nuPyProp - A Monte Carlo Neutrino Simulator & Propagator

Sameer Patel

(University of Iowa)

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Overview

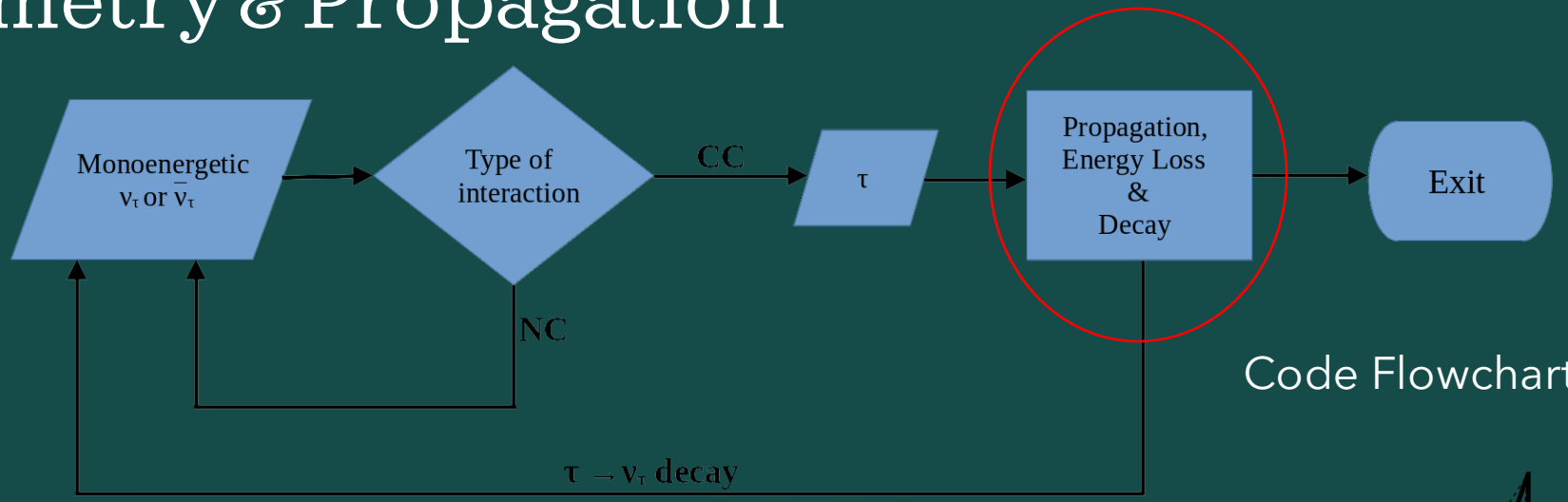
- nuPyProp models ν_τ/ν_μ flux attenuation & distribution of τ/μ in the Earth.
- Part of the νSpaceSim[+] package.
- Provides a publicly-available, expandable & modular code package.
- Two EM energy loss mechanisms – stochastic & continuous.
- $\nu_\tau \rightarrow \tau$ as well as $\nu_\mu \rightarrow \mu$ propagation.

Module	Model/Type
Earth/Geometry	PREM, User Defined
Neutrino/Anti-Neutrino Cross Section	ALLM, BDHM, CTEQ18-NLO, CTW, nCTEQ15, User Defined
Ionization Energy Loss	Bethe-Bloch
Bremmstrahlung Energy Loss	Petrukhin & Shestakov
Pair Production Energy Loss	Kokoulin & Petrukhin
Photonuclear Energy Loss [$F_2(x,Q^2)$, except BB]	BB, ALLM, BDHM, CKMT, User Defined
Electromagnetic Energy Loss Mechanisms	Stochastic, Continuous

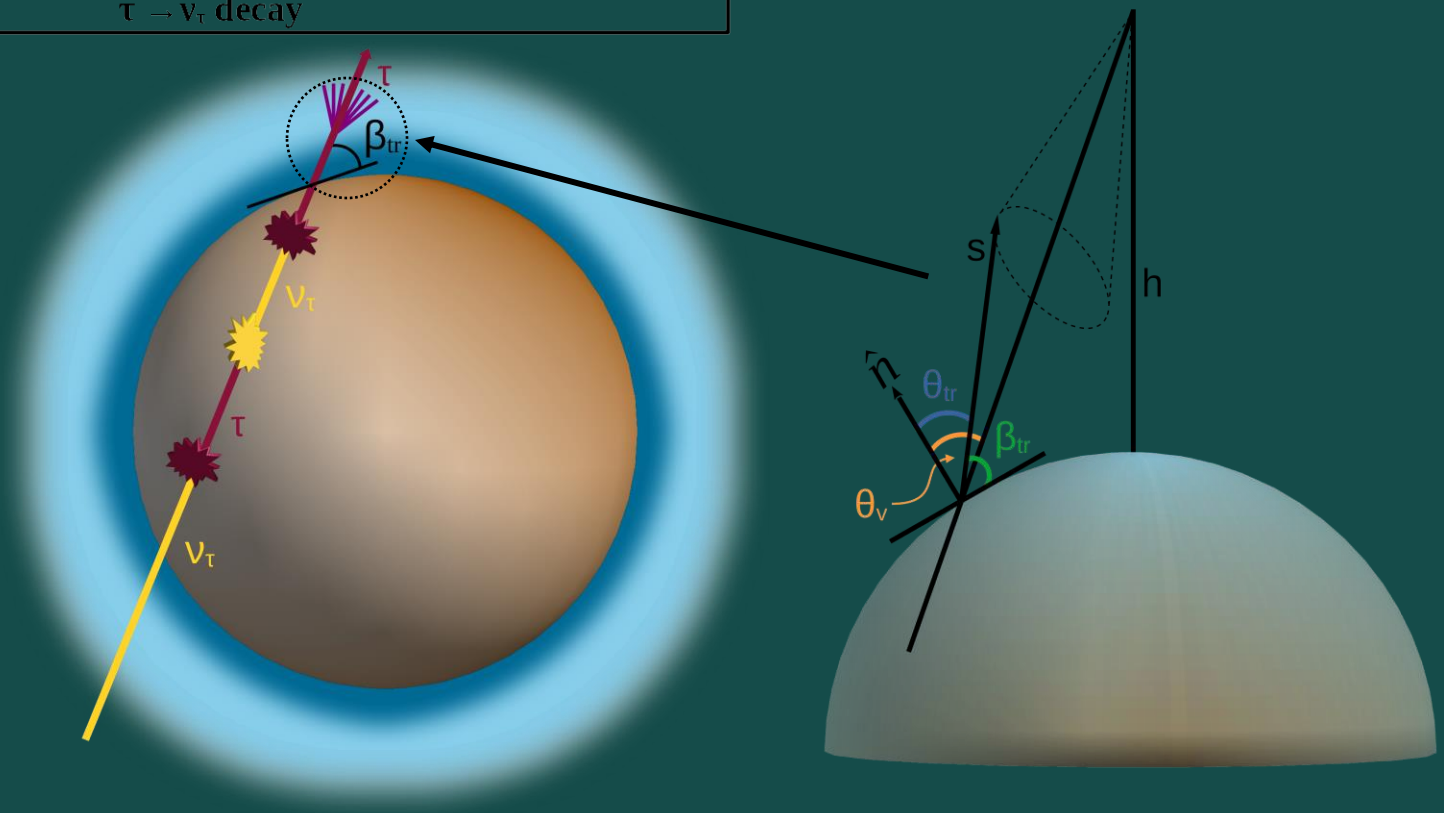
Theoretical Model Options in nuPyProp

[+]See contribution #1025

Geometry & Propagation

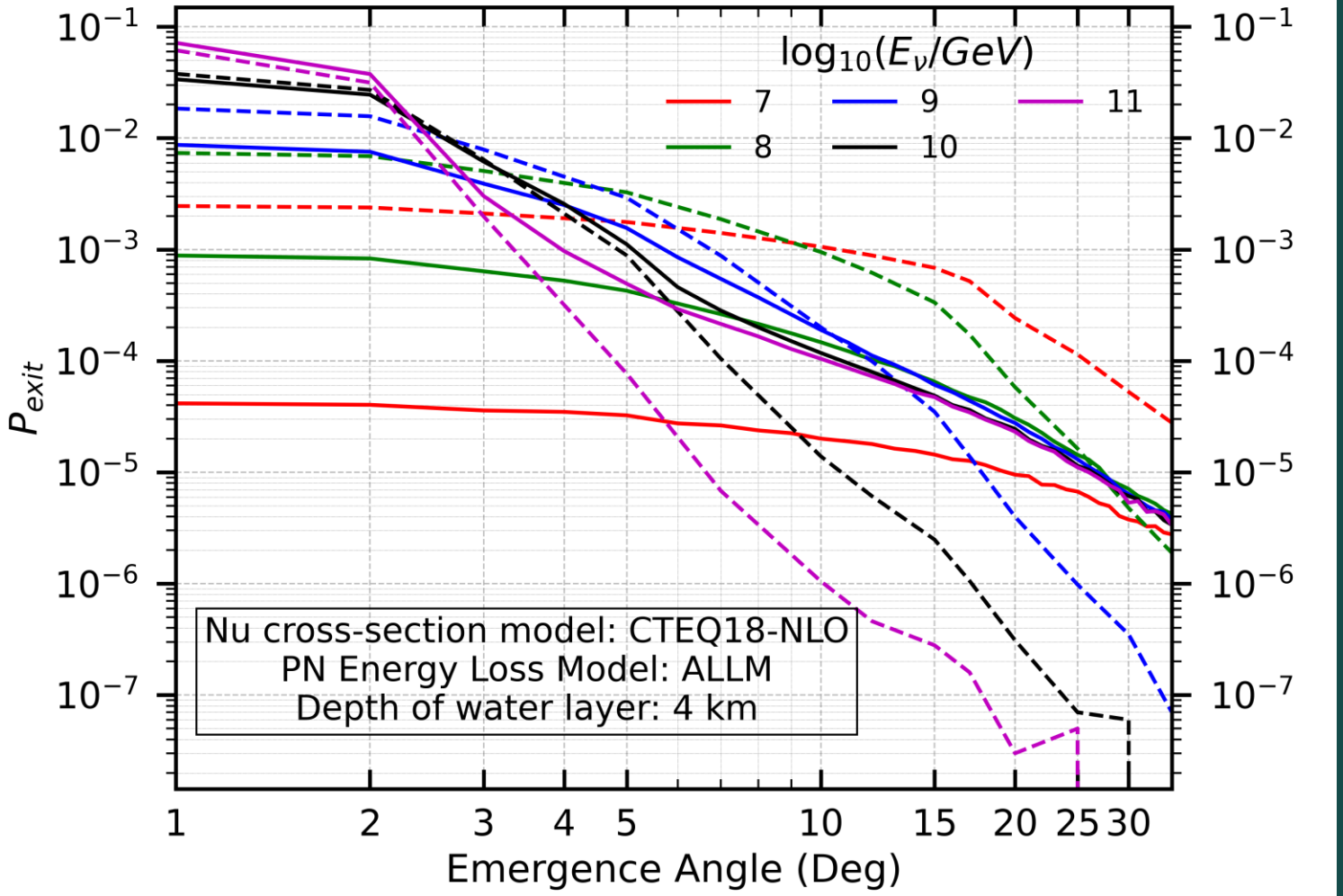


Code Flowchart



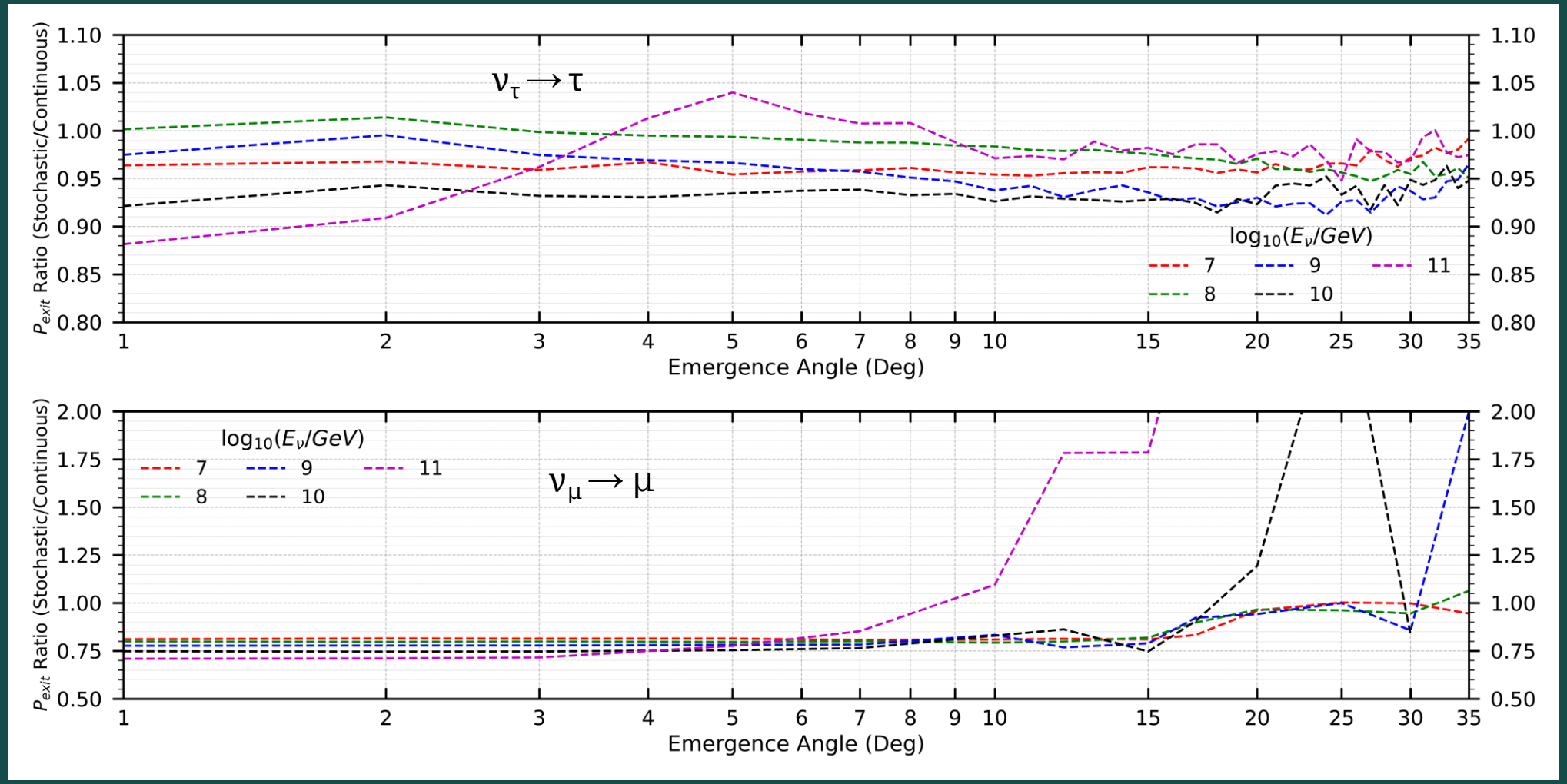
Geometry of Tau Neutrino Induced Air Shower

$\nu_\tau \rightarrow \tau$ & $\nu_\mu \rightarrow \mu$ Exit Probabilities



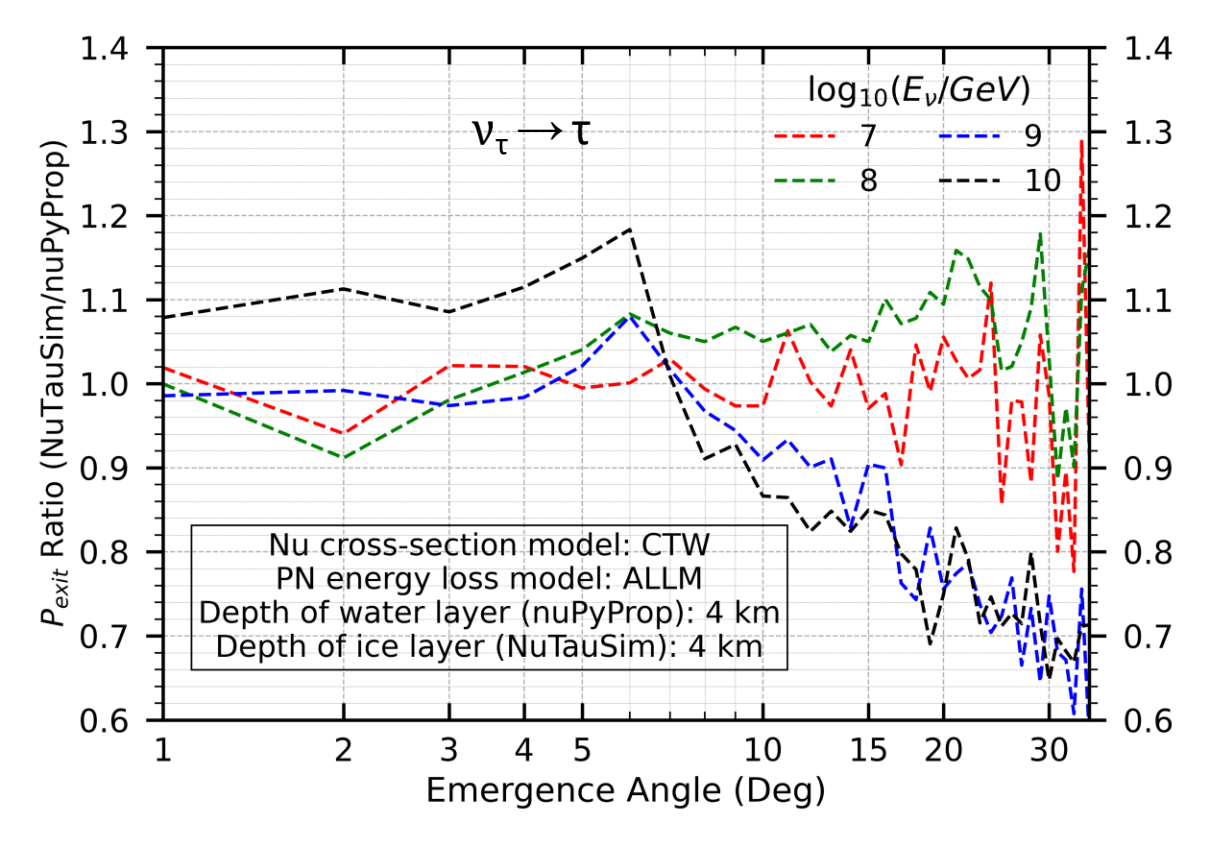
$\nu_\tau \rightarrow \tau$ (solid) & $\nu_\mu \rightarrow \mu$ (dashed)

Stochastic Vs. Continuous Energy Losses

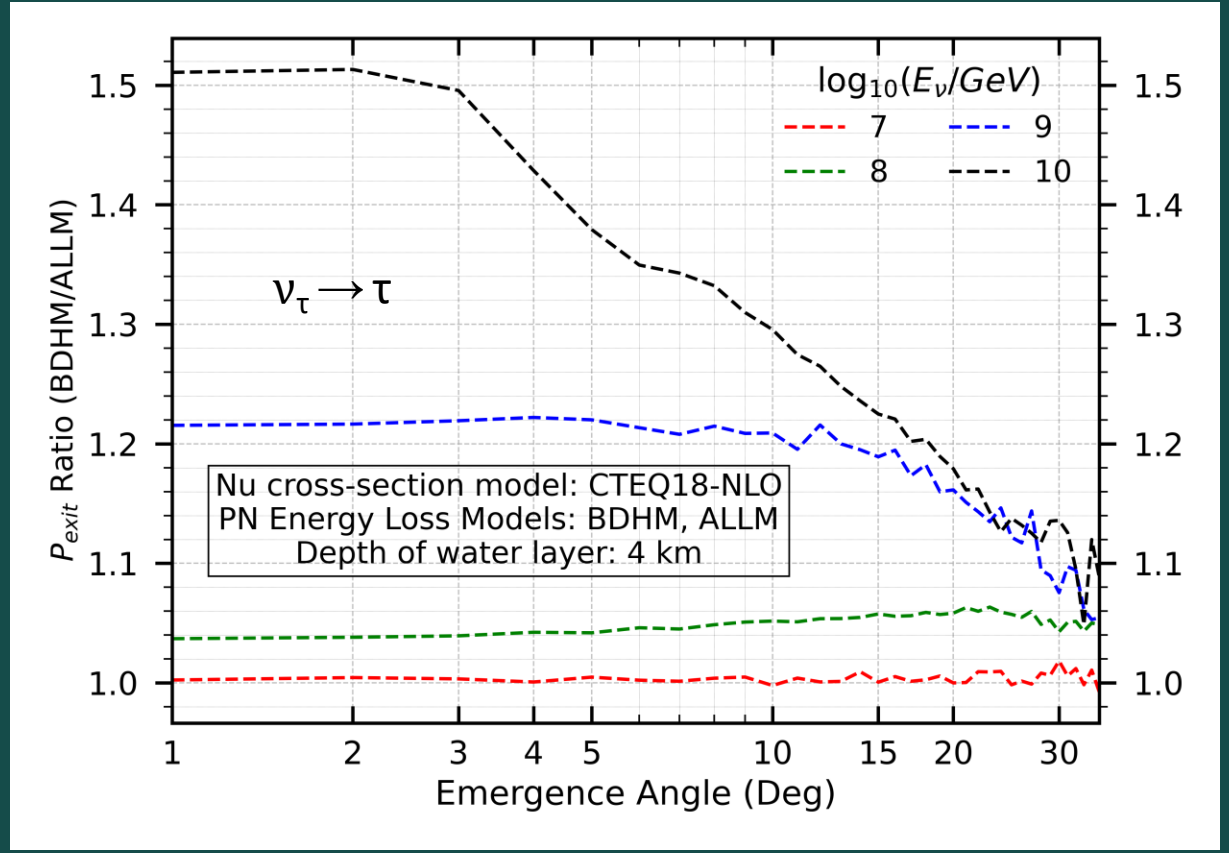


P_{exit} Ratios (Stochastic/Continuous)

Comparisons & Error Quantification



nuPyProp Vs. NuTauSim *(Alvarez-Muñiz et. al, 2019)* for $\nu_\tau \rightarrow \tau$



nuPyProp Results for $\nu_\tau \rightarrow \tau$ with ALLM Vs. BDHM PN Energy Loss Models

Thank You!