Contribution ID: **143** Contribution code: **INSTR/SW** Type: **Oral**

Cosmology and multi-messenger astrophysics with the THESEUS space mission

Wednesday 4 September 2024 15:45 (15 minutes)

The Transient High-Energy Sky and Early Universe Surveyor (THESEUS) is a mission concept aimed at fully exploiting Gamma-Ray Bursts (GRB) for
investigating the early Universe and as key phenomena for multi messenger astrophysics. Developed by a large European collaboration coordinated by INAF and under study by ESA since 2018, THESEUS is currently one of the three candidate M7 missions for a launch in the mid '30s. By providing an unprecedented combination of X-/gamma-ray monitors, on-board IR telescope and spacecraft autonomous fast slewing capabilities, this mission would be a wonderful machine for the detection, multi-wavelength characterization and redshift measurement of any kind of GRBs and many classes of X-ray transients, including high redshift GRBs for cosmology (pop-III stars, cosmic reionization, SFR and metallicity evolution up to the "cosmic dawn") and electromagnetic counterparts to sources of gravitational waves (e.g., short GRBs, soft X-ray and KN emission from NS-NS / NS-BH mergers). Through these unprecedented capabilities and a flexible guest observer programme, THESEUS will also have a great impact on general time-domain astrophysics and, in all respects, will provide an ideal synergy with the very large astronomical facilities of the future in the e.m. (e.g., ELT, CTA, SKA, Athena) and multi-messenger (e.g., Einstein Telescope, Cosmic Explorer, km3NET) domains.

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Session Classification: Parallel 2