Cosmic string parameter estimation with `SGWBinner`

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On behalf of the CosWG Proj-13 group

Goals of the project:

2) How well can we recover a (simulated) cosmic string SGWB?

3) What progress still needs to be made in cosmic string SGWB modeling?

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- Only parameter is coupling to gravity, $G\mu$.
- Power spectrum is also extracted from simulation.

Overview of testing `SGWBinner`

1) Start with a template for a cosmic string SGWB and a LISA noise model.
2) Inject a signal with known parameters.
3) `SGWBinner` performs an MCMC minimization over the template parameter space; reports best-fit parameters and covariance matrix, as well as confidence regions.

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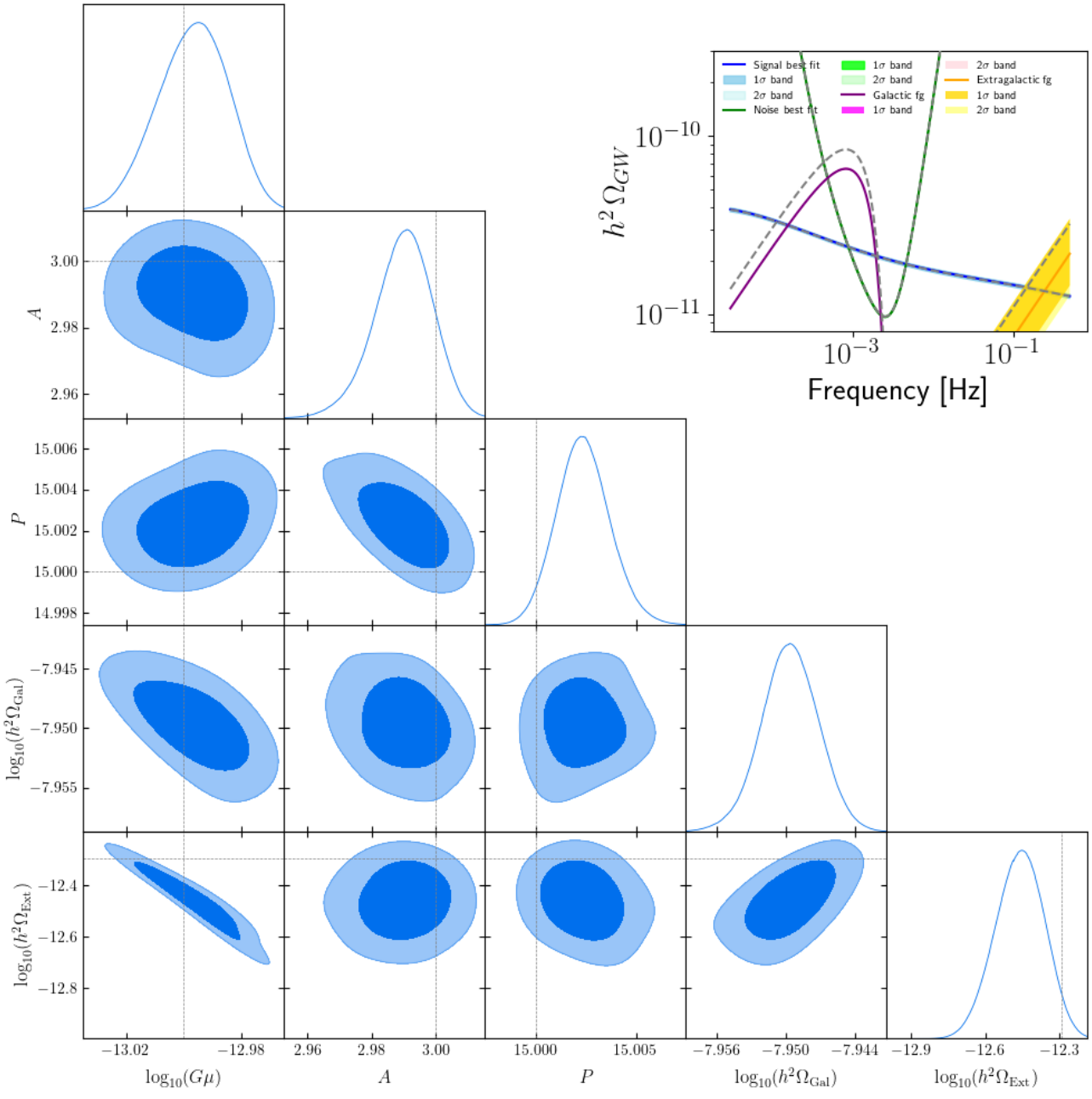
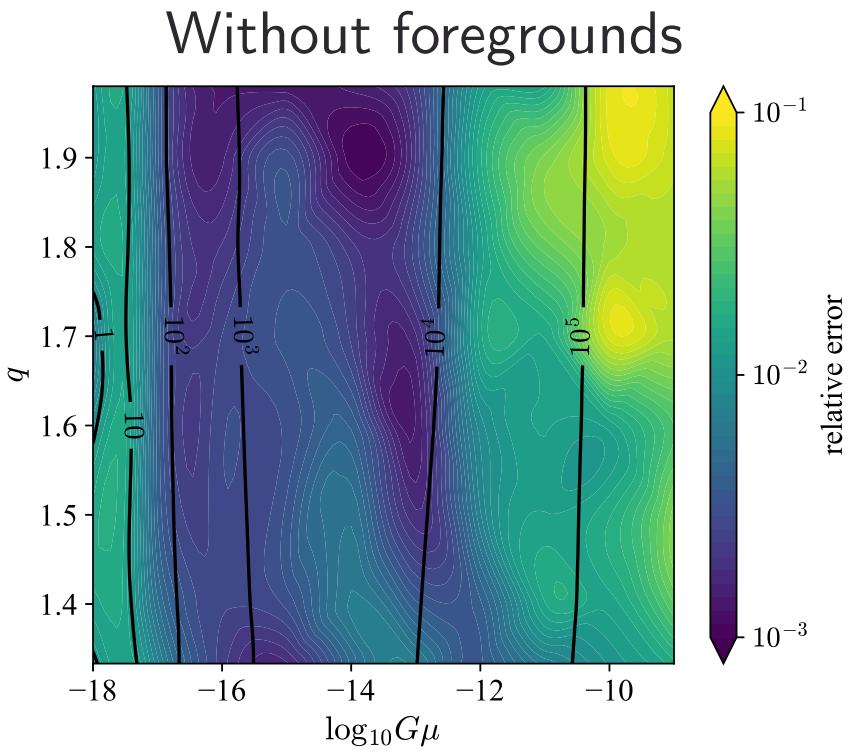
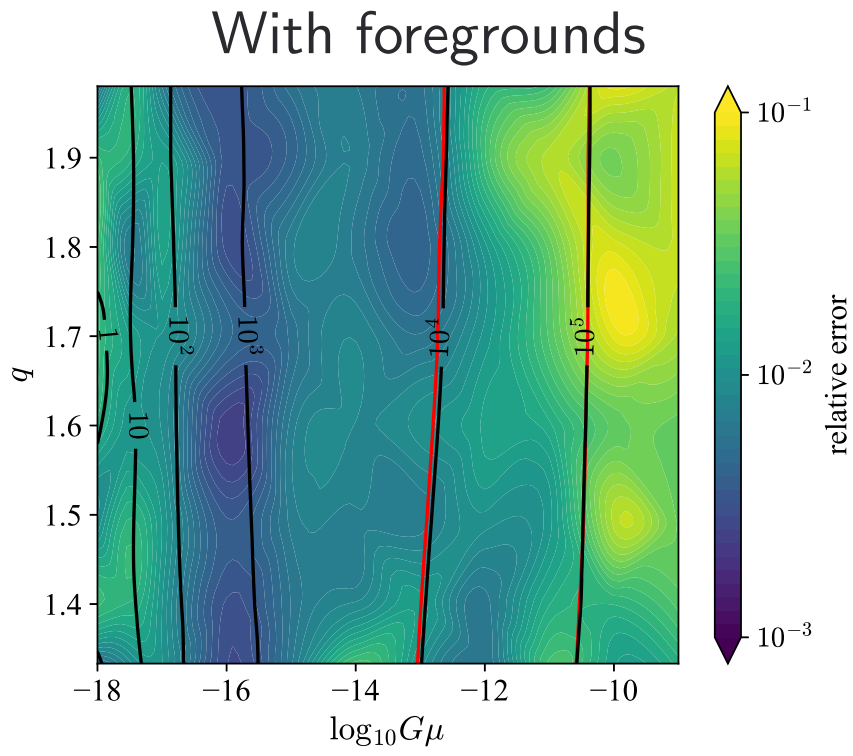
We (optionally) include galactic and extragalactic binary sources.

Sample reconstruction (Model II, $G\mu = 10^{-13}$)

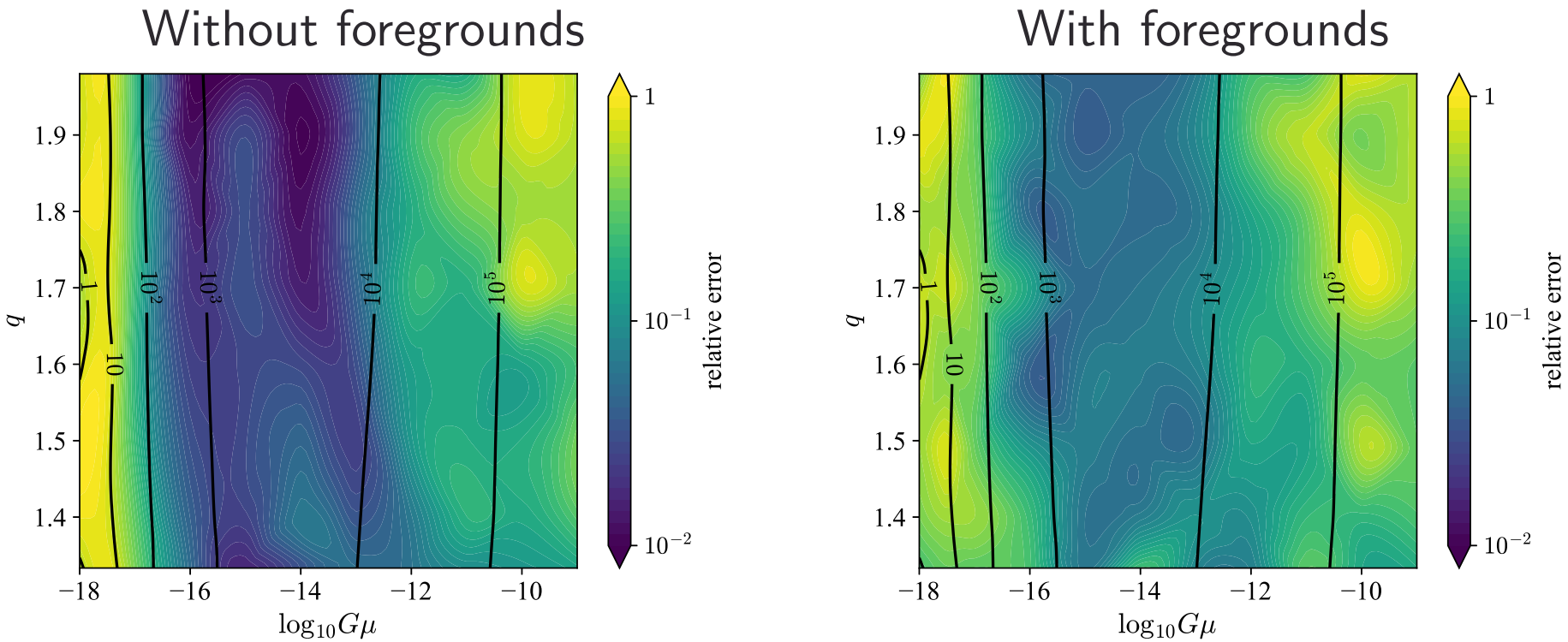


Results for Model I: $\log_{10}(G\mu)$

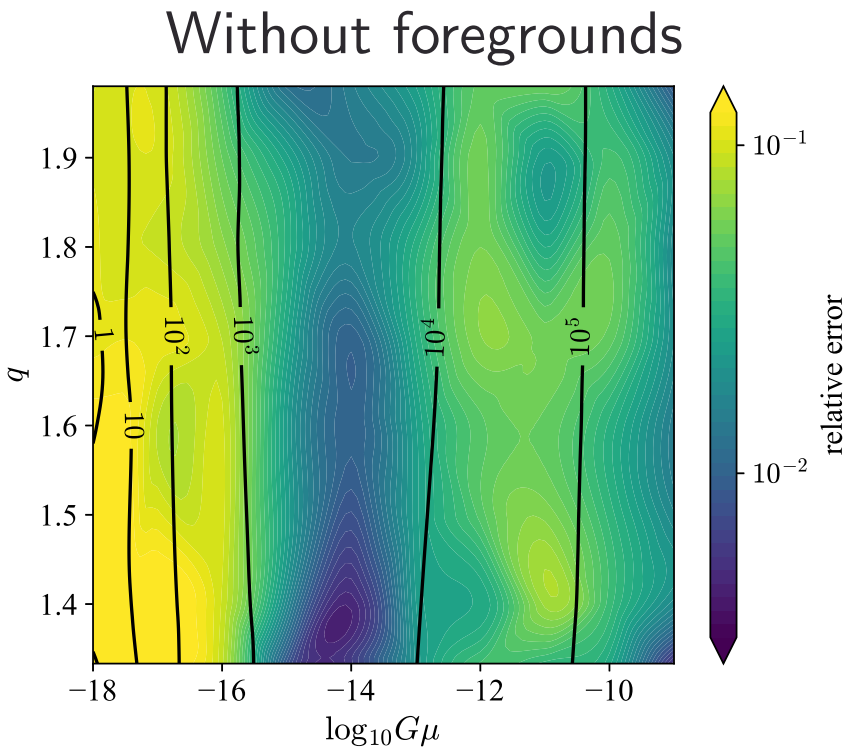


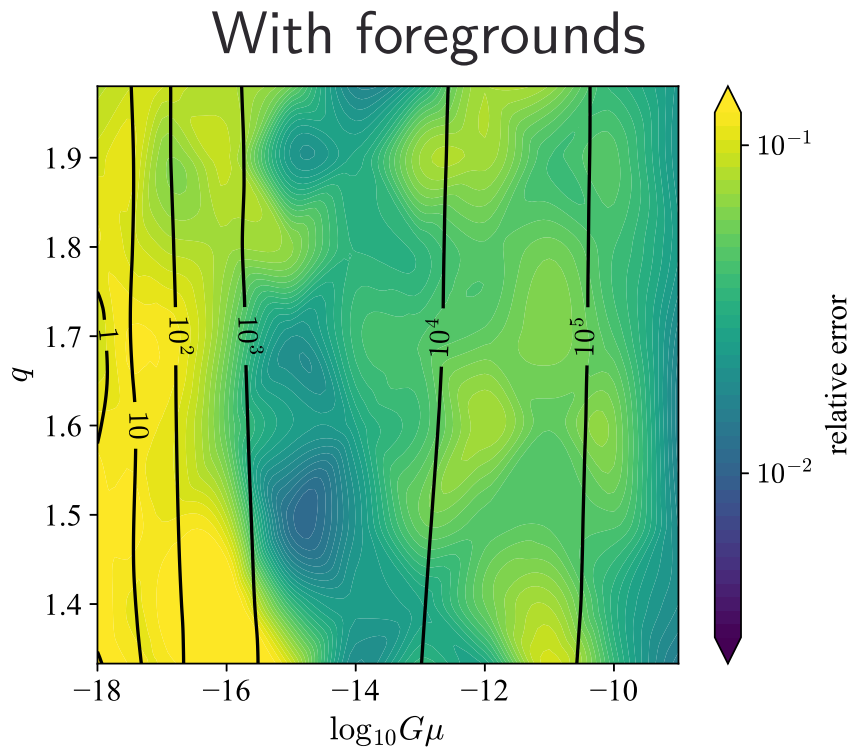


Results for Model I: $\log_{10}(\alpha)$

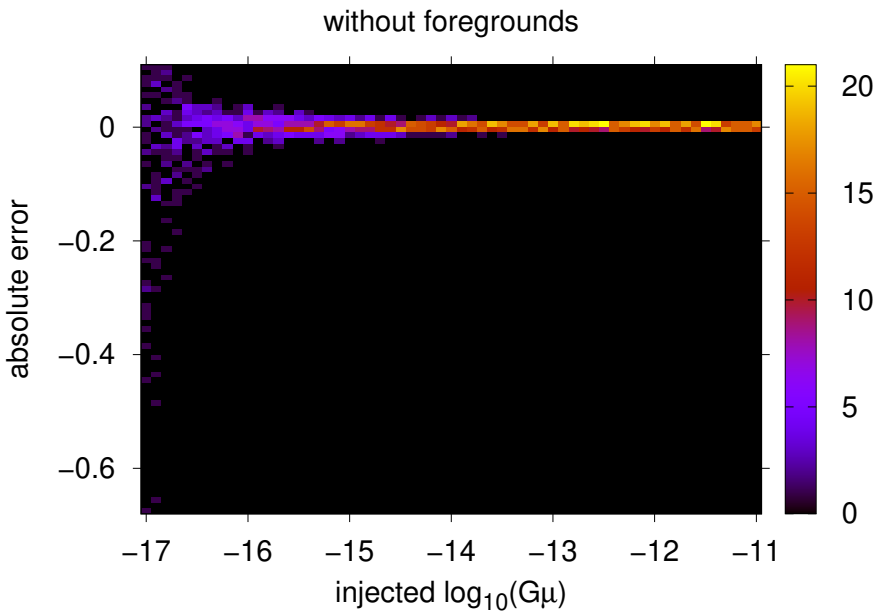


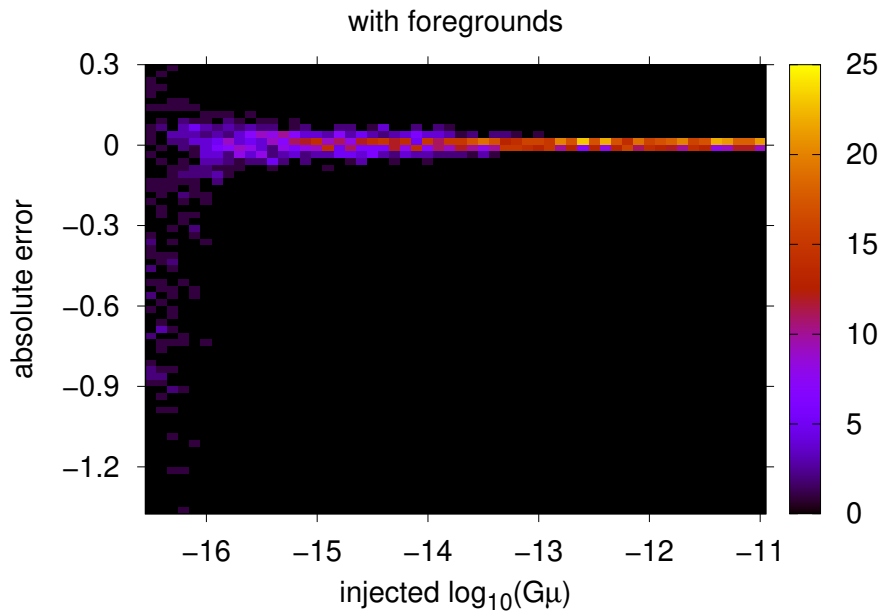
Results for Model I: q





Results for Model II





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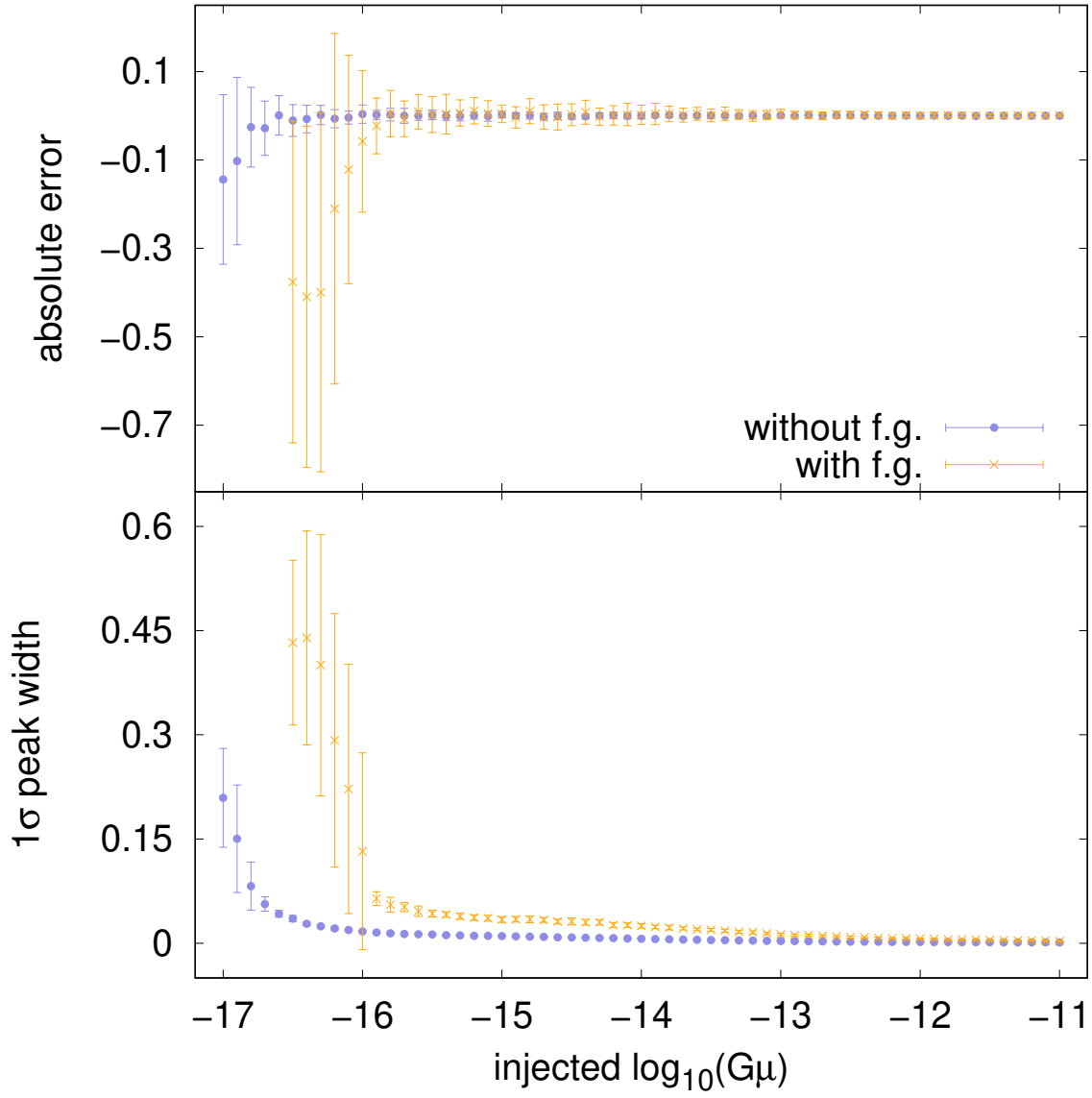

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- Reconstruction is very accurate and precise at largest tensions.
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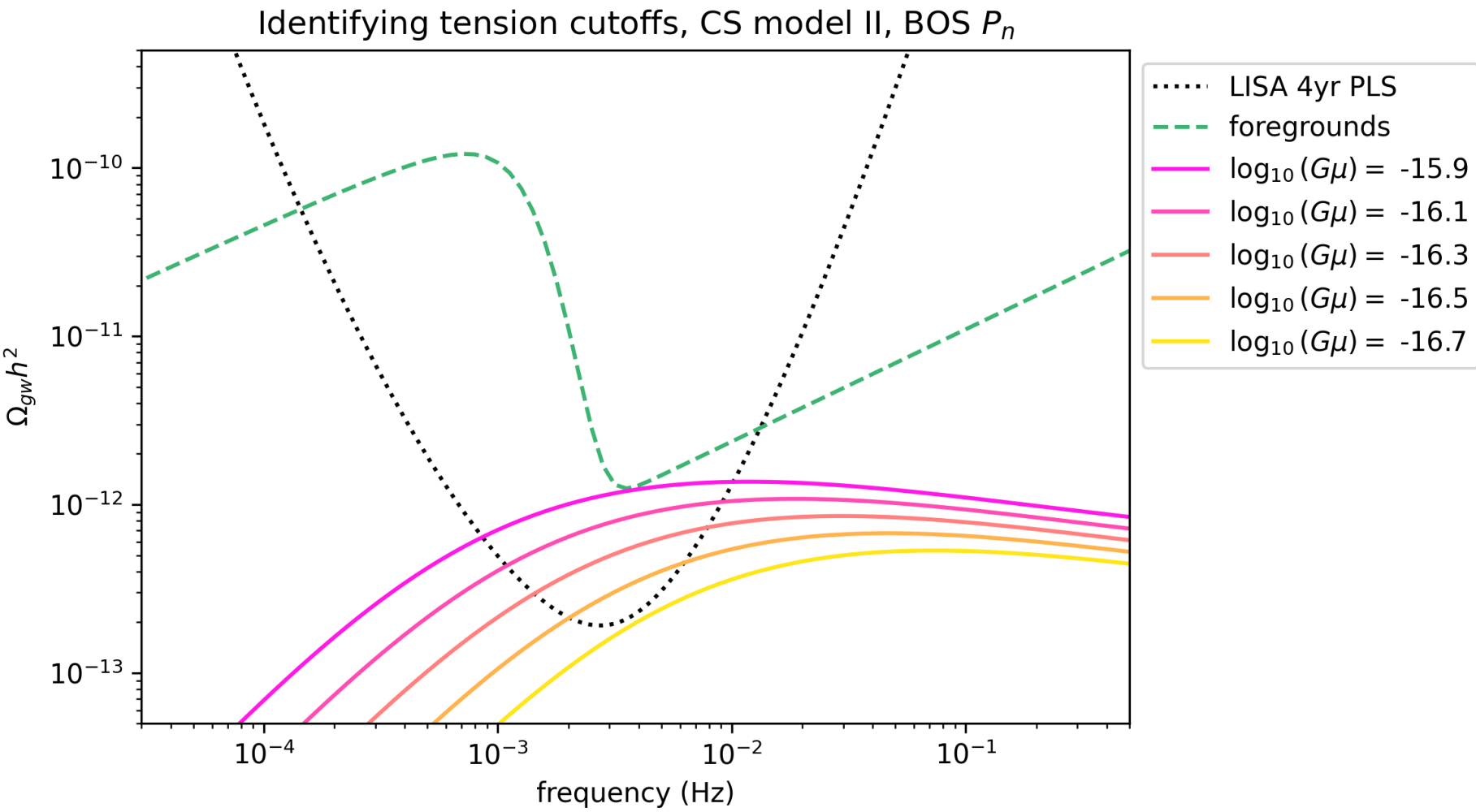
For future work:

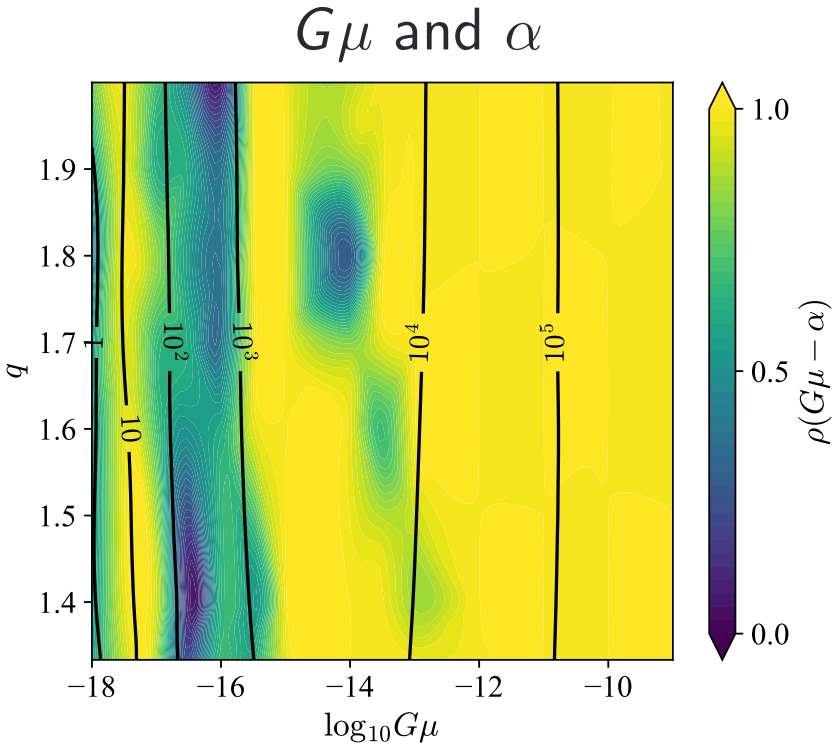
- How well can we probe extra degrees of freedom?
- How well does `SGWBinner` fit a 'true' signal which is slightly different from the template signal?
- How can the current templates be refined?

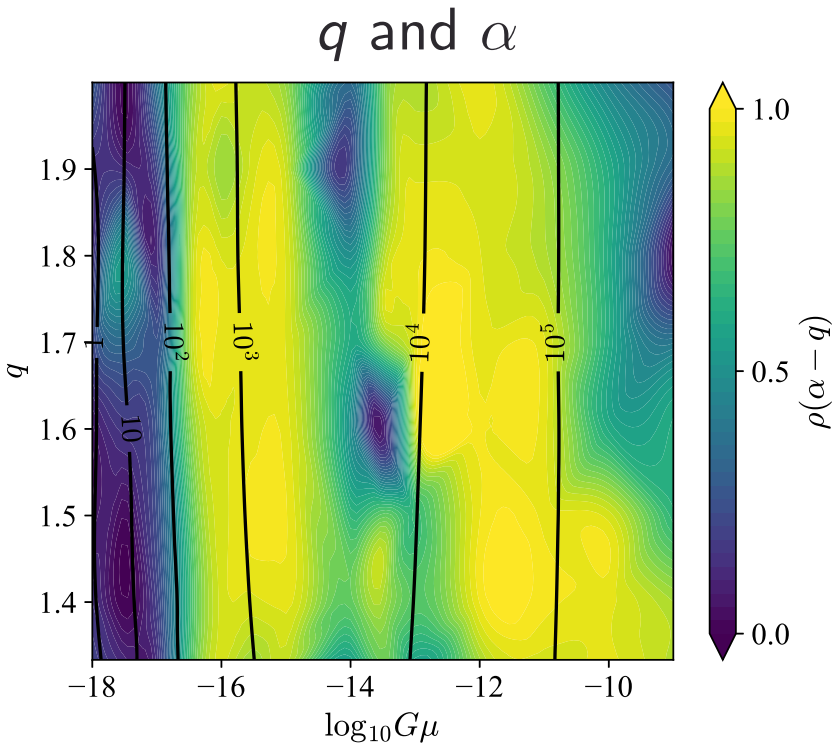
Additional slides

SGWB below foregrounds/LISA degrades reconstruction

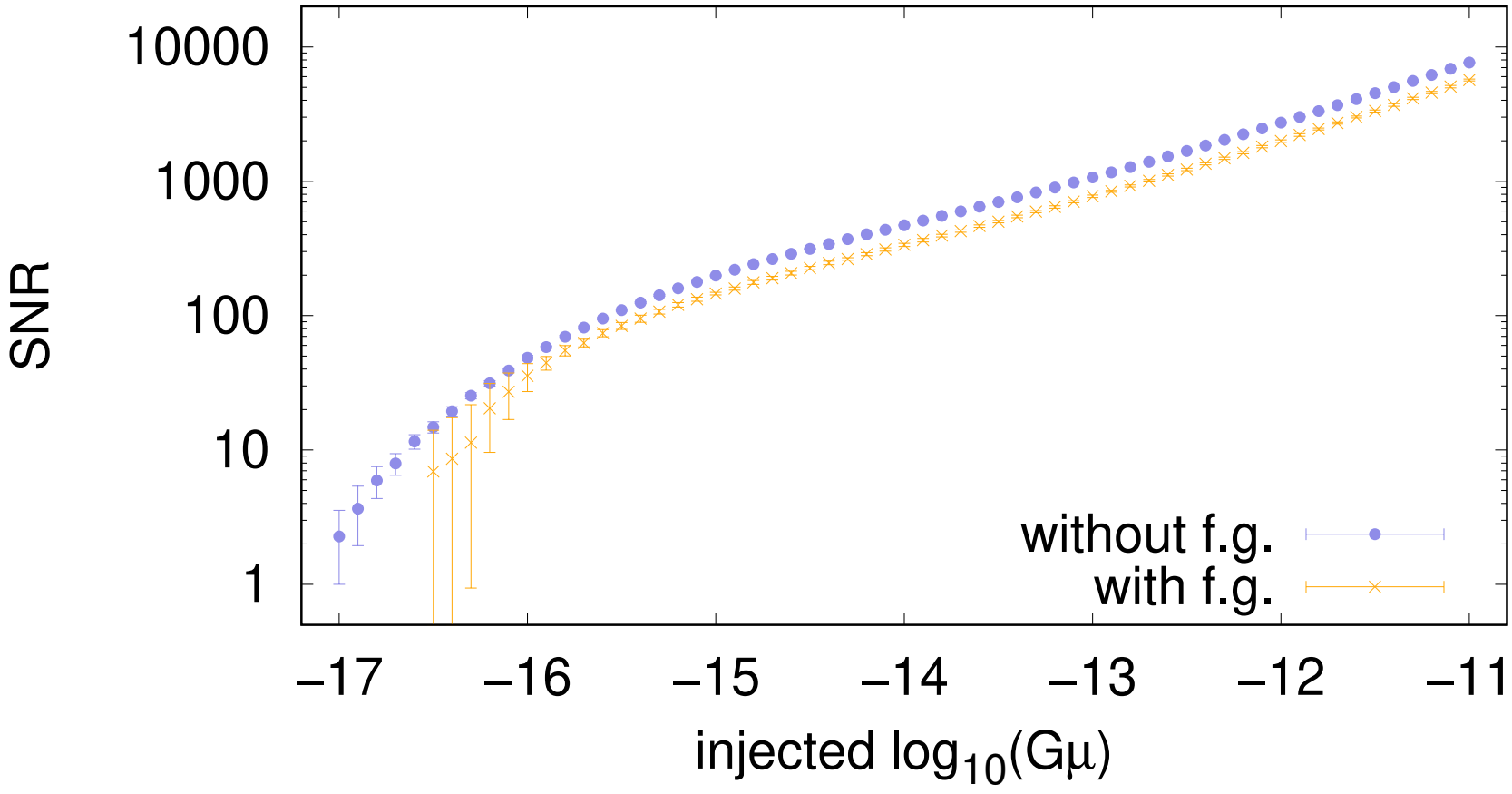


Correlations in Model I





SNR in Model II



10 extra degrees of freedom at $T = 10^{-1.5}$ GeV, $G\mu = 10^{-10}$