

# **Snowmass 2021 – RF05 CLFV**

## **Kick-off workshop: Muon Decays and Transitions**

**Sacha Davidson (Lyon), Bertrand Echenard (Caltech)**

**July 2, 2020**

# Snowmass process

Snowmass is a year long process initiated by APS DPF to provide 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)

Snowmass is primarily a **science study** group, and the outcome of this process is a report on the science.

This report will serve as input to the P5 Panel (Particle Physics Project Prioritization Panel, subpanel of HEPAP) whose role is to formulate a 10-year plan (20-year vision) for the U.S. program within funding constraints. Last Snowmass report ([here](#)) and P5 report ([here](#)).

Similar the recent European Strategy Group effort (see [here](#)).

# Rare Processes and Precision Measurement Frontier

The Frontier for Rare Processes and Precision Measurements explores fundamental physics with intense sources and ultra-sensitive detectors.

Activities are divided into 6 topical groups:

- RF01: Weak decays of b and c quarks
- RF02: Weak decays of strange and light quarks
- RF03: Fundamental Physics in Small Experiments
- RF04: Baryon and Lepton Number Violating Processes
- **RF05: Charged Lepton Flavor Violation (electrons, muons and taus)**
- RF06: Dark Sector Studies at High Intensities

Unsure where your idea belongs? Don't hesitate to contact us and we'll gladly help you

**Frontier kick-off meeting:** July 28, 2020

**Snowmass Planning Meeting:** November 4-6, 2020 at FNAL

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This topical group will address experimental and theoretical aspects of charged lepton flavor violation:

- Muon and tau LFV reactions ( $\mu \rightarrow e \gamma$ ,  $\mu \rightarrow 3e$ ,  $\mu$ - $e$  conversion, tau decays)
- Muonium-antimuonium oscillations and LFV leptonium decays
- Meson and baryon LFV decays ( $K \rightarrow \pi e \mu$ ,  $B \rightarrow K \tau e$ , ...)
- Decays of heavy states ( $h, t, Z, Z' \dots$ ) and other LFV processes at high-energy colliders
- Light to heavy lepton LFV transitions (EIC, muon beam, ...)

Aim to collect and coherently organize studies on these broad set of topics to develop a global picture and a future roadmap.

# Synergies with other groups / frontiers

Some topics will obviously overlap with other groups / frontiers (non-exhaustive list)

## RP frontier:

- RF1: Weak decays of b and c quarks
- RF2: Weak decays of strange and light quarks
- RF3: Fundamental physics in small experiments

## Other frontiers:

- AF5: Accelerators for PBC and Rare Processes
- EF02: EW Physics: Higgs Boson as a portal to new physics (and top,Z)
- EF09: BSM physics – more generic explorations
- NF03: Neutrino BSM
- TF06: Theory for precision
- TF08: BSM model building
- .....

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We have started discussion to understand how to organize cross-group / cross-frontier topics with some of these groups. For all synergistic activities, we plan to follow the relevant developments and organize joint discussions when beneficial.

The CLFV group is organizing a series of  $\sim\frac{1}{2}$  day workshops during the summer to discuss various CLFV processes and explore synergies with other frontiers.

## Upcoming workshops – Thursdays at 10h00am Central Time (each 3 weeks)

- July 2: Muon transitions and decays, muonium-antimuonium
- July 23: *Tau decays, electron-tau transitions*
- August 13\*: *Meson and baryon decays*
- September 3\*: *Heavy states decays*
- September 24\*: *CLFV with high intensity muon factory*

These workshops will be followed by shorter meeting during the fall to discuss specific topics and organize the Snowmass planning meeting in November.

\*Still tentative, final dates to be confirmed on CLFV TWIKI page / slack channel

**RF05 – CLFV TWIKI page:**

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

**Slack channel:**

rpf-05-clfv

**Mailing list:**

SNOWMASS-RPF-05-CLFV@FNAL.GOV

**Convener:**

S. Davidson (s.davidson@lupm.in2p3.fr),  
B. Echenard (echenard@caltech.edu)

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

- Help conveners to organize activities and encourage the community to study these ideas
- Should contain a brief description and cite the relevant papers to study
- Submission at <https://snowmass21.org/loi>

## **Contributed Papers (submission : April 1, 2020 – July 31, 2021)**

- Part of the Snowmass proceedings and permanent record of Snowmass 2021
- 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.
- Submission instructions: <https://snowmass21.org/submissions/>

## **Expression of Interest**

- Informal message to conveners to aid us in probing the interest of the community at large, organize future meetings and facilitate connections between people interested in similar studies. Please fill this [google form](#).
- Feel free to contact us with ideas or for volunteering to show your work or your ideas

**Please help us to reach out to the community and encourage participation!**



## CLFV - Muon Decays and Transitions

10:00 AM	→ 10:15 AM	<b>Introduction</b> Speakers: Bertrand Echenard (Caltech), Dr Sacha Davidson (University of Lyon)	🕒 15m
10:15 AM	→ 10:45 AM	<b>Theory overview: CLFV at muon scale</b> Speaker: Prof. Joe Satō (Saitama University)	🕒 30m
10:45 AM	→ 11:15 AM	<b>Mu → e gamma - experimental aspects</b> Speaker: Prof. Francesco Renga (INFN Roma)	🕒 30m
11:15 AM	→ 11:45 AM	<b>Mu → 3e - experimental aspects</b> Speaker: Prof. Niklaus Berger (University of Mainz)	🕒 30m
11:45 AM	→ 12:15 PM	<b>Break</b>	🕒 30m
12:15 PM	→ 12:45 PM	<b>Mu-e conversion - experimental aspects</b> Speaker: Frank Porter (Caltech)	🕒 30m
12:45 PM	→ 1:15 PM	<b>Light new physics in muon decays</b> Speaker: Prof. Jure Zupan (University of Cincinnati)	🕒 30m
1:15 PM	→ 1:35 PM	<b>Muonium-antimuonium transitions</b> Speaker: Alexey Petrov (Wayne State University / MCTP)	🕒 20m
1:35 PM	→ 1:55 PM	<b>Probing antimatter gravity with muons</b> Speaker: Daniel Kaplan (Illinois Institute of Technology)	🕒 20m
1:55 PM	→ 2:00 PM	<b>Closing remarks</b>	🕒 5m

Each talk should include some time for questions and discussion

## To conclude

- Snowmass 2021 has started – process will culminate with community meeting in July 2021 and publication of science report.
- We expect the first series of workshop will stimulate novel ideas and spark interesting discussions. Now is a good time to plan comprehensive studies, tempus fugit!
- We look forward to your input and shape this process based on it. Please let us know if you plan to submit a LOI or if you are interesting on collaborating to specific studies.
- Raise your hand (or just speak up) if you have questions/comments!

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