Contribution ID: **202** Type: **Poster**

Exploring Higher-Order Modes in Gravitational Wave Astronomy: Insights from LISA

The Laser Interferometer Space Antenna (LISA) is a groundbreaking gravitational wave astronomy project that aims to uncover the secrets of the universe by detecting low-frequency gravitational waves. While LISA's primary focus is on studying massive black hole mergers, its capability to explore higher-order modes (HOMs) opens new frontiers in astrophysics. This abstract investigates the collaborative synergy between LISA's detection expectations, numerical relativity simulations, and advanced visualization techniques, shedding light on the complex dynamics of HOMs.

LISA's sensitivity to lower frequencies enables it to detect subtle signatures of asymmetries in astrophysical sources such as black hole binaries. Leveraging simulations, we delve into the theoretical foundations of HOMs, illuminating expected gravitational wave signals.

Our Python-based Visualization toolkit is critical for analyzing numerical relativity-generated gravitational wave data. These visualisations effectively capture the spatial and temporal complexities of higher-order modes, improving qualitative understanding and facilitating the widespread dissemination of scientific findings.

This study aims to improve our understanding of higher-order modes in gravitational waves and their profound implications for astrophysics and fundamental physics by taking a multidisciplinary approach. This abstract highlights LISA's transformative potential, paving the way for groundbreaking insights into the universe.

Track type

Gravitational waves

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Session Classification: Poster Session