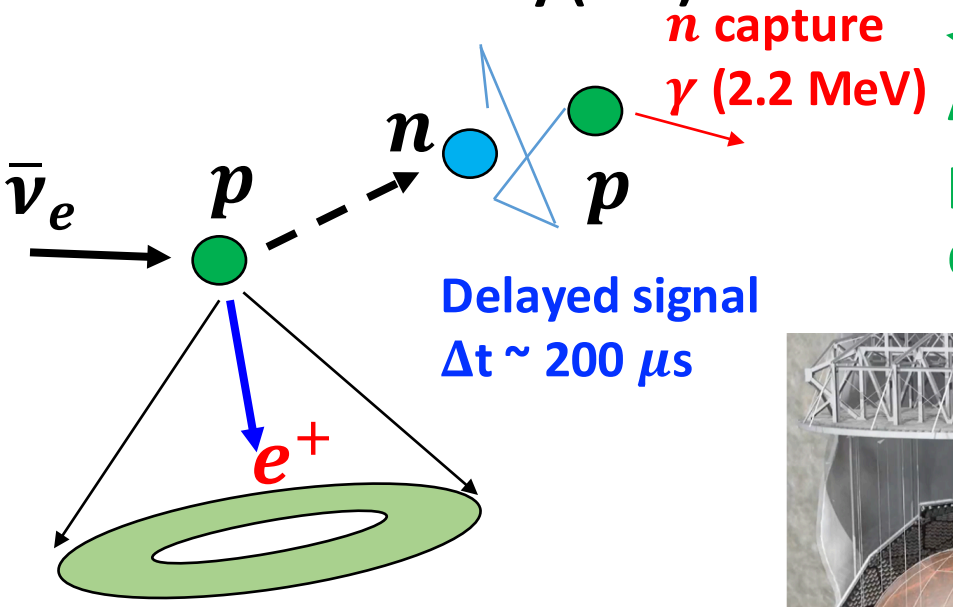
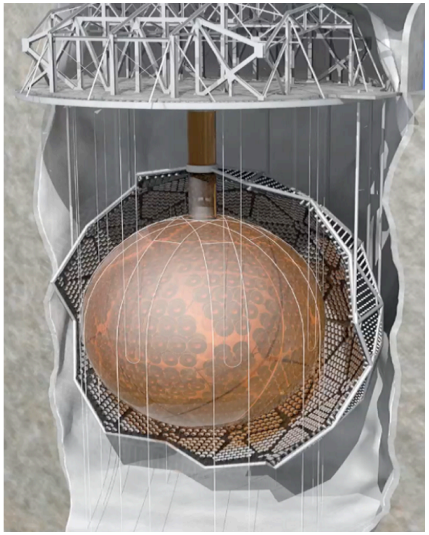
Neutron detection in the water phase of SNO+ experiment

- **Efficient detection of neutrons in water is important because of its physics applications, e.g., reactor $\bar{\nu}_e$ detection via inverse-beta-decay (IBD).**



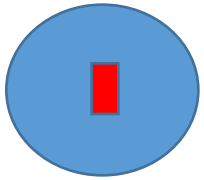
A challenging task to detect in pure water Cherenkov detector due to the low energy.



SNO+ detector

- ✓ **Multipurpose neutrino experiment**
- ✓ **Reuse the infrastructure of the SNO**
- ✓ **900 tons of pure water (water phase) in a 12-m-diamter AV.**
- ✓ **More than 9,000 PMTs**

A neutron source (AmBe) is deployed for n-detection study.



$\alpha + {}^{9}\mathrm{Be} \rightarrow {}^{12}\mathrm{C}^{*} + n$

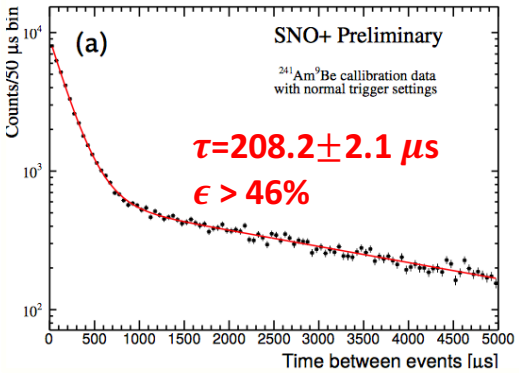
${}^{12}\mathrm{C}^{*} \rightarrow {}^{12}\mathrm{C} + \gamma$ (prompt) 4.4 MeV

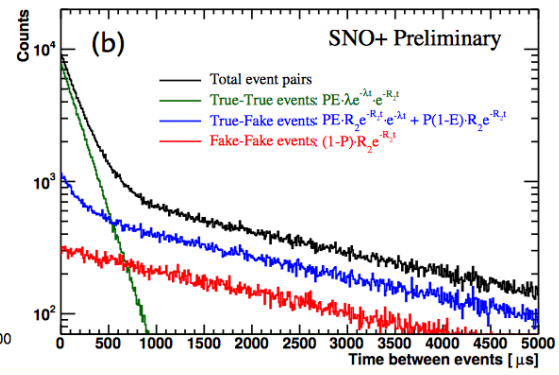
$n + p \rightarrow d + \gamma$ (delayed) 2.2 MeV

Trigger threshold is lowered to ~1.5 MeV to detect the n events

Analysis of AmBe

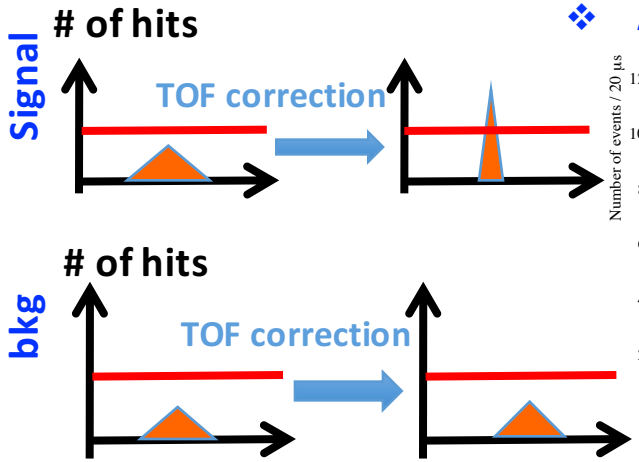
- Pairs selected spatially independent
- Only the first delayed event

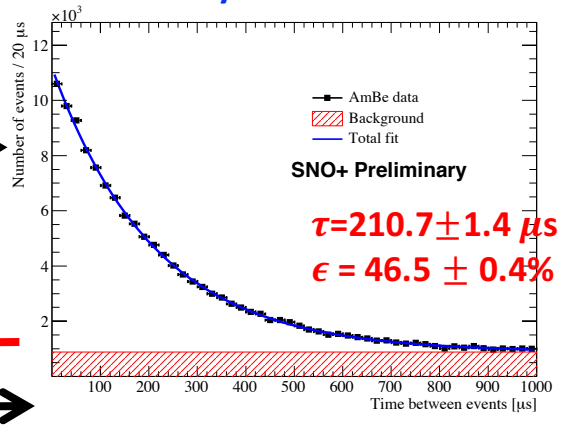




Ongoing analysis

- Pairs selected spatially dependent
- All the delayed events





- We have successfully detected neutrons with an efficiency of 46.5±0.4%, which is the largest featured by an unloaded water Cherenkov detector. This opens up the IBD study in SNO+ water phase.