How are the whitepaper messages translating to the Snowmass reports?

- Some thoughts from the topical group conveners. What are the main messages in the topical group and frontier reports?
- Discussion with whitepaper authors and audience. Are the messages aligned?

NF04 executive summary

The advent of real-time astronomy through high-energy neutrinos has already led to a handful of likely observations of cosmic sources connected to high energy neutrino production. The expected growing numbers of such detections as well as the larger statistics enabled by upcoming neutrino telescopes will allow to probe particle acceleration in the sources as well as the mechanisms powering cosmic accelerators. In the next decade, we expect the emergence of large neutrino telescopes which will use radio detection to capture neutrinos up to ZeV in energy. This will enable discoveries of cosmic acceleration of neutrinos at the highest energies. In addition, information on the neutrino properties and new physics can be established at these extreme energies for the first time.

Neutrino frontier report

At the highest energies, the advent of real-time astronomy with high-energy neutrinos detected in IceCube has already led to a handful of likely sources of cosmic sources connected to high energy neutrino production. The expected growing numbers of such detections as well as the larger statistics enabled by upcoming neutrino telescopes such as IceCube-Gen2 will allow to probe particle acceleration in the sources as well as the mechanisms powering cosmic accelerators. In the next decade, we expect the emergence of large neutrino telescopes which will use radio detection to capture neutrinos up to ZeV in energy. This will enable discoveries of cosmic acceleration of neutrinos at the highest energies. In addition, information on the neutrino properties and new physics can be established at these extreme energies for the first time.

Neutrino frontier report

High-Energy and Ultra-High-Energy Neutrino Detectors Detection of neutrinos at the TeV scale and beyond has been pioneered by big neutrino telescopes like ICECUBE and KM3NET. The amount of physics and astrophysics and multi-messenger possibilities from these detectors is remarkably broad, and they have been exceptionally successful. Future plans for these detectors focus on moving toward even higher energies, into the EeV and ZeV regimes, which require scales going well beyond km^3 or new technologies, exploiting the Askarayan effect or radar echoes off ionization trails. In many cases, the enabling "technology" for these telescopes is a piece of geography: polar or Greenland ice sheets, mountain ranges that can be used as targets, etc. At the same time, there is a new opportunity at the LHC with the "Forward Physics Facility" (FPF) to detect neutrinos produced in collisions, perhaps with the possibility of tagging the neutrino production vertex in a collider detector.

High priorities over the next several years for these detectors are:

- Develop further the ability for sensitive radio detection of neutrinos interacting in ice or the atmosphere
- Demonstrate at larger scales the detection of neutrinos via radar echos off ionization cascades
- Create low-cost ways of scaling to ever-larger telescopes sizes
- Create intelligenet triggers for background rejection at the FPF
- Create larger-scale high-resolution tracking options for FPF neutrino events

NF executive summary (in progress)

- **Discovering new particles and interactions** Neutrino properties are not as well constrained as those of the other known particles and thus admit new interactions at a strength comparable to their Standard Model interaction strength. They may also have unexpected properties. This in turn makes neutrinos a uniquely sensitive tool to probe the physics of a wide range of dark matter models as well as for generic searches for low-scale new physics. At the same time, neutrino experiments combine high luminosity sources of photons, nuclear and meson decays with very sensitive and large detectors. Neutrino experiments are thus discovery-class facilities for a wide range of models of BSM physics, many of which have been conceived only in view of recent LHC results.

Owing to current and future advances in detection capabilities, neutrinos can be used as a tool to study a wide variety of phenomena.

- **Neutrinos as astrophysical messengers** Neutrinos are the second most abundant particle in the Universe – after photons – and play an important role in many astrophysical environments and cosmology. Studying neutrinos allows us to learn about a wide range of environments, like stellar fusion processes, supernova explosions, nucleosynthesis, and the origin of the highest-energy particles ever observed. Cosmology is sensitive to the number of neutrinos, the sum of their masses, and to potential new neutrino interactions. In return, the more precisely we can determine neutrino properties in the laboratory, the fewer the degrees of freedom in fits to cosmological data.