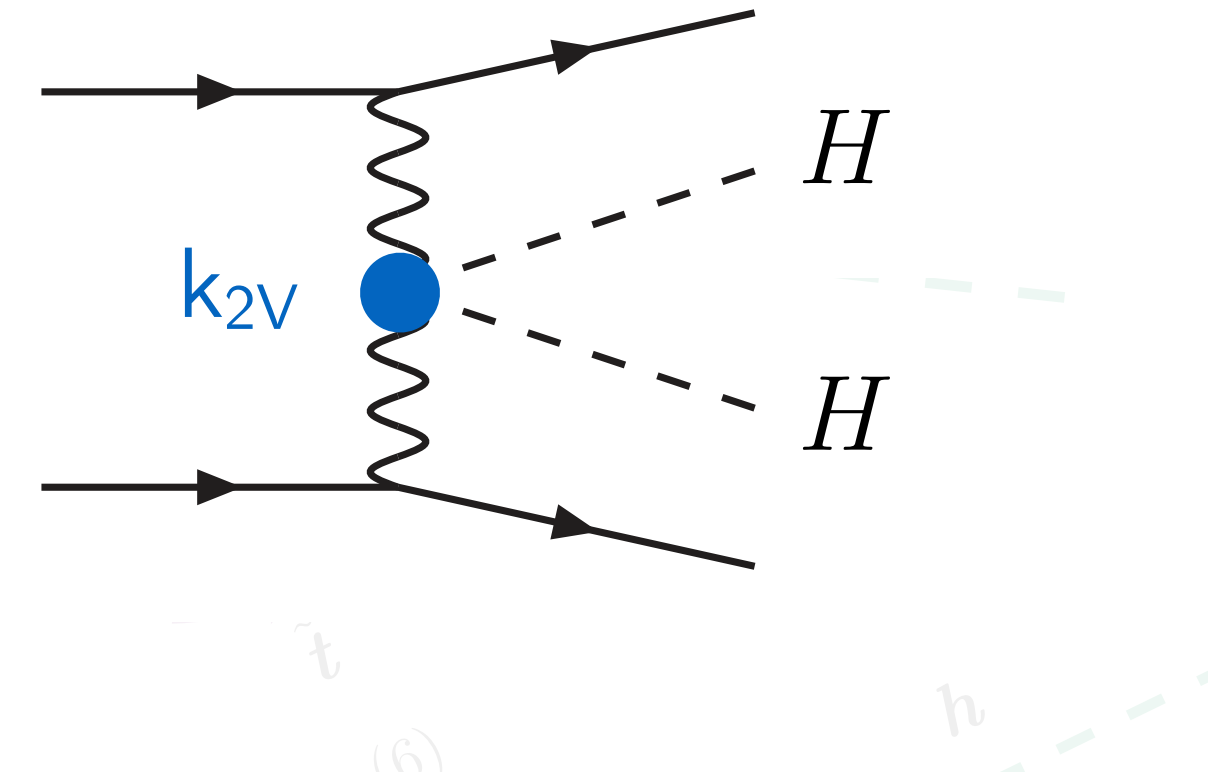
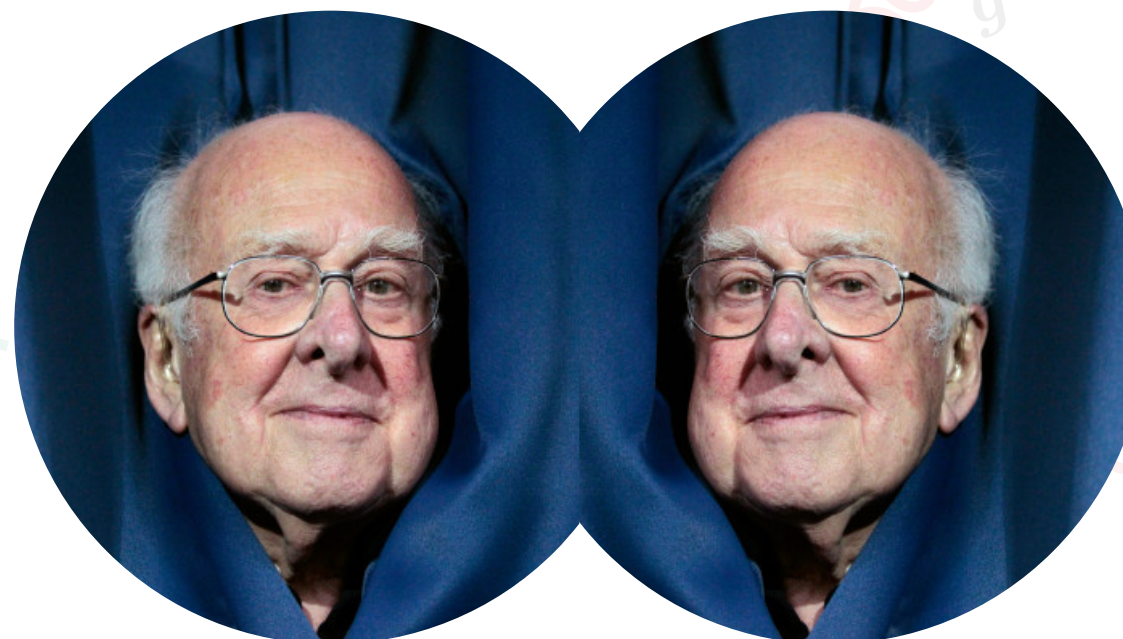
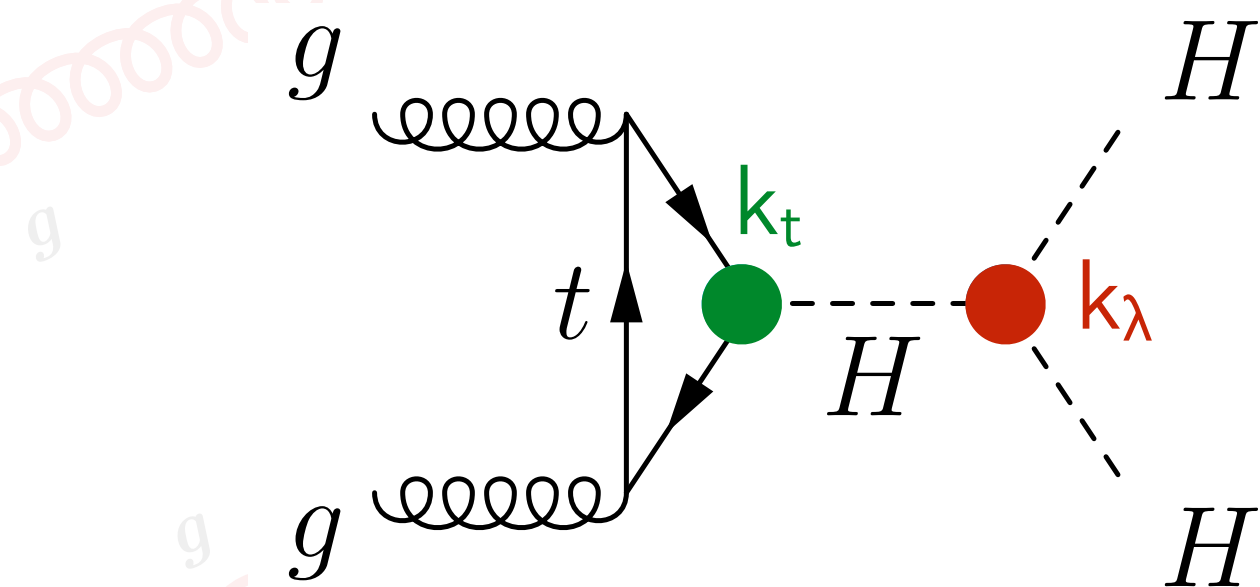




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$$HH \rightarrow bb\tau\tau$$

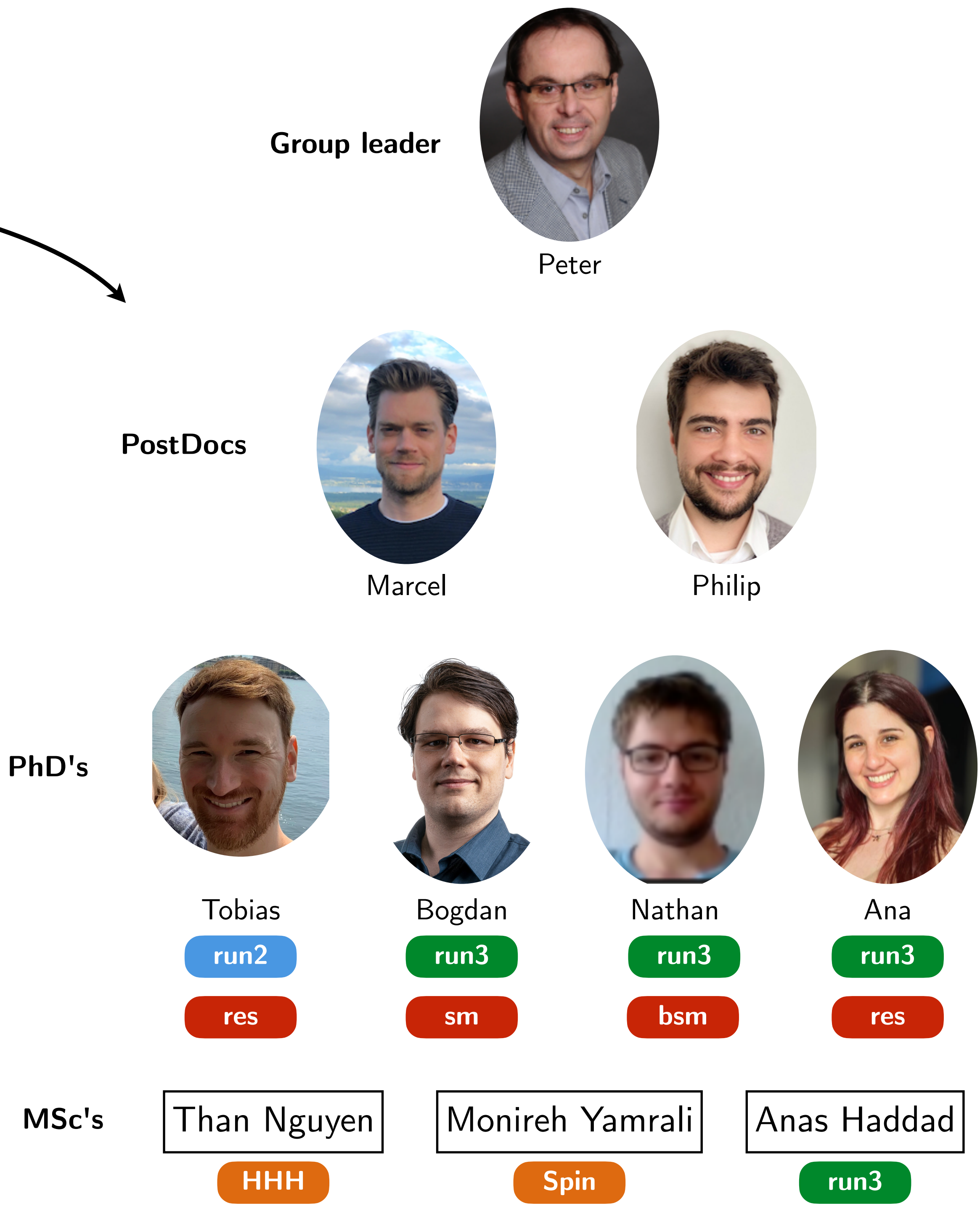
— UHH Run 3 Plans —

Marcel & Philip for the UHH group

UHH $HH \rightarrow bb\tau\tau$ Kickoff

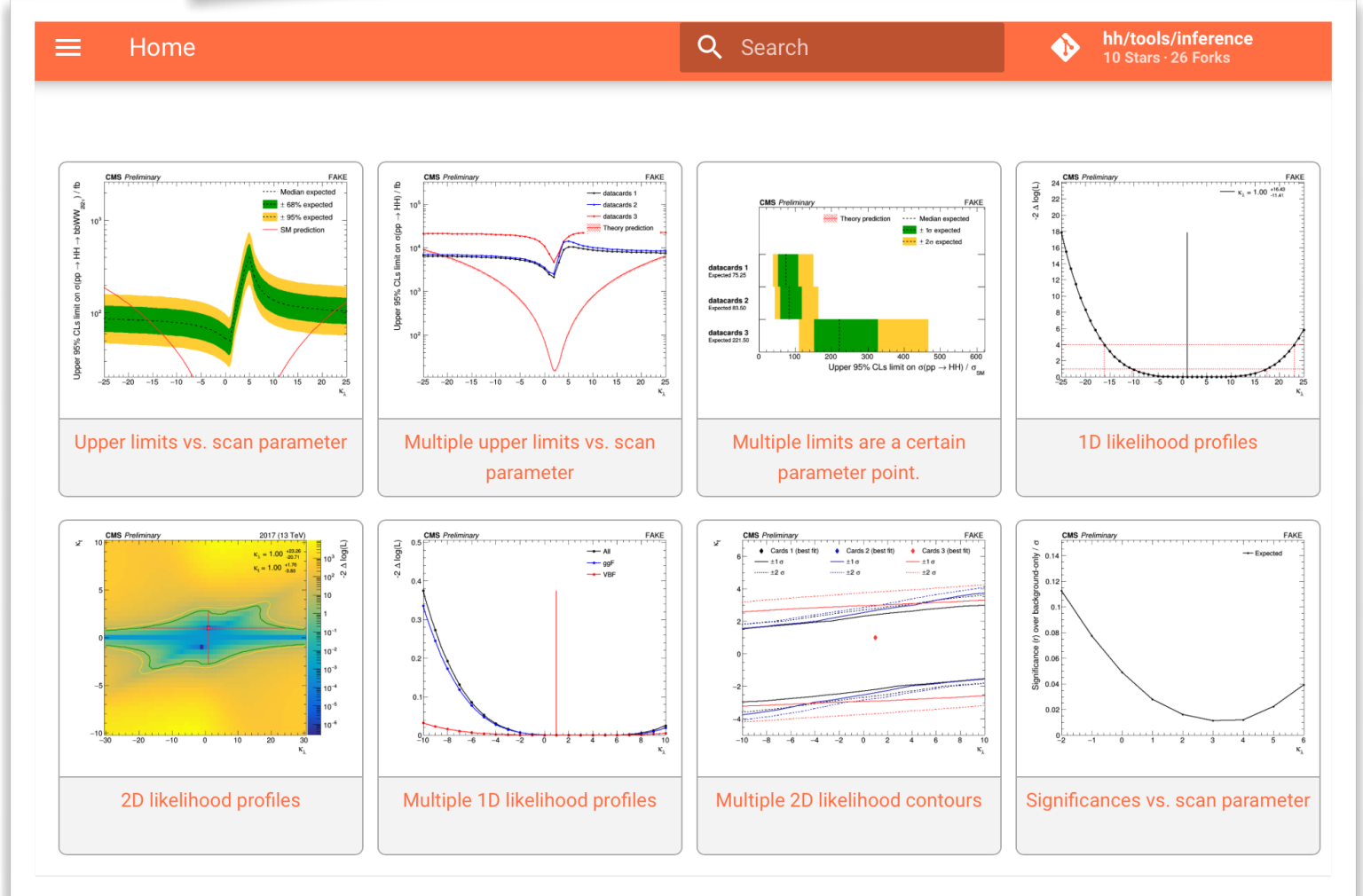
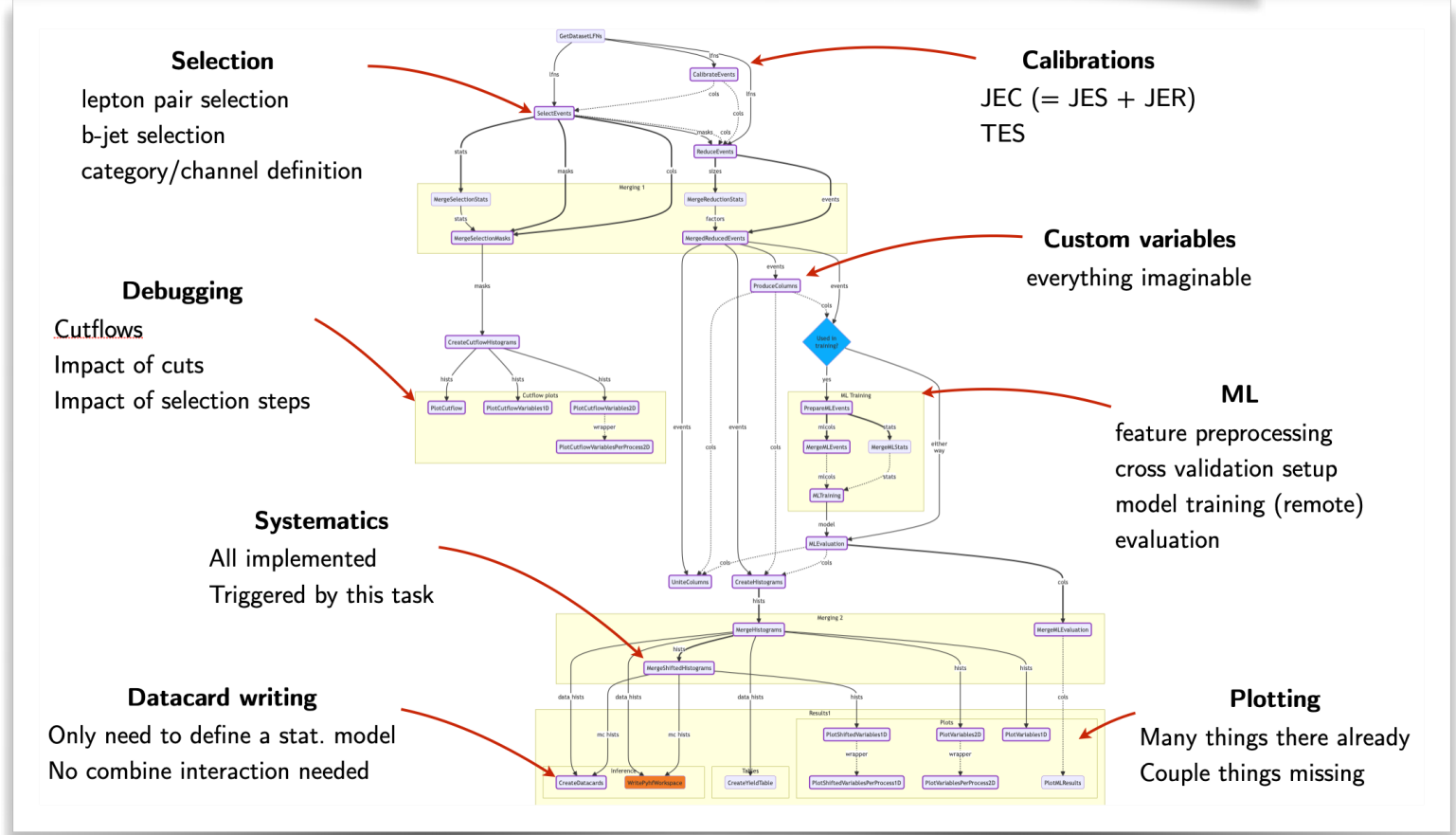
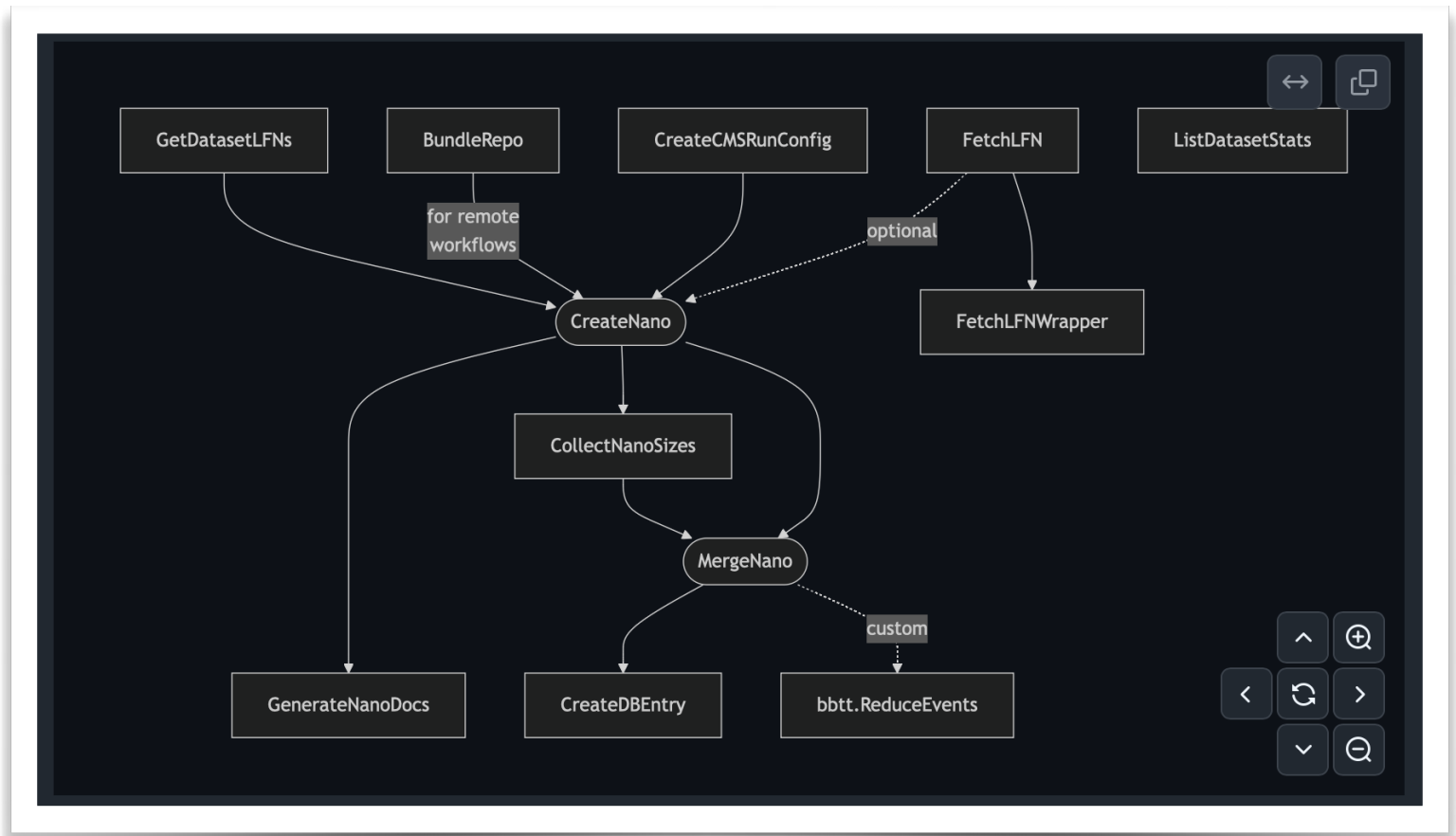
11.10.2024

- **UHH (Schleper)** $\mathcal{C}/f$
 - History in various τ and $b\bar{b}\tau\tau$ topics
 - 
- **Zürich (UZH)**
 - Jona Motta (PostDoc)
- **Paris (CNRS, Ecole-Poly)**
 - Louis Portales (Staff), Roberto Salerno (former PC)
- **Milano-Bicocca / Boulder**
 - Davide Zuolo (PostDoc)
- **CIEMAT**
 - Maria Cepeda (Staff, former HIG L2)
- **ETH / Pisa**
 - Konstantin Androsov (PostDoc, former TAU L2)
- **Lisbon** $\mathcal{C}/f$
 - Johan Wulff (PhD)
- **Tallinn** $\mathcal{C}/f$
 - Torben Lange (PostDoc)
- **Louvain, Texas, ...**



Analysis flow

- **UHH Nanogen** ([link](#))
 - Tools for custom NanoAOD production starting at central MiniAOD
 - Stores all outputs on Desy dCache
 - Adds custom collection on top of default ones
 - ▷ Latest taggers for jets and taus
 - ▷ Constituents of jets, fat jets, taus, boosted taus
- **HH → bbττ analysis / columnflow** ([link](#), [link](#))
 - Fully automated analysis workflow
 - Vectorized approach (NumPy / Awkward array) for fast turnaround (1 day)
 - All central CMS recipes implemented
 - Previous run 2 analysis fully implemented as baseline
 - **Improvements towards run 3 ongoing**
- **CMS HH inference tools** ([link](#))
 - Automated tools for statistical inference (combine) for all HH
 - Includes "Physics Model" that models κ_λ dependence on discriminant level
 - Collection of recommended recipes to produce
 - ▷ Limits & limit scans
 - ▷ Likelihood scans
 - ▷ Pulls & impacts, debugging tools



- **Timeline for using run 3 data**

- PC: "Analyses using only 22/23 data must publish **by Moriond 25** (pre-app Jan!). Otherwise wait for **full run 3 data!**"
- The CMS $bb\tau\tau$ group targets 2+ publications
 - ▷ 1. Partial run 3 (2022 + 2023, 4 eras) + run 2 datacard combination
 - ▷ 2. Full run 3 + run 2 reprocessing (10 eras), full combination
 - ▷ 3+. Other interpretations (resonant, BSM / EFT, 2HDM, ...)

- **Physics topics**

- Exploit differences between resolved and boosted topologies, both on bb and $\tau\tau$ branches
- Continue ML based $\tau\tau$ reconstruction / regression, potentially also exploiting spin correlations for background suppression
- Discriminant training, also diving into more advanced NN architectures (DeepSets, graphs, transformers)
- Improved background estimation (DY, QCD)
- Optimized ggF vs. VBF treatment
- Targeting various interpretations in parallel

- **Currently ongoing**

- Relax selection criteria & use ML techniques for improved background suppression
- Optimize κ_λ morphing in statistical inference with feedback to ML strategy
- Discriminator development based on our $\tau\tau$ NN regression effort in run 2 (resonant)
- Custom NanoAOD production

Backup

