Expected BNL-HS event rate with 1MW, 100kTon

- Oscillation Probability Calculation
- 4 trial ν-fluxes
- Cross sections
- Expected event rates
- Conclusions

Oscillation Prob. Calc.

- Direct numerical solution of 3 neutrino evolution equation:
  $i\frac{d\nu(x)}{dx} = [\frac{1}{2E}UM^2U^\dagger + V(x)]\nu(x)$
- Full matter effects using a detailed density profile (PREM) $\longrightarrow$
- Chose:
  - $\sin^2 2\theta_{12} = 0.8$
  - $\sin^2 2\theta_{23} = 1.0$
  - $\sin^2 2\theta_{13} = 0.04$
  - $\delta_{CP} = 0$
  - $\Delta m^2_{sol} = 5 \times 10^{-5}$
  - $\Delta m^2_{atm} = 3 \times 10^{-3}$
  - BNL-HS baseline = 2540km
- Don't trust below 500 MeV too much.

4 ν-fluxes

1. On axis, P889 AGS beam brightened to 1MW and,
2. Same but 1.5° off axis.
3. On axis, NuMI beam brightened to 1MW, “transplanted” to BNL and,
4. Same but 1.0° off axis.

Cross sections

- Cross sections from P889 $\longrightarrow$
- Assuming a water target
- Considering QE CC only.
- No attempt to look at backgrounds yet.

Event rates

Events/kTon/PoT:

$$\Phi[\frac{N_\nu}{cm^2 \cdot \mathrm{PoT} \cdot E_{bin}}] * \sigma[cm^2/n] * \frac{N_n}{kTon}$$

1MW beams:

- "Super" P889: 0.096MW @ 4×10^{13} PoT/1.6 sec spill $\rightsquigarrow$ 4.2×10^{14} PoT @ 1 MW.
- "Transplanted" NuMI: 0.4MW @ 3.9×10^{13} PoT/1.87 sec spill $\rightsquigarrow$ 9.7×10^{13} PoT @ 1 MW.

Events/Year:

- Assume 3e7 seconds / year (100% running)
- No fiducial cuts, no reconstruction efficiencies.
- No background contamination.

Conclusions

- 100k+ far detector events per year based on many optimistic assumptions (I'm surprised it is so high: mistake?!)
- For the same power, BNL's AGS is better than a "super" NuMI.
- This is only a simple and young analysis. It needs to be checked and improved:
  - Reconstruction efficiencies,
  - Backgrounds and finally
  - Exploration of sensitivities