

# Snowmass 2021

## EF09 - BSM

More general explorations

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[https://snowmass21.org/energy/bsm\\_general](https://snowmass21.org/energy/bsm_general)



**WISCONSIN**  
UNIVERSITY OF WISCONSIN-MADISON



May 8<sup>th</sup> 2020  
Kick-off meeting



# Agenda for today's meeting

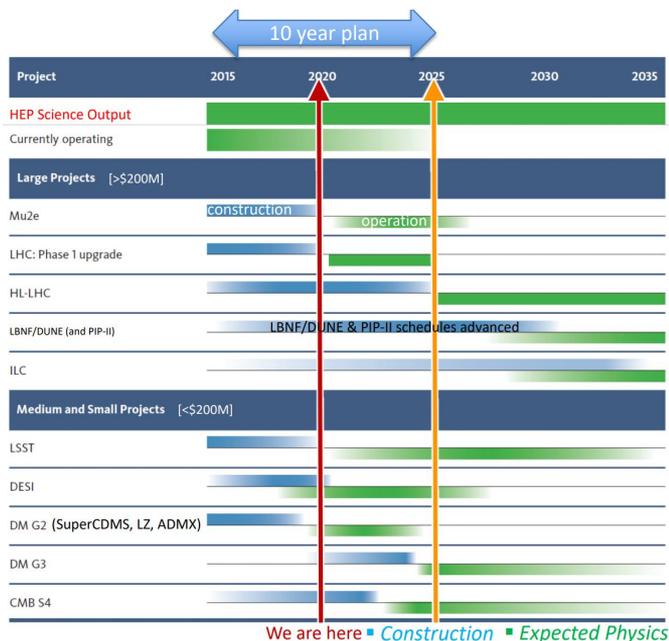
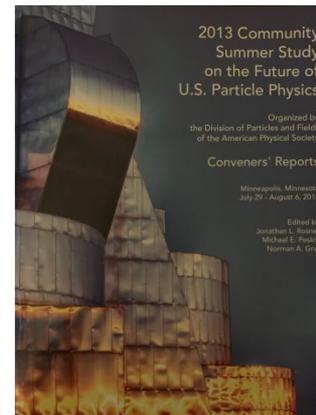
- Main goals for today's kick-off meeting:
  - Communicate the context and goals of this group
  - Answer (and seek answers to) questions you may have
  - Gather community input! Don't be shy to bring up your suggestions!
- Introduction
  - Goals / Organization / Topics
- Additional discussion / brainstorming
  - Questions on group organization
  - Discussion / Suggestions on group's scope and topics
- Raise your hand (or just speak up) if you have questions/comments!
  - We left this meeting on purpose with a lightweight agenda

# The Snowmass process

- The Snowmass process is an opportunity for the entire HEP community to come together to identify and document a vision for the future of particle physics in the U.S. and its international partners.
  - “Its narrative will communicate the opportunities for discovery in particle physics to the broader scientific community and to the [US] government” (Young-Kee Kim, Town Hall Meeting)
- The Snowmass process is defined as a “Science” study group
  - i.e. science first!
- The output of this process will be used as input to the P5 (Particle Physics Project *Prioritization* Panel) that is in charge of formulating a 10-year plan (20-year vision) for the U.S. within funding constraints
  - direct impact on the particle physics program and its international participation
- Analogous to the recent European Strategy effort, see [briefing book](#)

# History: Snowmass 2013

- Last Snowmass was done 2012-2013:  
[snowmass reports](#), [P5 report](#)



## Five scientific drivers:

- Higgs as a tool for discovery
- Physics associated with  $\nu$  mass
- New physics of Dark Matter
- Dark Energy & Inflation
- Explore the unknown: new particles, interactions, and physical principles

# Snowmass 2021

- Final aim is to produce a report documenting our scientific vision
- Snowmass 2021 kick-off Town Hall meeting on April 18th ([video](#), [indico](#))
- Planning Meeting: Nov 4<sup>th</sup>-6<sup>th</sup> 2020 @ Fermilab
- Summer Study (closing meeting): July 11<sup>th</sup>-19<sup>th</sup> 2021 @ UW Seattle
  - By this time a full draft of the snowmass report is due
- Work divided in ten *frontiers* →
- To make this effort a success:
  - Engage widely the community
  - Encourage to hear ideas from everyone, Incl. young members!! (see [snowmass young](#))
  - Let's not be afraid to lay out ambitious and scientifically sound ideas!

**Energy Frontier**  
Neutrino Physics Frontier  
Rare Processes and Precision  
Cosmic Frontier  
Theory Frontier  
Accelerator Frontier  
Instrumentation Frontier  
Computational Frontier  
Underground Facilities  
Community Engagement Frontier

# Snowmass 2021 - Energy Frontier

- The Energy Frontier (EF) group will explore the TeV energy scale and beyond.
  - Agenda includes understanding the heaviest particles of the Standard Model (SM), as well as exploring physics beyond the SM to discover new particles and interactions.
- Focus on a set of scientific questions and the scientific merit of various experimental options (e.g. colliders) to probe them
  - Build on top of existing studies (e.g. European Strategy Group)
  - Add new studies and information as well as new ideas!
- HL-LHC is a baseline reference for collider physics
  - However, equally important to make a strong case for continued support of its scientific output!
- Future colliders already proposed include:  
ILC, CLIC, FCC, CepC/SppC, LHeC, EIC\*,  $\mu$ -collider\*, etc..

\* = not (fully) considered in the European Strategy exercise

# Energy Frontier (EF)

- Kick-off meeting: May 21<sup>st</sup> 2020 ([indico](#))
  - EF workshop July 9-10 2020
  - Follow-up workshops: Jan/Feb 2021, May/June 2021
- Activity divided in nine topical groups (TG):

## Electroweak Physics:

- EF01: Higgs boson properties and couplings
- EF02: Higgs boson as portal to new physics
- EF03: Heavy flavor and top-quark physics
- EF04: Electroweak precision physics

## QCD and Strong Interactions:

- EF05: Precision QCD
- EF06: Hadronic structure and forward QCD
- EF07: Heavy Ion

## BSM Physics:

- EF08: Model-specific explorations
- EF09: More general explorations**
- EF10: Dark-matter at colliders

Confused? Unsure where your idea belongs?  
Please write to us and we'll be happy to confirm or direct you to the right people!

# EF09 - BSM: General exploration

SNOWMASS-EF-09-BSM\_GENERIC@FNAL.GOV

[Twiki](#)

[Indico](#)

Slack: [ef09-bsm-generic](#)

- This topical group aims to study the sensitivity of Beyond Standard Model (BSM) phenomena for future experiments in the energy frontier.
  - Particular emphasis is given to signatures that appear in a large variety of BSM extensions.
- Aim to collect and coherently organize studies on these broad set of topics
- Organization:
  - After this kick-off, bi-weekly meetings on Fridays @ 12:00 (noon) Eastern time
  - Starting on May 29<sup>th</sup>
    - 3 weeks from now, due to EF kick-off on May 21th
  - Can doodle new time later on if needed, depending on participation/interests
  - Meetings announced on the mailing list and on slack
- Please help us to reach out to the community and encourage participation!

# EF09: Group's topics

Started with an *initial* set of broad topics that fit the purpose of this group

- New Fermions:  
e.g. Top partner, Sterile Neutrinos, excited quark/leptons, (contact interactions)
- New Bosons:  
e.g.  $W'$ ,  $Z'$ , including diboson resonances
- Long-Lived Particles signatures
- Dark/Hidden sectors
- EFT interplay with BSM

# EF09: Group's topics - II

- In order to make a coherent report it would be good to have a set of core benchmarks that can give an overview and allow cross-comparison
  - Consistency of assumption plays a key role
- Equally important to highlight specific models/questions that can be particularly suited for approach/machine X
- In addition to existing future collider project, a natural fit for this group are “side-experiments” that maximize the reach of proposed colliders
  - An easy example are dedicated experiments searching for long-lived particles  
Examples from current collider: Faser, MATHUSLA, CODEX-B, etc...
- Being a BSM “Generic” group, we welcome new ideas/experiments that fit the energy frontier topic and can bring excitement to the community!

# EF09 synergies with other groups

Inevitable that topics overlap (bi-directionally) with other groups

- Example of topics EFX -> EF09
  - MET signature as mono-X (EF10: dark-matter)
  - EFT studies in the electroweak sector (EF04: EWK precision)
  - Etc.. etc..
- Example of topics EF09 -> EFY
  - SUSY Higgsino combinations incl. LLP (EF08: BSM model-specific)
  - Etc.. etc..

While some initial effort was done to try to divide topics, it will really be a fluid discussion and close collaboration with various groups

# EF09 synergies with other frontiers

Quite some synergy with other frontiers as well

- Intensity frontier, e.g.
  - complementarity in dark photon searches, e.g. LDMX
  - see also [Physics-Beyond-Colliders](#) CERN study group
- Instrumentation frontier
  - New detectors and capabilities that enable new signatures
- Computational frontier
  - model-agnostic BSM physics using Machine learning techniques
- Theory frontier
  - Collider phenomenology, BSM model building, ...

For all synergistic activities, the aim is to follow the relevant developments and have dedicated reports/joint discussions when needed and beneficial.

# Contributing to EF09

- Several mechanisms to indicate your interest and contribute with studies to the group
- Join our bi-weekly meetings!
  - Even if time is limited, ideas and critical reviews of other people's work and general discussions!
- We've setup a very simple/quick form to collect interests in studying relevant topics for this group
  - Study you're interested / planning to perform
  - Ideas for which you seek collaborators!
  - Topics you're interested in collaborating with others
  - Thanks to those of you who have already filled this out!

Expression of Interest: Snowmass 2021 - EF09

Please use this form to communicate your interest in either performing a study or join studies in a particular area.  
For more information on activities covered by this group see also the twiki page: [https://snowmass21.org/energy/bsm\\_general](https://snowmass21.org/energy/bsm_general)

\* Required

Email address \*

Your email

Full name \*

Your answer

Other Collaborators

Your answer

Topic (short) \*

Your answer

Description or Comments (short paragraph)

Your answer

References (if any)

Your answer

Submit

# Contributing to EF09 - II

- Submission of Letter-of-Interests: <https://www.snowmass21.org/docs/upload.php>
  - Short (2-pages) descriptions of studies that you are planning or interested in pursuing
  - Call open April 1<sup>st</sup> - Aug 31<sup>st</sup> 2020
- Contributed papers: <https://snowmass21.org/submissions/start>
  - More extensive studies / White papers / Technical articles (open until 07/2021)
  - Will be part of snowmass proceedings, also submitted to arXiv
  - Ensures the contribution will be properly recognized by the wider physics community. By the authors own judgement, it can be a pure Snowmass contribution or a peer-reviewed paper.
  - Note: for large Collaborations we also expect public technical documents that can be incorporated as done for the European Strategy (details still under discussion)
- It is important for the spirit of this process to do a reasonable effort to provide a fair access of the physics potential of each future program

# Some technical details

- For Snowmass 2013, a dedicated “MC group” coordinated tools and production of simulation samples
- Many things evolved since that time
  - e.g. many exp-specific frameworks for studies on FCC-ee, CepC, FCC-hh, CppC, and more
- Taskforce setup for Snowmass 2021 to:
  - Survey existing frameworks
  - Evaluate needs for MC production, based on inputs from the various topical groups
- We’ll have support from OSG in terms of CPU/storage resources, but requires a coordinated effort to be used efficiently
- Expect plan to be finalized by July 2020 EF workshop
- If you have specific MC needs for your analysis, please do let us know!

# Plans for next meetings

Initial planning for the upcoming meetings:

- Review of existing (e.g. European Strategy, CDRs, ..) studies for dedicated topics and collider/experiments options
  - Discussion and input from the community is critical to identify areas where further development is encouraged!
- Start discussion on some core common benchmarks that are critical for cross-experiment comparisons and define “must-have” studies for the report
- We also welcome contributions, especially by people seeking additional collaborators at early stages
  - We can help “networking” through the expression of interest forms
  - Contact us with ideas or for volunteering to show your work or your ideas!

# Conclusions

- Snowmass 2021 community process has started - aims for a full draft report by July 2021
  - Ample time for comprehensive studies and novel ideas to explore... but time flies :)
- Specific topics for this working group are far from set: bring your own ideas!
  - Reminder. expression of interest form: <https://forms.gle/1freqMHfTjAobga86>
  - We look forward to your input and shape this process based on it

**Reminders:**

EF kick-off meeting: May 21<sup>st</sup> 9:00 AM Eastern Time ([indico](#))

Next EF09 meeting: May 29th 12:00 (noon) Eastern Time

Sign-up to our mailing list and slack channels! (see [twiki](#))

# BACKUP

# Contributing to Snowmass -- timeline

