

Pion decay beam sensitivities with NuSTORM

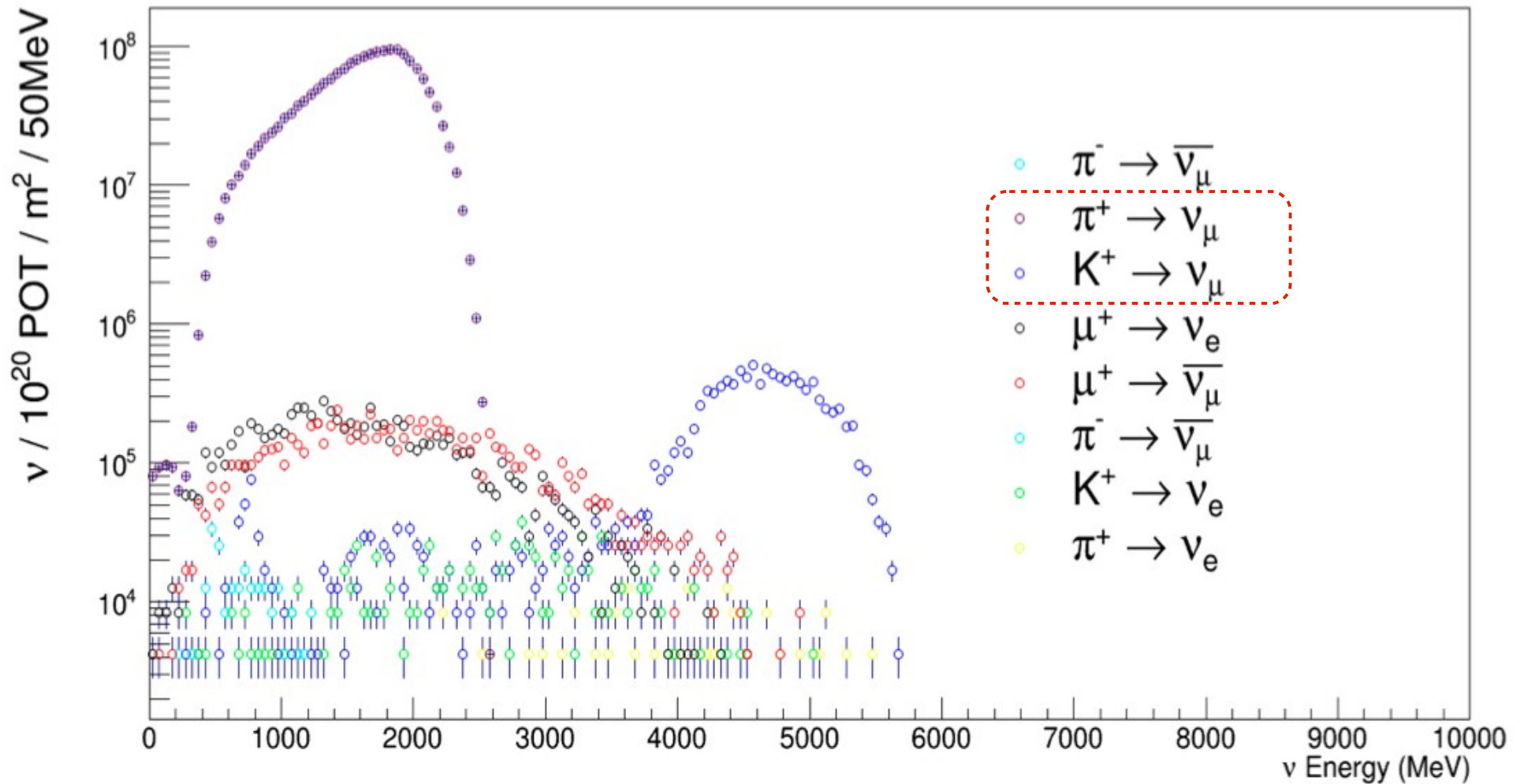
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MAP 2014 Spring Meeting
Fermilab, May 29th, 2014

In this talk

- What the title says: study what can be done with neutrinos produced from pion decay at NuSTORM
 - How many events would we get?
 - Would these provide any useful information towards CP violation searches?
 - Can they help increase LBNE sensitivities?
- We will consider the same detector size and baseline as LBNE (34 kt, 1300 km)

NuSTORM flux from pion decay

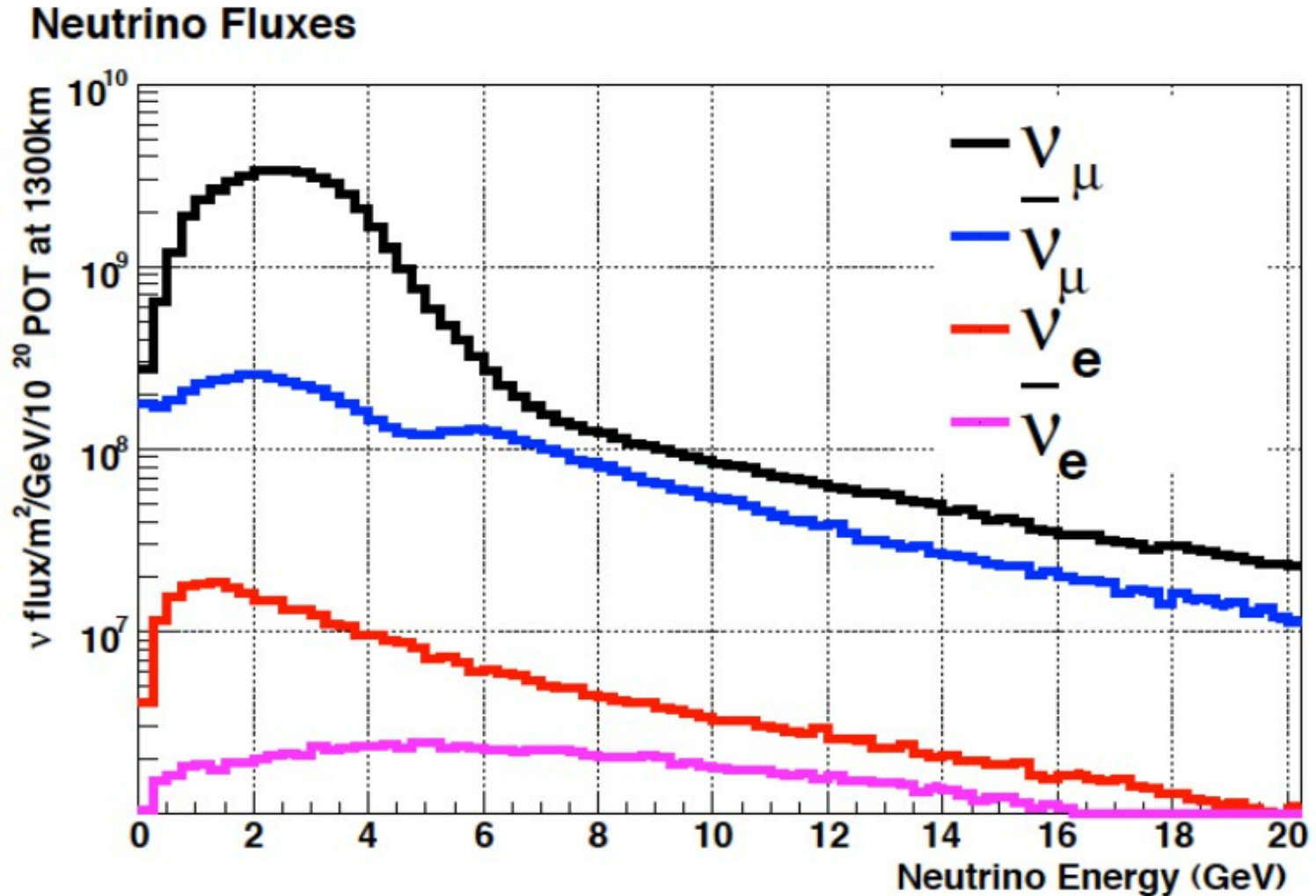


From David Adey's results (see his talk from yesterday)

Assumptions

- No antineutrino data available yet
(ie, some assumptions need to be made)
 - We assume that the nubar fluxes will have approximately the same shape as nu fluxes
 - We will show how the results vary when nubar fluxes are 80%-100% of the nu fluxes

LBNE flux



From the talk by Kevin Yarritu at NuFlux

Workshop, Pittsburgh, Dec 2012

Total number of events (10 yrs)

LBNE

Channel	Signal	Backgr.
$\nu_\mu \rightarrow \nu_e$	1131	701
$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$	361	634
$\nu_\mu \rightarrow \nu_\mu$	16443	84
$\bar{\nu}_\mu \rightarrow \bar{\nu}_\mu$	11398	64

34 kton, 1.2 MW
(1e21 PoT, 120 GeV, 1.65e7 sec/yr)

NuSTORM π -decay

Channel	Signal	Backgr.
$\nu_\mu \rightarrow \nu_e$	234	14
$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$	23-29	5-7
$\nu_\mu \rightarrow \nu_\mu$	315	7
$\bar{\nu}_\mu \rightarrow \bar{\nu}_\mu$	94-117	3-4

34 kton, 6e21 PoT

Nominal would be these,
divided by 6

Some simulation details

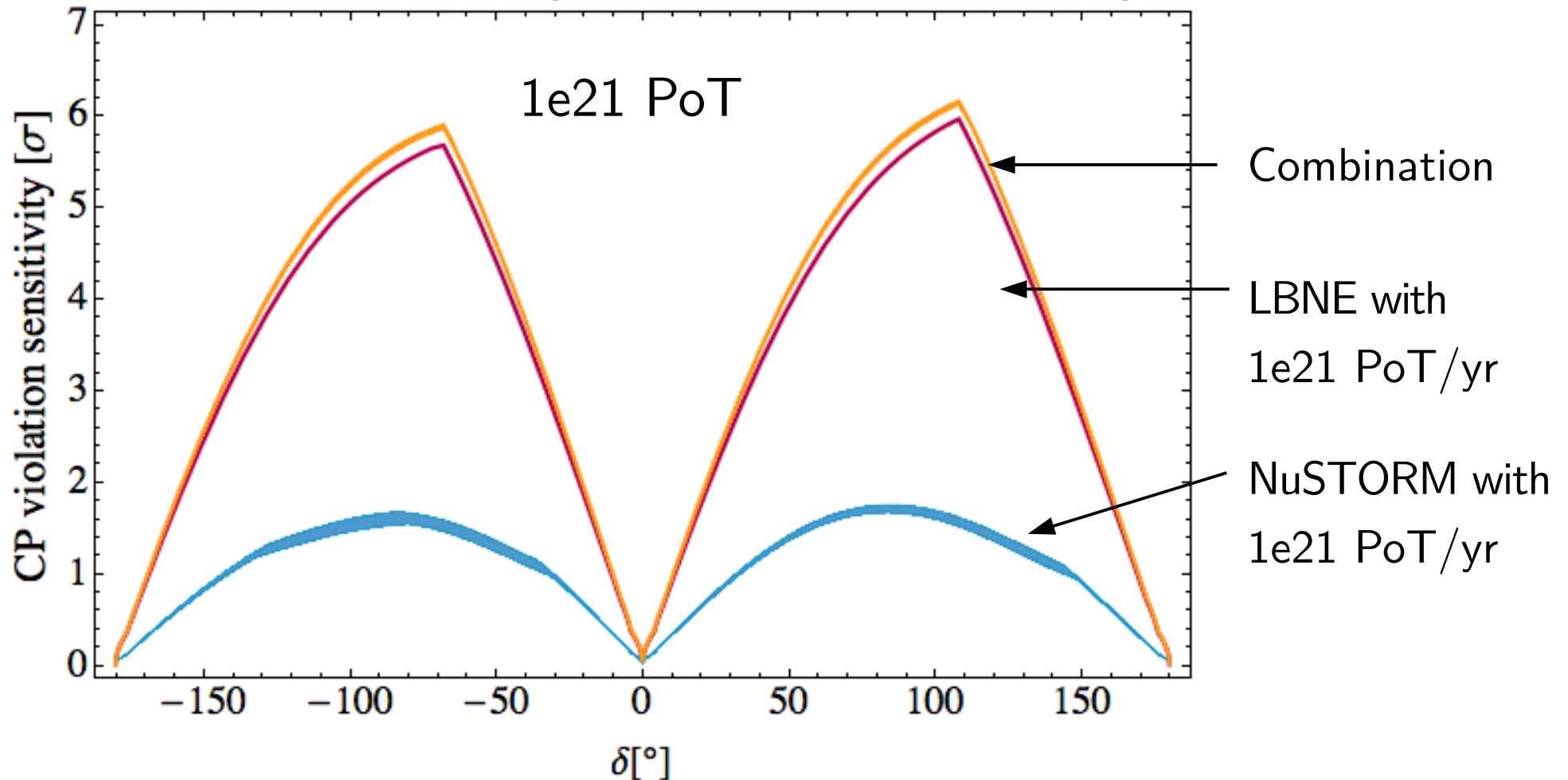
- All channels include a 1%- 5% normalization uncertainty on signals and backgrounds
- $\theta_{23} = 40^\circ$
- Normal hierarchy
- Both sign and octant degeneracies are searched for during marginalization

Some simulation details

- Detector response simulated as in the LBNE CDR (October 2012):
 - 1% backgrounds (both CC and NC); migration matrices used to simulate the mis-reconstruction at low E for NC contribution
 - 80%-85% signal efficiencies
 - $0.15 \times \sqrt{E}$ gaussian smearing for $\nu_{\mu e}$ and $\bar{\nu}_{\mu e}$
 - $0.20 \times \sqrt{E}$ gaussian smearing for $\nu_{\mu \mu}$ and $\bar{\nu}_{\mu \mu}$

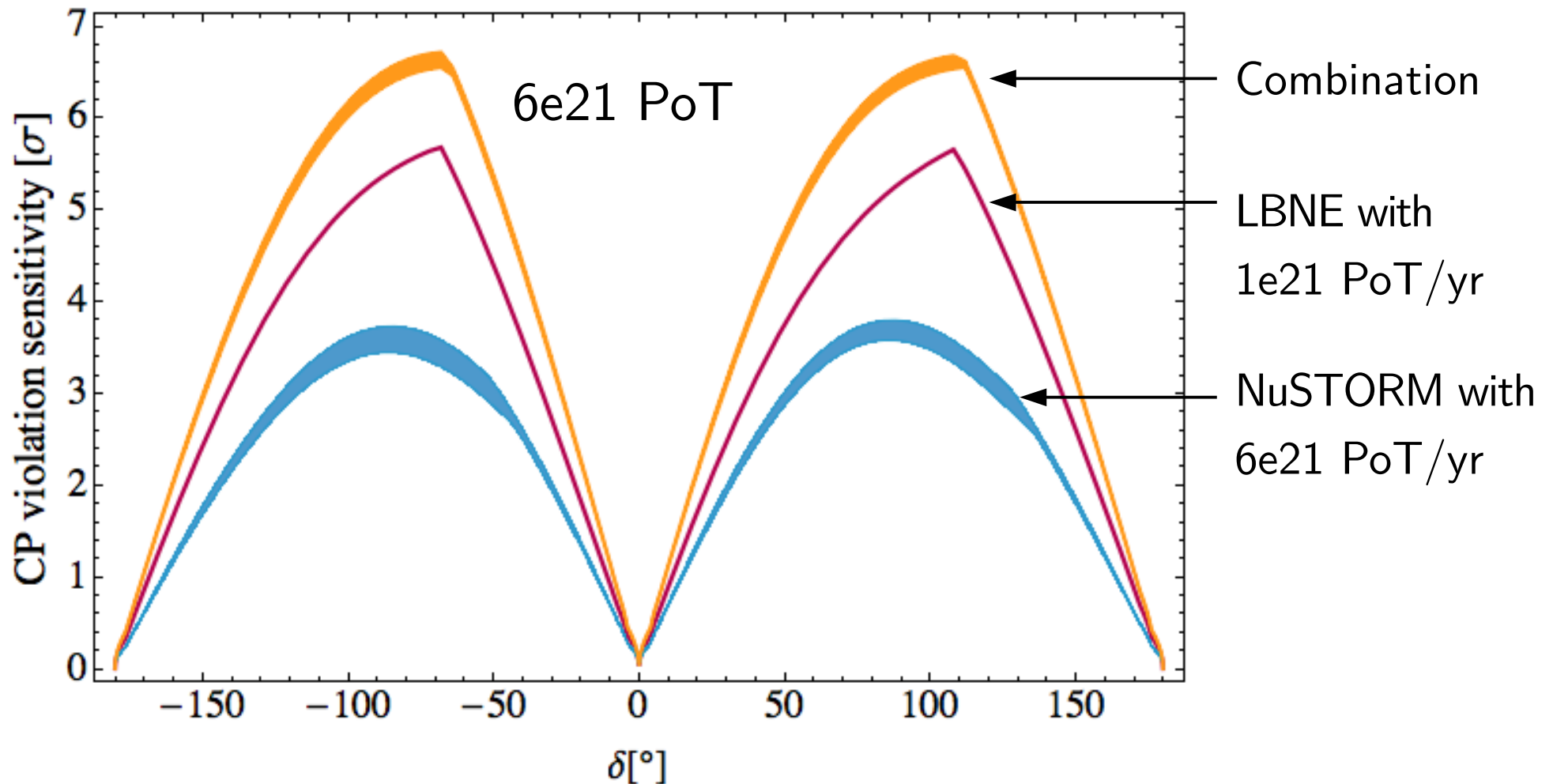
CP violation sensitivity

Results for 34kt, 10 yrs of data taking, 1%-5% sys



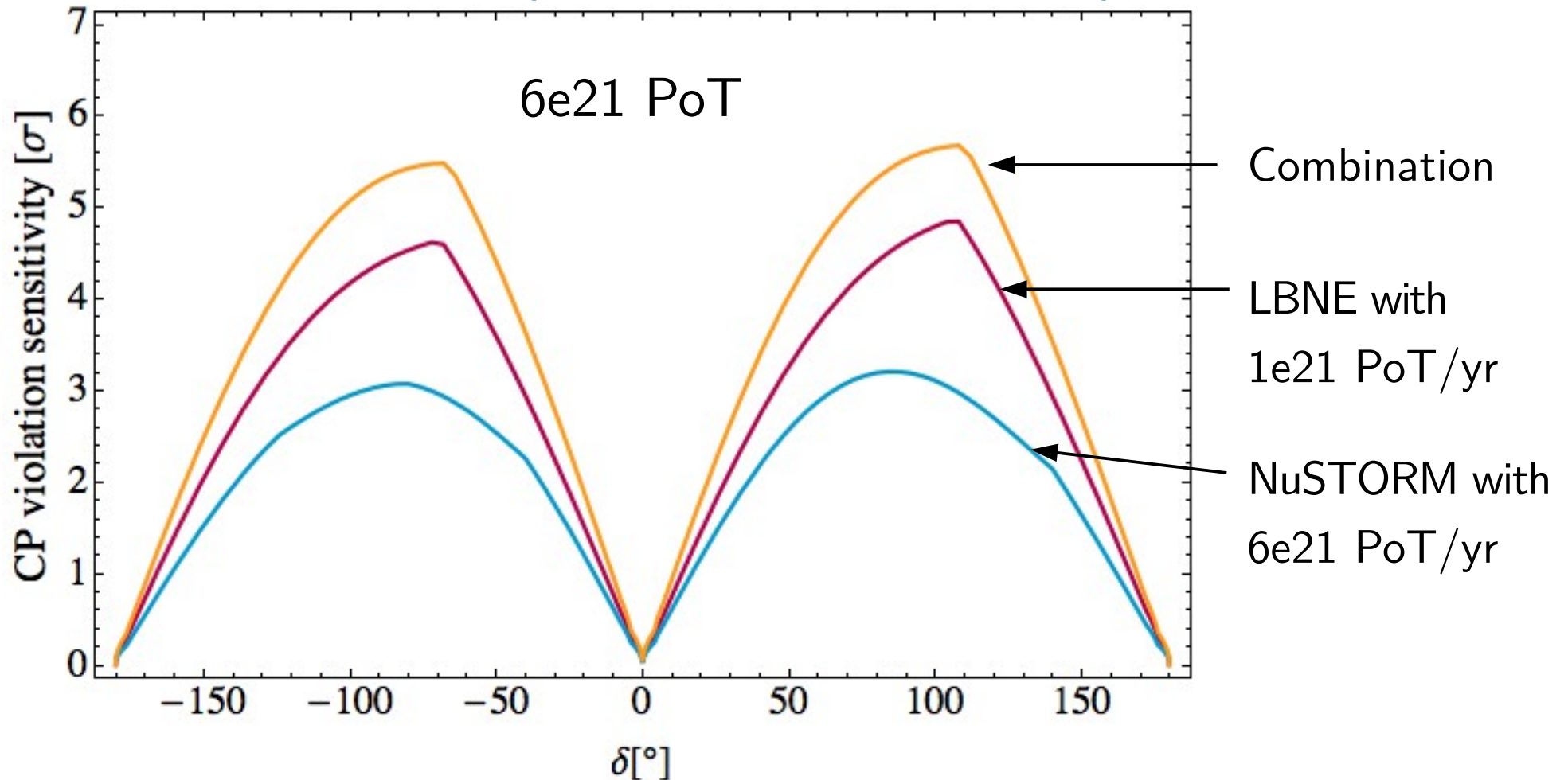
CP violation sensitivity

Results for 34kt, 10 yrs of data taking, 5% sys



CP violation sensitivity

Results for 34kt, 6 yrs of data taking, 1%-5% sys



Conclusions

- NuSTORM would be able to deliver neutrinos from pion decay with energies around 1.5-2 GeV (plus a second peak from kaon decay at ~ 5 GeV)
- For same number of PoT as LBNE, NuSTORM could bring **an additional 230 (35) events** in ν_{e} ($\bar{\nu}_{e}$) appearance at the LBNE detector in 10 years
- Result: enhancement of a possible CP violating signal at LBNE ($\sim 1\sigma$ extra for maximal CP violation), and a **significant increase of** the CP fraction for **5σ sensitivity**

Thank you!