# *Advanced* statistic projects advertisement

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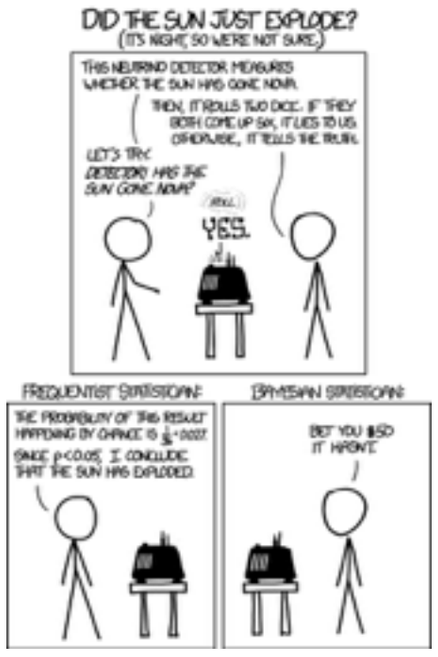


We propose **two projects** to illustrate the usage of *cool* statistical techniques:

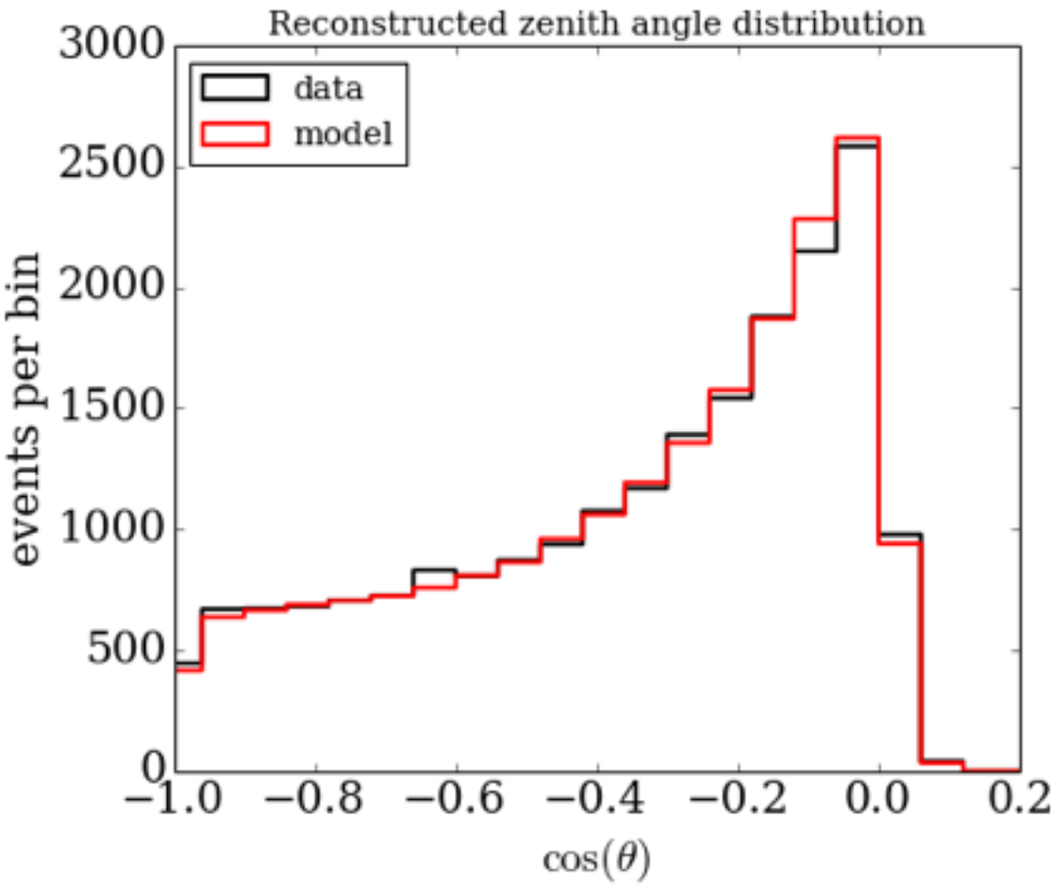
**A** *Toy study* of the atmospheric neutrino distribution.

**B** Point Source *stacking* analysis with the HESE events.

(*Zig will also do a *bonus* discussion on unfolding for those interested.)

# A *Toy study* of the atmospheric neutrino distribution.

- In Brief: You will be given atmospheric neutrino data and a *toy model* that explains the data. The model has several *parameters.* You have to find the confidence (credibility) regions of the parameters.

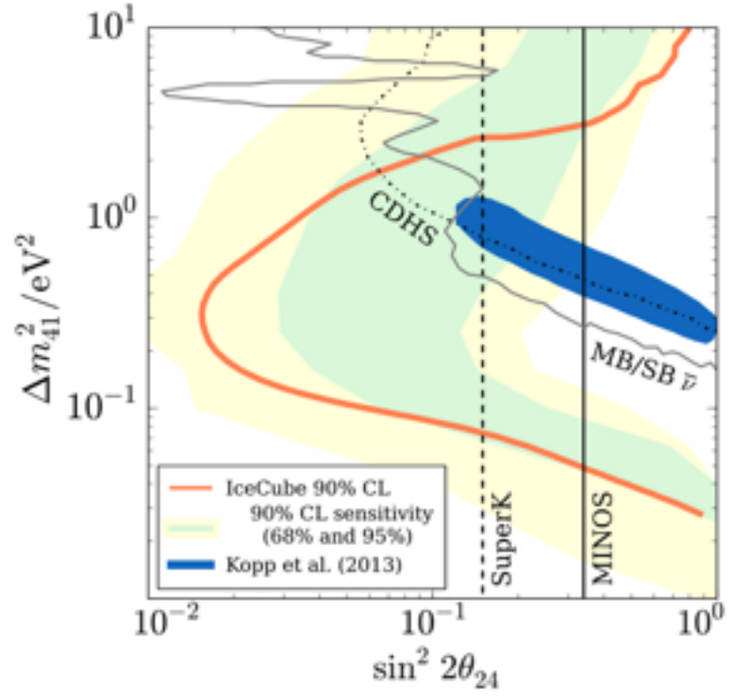


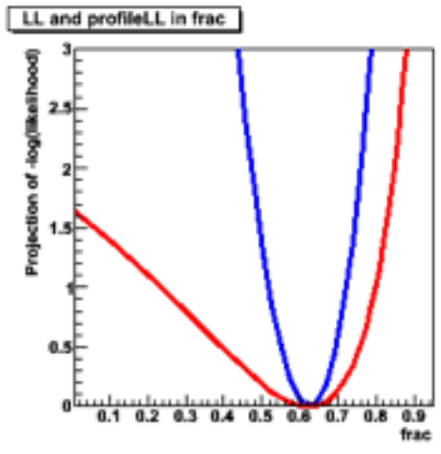

model:

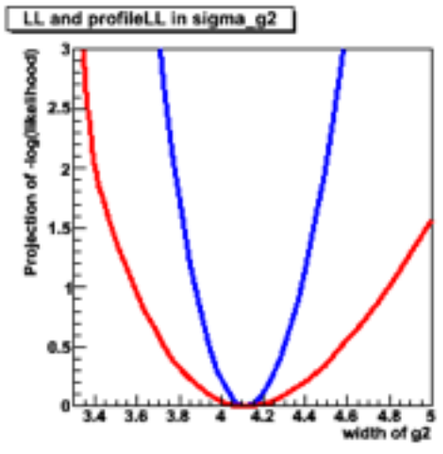
$$\phi_{\text{atm}}(E_\nu, \cos\theta) = N_0 \left( \phi_\pi + R_{\pi/K} \phi_K \right) \left( \frac{E_\nu}{E_0} \right)^{-\Delta\gamma}$$

# A *Toy study* of the atmospheric neutrino distribution.

- <u>Things we will discuss</u>:
  - ★ Binned likelihood construction.
  - ★ Nuisance parameters and priors.
  - ★ Estimation of confidence limit ranges using the *brazilian* construction.
- ★ Likelihood profiling and confidence interval. (frequentist)
- ★ Likelihood marginalization and credibility region. (bayesian)

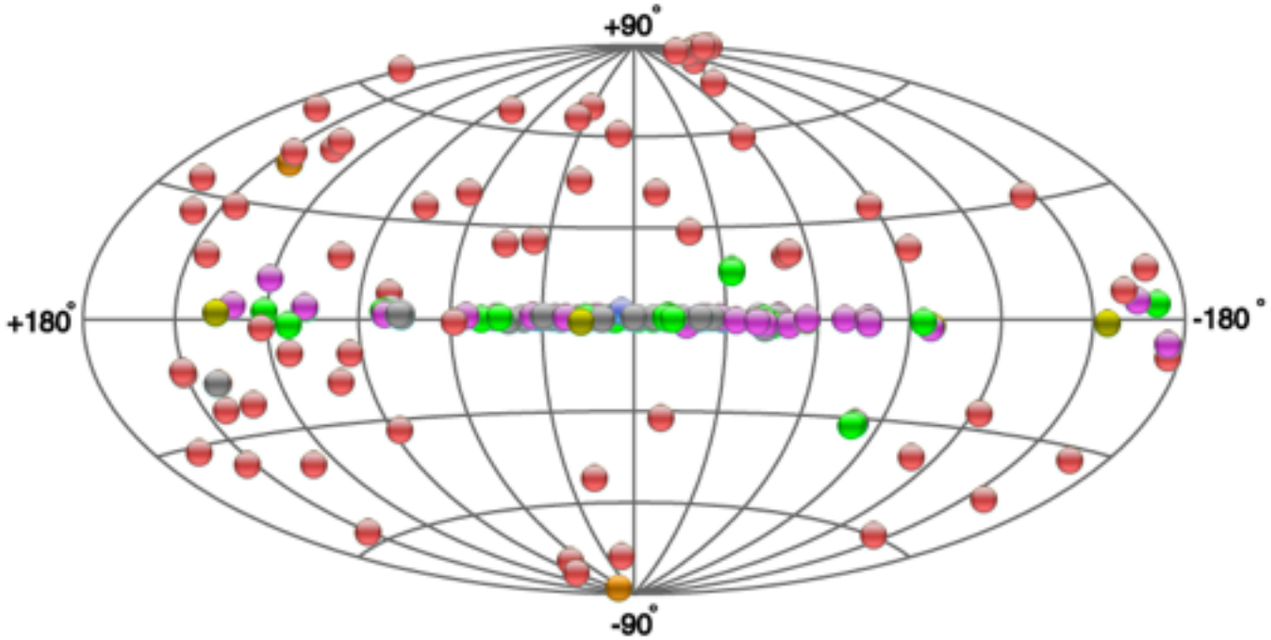


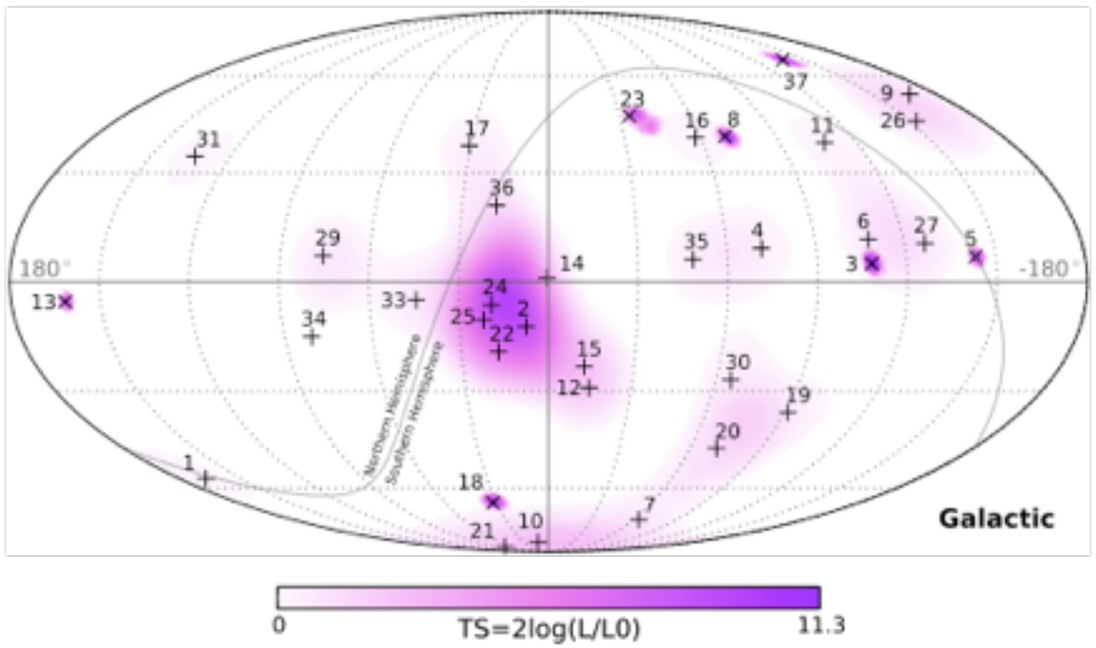



# **B** Point Source *stacking* analysis with the HESE events.

- In Brief: You will be given the HESE 3 year sample and several catalogs. You have to find if there is evidence of spacial correlation between the two sets.



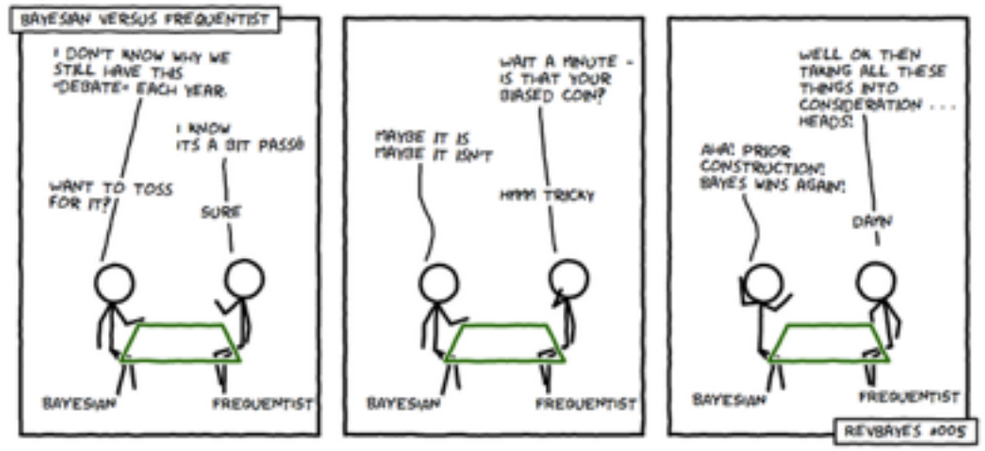

(TeVcat)




(HESE skymap)

**B** Point Source *stacking* analysis with the HESE events.

- To make it more interesting we have created *fake* catalogs too. Some are correlated, some are not. You have to find out.




- <u>Things we will discuss</u>:
  - ★ The PS stacked likelihood and test statistic.
  - ★ Hypothesis rejection in the bayesian construction.
  - ★ Hypothesis rejection in the frequentist construction (p-value calculation using *scrambling*).