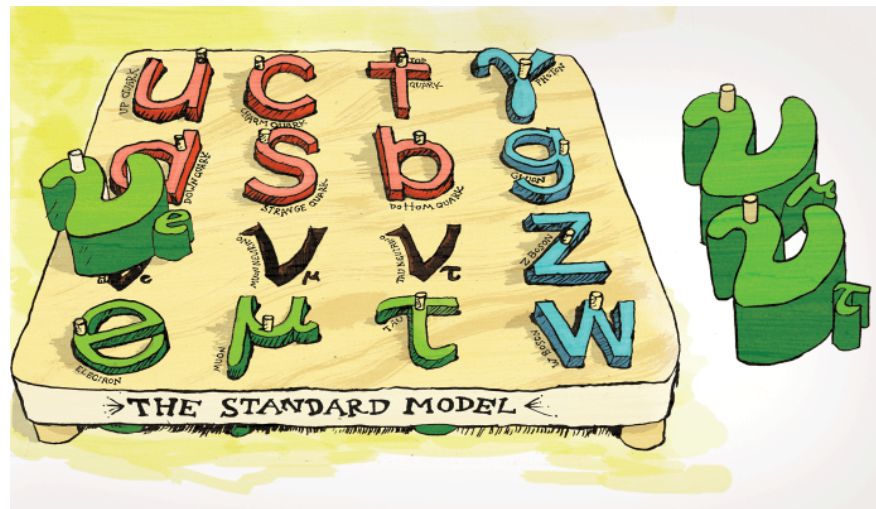


TF11 – Neutrino Physics Introduction



Co-Conveners: André de Gouvêa (Northwestern), Irina Mocioiu (Penn State),
Saori Pastore (Washington U.), Louis Strigari (TAMU)

Theory Town Hall Meeting – Hyperspace

July 30, 2020

Plan for the Hour:

- Introduction (this talk) + Q&A
- Neutrino Phenomenology (Irina) + Q&A
- Neutrinos in Astrophysics and Cosmolgy (Louis) + Q&A
- Nucleons and Nuclei for Neutrinos: Neutrino Scattering & Neutrinoless Double-beta Decay (Saori) + Q&A
- Final Questions and Comments, Next Steps

Burning Questions: Theory and Phenomenology

- Theory and Phenomenology of Neutrinos
- Theory and Phenomenology for Neutrinos

Burning Questions: Theory and Phenomenology

- **Theory and Phenomenology of Neutrinos**

- What is the origin of nonzero neutrino masses? Open questions, models, and how do we learn more? How does this connect with other open questions in particle physics and cosmology (dark matter puzzle, baryogenesis, stability of the Higgs boson mass)?
- Is there a theory of flavor? What is it? How do we learn more? How well do we need to know the elements of the mixing matrix (including CP-violating ones), and why? How are leptons and quarks connected?
- Solving current (and future!) neutrino puzzles, including the short-baseline anomalies.
- ...

- **Theory and Phenomenology for Neutrinos**

- Simulating astrophysics sources of neutrinos and computing neutrino transport in these environments (e.g., SN, cosmic rays sources);
- New neutrino properties and how they impact the early universe cosmology (both to measure neutrino properties and solve puzzles in cosmological data);
- Computing neutrino-nucleon and neutrino-nucleus scattering, from low-energy scattering including $\text{CE}\nu\text{NS}$ solar and supernova neutrinos up to DIS, including implementation and validation against electromagnetic data;
- Computing matrix elements for neutrinoless double-beta decays for different sources of lepton-number violation. Other probes of lepton-number violation.
- Neutrino phenomenology for neutrino experiments. What (new) neutrino properties and interactions will be measured/constrained in future neutrino experiments (oscillations, $\text{CE}\nu\text{NS}$, solar, atmospheric, SN, and UHE neutrinos, direct detection experiments);
- Not-neutrino phenomenology for neutrino experiments (e.g., searches for DM in neutrino experiments, searches for hidden sectors, etc);
- ...

Engage!

We have been collecting information on current and past activities here:

<https://snowmass21.org/theory/neutrino>, including those that took place in our previous life as NF08.

Our mailing list is SNOWMASS-TF11-NEUTRINO_THEORY@fnal.gov and we have a dedicated Snowmass Slack channel [#tf11-neutrinos](#).

You can participate by submitting Letters of Interest^a (deadline August 31, 2020) and Contributed Papers on any and all related topics (and spreading the word).

We are considering organizing a 2 to 3 half-days Virtual Neutrino Theory Workshop in September in order to get the community together and discuss different aspects of neutrino theory and phenomenology. Input most welcome!

We also plan to take advantage of both the Neutrino Frontier Workshop and the Theory Frontier Workshop in the March of 2021.

^aRemember to cross-list neutrino theory LOIs to NF and TF.