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Exploring the Gravitational-Waves Universe with THESEUS

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The Transient High Energy Sky and Early Universe Surveyor (THESEUS) is a mission concept under development by a large international collaboration aimed at exploiting Gamma-Ray Bursts for investigating the early Universe and monitoring the X-ray sky with an unprecedented combination of deep sensitivity and large field of view. These goals will be achieved through a unique combination of instruments allowing GRBs and X-ray transients detection and arcmin localization over a broad FOV (more than 1sr) and an energy band extending from several MeVs down to 0.3 keV with unprecedented sensitivity, as well as on-board prompt (few minutes) follow-up with a 0.6m class IR telescope with both imaging and spectroscopic capabilities. THESEUS is thus perfectly suited for detecting, locating and identifying the electromagnetic counterparts to sources of gravitational radiation, which may be routinely detected in the late '20s / early '30s by next generation facilities like aLIGO/aVirgo, eLISA, KAGRA, ILIGO, Einstein Telescope, Cosmic Explorer. If selected within the ESA/M5 programme, the launch of THESEUS will coincide with a golden era of multi-messenger astronomy, to which this mission will provide a fundamental contribution. The detection of EM counterparts of GW (or possibly neutrino) signals will enable a multitude of science programmes (e.g. Bloom et al. 2009; Phinney 2009) by allowing for parameter constraints that the GW/neutrino observations alone cannot fully provide. For example, finding a GW/neutrino source EM counterpart in X-rays with THESEUS/SXI, will allow to localize the source with an accuracy good enough for optical follow-up and hence to possibly measure its redshift and luminosity. On the other hand, not finding an EM counterpart will constrain merger types (such as BH-BH mergers), emission mechanisms, astrophysical conditions at the time of merger, and total energetics.

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