PCOS Meeting @ HEAD 2019

Guido Mueller
for the GWSIG

Gravitational Wave Science Interest Group (GWSIG):

Purpose:

- Track and analyze evolving science goals and requirements
- Support mission studies and concept development for future space-based gravitational wave observatories
- Aid efforts to analyze technology development and prioritization plans
- Advocate for the brand new field of gravitational wave astronomy, …, and promote the discovery space in this new field to the wider scientific community and to the public.

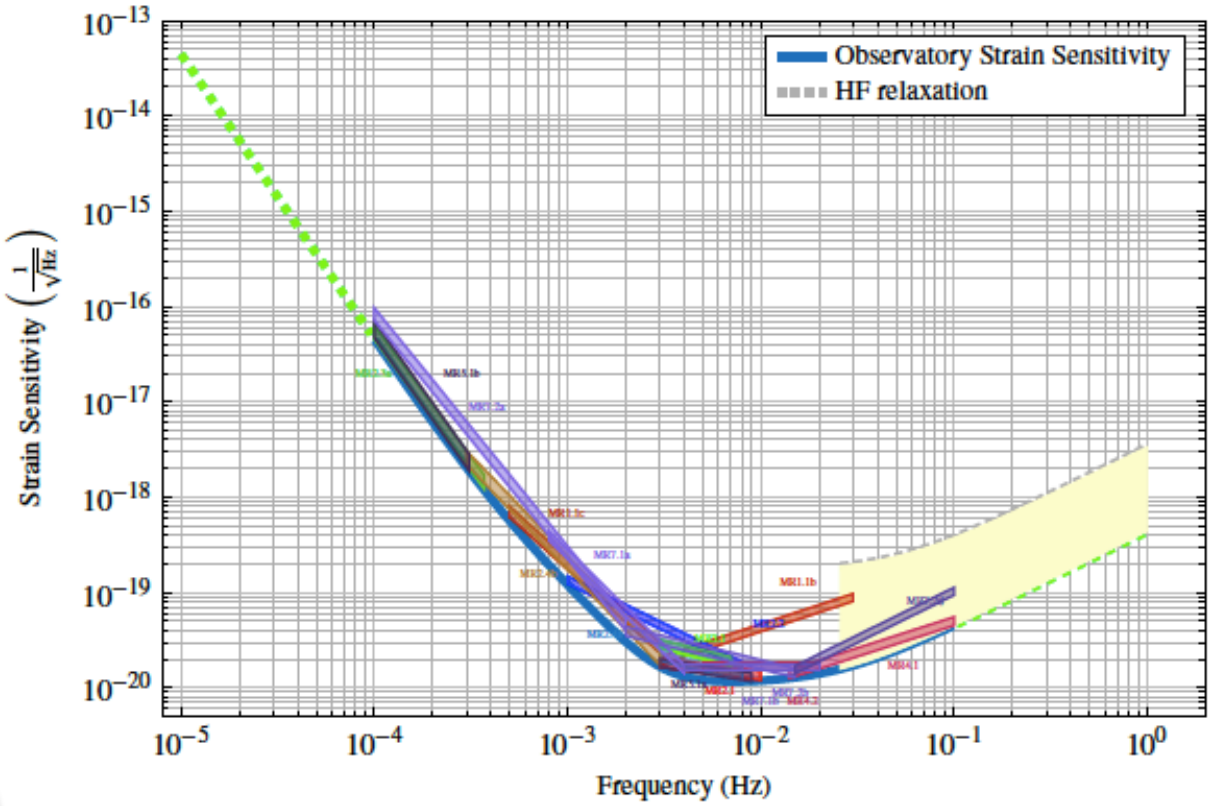
See: https://pcos.gsfc.nasa.gov/sigs/gwsig.php

Gravitational Wave Science Interest Group (GWSIG):

Science goals:

- ➡ **Provided input to: LISA Science Requirements Document**
  - **8 Science Objectives**
  - ➡ **Strain sensitivity**

GWSIG = Community → US-Rep. on ESA SST

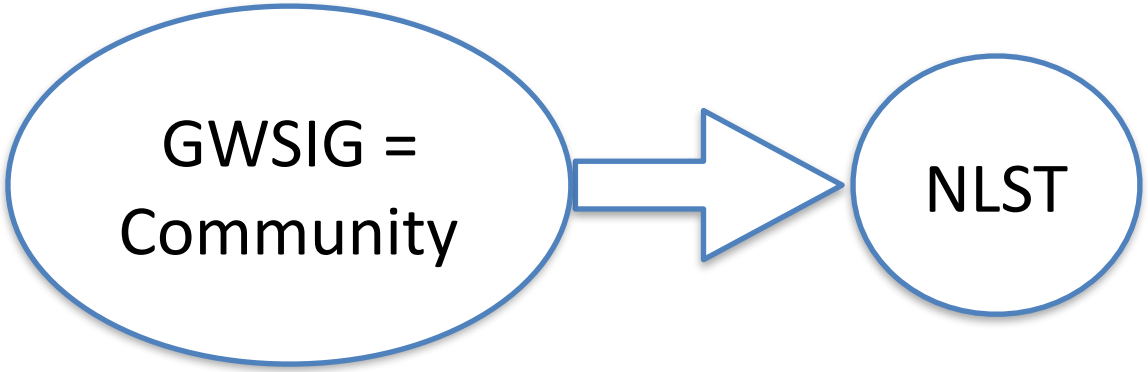


e 1: Blue solid line: Sky, inclination and polarisation-averaged constraints on the strain sensitivity of the ervatory, derived from the measurement requirements for each observational requirement (coloured lines). The green dotted lines above 0.1 Hz and below 0.1 mHz indicate *mission goals*. The grey dashed line indicates the envelope of the sensitivity at high frequency due to nulls in the observatory response arising from the choice of arm-length (see Section 2.4.2 for details).

Gravitational Wave Science Interest Group (GWSIG):

Science goals:

➡ **White papers from the community**



These white papers were developed by the US LISA-interested community to respond to the National Academies Astronomy and Astrophysics Decadal Survey.

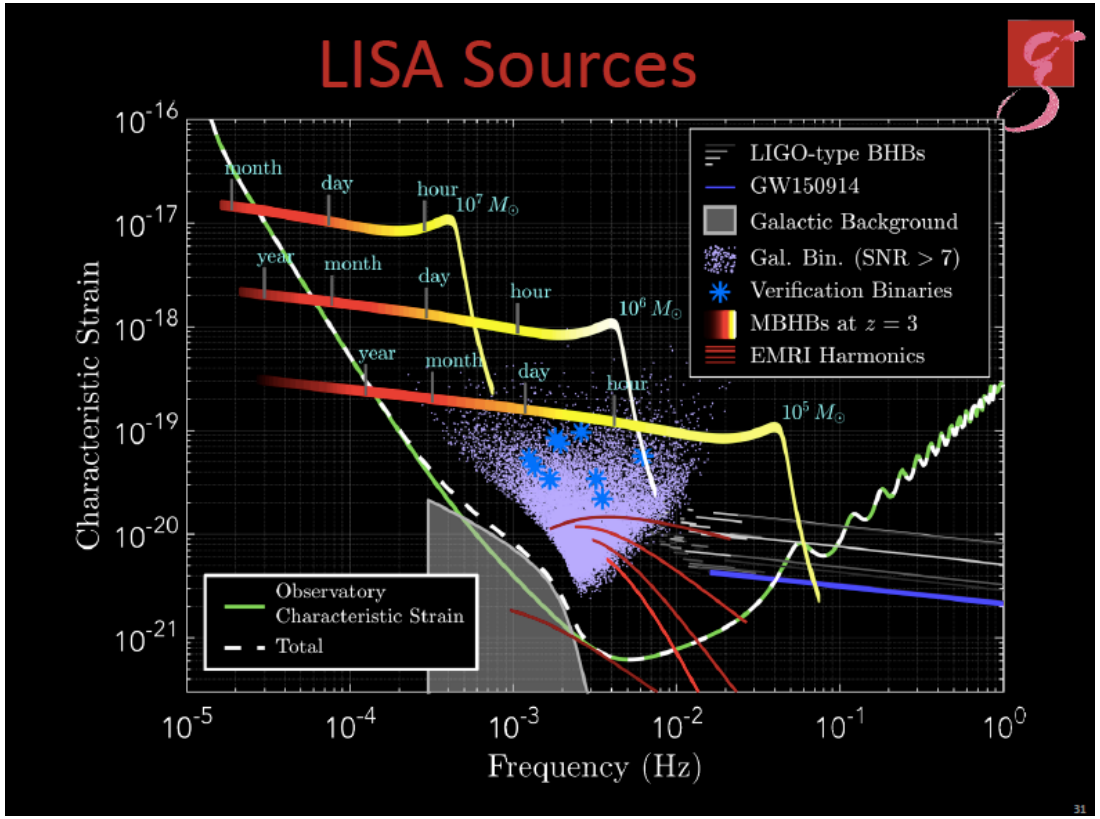
1. Tests of General Relativity and Fundamental Physics with Space-based Gravitational Wave Detectors
2. The Gravitational View of Massive Black Holes
3. Disentangling nature from nurture: tracing the origin of seed black holes
4. Where are the Intermediate Mass Black Holes?
5. Astro2020 Science White Paper: Cosmology with a Space-Based Gravitational Wave Observatory
6. GRAVITATIONAL WAVE SURVEY OF GALACTIC ULTRA COMPACT BINARIES
7. ASTRO2020 DECADAL SCIENCE WHITE PAPER: WHAT WE CAN LEARN FROM MULTI-BAND OBSERVATIONS OF BLACK HOLE BINARIES
8. Multimessenger science opportunities with mHz gravitational waves
9. The unique potential of extreme mass-ratio inspirals for gravitational-wave astronomy
10. The state of gravitational-wave astrophysics in 2020
11. The Discovery Potential of Space-Based Gravitational Wave Astronomy
12. An Arena for Multi-Messenger Astrophysics: Inspiral and Tidal Disruption of White Dwarfs by Massive Black Holes

Gravitational Wave Science Interest Group (GWSIG):

Purpose:

- **Support mission studies and …**

GWSIG = Community → NLST, ESST NASA, ESA, Consortium



Gravitational Wave Science Interest Group (GWSIG):

Purpose:

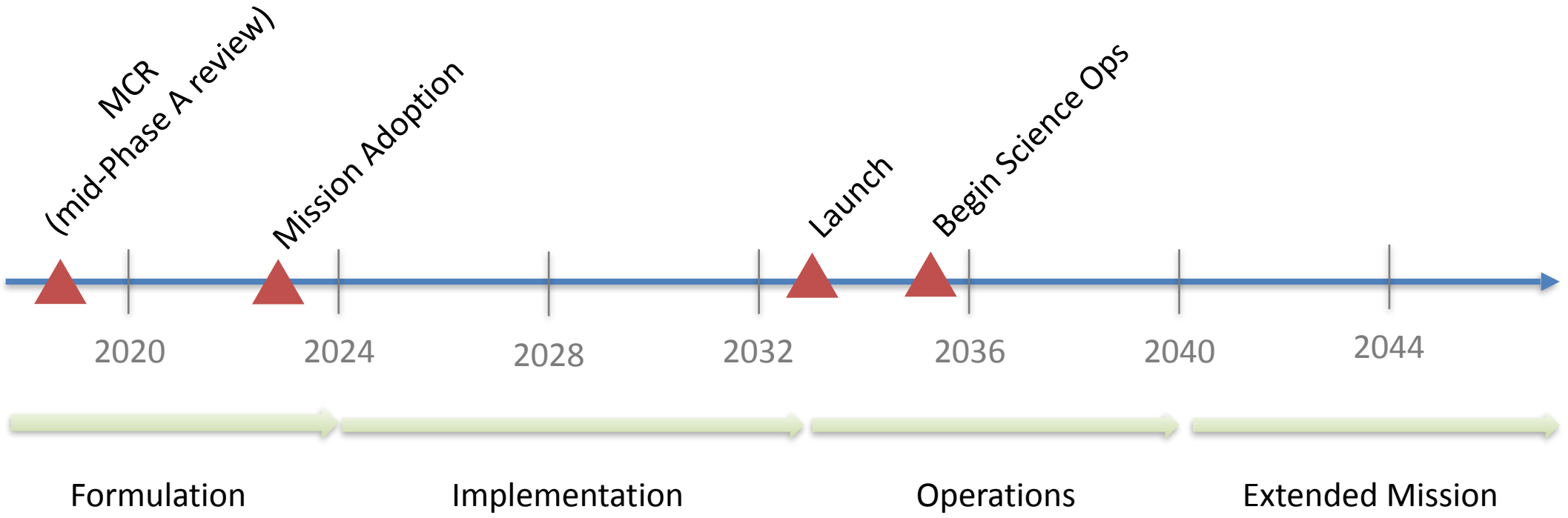
- Track and analyze evolving science goals and requirements
- Support mission studies and concept development for future space-based gravitational wave observatories
- **Aid efforts to analyze technology development and prioritization plans**
  - **LISA Study Office has taken over**
- **Advocate for the brand new field of gravitational wave astronomy, …, and promote the discovery space in this new field to the wider scientific community and to the public.**
  - **AAS, APS, HEAD - meetings, White Papers etc.**

LISA Project

Partnership

Party	Responsibility
ESA	• Mission Lead • Spacecraft • Launch Vehicle & Operations • some payload elements
LISA Consortium	• Payload and science lead • Funded by European National Agencies
NASA	• Key payload elements • Spacecraft contributions • Science and analysis support

Notional Schedule



LISA in the US (highlights)

- NASA Study Office (study scientist: Ira Thorpe @ GSFC)
  - "proto-project" hosted by Physics of the Cosmos Program
  - GSFC: management, science, and system engineering lead; telescope and laser development
  - JPL: science and systems engineering support; interferometry and micropropulsion development
  - MSFC: science support
  - UF: Charge management development and telescope metrology support
- NASA LISA Study Team
  - NASA-appointed volunteers (chair: Kelly Holley Bockelmann @ Vanderbilt)
  - Interface with Decadal Survey, provide input to HQ and Study Office
- LISA Preparatory Science Grants
  - Lay groundwork for LISA Science participation in the US
  - 10 grants funded

LISA and Astro2020

- LISA is part of “program of record”
  - Certain level of US participation in LISA is assumed
- Astro2020 specifically asked to consider upscopes (and descopes)
  - US has potential to do more
    - Increased science participation
    - Additional payload contributions
    - Additional spacecraft contributions
  - Benefits
    - Increased science
    - increased US technical insight
    - reduced mission risk

BACKUP

Gravitational Wave Science Interest Group (GWSIG):

Mission requirements:

➡ **Single link instrument requirements for LISA (L = 2.5 Gm)**

$$S_{\delta L}(f) \leq \frac{10\text{pm}}{\sqrt{\text{Hz}}}\sqrt{1+\left(\frac{2\text{mHz}}{f}\right)^4}$$

$$S_{\delta a}(f) \leq \frac{2.4\,\text{fm/s}^{-2}}{\sqrt{\text{Hz}}}\sqrt{1+\left(\frac{0.4\text{mHz}}{f}\right)^2}\sqrt{1+\left(\frac{f}{8\text{mHz}}\right)^4}$$

$$f = [0.1\,\text{mHz}, 0.1\,\text{Hz}]$$
$$(\text{Goal}\ [0.02\,\text{mHz}, 1\,\text{Hz}])$$