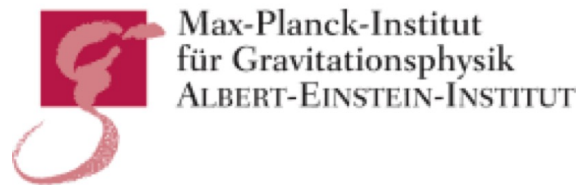
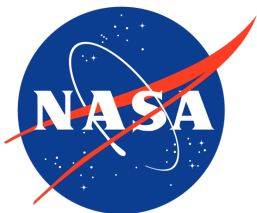


Erebor: A GPU-accelerated multi-source global fit pipeline

Michael Katz, Nikos Karnesis, Natalia Korsakova,
Jonathan Gair, Nikolaos Stergioulas

Towards LISA Catalogs
June 12-14, 2023
Nice, France



Main characteristics:

GPU-acceleration for increased efficiency

Ensemble setup for marginalization

Cohesive singular-band setup

Large-scale batched singular MCMC for search

Reversible jump MCMC techniques

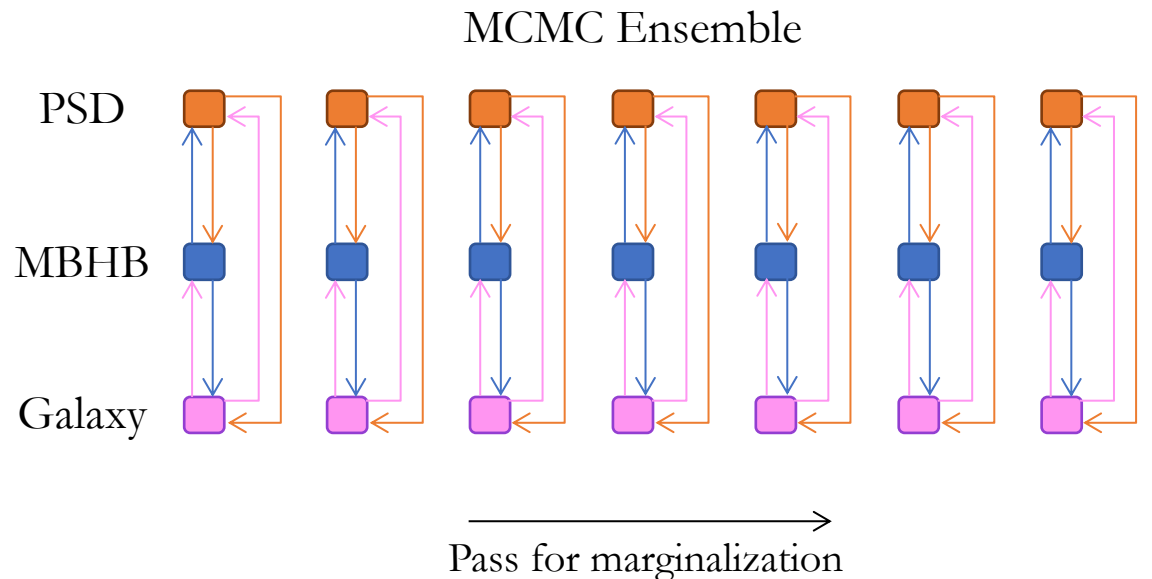
Multiple end functionality options

Increased efficiency using GPUs

- $\sim 70x$ improved **energy** efficiency for Galactic binary waveforms
- Specialized memory structures of GPUs (shared memory)
- Increasing computational power in future
- Small number of machines

Ensemble setup

- Greater parallelization capabilities
- Cross-walker information
- Batched marginalization
 - all cold chain information (all sources)
 - Number of walkers different residuals and/or PSDs

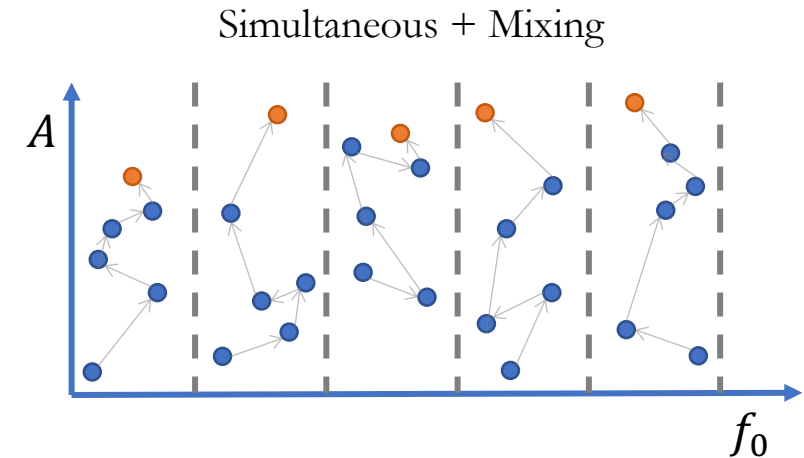
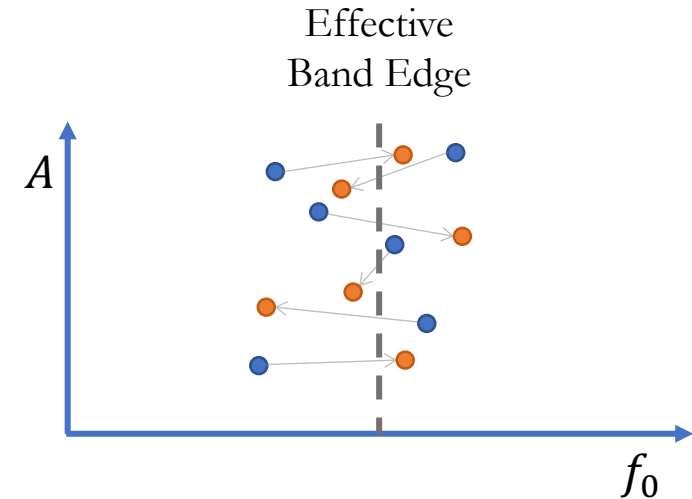


Cohesive singular band setup

- Minimize “band-edge” issues
- Utilize resources where needed
- Larger-scale RJ distributions

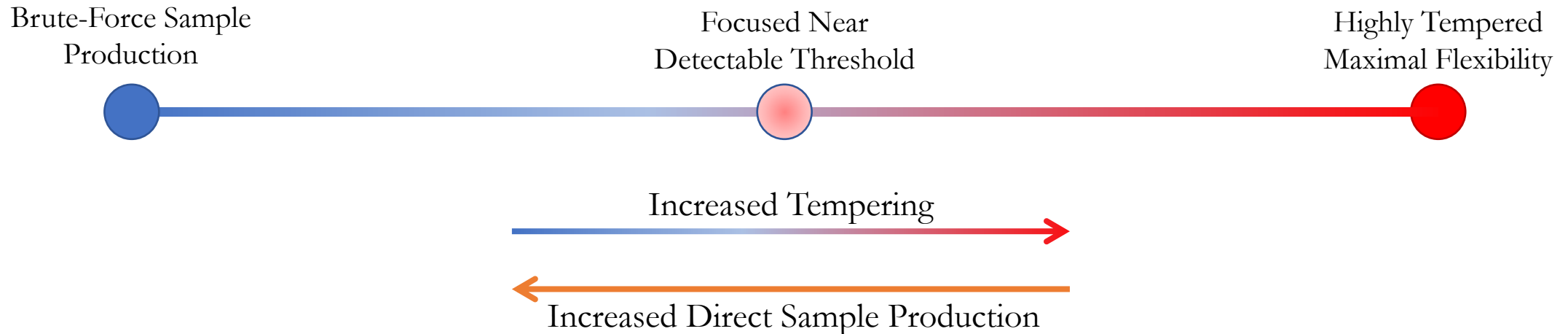
Search algorithm

- Large-scale batched MCMCs on GPU
- Mixing steps with GBs, MBHBs, PSD
- ~24-48 hours (preliminary)

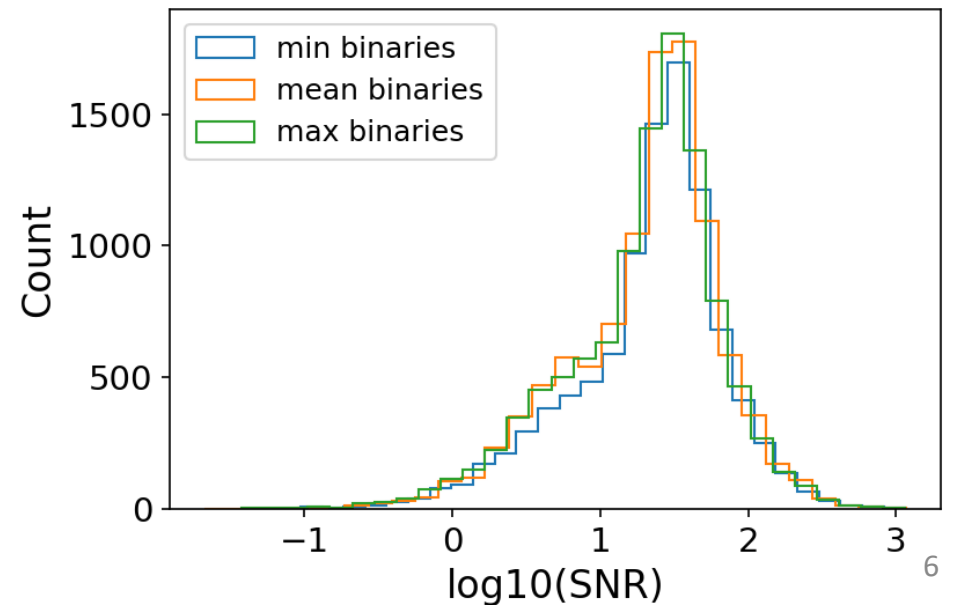
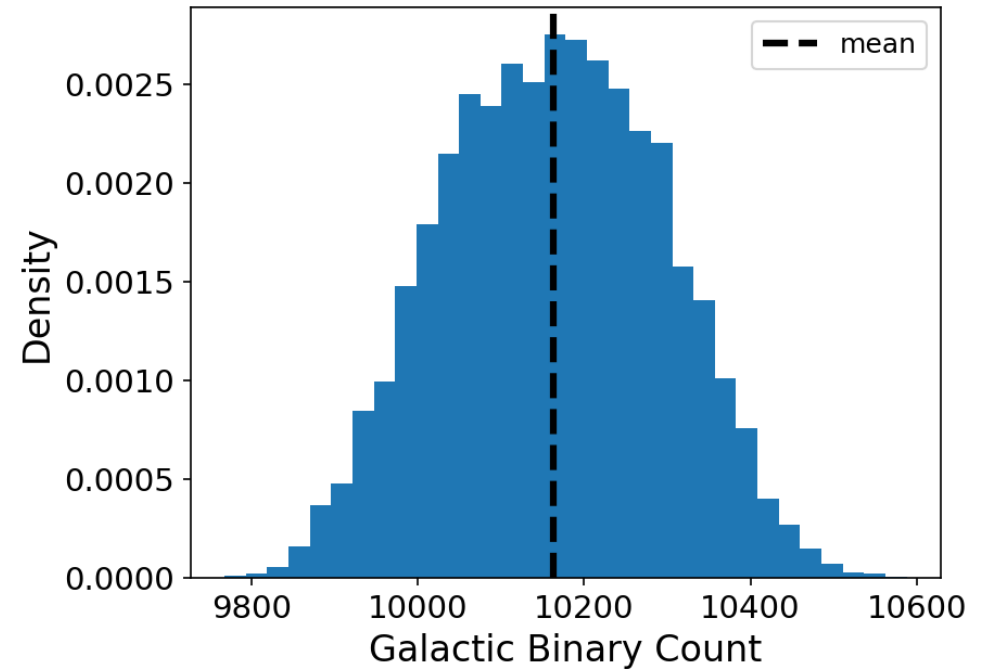
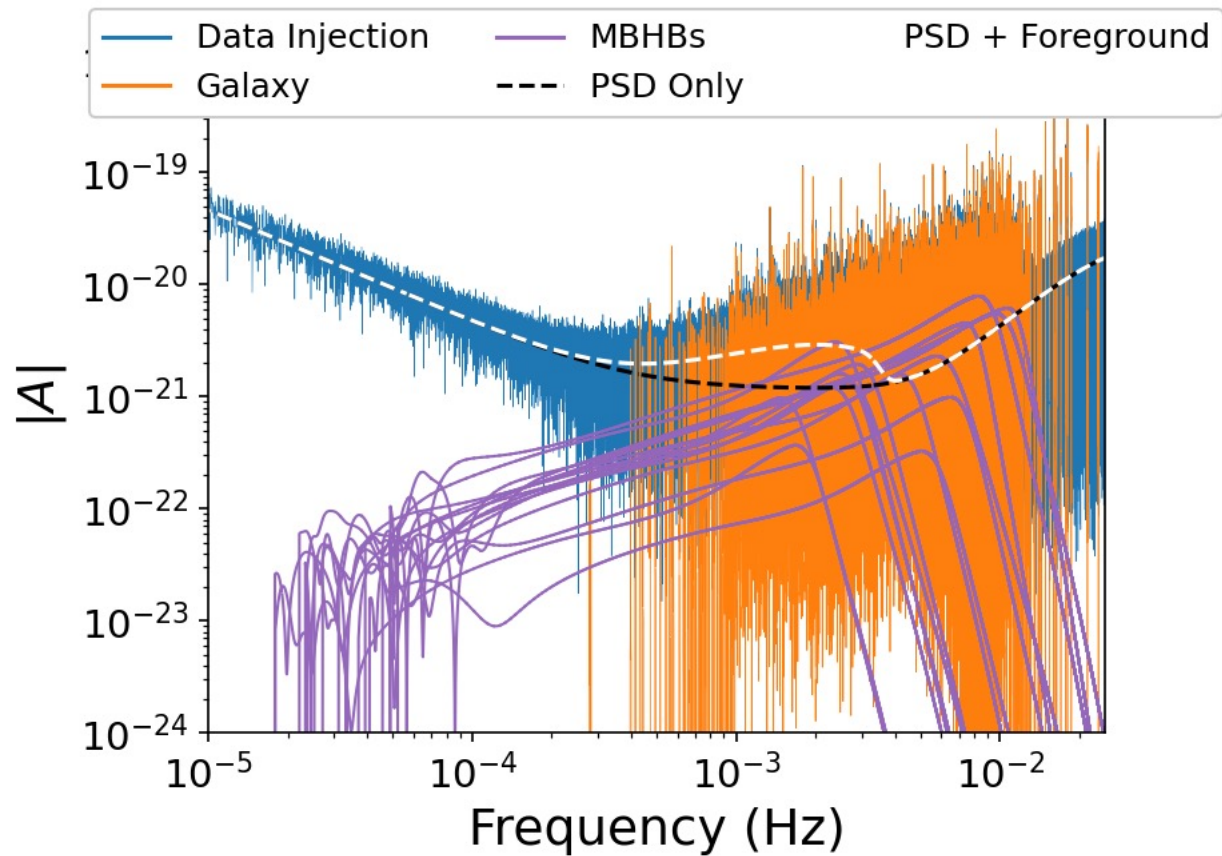


Multiple end functionality options

- Large-scale tempered RJMCMC (similar to Tyson+)
- No tempering brute-force evaluation
 - Efficient evolution of a search or previous sample
- Middle setup tempering over the low-signal sources
 - Focused marginalization over detectability threshold



Preliminary Results



Computation cost comparison

Algorithm Hardware	GPU (Katz+)	CPU (Littenberg+)
Number of Machines	3	1000
Hours for algorithm	~78	~120
Energy Consumption	93 kW hr	732 kW hr
Energy Cost (50 cents / kW hr)	€47	€366
Factor improvement	~8	

Future outlook/plan

- Wrap up initial algorithm/catalog/paper
- Compare against LDC injections and other solutions
- Documentation and Tutorials in LISA Analysis Tools (code package)
- Characterize full adjustability
- Improve efficiency
- Discuss with Tyson+ about merging