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Disentangling the Black Hole Mass Spectrum with Photometric Microlensing Surveys

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Lawrence Livermore National Laboratory

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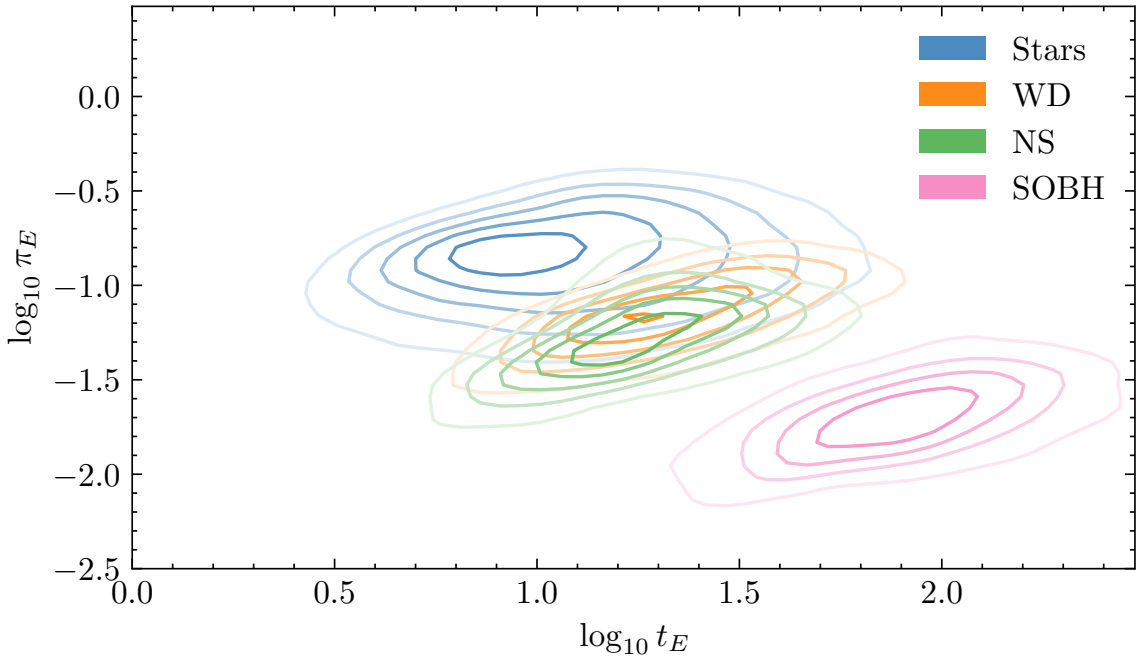
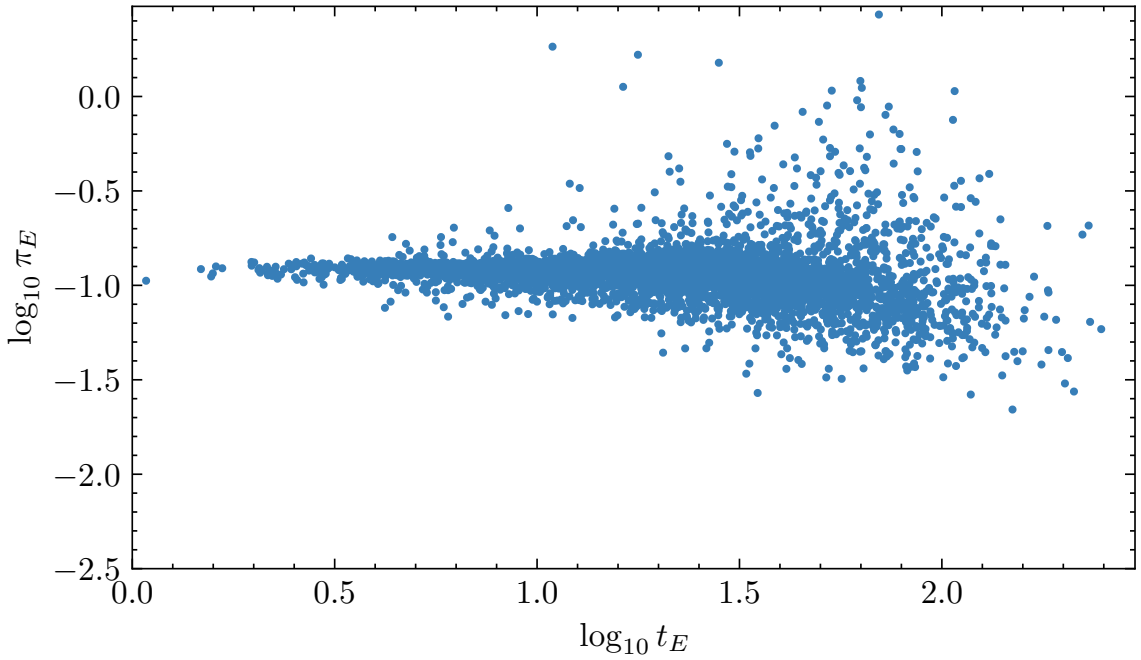
Based on
Perkins et al 2024 ApJ 961 179
(arXiv:2310.03943)

Motivation - Detectability in Parameter Distributions

Lam + 2020
Golovich + 2022





Separation in distributions of observable parameters ⇒ Possibility of informative inference, despite uncertainty and selection bias

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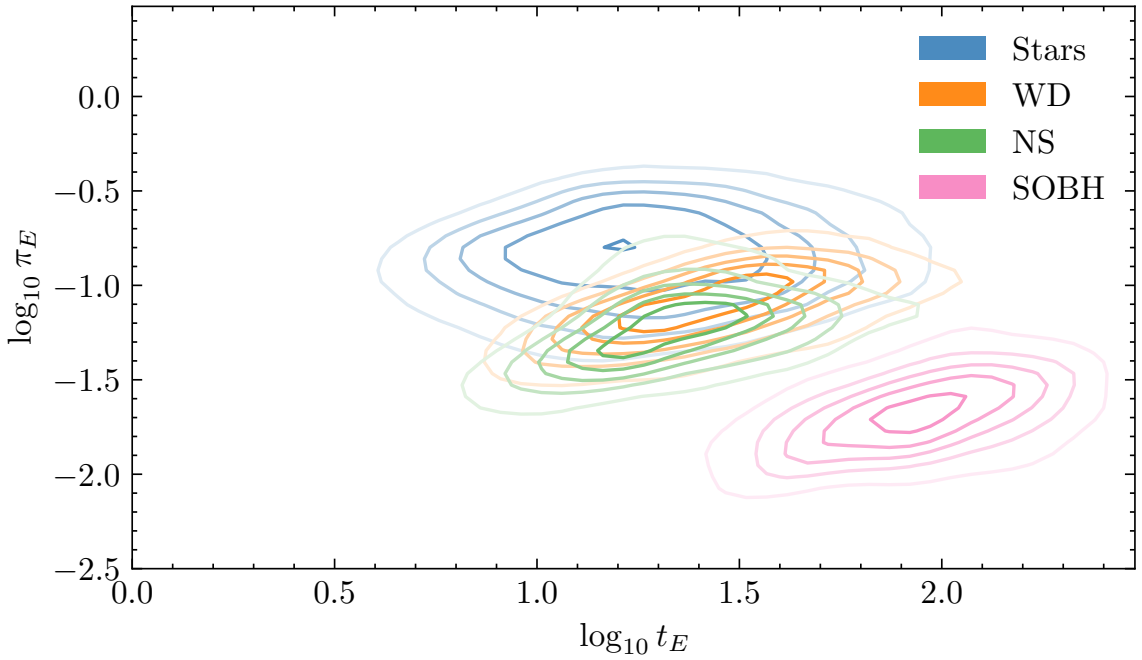

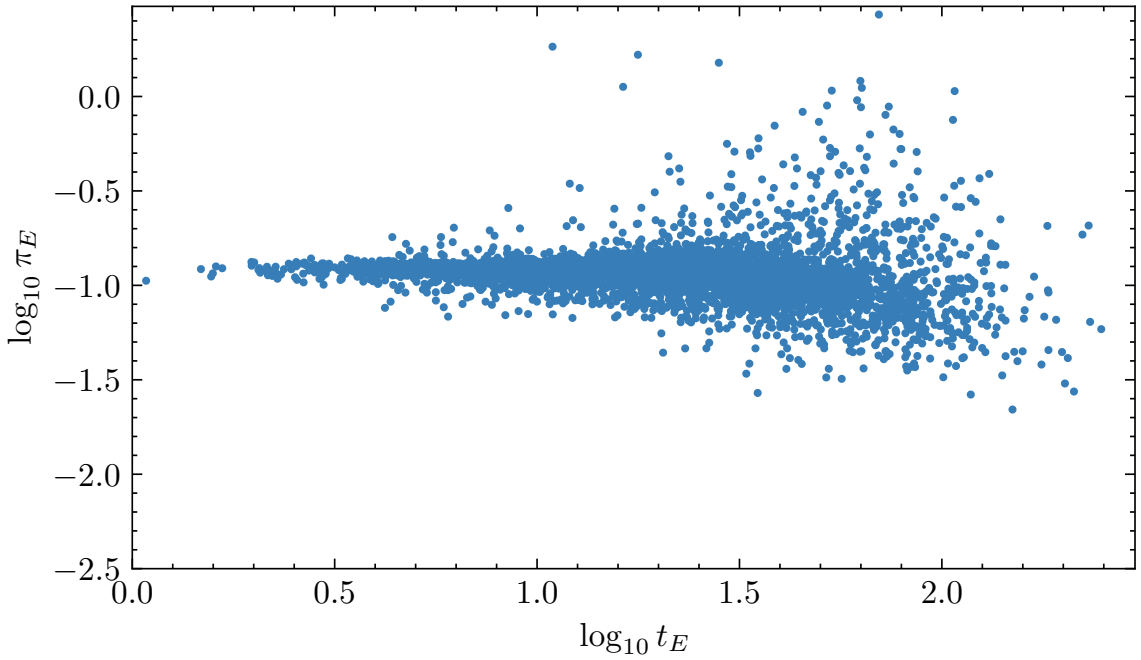

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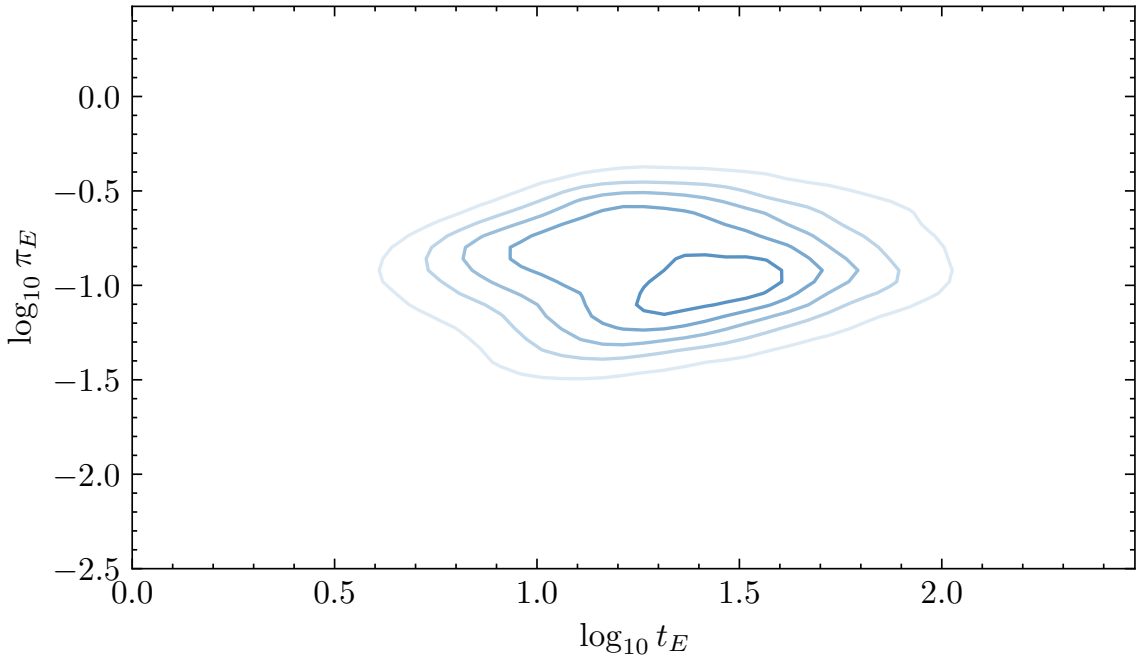

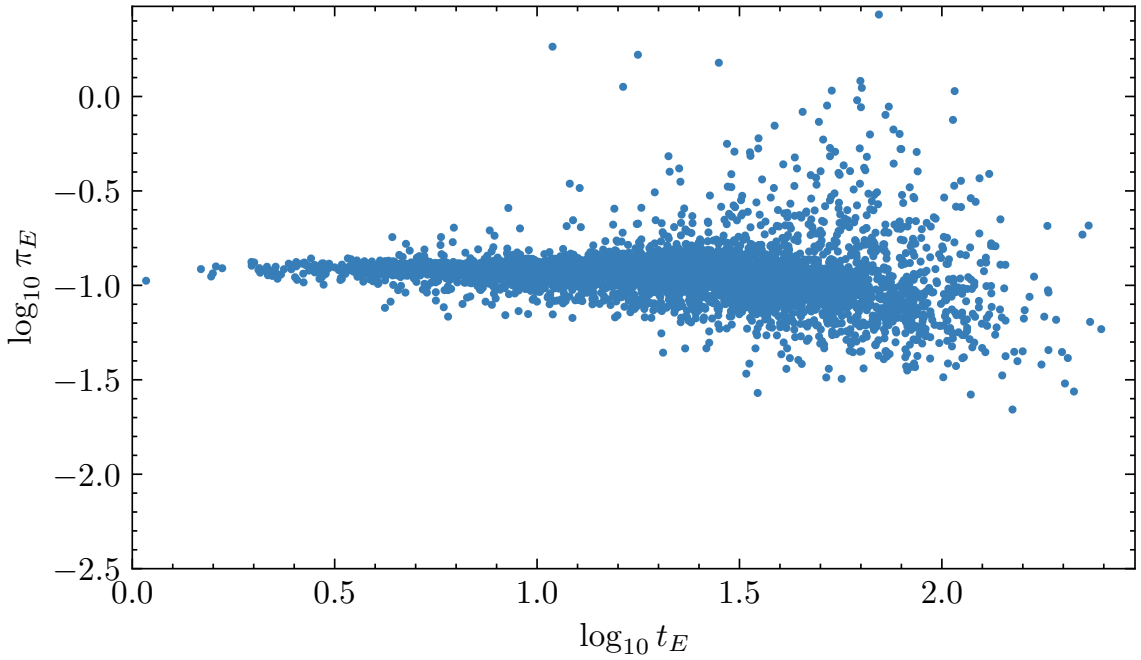

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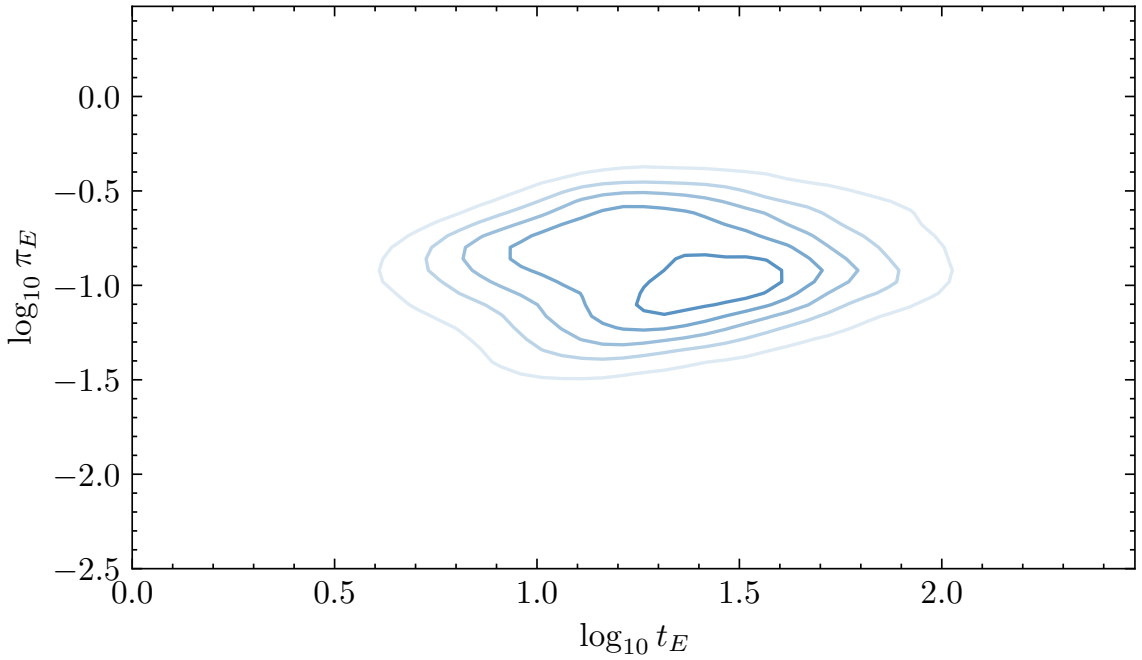

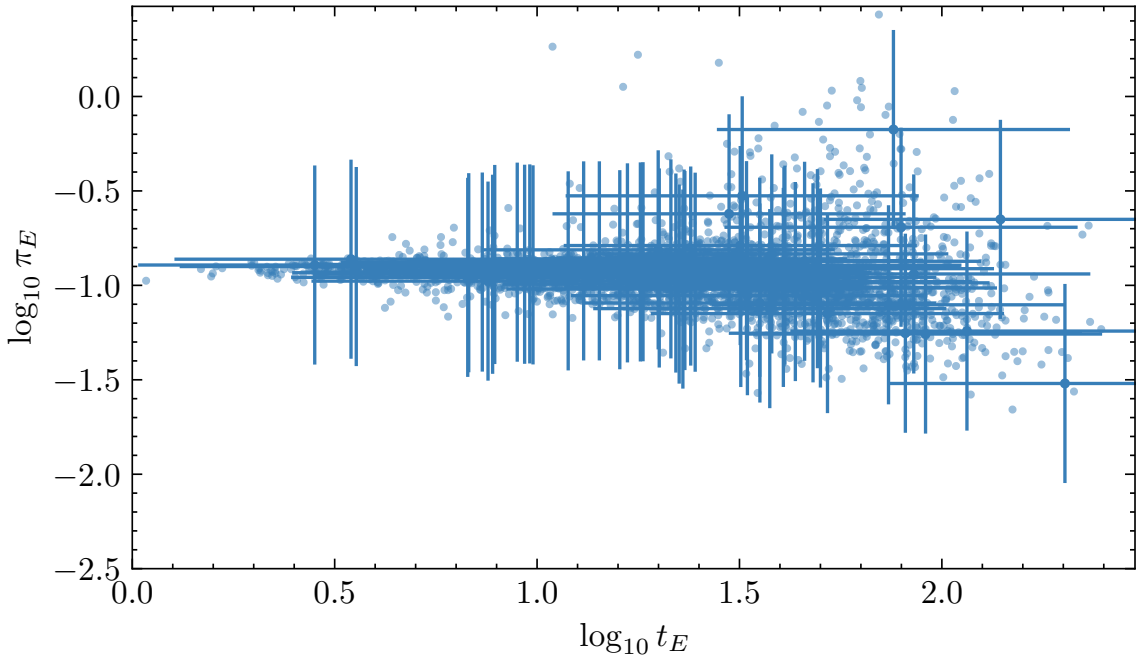

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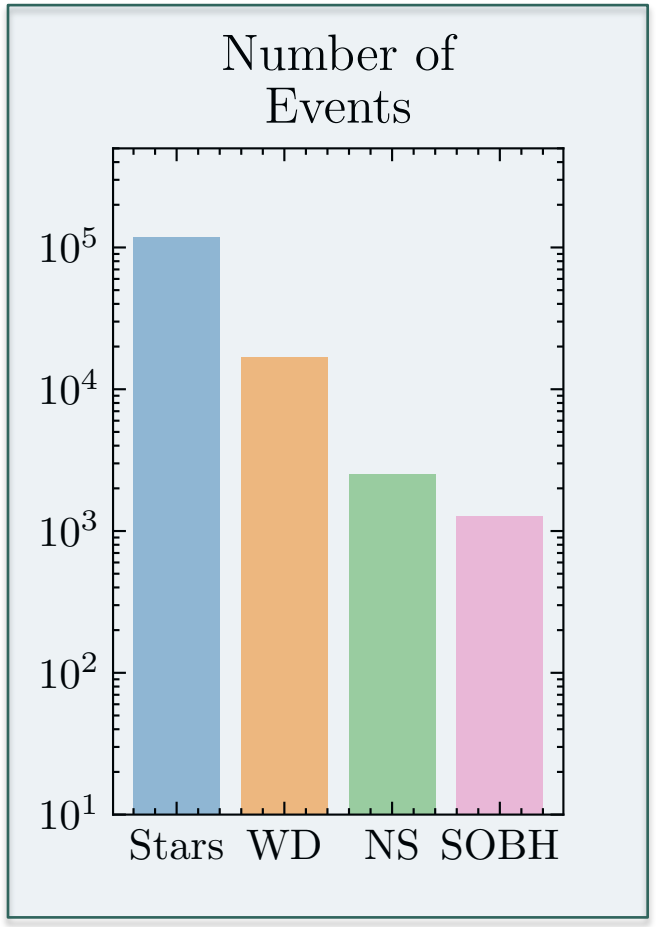
Methodology - Fully Bayesian Hierarchical Inference

$$p(d_1 \ \ldots d_N \ | \text{Model}) \propto p(N|\text{Model}) \times \prod_i p(d_i|\text{Model})$$

Loredo 2004
Vitale + 2020
Mandel + 2019
Taylor, Gerosa 2018



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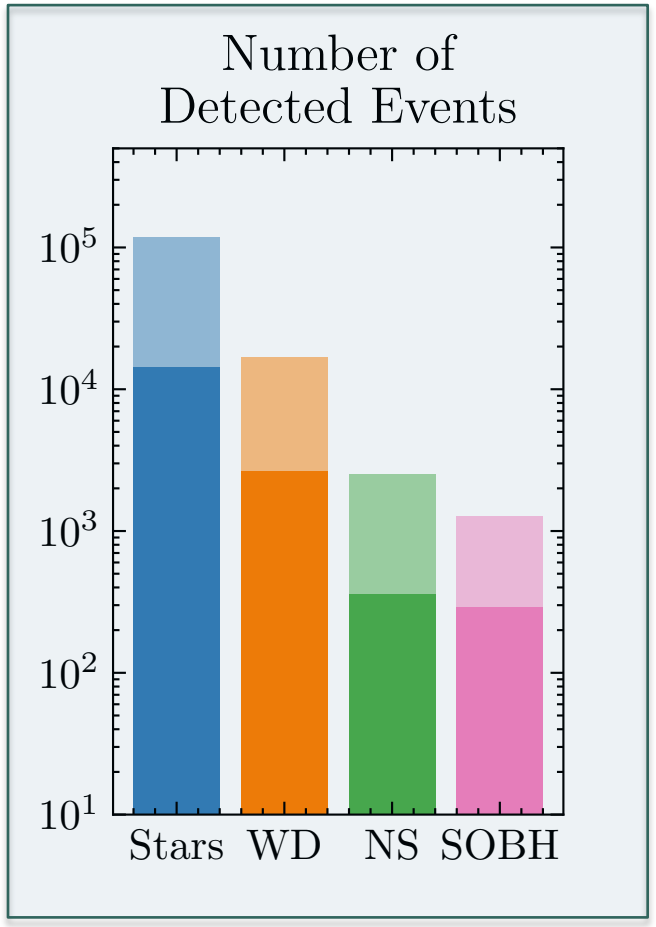

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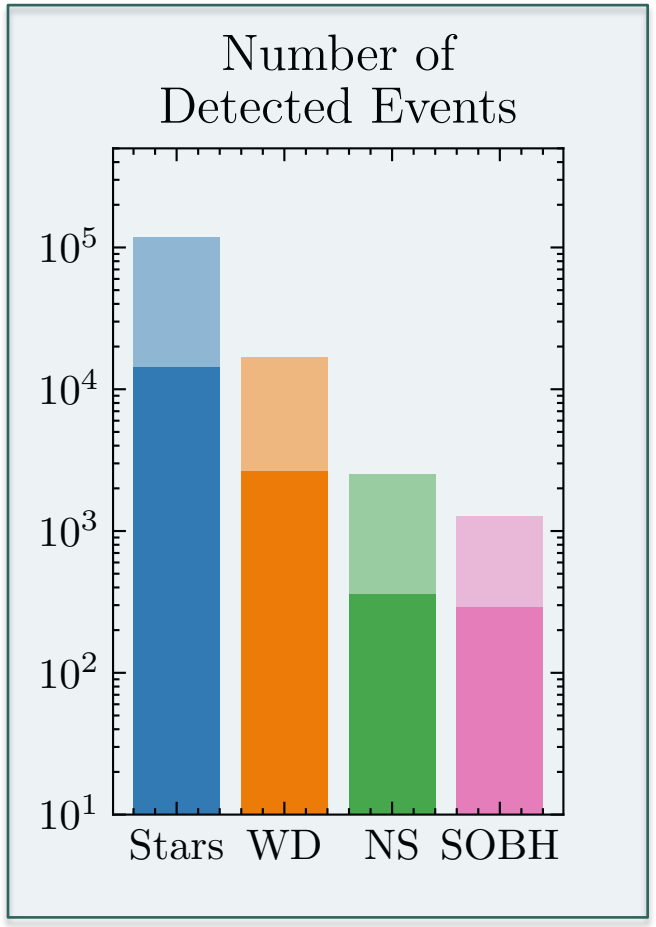

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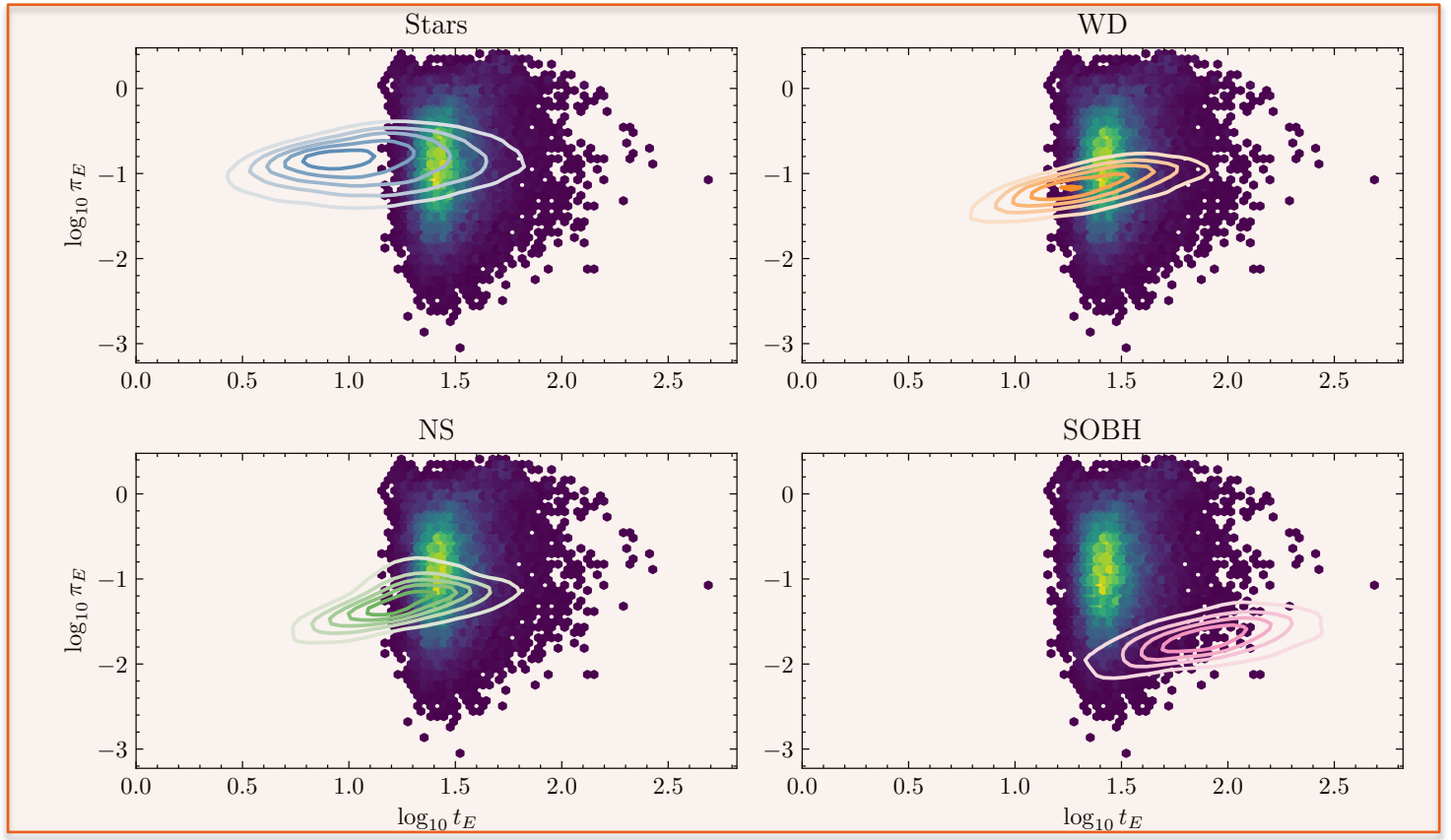
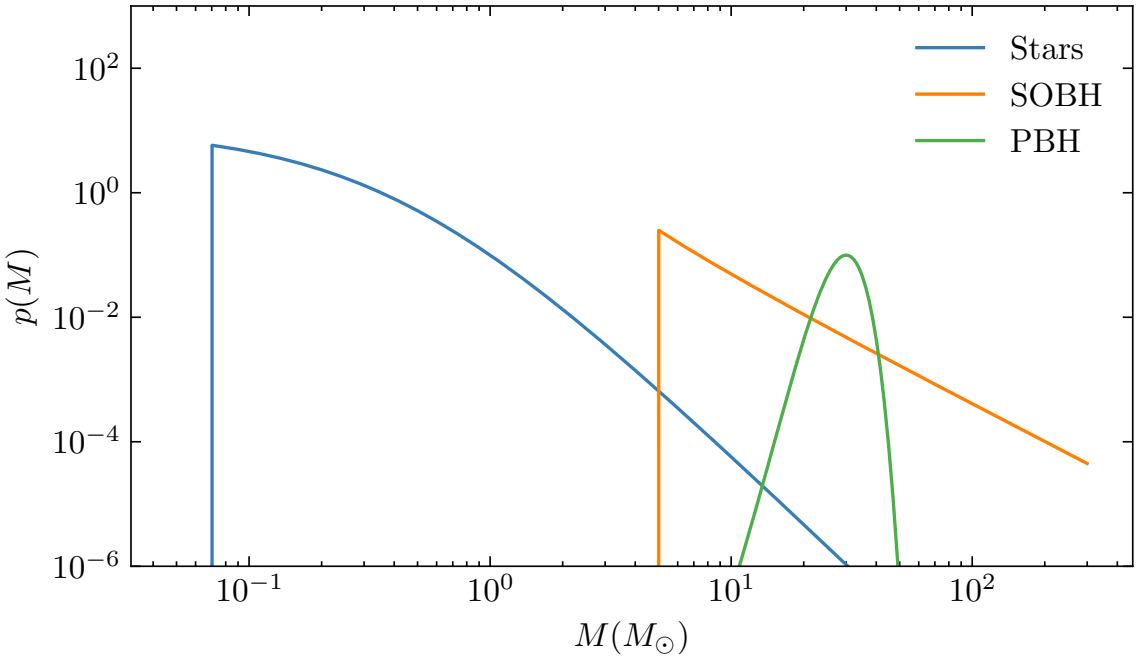
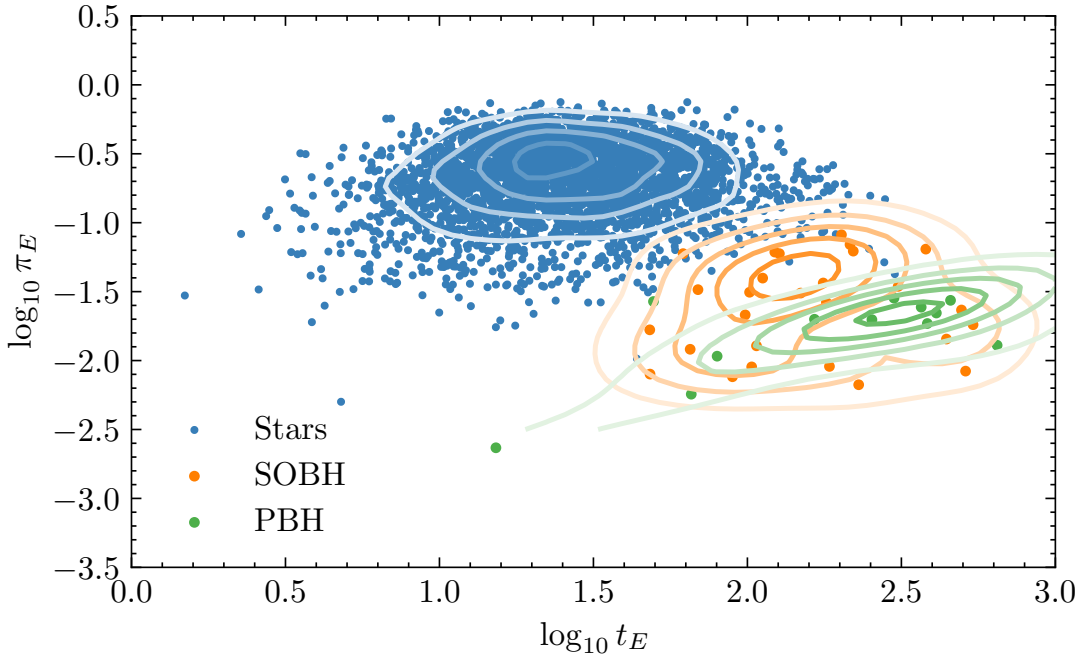
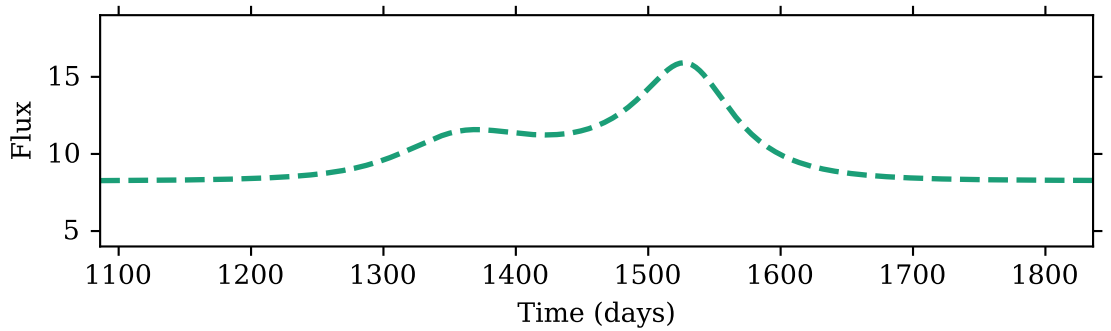


Validation Through Simulation







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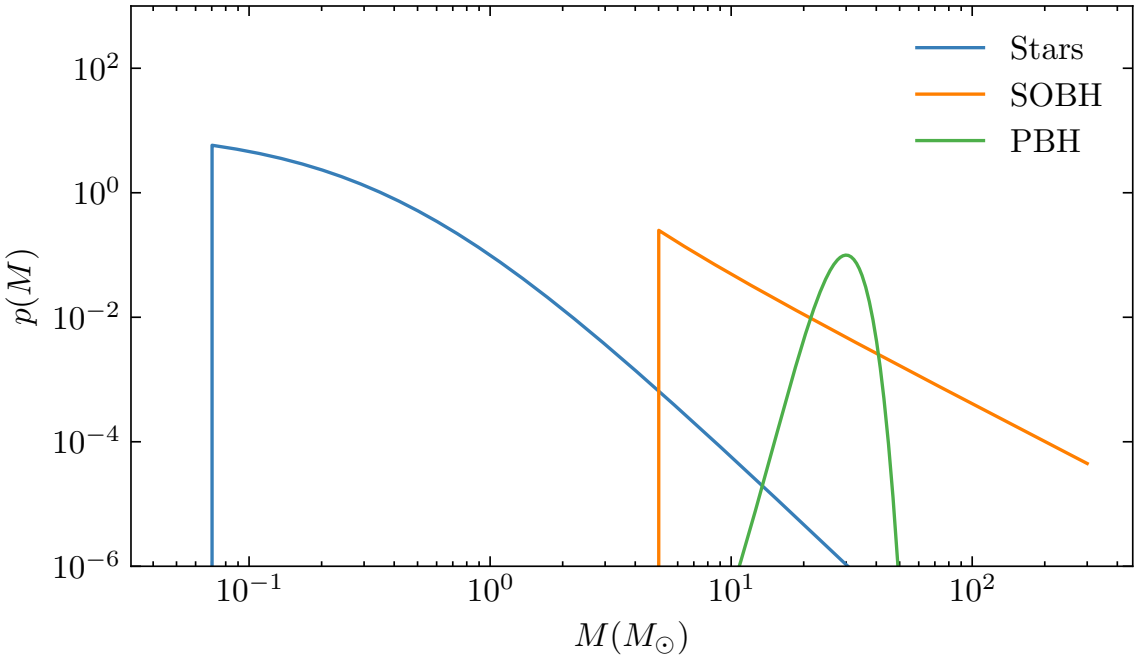

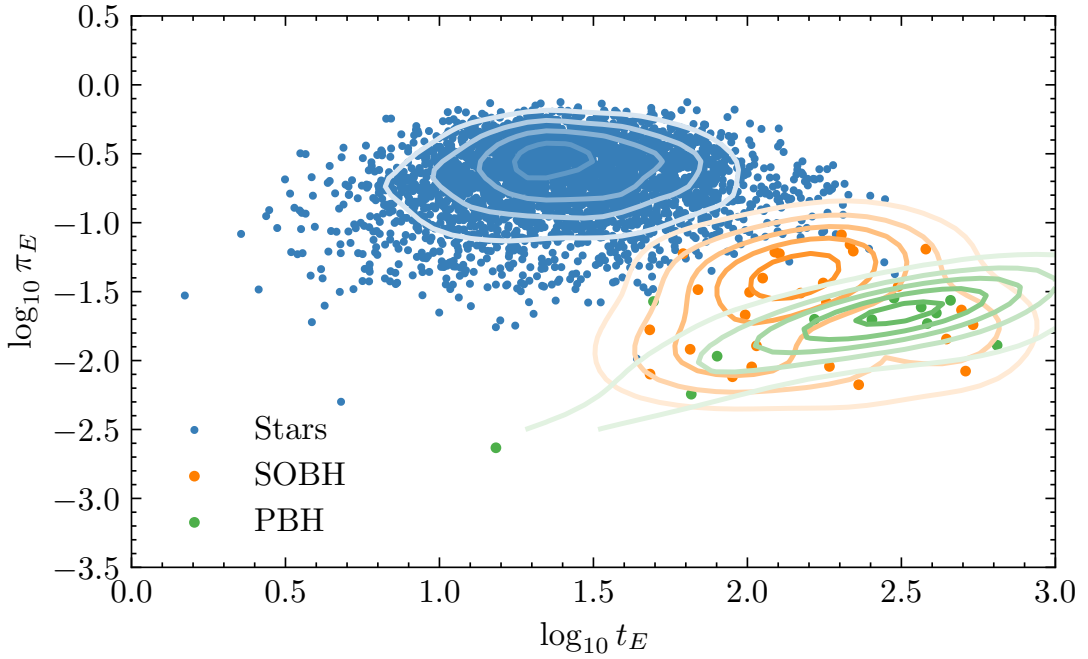

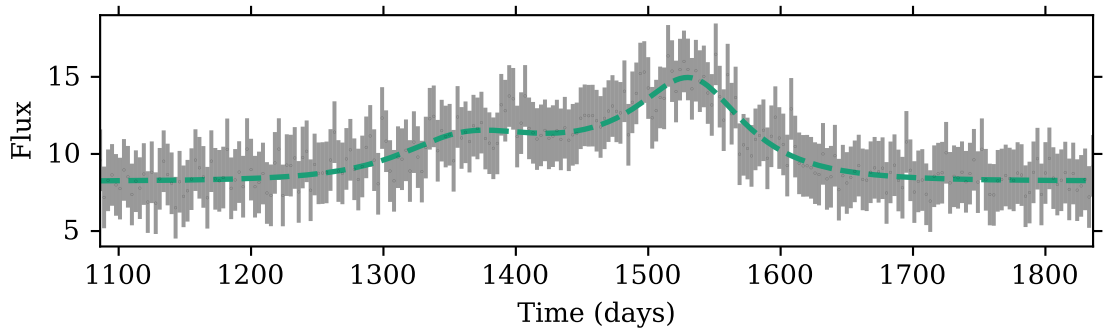

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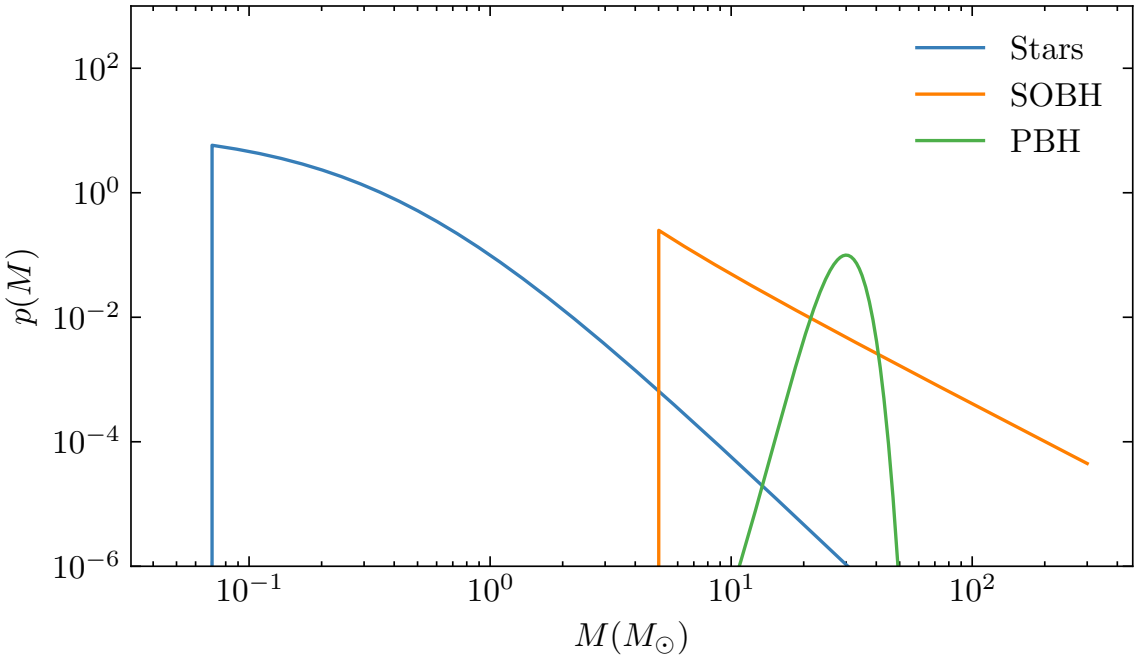
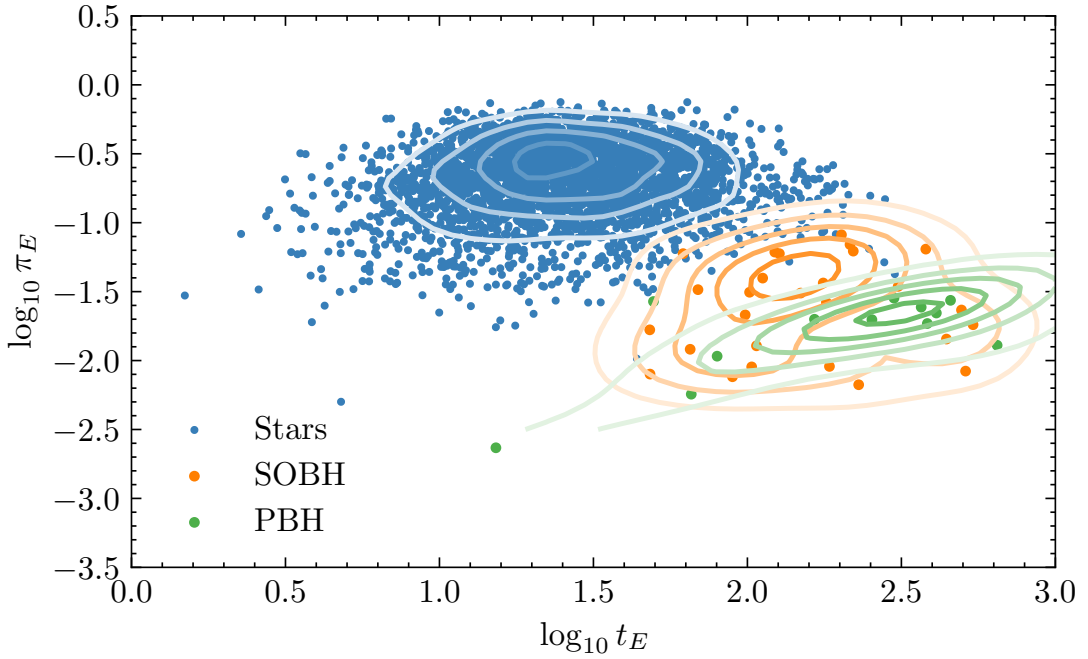
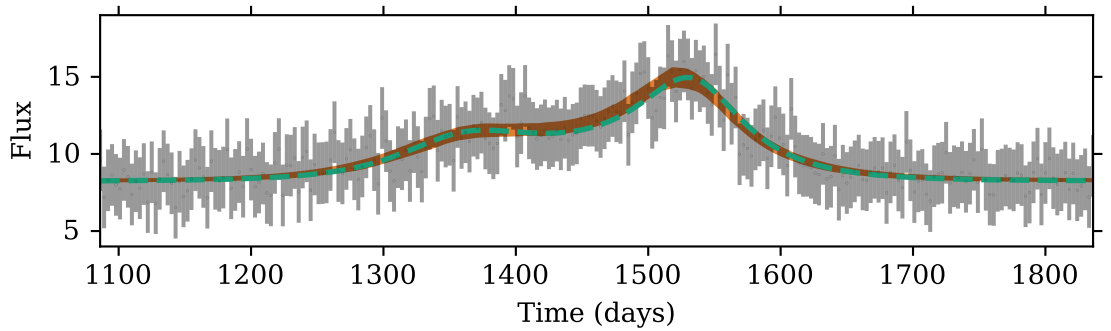
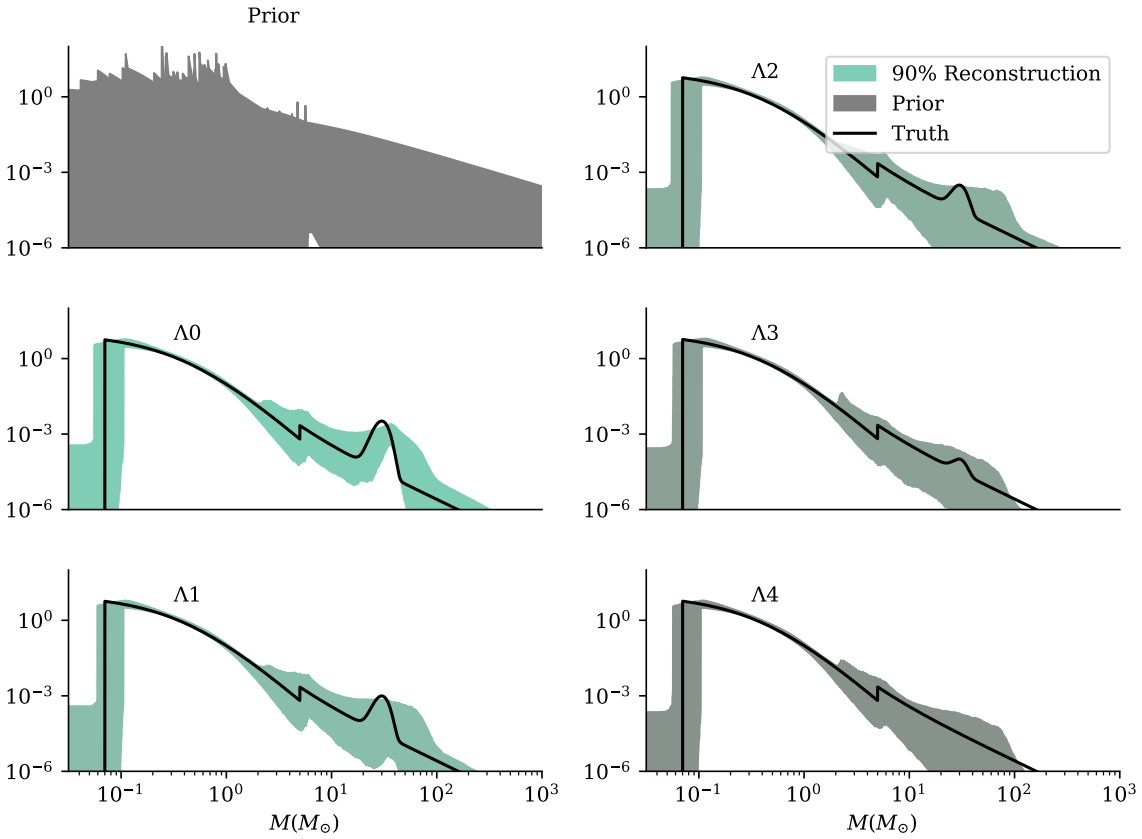
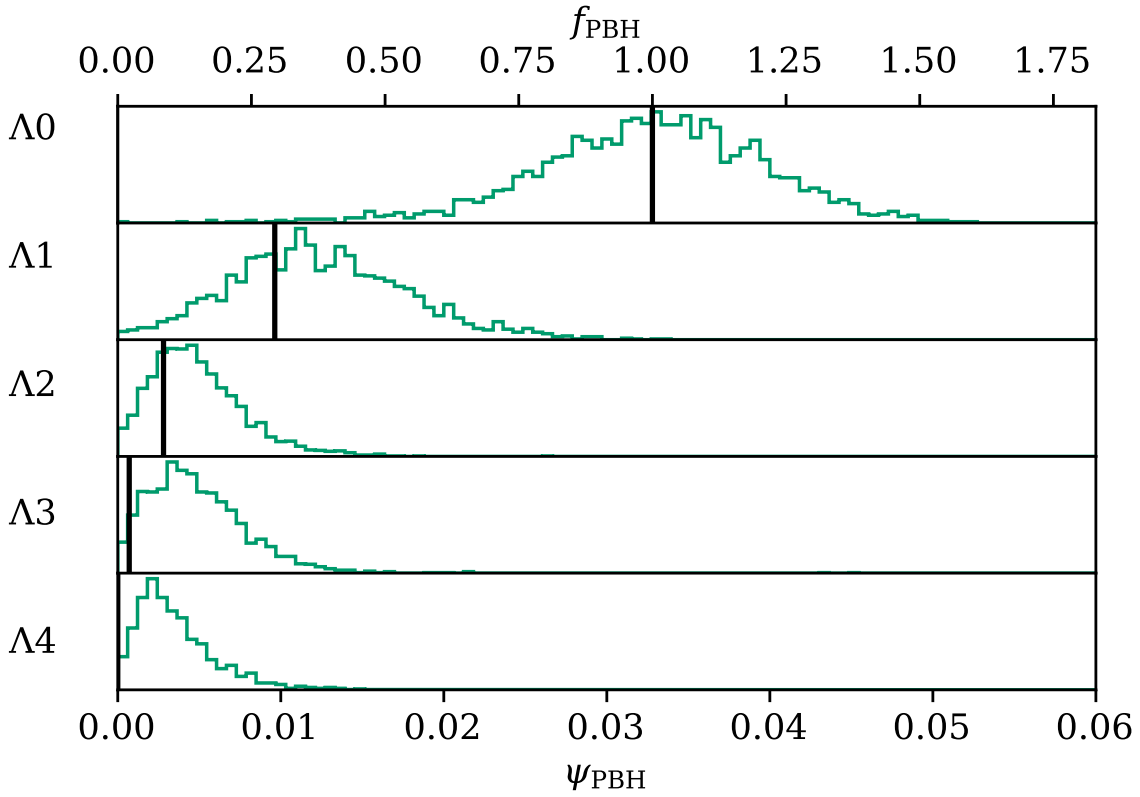






Predicted Constraints on PBH Abundance and Lens Mass Distribution - Posteriors





Hierarchical inference seems very likely to produce informative constraints on PBH abundance, while marginalizing over many sources of uncertainty

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