ENERGY FRONTIER

Conveners:
Meenakshi Narain (Brown University)
Laura Reina (FSU)
Alessandro Tricoli (BNL)

Useful Links:
• Wiki
• Indico
• Slack channels
• Calendar
Energy Frontier (EF) Science Goals

• The goal is to explore the TeV energy scale and beyond

• It is an exciting time for Snowmass 2021
  • The LHC program is maturing
    • Run 1 delivered the Higgs boson
    • Run 2 is providing a wealth of new measurements.
    • The HL-LHC will usher in the era of precision Higgs physics.
  • There are exciting results from other frontiers: rare processes, cosmology, …
  • There is no preferred model for physics beyond the SM!
  • It is time to think beyond the LHC and update the scenarios of proposed future colliders.
• There is a lot of space to propose new ideas, new perspectives, new tools.

• Energy Frontier Organization: Ten Topical Groups (EF01 to EF10) which focus on
  • Electroweak (EW) physics
  • QCD and Strong Interactions
  • Beyond-Standard-Model (BSM) physics
Energy Frontier Machines

- Discoveries at the Energy Frontier are intricately linked to new accelerators and detector instrumentation.

- Proceed along two complementary directions
  - Study known phenomena at high energies
    - **Factory of Higgs bosons** (or other known particles)
    - Electroweak (EW) physics
    - QCD and Strong Interactions
  - Search for direct evidence of BSM physics
    - Next high energy frontier machine

- What are the most promising future colliders?

From our EF02 colleagues (Meade, Ojalvo):
Energy Frontier Practicalities

• What is the best way for early career physicists (student, postdoc) to contribute to the Snowmass process? ➔ Join a Snowmass Early Career Group!
• Signup and attend EF topical group meeting and get involved in a project of interest
• The EF Snowmass Early Career group is currently organizing
  • Interest survey for assistance with projects
  • Study matching
  • Monte Carlo workshops

• Bi-weekly chats to discuss EF developments
  • Discussions from an early career perspective
  • Updates from each Topical Group Liaison
  • Every other Tuesday at 19h CERN Time, 12h US Central Time

• Communication and contacts:
  • Slack Channels of Interest (all public) #early-career-energy-frontier-coordination
  • Listserv: SNOWMASS-EARLY-CAREER-EF@FNAL.GOV
  • Link to SEC+EF Topical Group Liaisons
  • Current SEC Contacts: Grace Cummings, Amber Roepe [rotating positions]
We invite you to the Energy Frontier

Snowmass is a time for the community to innovate and set new directions without prior barriers and constraints

The success of the Energy Frontier depends on your engagement and ambitions!

Let’s collectively DREAM BIG!
BACKUP
Energy Frontier Topical Groups

- Ten Topical Groups study and compare the physics reach of future colliders.

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<th>Topical Group</th>
<th>Co-Conveners</th>
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<td>EF01: EW Physics: Higgs Boson properties and couplings</td>
<td>Sally Dawson (BNL)</td>
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<td>Andrey Korytov (U Florida)</td>
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<td>EF02: EW Physics: Higgs Boson as a portal to new physics</td>
<td>Patrick Meade (Stony Brook)</td>
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<td>Isobel Ojalvo (Princeton)</td>
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<td>EF03: EW Physics: Heavy flavor and top quark physics</td>
<td>Reinhard Schwienhorst (MSU)</td>
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<td>Doreen Wackeroth (Buffalo)</td>
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<td>EF04: EW Physics: EW Precision Physics and constraining new physics</td>
<td>Alberto Belloni (Maryland)</td>
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<td>Ayres Freitas (Pittsburgh)</td>
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<td>EF06: QCD and strong interactions: Hadronic structure and forward QCD</td>
<td>Huey-Wen Lin (MSU)</td>
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<td>EF08: BSM: Model specific explorations</td>
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<td>Elliot Lipeles (UPenn)</td>
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<td>Nausheen Shah (Wayne State)</td>
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<td>Zhen Liu (Maryland)</td>
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<td>Simone Griso (LBL)</td>
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<td>EF10: BSM: Dark Matter at colliders</td>
<td>Caterina Doglioni (Lund)</td>
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<td>LianTao Wang (Chicago)</td>
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Some selected “Focus questions”

• What is the scale of new physics that can be probed with **precision measurements**?
• How can future colliders address the **naturalness** problem to an extent that either new physics appears or a new paradigm of thinking about naturalness can emerge?
• How can measurements in the **Higgs sector** be combined with measurements in other sectors to improve our understanding of high scale physics?
• How can the **top quark** help elucidate the Higgs sector and inform about possible physics beyond the SM?
• What is the future of **PDF determinations**?
• What is the ultimate precision for $\alpha_s$ and how do we achieve it? How does the knowledge of hadron structure affect measurements of $\alpha_s$ in various processes?
• What is the fundamental composition of **Dark Matter**? What are the best ways to probe the composition of DM and whether it interacts weakly?
• And more…
Future Collider Scenarios & Timelines from ESPP
Update needed to this chart during Snowmass 2021

- Will add EIC and Muon Collider to this chart.
- Will consider new proposals that may come up during Snowmass 2021.
  - e.g. initiatives for gamma-gamma and plasma colliders etc.