

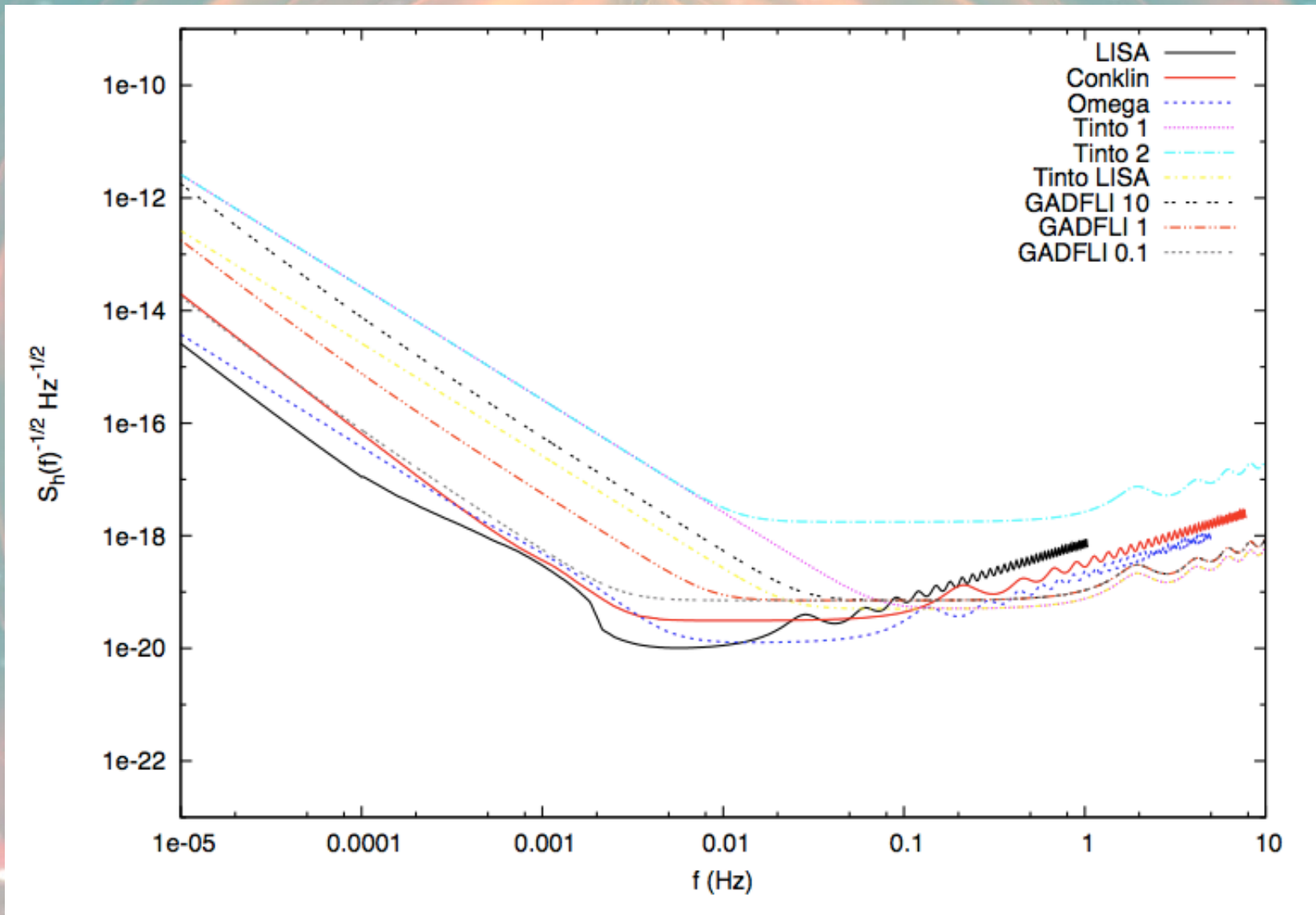
GADFLI

Sean T. McWilliams
stmckill@princeton.edu
Princeton University

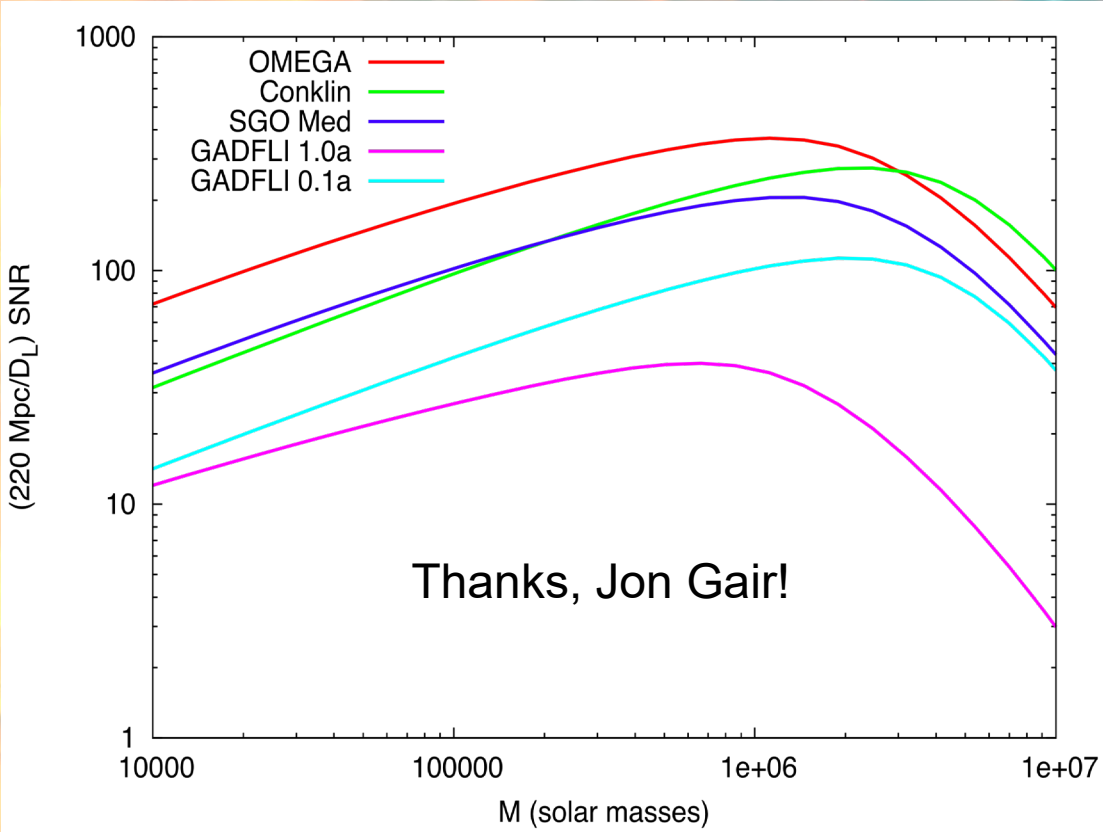
This Mission concept has also been conceived and proposed independently by Tinto et al.

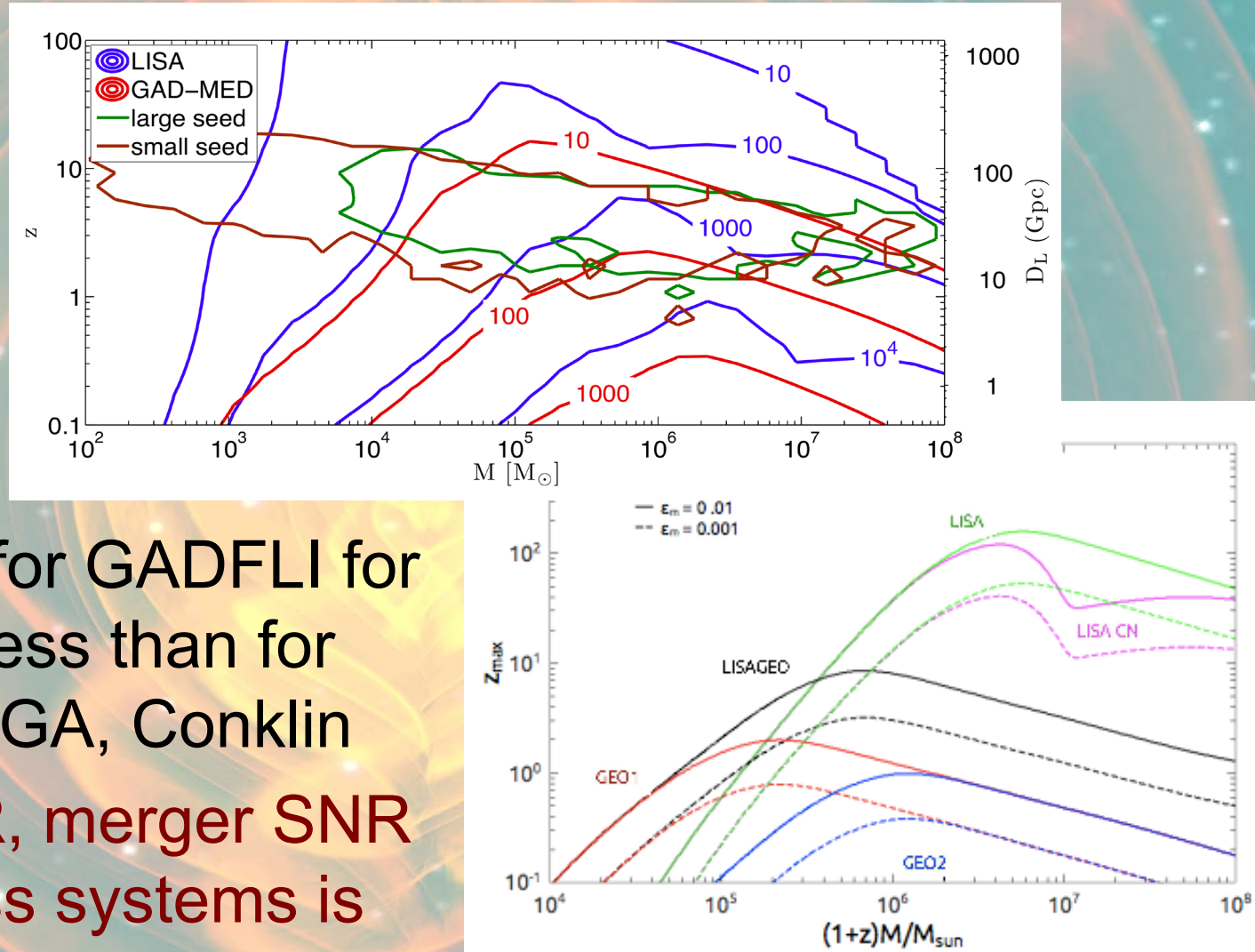
December 20, 2011

- Can we treat GADFLI and GEOGRAWI as one concept? **Yes, with a few small caveats.**
- Which GADFLI concept should we evaluate in the workshop? **GADFLI with standard LISA acceleration noise, i.e. GEO LISA from Tinto et al.**
- Strong feelings about a single spherical proof mass? **No.**
- Disposal? **Need adequate propulsion to control descent (i.e. let's crash in the ocean).**



- All designs should see EMRIs, modulo the extreme uncertainty of EMRI event rates.
- EMRI parameter estimation does generally obey $1/\text{SNR}$ expectations.





- Total SNR for GADFLI for MBHBs is less than for SGO, OMEGA, Conklin
- **HOWEVER**, merger SNR for low mass systems is largest for GADFLI

de Araujo, et al., arXiv:1112.1565

Waveform Model

- Use a parametrized model that correctly encodes parameter information
- Extrinsic parameters can easily be scaled/shifted, result is a VERY robust apples-to-apples comparison

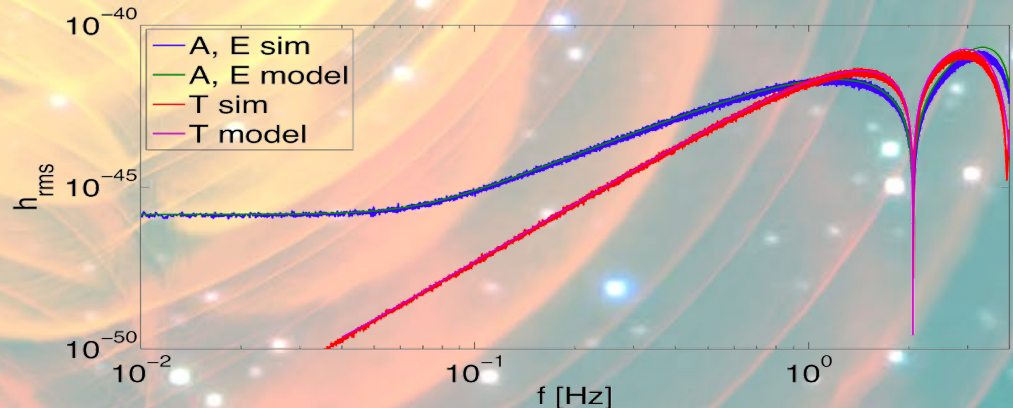
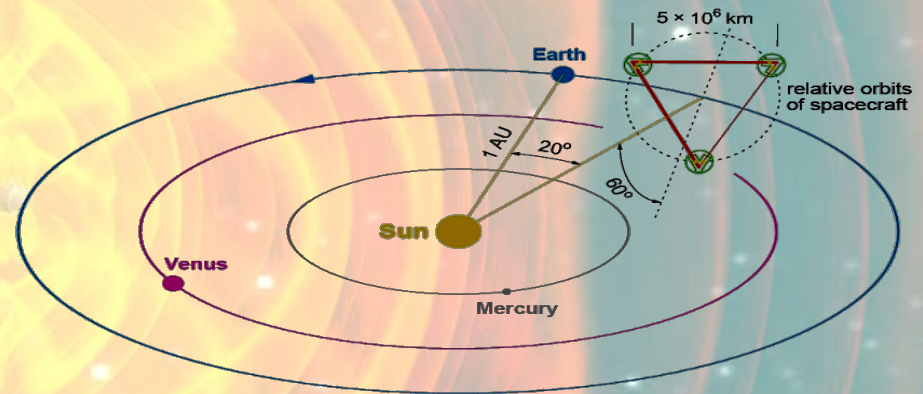
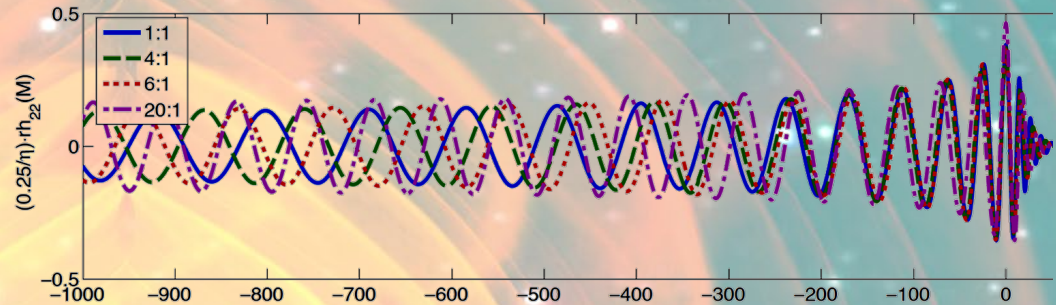
$$(1+z)M_{\text{tot}}, D_L, t_c, \varphi_{\text{orb}}, \theta_{\text{sky}}, \theta_{\text{sys}}$$

Instrument Modeling

- Realistic orbit model for SGO Med, OMEGA, Conklin, and GADFLI
- Instrumental noises from RFIs
- Full response function using Synthetic LISA (Vallisneri)

Calculating uncertainties

- Use the Fisher matrix formalism to estimate uncertainties



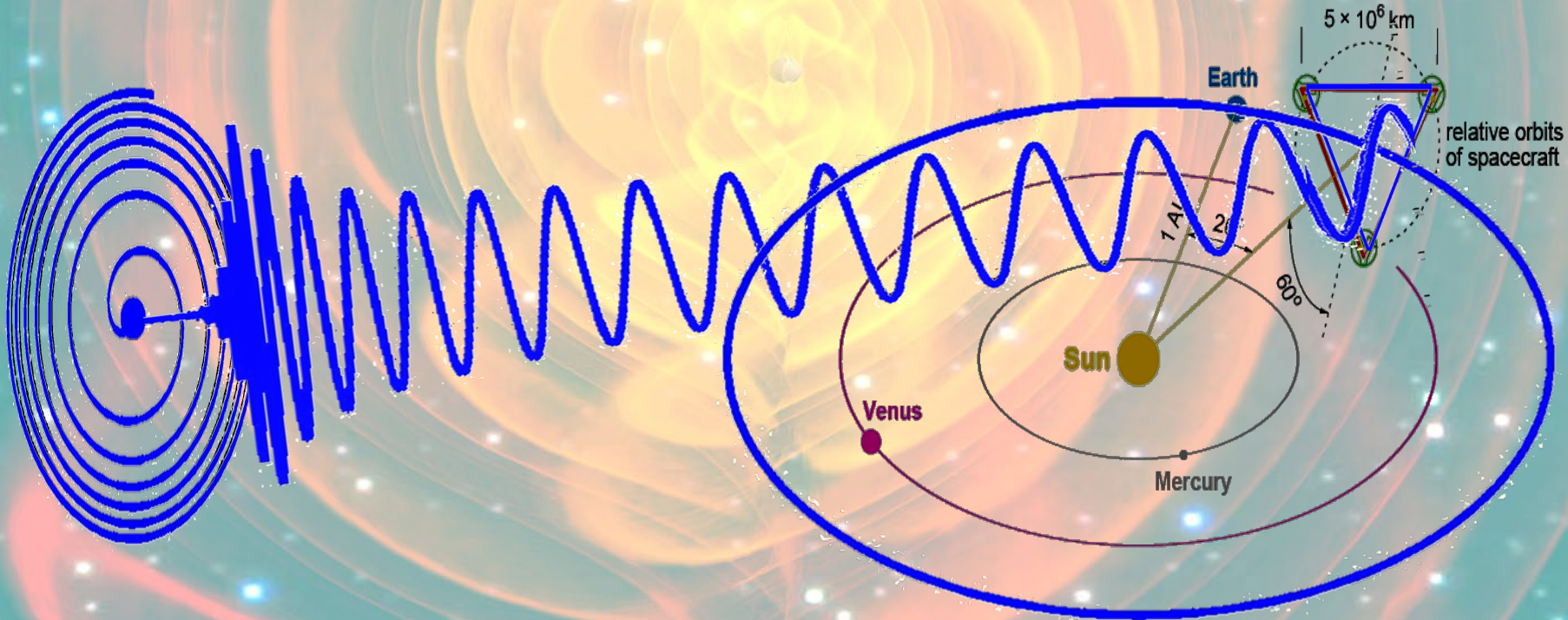


LISA

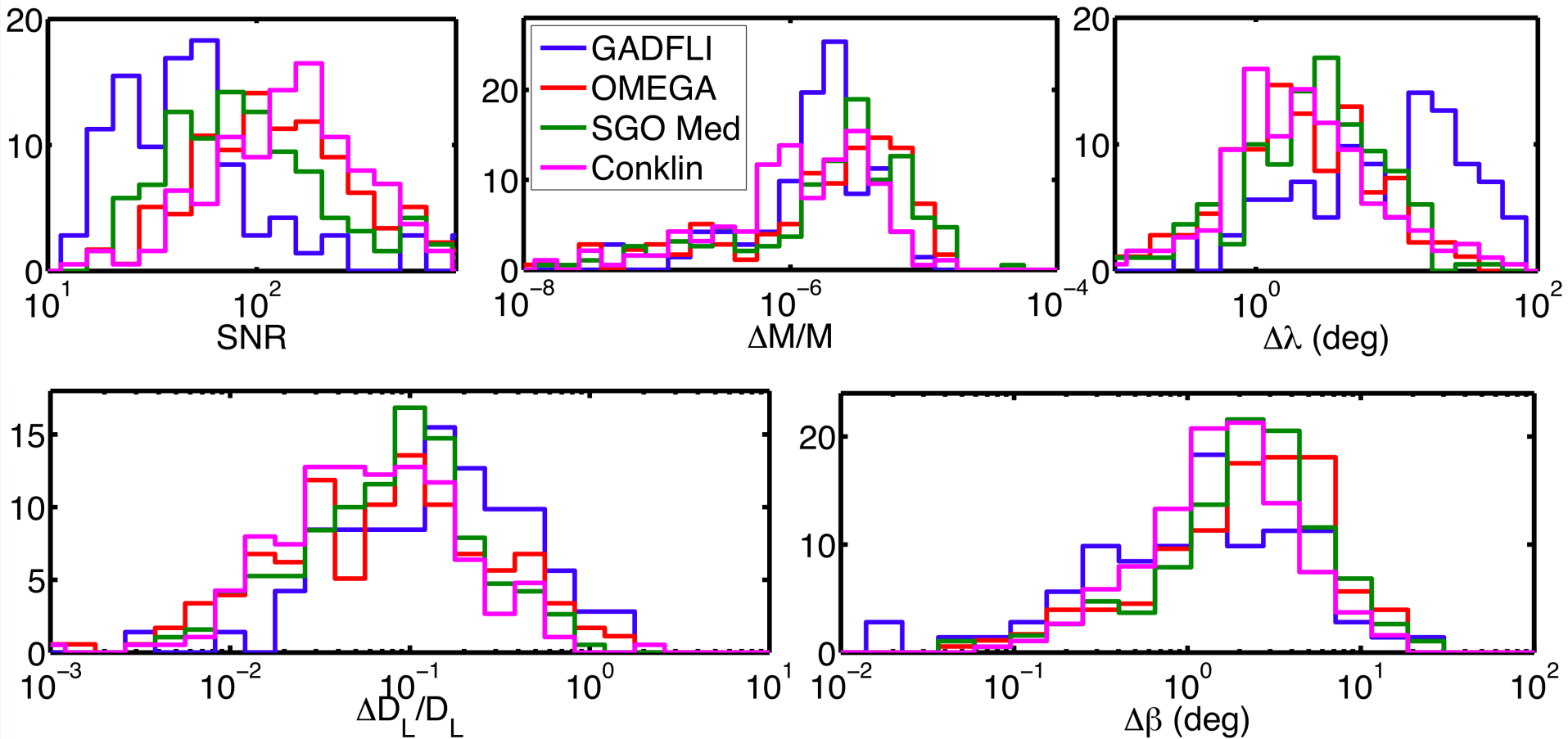
How does LISA measure parameters?



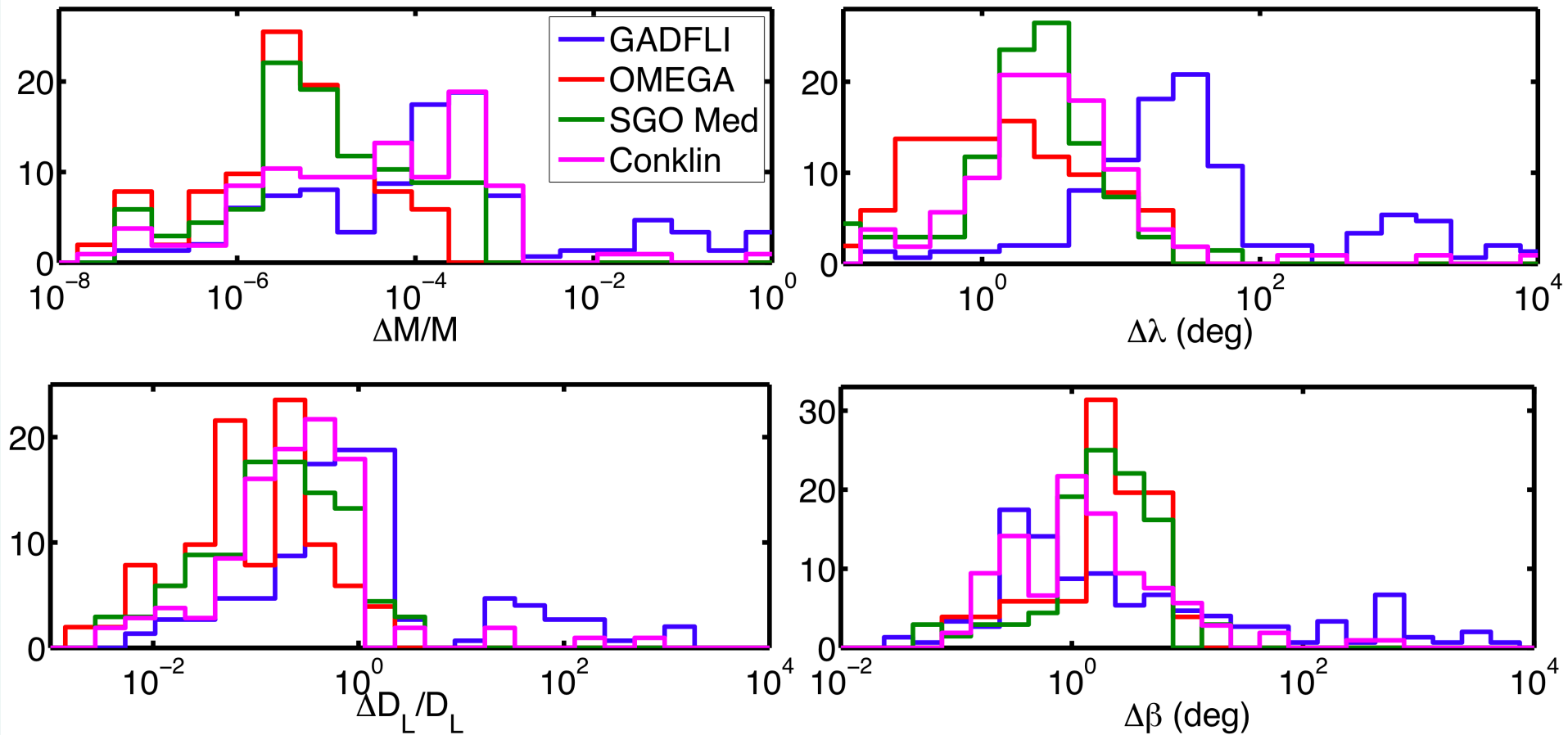
- Intrinsic parameter dependence of waveforms (for MBHBs, q , S_1 , S_2 , e)
- Independent waveform channels, with different frequency and spatial dependencies (aka TDI observables)
- Doppler modulation: annual (all) and shorter periods (geocentric)
- Frequency dependence of response function



- GADFLI makes up for lost SNR with diurnal modulation

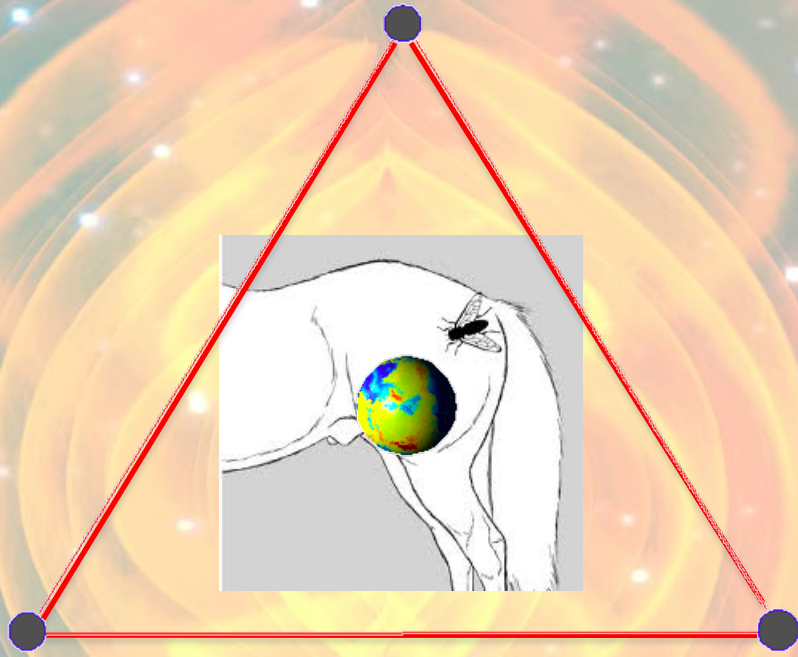


- GADFLI *partially* makes up for lost SNR with diurnal modulation
- Bimodal behavior driven by sky position – high latitude sources take a hit
- However, spin will likely break this degeneracy



- Given the goal of sending a variety of design options to Team X at different cost points, GADFLI best fills the niche of high performance at low cost.
- Since, among interferometric detectors, GADFLI has the lightest/smallest components on the smallest/most nearby orbits, it should be the cheapest possibility.
- There is good reason to believe GADFLI could *outperform* other designs for estimating MBHB source parameters when spin is included, due to its sensitivity at higher frequencies, and its daily orbital modulation of signals.

Geocentric and SGOs will outperform the drag-free designs by orders of magnitude in parameter estimation.		armlength (Mm)	telescope dia. (cm)	modulations /yr
	GADFLI	0.073	15	730
	OMEGA	1.04	30	7
	Conklin	0.67	20	6



GADFLI -- Geostationary Antenna for Disturbance-Free Laser Interferometry
Wikipedia defines a gadfly as “a person who upsets the status quo by posing upsetting or novel questions, or just being an irritant.” Hopefully this concept is the right balance of novel question and irritant.