Funding for LISA

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In the coming decade, one exciting new project that everyone should keep their eye on is the Laser Interferometer Space Antenna (LISA). This ESA/NASA collaboration will be the culmination of over half a century of research, planning, and development that will take our understanding of the universe to the next level. Like all projects, the LISA mission will rely heavily on funding to be successfully executed. This paper will discuss potential reasons to stop funding this mission and weigh it against the potential gains. I intend to bring to light the need for continued funding.

LISA is a gravitational wave detector due to launch in 2037. The mission will consist of three separate spacecraft positioned 2.5 million KM away from each other in an equilateral triangle. The instruments will be capable of detecting neutron star and black hole mergers before they happen, giving optical telescopes time to observe the event in real-time. Also, this observatory will help refine the Hubble constant even further by giving the most accurate distance measurements ever recorded. Gravitational waves will be detectable from our universe's earliest moments, allowing us to have a clearer view of its evolution.

One argument against the funding of LISA is the numerous observatories already searching for and researching gravitational waves. There are currently ten ground-based gravitational wave detectors on earth. A legitimate question is, why do we need more?

We need only to look to our past to see the reason. For 300 years humanity stared at the stars using rudimentary telescopes, restricted in our viewing by our atmosphere and pull of gravity on our massive equipment. Upon the launch of the first space observatories, the universe began to reveal its secrets exponentially.

Just as the first optical telescopes were prevented from reaching their full potential here on Earth, gravitational wave detectors also have their limitations. Not only does gravity affect our measurements, Earth itself is also constantly moving due to plate tectonics. The most precise measurements require a gravity-free environment with a huge, unobstructed distance between the individual detectors. This scale and environment cannot be replicated on Earth.

The ground-based gravitational wave detectors and LISA will work hand in hand. They will have a “detection/confirmation” relationship. LISA will first detect the imminent astronomical event, the ground-based detectors will then see the event as it unfolds. This is because LISA will observe gravitational waves in a different frequency band than the detectors here on Earth.

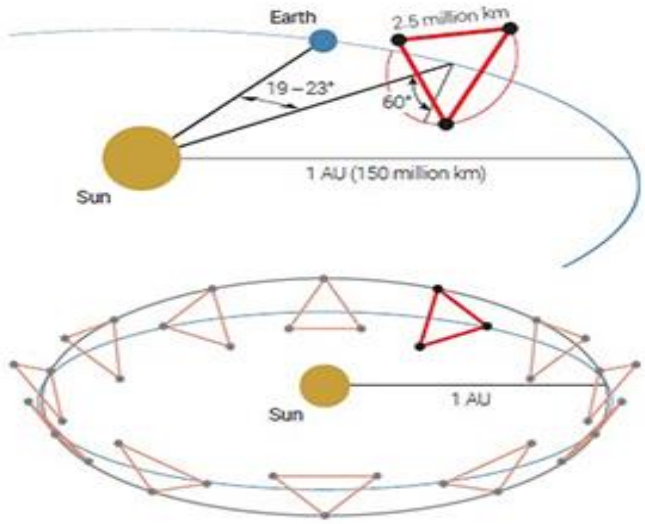

Figure 1. *The three LISA spacecraft in orbit around the Sun.*

In **Figure 1**, you will see a general configuration of the LISA detectors as it follows the Earth’s path around the Sun. The equipment will be in perpetual free fall, unhindered by the gravity of earth. The result will be the most accurate observations ever collected.

With an initial $2 billion budget, one would be remiss if they didn’t confirm that the technology was sound, and the scientific advancement is proven to be worth the price.

In 2015, ESA launched a pilot mission, “LISA Pathfinder”. This proof of concept concludes that the technology planned in the LISA mission is effective and reliable. The equipment exceeds the requirements needed for successful implementation. €400 million has already been spent on this pathfinder mission and it serves as an initial investment towards the successful deployment of LISA in 2037.

To ease concerns even more, the total cost of this mission will not fall solely on a single organization. The plan is for both ESA and NASA to share the cost equally, this will bring the cost down to $1 billion for each agency.

LISA is to be one of the greatest and most ambitious space observatories constructed, the price tag is only an indication of the sophistication and magnitude of the project. With a 50% reduction of cost for each space agency, the mission is an *opportunity* that cannot be passed up.

In comparison to other space observatories, you will note that its budget is comparable to most missions NASA has funded in the past. As you can see in **Figure 2**, LISA’s budget is surpassed by the Chandra X-ray Observatory, the

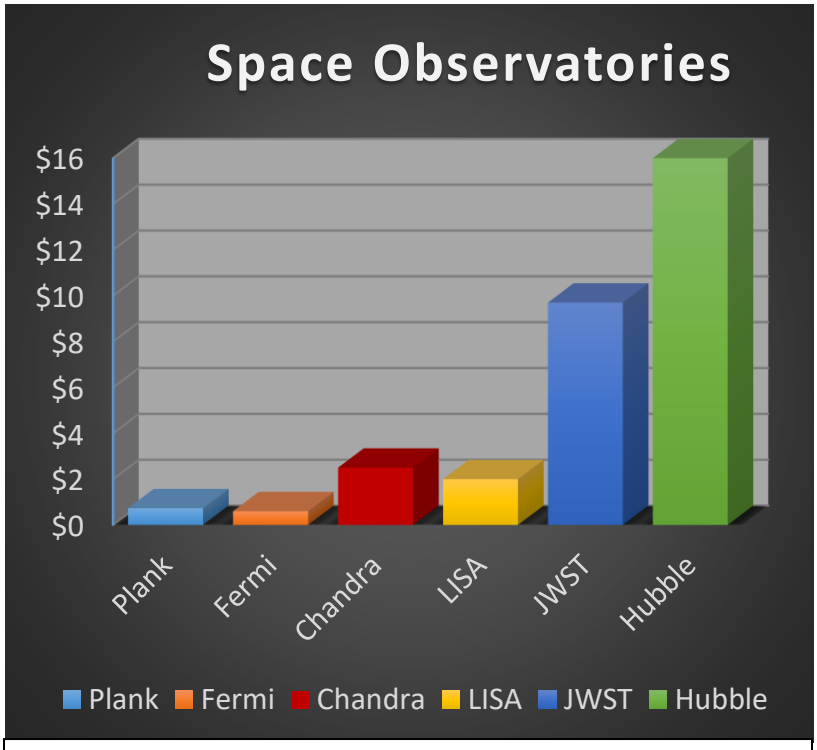

Figure 2. *Cost of Space Observatories in Billions of Dollars*

JWST, and dwarfed by the total operating cost of the Hubble Space Telescope.

In summary, LISA will revolutionize the way we view our universe. This space observatory will not replace but complement our ground-based gravitational wave detectors. The project's proposed cost is a small price to pay to improve the newest form of space observation. This will be a new window into the universe, its potential is vast and is the most logical next step forward in astronomic observational techniques. Funding must continue.

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