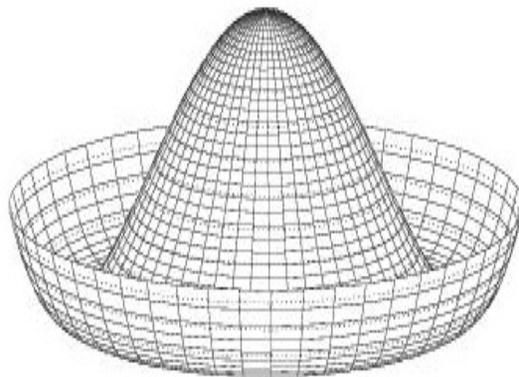


# Higgs Activities in Snowmass Process

S. Dawson, BNL, Nov. 11, 2020



# Snowmass process

- Community driven: Division of Particles and Fields of American Physical Society provides overall leadership
- Effort divided into **10 Frontiers**, each of which has multiple working groups (termed **topical groups**)
- Each working group has regular meetings, workshops, etc
- Process began in April, 2020 and will continue through Fall, 2021

# Frontiers and Topical Groups

Higgs



10 Frontiers	80 Topical Groups
Energy Frontier	Higgs Boson properties and couplings, Higgs Boson as a portal to new physics, Heavy flavor and top quark physics, EW Precision Phys. & constraining new phys., Precision QCD, Hadronic structure and forward QCD, Heavy Ions, Model specific explorations, More general explorations, Dark Matter at colliders
Frontiers in Neutrino Physics	Neutrino Oscillations, Sterile Neutrinos, Beyond the SM, Neutrinos from Natural Sources, Neutrino Properties, Neutrino Cross Sections, Nuclear Safeguards and Other Applications, Theory of Neutrino Physics, Artificial Neutrino Sources, Neutrino Detectors
Frontiers in Rare Processes & Precision Measurements	Weak Decays of b and c, Strange and Light Quarks, Fundamental Physics and Small Experiments. Baryon and Lepton Number Violation, Charged Lepton Flavor Violation, Dark Sector at Low Energies, Hadron spectroscopy
Cosmic Frontier	Dark Matter: Particle-like, Dark Matter: Wave-like, Dark Matter: Cosmic Probes, Dark Energy & Cosmic Acceleration: The Modern Universe, Dark Energy & Cosmic Acceleration: Cosmic Dawn & Before, Dark Energy & Cosmic Acceleration: Complementarity of Probes and New Facilities
Theory Frontier	String theory, quantum gravity, black holes, Effective field theory techniques, CFT and formal QFT, Scattering amplitudes, Lattice gauge theory, Theory techniques for precision physics, Collider phenomenology, BSM model building, Astro-particle physics and cosmology, Quantum information science, Theory of Neutrino Physics
Accelerator Frontier	Beam Physics and Accelerator Education, Accelerators for Neutrinos, Accelerators for Electroweak and Higgs Physics, Multi-TeV Colliders, Accelerators for Physics Beyond Colliders & Rare Processes, Advanced Accelerator Concepts, Accelerator Technology R&D: RF, Magnets, Targets/Sources
Instrumentation Frontier	Quantum Sensors, Photon Detectors, Solid State Detectors & Tracking, Trigger and DAQ, Micro Pattern Gas Detectors, Calorimetry, Electronics/ASICS, Noble Elements, Cross Cutting and System Integration, Radio Detection
Computational Frontier	Experimental Algorithm Parallelization, Theoretical Calculations and Simulation, Machine Learning, Storage and processing resource access (Facility and Infrastructure R&D), End user analysis
Underground Facilities and Infrastructure Frontier	Underground Facilities for Neutrinos, Underground Facilities for Cosmic Frontier, Underground Detectors
Community Engagement Frontier	Applications & Industry, Career Pipeline & Development, Diversity & Inclusion, Physics Education, Public Education & Outreach, Public Policy & Government Engagement



# Higgs Efforts very distributed

## ENERGY FRONTIER:

EF01: Higgs Boson Properties and Couplings

EF02: Higgs Boson as a Portal to New Physics

EF04: EW Precision Physics and Constraining new physics

## THEORY FRONTIER:

TF06: Theory Techniques for Precision Physics

TF07: Collider Phenomenology

## COMPUTATIONAL FRONTIER:

CompF2: Theoretical Calculation and Simulation

Many overlaps and synergies! Good communication between groups so far

# Higgs Activities in Snowmass Groups

- Focus on developments since European Strategy Group report
- Topical groups have heard many interesting talks and groups are beginning to do new physics studies
- EF01: Higgs Boson Properties and Couplings
  - Higgs mass and width
  - Higgs decays (including H to invisible and rare decays)
  - Higgs production modes: inclusive and differential measurements
  - HH production
- Ongoing studies:
  - New techniques for HH measurements (including machine learning)
  - Light flavor tagging (charm and strange Yukawas and detector requirements)
  - Constraining Higgs to invisible
  - What is needed theory precision for Higgs studies

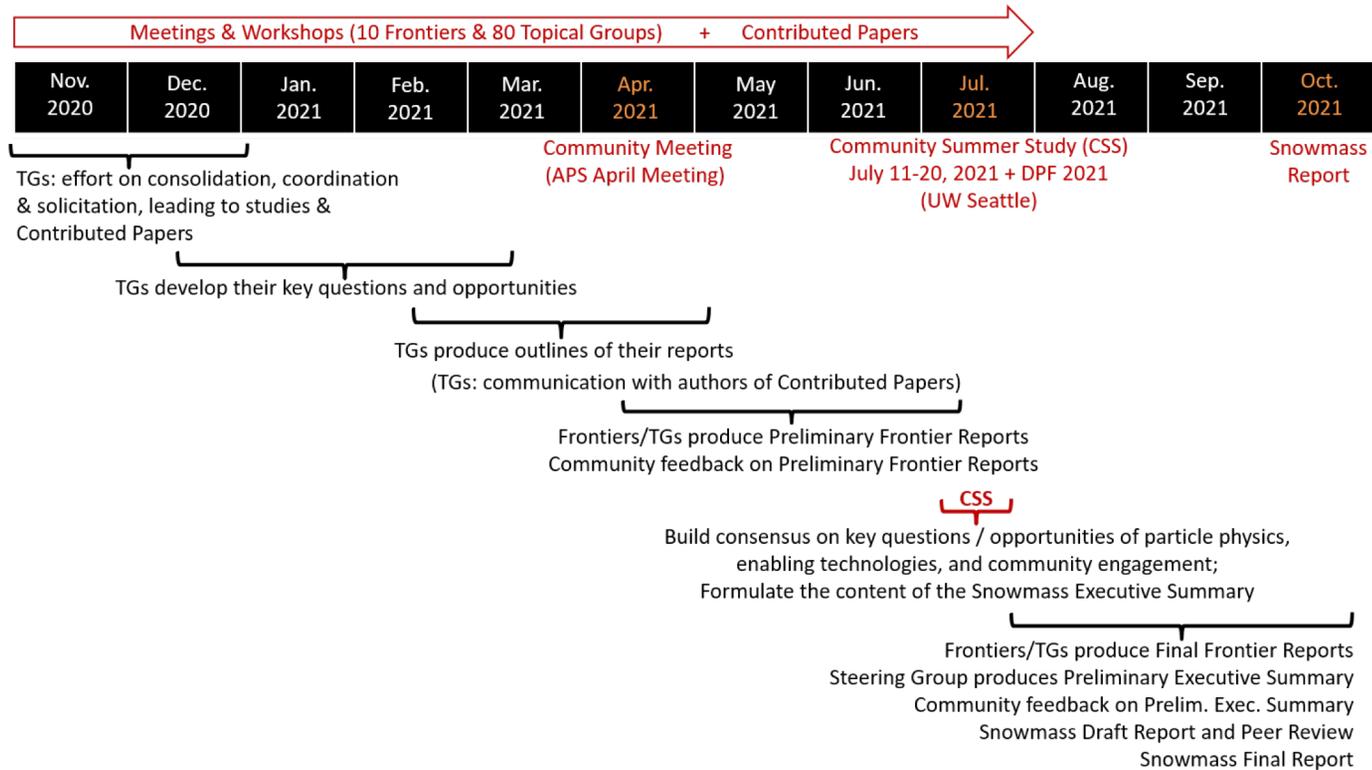
# Higgs Activities in Snowmass Groups

- **EF02: Higgs Boson as portal to new physics**
  - Understanding the big picture: new theoretical motivations for high scale physics?
  - How do measurements translate into knowledge of the UV model?
  - Comparison of reach for BSM Higgs studies at new colliders
- **EF04: EW precision physics and constraining new physics**
  - Goal is to update SMEFT fits from ESG
    - Updated inputs
    - Updated theory
    - Understanding flavor
  - Synergy with LHC EFT working group (Many individuals are involved in LHC Higgs group, LHC top group, LHC EW group, LHC EFT group, EF04,  $e^+e^-$  studies)

# Snowmass Process

- Snowmass **does not** make recommendations
- A committee appointed by DOE and NSF (P5) will take Snowmass input and make recommendations
- Snowmass is an open process: **All** are welcome to attend meetings and contribute
- Contributions are in the form of *White Papers* which will be summarized in Topical Group Reports (20-50 pages)
  - You can just write a white paper and submit it, but it would be extremely useful if you contacted topical group leaders and discussed preliminary ideas
- Topical group summaries will attempt to compare physics potentials of future options
- Builds on work of European Strategy Group

# Snowmass Timeline



# Conclusions

- Contributions from LHC Higgs group are very welcome
  - Either from individuals or working groups
  - Updates since ESG important
- Distributed Higgs efforts in Snowmass process
- It's not too late to get involved in Snowmass topical group efforts
- Goal is to have Snowmass Higgs efforts synergistic with other worldwide efforts
- To contribute white papers, see the schedule of meetings, or sign up for mailings go to: [Snowmass 2021](#)