TF07: Collider phenomenology

Fabio Maltoni, Shufang Su, Jesse Thaler

$$\sigma_{\rm obs} \simeq \frac{1}{2E_{\rm CM}^2} \sum_{n=2}^{\infty} \int {\rm d}\Phi_n \, |\mathcal{M}_{AB\to 12\ldots n}|^2 f_{\rm obs}(\Phi_n)$$

→ **interpretation**

- **beam**
- **sum over final-state multiplicity**
- **integrate over phase space**
- **scattering amplitude**
- **observable**

Two recent developments

- deep learning
- public collider data

Theoretical need from experimental side

- precision
- targets for future colliders

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Reports: https://bit.ly/3cnOT2Y
Feedback: https://bit.ly/3altHEc

Observables

- Kinematic features
- Jet substructures
- Multi-point energy correlators
- Machine-learning-based observables
- Optimal transport
- Quantum algorithms

I. Moult

Event Generators

- Multi-purpose event generators
- Extending applicability/reducing uncertainties
- Computational challenge
- Machine-learning-based generators

C. Krause

Calculations

- Precision of EW, Higgs, and top physics
- Resummation techniques
- Precision calculations for lepton colliders
- Study of elusive signatures
- Extracting SM parameters
- EW radiation

F. Maltoni

Interpretation tools

- Anomaly detection
- Effective field theory
- Data and analysis preservation

Search Strategies

- Cascade decay signatures
- Dark sectors
- Low mass scalars …

Physics at future colliders (EF)

TF07: Executive Summary

- Essential interface between theory and exp HEP community.
- New generation of observables are developed.
- Precision calculations and state-of-art event generators are essential.
- New computational paradigms for theoretical calculations must be pursued.
- Growing catalog of model-agnostic search strategies.
- Exotic collider signatures inspire new data analysis strategies/motivates new exp facilities.
- Probe unexplored SM phenomena.
- Machine learning is having a transformational impact on collider phenomenology.
- Collaborate with exp community to advocate for/assist with long-term data preservation efforts.
- Play a key role in defining the physics case for future colliders.
- A wide spread sense of urgency.