Multi-messenger Astronomy with LISA and Athena

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The science cases of both LISA and Athena are outstanding, leading to the missions being selected as the 2nd and 3rd Large class (flagship) missions of the European Space Agency's Cosmic Vision Programme. Both missions will observe the most energetic and extreme objects in the universe; the supermassive black holes theorised to be powering the Active Galactic Nuclei (AGN) and to be, when in a binary system, the loudest sources of low-frequency gravitational waves in the Universe. Athena is a large area X-ray telescope, and can detect the emission from hot gas around the massive black holes during a merger, whereas LISA will detect the gravitational waves emitted during the inspiral, merger and ringdown.

The additional science that the concurrent operation of the two missions could achieve may provide breakthroughs in scientific areas beyond what each individual missions is designed for. The additional science encompasses a series of fundamental questions in modern physics and astrophysics, such as: the dynamics of fluid particles in time varying, strong gravity environments; the onset of nuclear activity in the core of galaxies hosting massive black holes; the physical origin of relativistic jets around spinning black holes, and their launch and interaction with the galactic environment; the cosmic distance scale; and the measurement of the speed of gravity.

This presentation will describe the additional science achievable with multi-messenger observations specifically from the concurrent operation of LISA and Athena; namely the merger of supermassive black holes (M_{tot} ~$10^6 M_\odot$) out to redshift, $z < 2$. In addition to the science, the presentation will also focus on the operational constraints imposed by both missions, for example, the sky localisation capabilities of LISA, coupled with the field-of-view of the Wide Field Imager (WFI) of Athena.