# Group #1: Supernova Neutrinos

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# Outline

- Introduction
- Parameters of SN models
- Luminosity vs time plots
- Flux at detectors

# Introduction

- detection of neutrinos emitted from SNe using SNOwGLoBES
- SNOwGLoBES computes expected event rates in different neutrino detectors and collate its output into signal data file per detector per interaction channel
- SNEWPY is a python package for working with supernova neutrinos
- 3 parts:
  - extraction of SN neutrino emission - f(t, E, theta, flavor)
  - "way to Earth" - convolution of neutrino flux = flavor transformation
  - "flux catch" by SNOwGLoBES

# Parameters of SN models

- progenitor mass [solMass] - mass of model progenitor
- rotational velocity [rad/s] (of progenitor)
- SN equation of state (eos) - LS220, HShen, ...
- Direction – 2 options:
  - "from which direction we look at supernova" (north, south, ..)
  - "which flux we want" (1,2,3)
- magnetic field B0 exponent [G]
- ...

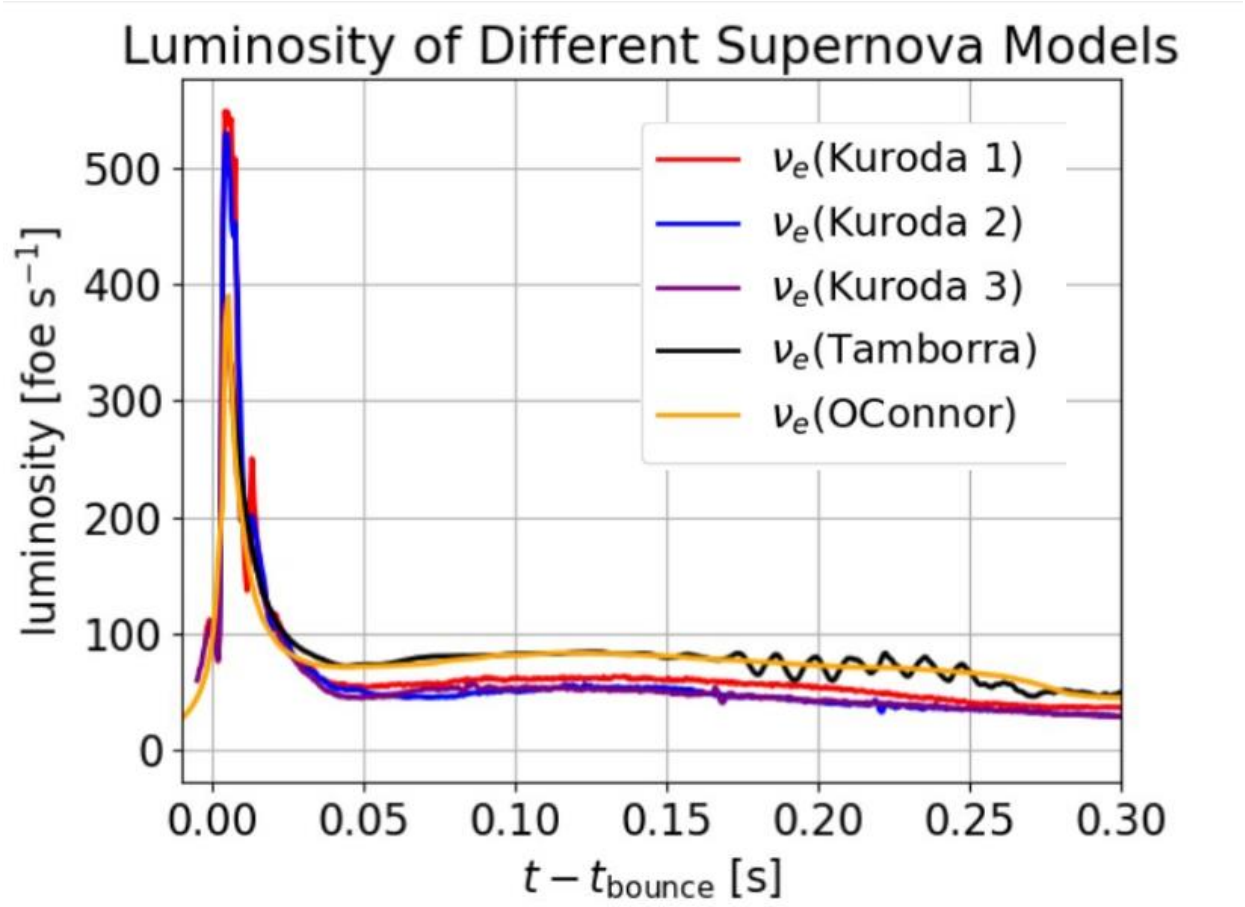
$$A_\phi = \frac{B_0}{2}\frac{R_0^3}{r^3 + R_0^3} r \sin\theta,$$
$$A_r = A_\theta = 0,$$

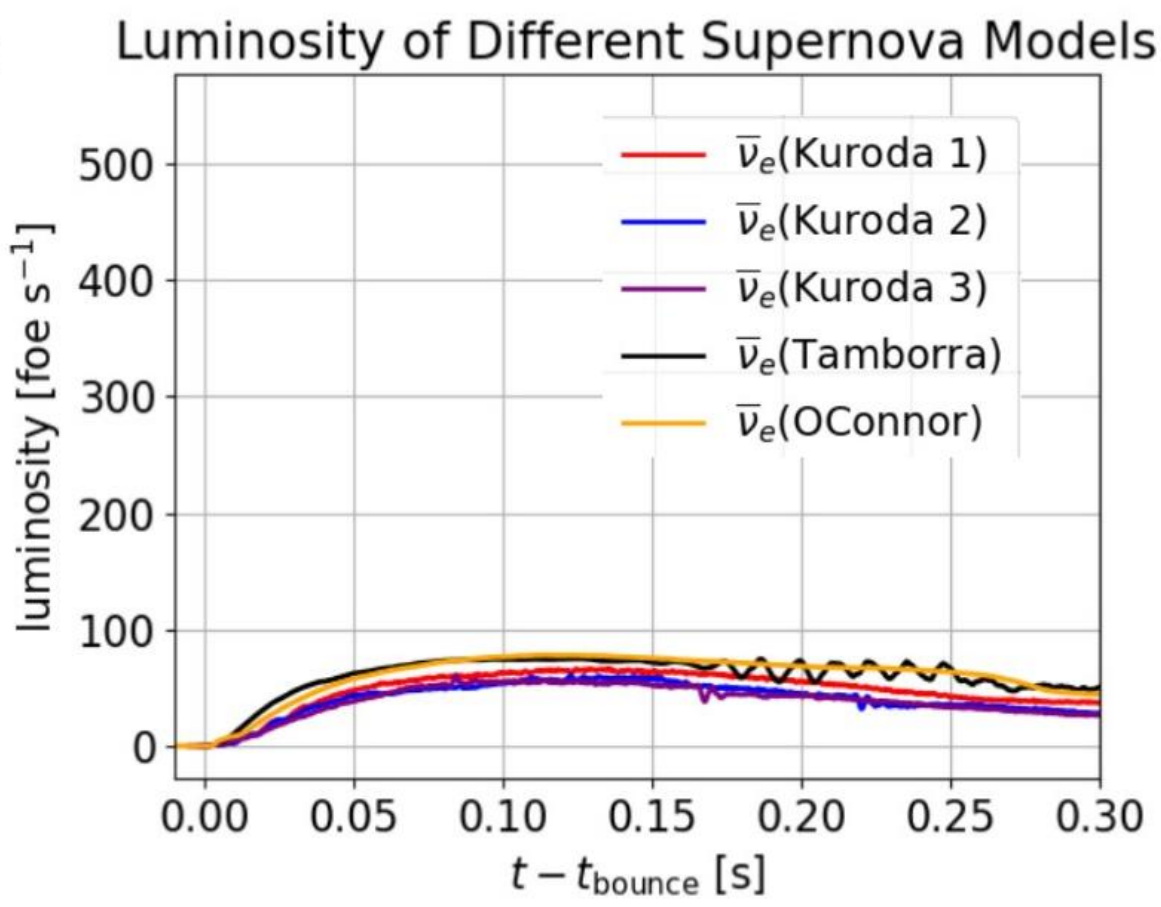
# Our Selected Models

| Model Name | Rotational Velocity (rad/s) | Magnetic Field Exponent | Direction |
|---|---|---|---|
| Kuroda 2020 (1) | 0 | 0 | N/A |
| Kuroda 2020 (2) | 1 | 12 | N/A |
| Kuroda 2020 (3) | 1 | 13 | N/A |
| Tamborra | N/A | N/A | 1 |
| O'Connor | N/A | N/A | N/A |

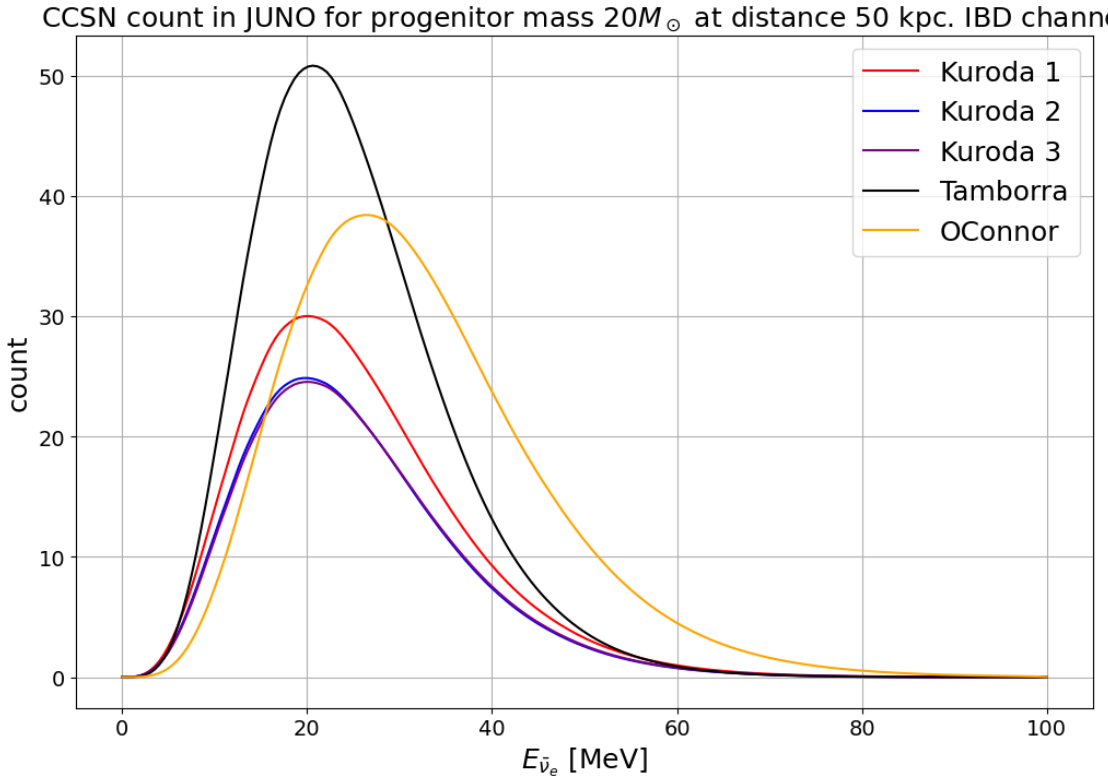
Included models were simulated for progenitor mass of 20 solar masses and used the LS220 equation of state.

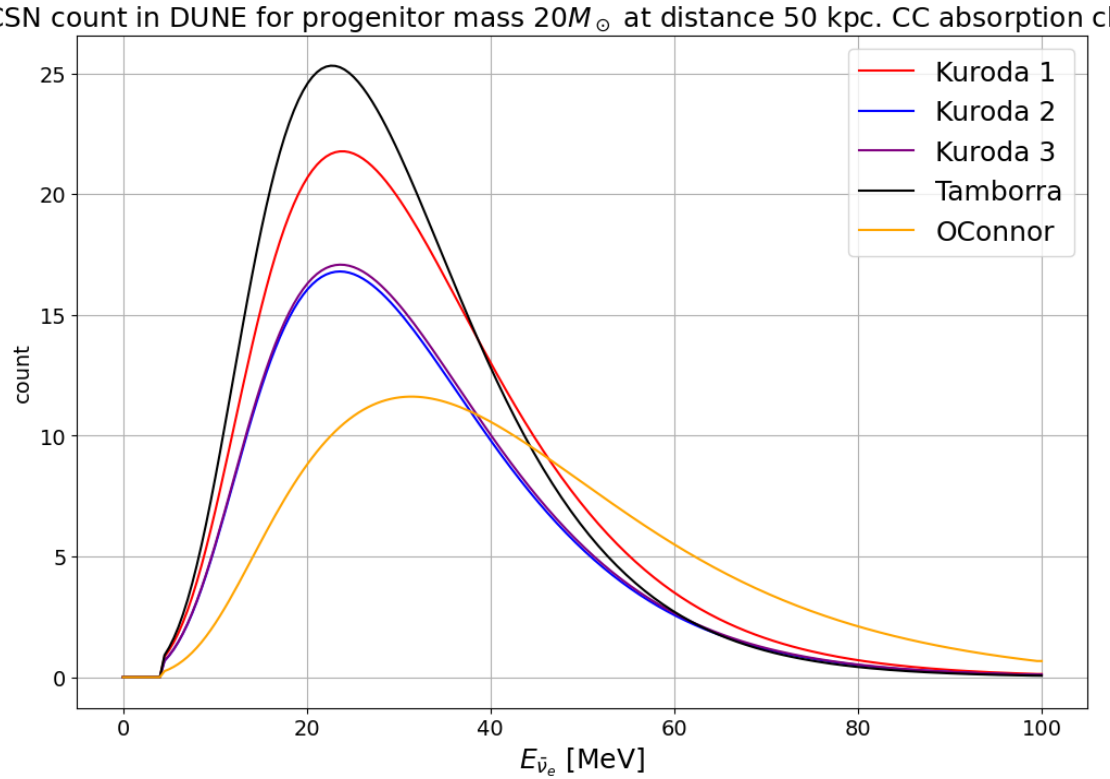
# Our Selected Models (Luminosity)



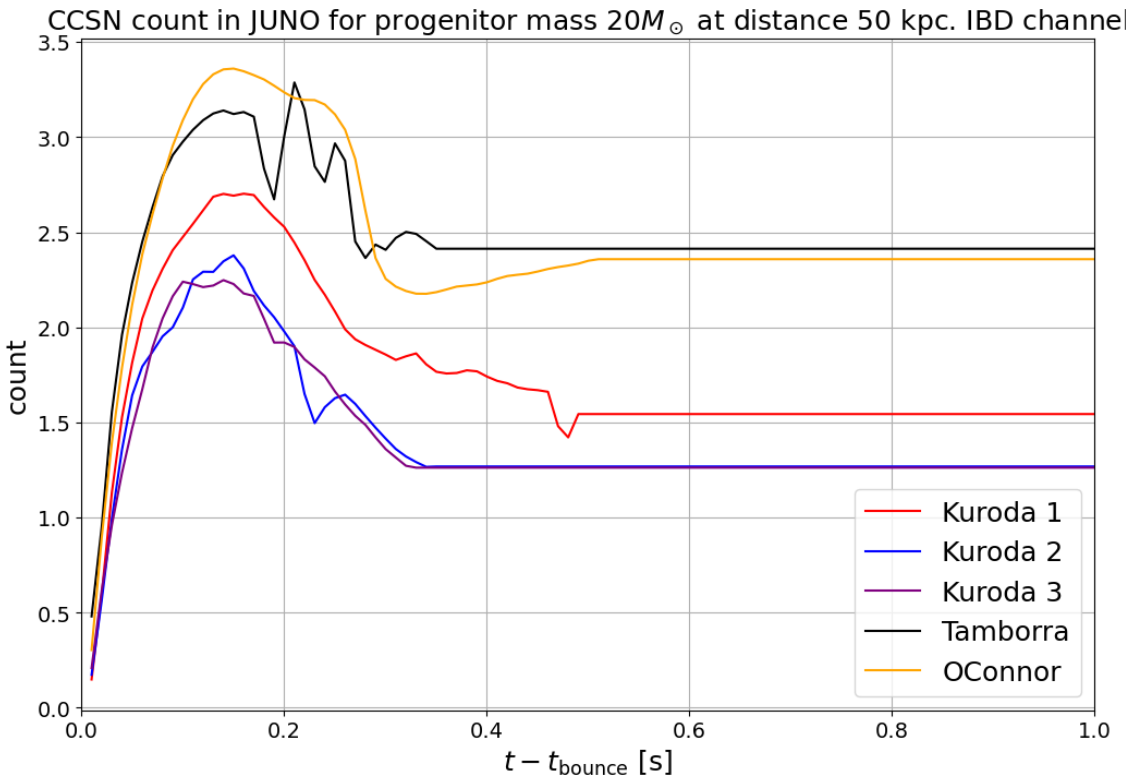
# Detector count from the first 10s of the "bounce"

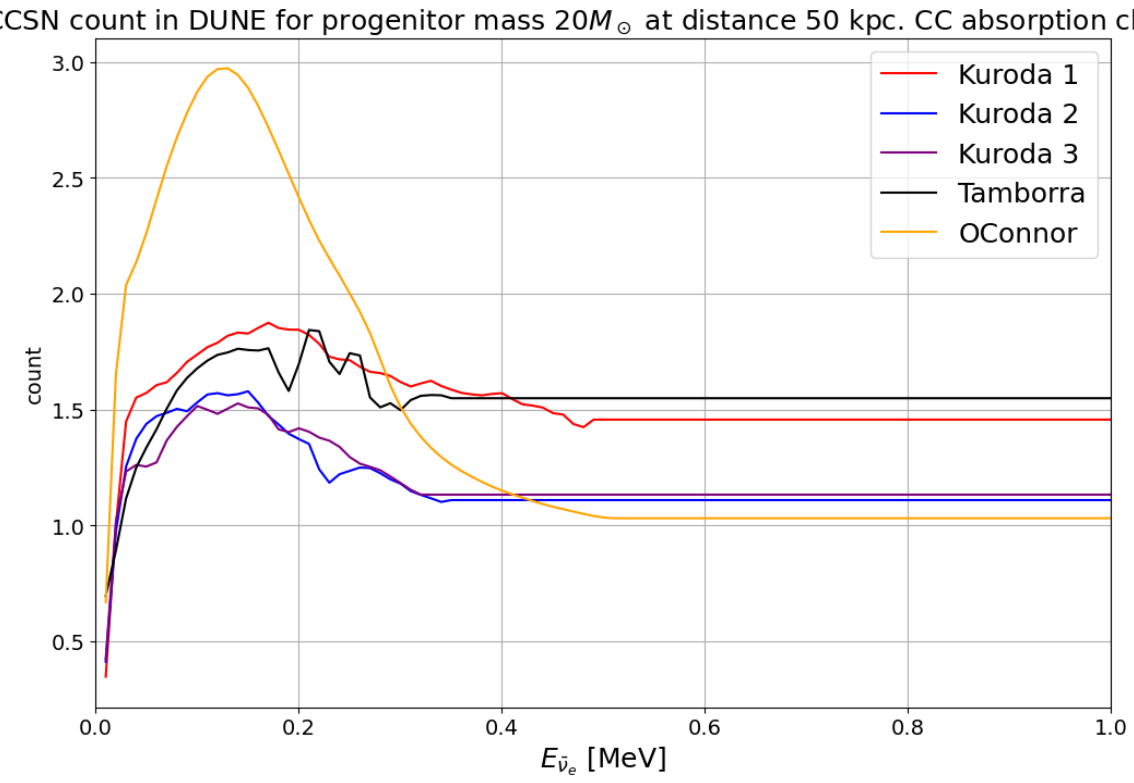



Potential in distinguishing models. For example: Tamborra vs. Kuroda 2,3 in JUNO; Tamborra vs O'Connor in DUNE

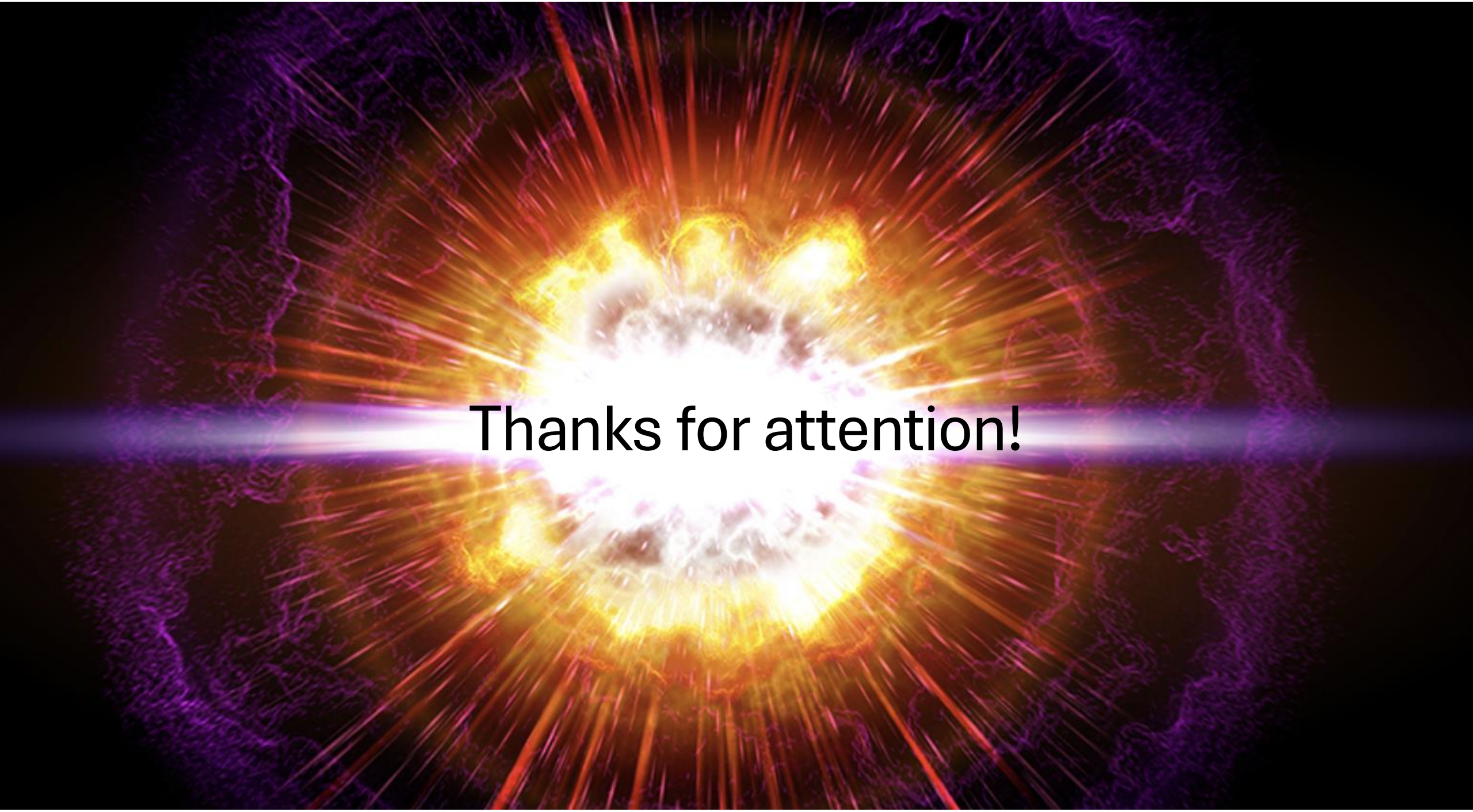
# Detector count for neutrinos with energies ≤ 100 MeV



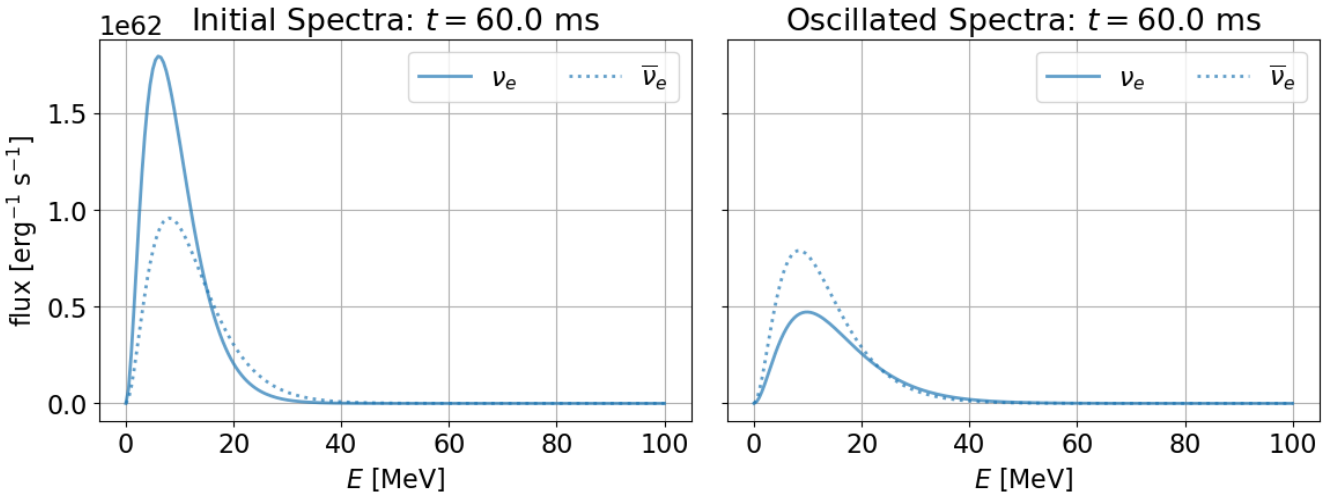
# References

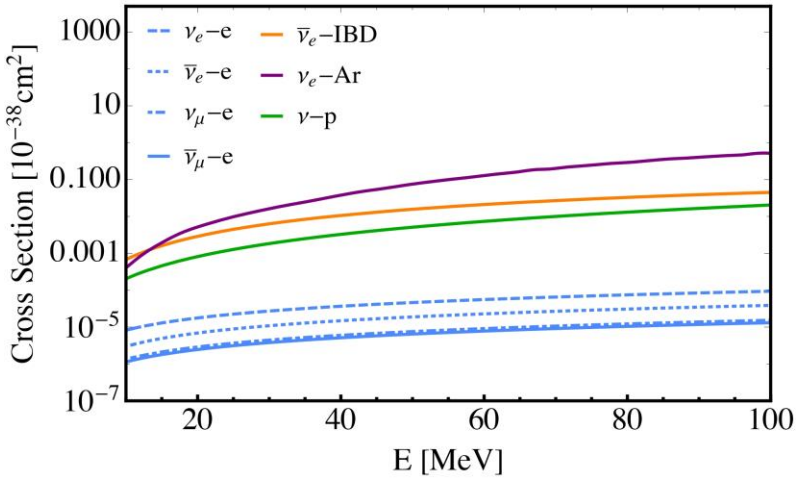

- https://snewpy.readthedocs.io/en/stable/models.html
- https://arxiv.org/pdf/1807.02366
- https://arxiv.org/pdf/2105.00665
- https://joss.theoj.org/papers/10.21105/joss.03772


Thanks for attention!

# Backup slide – why are there less counts in DUNE although it is "larger" than JUNO

- Oscillation
- Cross section
- # of targets (Tabrizi & Horiuchi 2021)
  - JUNO: 1.21E33
  - DUNE: 6.02E32
- Efficiency (in SNOwGLoBES)
  - JUNO: not included
  - DUNE: ε = 1 for E > 5.0 MeV




Tabrizi Z., Horiuchi S., 2021, JCAP, 2021, 011

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