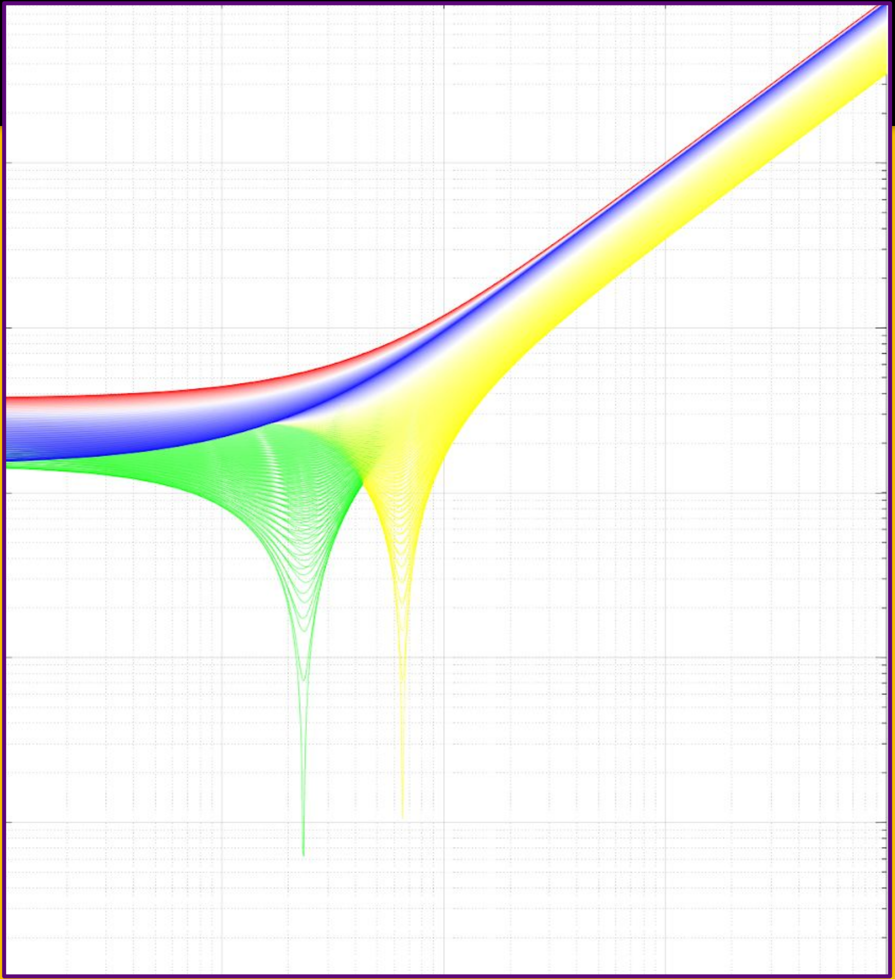
Least Informative Priors for $0\nu\beta\beta$ Decay



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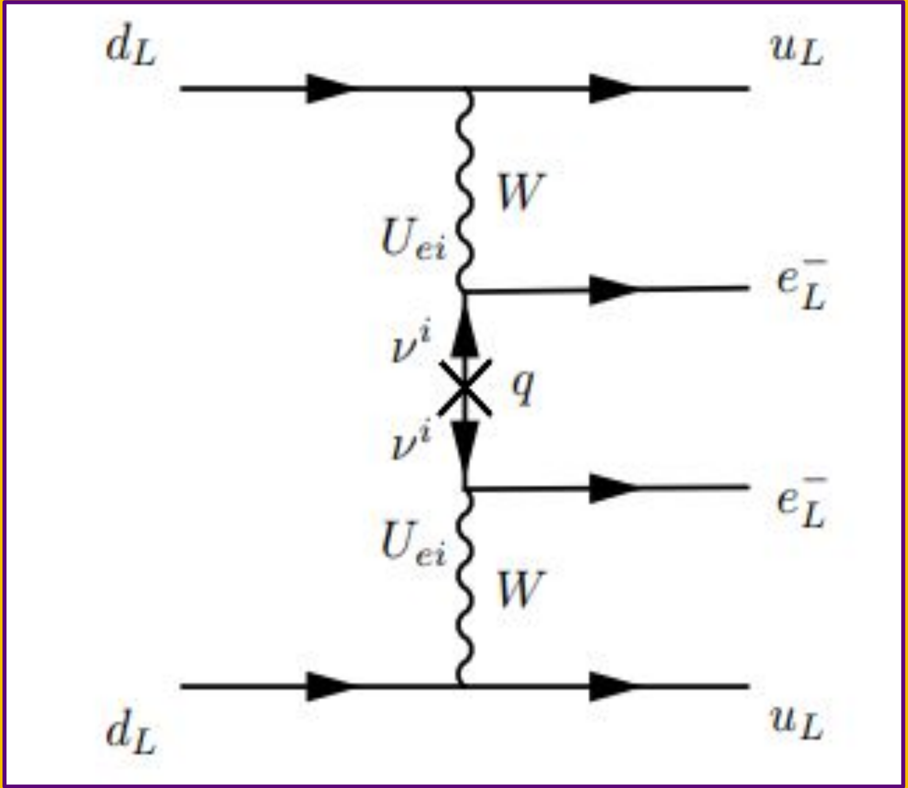
Constraints on Massive Neutrinos

- Flavor oscillation
  - Δm_{12}^2 and Δm_{13}^2 measured.
  - Sign of Δm_{13}^2 unknown.
- Cosmology
  - Σm_i bounded from above.
- Direct $0\nu\beta\beta$ decay searches
  - $m_{\beta\beta}$ bounded from above.
  - Dependent on host isotope.



[1]

Key Question

How do we turn constraints on

Δm_{ij}^2, Σm_i , and $m_{\beta\beta}$

into constraints on

m_i , α, and β?

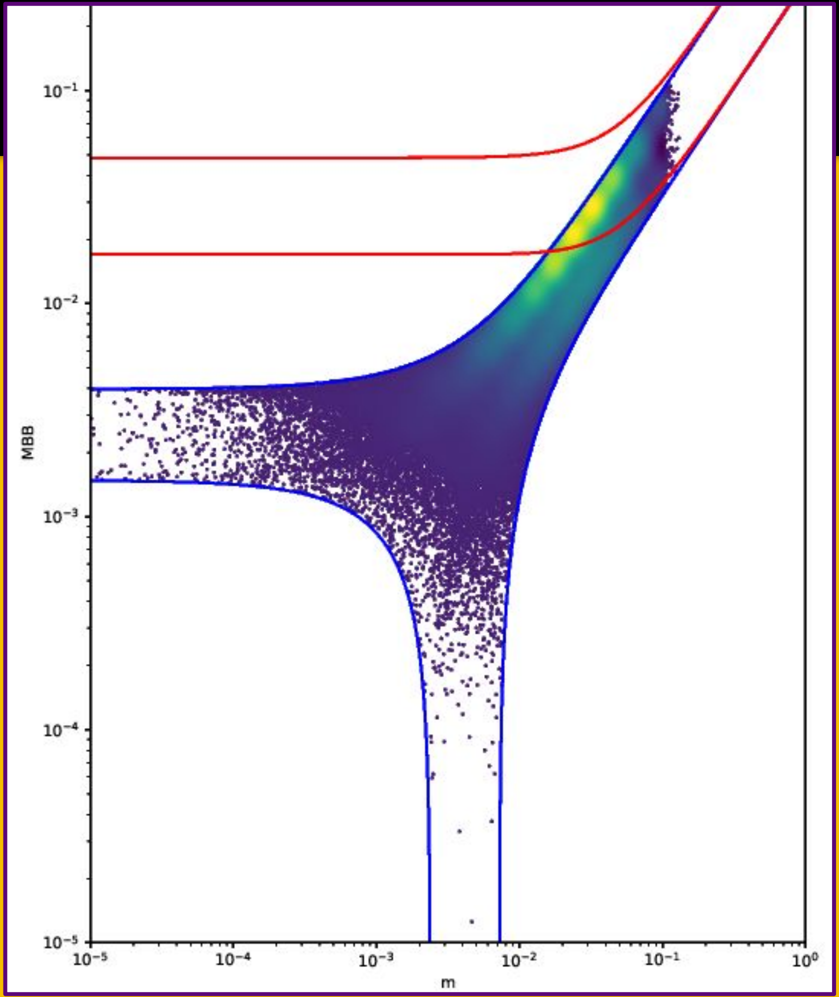
Majorana phases

Bayesian Methodology

- **Goal:** update prior knowledge $\pi(\theta)$ with data and likelihood $L_{data}(\theta)$ to obtain posterior knowledge $p(\theta)$.

- Markov Chain Monte Carlo (MCMC) achieves this by iterative sampling from local proposal distributions.

- Posterior samples are sufficient to calculate densities and CI's.



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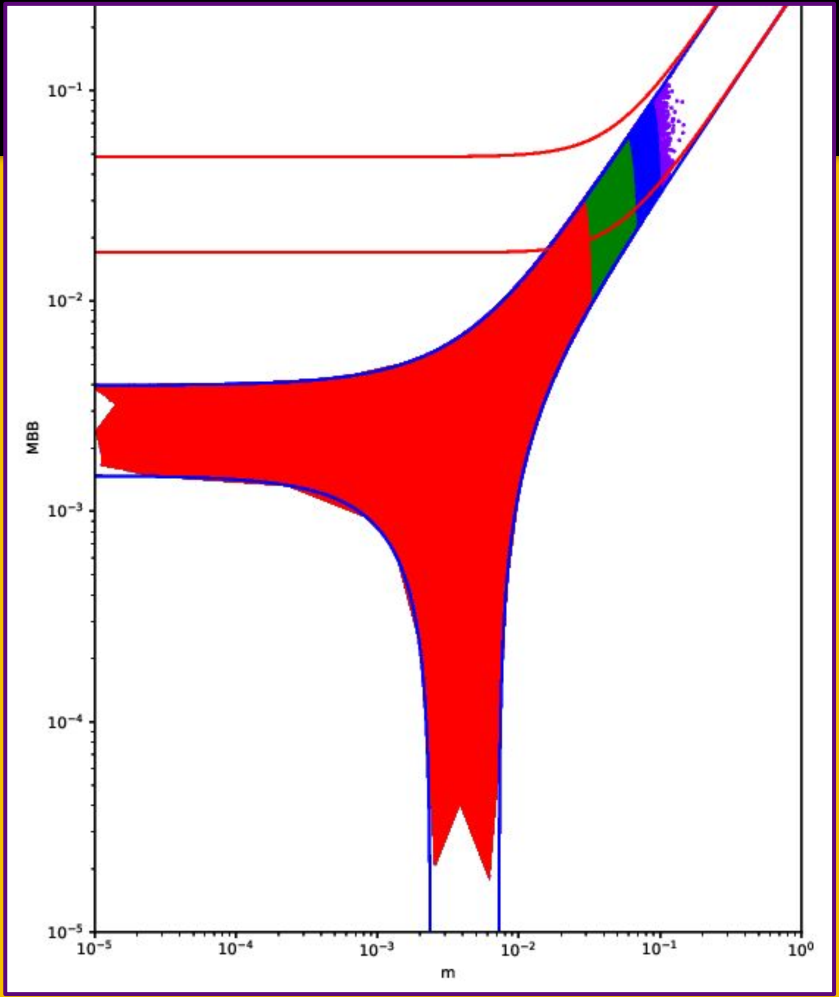
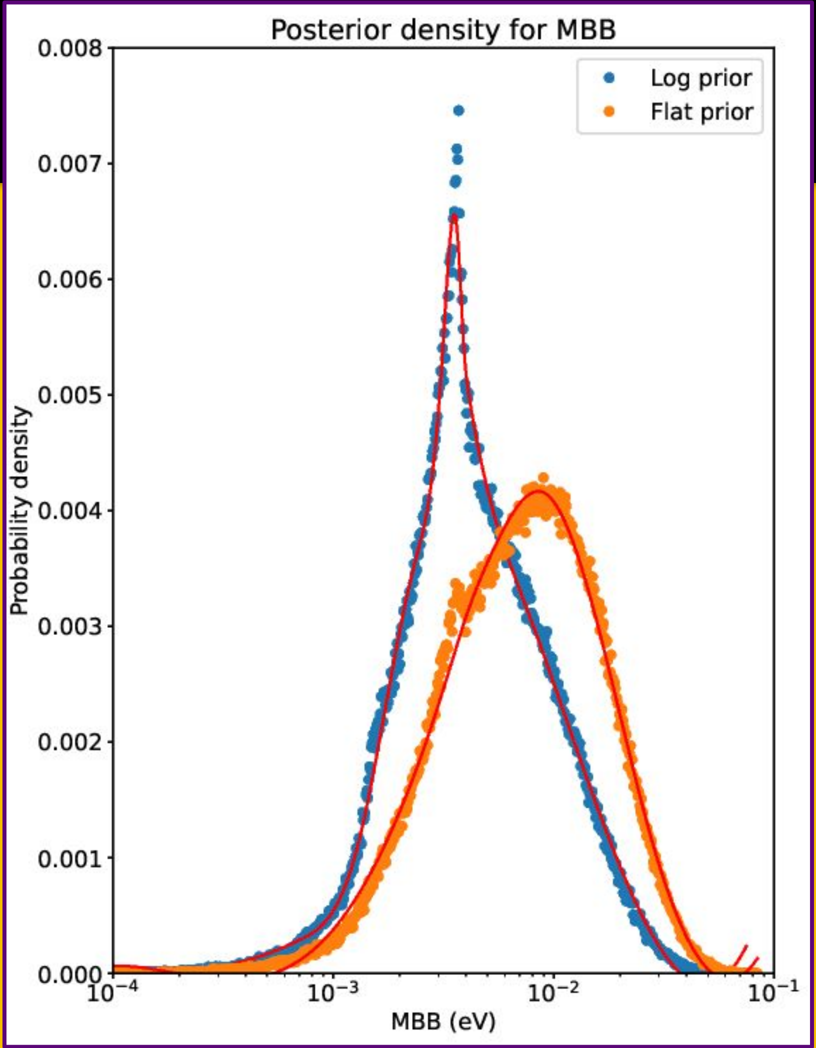


Influence of Different Priors

- What do we believe without evidence?
  - Indirect evidence hard to quantify
- Flat prior: all masses equally likely
- Log prior: all mass scales equally likely

Which is best?

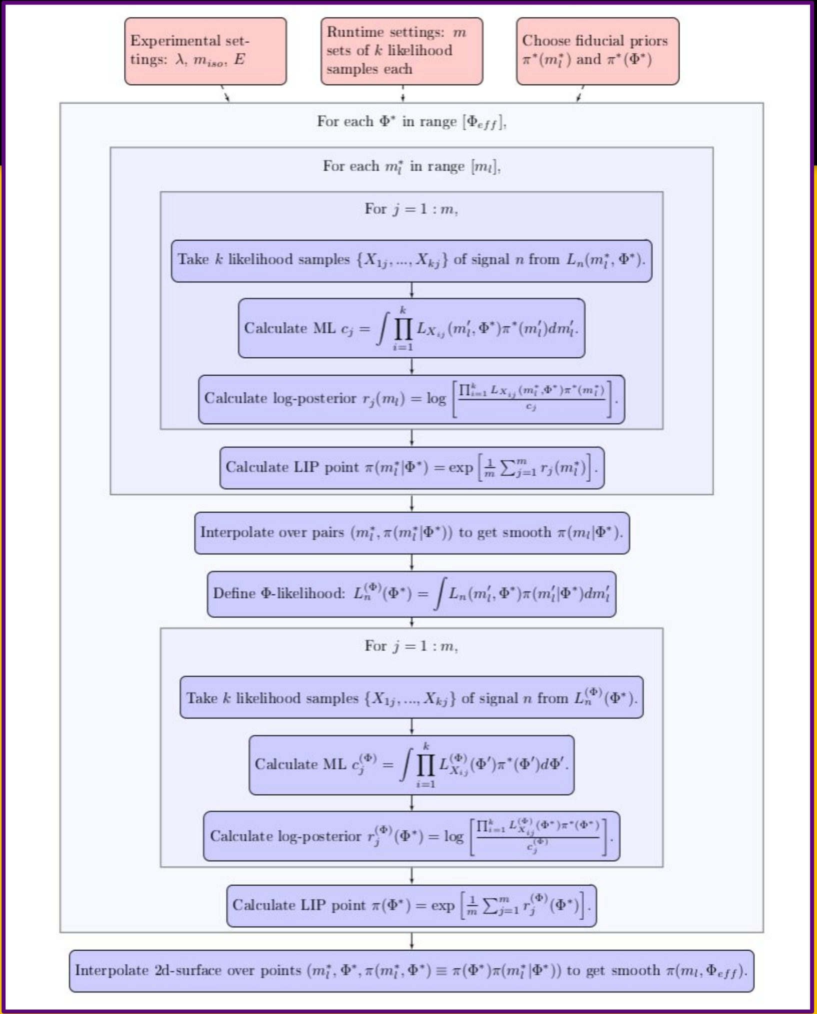


Least-Informative Priors

- **Information theory:** we want posterior to arise from experiment, not our prior biases.
- LIP maximizes information difference between prior and posterior:

$$\langle D_{KL}(p|\pi)\rangle_{data} = \int dX \int d\theta \; p(\theta|X) \log\left(\frac{p(\theta|X)}{\pi(\theta)}\right)$$

- Calculate via parallel likelihood samplings $\Rightarrow$



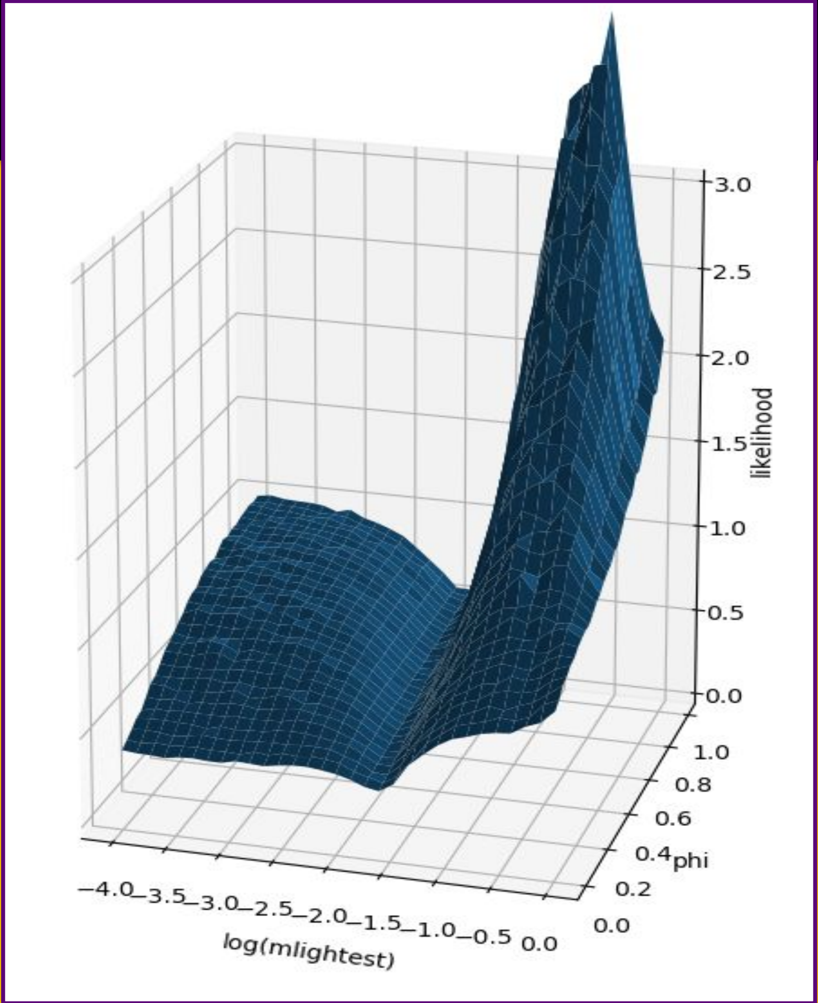
Preliminary Results

- Computation of LIPs for specific $0\nu\beta\beta$ experimental configurations.

- Confirmation that posterior-prior information gain is improved (via MCMC).

Next Steps

- Study impact on $0\nu\beta\beta$ constraints
- Analytically explain key features



Works Cited

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