Snowmass 2021

RARE PROCESSES AND PRECISION MEASUREMENTS FRONTIER

RF4: Baryon and Lepton Number Violating Processes

August 20, 2020

co-Conveners:

Pavel Fileviez Perez (Case Western Reserve University)

Andrea Pocar (University of Massachusetts, Amherst)

Topical groups:

1- Theories for B and L number violation: P. Fileviez Perez (CWRU), M.B. Wise (Caltech)

2- Neutrinoless double beta decays: V. Cirigliano (LANL), A. Pocar (UMass)

3- B and L violation at colliders: R. Ruiz (Lovain Univ.), E. Thomson (UPenn)

4- Proton decay: E. Kearns (Boston Univ.), S. Raby (OSU)

5- n-nbar oscillations: K. Babu (OSU), L. Broussard (ORNL)

6- More exotic L and B violating processes: S. Gardner (UK), J. Heeck (UCI)

7- Connections to Cosmology: A. Long (Rice Univ.), C. Wagner (Univ. of Chicago/ANL)

News after July 27 !

https://indico.fnal.gov/event/44472/

ACFI Workshop

Aug 3-6, 2020, Univ. of Massachusetts-Amherst

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

https://indico.fnal.gov/event/44472/timetable/#20200803

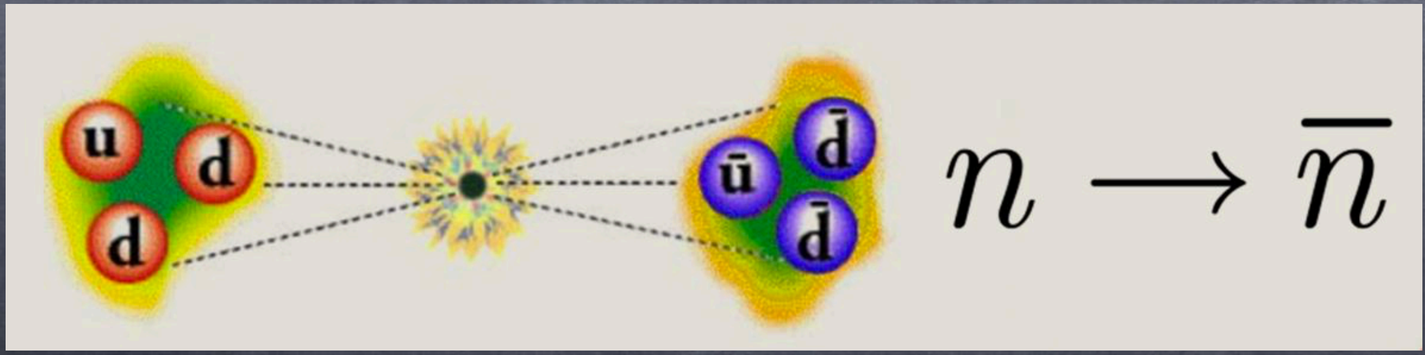
Co-organizers:

Joshua Barrow (University of Tennessee)

Leah Broussard (Oak Ridge National Laboratory)

Jordy de Vries (University of Massachusetts Amherst/Riken Brookhaven)

Michael Wagman (Fermi National Accelerator Laboratory)



n – nbar oscillations (from Leah Broussard)

Aware of four LOIs in the works:

- Theory and experimental opportunities summary
  (resulting from the ACFI workshop)
- DUNE n-nbar
- ESS n-nbar
- ORNL/ESS sterile neutron searches
  (this one will be targeting primarily RF6 (dark sectors) but cross-listed with RF4 because of the strong connection to nnbar development)

An LOI BNV=2 theory motivations might also be organized

BLV @ colliders (from Richard Ruiz)

Two LOI's in the pipeline:

- Neutrinoless Double Beta Decay in Effective Field Theory and Simplified Models
  People involved: Jordy de Vries, Richard Ruiz, Wouter Dekens

- Neutrino Mass Models at Colliders in Snowmass 2021 Era
  Peole involved: Tao Han, Tong Li, Xabi Marcano, Manimala Mitra, Richard Ruiz

Neutrinoless double beta decay – theory (from Vincenzo Cirigliano)

LOIs on neutrinoless double beta decay in presence of sterile neutrino :
(matrix element vs mass and mixing of the sterile states, the relevant EFT, etc)

- Neutrinoless Double Beta Decay in Effective Field Theory and Simplified Models
  People involved: Jordy de Vries, Richard Ruiz, Wouter Dekens
  (listed in previous slide too)

- Bridging particle and nuclear physics for neutrinoless double beta decay with EFTs
  Peole involved: Vincenzo Cirigliano, Wouter Dekens, Jordy de Vries,
  Michael Graesser, Emanuele Mereghetti

Also talking with some of the collider people after BLV.

Neutrinoless double beta decay – activities with the Neutrino Frontier

The Neutrino Frontier (NF05) has organized four mini-workshops, two theoretical and two experimental, in July and August. Large community, HEP/NP overlap, many frontier want to be there (latest one if CF)

Experiment

August 2020

19 Aug Mini Workshop: 0nubb Experiment II → ideas for the future, moderated by Wick Haxton

12 Aug Mini Workshop: Neutrino Electromagnetic Properties

05 Aug Mini Workshop: 0nubb Experiment I → status of the field

July 2020 https://indico.fnal.gov/category/1172/

Theory

22 Jul Mini Workshop: Nuclear theory of neutrinoless double-beta decay

15 Jul Mini Workshop: Particle theory of neutrinoless double-beta decay

Slides presented by Andrea in conclusion to yesterday's mini-workshop illustrating the new "benchmarks" for 0ν DBD (experimental goals, theory input) (developed with Vincenzo Cirigliano and Michael Ramsey-Musolf)

Neutrinoless double beta decay – activities with the Neutrino Frontier

Interactions with Lisa Kaufman and Ben Jones (NF05) initiated at the end of June.

- Avoid duplication and co-sponsor future events and share LOI's between the two groups (announced at Aug 19 workshop to the community)
- Expect a healthy number of LOI's (some shared with CF, IF)
  - ideas to get to 10^{30} year sensitivity (with a few technologies)
  - isotope procurement
  - multi-purpose detectors
- Agreed to have two ACFI/UMass workshops (to be finalized soon):
  - Part I: mid December (virtual) (prepare all-hands meeting in Spring)
  - Part II: mid May (in person?) (finalize contributed papers)

Neutrino theory workshop (Pavel F. P.)

September 21 to 23 (MTW)
10:00-14:00 US Central Time. (8:00 to 12:00 Pacific, 17:00 to 21:00 in Europe)
Six 2-hour sessions - two-per-day - broad topics

1 - Neutrinos in astrophysics and cosmology
2 - Neutrino interactions with matter
3 - Neutrinoless double-beta decay and other nuclear-physics probes of neutrino properties
4 - Neutrino phenomenology (including oscillations, collider searches, charged-lepton and meson processes)
5 - Not-neutrino phenomenology of neutrino experiments (e.g. dark sector searches)
6 - Neutrino mass and flavor model-building

- Each session: 1-2 plenary talks (~20 minutes each). Plenary speakers asked to aim their talks towards the future: define outstanding questions and discuss how these will be attacked in the coming years. Plenary talks should also aim to establish connections among different sub-topics, different topical groups in TF and NF, and other areas of Science.

- The rest of the session will consist of discussions and contributed talks (~10 minutes each): contributed talks providing a talk title, abstract, and the best-fit session. Contributed talks are an excellent opportunity for younger people to contribute (connection to specific LOIs)

Neutrino theory LOI in (multi-frontier)

Probing High Scale Physics via Standard Model Parameters

David Dunsky[1,2], Lawrence J. Hall[1,2], and Keisuke Harigaya[3]

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Thematic Areas:

(TF05) Lattice gauge theory
(TF08) BSM model building (Primary)
(EF03) EW Physics: Heavy flavor and top quark physics
(EF05) QCD and strong interactions: Precision QCD
(NF03) BSM
(RF04) Baryon and Lepton Number Violating Processes
(CF01) Dark Matter: Particle Like
(CF03) Dark Matter: Cosmic Probes