

# Snowmass 2021

## Theory Frontier TF07

## Collider Phenomenology

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Kickoff Meeting: July 30, 2020

# First thing first...

**What's the difference from the other frontiers?**

## E.g. Energy Frontier

- ◎ specific machines, channels, new physics models, ...

## TF07 (Collider Phenomenology)

- ◎ concepts, techniques, tools, advances, ...

**There are clear synergies with Energy Frontier activities,  
and we encourage cross-cutting theory contributions**

# Description

## TF07: Collider Phenomenology

- ◎ Illustrate **exciting new directions** in collider phenomenology
- ◎ Establish **key connections** between cutting-edge theoretical advances and current and future experimental opportunities
- ◎ Identify the **most promising avenues** where major theory breakthroughs could take place in the coming years, which could lead to transformative concepts and techniques in collider phenomenology.

# Topics in Scope (1 of 5)

## Topics

- ◎ New collider **data analysis strategies**, including kinematic variables, tagging methods, clustering algorithms, and machine learning approaches (CompF3)
- ◎ Novel **collider signatures**, including those that are currently difficult to study or require alternative event reconstruction
- ◎ Techniques to maximize the sensitivity and broaden the range of **new physics searches**, including multi-channel combinations and anomaly detection

# Topics in Scope (2 of 5)

## Topics

- Advances in **event simulation**, including those that can increase accuracy/precision and overcome speed/storage limitations
- Refined definitions of **collider observables**, for example those that incorporate theoretical and experimental developments
- Theory input on the targets and challenges for **current and next-generation colliders** (AF)

# Topics in Scope (3 of 5)

## Topics

- ◎ Top-down: implications of **model building developments** (TF08) in identifying smoking gun signatures of new physics and developing targeted analysis strategies
- ◎ Bottom-up: effective field theories (TF02) and simplified models for **model-independent characterization** and interpretation of collider data
- ◎ Impact of the **precision frontier** (TF06) on event generation and collider measurements

# Topics in Scope (4 of 5)

## Topics

- ◎ Applications of **amplitudes developments** (TF04) for precision predictions and new physics characterization
- ◎ Impact of **non-perturbative methods** to improve collider inputs (e.g. parton distribution functions, fragmentation functions, strong coupling constant), including lattice field theory (TF05) and analytic techniques
- ◎ Connections to **astrophysics and cosmology** (TF09), including collider probes of dark sectors and baryogenesis



# Topics in Scope (5 of 5)

## Topics

- ◎ Connections to the **intensity frontier**, including collider probes of neutrino physics (TF11), flavor physics, and CP violation (TF06)
- ◎ Relevance of **quantum information** (TF10, CompF6) for collider analyses
- ◎ More... [Please contact us if there is an important topic or connection that we left off this list. The goal for TF07 is to include all exciting directions in collider phenomenology!]



# Contact and Contributions

## Contact

- Email list: [SNOWMASS-TF-07-COLLIDER\\_PHENO@fnal.gov](mailto:SNOWMASS-TF-07-COLLIDER_PHENO@fnal.gov)
- Slack channels: tf07-collider
- Emails: [fabio.maltoni@uclouvain.be](mailto:fabio.maltoni@uclouvain.be), [shufang@email.arizona.edu](mailto:shufang@email.arizona.edu), [jthaler@mit.edu](mailto:jthaler@mit.edu)

## Contributions

- Letter of Interest (LOI): **deadline Aug 31, 2020 (no real deadline)**
- Contributed Paper: **deadline July 31, 2021**  
<https://snowmass21.org/submissions/start>
- Cross list to multiple frontier/topic group

# Meetings

## Meetings

- Community Planning Meeting (Oct 5-9, 2020, virtual)
- Theory Frontier Conference (Mar 17-19, 2021, KITP)
- Community Summer Study (July 11-20, 2021, Seattle)
  
- Your Input: Would it be beneficial to arrange separate TF07 discussions? (e.g. 2-3 hours on specific topics, with short presentations about recent developments and summaries of current status)

# Questions? Suggestions?

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**Please raise your Zoom hand or type into the chat window to ask questions or make suggestions**

**Most important take-away message from today:  
We welcome your LOIs and contributed papers!**

# Discussions

## Q&A

- ◎ Your Input: Would it be beneficial to arrange separate TF07 discussions? (e.g. 2-3 hours on specific topics, with short presentations about recent developments and summaries of current status)
- ◎ How are we going to organize our activities to keep the collider physics effort like a coherent one and not the sum of many smaller disconnected efforts ?
- ◎ An important issue for collider theory is ensuring that the required calculations for precision measurements, PDFs, and Monte Carlos are enabled by a strong theory effort. What proactive measures can you see the theory community supporting in this area?