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High-energy radiation from thunderstorms and lightning with the Large Observatory for x-ray Timing (LOFT) mission

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We explore the possible contributions of the Large Observatory for X-ray Timing (LOFT) mission to the study of high-energy radiation from thunderstorms and lightning. LOFT is a mission dedicated to X-ray timing studies of astrophysical sources, characterised by a very large effective area of about 8.5 square meters at 8 keV. Although the main scientific target of the mission is the fundamental physics of matter under extreme conditions, the peculiar instrument concept allows significant contributions to a wide range of other science topics, including the cross-disciplinary field of high-energy atmospheric physics, at the crossroad between geophysics, space physics and astrophysics.

In this field we foresee the following major contributions:

- detect $\approx$ 700 Terrestrial Gamma-ray Flashes (TGFs) per year, probing the TGF intensity distribution at low fluence values and providing an unbiased sample of bright events thanks to the intrinsic robustness against dead-time and pile-up;
- provide the largest TGF detection rate surface density above the equator, allowing for correlation studies with lightning activity on short time scales and small regional scales, to probe the TGF / lightning relationship;
- lower by a factor $\approx$ 5 the minimum detectable fluence for Terrestrial Electron Beams (TEBs), an additional tool to probe TGF production mechanism and the lower edge of TGF intensity distribution;
- open up a discovery space for the detection of high-altitude electron beams and weak X-ray emissions associated to Transient Luminous Events (TLEs).

LOFT has been studied as a candidate ESA M3 mission during an extensive assessment phase. The high level of readiness and maturity of the mission, as well as the clean and solid assessment of its unique science case, make LOFT a competitive mission with a compelling science case. For this reason, its development has been continued, aiming at new launch opportunities.