What do you want to see at BOOST 2025?
Questions & Responses

What do **theorists** want to see from **theorists** by 2025?
What do **theorists** want to see from **experimenters** by 2025?
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Context:

- 6 years from BOOST 2019
- 2 years after Run 3 is finished, bringing us to ~250 fb-1 of pp data
- the last BOOST before the start of HL-LHC (or penultimate, if delayed)
- likely in the construction phase of a new accelerator, if one is indeed planned

What do **theorists** want to see from **theorists** by 2025?

Calculate observables to high precision that can be compared directly to data

- 1-2% uncertainty
- NNNLL + NNLO + NP with grooming
- Good enough to extract α_s for PDG.
- More reasonable parameterization of soft stuff

Learn something about quantum field theory from jet physics

- Improved understanding, like in other fields of theoretical physics
- Better motivate Standard Model physics, not just to find BSM.

Less machine learning (several)

- It's data visualization not theoretical physics.
- Does non-ML collider physics (e.g. tool development) count as theoretical physics? Should we view the current ML tool development similarly to how the development of observables 10 years ago was viewed?

What do **theorists** want to see from **experimenters** by 2025?

Continued great work
- Reduce systematics
- Find new physics

Include theory uncertainty on all experimental plots
- Done already for fixed-order comparisons (scale variation) and PDF uncertainties
- Include MC parameter uncertainties consistently

Continued support for open data
- run and show the same analyses from Run 3 on open data

Measure something fundamental
- Higgs width with jet substructure
- Strong coupling constant

Be systematic
- Standardize measurements between collaborations
- More reporting of data with multiple choices of algorithm parameters to test dependence.

What do **experimenters** want to see from **theorists** by 2025?

Generic:

- How exactly the data from run 2/3 was incorporated by theorists and what tangible improvements have been made with all this new data

Monte Carlo:

- better prescriptions for uncertainties (and smaller!)
- improved (and faster) tuning of MC
- "trustable" models, in particular for QCD/multijet processes & jet substructure
- QCD Monte Carlo that agrees with our data, especially in the area of jet substructure.

Calculations and observables:

- clear guidelines for areas of theoretical (in)stability and usage
- phase space safety and applicability
- new ideas for how to constrain theoretical uncertainties in measurements

Algorithms and ML:

- greater physics knowledge built into the NN/ML architectures (symmetries, invariance)
- clear "wish list" of what to do/measure with ML models

What do **experimenters** want to see from **experimenters** by 2025?

Monte Carlo:
- tuning of MC
- use QCD MC models for background estimates for searches

Measurements:
- more excitement
- more measurements to do the tuning
- precision studies using JSS with full Run2

Searches:
- model-independent search techniques/stat analysis tools

Machine learning:
- Portable and explainable ML that can be easily shared
- An honest assessment about what it is that we want to do with ML methods.
  - Is it strictly greater numerical performance? Is it to learn something from the models that the networks implement? Is it to be able to interpret what the model has learned somehow?
- Training your ML Models directly on data and using to improve MC

Techniques and capabilities:
- detailed prospects for scope of all/JSS/boosted searches & meas. at HL-LHC & new colliders
- complete event level substructure with universal pflow and met
- bottom up uncertainties on everything we measure (jets, clusters, tracks, pflow objects, substructure observables)

Panel Discussion Topics

1. ***Should there be a BOOST 2025?***
    a. Can and should we **expand the purview of the techniques/ideas** from this community -- often pioneered here -- to others? If so, how and in what directions (theory, QFT, ML, algorithms)?
2. How do we conceive of the role of **machine learning** in jet physics, and in particular, in the BOOST scientific community?
3. Should we aim to -- and if so, how -- build interest and motivation for **precision measurements, calculations, and heavy ion** physics?
    a. What will (can)"boost" teach us about the **quark gluon plasma**?
4. What are the most important **roles of theory** in the BOOST community? How can we continue to connect to **both the BSM and precision** communities?