Comparison of facilities
(discussion, my point of view)

NuFact 2011

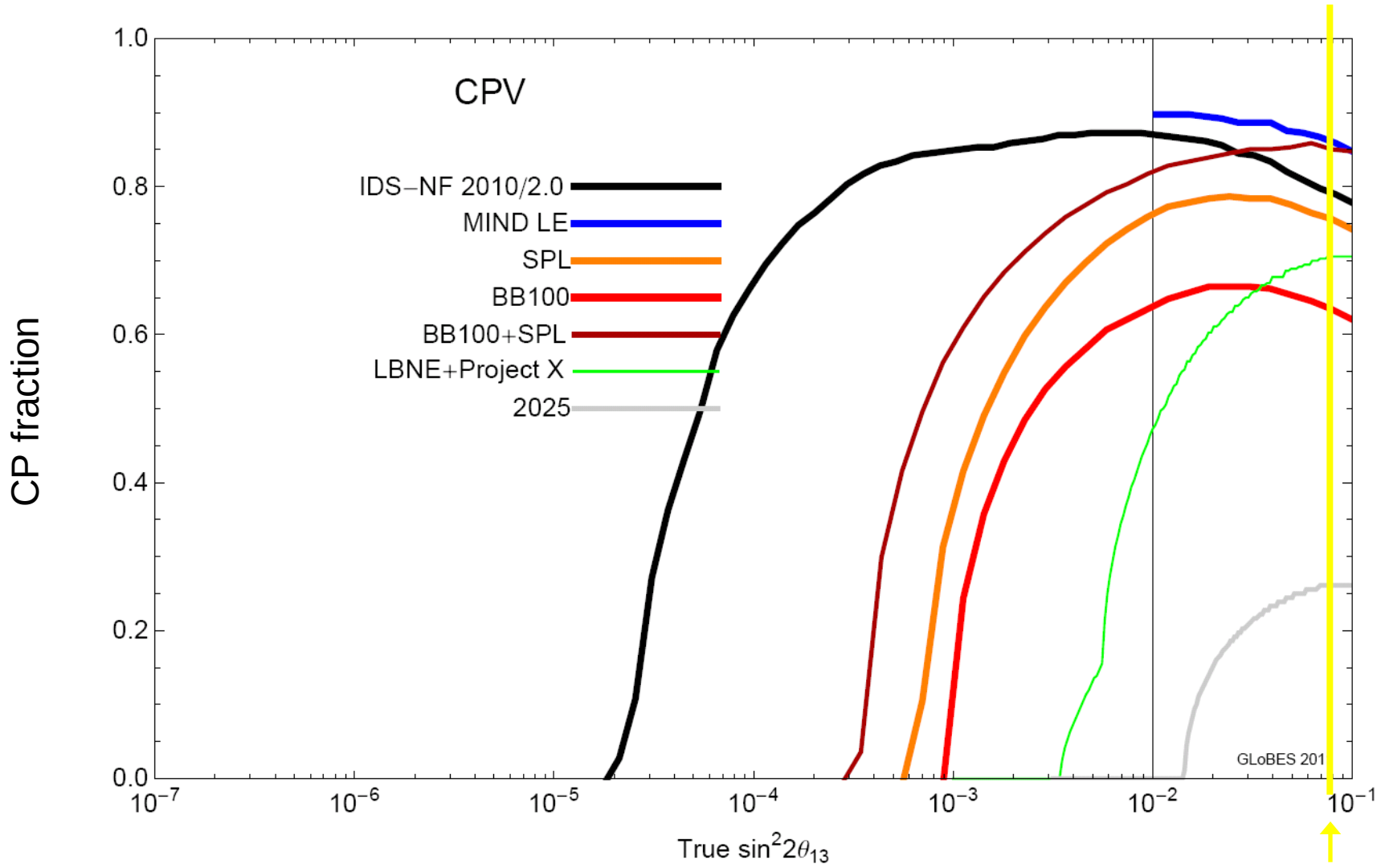
August 1-6, 2011

Geneva, Switzerland

Walter Winter

Universität Würzburg

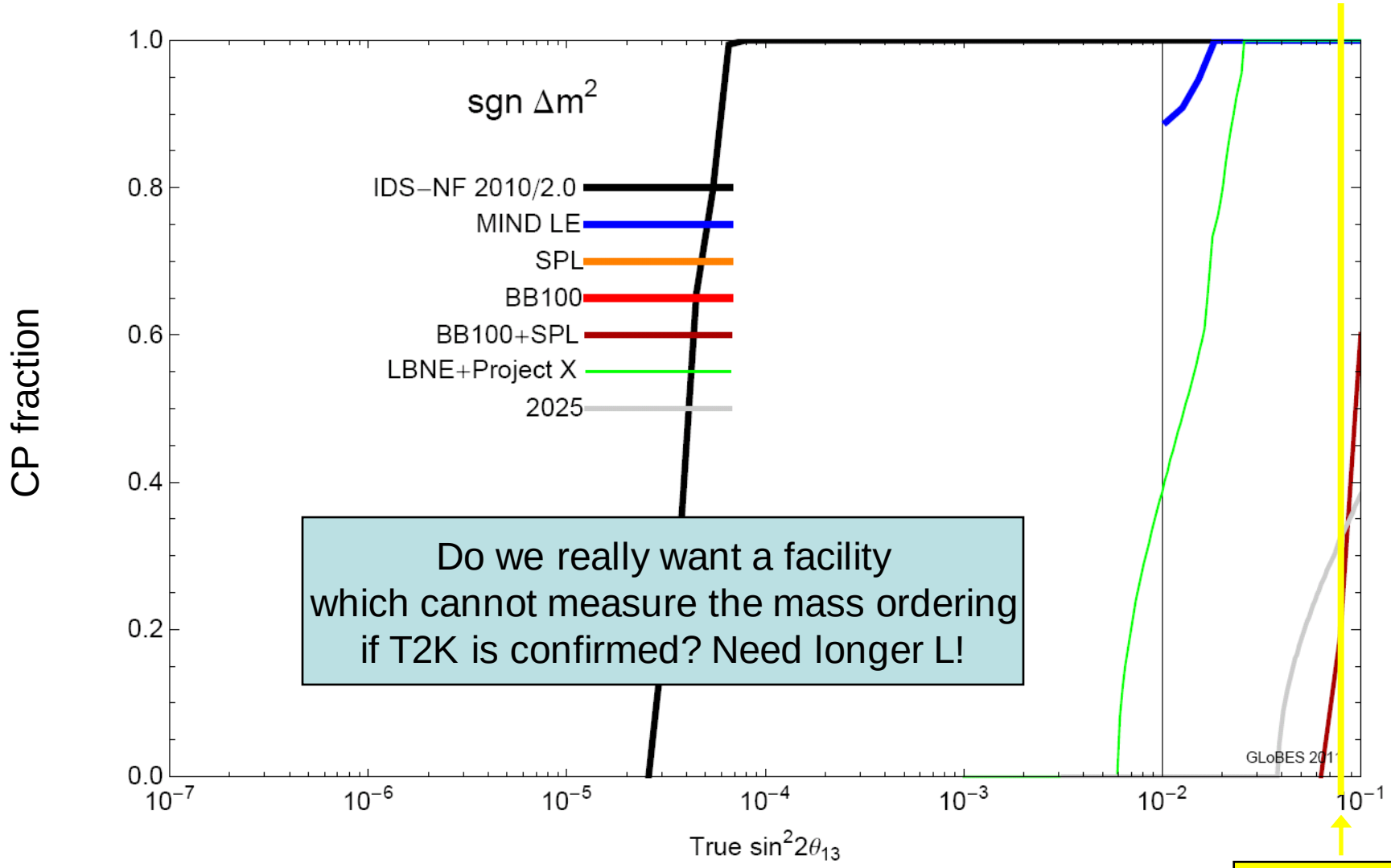
Comparison: CP violation



P. Huber @ ECFA Panel review, May 2011

Global fit
Fogli et al, 2011

Comparison: Mass ordering



P. Huber @ ECFA Panel review, May 2011

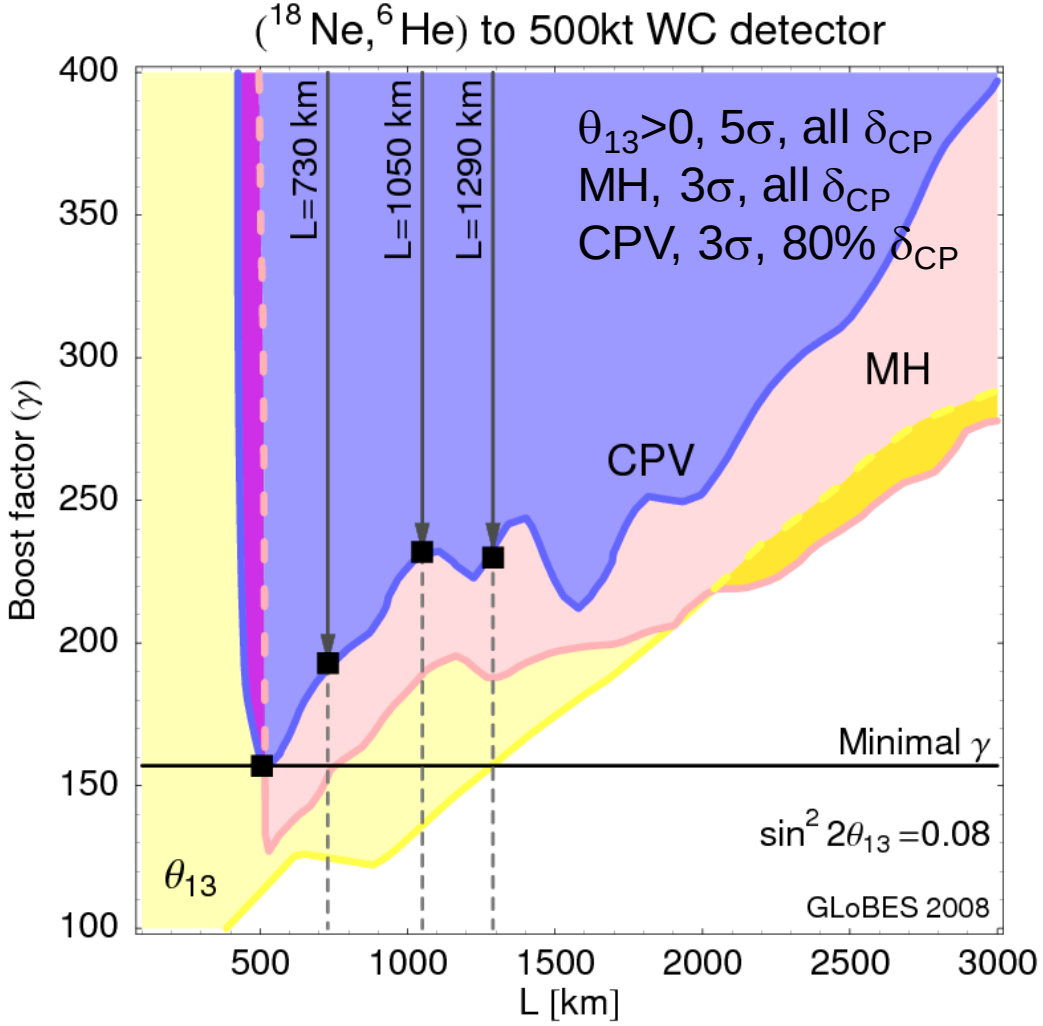
Optimization for large θ_{13}

Do we know how the optimal setups for large θ_{13} look like?

Are the proposed setups optimal?

Beta beams:
Optimization for large θ_{13}?

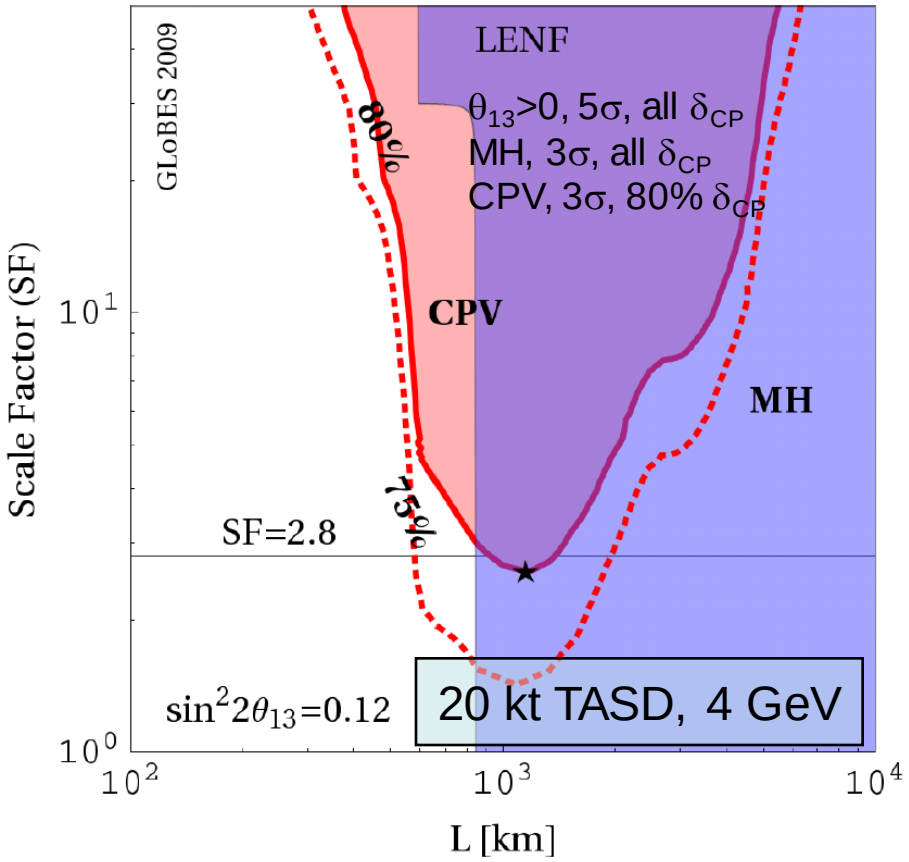
- "Minimal" beta beam for T2K hint:
  L > 500 km,
  γ>160
- Lower γ possible for B, Li if high enough Lumi (Earth matter effects!)



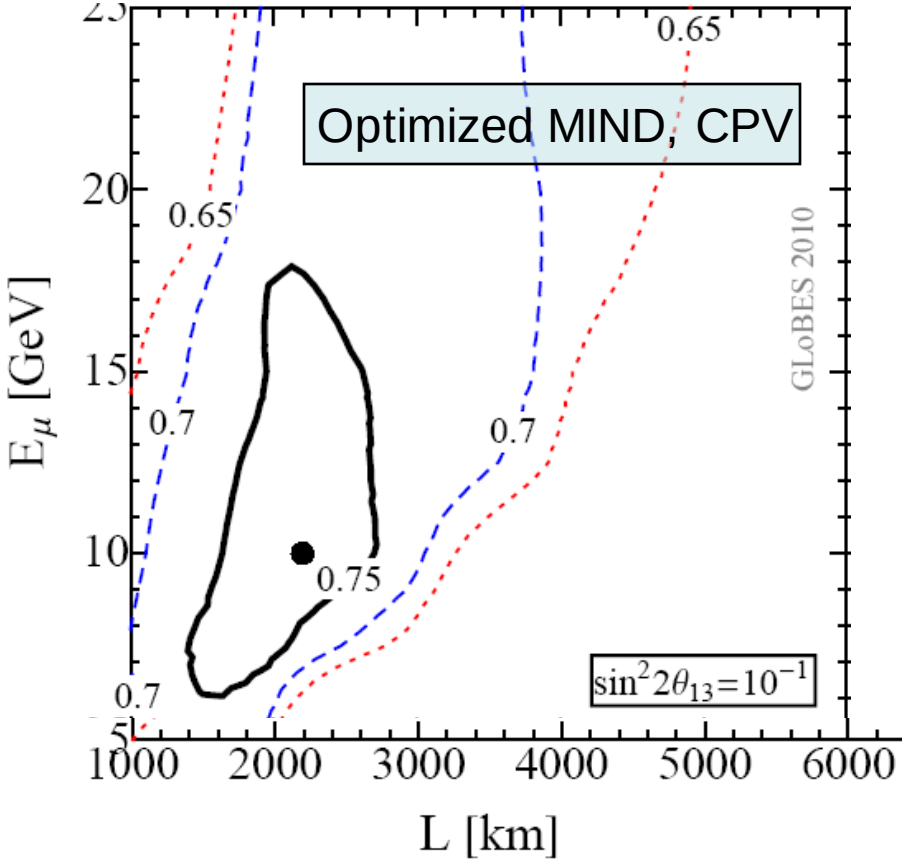
(arXiv:0804.4000)

Neutrino Factory:

Optimization for large θ_{13}?



Tang, Winter, 0911.5052

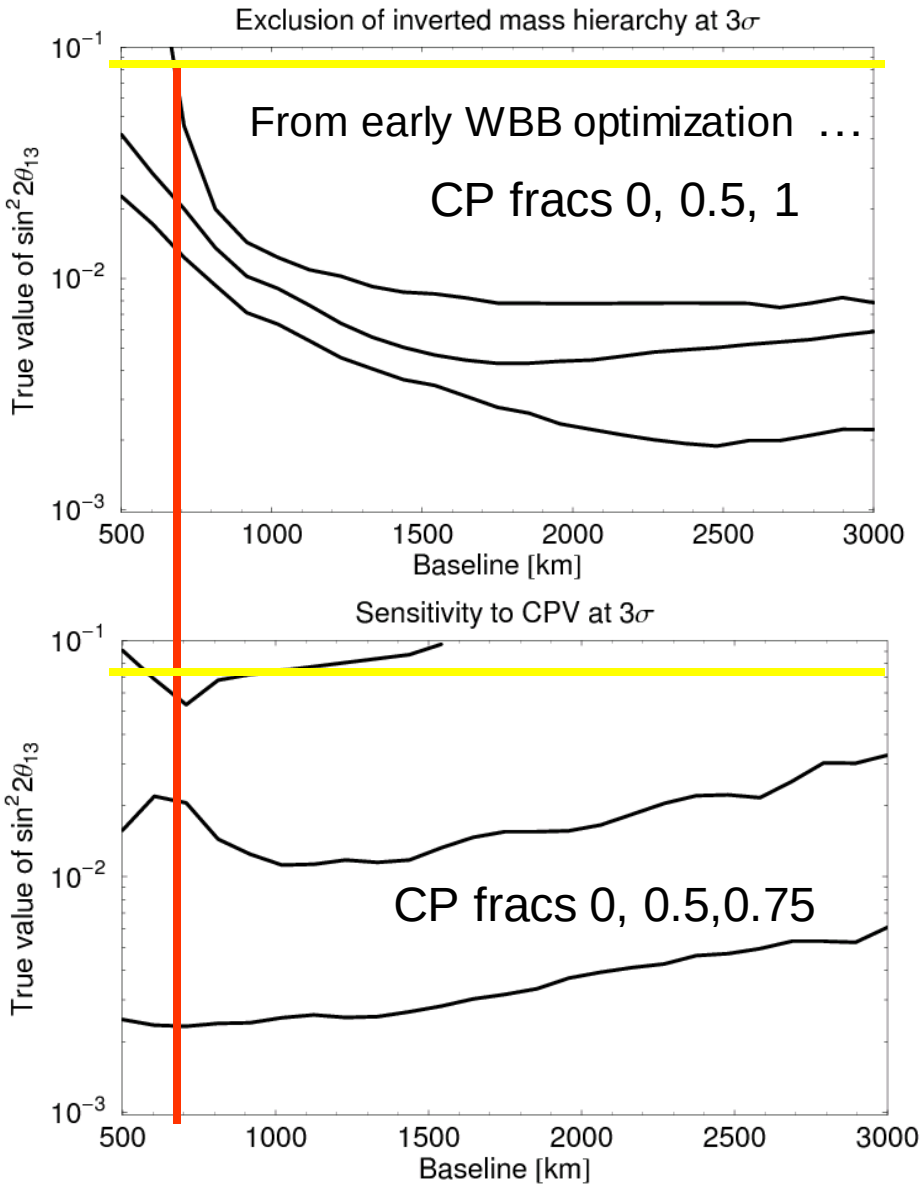


Agarwalla, Huber, Tang, Winter, 1012.1872

Open questions:
Staging? Platinum channel? Matter density uncertainty?

Superbeams:
Optimization for large θ_{13}?

- Some general optimization performed
  (e.g. Barger et al, hep-ph/0607177) →
- However:
  Not so clear (to me) how "minimal" setup would look like
- A high intensity upgrade of MINOS?
  (possibly with lower $E_{p:}$ need just long enough L to measure mass ordering)

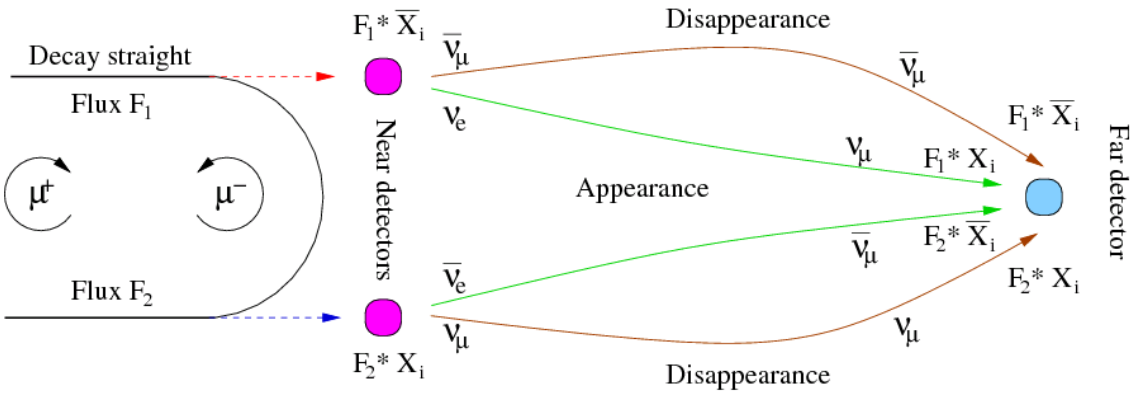


Optimization: conclusion?

- For NF, BB, we can predict the optimal setup as a fct. of $\sin^2 2\theta_{13}$ and detector performance
- For SB, typically external boundary conditions have lead to a particular optimization; also more complicated function of E_p, OA, horn tune ⇨ can that be further optimized for a particular θ_{13}?

Systematics: Cross secs.

- Normalization error especially important for precision measurements for large θ_{13}! Backgrounds less relevant!
- Superbeam:
  $\nu_\mu \Rightarrow \nu_e$, $\nu_\mu \Rightarrow \nu_\mu$: Where ν_e X-sec measured?
- Beta beam:
  $\nu_e \Rightarrow \nu_\mu$: Where ν_μ X-sec measured?
- Superbeam+Beta beam:
  ND in SB measures X-sec needed for FD in BB, and vice versa ⇨ synergy?
- NuFact:
  Only ν_μ X-Secs needed (at ND, if both polarities)



(Tang, Winter, arXiv:0903.3039)

Other impact factors?

- Can luminosity be easily achieved? How robust are these predictions?
- Can the experiment constrain the oscillation parameters in a self-consistent way by using different osc. channels?
- Are there other, potentially dangerous, systematics?
- What happens if there is new physics? Can the experiment be upgraded?

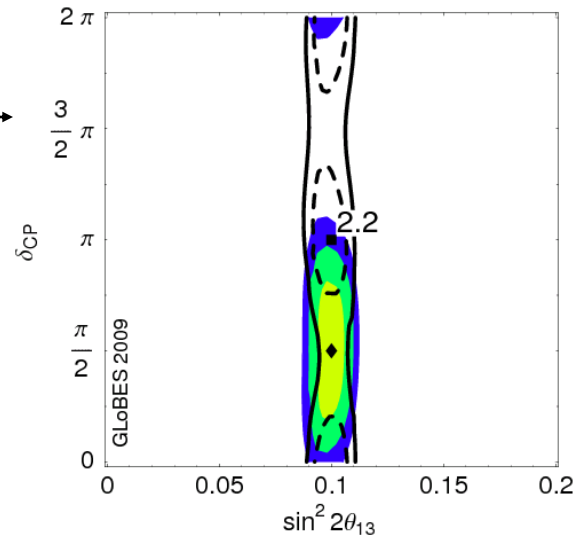
➢ How should one show these impacts in a comparison plot?

Performance comparison

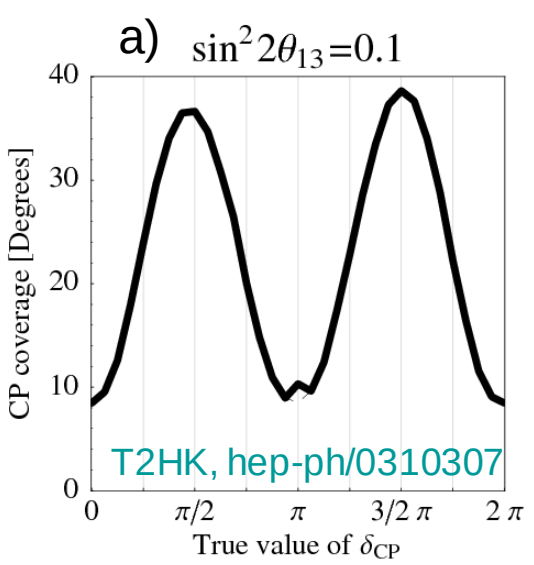
… for large θ_{13}?

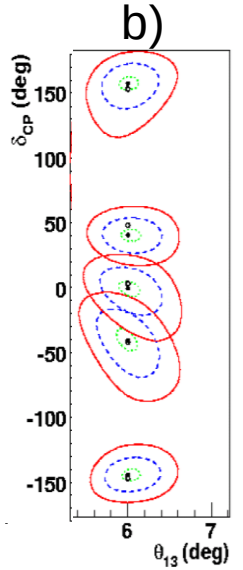
- The key question: How can future experiment improve the fit expected from the next gener.? →

T2K+NOvA+Double Chooz+Daya Bay
Huber, Lindner, Schwetz, Winter, 2009



- The key problems:
  - Theory: How much precision on δ_{CP} do I want? E. g. Precision ~ quark sector, error on $\delta_{CP} \sim \theta_C$ (QLC), etc.
  - The value of δ_{CP} will likely remain rather vague (since reactor exps have no δ_{CP} sensitivity)
  - Two solutions:
    a) Show funct. dep. on δ_{CP}?
    b) Choose „benchmark“ points?





(NF, Laing)

Related questions

- Which setup would one choose for large θ_{13} (physics wise)? A superbeam? The one with the best δ_{CP} precision? The one with the best potential to search for new physics? The most robust setup?
- How to express sensitivities in terms of error on parameters? No systematics vs. conservative systematics? Who defines that? How quantify luminosity impact/cross section impact?