

GLOBES

Patrick Huber

IPNAS, Virginia Tech

International Neutrino Summer School

Fermilab, July 6-17, 2009

What?

General Long Baseline Experiment Simulator

GLOBES is a software package designed for

- Simulation
- Analysis
- Comparison

of neutrino oscillation experiments

Where?

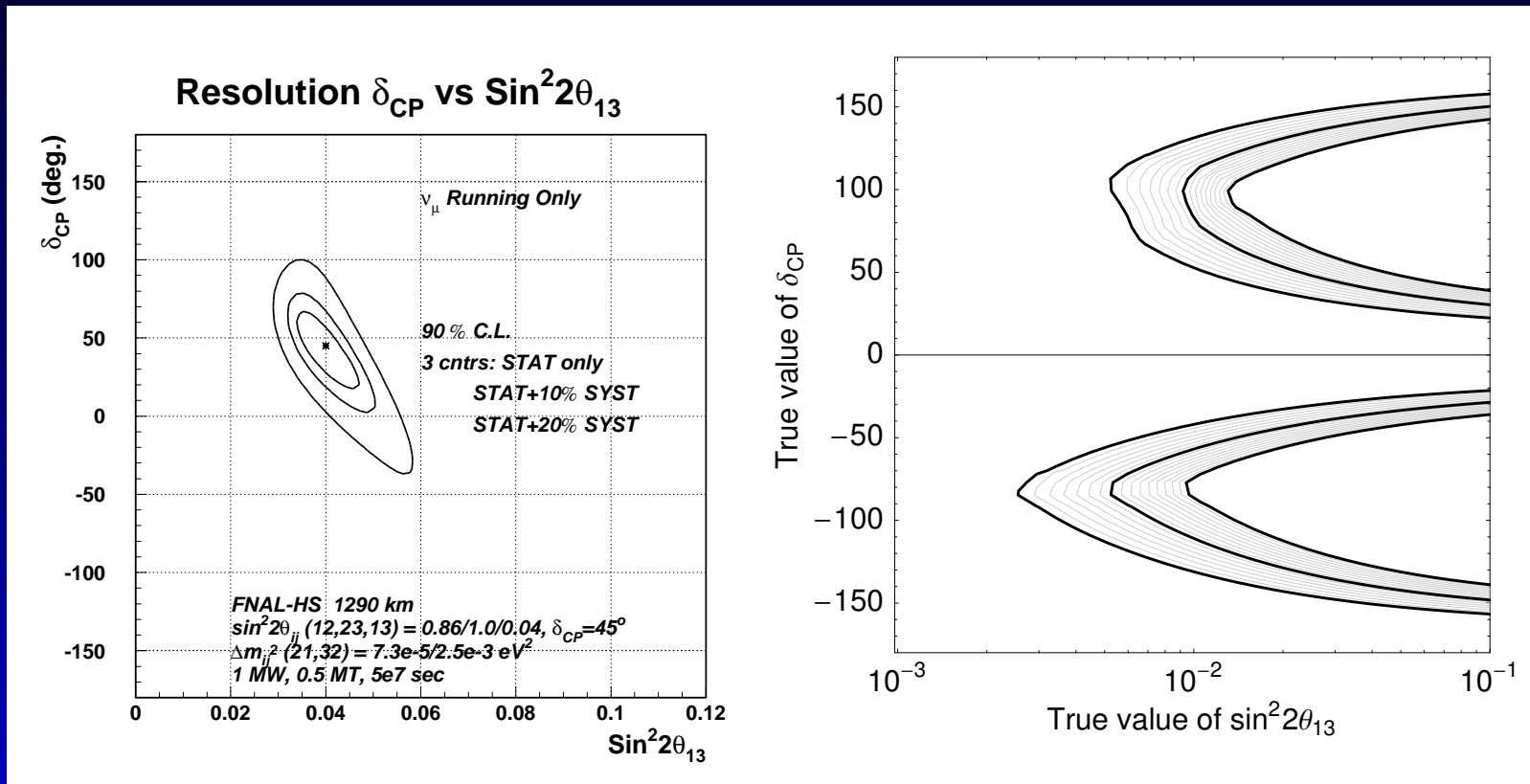
It is developed and maintained by

- PH
- Joachim Kopp
- Manfred Lindner
- Walter Winter

URL – <http://www.mpi-hd.mpg.de/lin/globes/>
email – globes@mpi-hd.mpg.de

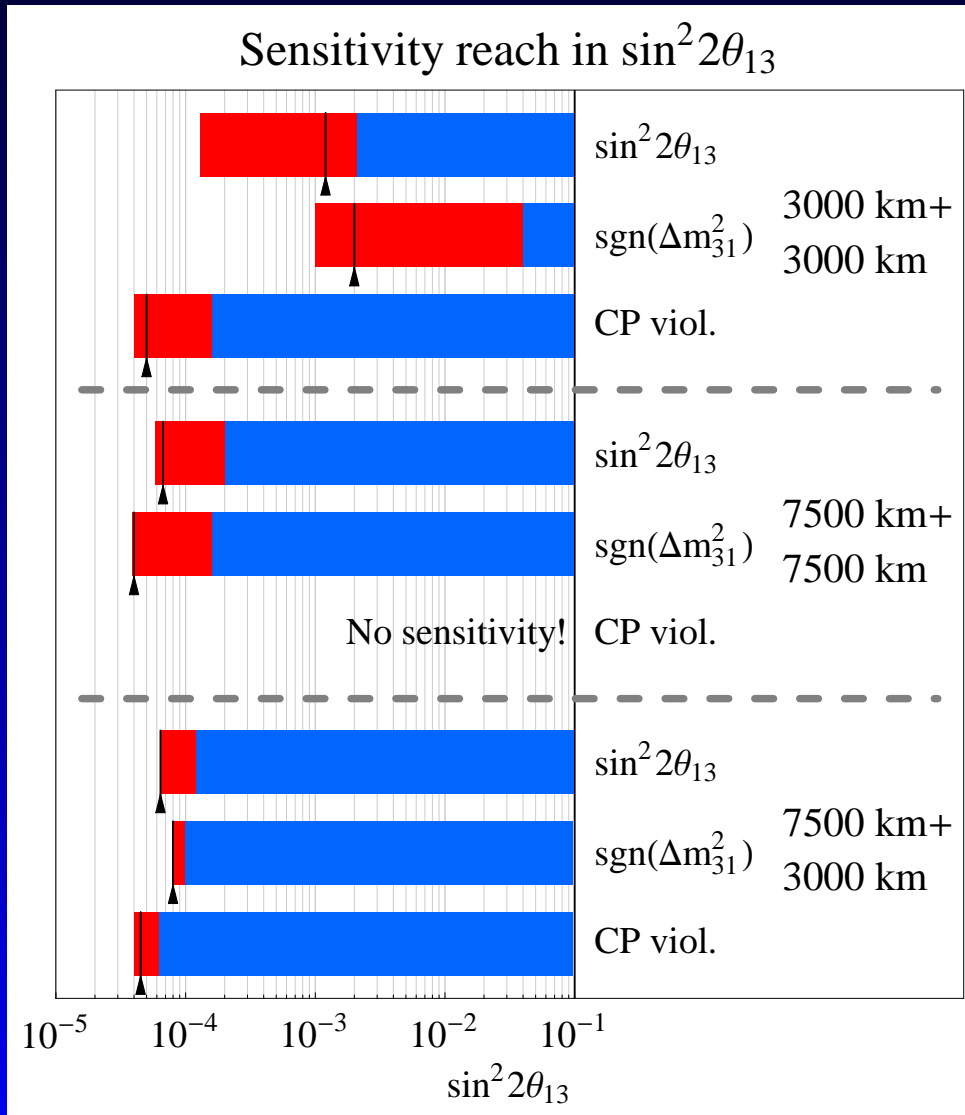
Why?

Wide band beam



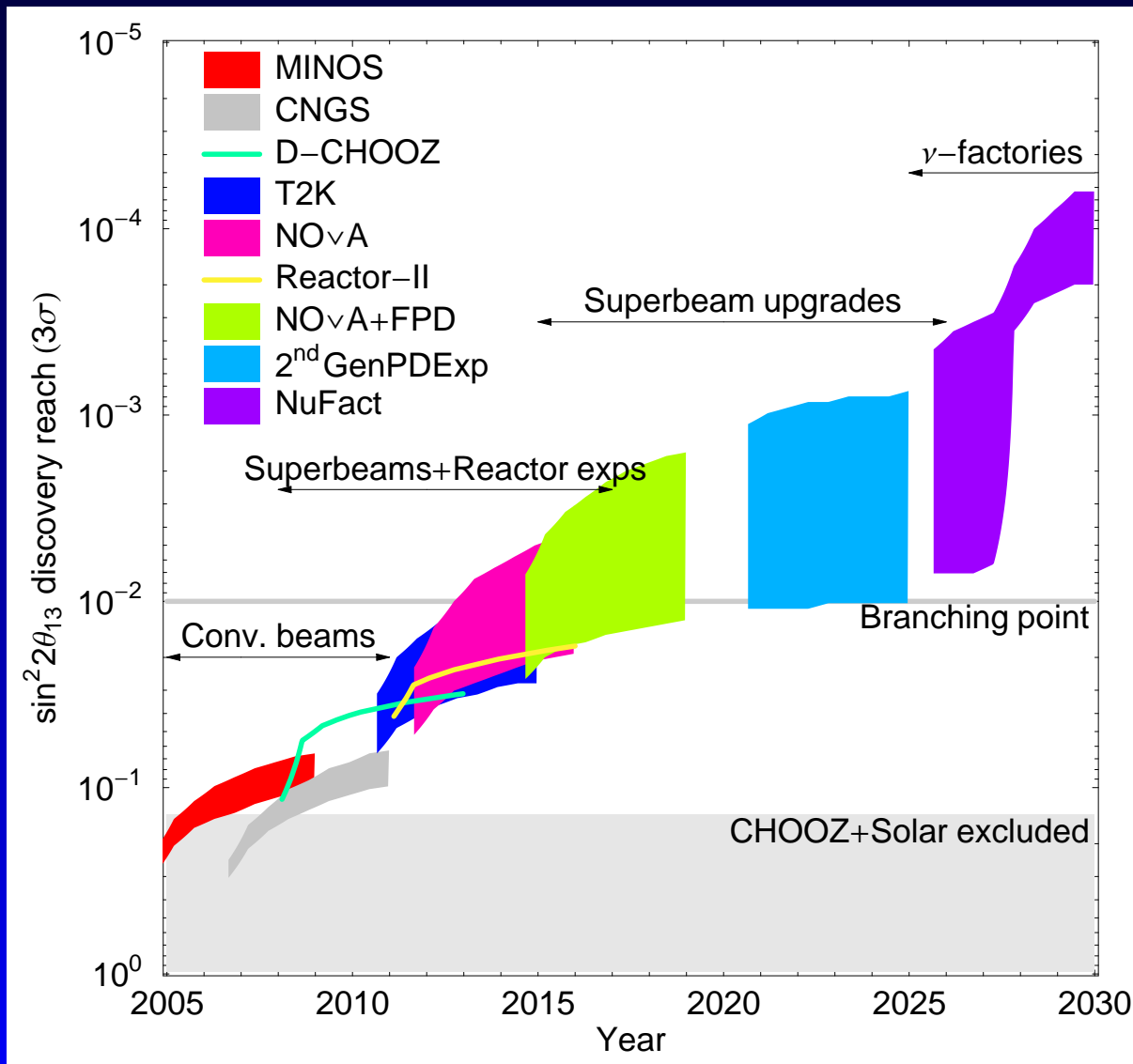
Why?

APS study



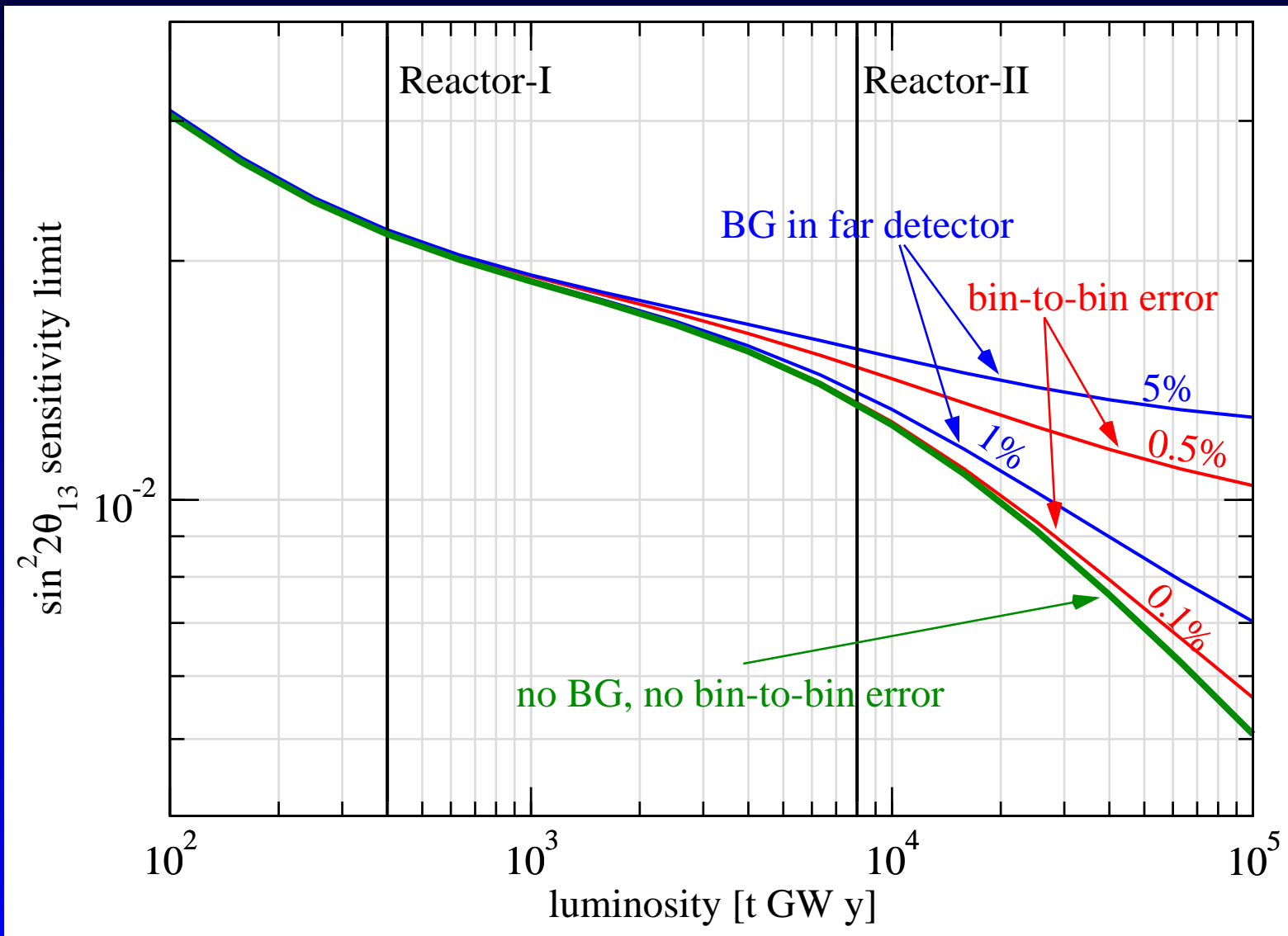
Why?

Fermilab's Proton driver report



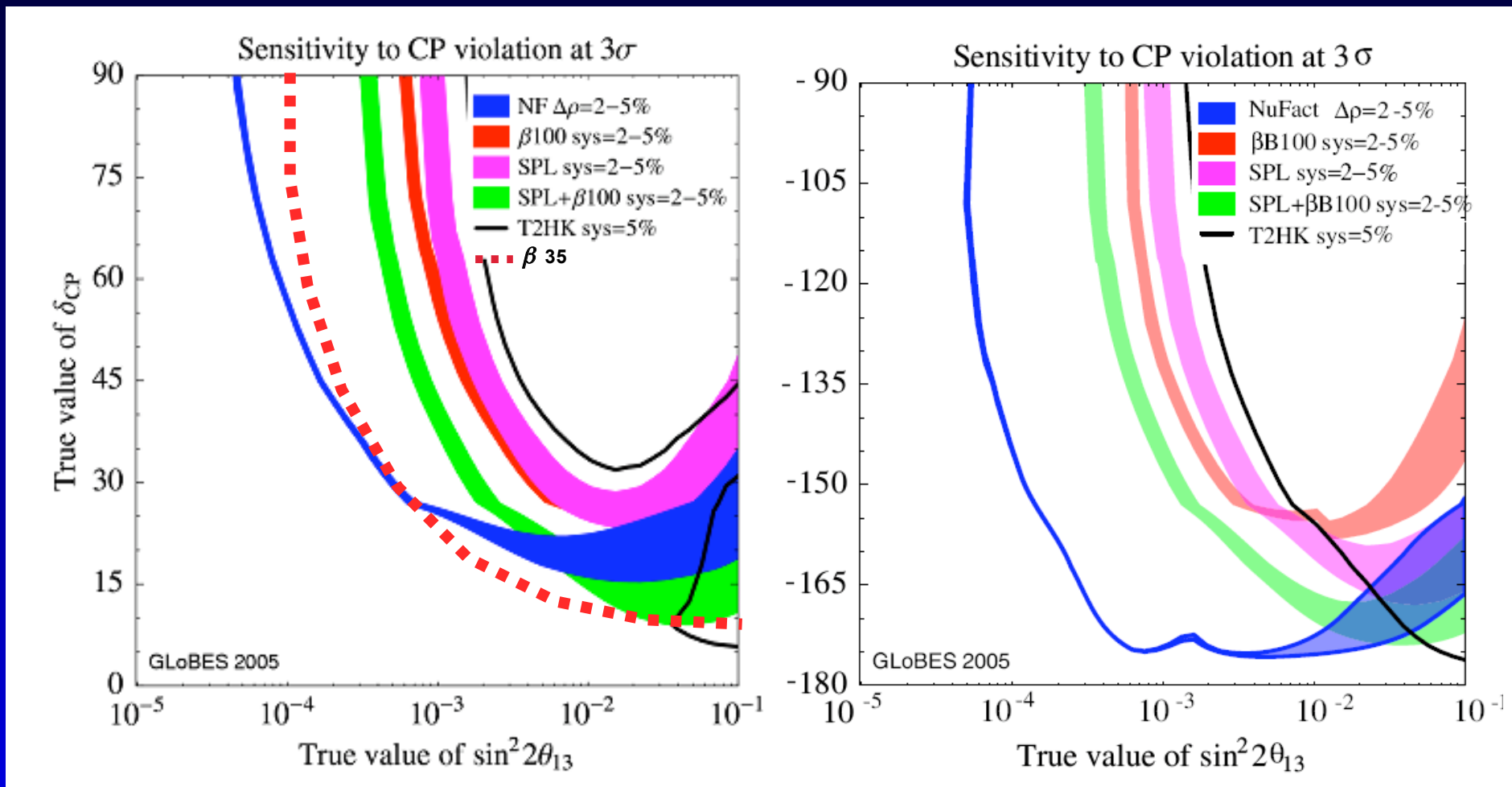
Why?

White paper on reactor neutrinos



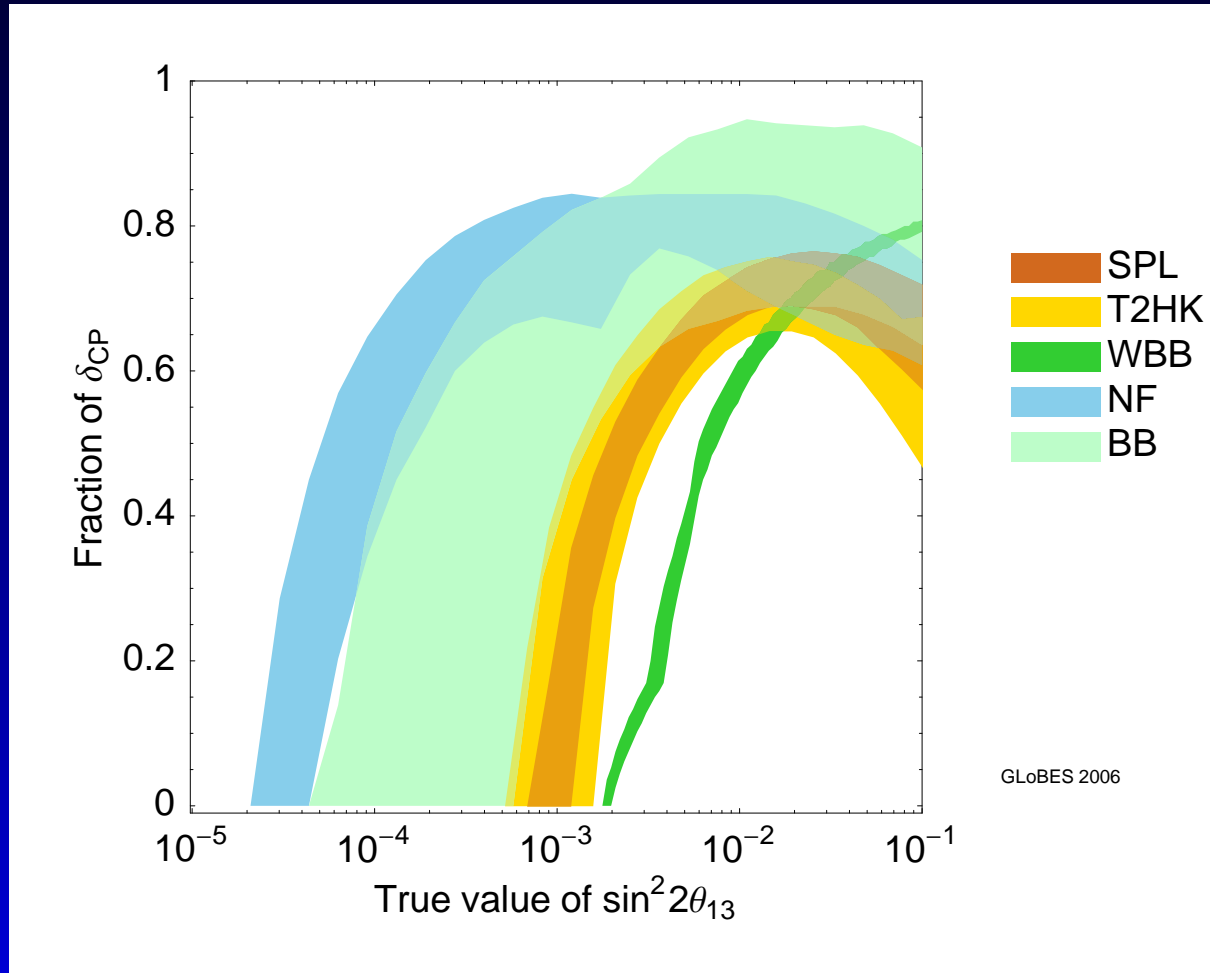
Why?

CERN strategy group



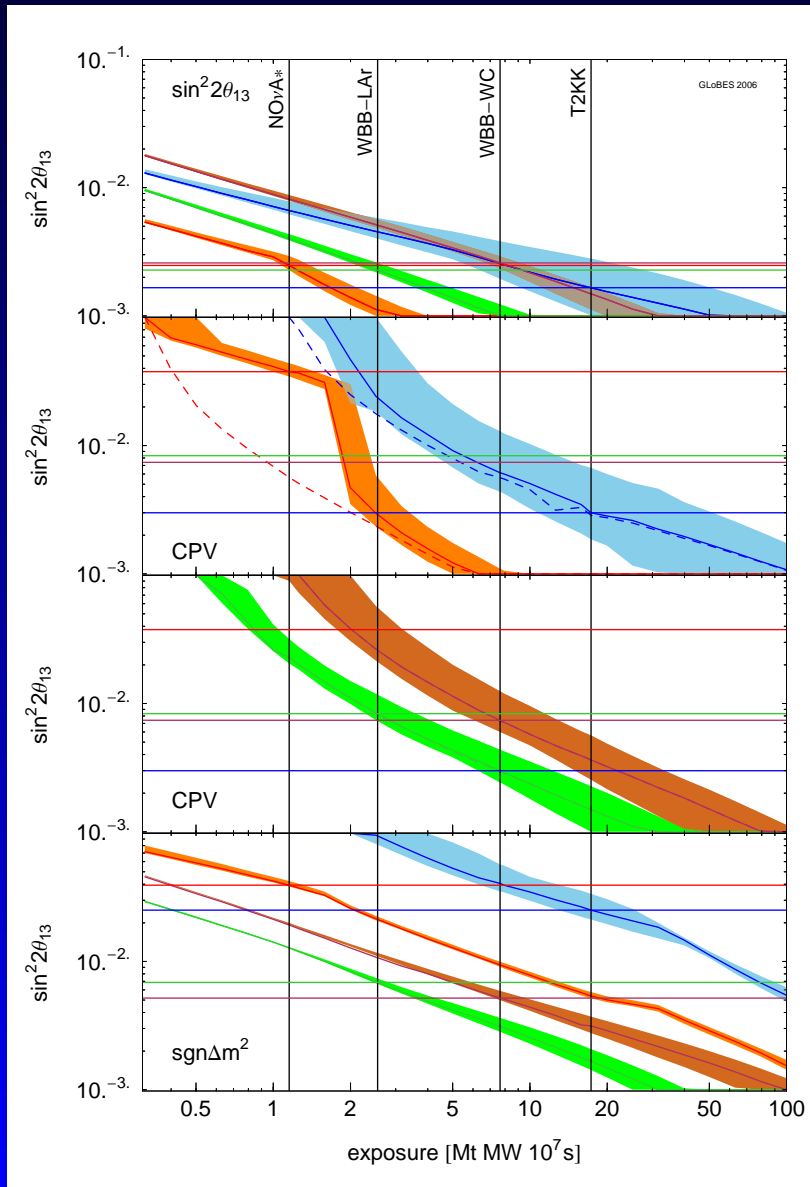
Why?

ISS



Why?

Joint BNL-FNAL study group



Reliability

- Re-use of code, the more a code has been used in real world applications the less likely are severe bugs.
- Extensive testing
- Good documentation
- Intuitive API with error checking

Reproducibility

The information given in a publication or proposal is not sufficient to reproduce the sensitivity estimates.

- General data storage and exchange format for the inputs \Leftrightarrow flexibility?
- All implicit assumptions and approximations have to be documented, that includes the actual algorithms \Leftrightarrow accuracy of documentation?
- Version control and archiving

Documentation

Without good documentation, the best software is useless or will be after very short time (=memory decay constant of typical physicist). This is a general problem with legacy code!

Document what you do – do what you document and make sure that the average user understands what is going on. Also documentation needs testing and debugging.

GLOBES history

- development started 2004 – PH, M. Lindner, W. Winter
- major effort went into documentation
- first release August 2004 – version 2.0.0
- major bug fix release March 2005 version 2.0.11
- J. Kopp joined in July 2005
- January 2007 – version 3.0, addition of major features
- 93 publications citing the GLOBES paper, creating a total of 1514 citations

Design considerations

- GPL
- C-library – very portable, easy to interface, numerically efficient
- Unix style separation of functionality – freedom to design analysis and to use any graphics tools
- Experiments are defined using AEDL – relatively complicated parser, transparent experiment definition
- Pull approach for systematics – flexible and intuitive
- Local minimization instead of grids – much faster

Features

- Accurate treatment of systematical errors
- Arbitrary matter profile & uncertainties
- Arbitrary energy resolution function
- Single and multiple experiment simulation
- Simple χ^2 calculation
- Inclusion of external input
- Projection of χ^2 (minimization)
- User-defined systematics, oscillation probability engine, priors
- Full support for lists in AEDL
- Interpolating functions in AEDL
- ...

Summary

GLOBES

- is the only open source software of its kind
- has withstood the test of time (next month, 5 years!)
- is at the core of most strategy documents
- completely in C
- flexibility to deal with complex many detector setups and non-standard physics

Installation

If you have Linux

- Install GSL if you don't have it already –
<ftp://ftp.gnu.org/gnu/gsl/>
- Go to
<http://www.mpi-hd.mpg.de/lin/globes/downloads>
– download GLoBES
- `./configure`
`make`
`sudo make install`

Installation

If you have a Mac

- Install GSL if you don't have it already –
<ftp://ftp.gnu.org/gnu/gsl/>
- Download
<http://www.phys.vt.edu/pahuber/globes-3.1.3.tar.gz>
- unpack it and change into the directory created by this

```
./configure --disable-rpath --enable-no-binary=yes  
make  
make install
```