

# Snowmass 2021

*RARE PROCESSES AND PRECISION MEASUREMENTS FRONTIER*

## **RF4: Baryon and Lepton Number Violating Processes**

June 25, 2020

co-Conveners:

[Pavel Fileviez Perez](#) (Case Western Reserve University)

[Andrea Pocar](#) (University of Massachusetts, Amherst)

# Subgroups and topical leaders

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- Theories for Baryon and Lepton Number Violation (Mark Wise, Pavel Fileviez Perez)
- Baryon and Lepton number violation at colliders (Evelyn Thomson, Richard Ruiz)
- Neutrinoless double beta decay (Vincenzo Cirigliano, Andrea Pocar)
- Proton decay (Ed Kearns, Stuart Raby)
- $n$ - $\bar{n}$  oscillations (Leah Broussard, Kaladi Babu)
- More exotic L and B violating processes (Susan Gardner, Julian Heeck)
- Connections to Cosmology (Andrew Long, Carlos Wagner)

Alexey Petrov — internal frontier liaison

# BLV circa 2020 – July 6-8 – virtually at Case Western Reserve U.

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## Speakers:

*K. Babu (OSU)*  
*L. Broussard (ORNL)*  
*V. Cirigliano (LANL)*  
*J. De Vries (UMass)*  
*P. Fileviez Perez (CWRU)*  
*B. Fornal (Univ. of Utah)*  
*S. Gardner (Univ. of Kentucky)*  
*T. Han (Univ. of Pittsburgh)*  
*J. Heeck (UC-Irvine)*  
*E. Kearns (Boston Univ.)*  
*A. Long (Rice Univ.)*

*D. McKeen (TRIUMF)*  
*A. Petrov (Wayne State Univ.)*  
*A. D. Plascencia (CWRU)*  
*A. Pocar (UMass)*  
*S. Raby (Ohio State Univ.)*  
*R. Ruiz (Louvain Univ.)*  
*G. Senjanovic (ICTP)*  
*E. Thomson (UPenn)*  
*J.C. Vasquez Carmona (UMass)*  
*C. Wagner (Univ. of Chicago/ANL)*

## Organizing Committee:

*S. Feyzbakhsh (UMass)*  
*P. Fileviez Perez (CWRU) co-Chair*  
*E. Golias (CWRU)*  
*C. Murgui (IFIC/CWRU)*  
*A. Pocar (UMass) co-Chair*  
*A. D. Plascencia (CWRU)*  
*S. Thibado (UMass)*

<https://artsci.case.edu/blv2020/>

- All topical leaders will participate, plus several other speakers
- Officially part of Snowmass21 (need to create indigo page)
- Mediated discussion and community input
- Identify topics for LOI's: umbrella, specific groups and leaders, to solicit, new ideas to foster, optimization of outreach

# $n - n\bar$ (from Leah Broussard)

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- LOI's:
  - ESS NNbar program
  - ORNL/ANNI program
  - DUNE nnbar searches.
- People contacted: Yuri Kamyshev, David Milstead, Gustaaf Brooijmans, Mike Snow, Albert Young, Valery Nesvizhevskiy, Alexey Fomin, Hirohiko Shimizu, Georgia Karagiorgi, Linyan Wan, Klaus Kirch, ...
- Workshops: ACFI DeltaB=2 (next slide), one focused on the ORNL/ESS NNBar program
- Other frontiers: Contact with RF6 "Dark Sector Studies"
- European Strategy impact: Shared overarching goals
- Pheno models: Electroweak post-sphaleron baryogenesis
- Relevant facilities: European Spallation Source (ESS)

<https://www.physics.umass.edu/acfi/seminars-and-workshops/theoretical-innovations-for-future-experiments-regarding-baryon-number>

## Theoretical Innovations for Future Experiments Regarding Baryon Number Violation by Two Units I

Co-organizers:

Joshua Barrow (University of Tennessee)

Leah Broussard (University of Tennessee/Oak Ridge National Laboratory)

Jordy de Vries (University of Massachusetts Amherst/Brookhaven National Laboratory)

Michael Wagman (Massachusetts Institute of Technology)

- Prepare LOI(s) for n-nbar physics
- A follow-up workshop in the Spring to identify and rank scientific priorities with the goal of shaping the physics program for the next few decades.
- Survey the opportunities in experiment and theory in order to build the foundation for the strategy for Snowmass.

## BLV at colliders (from Evelyn Thomson)

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- People contacted: I've reached out to ATLAS and SUSY conveners to advertise the collider topic. Will be in contact next week with RPV experts on CMS and ATLAS (Javier Montejo Berlingen — CERN, Katherine Pachal — Duke, Larry Lee from Harvard, Jeff Dandoy — Penn, CMS Lucien (Kin Ho) Lo, — U. Florida)
- Workshops: for SUSY in general, Iacopo Vivarelli from Sussex on ATLAS sent out invitation to collect ideas and commitments for SUSY upgrade studies to be completed for Snowmass. There will be a first discussion in a SUSY upgrade meeting on July the 6th
- Other frontiers: Contacted EF-08 BSM for model-specific explorations, they have a meeting today at 11am on SUSY. Elliot Lipeles is at Penn also.
- European Strategy impact: No RPV SUSY studies were included for ATLAS.

# Neutrinoless double beta decay — strategy

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Vincenzo and I discussed at length this week:

- ‘tonne-scale’ was NSAC 2015 recommendation
- what is the next benchmark ?  
(for tonne-scale it was to cover inverted neutrino mass ordering)
- identified experimental and theory paths (not just high-scale See-saw, sterile nu’s, ...)
- other probes of LNV?
- People so far: [Michael Ramsey-Musolf](#), [Jordy de Vries](#), [Krishna Kumar](#)
- Draft email to DBD community by this weekend, send to seed email list, with info on the process, deadlines, etc, with recommendation to broadcast beyond the ‘usual suspects’ (experimental collaborations, theorists)
- Clear guidelines and encouragement for LOI’s. Try to reach to possible new experimental players
- Interface with other Frontiers, particularly Neutrino Frontier (Lisa Kaufmann, Ben Jones — APP already reached out to avoid duplication of effort)

# Neutrinoless double beta decay — workshops

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The Neutrino Frontier is organizing two half-day workshops in July:

22 Jul [Mini Workshop: Nuclear theory of neutrinoless double-beta decay](#)

15 Jul [Mini Workshop: Particle theory of neutrinoless double-beta decay](#)

<https://indico.fnal.gov/category/1172/>

Plans to organize an ACFI (virtual or in person, we'll see) workshop on “Beyond the tonne scale” (Spring '21?)