The JSNS$^2$ Experiment

- Purpose of JSNS$^2$ : search for sterile neutrinos with $\Delta m^2$ near $1$eV$^2$
- A 3 GeV J-PARC proton beam collision with mercury target
- MuDAR, muon decay at rest : $\mu^+ \rightarrow e^+ + \bar{\nu}_\mu + \nu_e$
- Searching for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$
- IBD, Inverse Beta Decay : $\bar{\nu}_e + p \rightarrow e^+ + n$
- JSNS$^2$ Target : fiducial volume of 17 tons, GdLS, 24 m baseline

Configuration & Motivation

Generating process of Beam-related gamma

- Generation Process :
  J-PARC proton beam collision with Hg target → Neutron generation → Neutron capture by concrete below detector → Emitting gammas

- Energy of beam-related gammas : $\sim 8$MeV, * Delayed energy region of IBD, $7\sim 12$ MeV

Beam-related gammas may increase accidental background. JSNS$^2$ has installed lead blocks and iron as a primary shielding for beam-related gammas. Shielding configuration is optimized using Monte-Carlo simulation
Lead and Iron shielding

Structure of JSNS$^2$ detector in MC

- JSNS$^2$ detector in MC: 3-layered cylinder for target, gamma catcher, veto
- Shielding: Iron plate
  - 6 m X 9 m X thickness
  - Lower layer of lead: 2.5 m radius(R2) X 5cm
  - Upper layer of lead: (R1) X 5cm

Shielding effects are estimated through deposited energy for each shielding configuration within the constraint of JSNS$^2$ facility.

For the enhanced shielding,
- increase the upper radius of lead, R1 up to gamma catcher area from target
- iron 22mm thicker

It will reduce the beam related gamma background by 52% in sterile delayed region of JSNS$^2$. This setup is applied for data taking in 2021.

Summary

- Proper shielding configuration is studied with Monte-Carlo simulation
- Reducing beam induced gamma by 52%
- Enhanced lead and iron shielding is set up
- Now we are taking data from Jan 12$^{th}$ with beam.
- The data is being analyzed. You will see the results soon.