

# What EF most needs from theory

- Open discussion -

## EF Restart Meeting

Aug 30- Sep 3, 2021

[Meenakshi Narain](#) (Brown U.)

[Laura Reina](#) (FSU)

[Alessandro Tricoli](#) (BNL)

## Refine and fully deploy existing techniques for calculating observables, modelling events, and interpreting collider data in searching for new physics.

- Assess origin of theoretical uncertainties at all levels (PDF, matrix elements, parton shower) and identify areas where progress could have more impact.
- Understanding non-perturbative effects for hadron collider phenomenology.
- Interface of theoretical calculations with experimental measurements.
- More accurate modelling of complex signatures: precision in high-multiplicity, off-shell effects, etc. (aim for th-vs-exp comparison in fiducial volume)
- Complementarity and interplay between model-dependent and model-independent BSM searches: define clear strategies.
- Global fits of EW+Higgs+top+ ... data: improve interpretation, assessment of validity, superior reach wrt model-specific analyses, reach of future lepton and hadron colliders.
- In general: highlight connections to specific colliders.
- ...

## Explore cutting-edge new ideas for calculating observables, modelling events, and interpreting collider data in searching for new physics.

- Perspective on new strategies for collider data analysis (machine learning, geometric techniques, new kinematic techniques, etc.)
- Unexplored/unconventional signatures: which ones, where, and how.
- How to model, analyze, and interpret multi-Z/W/H processes (“multi” here means  $O(10)$ )
  
- Perspective on new strategies for theoretical calculations: how to reach higher precision with new more effective techniques.
  
- New theoretical ideas/tools: scattering amplitude in connection with EFT, dispersion relation (test of QFT principles at colliders).
- ...

We look forward to further exploring these ideas during Snowmass through interaction with several TG of the Theory Frontier, in particular:

TF07: “Collider phenomenology” (Fabio Maltoni, Shufang Su, Jesse Thaler)

TF06: “Theory techniques for precision Physics” (Radja Boughezal, Zoltan Ligeti)

TF08: “BSM model building” (Patrick Fox, Graham Kribs, Hitoshi Murayama)