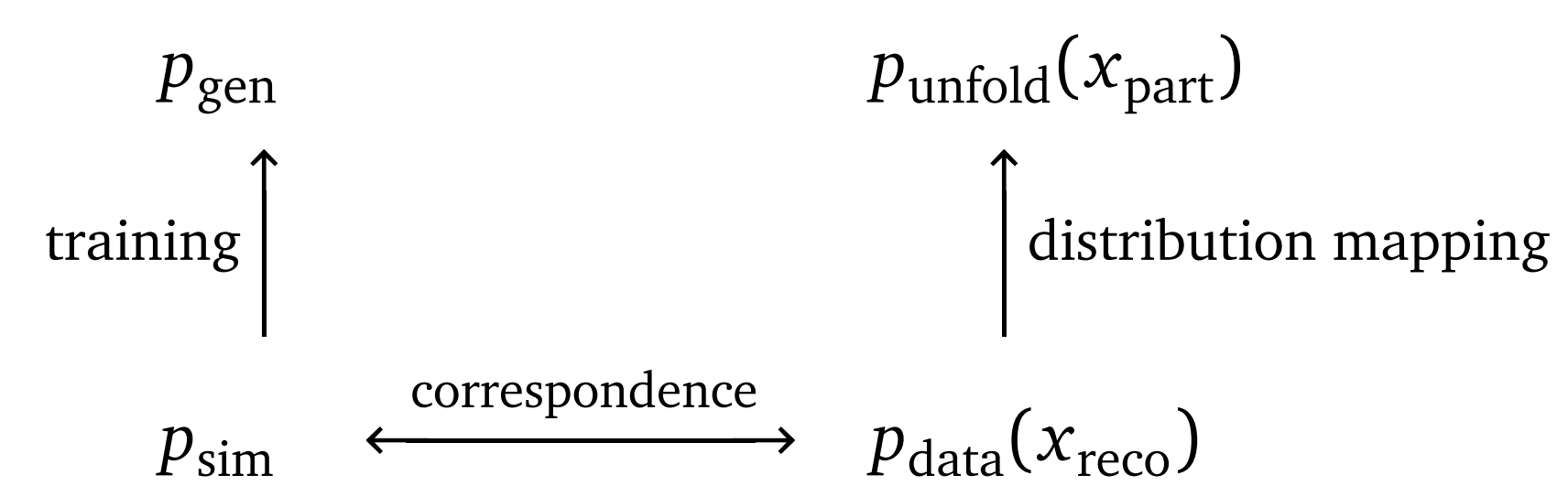
- High-dimensional, unbinned, precise unfolding

### ML methods and tools

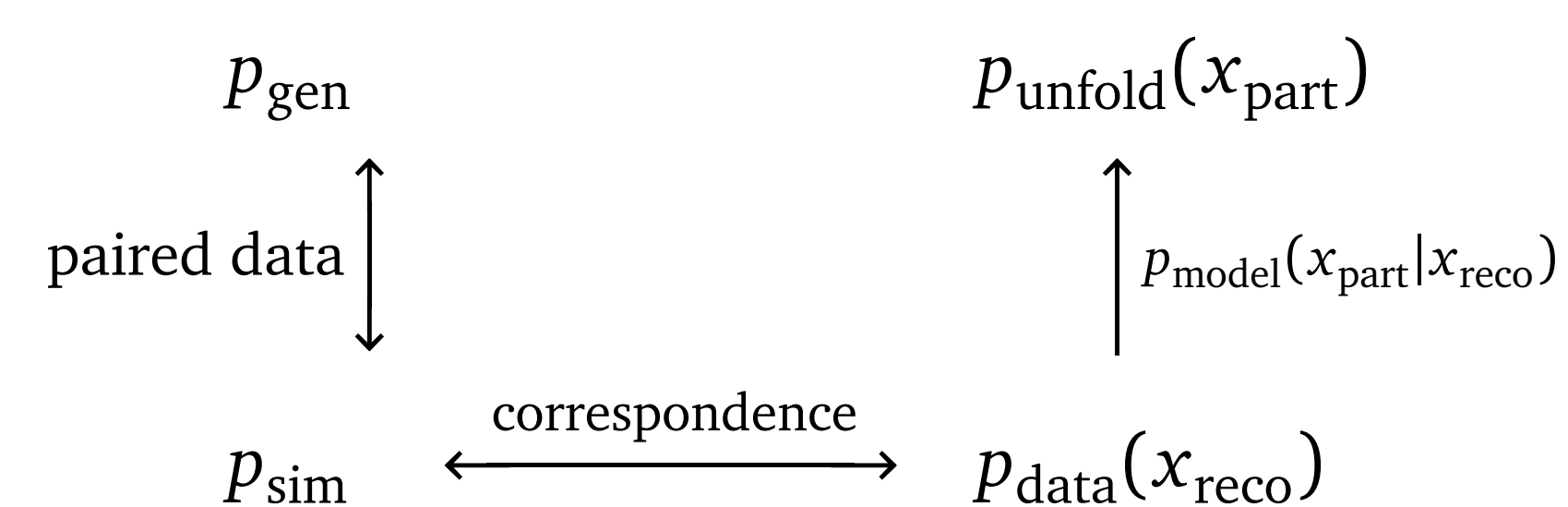
Reweighting: *OmniFold*



Mapping distributions: *bSB* and *DiDi*

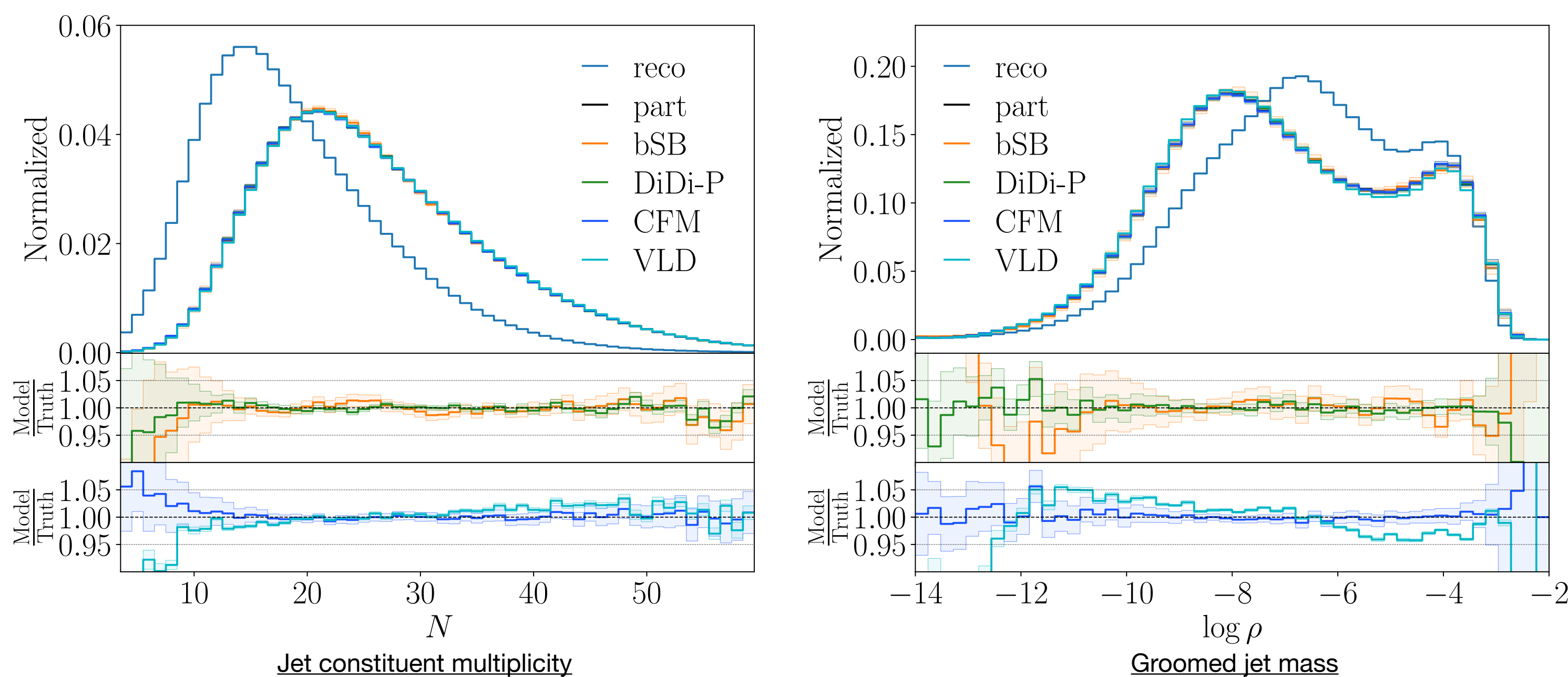


Generative unfolding: *CFM* and *VLD*

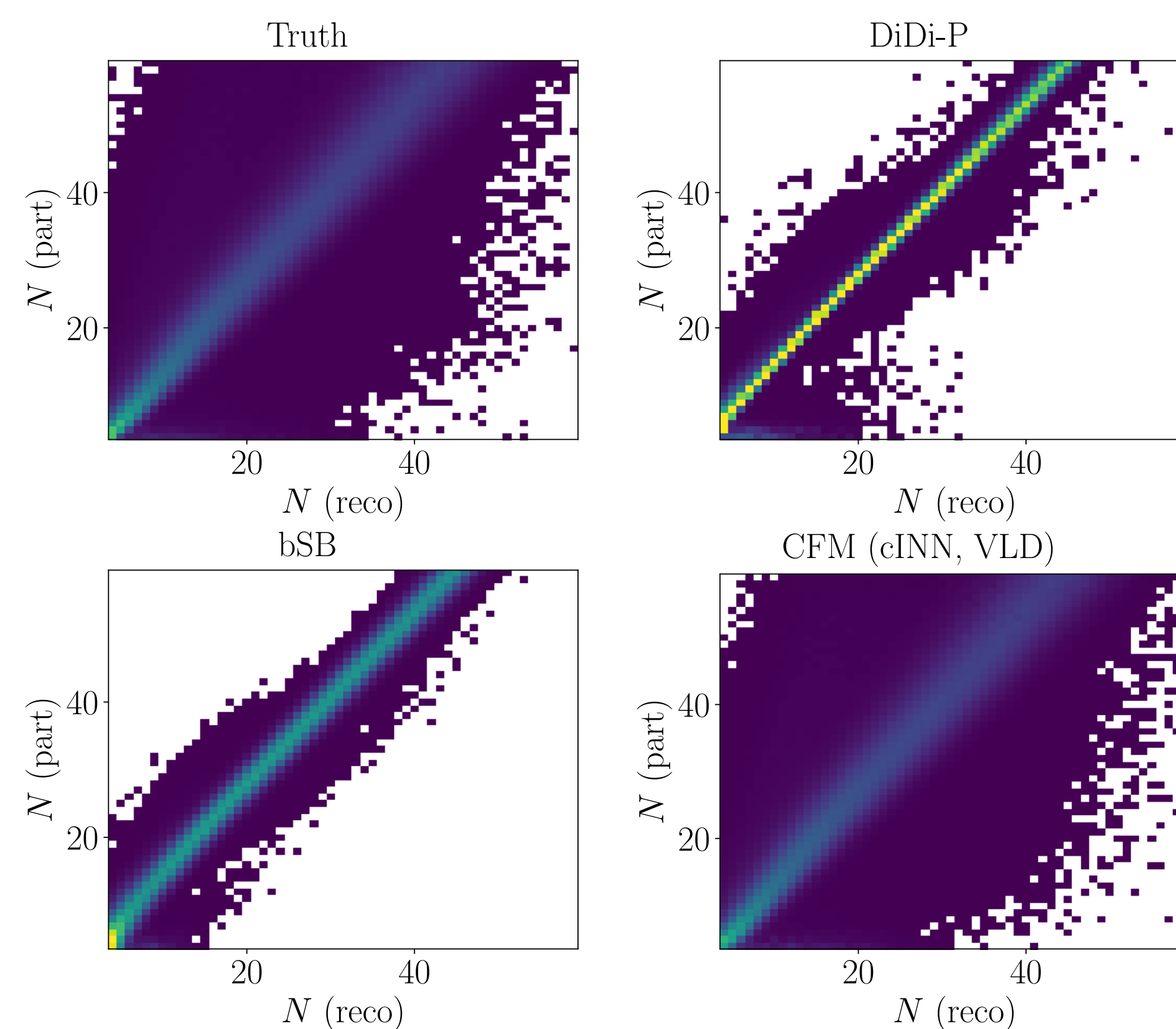


### Results

Unfolding of detector effects:  $Z + jets$

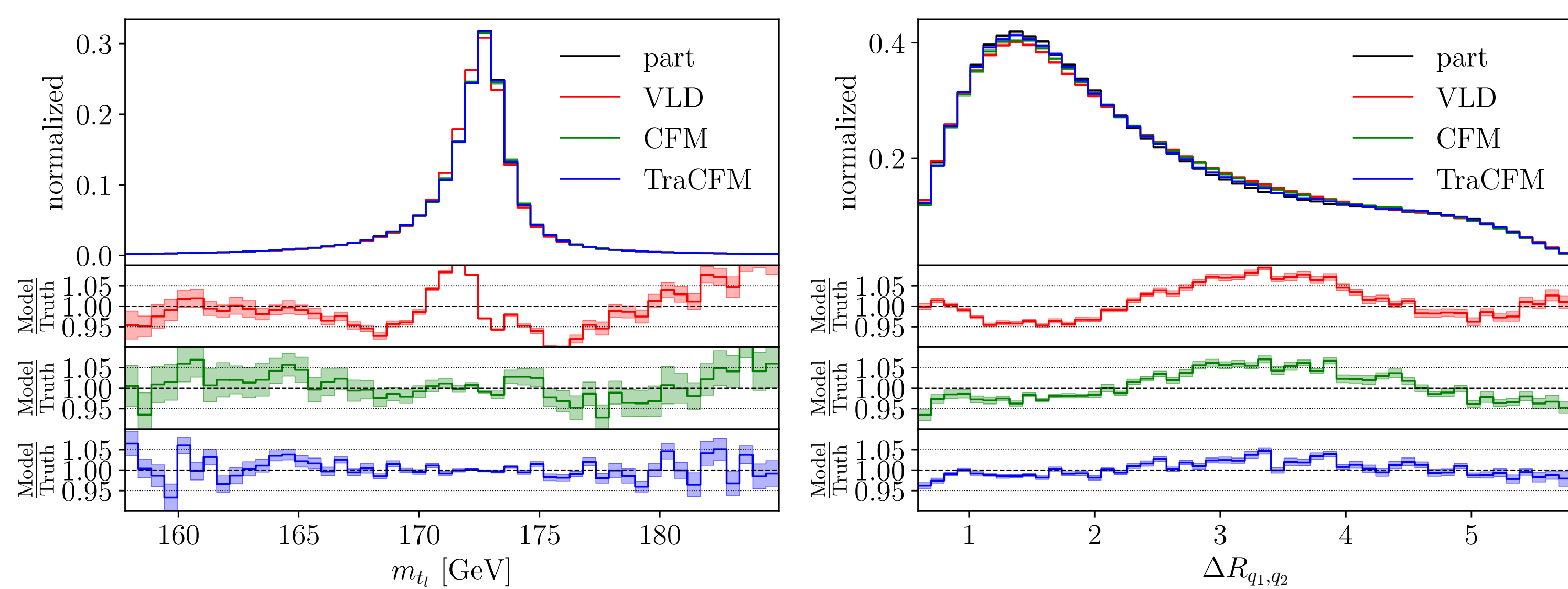


- Percent-level precision in the 6-dimensional phase space
- Complementarity of methods allow for closure checks

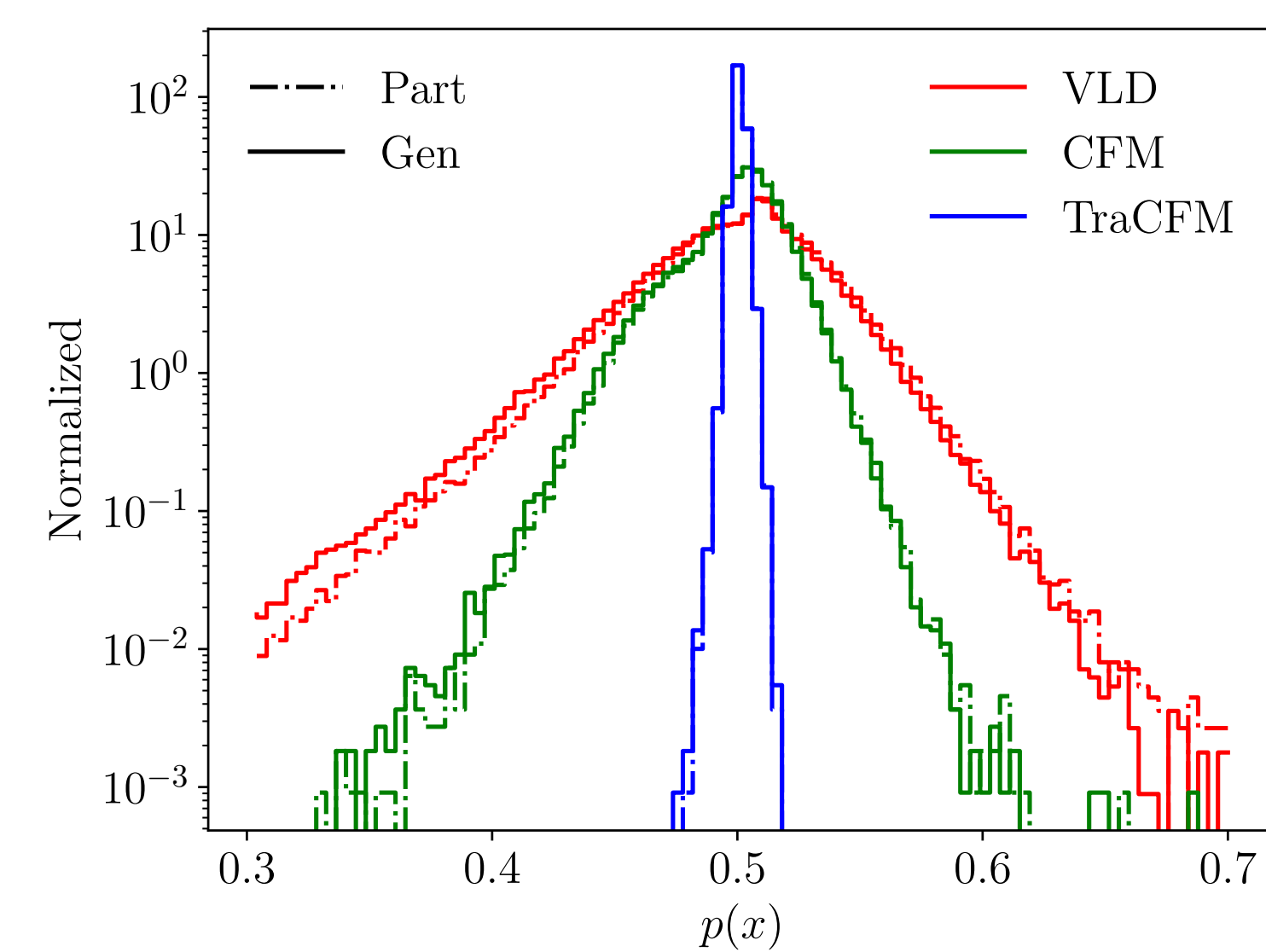


- Mapping distributions: more efficient diagonal transport from reco to unfolded
- Generative unfolding: closer to truth, but more complex to train

Unfolding to parton level:  $t\bar{t}$  semileptonic decay



- Percent-level precision in the full 19-dimensional phase space
- Mass resonances and angular correlations well reproduced



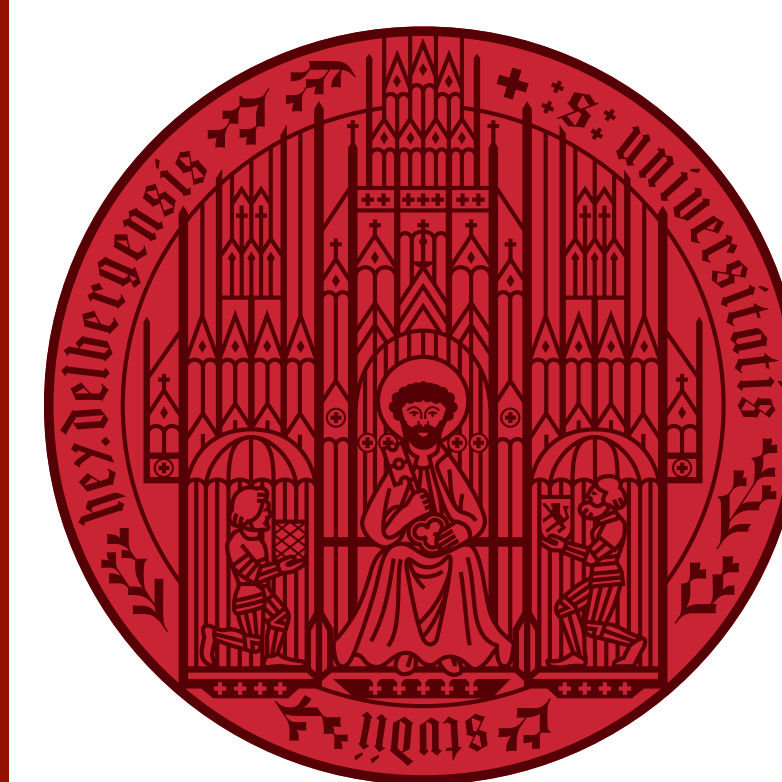
- Trained classifier shows great improvement in precision

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