Seattle Snowmass Summer Meeting 2022

Community Summer Study
SNOWMASS
July 17-26 2022, Seattle

Saturday, July 16, 2022 - Tuesday, July 26, 2022

Scientific Program

Snowmass is a scientific study. It provides an opportunity for the entire particle physics community to come together to identify and document a scientific vision for the future of particle physics in the U.S. and its international partners. Snowmass will define the most important questions for the field of particle physics and identify promising opportunities to address them.

To learn more details: https://snowmass21.org

ENERGY FRONTIER

The Energy Frontier (EF) group will explore the TeV energy scale and beyond. Our sharply focussed 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, including unraveling the mystery of dark matter. In this context, the EF group will carry out (and compile) detailed studies of Electroweak (EW) physics, QCD and strong interactions, and Beyond-Standard-Model (BSM) physics under different future accelerator scenarios, including lepton-lepton, hadron-hadron, and lepton-hadron colliders.

EW Physics: Higgs Boson properties and couplings

EW Physics: Higgs Boson as a portal to new physics

EW Physics: Heavy flavor and top quark physics

EW Physics: EW Precision Physics and constraining new physics

QCD and strong interactions:Precision QCD

QCD and strong interactions:Hadronic structure and forward QCD

QCD and strong interactions: Heavy Ions

BSM: Model specific explorations

BSM: More general explorations

BSM: Dark Matter at colliders

Neutrino Physics Frontier

This Frontier covers topics relevant to physics associated with neutrinos.

Neutrino Oscillations

Understanding Experimental Neutrino Anomalies

BSM

Neutrinos from natural sources

Neutrino properties

Neutrino Interaction Cross Sections

Applications

Theory of Neutrino Physics

Artificial Neutrino Sources

Neutrino Detectors

Rare Processes and Precision

The Frontier for Rare Processes and Precision Measurements explores fundamental physics with intense sources and ultra-sensitive detectors. It encompasses seeking tiny deviations from Standard Model expectations in properties and transitions of elementary particle and searches for extremely rare processes. The Frontier for Rare Processes and Precision Measurements experiments use precision measurements to probe quantum effects and employ sophisticated theoretical techniques for their interpretations. These experiments typically investigate new laws of physics that manifest themselves at higher energies or weaker interactions than those directly accessible at high-energy particle accelerators. These experiments require the greatest possible beam intensities of electrons, muons, photons or hadrons, as well as large detectors, which provide an opportunity for substantial new discoveries complementary to other Frontier experiments.

Please follow the links to the Topical Groups below to learn about specific topics, experiments, and theoretical methods employed in the Frontier for Rare Processes and Precision Measurements.

Weak decays of b and c quarks

Weak decays of strange and light quarks

Fundamental Physics in Small Experiments

Baryon and Lepton Number Violating Processes

Charged Lepton Flavor Violation (electrons, muons and taus)

Dark Sector Studies at High Intensities

Hadron Spectroscopy

Cosmic Frontier

The Cosmic frontier includes probes of the fundamental nature of dark matter and dark energy, and opportunities using astrophysical and cosmological data to learn about fundamental physics.

Dark Matter: Particle-like

Dark Matter: Wave-like

Dark Matter: Cosmic Probes

Dark Energy and Cosmic Acceleration: The Modern Universe

Dark Energy and Cosmic Acceleration: Cosmic Dawn and Before

Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

Cosmic Probes of Fundamental Physics

Theory Frontier

The goal of the Theory Frontier is to articulate the recent advances and future opportunities in all aspects of theory relevant to HEP, including particle theory, formal/string theory, cosmological and astro-particle theory, and quantum information science. As a cross-cutting frontier, the Theory Frontier is also charged with coordinating theory-related activities with the other frontiers in topics of overlapping interest.

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 & cosmology

Quantum Information Science

Theory of neutrino physics

Accelerator Frontier

The Accelerator Frontier activities include discussions on high-energy hadron and lepton colliders, high-intensity beams for neutrino research and for the “Physics Beyond Colliders”, accelerator technologies, science, education and outreach as well as the progress of core accelerator technology, including RF, magnets, targets and sources.

Beam Physics and Accelerator Education

Accelerators for Neutrinos

Accelerators for EW/Higgs

Multi-TeV Colliders

Accelerators for PBC and Rare Processes

Advanced Accelerator Concepts

Accelerator Technology R&D

Instrumentation Frontier

The Instrumentation Frontier group is geared to discussing detector technologies and R&D needed for future experiments in collider physics, neutrino physics, intensity physics and at the cosmic frontier. It is divided into more or less diagonal sub-groups with some overlap among a few of them. The sub-groups are Calorimetry, Cross Cutting and Systems Integration, Electronics/ASICs, Micro Pattern Gas Detectors, Noble Elements, Photon Detectors, Quantum Sensors, Solid State Detectors and Tracking, and Trigger and DAQ. Synergies between the different sub-groups, as well as with other Frontier groups and research areas outside of HEP will be paid close attention to.

Quantum Sensors

Photon Detectors

Solid State Detectors and Tracking

Trigger and DAQ

Micro Pattern Gas Detectors (MPGDs)

Calorimetry

Electronics/ASICs

Noble Elements

Cross Cutting and Systems Integration

Radio Detection

Computational Frontier

Software and Computing are an integral part of the science process. High Energy Physics traditionally had the largest computing resource needs and subsequently most complex software stack in science. This is not true anymore, with many other science domains predicting equal or larger resource needs. The Computational Frontier will assess the software and computing needs of the High Energy Physics community emphasizing common needs and common solutions across the frontiers. We want to gain an overall understanding of the community's needs and discuss common solutions to them in the context of current and future solutions from the HEP community, other science disciplines and industry solutions. Our focus is to facilitate discussions amongst all frontiers and don't separate them into individual groups.

Experimental Algorithm Parallelization

Theoretical Calculations and Simulation

Machine Learning

Storage and processing resource access (Facility and Infrastructure R&D)

End user analysis

Quantum computing

Reinterpretation and long-term preservation of data and code

Underground Facilities Frontiers

This topic crosscuts several scientific Frontiers. Underground_Facilities_and_Infrastructure covers requirements for underground science to succeed, including underground lab development, low background methods, and interdisciplinary synergies.

Underground Facilities for Neutrinos

Underground Facilities for Cosmic Frontier

Underground Detectors

Supporting Capabilities

Synergistic Research

An Integrated Strategy for Underground Facilities and Infrastructure

Community Engagement Frontier

The Community Engagement Frontier consists of several topical groups, namely applications, career pipeline and development, diversity and inclusion, physics education, public education and outreach, and public policy and government engagement. The objective is to improve and sustain strategic engagements with our communities in order to draw support for and strengthen the field of particle physics, while playing key roles in serving those communities. These engagements take well-coordinated efforts in many areas where the communities of experts and non-experts can understand and communicate our field’s value, maximize its impact on global socioeconomic development, and open its doors to broader participation. The efforts aim to support and encourage practical applications of research in particle physics and technology transfers to industries, career development and job opportunities for graduates and young physicists, encouragement and inclusion of diverse physicists reflecting the diversity in our communities, improvement in physics education to produce talented and qualified students, outreach to motivate pupils and students, and to communicate the essence and impact of physics research, and finally engagement with governments and policymakers in matters of education and research for continued funding supports.

Applications & Industry

Career Pipeline & Development

Diversity & Inclusion

Physics Education

Public Education & Outreach

Public Policy and Government Engagement

Environmental and Societal Impacts