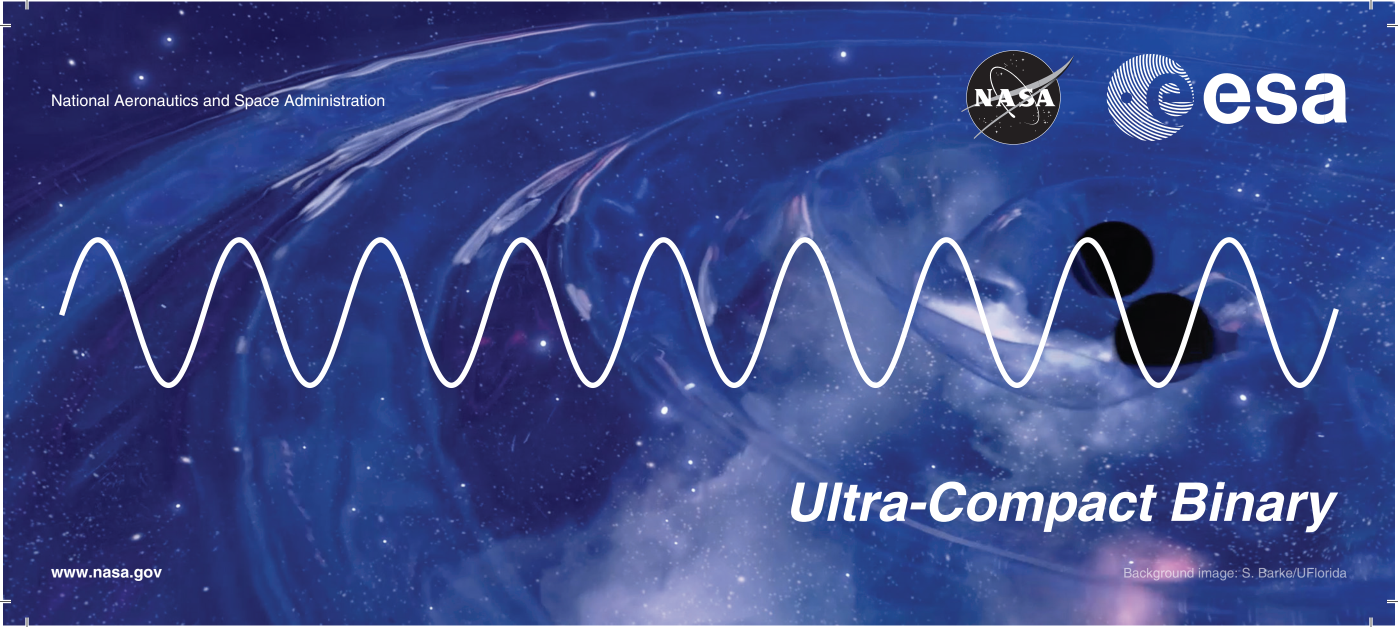
National Aeronautics and Space Administration



Ultra-Compact Binary

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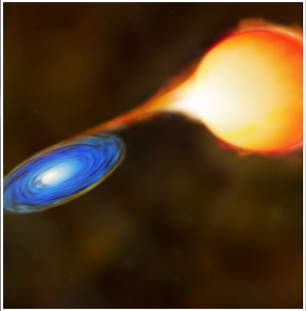
Background image: S. Barke/UFlorida



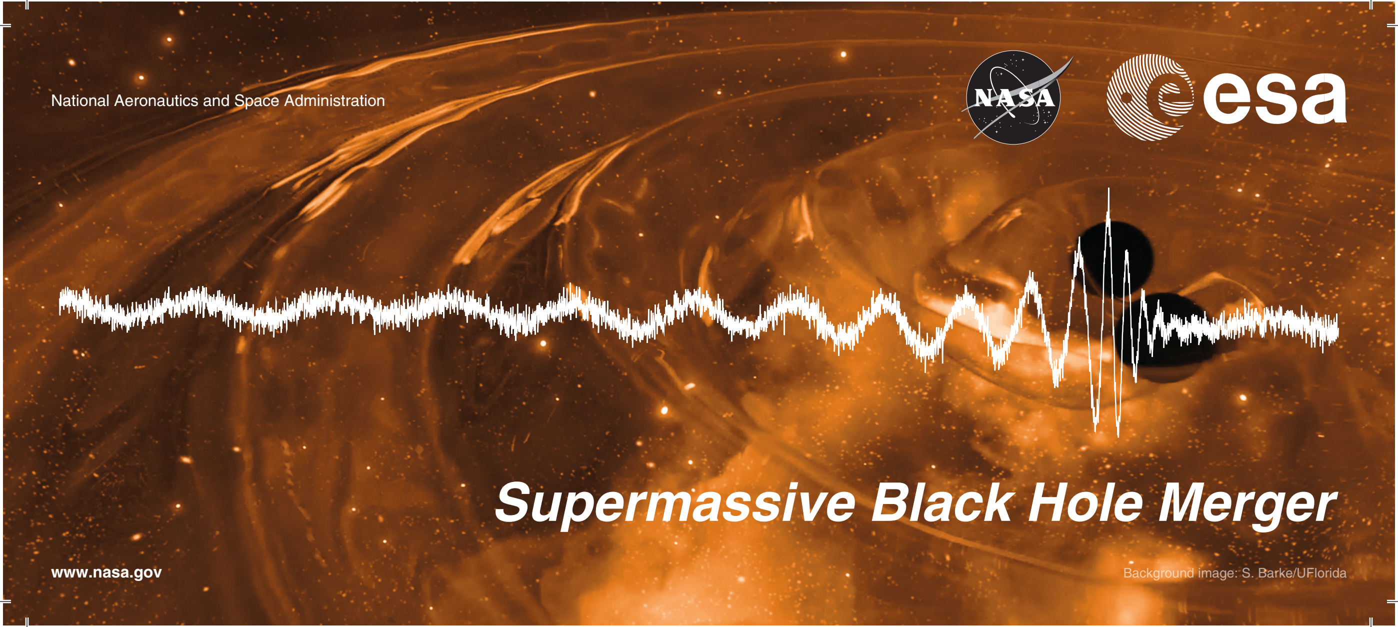
NASA is partnering with ESA on a space-based gravitational-wave (GW) observatory. Rather than producing an *image* or *spectrum* by detecting electromagnetic radiation, a GW observatory produces a *waveform* by detecting the change in displacement of widely separated test masses to measure the ripples in space-time caused by gravitational radiation emission, revealing source properties otherwise unobtainable. A GW observatory will measure signals from a wide range of previously invisible sources, revolutionizing astronomy and leading to a deeper understanding of the universe.

Ultra-Compact Binaries

Our galaxy contains ~50 million UCBs comprised of white dwarfs, neutron stars and black holes. These generally evolve slowly, with nearly circular orbits. This population contains a fossil record of stellar evolution, including cataclysmic variables and supernovae Ia progenitors.

NP-2017-12-536-GSFC

For more information, visit: elisascience.org and pcos.gsfc.nasa.gov/studies/L3/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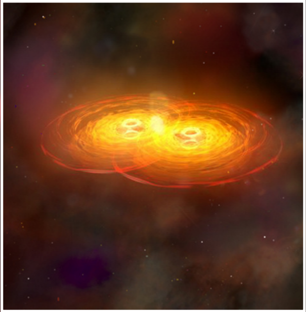

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Supermassive Black Hole Mergers

Supermassive black holes (SMBHs) inhabit the centers of galaxies. Understanding the mechanisms of SMBH growth is an enduring problem in astrophysics. Some models suggest that they grow via galaxy mergers. Merging supermassive black holes will be strong gravitational wave sources, and allow testing of these models.

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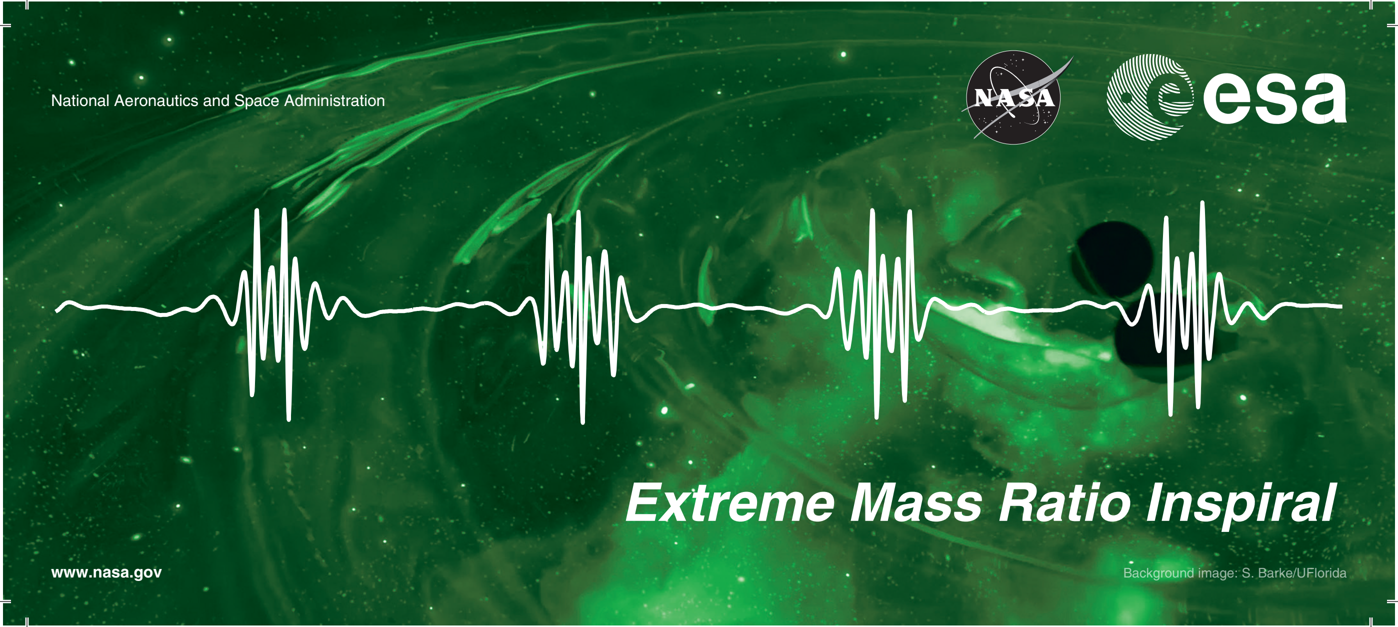
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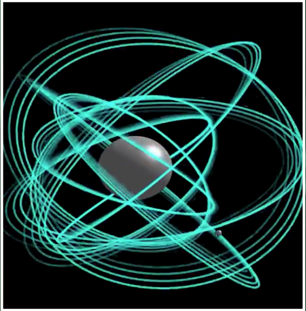

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Extreme Mass Ratio Inspirals

EMRIs describe the capture and inspiral of compact stellar remnants into the massive black holes at the centers of galaxies. The years-long inspiral generates gravitational waves that encode the properties of the black hole. The orbits are eccentric and exhibit “zoom-whirl” behavior.

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Eccentric Binary

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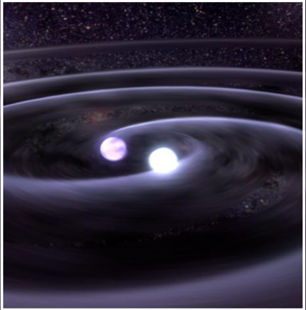

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Eccentric Binaries

The shape of a gravitational waveform captures the shape of the orbit in a binary. Many binaries are formed and evolve through dynamical processes that constantly change the shape and size of the orbit. Detecting the gravitational waves from these binaries can tell us something about their shape, and their evolutionary history.

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