

# Göttingen Activities 21/22

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Sherpa Annual Meeting

05/01/22



GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung

# The team

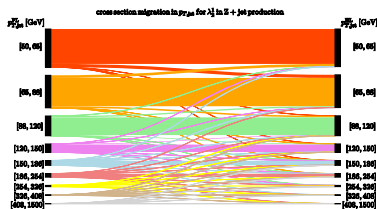
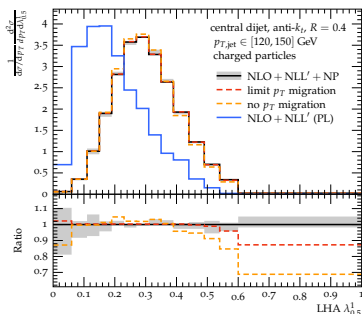
- **Steffen Schumann** – team leader
- **Enrico Bothmann** – long-term postdoc
- **Daniel Reichelt** – PhD, graduated 21, now Durham
- **Simon Luca Villani** – PhD, to graduate in 22
- **Timo Janßen** – PhD, 3rd year
- **Max Knobbe** – PhD, 2nd year
- **Niklas Schwanemann** – MSc, graduated 21, now Mainz



## • Automated NLL resummation

with Daniel + Simone Marzani, Gregory Soyez

- (groomed) jet angularities (JHEP **07** (2021), 076 & arXiv:2112.09545)
- on-going: e.g.  $y_{23}$  resummation in  $Hjj$  with Stefan & Marek

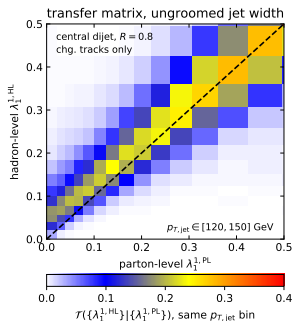
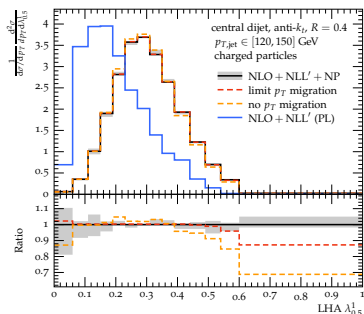


- ↳ NLO+NLL' accuracy, channel separation using flavour- $k_t$  algorithm
- ↳ new transfer-matrix approach to account for NP corrections (from MC)

## • Automated NLL resummation

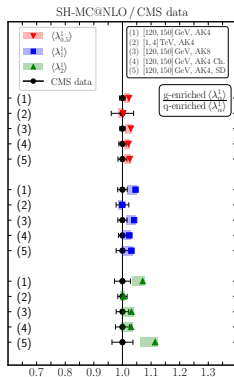
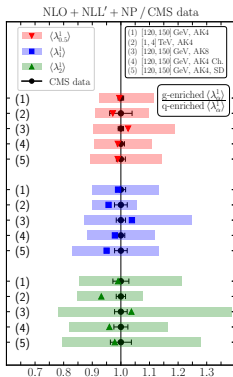
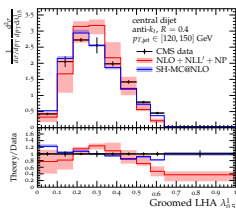
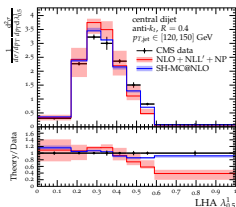
with Daniel + Simone Marzani, Gregory Soyez

- (groomed) jet angularities (JHEP **07** (2021), 076 & arXiv:2112.09545)
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- ↪ NLO+NLL' accuracy, channel separation using flavour- $k_t$  algorithm
- ↪ new transfer-matrix approach to account for NP corrections (from MC)

## Automated NLL resummation – cont'd



- ↪ improved modelling of data with transfer-matrix method
- ↪ good description with MC@NLO, MEPS@NLO
- ↪ potential for tuning of MC hadronisation & underlying event

- **ML for phase space sampling, ME surrogates**

with Timo, Frank S + Max, Enrico

- NN ME surrogates (arXiv:2109.11964 [hep-ph])
- on-going: employ Nested Sampling methods (Yallup, Handley)

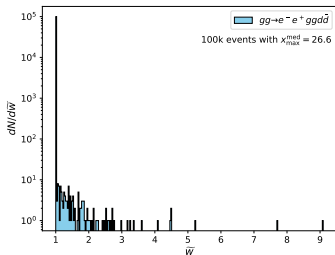
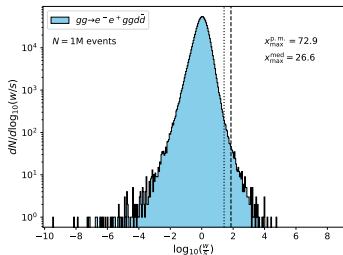
**Algorithm 2:** Two-stage rejection-sampling unweighting algorithm using an event-wise weight estimate.

```
while true do
  generate phase-space point  $u$ ;
  calculate approximate event weight  $s$ ;
  generate uniform random number  $R_1 \in [0, 1)$ ;
  # first unweighting step
  if  $s > R_1 \cdot w_{max}$  then
    calculate exact event weight  $w$ ;
    determine ratio  $x = w/s$ ;
    generate uniform random number  $R_2 \in [0, 1)$ ;
    # second unweighting step
    if  $x > R_2 \cdot x_{max}$  then
      | return  $u$  and  $\tilde{w} = \max(1, s/w_{max}) \cdot \max(1, x/x_{max})$ 
    end
  end
end
end
```

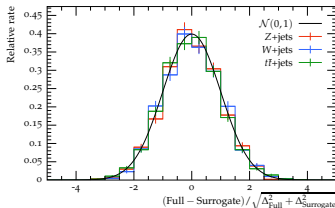
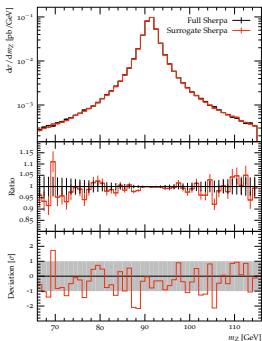
↪ train NN to predict ME  $\times$  PS event weight from momenta

# Main Activities 21/22

## • ML for phase space sampling, ME surrogates – cont'd



## • validation for $W/Z + 4j, t\bar{t} + 3j$



↪ fully compatible samples

- ML for phase space sampling, ME surrogates – cont'd

↪ performance measures for  $W + 4j$  channels

|   | $dg \rightarrow e^- \bar{\nu}_e g g g u$ | $dd \rightarrow e^- \bar{\nu}_e g g d u$ | $ud \rightarrow e^- \bar{\nu}_e d u u \bar{d}$ |
|---|--|--|--|
| $\epsilon_{\text{full}}$  | 1.4e-3                                   | 3.1e-4                                   | 3.6e-4   |
| $\epsilon_{1\text{st,surr}}$  | 7.1e-4                                   | 1.1e-4                                   | 1.3e-4   |
| $\langle t_{\text{full}} \rangle / \langle t_{\text{surr}} \rangle$ | 667                                      | 162                                      | 25   |
| $x_{\text{max}}^{\text{p.m.}}$                                      | 234.03                                   | 544.96                                   | 1642.77  |
| $\epsilon_{2\text{nd,surr}}^{\text{p.m.}}$                          | 8.5e-3                                   | 5.2e-3                                   | 1.8e-3   |
| $\alpha^{\text{p.m.}}$  | 0.9953                                   | 0.9958                                   | 0.9953   |
| $f_{\text{eff}}^{\text{p.m.}}$                                      | 1.93                                     | 0.29                                     | 0.02   |
| $x_{\text{max}}^{\text{med}}$                                       | 40.28                                    | 30.53                                    | 38.53  |
| $\epsilon_{2\text{nd,surr}}^{\text{med}}$                           | 5.3e-2                                   | 8.5e-2                                   | 7.3e-2   |
| $\alpha^{\text{med}}$   | 0.9285                                   | 0.8204                                   | 0.4323   |
| $f_{\text{eff}}^{\text{med}}$                                       | 10.36                                    | 3.91                                     | 0.25   |



- **EW/QCD corrections, shower matching & merging**

with Enrico, Simon Luca, Davide & Marek

- $ZZ(j)$  with EW Sudakov, virtual corrections (arXiv:2111.13453 [hep-ph])
- on-going: LI processes with parton showers

- **Misc – on-going**

- GPU-based ME generation: Enrico + Max
- exploration into tuning with Apprentice: with Enrico + Max
- extended MCgrid/PineAPPL interface for NLO EW corrections: Enrico

- **Proposal**

- joint “Jets with Sherpa” study with 3.0?