

# Supernova and Low-Energy Neutrinos Working Group

Convenors: Kate Scholberg (Duke), Inés Gil-Botella (CIEMAT)

Meetings: Every two weeks (during “Physics weeks”)

Wednesdays at 10am CDT, 4pm CET, 5pm CEST

E-mail list: DUNE-PHYSICS-SNB (78 subscribers currently)

Website:

[https://web.fnal.gov/collaboration/DUNE/SitePages/  
Supernova and Low-Energy Neutrinos Working Group.aspx](https://web.fnal.gov/collaboration/DUNE/SitePages/Supernova%20and%20Low-Energy%20Neutrinos%20Working%20Group.aspx)

# Low Energy Working Group Charge

- **understand the science reach**
  - **evaluate detector parameters that meet the science needs**
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- many connections with TF/other working groups:
    - FD optimization task force
    - FD performance wg
    - software/sim/recon
    - DAQ/trigger
    - photons
    - cosmogenics
    - radiologicals (cleanliness)
    - prototypes
    - ...

# We are working on a list of tasks that need to be addressed

## Tasks: (Preliminary, to be completed)

- Top level: physics signatures with oscillation effects, reach (MH, SN physics)
- Improve/develop SN event generator
  - Include NC, nuebar, ES channels
  - Include realistic angular distributions
  - Integrate with LArSoft
  - Produce SN-burst like samples with realistic time distribution
- Low-energy event reconstruction
  - Electron track fitter
  - Particle/channel ID (deexcitation gamma selection), bremsstrahlung
- Studies with SN event generator and reconstruction
  - Energy resolution
  - Gamma tagging selection, interaction-channel-tagging selection efficiency
  - Angular resolution, directionality studies
  - Backgrounds:  $^{39}\text{Ar}$ , radiologicals
  - DAQ/trigger studies
- Improve deexcitation gamma simulation with MARLEY
- Definition of photon detection requirements (in coord with photon detector WG)

# Tasks beyond SNB physics

- **Solar neutrino** studies
  - Physics reach
  - Backgrounds
- **Diffuse Supernova Neutrino Background** studies
  - Physics reach
  - Backgrounds
- Specific studies of low-energy data with **LAr prototypes**
- Comparison between **single and dual-phase performance** for low energy events

# Synergies

1. Physics signatures with oscillation effects and physics reach (in collaboration with **theorists to be involved in our WG**)
2. Improve/development SN event generator (in collab. with **software WG**)
3. Low energy event reconstruction (in collab. with **FD reconstruction WG**)
4. Studies with SN events on energy resolution, gamma tagging, directionality, backgrounds, DAQ/trigger (synergies with **FD DAQ, photon detection, cosmogenics, purity/radiopurity WGs**)
5. Definition of photon detection requirements (in coord. with **FD performance WG** and **Photon Detection WG**)
6. Comparison between single and dual-phase performance for low energy events (in collab. with **FD Task Force, FD single phase TPC, FD dual phase TPC WGs**)

# We would like to have an updated list of people working in the tasks

**Members and Tasks:** please sign up or suggest others

Name	Area of work or associated working group	Tasks
Kate Scholberg	Sim/Recon	Simple event generator
MARLEY group		Realistic deexcitation event generator
Gleb Sinev	Photon sim, Sim/Recon	39-Ar backgrounds, low-energy electron fitter
Fernando Rossi Torres	Non-standard physics, Sim/Recon	
Cecilia Lunardini, Alankrita Priya, Alexander Warren	DSNB, SN theory	DSNB, neutronization burst sensitivity studies

**(to be completed)**

**Please let us know your interests**

# What's been done already, and what's in progress?

....don't always need to completely reinvent the wheel, but we *do* want better wheels



Task	Who	Status/To Do	References
<b>Fast event rate studies for physics sensitivity</b>	SNOwGLOBES group, A. Friedland	Most distributions from LOI/CDR made with this; needs more channels, updates	<a href="http://phy.duke.edu/~schol/snowglobes">http://phy.duke.edu/~schol/snowglobes</a> , old LBNE sciop document, CDR
<b>Event generator</b>	KS, AJ Roeth	Simple nueCC generator w/ deex; need more channels, angular info, integration into LArSoft	Old docdb 7815, 7757, 8074, 8225
<b>Deexcitation gamma modeling</b>	AJ Roeth, MARLEY	See above; better modeling w/MARLEY underway (+BACON, etc)	Old docdb 7088 + above, 9/15 collab meeting SNB session
<b>Energy resolution studies</b>	Z. Li, G. Sinev	Mostly done in $\mu$ BooNE geometry; needs updating	Old docdb: 6185, 6191, 6210, 6538, 8003, 8166, 8297, 8448, 9318, 9391, 9480, 9742
<b>Physics studies for event resolution requirement</b>	G. Sinev, A. Friedland	Study of resolution required for visibility of spectra feature	Old docdb: 9480
<b>Angular resolution studies</b>	Z. Li	Study of electron tracks with simple fitter	Old docdb: 6538
<b>Physics studies for time resolution requirement</b>	G. Sinev	Study of visibility of time feature	Old docdb: 9487
<b>Low-energy reconstruction</b>	Z. Li	Simple linear fitter	Old docdb: 6538, 8003, 8448
<b>39-Ar</b>	G. Sinev	Study of photon detector triggering	New docdb: 34, 9/15 collab meeting
<b>Radiological/cosmo bg studies</b>	V. Gehman, K. Oliver-Mallory (+D. Mei et al.)	Calculation w/CR flux, + 40-Ar xscsn + decay spectra+ radiologicals	Old docdb: 7036, 8455, 9269, 9309, 9470; arXiv: 1202.5000
<b>Cosmogenic bg</b>	Z. Li	Simple muon study w/ $\mu$ BooNE only	Old docdb: 8057, 8399, 8812
<b>Photon studies</b>	G. Sinev, A. Himmel	Efficiencies vs energy for reference & alternate	See photon group materials, 9/15 collab meeting

- Inputs and ideas from all members are warmly welcome!
- Many tasks open to new contributors!
- Coordination with other Working Groups and Task Forces will be defined in the coming weeks