NASA LISA Study Team (NLST)

Update, Activities, & Decadal Preparations

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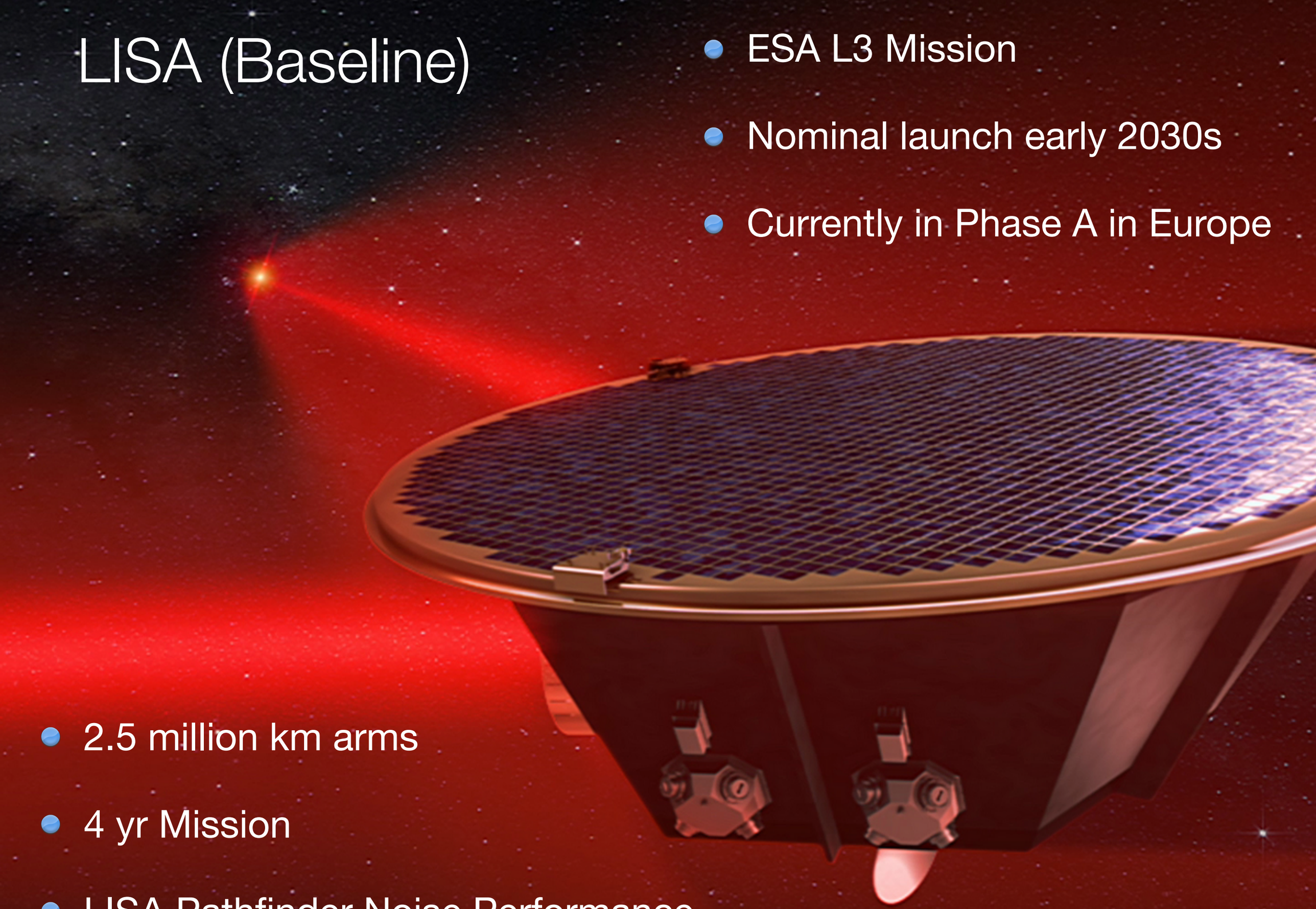
for the NASA LISA Study Team

Image: S. Barke (U. Florida)

LISA (Baseline)

- ESA L3 Mission
- Nominal launch early 2030s
- Currently in Phase A in Europe



- 2.5 million km arms
- 4 yr Mission
- LISA Pathfinder Noise Performance

NASA LISA Study Team

Kelly Holley-Bockelman (Chair)	Vanderbilt
Jillian Bellovary	CUNY-Queensborough
Peter Bender	U. Colorado
Emanuele Berti	Johns Hopkins
Warren Brown	Harvard-Smithsonian
Robert Caldwell	Dartmouth
Neil Cornish	Montana State
Mike Eracleous	Penn State
Craig Hogan	Fermilab
Brittany Kamai	Caltech
Joey Key	U. Washington-Bothell
Shane Larson	Northwestern
Sean McWilliams	West Virginia
Guido Mueller	U. Florida
Priyamvada Natarajan	Yale
David Shoemaker	MIT
Deirdre Shoemaker	Georgia Tech
Tuck Stebbins	U. Colorado

Established by NASA HQ to assist the U.S. community in preparing for Astro2020 and provide input to the Study Office and NASA HQ on the LISA mission. It consists of independent U.S. scientists with expertise in gravitational wave technologies, signal analysis, and astrophysics.

Ex Officio

Terri Brandt	NASA PCOS
Rita Sambruna	NASA HQ
Ira Thorpe	GSFC
Elizabeth Ferrara	U Maryland
Pal McNamara (ESA Observer)	ESTEC
Martin Hewittson (ESA Observer)	AEI-Hannover

US LISA Study Office

Ira Thorpe (Study Scientist)	GSFC
Norman Rioux (System Engineer)	GSFC
Sridhar Manthripragada (Study Manager)	GSFC
Elizabeth Ferrara (Exec. Secretary)	U. Maryland

Pre-project that coordinates U.S. participation in the LISA mission. Activities include participating in mission definition, developing technologies and data analysis infrastructure, and laying the groundwork for future participation in LISA by the U.S. science community.

Principle Core Team

John Baker	GSFC
Jordan Camp	GSFC
John Conklin	U. Florida
Curt Cutler	JPL
Ryan DeRosa	GSFC
William Klipstein	JPL
Tyson Littenberg	MSFC
Jeff Livas	GSFC
Kirk McKenzie	JPL
Michele Vallisneri	JPL
John Ziemer	JPL

LISA Consortium

The scientific community is organized in the LISA Consortium, more than 1000 scientists worldwide. The management structure has strong US representation, and are good points of contact for you if you are interested in the Consortium.

Executive Board	6 members
Karsten Danzamnn (Lead)	AEI
David Shoemaker (US Liason)	MIT

Consortium Board	23 members
Neil Cornish	Montana State
Kelly Holley-Bockelman	Vanderbilt
Shane Larson	Northwestern
Guido Mueller	U. Florida
David Shoemaker (US Liason)	MIT

Working Groups (Multiple Chairs for Each)

WORKING GROUP	US Co-Chairs
Astrophysics	Shane Larson (Northwestern)
Fundamental Physics	Nico Yunes (Montana State)
Cosmology	Robert Caldwell (Dartmouth)
Waveform Modeling	Deirdre Shoemaker (Georgia Tech)
LISA Data Challenges	Michele Vallisneri (JPL)
Advocacy/Outreach	Kelly Holley-Bockelman (Vanderbilt)
Measurement Science	Guido Mueller (U. Florida)

NLST Terms of Reference

- **Develop science case for US participation in LISA in the 2020 Decadal Survey**

- **Interface between US community and NASA about our role in LISA**

- **Communicate with the Consortium**

- **Support LISA Study Office by providing technical and scientific analysis: Science Support and Data Rights**

US Decadal Preparations

Top Priority: 2020 Decadal

- Develop science case for US participation in LISA in the 2020 Decadal Survey
- LISA is happening: articulate the most compelling science case for LISA from within the community
    - Science White papers
    - APC White papers -- Mission considerations, Workforce Development

Gravitational Wave Spectrum

BIG BANG WAVES

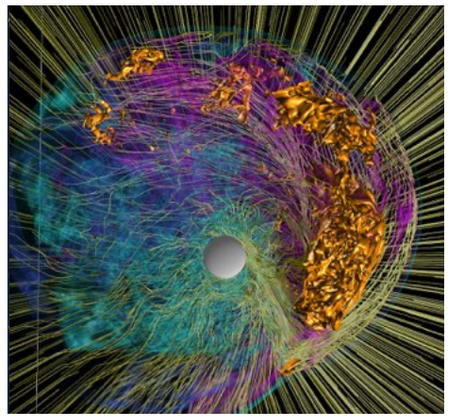
SUPERMASSIVE BH BINARIES

EXPLOSIONS

STARS + SMBH

BINARY MERGERS

COMPACT BINARIES



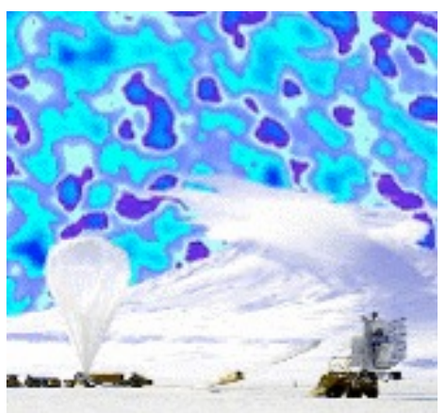
AGE OF THE COSMOS

YEARS HOURS SECONDS MILLISEC

PERIOD

FREQ

10^{-16} 10^{-12} 10^{-11} 10^{-10} 10^{-8} 10^{-6} 10^{-4} 10^{-2} 1 10^{2} HZ



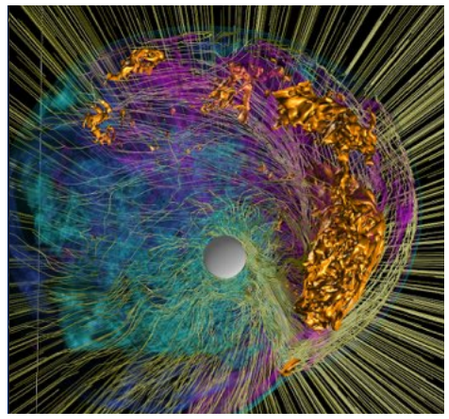
CMB

Pulsar Timing

Space

Ground

Gravitational Wave Spectrum



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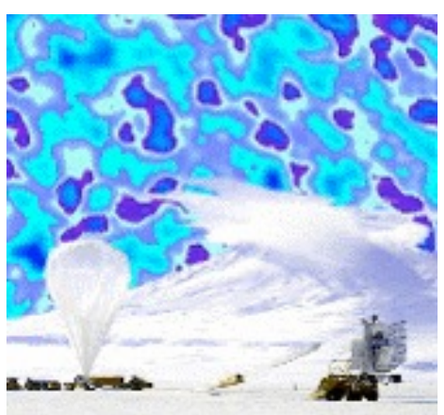

CMB

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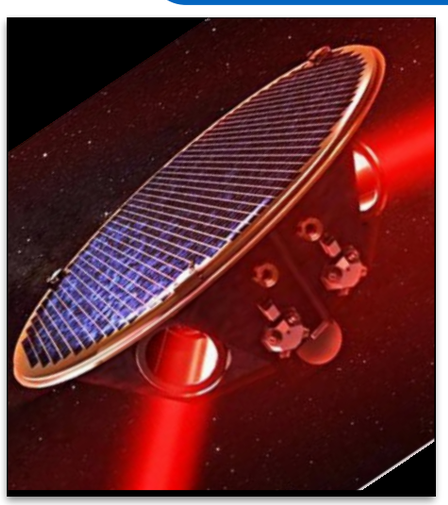


Space

Ground

Astro2020 White papers

Title	Authors
Gravitational wave survey of galactic ultra-compact binaries	Littenberg et al.
Cosmology with a space-based gravitational wave observatory	Caldwell et al.
The gravitational wave view of massive black holes	Colpi et al.
An arena for multi-messenger astrophysics: inspiral and tidal disruption of white dwarfs by massive black holes	Eracleous et al.
What can we learn from multi-band observations of black hole binaries	Cutler et al.
Multimessenger science opportunities with mHz gravitational waves	Baker et al.
Disentangling nature from nurture: tracing the origin of seed black holes	Natarajan et al.
The unique potential of extreme mass-ratio inspirals for gravitational wave astronomy	Berry et al.
The discovery potential of space-based gravitational wave astronomy	Cornish et al.
The state of gravitational wave astrophysics in 2020	McWilliams et al.
Tests of general relativity and fundamental physics with space-based gravitational wave detectors	Berti et al.
Where are the intermediate mass black holes?	Bellovary et al.

Beyond 2020 & White papers

- Coordinate with PCOS
  - Multi-messenger Science Analysis Group

- LISA Ambassadors Program
  - Science vignettes to illustrate LISA helps solve astrophysics problems

- Workshops for astro researchers
- Tools to help include LISA considerations in your work
    - LISA Data Challenges

LISA Observer Tool

https://heasarc.gsfc.nasa.gov/wsgi-scripts/lmmcdona/start.wsgi/

Lisa Observer Tool (dev v.1.3)

Source Parameters

Parameter suggestions for: Stellar Origin Binary

Intrinsic Mass of Object 1 (solar mass)	0.45	Intrinsic Mass of Object 2 (solar mass)	0.7
Luminosity Distance (Mpc)	0.0001	or Redshift	2.238e-8
Orbital Period (sec)	1000	or Separation Distance (km)	1.569e+5
Observation Time (years)	4.0		

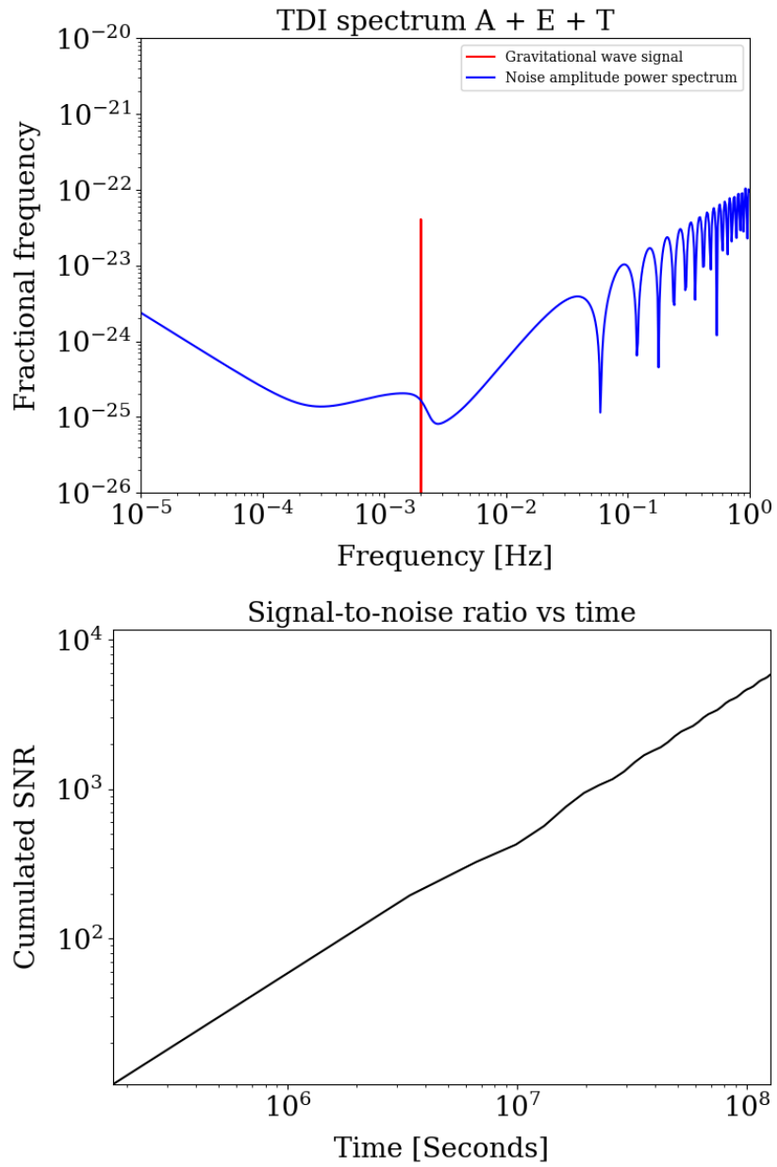
Sky Location and Orientation

Source Inclination Angle (deg)	0	Wave Polarization Angle (deg)	0

Location: ○ User Specified ◉ Favorable ○ Unfavorable

Ecliptic Coordinates	Longitude	0.0	Latitude	0.0

Reset | Submit



SNR = 2450.32737459 Longitude= 0. Latitude= 0.

Download Plotted Data

New Activity: Science Support Taskforce

- Determine what the US community needs, in terms of data access, capacity-building, infrastructure, user support + to maximize US participation in LISA science.

Heads up: Growing consensus that we need to be bold, innovative, proactive, and collaborative.

Our charge: identify the needs of the US community to engage in LISA science

- **Data requirements:** What information do observatories, surveys, and missions need to best conduct multi-messenger campaigns? What should be the priority for communication to maximize the science from individual sources? What type of data is needed by individual US scientists for participation in LISA Key Projects? What special considerations -- in terms of data access, reduction, or product -- could be placed to enable breakthrough science, and What is an ideal timeline of data access and updates as a function of science goal?

- **Capacity-building**: How do we best to foster discovery and broaden US participation in LISA science? What programs should be put in place to bridge astronomical and gravitational wave expertise, such as workshops, exchange programs, sabbaticals, fellowships, guest observer/archive programs? And How do we engage and grow the cohort of exceptional LISA talent in the US?

- **US LISA Science Center**: What special roles should a US LISA Science Center provide that is complementary to what is planned in the LISA Consortium? What would that entail in terms of redundancy, cross-checking, data reduction, storage, software, hardware, physical space, deliverables, skills and expertise of the staff, etc? How should the Science Center relate to the Project Office?

- **US Infrastructure:** What kind of infrastructure is needed to support the US role in analysis and science exploitation? Do these needs extend beyond the US contributions to the LISA Consortium analysis infrastructure? What physical infrastructure and management models might best enable a successful science product?

Study Team Purpose

Our agenda is simple:

We think LISA is awesome, and we want you to think that too.
We think the LISA science is awesome, and we want you to think that too.

Think about what your science would gain from LISA data input.

Are you thinking about something we should be aware of and include in our aspirations for LISA science?

GW science is still in its early days, and we are still learning!

How do you want LISA to be able to help you understand your science?

Thank you!