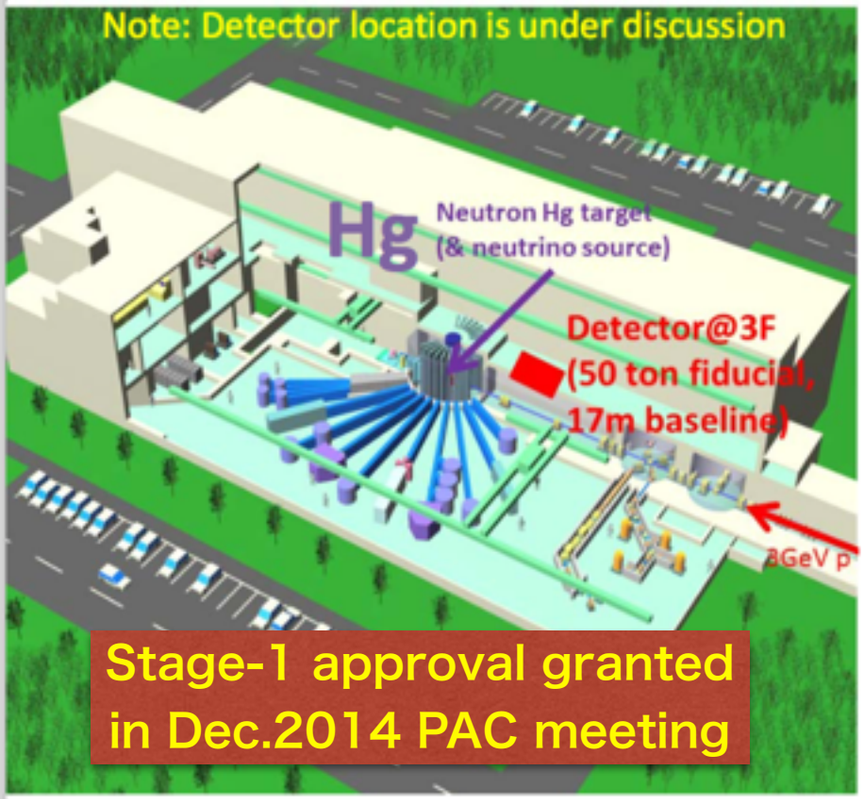
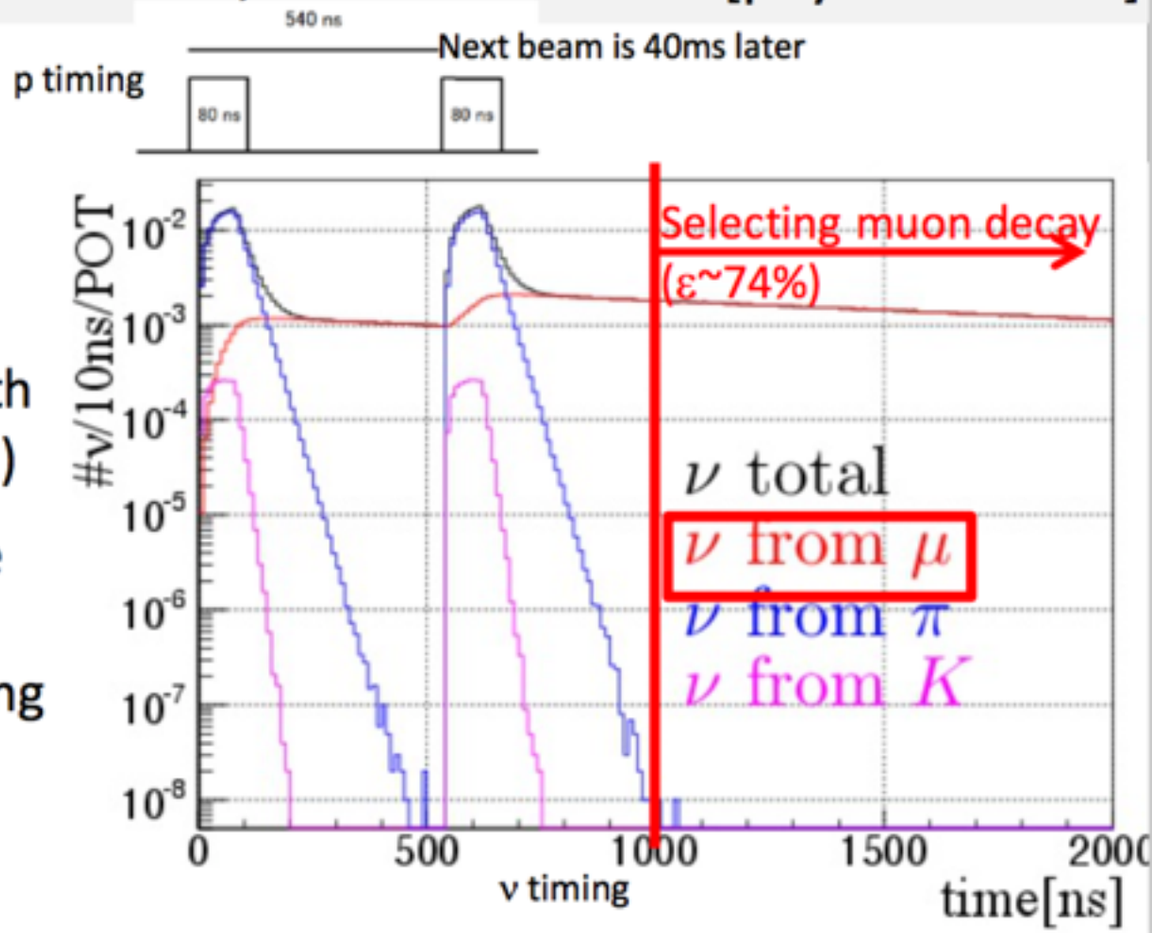
Sterile neutrino search @MLF (proposal in 2013)

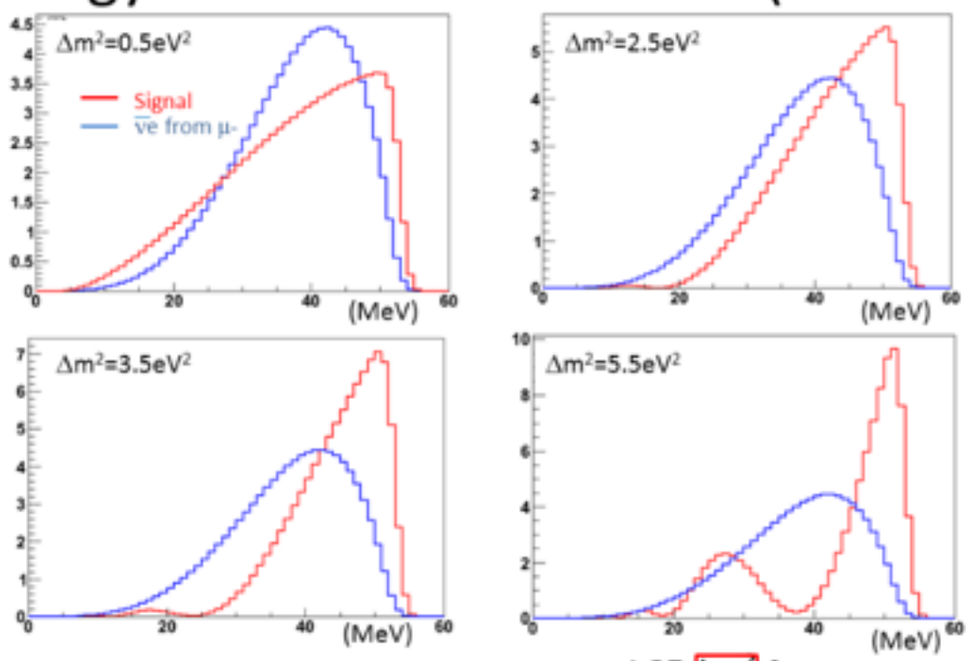
M. Harada *et al*, arXiv:1310.1437 [physics.ins-det]



- J-PARC P56 aims to confirm or refute the neutrino oscillation with sterile neutrino($\bar{\nu}_\mu \rightarrow \bar{\nu}_e$)
- With gating the time we can use ultra-pure neutrinos from stopping μ^+ (top-right)
- Energy distortion → sig vs BKG separation (bottom-left)



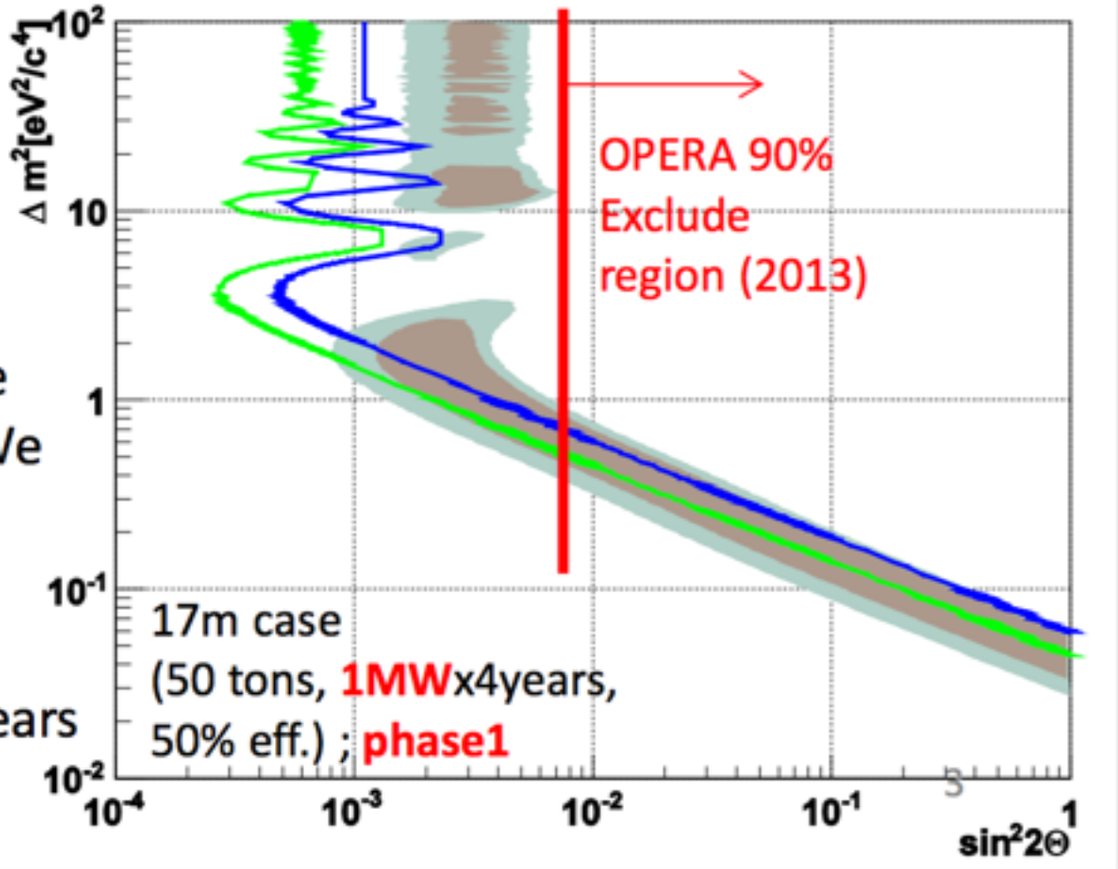
Energy distribution of events (L=17m)



$$P(\nu_\mu \rightarrow \nu_e) = \sin^2 2\theta \cdot \sin^2\left(\frac{1.27 \cdot \Delta m^2 \cdot L}{E_\nu}\right)$$

- Energy is smeared by 15%/sqrt(E) (detector E resolution)

- Sensitivity of P56 (right); blue 5σ, green 3σ. We conclude LSND region (brown (90%CL) & green (99%) within 4 years

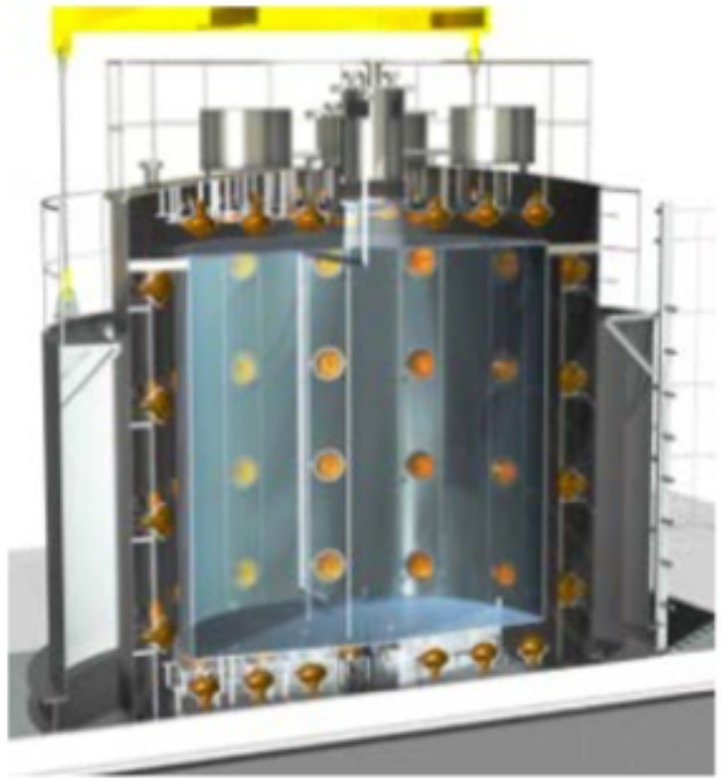


Detector and Detection Principle (reminder)

Detector

Target volume => **Gd-loaded LS**
(25tons x 2 detector ~ total 50tons)

150 10” PMTs/detector
E resolution ~ 15%/√MeV

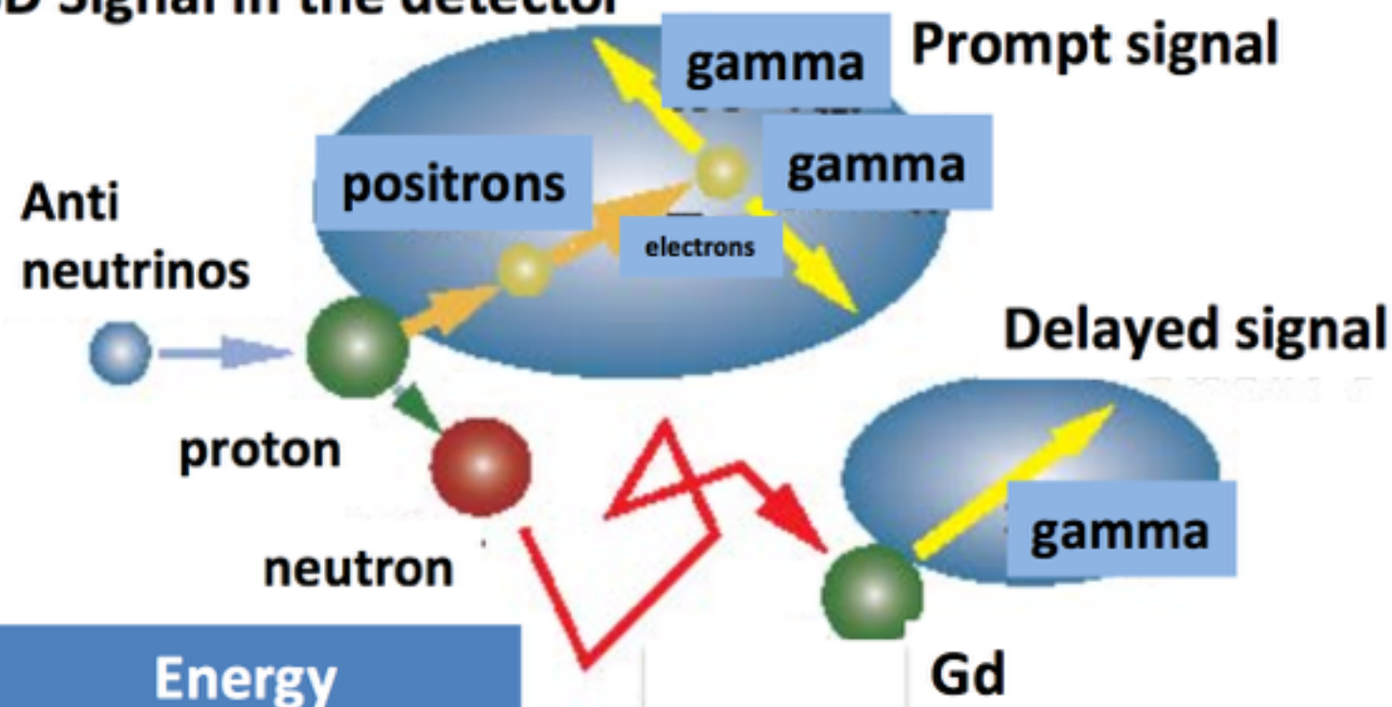


Delayed Coincidence (IBD)

$\bar{\nu}_\mu$ => oscillation $\bar{\nu}_e + p \rightarrow e^+ + n$

Identify ν with detecting
e^+ and γs from n capture on Gd.
=>Can reduce accidental BKG
(Gd~8MeV γs, capture time ~ 30 μs).

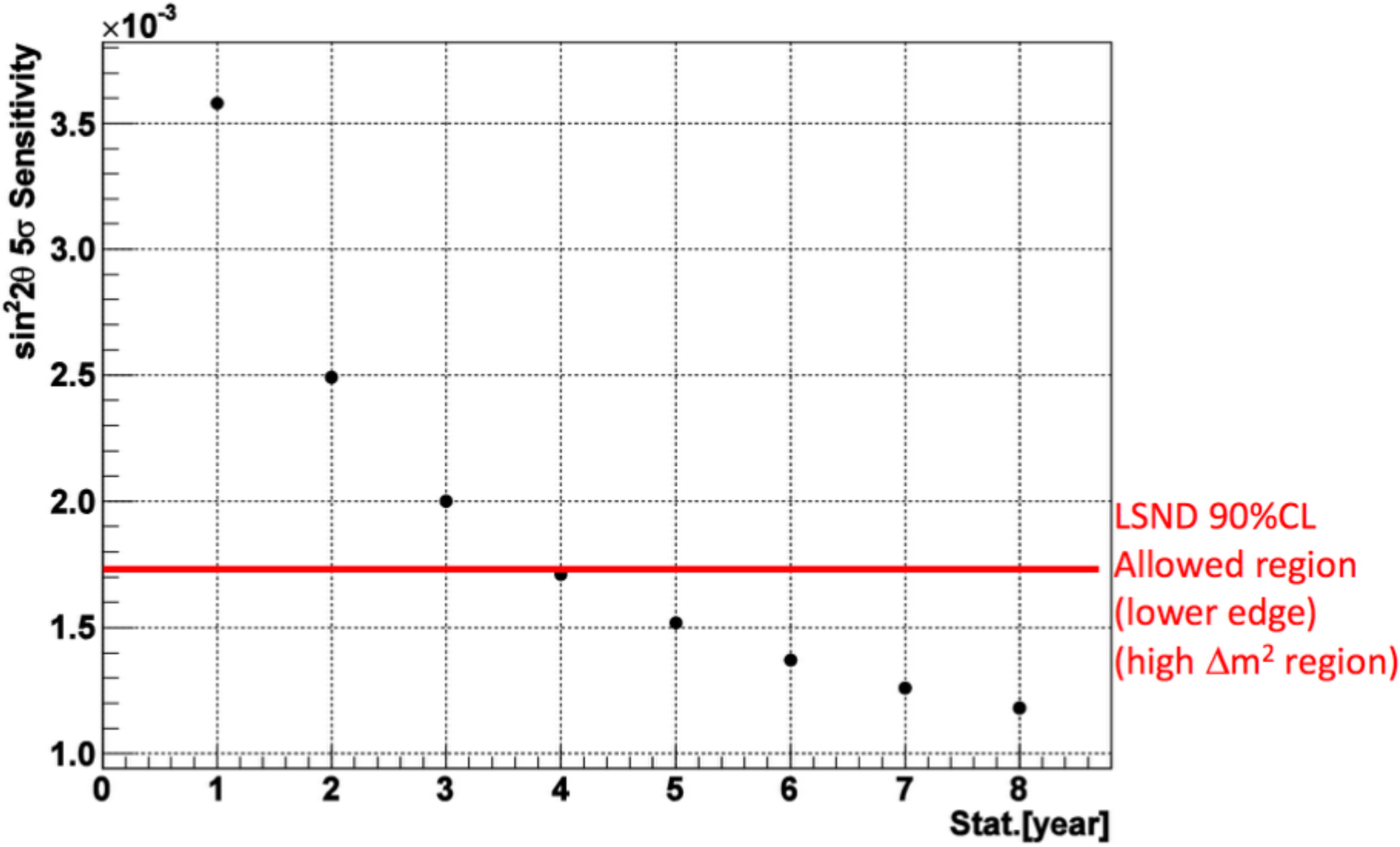
IBD Signal in the detector



Selection criteria for IBD

	Time from beam	Energy
Prompt signal	$1<T_p<10\mu s$	20<E<60MeV
Delayed signal	$T_p<T_d<100\mu s$	7<E<12MeV

5σ sensitivity as a function of MW x years



- We start to cover whole LSND 90% CL allowed region with 4 years x MW operation for high Δm^2 region.
  (This is also a good indicator for $\Delta m^2 > 2.0\ eV^2$ coverage)