

# experiment

## Making a compelling case for Snowmass 21

### Frontier for Rare Processes and Precision Measurements

**Alexey A. Petrov**  
Wayne State University

# What is Snowmass?

The Particle Physics Community Planning Exercise (a.k.a. “Snowmass”) is organized by the Division of Particles and Fields (DPF) of the American Physical Society.

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.

The P5, Particle Physics Project Prioritization Panel, will take the scientific input from Snowmass and develop a strategic plan for U.S. particle physics that can be executed over a 10 year timescale, in the context of a 20-year global vision for the field.

# Snowmass 2021: Frontiers

## Energy Frontier



Meenakshi Narain (Brown U)



Laura Reina (FSU)



Alessandro Tricoli (BNL)

## Frontier in Neutrino Physics



Patrick Huber (Virginia Tech)



Kate Scholberg (Duke University)



Elizabeth Worcester (BNL)

## Frontier for Rare Processes & Precision Measurements



Marina Artuso (Syracuse U.)



Alexey Petrov (Wayne State U.)



Bob Bernstein (FNAL)

## Cosmic Frontier



Aaron Chou (Fermilab)



Marcelle Soares-Santos (Brandeis)



Tim Tait (UC Irvine)

## Theory Frontier



Nathaniel Craig (UCSB)



Csaba Csaki (Cornell)



Aida El-Khadra (UIUC)

## Accelerator Frontier



Steve Gourlay (LBNL)

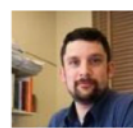


Tor Raubenheimer (SLAC)



Vladimir Shiltsev (FNAL)

## Instrumentation Frontier



Phil Barbeau (Duke)



Petra Merkel (FNAL)



Jinlong Zhang (ANL)

## Computational Frontier



Steven Gottlieb (Indiana U)



Ben Nachman (LBNL)



Oliver Gutsche (FNAL)

## Underground Facilities &

## Infrastructure Frontier



Laura Baudis (U. Zurich)



Jeter Hall (SNOLAB)



Kevin Lesko (LBNL)



John Orrell (PNNL)

## Community Engagement Frontier



Kétévi A. Assamagan (BNL)



Breese Quinn (Mississippi)

# Frontier for Rare Processes and Precision Measurements

*SnowMass2021*

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FRONTIER CONVENERS

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NEUTRINO PHYSICS FRONTIER

RARE PROCESSES AND PRECISION

COSMIC FRONTIER

THEORY FRONTIER

ACCELERATOR FRONTIER

INSTRUMENTATION FRONTIER

COMPUTATIONAL FRONTIER

UNDERGROUND FACILITIES

## RARE PROCESSES AND PRECISION MEASUREMENTS

### Frontier Conveners

Name	Institution	email
Marina Artuso	Syracuse University	martuso[at]syr.edu
Bob Bernstein	Fermi National Accelerator Lab	rhbob[at]fnal.gov
Alexey A Petrov	Wayne State University	apetrov[at]wayne.edu

### Description

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.

### -Table of Contents

- RARE PROCESSES AND PRECISION MEASUREMENTS
  - Frontier Conveners
  - Description
  - Topical groups
  - Calendar of meetings
  - Communications
  - Submitted LOI

<https://snowmass21.org/rare/start>



# Frontier for Rare Processes and Precision Measurements

## Topical groups

- **RF1: Weak decays of b and c quarks** (Angelo Di Canto/Stefan Meinel)
- **RF2: Weak decays of strange and light quarks** (Evgueni Goudzovski/Emilie Passemar)
- **RF3: Fundamental Physics in Small Experiments** (Tom Blum/Peter Winter)
- **RF4: Baryon and Lepton Number Violating Processes** (Pavel Fileviez Perez/Andrea Pocar)
- **RF5: Charged Lepton Flavor Violation (electrons, muons and taus)** (Bertrand Echenard/Sacha Davidson)
- **RF6: Dark Sector Studies at High Intensities** (Mike Williams/Stefania Gori)
- **RF7: Hadron Spectroscopy** (Tomasz Skwarnicki/Richard Lebed)

Liaisons with other frontiers:

- Energy Frontier: Angelo Di Canto
- Neutrino Frontier: Bob Bernstein
- Cosmic Frontier: Susan Gardner
- Theory Frontier: Alexey Petrov
- Accelerator Frontier: Bob Bernstein
- Instrumentation Frontier: Marina Artuso
- Computational Frontier: Stefan Meinel
- Community Engagement Frontier: Sophie Middleton

[SNOWMASS-RP-FRONTIER@fnal.gov](mailto:SNOWMASS-RP-FRONTIER@fnal.gov)

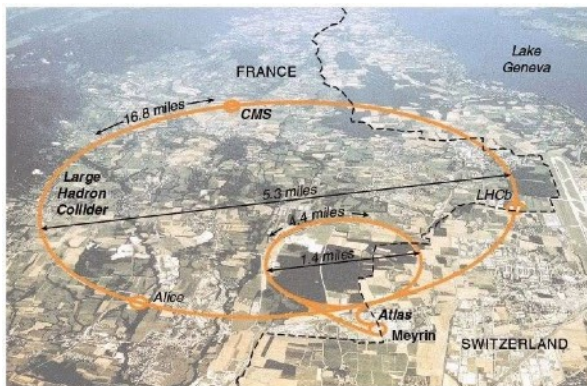
1. [SNOWMASS-RPF-01-HEAVY-QUARKS@FNAL.GOV](mailto:SNOWMASS-RPF-01-HEAVY-QUARKS@FNAL.GOV)
2. [SNOWMASS-RPF-02-LIGHT-QUARKS@FNAL.GOV](mailto:SNOWMASS-RPF-02-LIGHT-QUARKS@FNAL.GOV)
3. [SNOWMASS-RPF-03-FUNDAMENTL-SMALL@FNAL.GOV](mailto:SNOWMASS-RPF-03-FUNDAMENTL-SMALL@FNAL.GOV)
4. [SNOWMASS-RPF-04-BLNV@FNAL.GOV](mailto:SNOWMASS-RPF-04-BLNV@FNAL.GOV)
5. [SNOWMASS-RPF-05-CLFV@FNAL.GOV](mailto:SNOWMASS-RPF-05-CLFV@FNAL.GOV)
6. [SNOWMASS-RPF-06-DARK-SECTOR@FNAL.GOV](mailto:SNOWMASS-RPF-06-DARK-SECTOR@FNAL.GOV)
7. [SNOWMASS-RPF-07-HADR-SPECT@FNAL.GOV](mailto:SNOWMASS-RPF-07-HADR-SPECT@FNAL.GOV)

<https://snowmass21.org/rare/start>

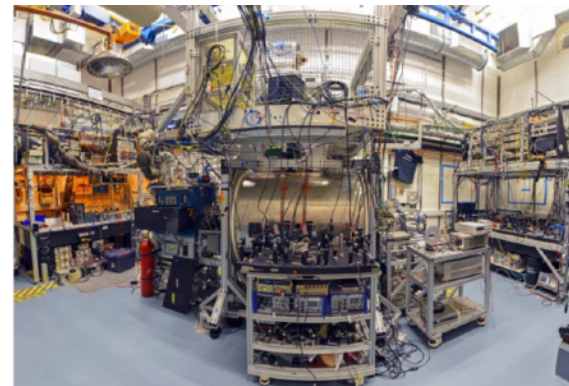
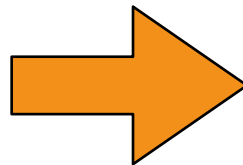
# Frontier for Rare Processes and Precision Measurements

## Topical groups

- RF1: Weak decays of b and c quarks (Angelo Di Canto/Stefan Meinel)
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Accelerator-based experiments



"Table-top" experiments

Frontier summary: searches for new (rare) phenomena with precision measurements

## **Letters of Interest (submission period: April 1, 2020 – August 31, 2020)**

Letters of interest allow Snowmass conveners to see what proposals to expect and to encourage the community to begin studying them. **They helped conveners to prepare the Snowmass Planning Meeting that took place on October 5 - 8, 2020 at Fermilab on Zoom.** Letters should give brief descriptions of the proposal and cite the relevant papers to study. Instructions for submitting letters are available at <https://snowmass21.org/loi>. Authors of the letters are encouraged to submit a full writeup for their work as a contributed paper.

## **Contributed Papers (submission period: April 1, 2020 – March 31, 2022)**

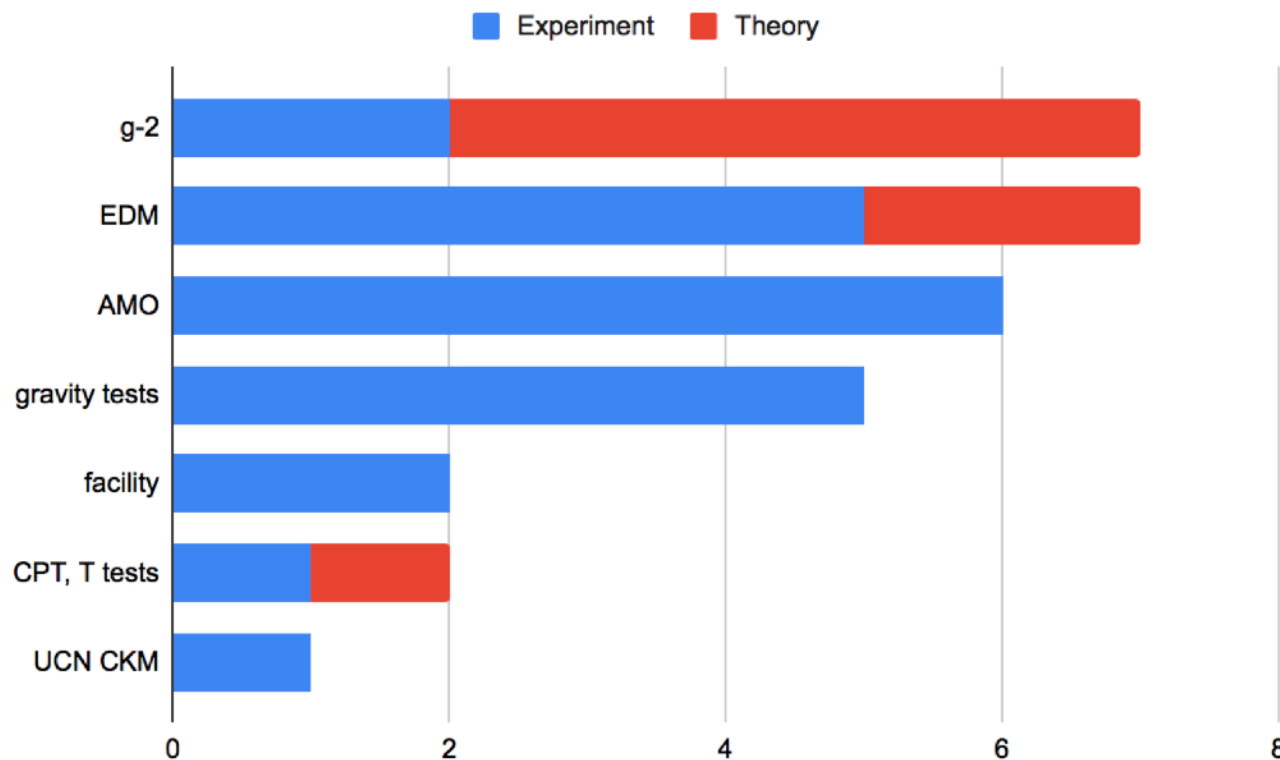
Contributed papers will be part of the Snowmass proceedings. They may include white papers on specific scientific areas, technical articles presenting new results on relevant physics topics, and reasoned expressions of physics priorities, including those related to community involvement. **These papers and discussions throughout the Snowmass process will help shape the long-term strategy of particle physics in the U.S.** Contributed papers will remain part of the permanent record of Snowmass 2021. Instructions for submitting contributed papers are available at <https://snowmass21.org/submissions/> (both solicited and non-solicited)

## **Final Product: Snowmass Report (submission: 30 September 2022)**

**The Town Hall meeting was held in response to Letters of Interest (LOIs) submitted to our Frontier. It offered the submitters of LOIs a chance to make presentations on the topic of their LOIs.**

# Letters of Interest (LOIs)

- 214 LOIs submitted to RPF
  - physics, devices/experiments, facilities
  - example distribution for RF3-5:



- wide variety of LOIs -> “on-point” Contributed Papers

## SnowMass2021

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### - Organization

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### - Snowmass Frontiers

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## Welcome to Snowmass 2021

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- Timeline:

31 August 2020:	Submission of Letters of Interest (LOIs)
End of March 2022:	Submission of Contributed Papers to arXiv
30 June 2022:	Preliminary reports of the Frontiers
July 2022:	Community Summer Study meeting (UW Seattle)
30 September 2022:	Final Reports

Sincerely,

Young-Kee Kim (DPF Chair), Tao Han (DPF Chair-Elect), Joel Butler (DPF Vice-Chair), Priscilla Cushman (DPF Past Chair)

Glennys Farrar (DAP Rep), Gabriela Gonzales (DGRAV Rep), Yury Kolomensky (DNP Rep), Sergei Nagaitsev (DPB Rep)

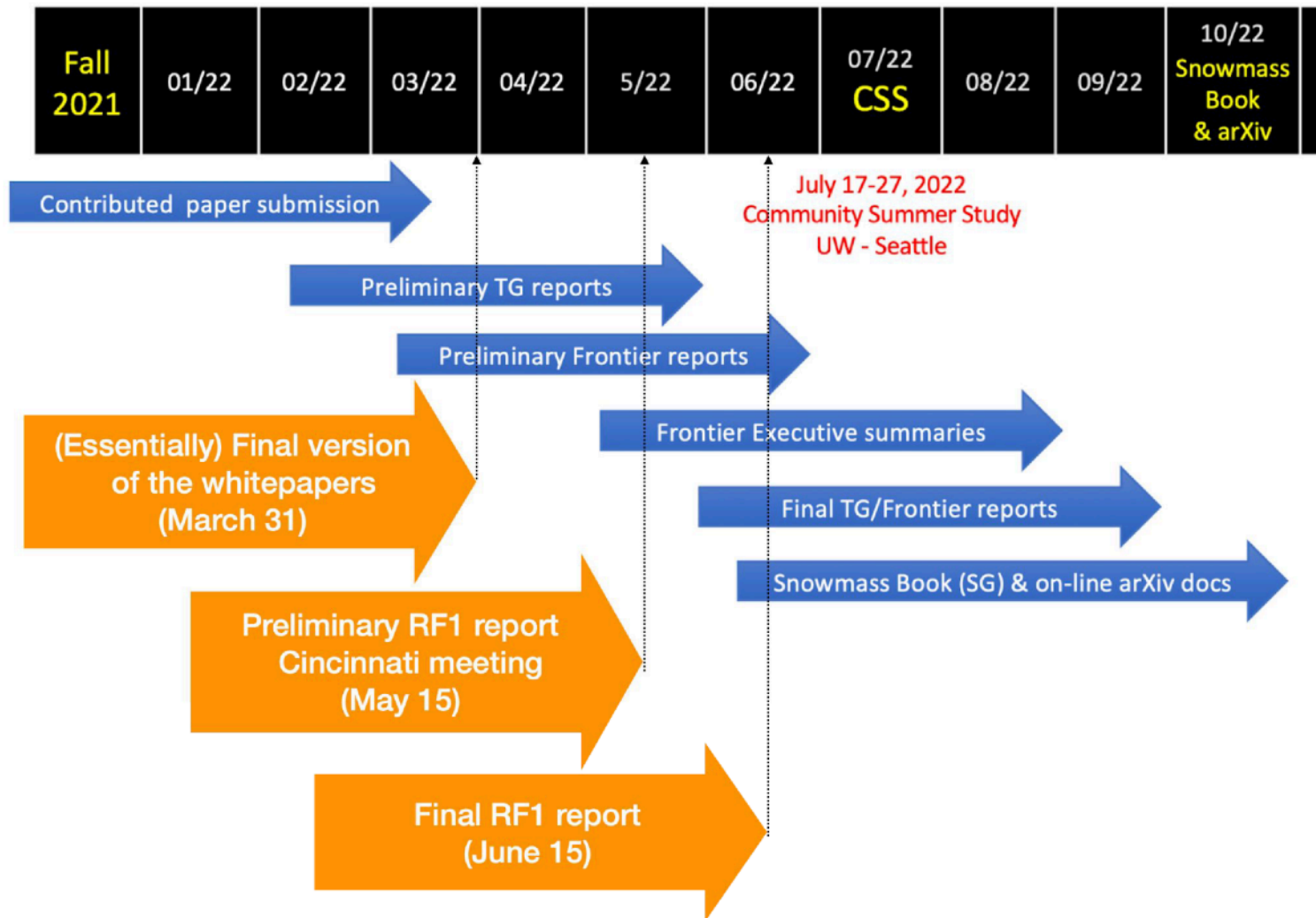
## DPF Community Planning Process

<https://snowmass21.org/start>

10 Frontiers



# Snowmass 2021: timeline



# The Way: idea $\Rightarrow$ LOI $\Rightarrow$ Contributed Paper

- Theoretical Letter of Intent

## Physics of muonium and muonium oscillations

Alexey A. Petrov<sup>1</sup>

<sup>1</sup>*Department of Physics and Astronomy  
Wayne State University, Detroit, MI 48201, USA*

Precision studies of a muonium, the bound state of a muon and an electron, provide access to physics beyond the Standard Model. We propose that extensive theoretical and experimental studies of atomic physics of a muonium, its decays and muonium-antimuonium oscillations could provide an impact on indirect searches for new physics.

## *Search for Muonium to Antimuonium Conversion*

**RF Topical Groups:** (check all that apply ☐/☒)

- ☐ (RF1) Weak decays of b and c quarks
- ☐ (RF2) Weak decays of strange and light quarks
- ☐ (RF3) Fundamental Physics in Small Experiments
- ☐ (RF4) Baryon and Lepton Number Violating Processes
- ☒ (RF5) Charged Lepton Flavor Violation (electrons, muons and taus)
- ☐ (RF6) Dark Sector Studies at High Intensities
- ☐ (RF7) Hadron Spectroscopy
- ☐ (Other) [Please specify frontier/topical group(s)]

**Contact Information:**(authors listed after the text)

Name and Institution: Jian Tang/Sun Yat-sen University

Collaboration: MACE working group

Contact Email: tangjian5@mail.sysu.edu.cn

**Abstract:** It is puzzling whether there is any charged lepton flavor violation phenomenon beyond standard model. The upcoming Muonium (bound state of  $\mu^+e^-$ ) to Antimuonium ( $\mu^-e^+$ ) Conversion Experiment (MACE) will serve as a complementary experiment to search for charged lepton flavor violation processes, compared with other on-going experiments like Mu3e ( $\mu^+ \rightarrow e^+e^-e^-$ ), MEG-II ( $\mu^+ \rightarrow e^+\gamma$ ) and Mu2e/COMET ( $\mu^-N \rightarrow e^-N$ ). MACE aims at a sensitivity of  $P(\mu^+e^- \rightarrow \mu^-e^+) \sim \mathcal{O}(10^{-13})$ , about three orders of magnitude better than the best limit published two decades ago. It is desirable to optimize the slow and ultra-pure  $\mu^+$  beam, select high-efficiency muonium formation materials, develop Monte-Carlo simulation tools and design a new magnetic spectrometer to increase S/B.

- Experimental Letter of Intent

- Step 0: LOI submission
  - if submitted: good!
  - if NOT submitted: also good!
- Step 1: Contributed paper (CP) decision
  - inform Frontier/Topical Group conveners that you are interested
  - project consolidation: if possible (conveners provide contacts)
  - CPs based on physics (if possible): trying to avoid multitude of similar CPs
- Step 2: Contributed paper submission
  - please submit your paper here: <https://snowmass21.org/submissions/>
  - submit your paper to arXiv

# What do we expect from a big experiment

- There are, technically, no rules on how many CPs are submitted by a large experiment such as Belle/Belle II
  - RF does provide guidelines
- RF: a single white paper that describes the detector/upgrades and physics program relevant to our frontier would be useful
  - individual topical group conveners may reach out about specific physics
  - “main” CP should describe the detector/upgrades, the key performance assets and the overall physics program
- RF TGs worked out different concepts on how they approach CPs
  - those concepts are designed to best suit the goals that each TG tries to accomplish
  - contributed papers are due at the end of March
  - please contact the TG conveners if you have not yet done so!

# Frontier for Rare Processes and Precision Measurements

## Topical groups

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<https://snowmass21.org/rare/start>



## RF1 Overview Whitepapers

Topic	Editor 1 (Experiment)	Editor 2 (Theory)
High precision in CKM unitarity tests in b and c decays	Stephane Monteil (Clermont-Ferrand U.)	Alexander Lenz (Siegen U.)
Searches for other sources of CP violation in b and c decays	Diego Tonelli (INFN Trieste)	Yuval Grossman (Cornell U.)
Lepton-flavor violation and lepton-flavor-universality violation in b and c decays	Patrick Koppenburg (Nikhef)	Gudrun Hiller (TU Dortmund)
Rare decays of b and c hadrons	Flavio Archilli (Heidelberg U.)	Wolfgang Altmannshofer (UC Santa Cruz)

The whitepapers should give a concise overview of the physics discovery potential and questions that can be addressed (from both theory and experiments point of views).

(Angelo Di Canto/Stefan Meinel)

## RF2: consolidation of the 25 Lols

- (1) Rare  $\eta$  and  $\eta'$  decays (th+exp)  
Editors: C.Gatto, L.Gan, S.Gardner, S.Tulin
- (2) Rare charged pion decays: LFU and  $V_{ud}$  (exp)  
Editors: D.Bryman, D.Hertzog
- (3) Rare kaon decays, mainly  $K \rightarrow \pi \nu \nu$ ,  $K_S \rightarrow \mu^+ \mu^-$ ,  $K_L \rightarrow \pi l^+ l^-$  (th)  
Editor: A.Buras. Confirmed to be ready by March 15th
- (4) Radiative kaon decays (th) – interest expressed  
Possible editors: G.D'Ambrosio, M.Knecht
- (5) Rare kaon decay experiments (exp) agreement reached and work started on a joint KOTO and NA62/KLEVER paper. Editorial team is established.  
About 20% of the paper is written. Confirmed to be ready by March 15th
- (6) New physics at kaon and hyperon factories, focus on hidden sectors (th+exp)  
Exp contributions from NA62, KOTO, KLEVER, LHCb, BESIII, STCF  
Editors: E.Goudzovski, D.Redigolo, K.Tobioka, J.Zupan  
Entering the final stage of the editorial process; to be published by Christmas
- (7) CKM 1<sup>st</sup> row unitarity tests (th)  
Editor: E.Passemar. Final Results being presented at CKM2021 week of Nov. 22

Ongoing discussion / awaiting response from Lol authors:

- ❖ Novel EFT connections between K and B physics: no response
- ❖ Lattice QCD computations for rare kaon decays: no response

(Evgueni Goudzovski/Emilie Passemar)



# White papers

- EDMs
  - AMO (invited Dave DeMille, Nick Hutzler, Blum)
  - Storage ring, neutron (Bill Morse, Winter)
  - Theory (Vincenzo Cirigliano, Bhattacharya, Blum)
  - Meet in 2 weeks to discuss scope/structure
- Proton EDM Storage Ring
  - Bill Morse, Y. Semertzidis
- Violation of Fundamental Symmetries, gravity (C, P, CP, T, CPT)
  - Sending out invitations soon
- G-2 Theory
  - MGm2TI will submit WP (invite LOI authors not covered)
- BSM
  - Move LOIs to other TGs or EDM WP
- Muon Facility/muonium gravity exp
  - Combine with other TGs (CLFV,...?)
- Atomic clocks
  - May be better suited to DM/axion search WP

(Tom Blum/Peter Winter)

## BLV Master White Paper

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1. **Theories for baryon and lepton number violation:** *P. Fileviez Perez (CWRU), M.B. Wise (Caltech)*
2. **Neutrinoless double beta decays:** *V. Cirigliano (LANL), A. Pocar (UMass)*
3. **Baryon and Lepton number violation at colliders:** *R. Ruiz (Cracow, INP), E. Thomson (UPenn)*
4. **Proton decay:** *E. Kearns (Boston Univ.), S. Raby (Ohio State Univ.)*
5.  **$n$ - $\bar{n}$  oscillations:** *K. Babu (OSU), L. Broussard (ORNL)*
6. **More exotic L and B violating processes:** *S. Gardner (Univ. of Kentucky), J. Heeck (Virginia)*
7. **Connections to Cosmology:** *A. Long (Rice Univ.), C. Wagner (Univ. of Chicago/ANL)*

Each pair of topical leaders will be in charge of their section.

LOIs and other white papers will be included or linked to, as needed.

(Pavel Fileviez Perez/Andrea Pocar)



## Theory

Rare muon decays and light new physics  
Physics potential with MEGII-fwd  
Possibility of Search for Bound  $\mu^- \rightarrow e^- \alpha$  Decay  
Searching for  $\mu^- \rightarrow e^+$  Conversion at Upcoming .... Radiative Muon Capture  
Search for Muon to Positron Conversion in  $\mu^- \rightarrow e^-$  Conversion Experiments  
Theory challenges and opportunities of Mu2e-II (**also in Mu2e II WP**)

## Current muon-to-electron conversion

Search for  $\mu$ -e Conversion by using Muonic Atoms .....Target (DeeMe)  
COMET  
Mu2e

## Current $\mu \rightarrow e$ gamma

The MEG II experiment and its future developments

## Current $\mu \rightarrow eee$

No LOI submitted

## New experiment for $\mu \rightarrow e$ gamma

A new experiment for the  $\mu \rightarrow e \gamma$  search

## Muonium-antimuonium

Physics of muonium and anti-muonium oscillations  
Search for Muonium to Antimuonium Conversion (MACE)



# Individual TG approaches: TG5 (cont)

## Mu2e II

All Mu2e-II stuff (13 LOIs)

## Tau

Tau Physics and Precision Electroweak Physics ..... at SuperKEKB/Belle II  
Physics Potential of a Super tau-Charm Facility\*  
Precision experiments at Super Charm-Tau Factory\*  
Physics in the t-charm Region at BESIII

## Low-energy muon facility at FNAL

Upgraded Low-Energy Muon Facility at Fermilab

## New facility at FNAL – ENIGMA

A New Charged Lepton Flavor Violation Program at Fermilab  
A Phase Rotated Intense Source of Muons (PRISM) for a  $\mu \rightarrow e$  Conversion Experiment  
Bunch Compressor for the PIP-II Linac

## High-energy colliders

Charged Lepton Flavour Violation at the FCC-ee

Altogether: 1 theory and 8-10 experimental CP

(Bertrand Echenard/Sacha Davidson)

# Individual TG approaches: TG6

Four main CPs built around Big Ideas (+ other contributed CPs)

## **Big Idea 1:**

Editors: Gordan Krnjaic, Natalia Toro

Detect dark matter particle production (production reaction or through subsequent DM scattering), with a focus on exploring sensitivity to thermal DM interaction strengths.

## **Big Idea 2:**

Editors: Brian Batell, Chris Hearty

Explore the structure of the dark sector by producing and detecting unstable dark particles: *Minimal Portal Interactions*.

## **Big Idea 3:** New Flavors and Rich Structures in Dark Sectors

Editors: Phil Harris, Philip Schuster, Jure Zupan

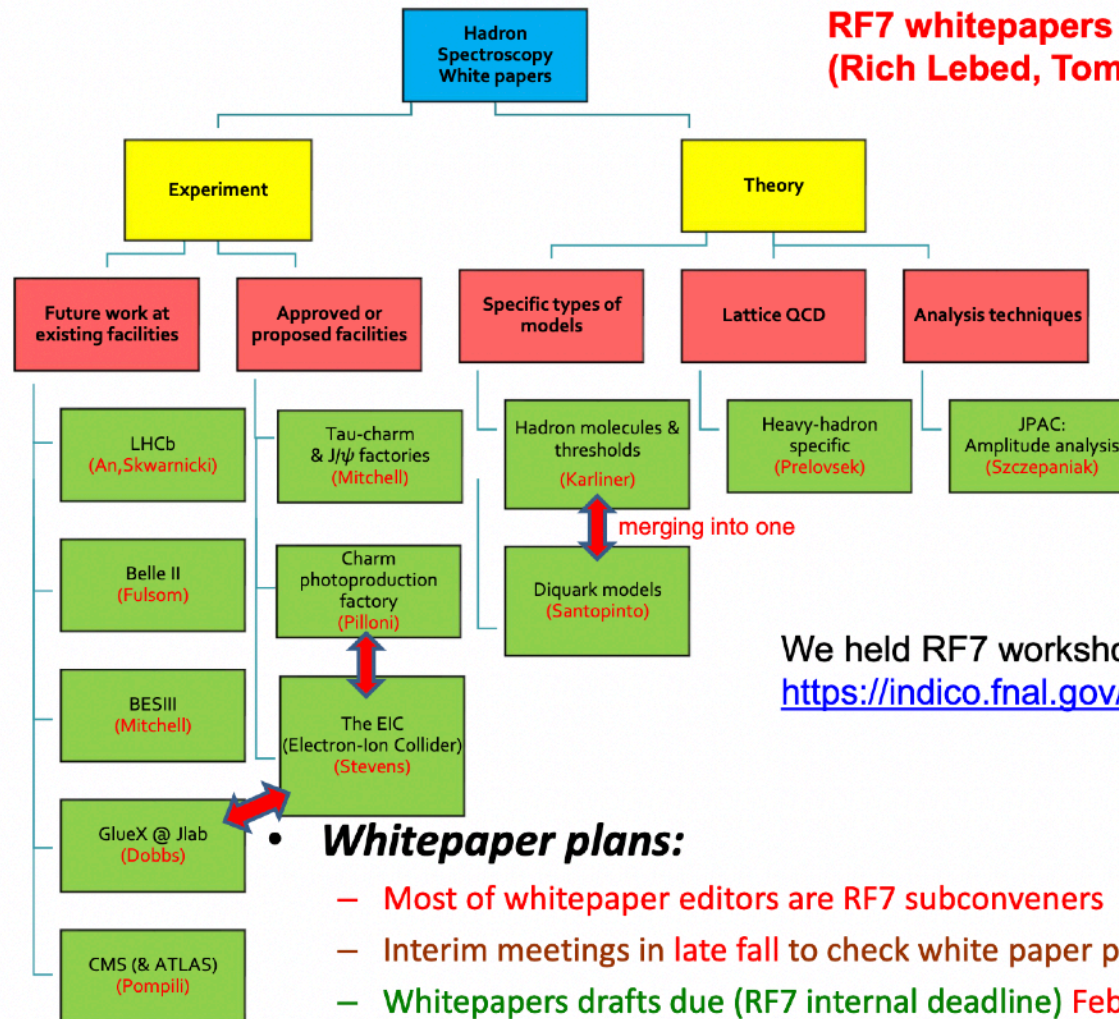
## **Summary of Experiments and Facilities:**

Editors: Phil Ilten, Nhan Tran

Short summaries of each experiment. We expect this will be a few paragraphs per experiment, and include a 1 or 2 sentence summary of each experiment that can be used in the RF6 report itself. Here, experiments can cite their own dedicated white papers or other summaries or published work.

# Individual TG approaches: TG7

**RF7 whitepapers plans**  
(Rich Lebed, Tomasz Skwarnicki)



merging into one

We held RF7 workshop on Oct 25:  
<https://indico.fnal.gov/event/51176/>

## • **Whitepaper plans:**

- Most of whitepaper editors are RF7 subconveners
- Interim meetings in late fall to check white paper progress
- Whitepapers drafts due (RF7 internal deadline) **February 1, 2022**
- Draft RF7 report: **March 31, 2022**

1

(Tomasz Skwarnicki/Richard Lebed)



## Snowmass Rare and Precision Measurements Frontier Spring Meeting

16-19 May 2022

US/Eastern timezone

### Overview

#### Scientific Programme

Pre-registration (to indicate interest in attending either in-person or virtually)

#### Participant List

Joachim Brod, Alan Schwartz

This meeting will occur approximately two months before the main Snowmass Meeting in July. The purpose of the meeting is to collectively assess the physics impact, feasibility, and priority of the numerous physics initiatives currently being studied. The goal is to produce and prioritize a list of measurements with the highest prospects for uncovering New Physics over the next ten years. Some of the meeting might be available remotely, i.e., held in hybrid mode; in that case there will be a fee for remote attendance.



**Starts** May 16, 2022, 9:00 AM

**Ends** May 19, 2022, 5:00 PM

US/Eastern

<https://indico.fnal.gov/event/51844/overview>

# Things to take home

- Community contributions are important
  - what opportunities are out there? what experiment(s) can best study them? how will it advance our understanding of Nature?
- If you plan to contribute, the time is now
  - contact us (Alexey, Bob, Marina) and TG conveners asap
- Step 1: Contributed paper (CP) decision
  - inform Frontier/Topical Group conveners that you are interested
  - project consolidation: if possible (conveners provide contacts)
- Step 2: Contributed paper submission
  - please submit your paper here: <https://snowmass21.org/submissions/>
  - submit your paper to arXiv





## Introduction: a bit of history...

- Before 1982: studies of future directions were done at large labs to address problems often specific to those labs



- Working out a unified strategy might be prudent

# Introduction: a bit of history...

- New departure for particle physics: DPF of APS commissions a “Summer Study on Elementary Particle Physics and Future Facilities”
  - Snowmass (CO), June 28- July 16, 1982
- Purpose: “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 U.S.”
- “...the future of our field from the point of view of of the best overall national program” (Charles Baltay)



Snowmass Village, CO

# Introduction: a bit of history...

- “Summer Study on Elementary Particle Physics and Future Facilities”
  - Snowmass (CO): June 28- July 16, 1982
  - approximately 150 participants
- ...
- “2001 DPF/DPB Summer Study on the Future of Particle Physics”
  - Snowmass (CO): 30 June-21 July, 2001
  - approximately 1200 participants
- “2013 Community Summer Study: Snowmass on the Mississippi”
  - New Model: pre-work+meetings
  - Univ. of Minnesota (MN): 29 July-6 Aug 2013
  - approximately 700 participants

Snowmass Village, CO



Univ. of Minnesota



## Snowmass Topics led to P5 Science Drivers

### Snowmass 2013 Report

- Frontiers
  - Energy Frontier
  - Intensity Frontier
  - Cosmic Frontier
- Cross-Cutting
  - Facilities (Underground and Accelerator)
  - Instrumentation
  - Computing
  - Theory
  - Communication

### P5 2014 Report

**Five intertwined scientific Drivers** were distilled from the results of a yearlong community-wide study:

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles



**29 recommendations !!**

Young-Kee Kim (U of Chicago)



# Snowmass 2021: advisory group

## Snowmass Advisory Group

- DPF Executive Committee

- Chair: Young-Kee Kim
- Chair-Elect: Tao Han
- Vice Chair: Joel Butler
- Past Chair: Prisca Cushman

### Steering Group

- Representatives from other Divisions

- DPB: Sergei Nagaitsev
- DNP: Yury Kolomensky
- DAP: Glennys Farrar
- DGRAV: Gabriela Gonzales

- Secretary/Treasurer: Mirjam Cvetc
- Councilor: Elizabeth Simmons
- Member-at-Large: Rick Van Kooten
- Member-at-Large: Elizabeth Worcester
- Member-at-Large: Natalia Toro
- Member-at-Large: Andre de Gouvea
- Member-at-Large: Mary Bishai
- Member-at-Large: Lauren Tompkins
- Early Career Member-at-Large: Sara Simon

- Editor and Communication

- Editor – Michael Peskin
- Communication – Bob Bernstein

- Representatives from the Int. Community

- Africa / Middle East
  - Azwinndini Muronga, Nelson Mandela Metropolitan Univ, South Africa
- Asia / Pacific
  - Atsuko Ichikawa, Kyoto University, Japan
  - Xinchou Lou, IHEP, China
- Canada
  - Heather Logan, Carleton University, Canada
- Europe / Russia
  - Val Gibson, Cavendish Laboratory, UK
  - Berrie Giebels, CNRS, France
- Latin America
  - Claudio Dib, Universidad Tecnica Federico Santa Maria, Chile

Steering group meets weekly; Advisory group meets once every 4 weeks;

All Frontier conveners + Advisory group + CPM/CSS LOC co-chairs meet once every 4 weeks

Monitoring the progress to make sure that all is moving forward smoothly to achieve the goals of the planning exercise