SGWB at LISA

Some open questions

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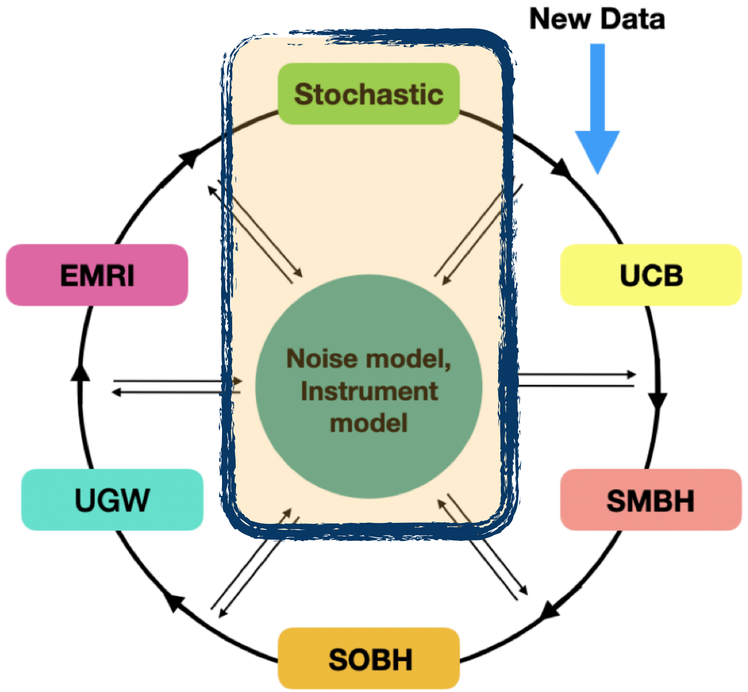
What’s in stochastic?



STOCHASTIC = INSTRU + ASTRO + COSMO + FIT RESIDUALS

Instrumental noise(s)

- **Content**: dominant noises (OMS and TM), other subdominant contributions?
- **Complexities**
  - Non-Gaussianities (unsubtracted glitches?)
  - Nonstationarities (orbits driven, temperature dependencies, regular re-calibrations, etc.)
- **Potential handles**
  - Previous knowledge (might yield priors or even templates?)
    - Auxiliary monitor channels (how much can they help? upper bounds?)
    - On-ground instrument characterization (upper bounds? confidence?)
  - Response functions (degeneracies? calibration errors?)
    - Multiple TDI channels (including cross correlations)
  - Smoothness in frequency and time (how smooth? risk of under or overfitting?)
- Should we perform sanity checks on, say, Gaussianity?

Astrophysical foreground(s)

Or astrophysical background(s), or confusion noise(s)

- **Content**: GBs, SOBBH, NSB, POPIII MHBHs, EMRIs…
- **Complexities**
  - Anisotropies (translating partly into nonstationarity in data streams)
  - Non-Gausiannities (popcorn, small number of sources)
  - Many models
- **Handles**
  - Some background have templates or priors (how reliable? do we capture everything?)
  - Anisotropy (Galaxy, partly known nonstationarities)
  - Response functions (degeneracies with noise, especially at low freq?)
- In the global fit, should it be an individual box?

Cosmological background(s)

- **Content**: phase transition, cosmic strings, primordial black holes, others…
- **Complexities**
  - Anisotropies (dipole from boost to CBM frame, yield nonstationarity)
  - Many models, some unmodeled (high flexibility needed?)
  - What if it is largely dominant?
- **Handles**
  - Some background have templates (how reliable?) or agnostic models (which ones?)
  - Upper bounds on the noise can yield upper bound on the signal?
  - Anisotropies (dipole, should we be look for more?)
  - Response functions (degeneracies with noise at low ?)
  - Smoothness in frequency and time (how smooth? risk of under or overfitting?)
- Should we include it in the global fit?

A few existing methods

- SGWBinner (arXiv:1906.09244)
  - Noise template (two or three types of noise)
  - Broken power law for signal
- Noise spline fit (e.g., arXiv:2307.00649)
  - Spline for noise (work in progress to relax some of the simplifying assumptions)
  - Signal simple templates
- Heavier tail distributions (based on arXiv:2305.04709)
  - Robustness against non-Gaussianities
- Gaussian processes for noise and/or signal
- Sky map (in progress)
  - Map anisotropies in the stochastic signal (currently no noise separation)
- The hope is to understand the powers and limitations, eventually combine (some of) them?

One possible setup