

Preparing for LISA Data Analysis

Confronting Folklore w/ Forecasts

“The MLDCs demonstrated that LISA data analysis is a solved problem”

The MLDCs demonstrated that LISA data analysis is a **solvable** problem

- Improve latency (Data accumulation, EM alerts, delivery of data products)  
- Realistic data (gaps, glitches?, calibration?, time-varying noise, other sources of systematic error) 
- Should re-vamp MLDCs w/ Level 1,2, & 3-like data products  
 - Not “just a game.”
 - Teach the project how to handle data rate & volume, deliver products on time.
 - Teach “The Community” what to expect, get them thinking about GI program.

“BBH waveforms are solved, check out LIGO/Virgo’s discoveries!”

BBH waveforms are close enough for **some** Science Objectives

- LISA operates in *completely different SNR regime* than LIGO
- Systematic Errors from models \gg Statistical Errors from noise at SNRs $> \sim 100$
 - GW150914-like “whopper” for LISA is $M \sim 10^{7-8\text{ish}}$ at $z \sim 5-10\text{ish}$!
- LIGO \sim never sees such high SNRs — will not solve this problem for us!
- Not just a feature of *templates*. Accuracy of NR simulations themselves comes in to play. 
- For *detection & population* studies (mass/rate vs. redshift, spin dist., 3D position, etc.) no big deal?
 - Waveform error budget for each Science Objective needs study (true for GBs too)  
 - Could prove **urgent** if study finds need for surge in simulation/template development
- For *precision measurement* (i.e. “fundamental physics” questions), it’s a really big deal.
 - **But is it urgent?** Could be left to community-led archival studies (e.g. GI program)...



“If we ever want to see an EMRI we need some serious waveform development now.”

TRUTH!

“LISA launch is in the 2030s. Plenty of time.”

Development of data analysis capabilities is **urgent**.

- If we all went into a 15-year coma and woke up with hard drives full of LISA data we'd be in trouble.
- Food for thought from the LIGO experience:
 - LSC has 100s of people working on data analysis and have the advantage of:
 - *much* narrower scope
 - few source classes,
 - fewer sources,
 - comparably tiny parameter space (LIGO CBC spans ~2 orders of magnitude in mass, LISA SMBBH spans 7-8)
 - sophistication of analyses had/has the benefit of growing adiabatically with detector capability
 - initial LIGO reached design sensitivity **almost 12 years ago**...analysis is still a scramble
 - ...and *still a really* hard problem!
 - LISA project will never(?) be that large
 - LISA prep work has to all be done through simulation. No benefit of “rehearsal” observing runs. **We're already running late.**