SN Modeling Group
Preview of SNEWPY

- 10 minutes (Evan): Intro to SNEWPY, some things it can do
- 5 minutes (Jim): Potential extension for Earth Matter effects
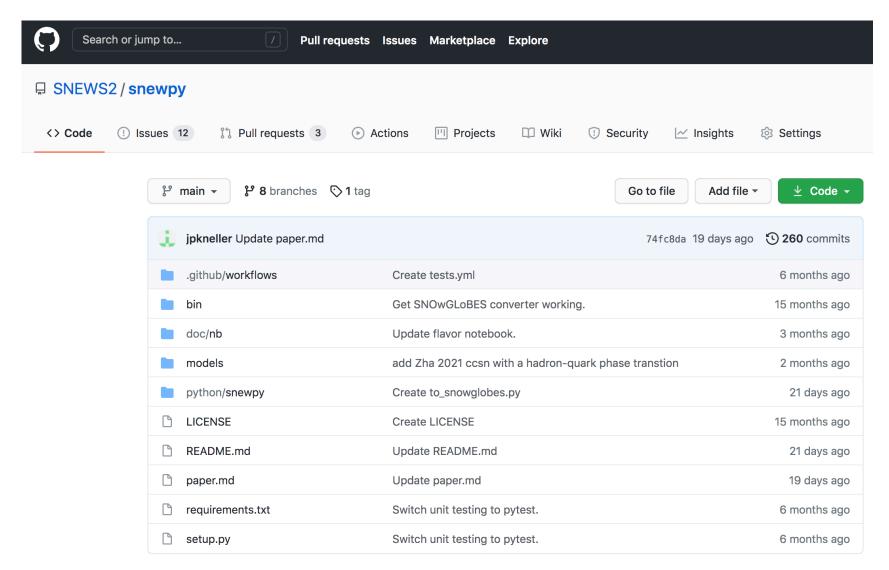- 15 minutes (Discussion): What would you like to see in SNEWPY

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+ other contributors

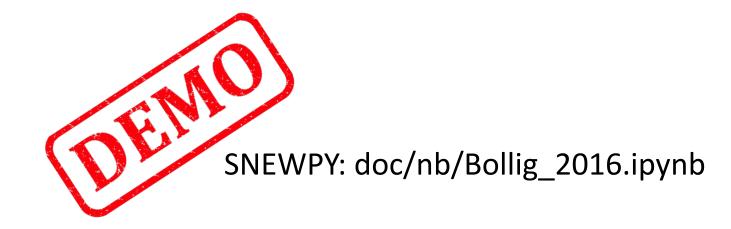# https://github.com/SNEWS2/snewpy

SNEWPY Timeline:

- Start of Hackathon: release version for use in hackathon

- SNEWPY hackathon presentation

- Throughout hackathon work on extensions

SNEWPY model landscape – common repository of SN neutrino modes

main ▾ | **snewpy** / **models** /

Go to file | Add file ▾ | ...

joshuashzha add Zha 2021 ccsn with a hadron-quark phase transtion | 5ecefc2 on Mar 10 | ⟳ History

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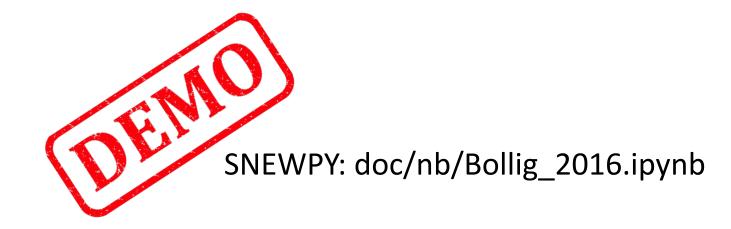|			
📁	Bollig_2016	Update README.md	6 months ago
📁	Fornax_2019	Remove jupyter checkpoint dot folder.	15 months ago
📁	Janka	Move simulations to models folder.	15 months ago
📁	Kuroda_2020	Add missing carriage return to model files.	6 months ago
📁	Nakazato_2013	Move simulations to models folder.	15 months ago
📁	OConnor_2013	Move simulations to models folder.	15 months ago
📁	OConnor_2015	Update README.	6 months ago
📁	PISN	Move simulations to models folder.	15 months ago
📁	Sukhbold_2015	Update README.md	6 months ago
📁	Type Ia	Move simulations to models folder.	15 months ago
📁	Warren_2020	Small cosmetic fix.	6 months ago
📁	Zha_2021	add Zha 2021 ccsn with a hadron-quark phase transtion	2 months ago

`https://github.com/SNEWS2/snewpy`

DEMO

SNEWPY: doc/nb/Bollig_2016.ipynb

SNEWPY oscillations – large suite of oscillation physics

1. **NoTransformation** - no oscillations.

2. **CompleteExchange** - the case where the electron flavors are completely swapped with a heavy lepton flavor

3. **AdiabaticMSW** - adiabatic neutrino evolution for both the normal or inverted mass ordering.

4. **NonAdiabaticMSWH** - the H resonance is nonadiabatic, the L resonance is adiabatic, for both the normal or inverted mass ordering.

5. **TwoFlavorDecoherence** - 50% mixing between the states whichever states mix at the H resonance, for both the normal or inverted mass ordering.

6. **ThreeFlavorDecoherence** - 33% mixing between all flavors and both neutrinos and antineutrinos.

7. **NeutrinoDecay** - Adiabatic evolution through the mantle of the supernova followed by decay of the heaviest mass neutrino state to the lightest in the vacuum. Note we use the approximation that the energy of the neutrino does not change.

8. **AdiabaticMSWes** - a four neutrino mixing case. The fourth mass state is assumed to be the heaviest and the new 'es' MSW resonance is adiabatic. The mass ordering of the three lighter neutrinos can be normal or inverted.

9. **NonAdiabaticMSWes** - a four neutrino mixing case. The fourth mass state is assumed to be the heaviest and the new 'es' MSW resonance is nonadiabatic. The mass ordering of the three lighter neutrinos can be normal or inverted.

`https://github.com/SNEWS2/snewpy`

SNEWPY: doc/nb/Bollig_2016.ipynb

SNEWPY detection estimates – interface to SNOwGLoBES

Experiment	Type	Mass (kt)	Location	11.2 $M_\odot$	27.0 $M_\odot$	40.0 $M_\odot$
Super-K	$H_2O/\bar{\nu}_e$	32	Japan	4000/4100	7800/7600	7600/4900
Hyper-K	$H_2O/\bar{\nu}_e$	220	Japan	28K/28K	53K/52K	52K/34K
IceCube	String/$\bar{\nu}_e$	2500*	South Pole	320K/330K	660K/660K	820K/630K
KM3NeT	String/$\bar{\nu}_e$	150*	Italy/France	17K/18K	37K/38K	47K/38K
LVD	$C_nH_{2n}/\bar{\nu}_e$	1	Italy	190/190	360/350	340/240
KamLAND	$C_nH_{2n}/\bar{\nu}_e$	1	Japan	190/190	360/350	340/240
Borexino	$C_nH_{2n}/\bar{\nu}_e$	0.278	Italy	52/52	100/97	96/65
JUNO	$C_nH_{2n}/\bar{\nu}_e$	20	China	3800/3800	7200/7000	6900/4700
SNO+	$C_nH_{2n}/\bar{\nu}_e$	0.78	Canada	150/150	280/270	270/180
NOνA	$C_nH_{2n}/\bar{\nu}_e$	14	USA	1900/2000	3700/3600	3600/2500
Baksan	$C_nH_{2n}/\bar{\nu}_e$	0.24	Russia	45/45	86/84	82/56
HALO	Lead/ν_e	0.079	Canada	4/3	9/8	9/9
HALO-1kT	Lead/ν_e	1	Italy	53/47	120/100	120/120
DUNE	Ar/ν_e	40	USA	2700/2500	5500/5200	5800/6000
MicroBooNe	Ar/ν_e	0.09	USA	6/5	12/11	13/13
SBND	Ar/ν_e	0.12	USA	8/7	16/15	17/18
DarkSide-20k	Ar/any ν	0.0386	Italy	—	250	—
XENONnT	Xe/any ν	0.006	Italy	56	106	—
LZ	Xe/any ν	0.007	USA	65	123	—
PandaX-4T	Xe/any ν	0.004	China	37	70	—

SNEWS2.0 white paper

SNEWPY detection estimates – interface to SNOwGLoBES

SNEWPY: doc/nb/SNEWS2.0_rate_table.py