

Toward Accurate Prediction of Neutron Multiplicity Associated with Neutrino Interactions



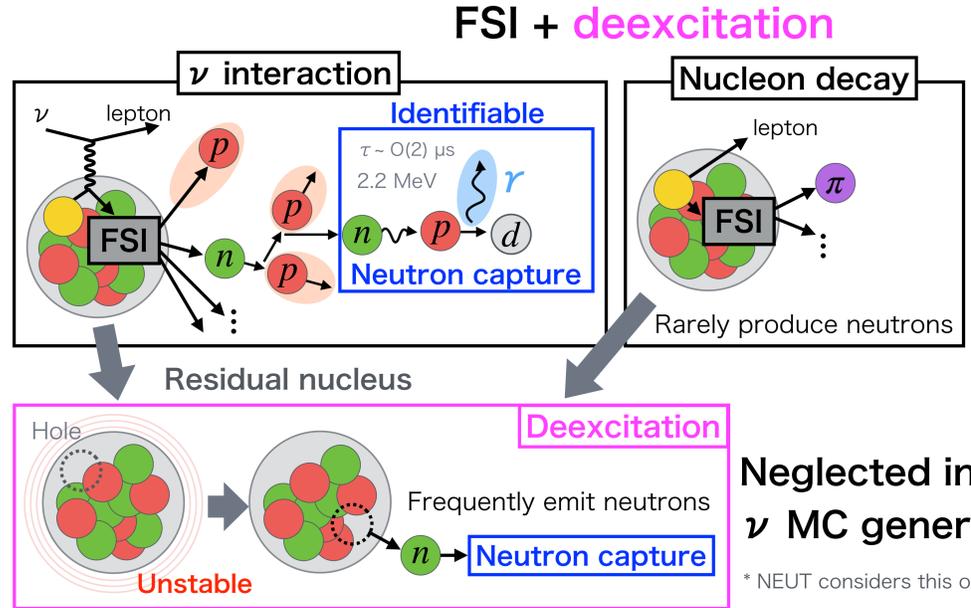
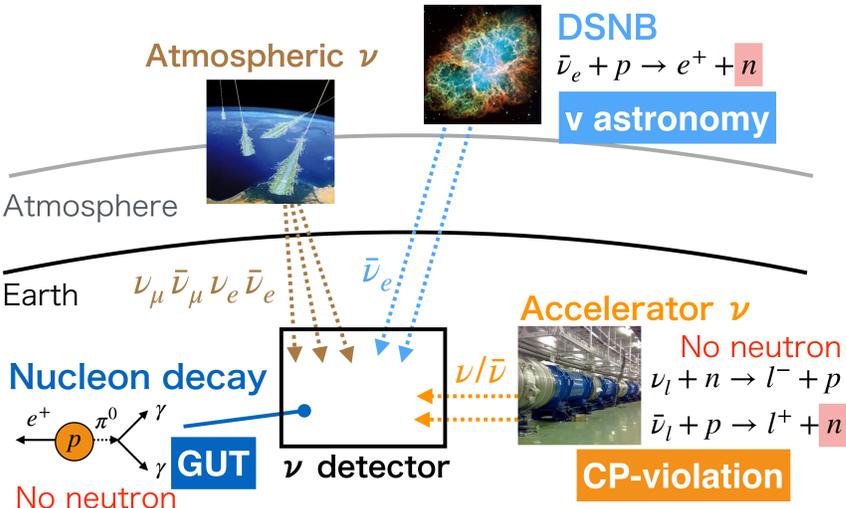
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1. Neutron Multiplicity & Nuclear Deexcitation

Neutrons are suffering from nuclear effects:



Neglected in existing ν MC generators*
* NEUT considers this only for ^{16}O -target

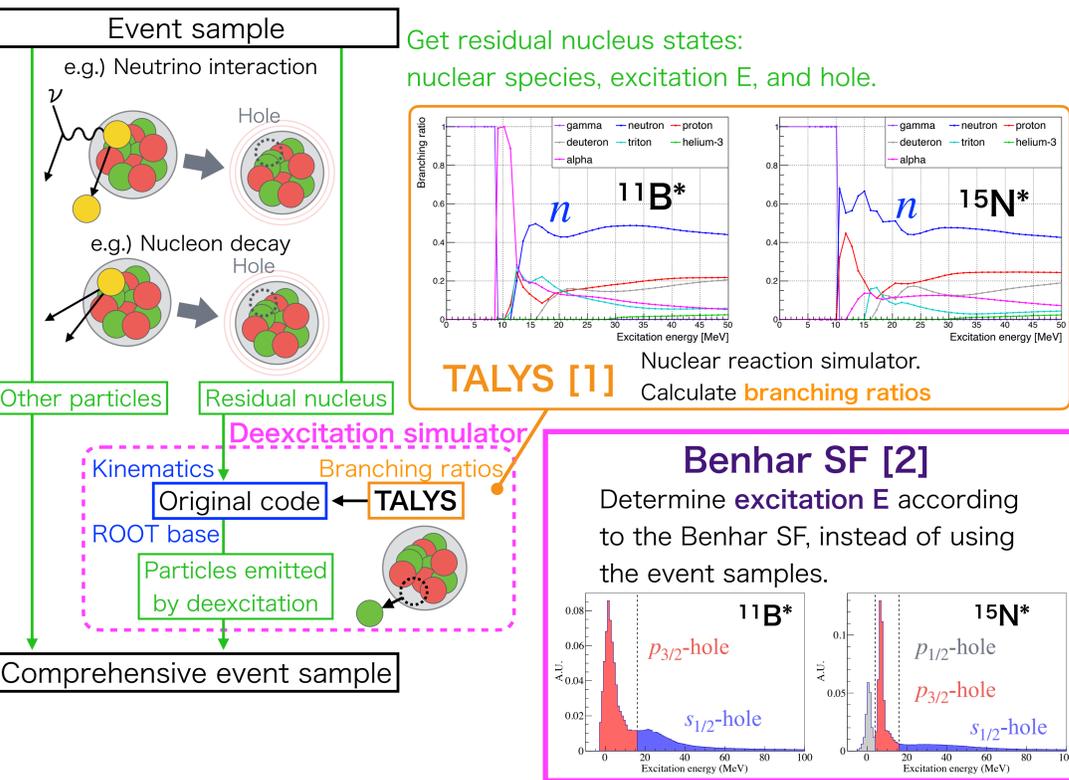
How can we reduce the main BG, atm. ν ?
How can we reduce the wrong sign ν ?
→ **Key observable: Neutron multiplicity**

KamLAND, JUNO (liquid scintillator)
SK-Gd, ANNIE (Gd-loaded water)

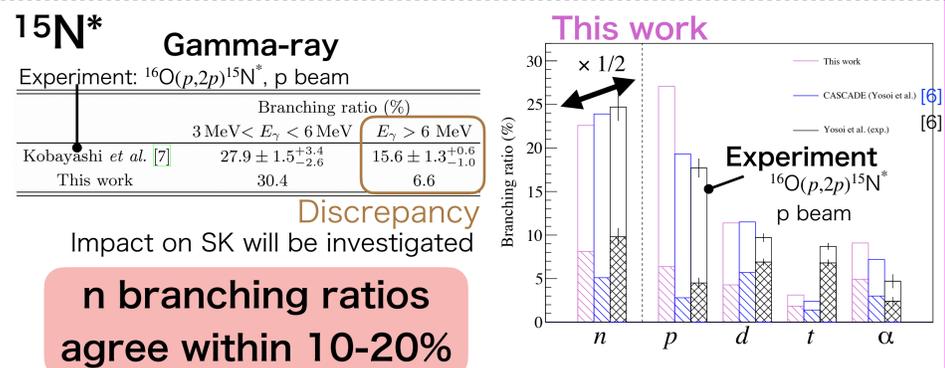
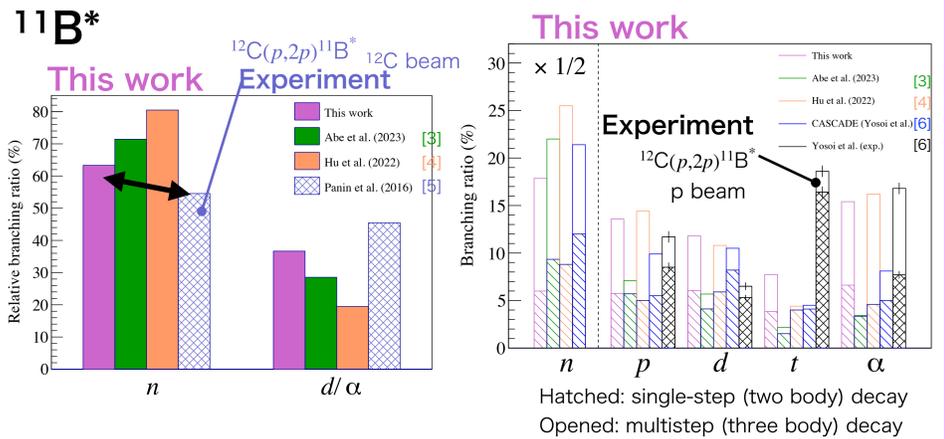
Aim

Provide a nuclear deexcitation simulator that is applicable to existing neutrino/nucleon decay generators

2. Simulation Procedure & Validations



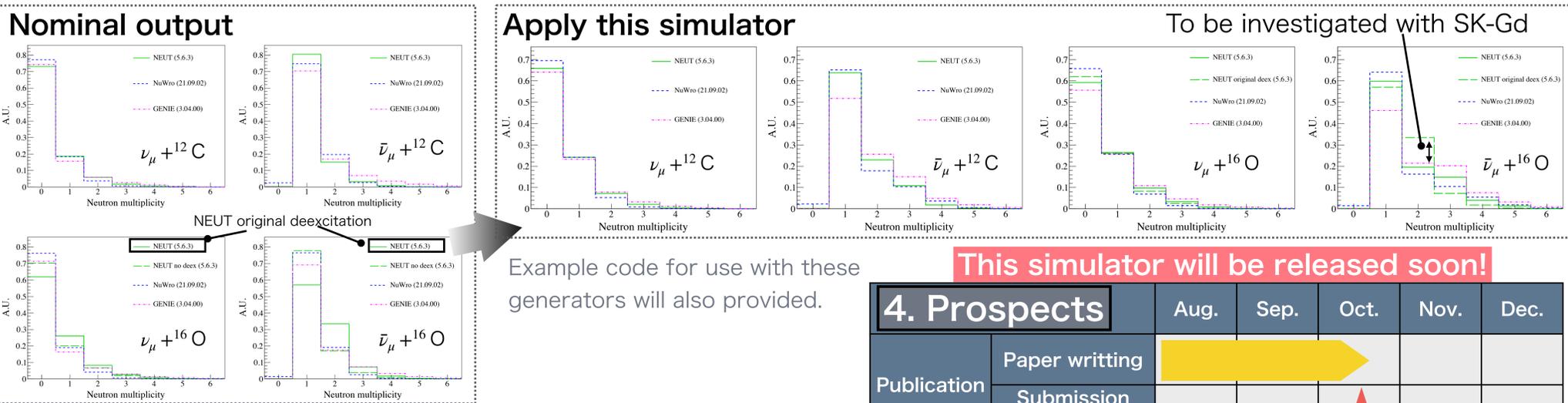
Validations



3. Application to Neutrino Interactions

CCQE, $E_\nu = 1 \text{ GeV}$, ^{12}C or ^{16}O

NEUT v5.6.3 (SF), NuWro v21.09.02 (SF), GENIE v3.04.00 (Local Fermi gas, hN FSI)



Mean neutron multiplicity

^{12}C	ν_μ			$\bar{\nu}_\mu$		
	NEUT	NuWro	GENIE	NEUT	NuWro	GENIE
Nominal	0.39	0.28	0.42	1.24	1.24	1.52
This work	0.48	0.38	0.55	1.51	1.50	1.72

^{16}O	ν_μ			$\bar{\nu}_\mu$		
	NEUT	NuWro	GENIE	NEUT	NuWro	GENIE
Nominal	0.43 (0.55)	0.30	0.51	1.28 (1.55)	1.24	1.55
This work	0.61	0.45	0.76	1.67	1.62	2.06

NEUT original deexcitation (It considered only for ^{16}O)

4. Prospects

	Aug.	Sep.	Oct.	Nov.	Dec.
Publication	Paper writing				
	Submission & code release			★	
Implementation	NEUT			➡	
	SK nucleon decay code			➡	

This simulator will be released soon!

Release after publication