



Division of Particles & Fields



Welcome to the TF Conference!

Tao Han

University of Pittsburgh

2021 DPF Chair

On behalf of the Snowmass Steering Group

Feb. 23, 2022



Snowmass

In June 28 - July 16, 1982, the APS DPF organized an workshop, at Snowmass, Colorado, to “assess the future of elementary particle physics, to explore the limits of our technological capabilities, and to consider the nature of future major facilities for particle physics in the US.”



The tradition has continued; activities broadened:
The DPF organizes our community every 7 - 10 years.

Snowmass 2021:



APS DPF-led community scientific study, kicked off in April 2020

To define the most important questions for the field of particle physics

To identify promising opportunities to address them, for the decades to come

- To achieve a broader & deeper understanding of the science in our field
 - To engage junior scientists & foster our community development
 - To reach a compelling vision for the field moving forward
- input to the “Particle Physics Project Prioritization Panel” (P5) process!

Snowmass Theory Frontier: breadth & depth



Nathaniel Craig



Csaba Csaki



Aida El-Khadra

Topical Group	Conveners
TF01: String theory, quantum gravity, black holes	Daniel Harlow (MIT), Shamit Kachru (Stanford), Juan Maldacena (IAS)
TF02: Effective field theory techniques	Patrick Draper (UIUC), Ira Rothstein (CMU)
TF03: CFT and formal QFT	David Poland (Yale), Leonardo Rastelli (Stony Brook)
TF04: Scattering amplitudes	Zvi Bern (UCLA), Jaroslav Trnka (UCD)
TF05: Lattice gauge theory	Zohreh Davoudi (UMD), Taku Izubuchi (BNL), Ethan Neil (CU Boulder)
TF06: Theory techniques for precision physics	Radja Boughezal (ANL), Zoltan Ligeti (LBNL)
TF07: Collider phenomenology	Fabio Maltoni (Louvain/Bologna), Shufang Su (U Arizona), Jesse Thaler (MIT)
TF08: BSM model building	Patrick Fox (FNAL), Graham Kribs (U Oregon), Hitoshi Murayama (UC Berkeley)
TF09: Astro-particle physics & cosmology	Dan Green (UCSD), Joshua Ruderman (NYU), Ben Safdi (UM), Jessie Shelton (UIUC)
TF10: Quantum Information Science	Simon Catterall (Syracuse), Roni Harnik (FNAL), Veronika Hubeny (UCD)
TF11: Theory of neutrino physics	André de Gouvêa (Northwestern U.), Irina Mocioiu (Penn State U.), Saori Pastore (Washington U.), Louis Strigari (TAMU)

Snowmass Theory Frontier: Overarching

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

Endless frontier

Snowmass Early Career

to represent early career members and promote their engagement in the Snowmass 2021 process; to build a long-term HEP early career community

Let's get to work, make your voice heard:

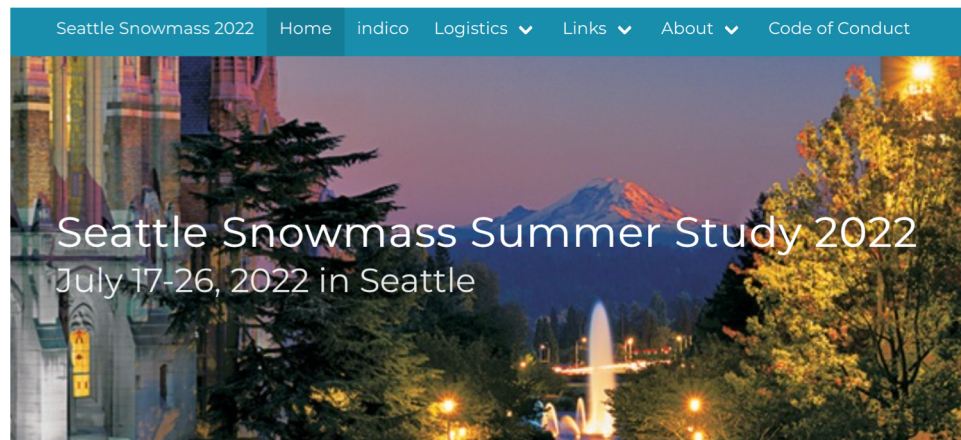
Engage in the dynamic TF activities!

Contributed papers (white papers) **by March 15**

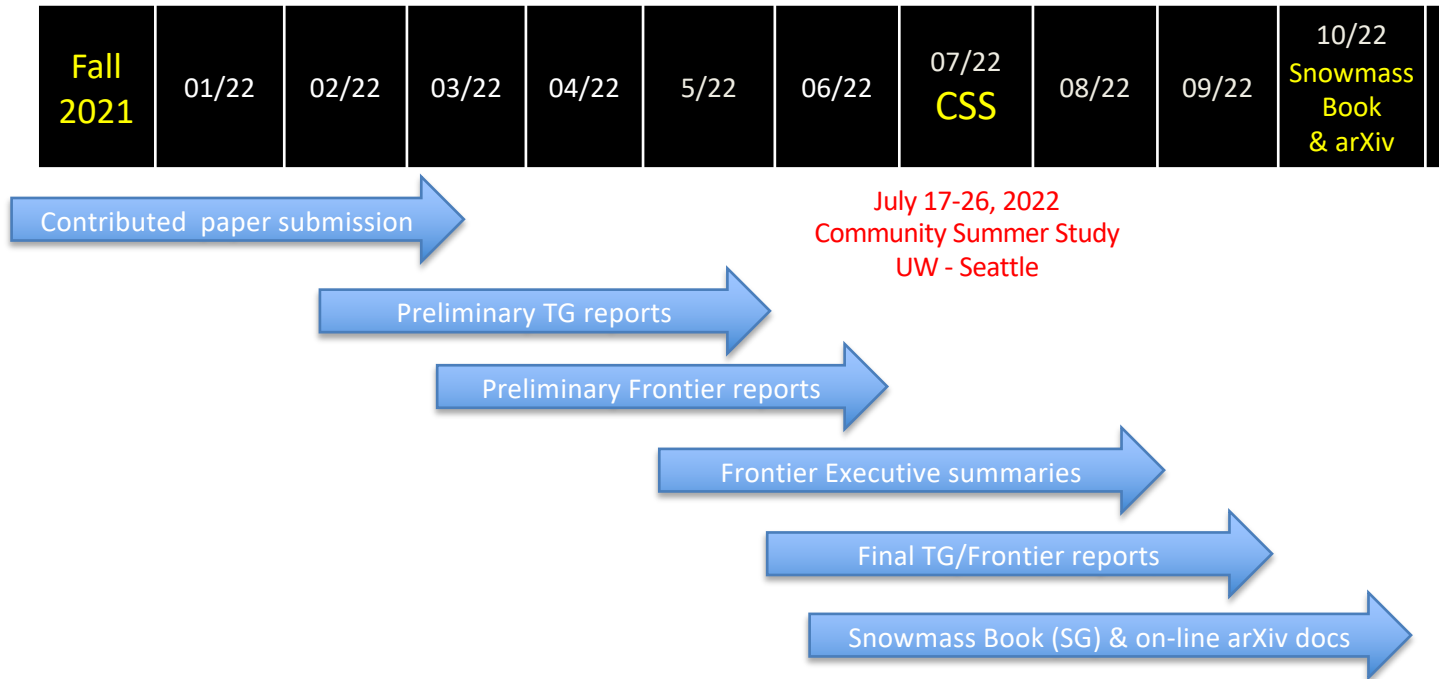
→ TG reports → Frontier reports → Snowmass Book

- Share the excitements of the science in our field.
- Show the importance of your work:
 - Impacts on experimental projects
 - Exploration of fundamental physics, new insights, intellectual pursuits
- Lay out the need for support from the communities & funding agencies.

Community Summer Study (CSS)



Snowmass Timelines



**Look forward to the best Snowmass outcome
& the next P5 exercise!
Enjoy the TF conference!**