# Physics potential of long baseline neutrino oscillation experiments

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# Outline

1. Setting the stage: Three flavour neutrino oscillations
2. The actors and their performance: Long Baseline experiments
3. Conclusions

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# On the way to physics beyond the Standard Model

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Understanding three-flavour neutrino oscillation parameters is crucial

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with $\Delta = \frac{\Delta m^2_{31} L}{4E}$ and $A = \frac{2\sqrt{2} G_F n_e E}{\Delta m^2_{31}}$.

Cervera et al. 2000, Akhmedov et al. 2004

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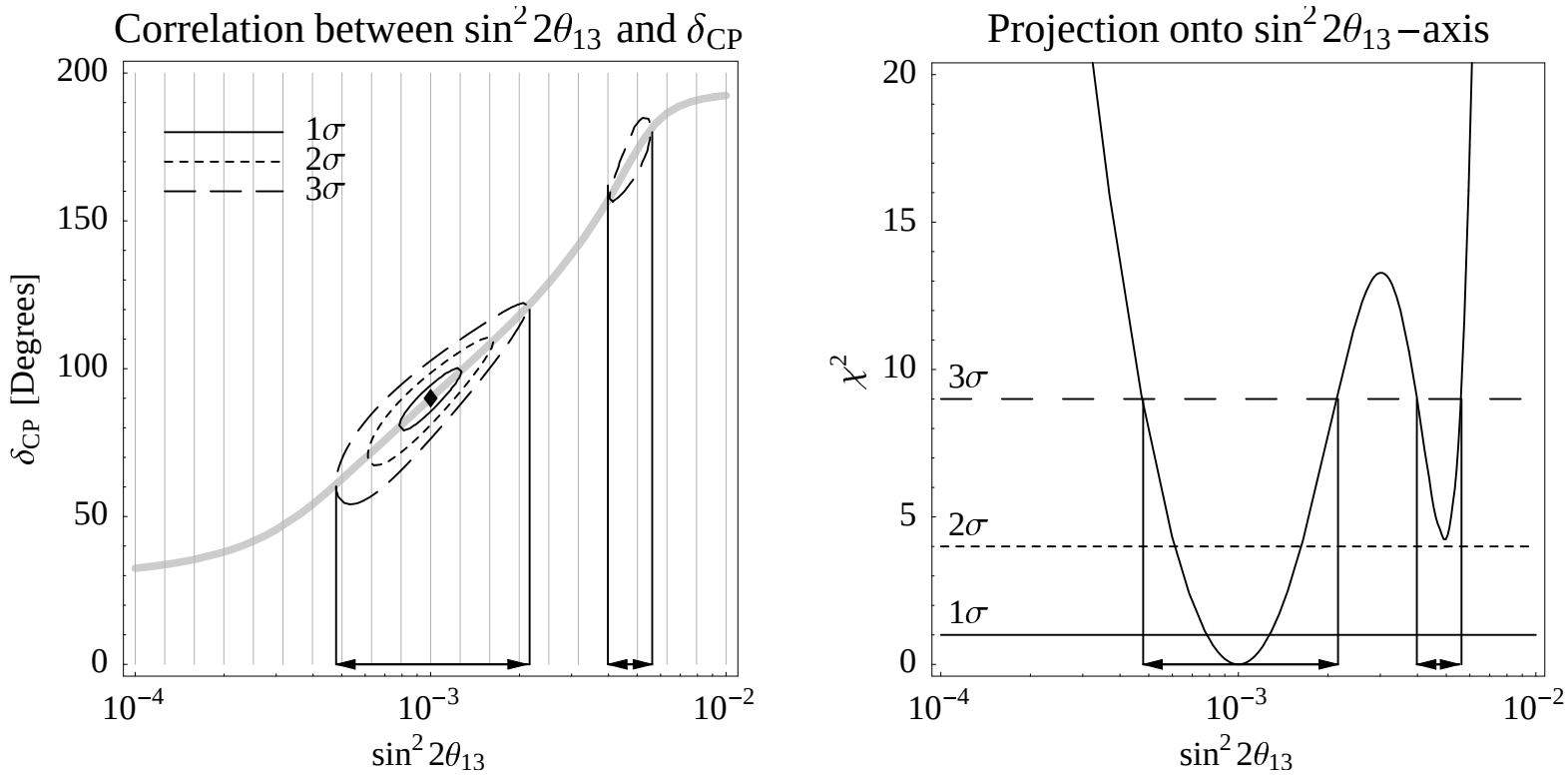


P. Huber, M. Lindner, W. Winter, hep-ph/0407333

# Breaking correlations and degeneracies

→ Combine different oscillation channels

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$$P(\nu_e \to \nu_e) \simeq 1 - \sin^2 2\theta_{13} \frac{\sin^2[(1-A)\Delta]}{(1-A)^2} - \alpha^2 \sin^2 2\theta_{12} \frac{\sin^2 A\Delta}{A^2}$$

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- Exploit the “magic baseline”, for which $A\Delta = \pi$

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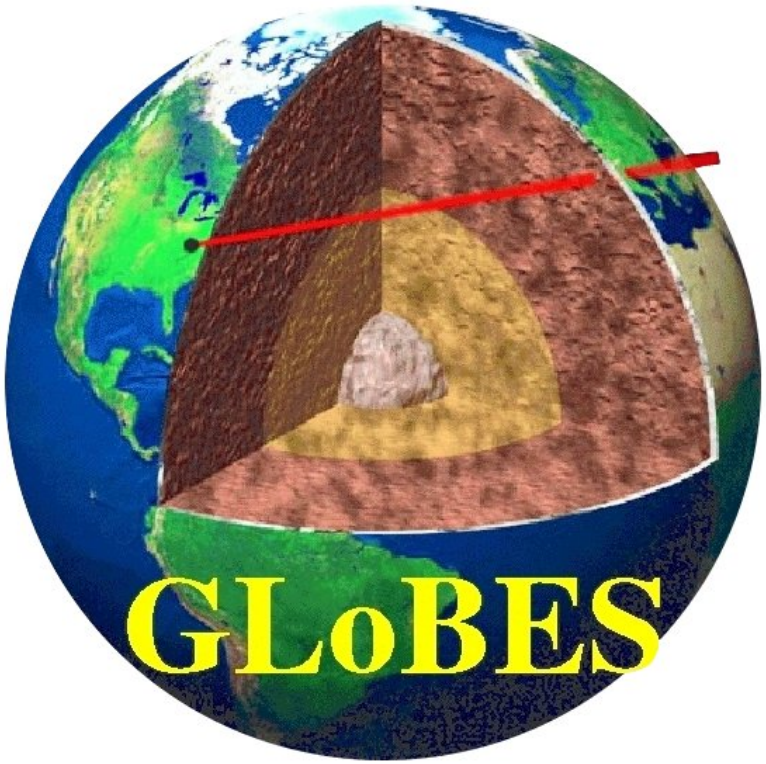


Huber, Lindner, Winter, hep-ph/0407333
Huber, JK, Lindner, Rolinec, Winter, hep-ph/0701187

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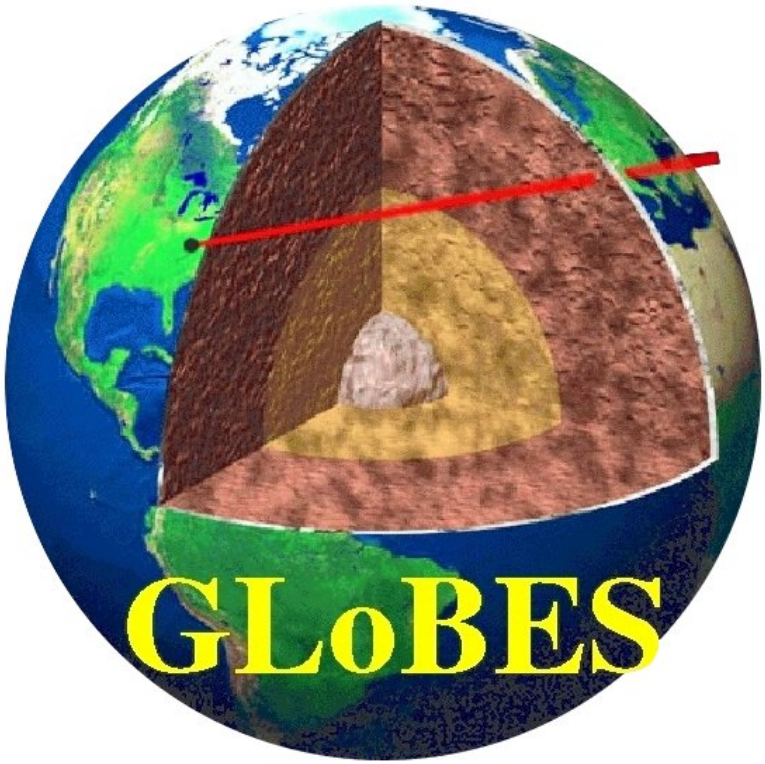


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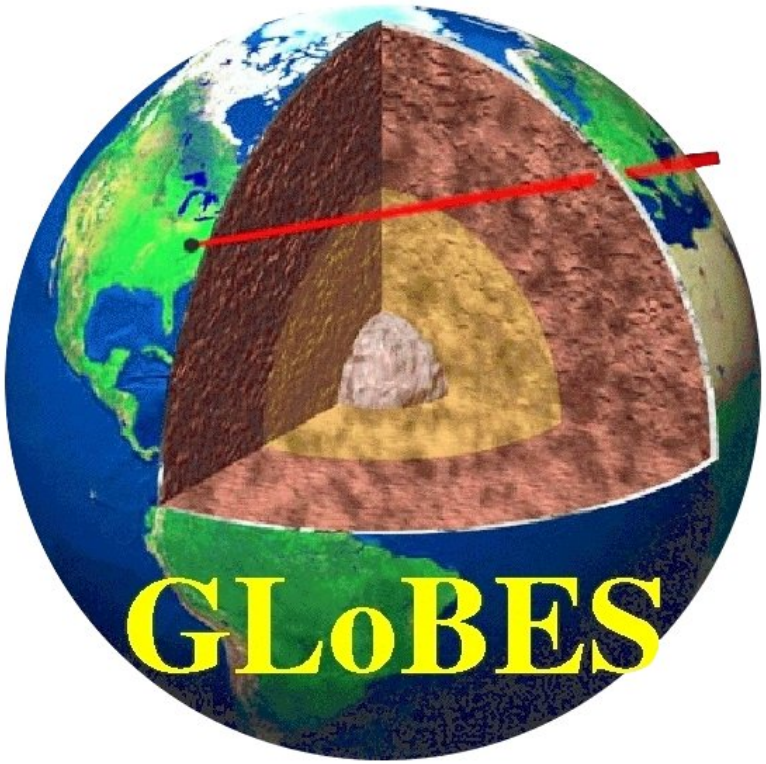


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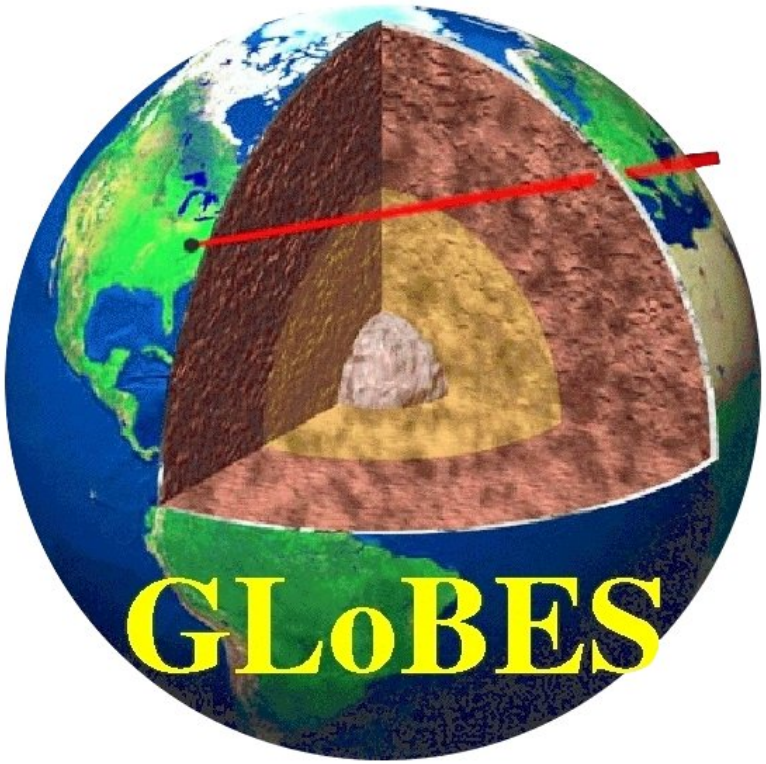


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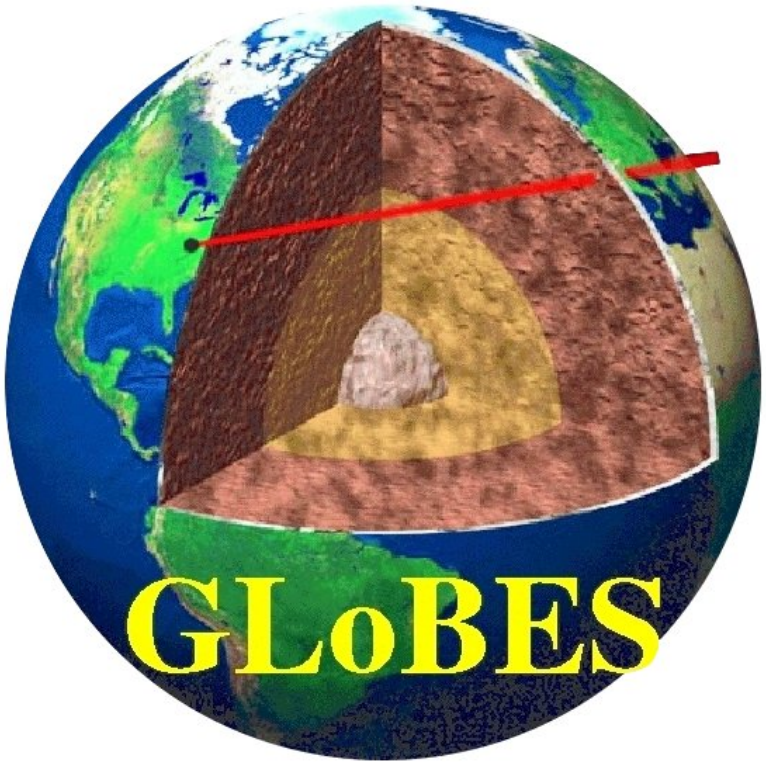


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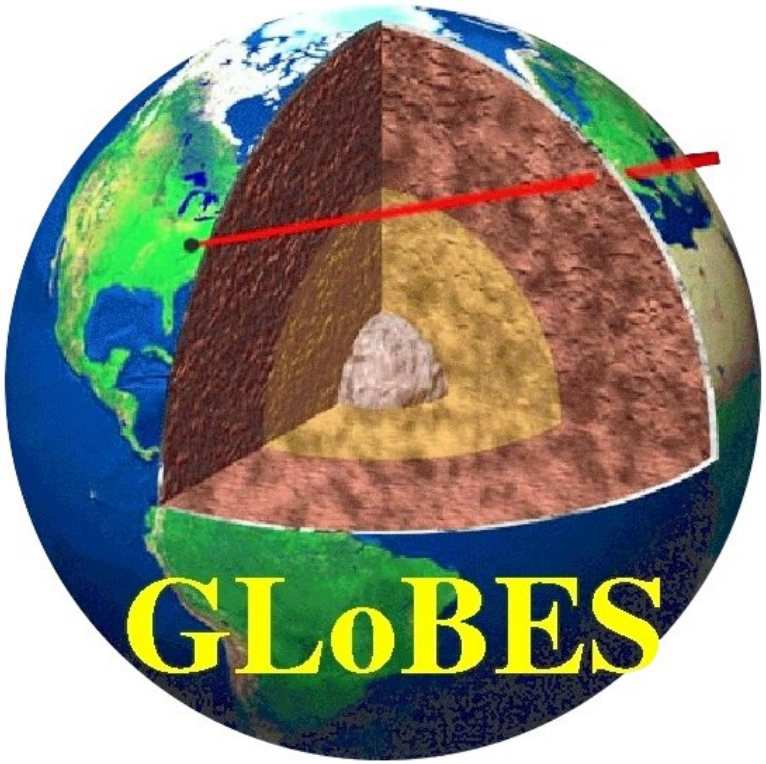


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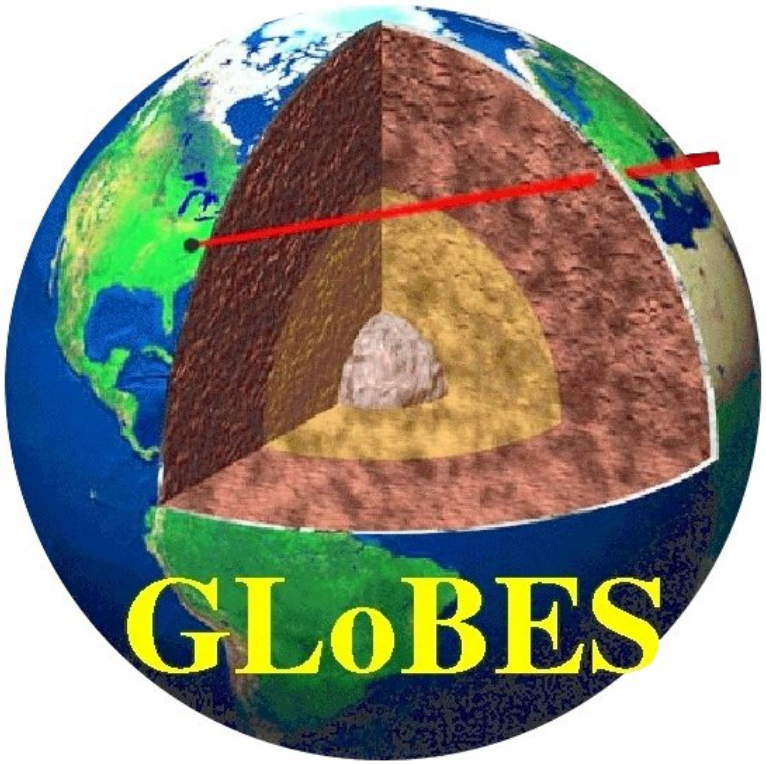


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- `www.mpi-hd.mpg.de/lin/globes`

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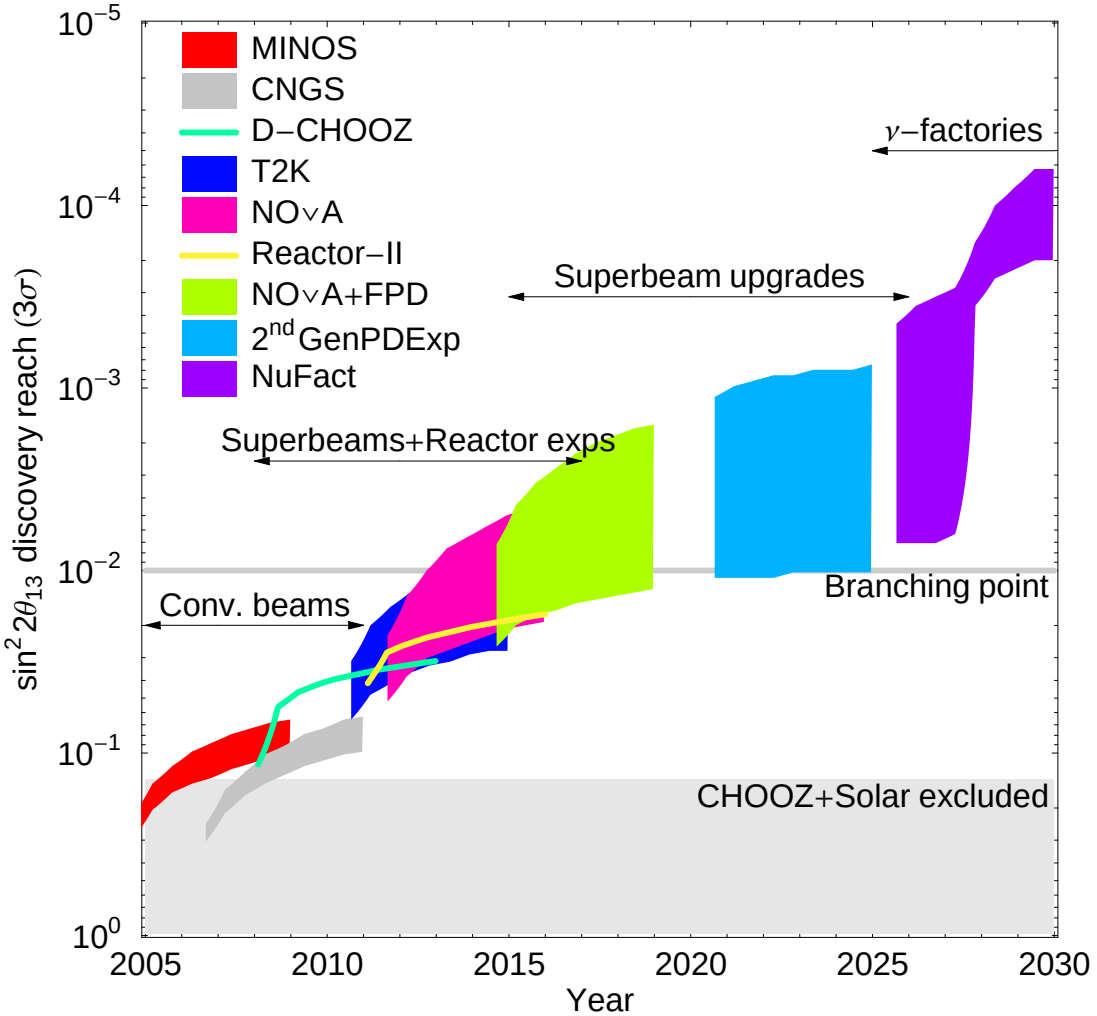


M.G. Albrow, . . . , W. Winter, et al., hep-ex/0509019

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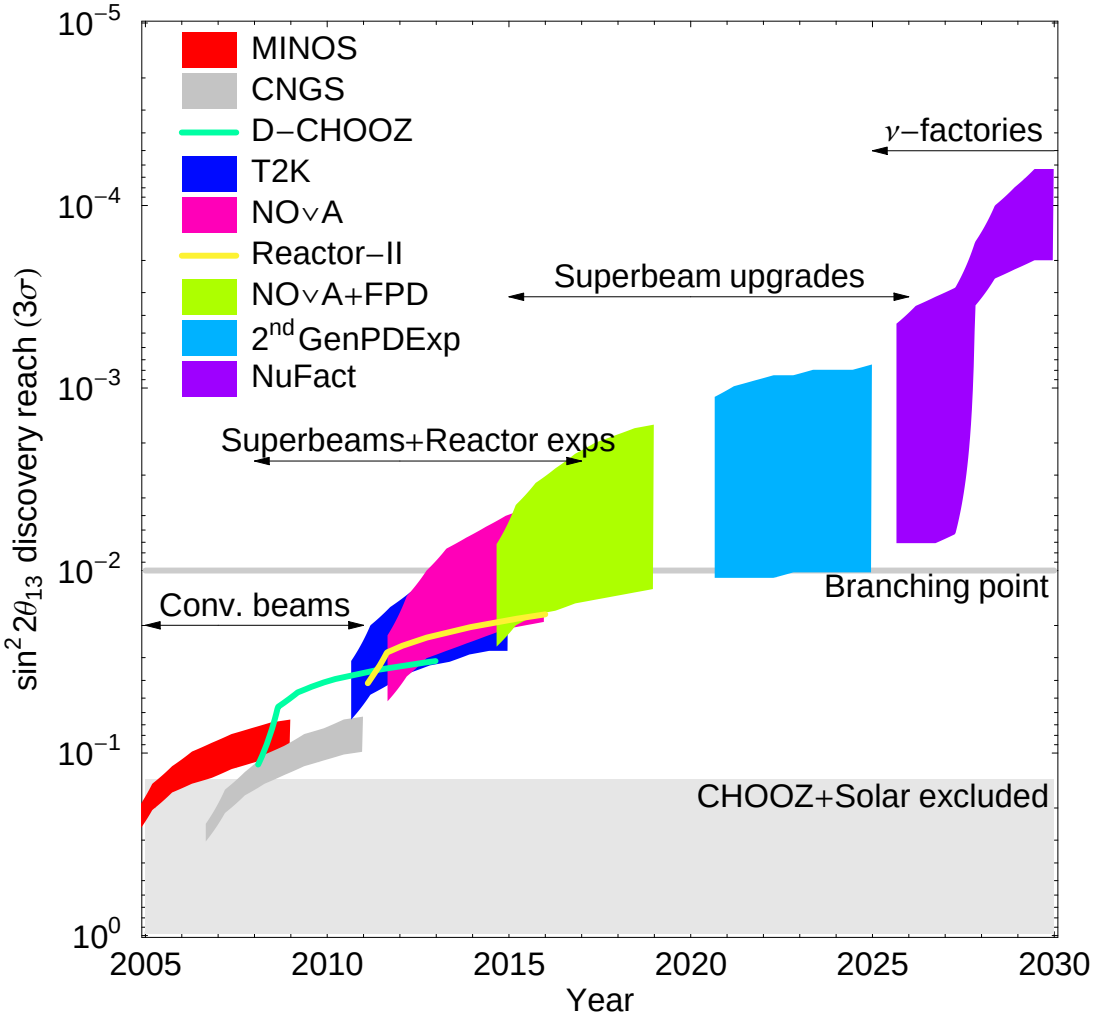


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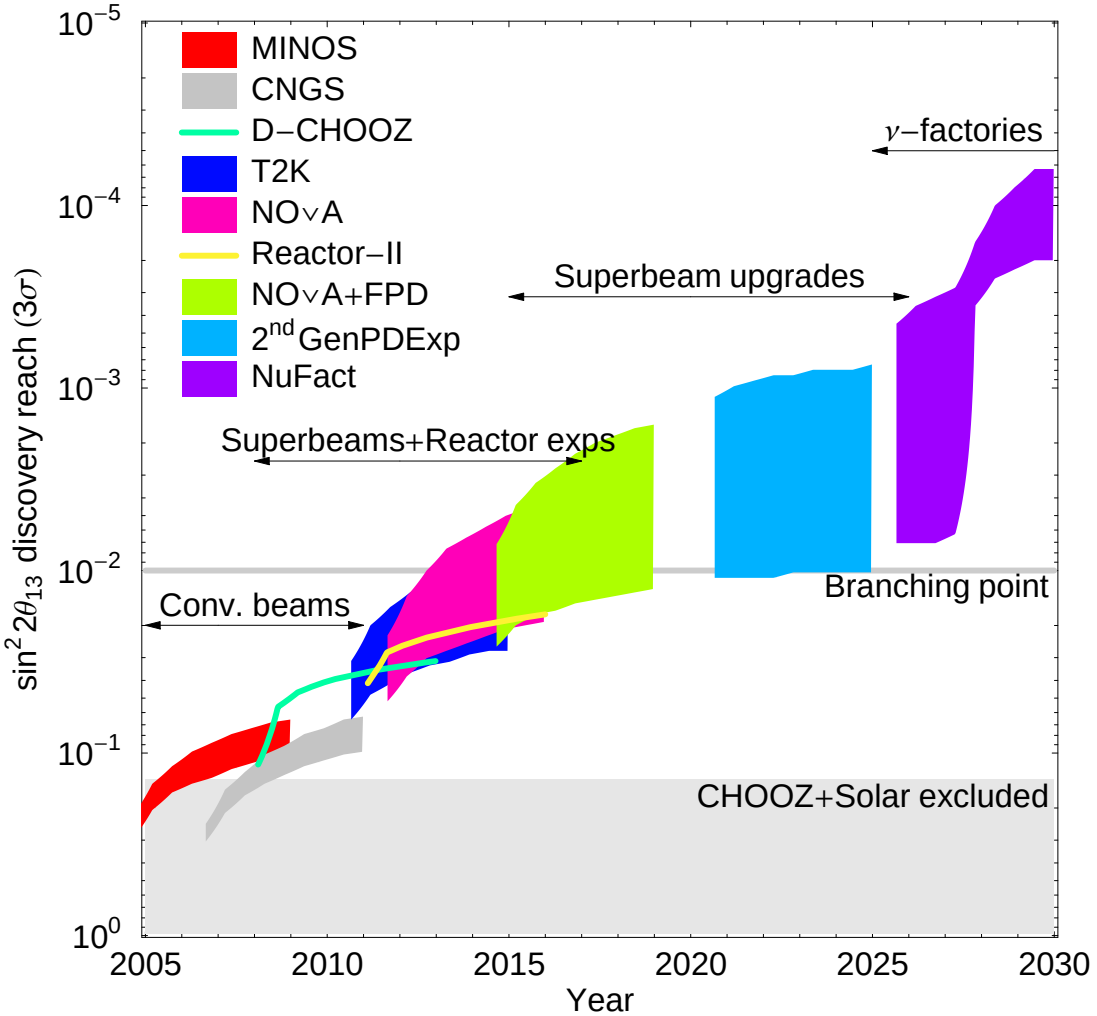


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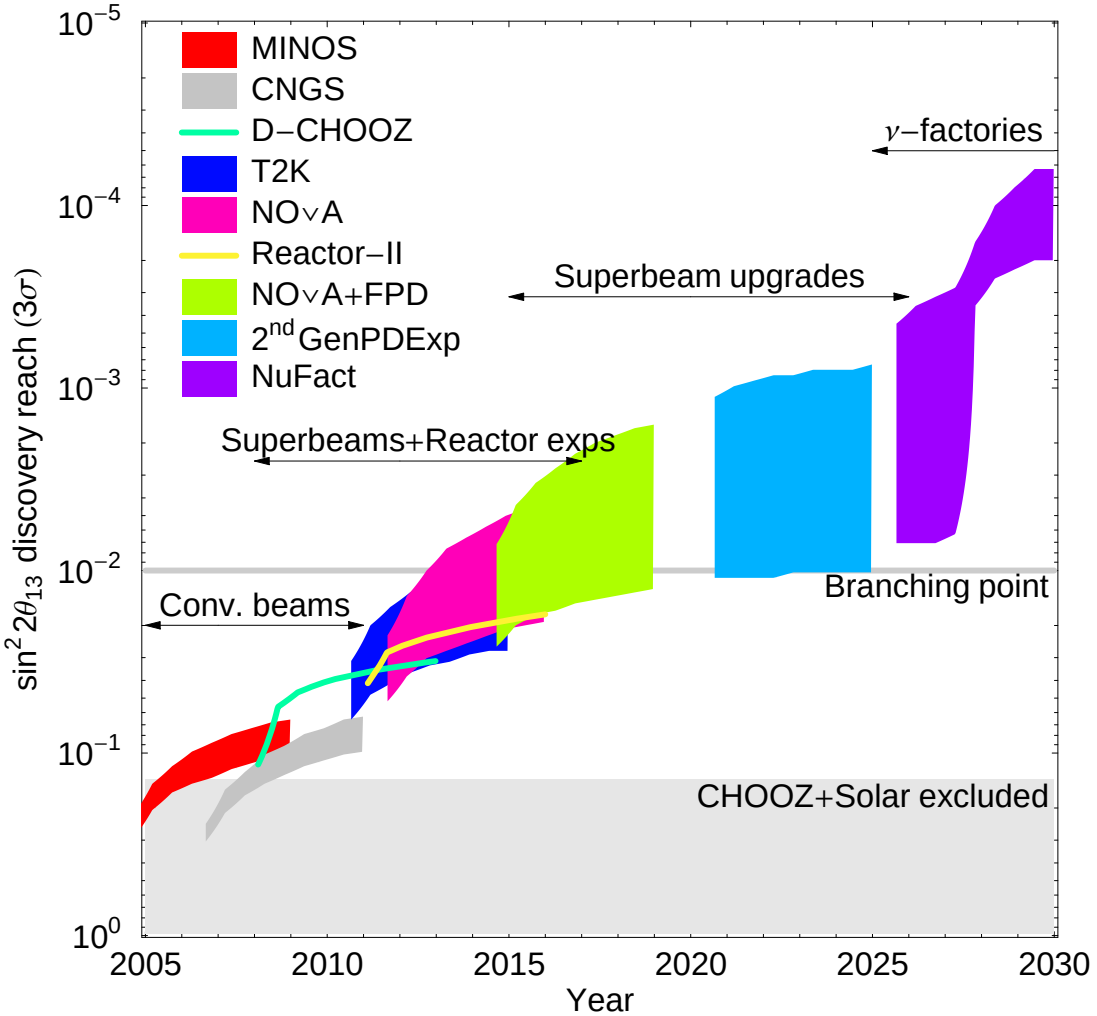


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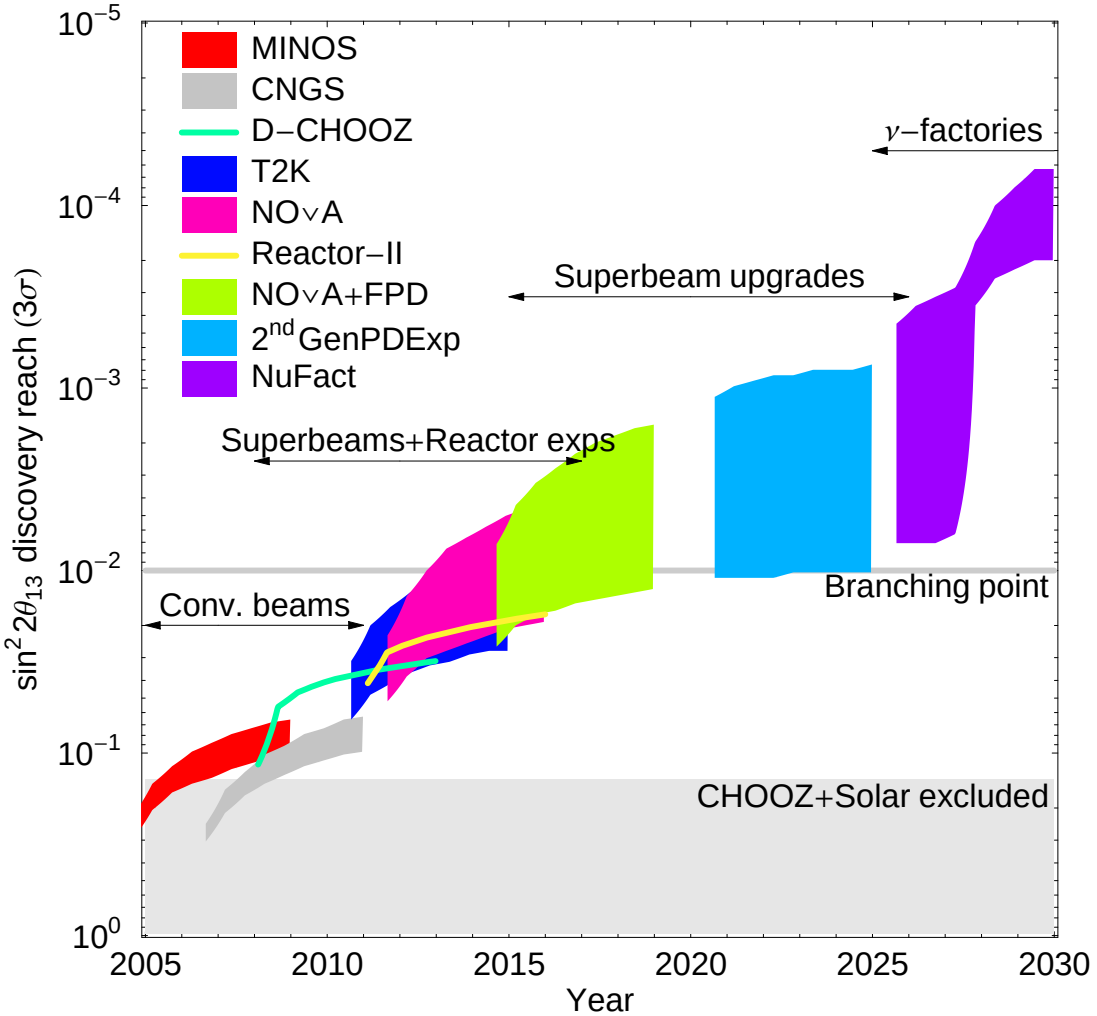


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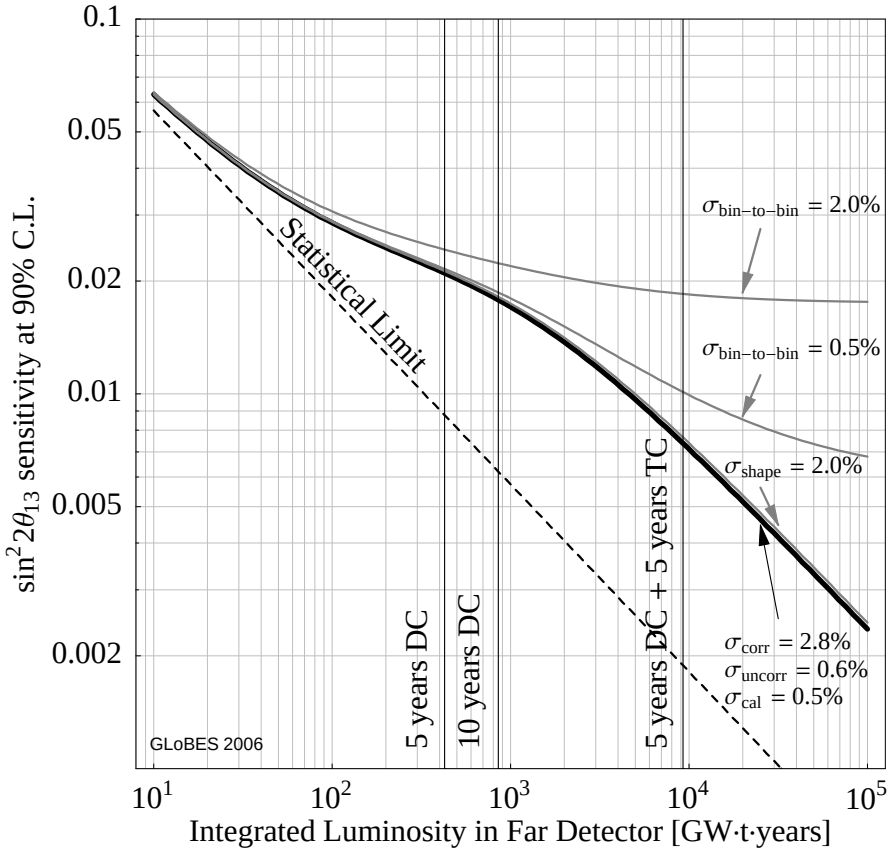
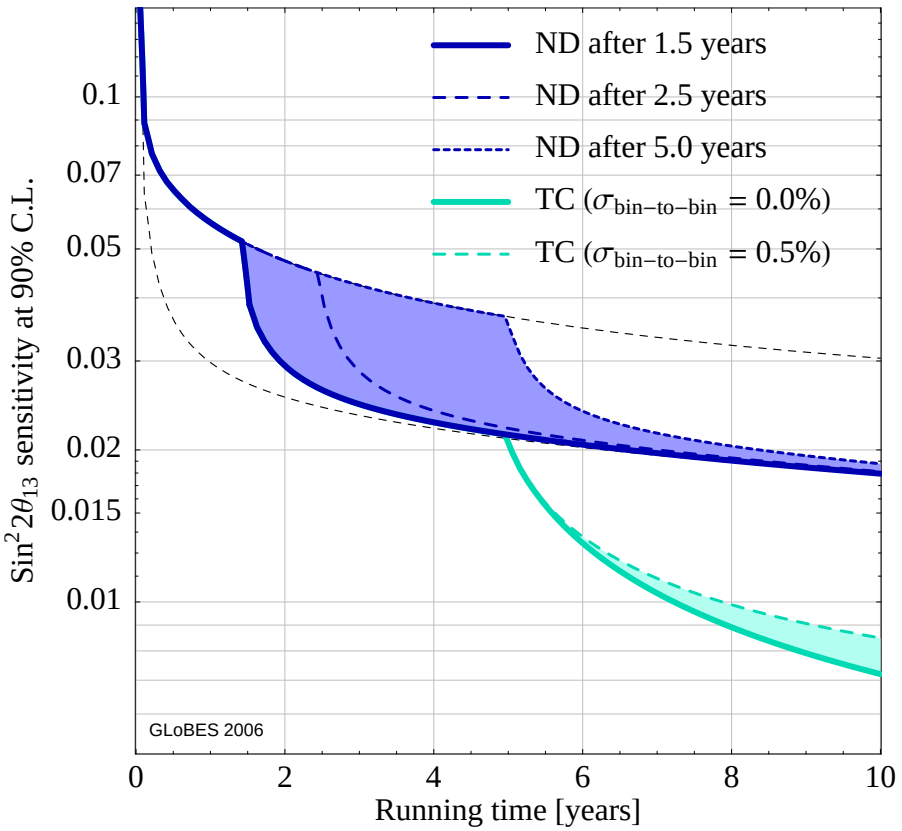
- We want to reach the branching point as quickly as possible.

# Towards the branching point: Reactor experiments




P. Huber, JK, M. Lindner, M. Rolinec, W. Winter, hep-ph/0601266

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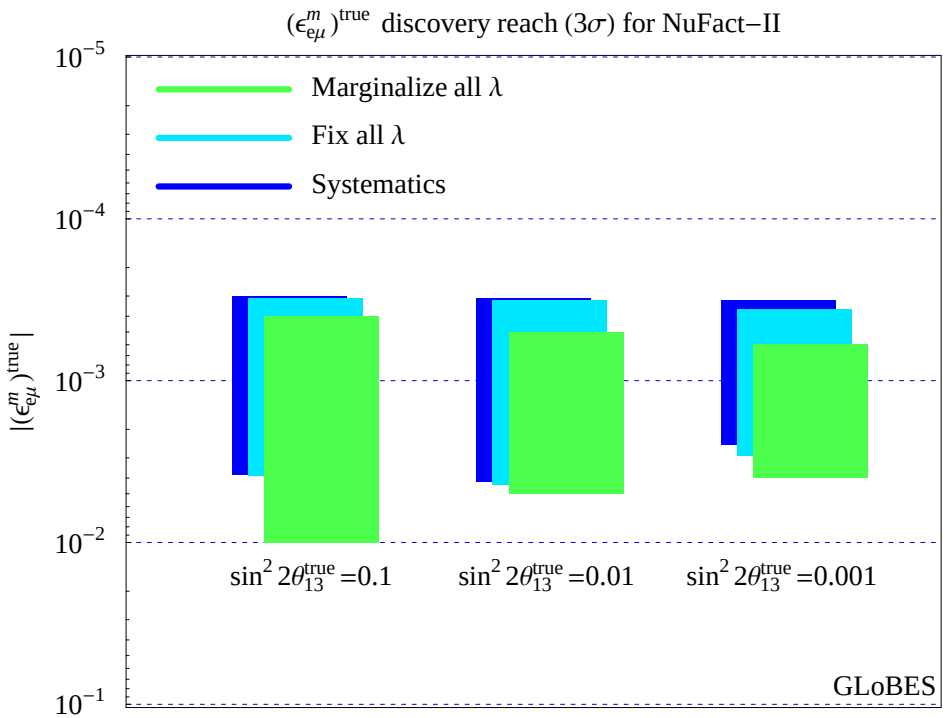


JK, M. Lindner, T. Ota, hep-ph/0702269

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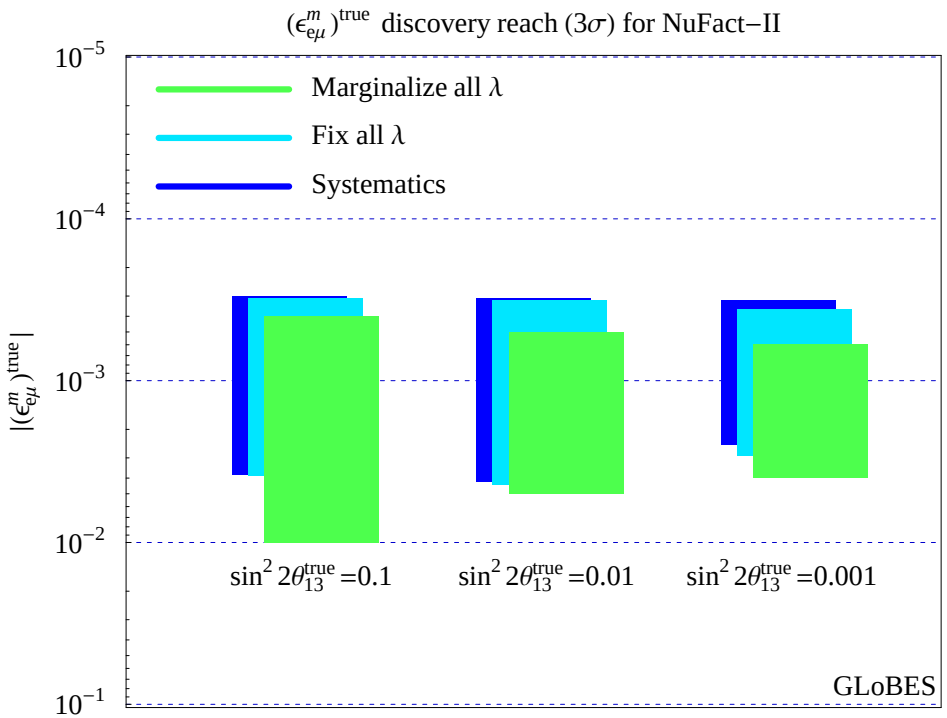


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Talk by T. Ota this afternoon

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- Main challenge: Disentangle parameter correlations and degenerate solutions
- Branching point for choosing the ultimate technology in neutrino physics at $\sin^2 2\theta_{13} \sim 0.02$
- Neutrino oscillation experiments can also be used to directly detect physics beyond the standard model, such as non-standard interactions.