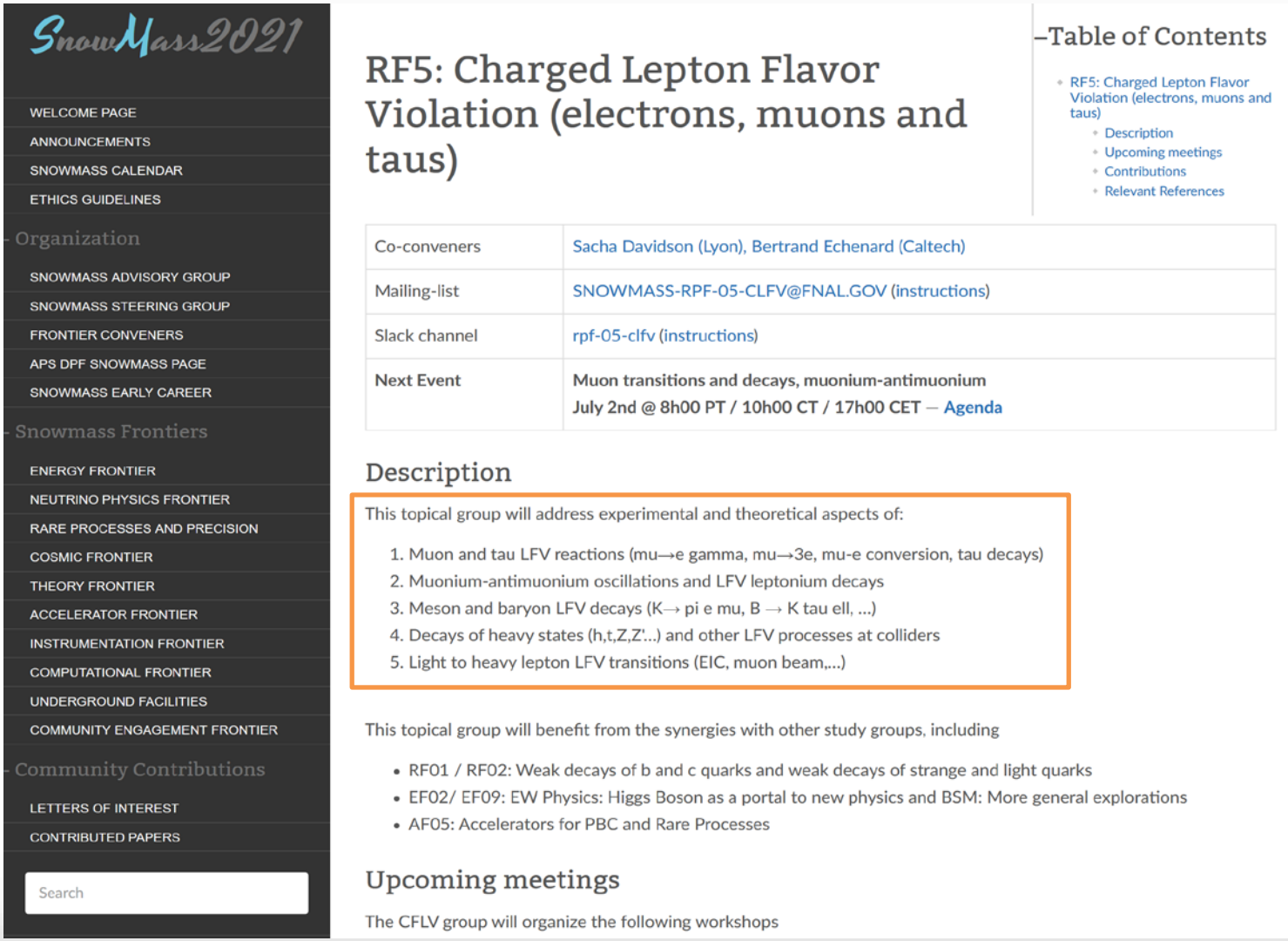
RF05 – Charged Lepton Flavor Violation

Rare and Precision Frontier Convener Meeting - June 25, 2020

S. Davidson (Lyon), B. Echenard (Caltech)

Wiki page

Redefined the topics description and added upcoming meeting calendar. We will add a section on LOI and track the topics in a google document.



SnowMass2021

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RF5: Charged Lepton Flavor Violation (electrons, muons and taus)

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Co-conveners	Sacha Davidson (Lyon), Bertrand Echenard (Caltech)
Mailing-list	SNOWMASS-RPF-05-CLFV@FNAL.GOV (instructions)
Slack channel	rpf-05-clfv (instructions)
Next Event	**Muon transitions and decays, muonium-antimuonium** **July 2nd @ 8h00 PT / 10h00 CT / 17h00 CET** – Agenda

Description

This topical group will address experimental and theoretical aspects of:

1. Muon and tau LFV reactions (mu→e gamma, mu→3e, mu-e conversion, tau decays)
2. Muonium-antimuonium oscillations and LFV leptonium decays
3. Meson and baryon LFV decays (K→ pi e mu, B → K tau ell, ...)
4. Decays of heavy states (h,t,Z,Z'...) and other LFV processes at colliders
5. Light to heavy lepton LFV transitions (EIC, muon beam,...)

This topical group will benefit from the synergies with other study groups, including

- RF01 / RF02: Weak decays of b and c quarks and weak decays of strange and light quarks
- EF02/ EF09: EW Physics: Higgs Boson as a portal to new physics and BSM: More general explorations
- AF05: Accelerators for PBC and Rare Processes

Upcoming meetings

The CFLV group will organize the following workshops

1. People/groups/experiments contacted and LOI

Experiment / people / group:

- Experiments:

Mu2e / Mu2e II	Bob Bernstein, Jim Miller	**Belle II**	Toru Iijima
COMET	Yoshitaka Kuno, Mihara Satoshi	**LHCb**	Flavio Archilli
DeeMe	Masaharu Aoki	**BES III**	Hai-Bo Li, Da-Yong Wang
Mu3e	Andre Schoening, Stefan Ritt	**NA62**	Evgueni Goudzovski
MEG / MEG II	Alessandro Baldini, Toshinori Mori	**g-2**	Marc Lancaster, Chris Polly
TauFV	Guy Wilkinson	**EIC**	Abhay Deshpande

- Contributors to the CLFV report of Snowmass 2013
- Personal contacts – a long list of theorists and experimentalists
- High intensity muon beam study group – cross-group with AF05
  - Currently a few people (FNAL, Caltech, CUNY) to study feasibility of FFAG or bright surface muon beam at FNAL.
  - Rapidly growing, several people have expressed interest (Kirch et al. @ PSI, Kaplan @ IIT, author of past PRISM study: Pasternak @ IC, more FNAL people,…)
  - Semi-regular meetings (still in the organizational phase) – coordination with AF05

The contact list can be dumped into Peter's spreadsheet if you wish.

1. People/groups/experiments contacted and LOI

Snowmass groups

- EF02 / EF09 to discuss heavy state (h,Z,Z',t) CLFV decays.
  - Just started discussion with EF09. I realized we forgot to include the energy frontier liaison in our preliminary discussion, we will cc you in the future.
  - EF02 hasn't responded yet, a little push might be in order.
- AF05 to discuss future accelerator concepts (with Bob).
- Need to coordinate with RF01/RF02 for meson and baryon LFV decays and RF04 to understand synergies.

1. People/groups/experiments contacted and LOI

Expected submissions:

- Mu2e / Mu2e II will submit several LOI for next generation mu->e conversion
- Belle II for tau CLFV
- Several new concept for mu->e gamma and mu->3e
- Muonium – antimuonium transitions
- FFAG / surface muon beam at FNAL
- Heavy state decays with EF09/EF02

We haven't heard about meson/baryon decays or light-to-heavy lepton transition so far (e.g. EIC), but the workshops should help stimulating contributions. We'll also do some personal follow-up.

Submitted so far:
None

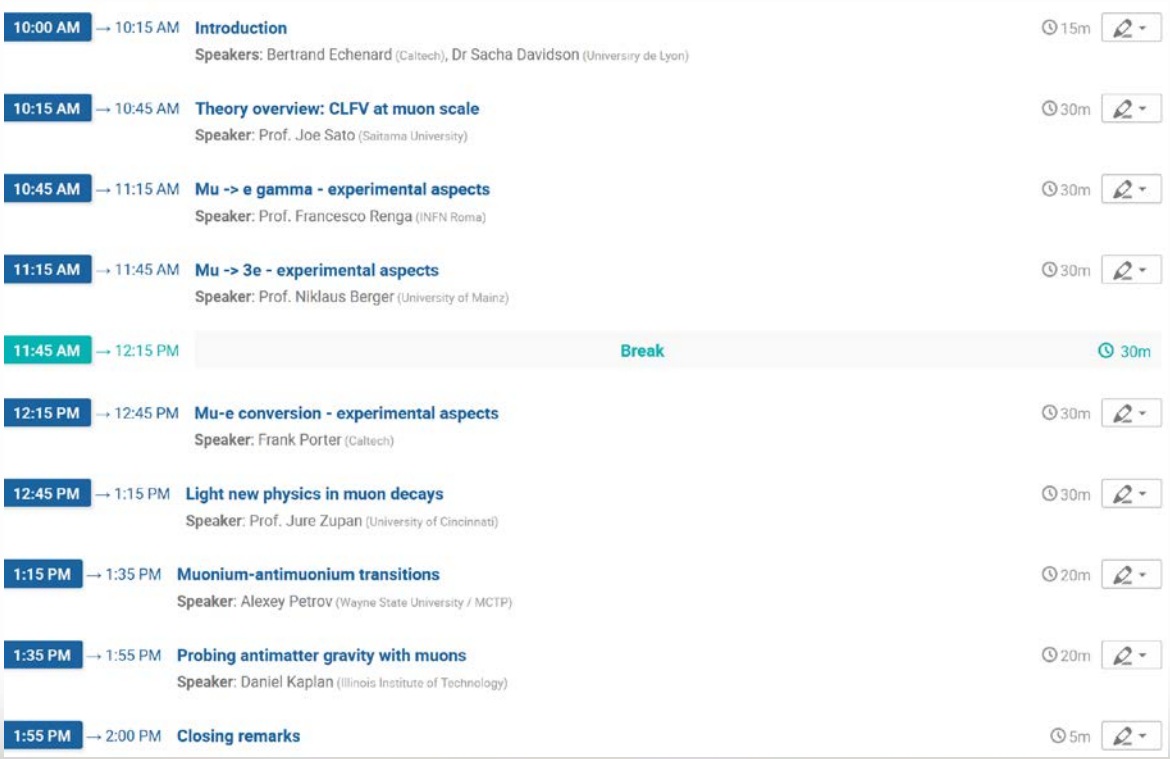
Related LOI:
AF0-RF0-007: "Upgraded Low-Energy MuonFacility at Fermilab"

2. Schedule for group

We have planned four ½ day workshops during this summer to discuss CLFV

- July 2, 2020 - Muon transitions and decays, muonium-antimuonium
- July 23, 2020 - Tau decays, electron-tau transitions
- August 13, 2020 - Meson/baryon and heavy state decays
- September 3, 2020 - High intensity muon factory at FNAL

Agenda for July 2nd workshop is finalized (https://indico.fnal.gov/event/44028/). We're working on the next workshop agenda.



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The high intensity muon factory workshop will bring together experimentalists and accelerator physicists – synergy with AF05.

We just started the discussions with EF09/02 about coordinating efforts, and we will probably have a cross-frontier workshop (maybe in September)

Organizational workshop in October to prepare the November Snowmass planning meeting.

3. Sub-groups / sub-conveners

Muon decays: Sacha and I are managing this.

Tau decays: S. Banerjee at Louisville (might consider adding another person)

Meson/baryon and heavy state decays: just started to explore connections with other groups and we'll decide if this warrants additional sub-conveners once we know more.

Accelerator concepts: just started discussion and we'll decide if this warrants additional sub-conveners once we know more

4. European Strategy group

CLFV is briefly mentioned in "**Other essential activities for particle physics**":

"Experiments in such diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported, as well as participation in such experiments in other regions of the world"

"These include measurements of …, rare muon decays with high intensity muon beams at PSI, FNAL and KEK, …"

No real impact on our planning, but it looks like there is an opportunity for an ambitious CLFV program in the US.

5. Work with other groups

Heavy state CLFV decays

- EF02 (CLFV Higgs decays): contacted by no reply yet
- EF09 (CLFV Z,Z',t decays): initial contact, plan to discuss how we would like to proceed. We will likely organize a joint session / workshop later this summer.

New accelerator concepts for muon CLFV

- AF05: discussion with E. Prebys (convener) and B. Bernstein (liaison)

Need to coordinate with:

- RF01 / RF02: CLFV in meson / baryon decays
- RF04 : identify synergies / common topics
- RF03 / RF06 : identify potential synergies

6. Phenomenology

Why study (c)LFV:

1. Gain information about the neutrino mass mechanism, complementary to observables and LNV
2. Gain insight on how and why the flavor sector works
3. Since backgrounds are low, find the unexpected (observation = clear sign of new physics)

Models we can probe:

Essentially all your favorite models that don't conserve lepton flavor (SUSY, Leptoquark, Z', heavy neutrinos,…) and light new physics with LFV coupling to leptons (e.g. axions, dark photons,…).

Relevant groups; see previous slides

6. Accelerator technologies

Relevant for CLFV:

AF05 - Accelerators for PBC and Rare Processes

- High-intensity muon beams (FFAG, surface muon beams)
- High intensity tau beams (e.g. tauFV)
- High-intensity kaon beams