From the HERMES fleet to the flight of the ALBATROS: surfing the waves of quantum space-time

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ABSTRACT

ALBATROS (Astonishingly Long Baseline Array Transients Reconnaissance Observatory in Space) is an ambitious astrophysical mission concept that uses a fleet of three small satellites to create an high-energy all-sky monitor with excellent localisation capabilities. The proposed orbits for the spacecrafts are three independent Earth-trailing heliocentric orbits, that will form a nearly equilateral triangular formation with 2.5 10^6 km arm length: the so-called *cart-wheel* formation. Each satellite is equipped with two opposite facing ~ 500 cm^2 effective area detectors each consisting of a segmented array of crystal scintillators (GAGG) with a half-sky Field of View, keV-MeV energy band, and temporal resolution better than one microsecond. Thanks to the million km baselines, temporal triangulation techniques allow unprecedented location accuracies, few arc-second/few arc-minutes, for bright/faint transients in a wide energy band, few keV-few MeV crucial for hunting the elusive electromagnetic counterparts of Gravitational Waves, that will play a paramount role in the future of *Multi-messenger Astronomy*.

This project is an example of high-energy distributed astronomy: a new concept of modular observatory consisting of a fleet of small satellites displaced over a large array, with sub-microsecond time resolution and wide energy band (keV-MeV). A pathfinder of *ALBATROS* is already under development through the *HERMES* (High Energy Rapid Modular Ensemble of Satellites) and SpIRIT (Space Industry Responsive Intelligent Thermal Nanosatellite) projects: a fleet of six 3U cube-sats (HERMES) to be launched by the end of 2023 plus one 12U cube-sat (SpIRIT) to be launched by the end of 2022.

ALBATROS will furnish the golden sample of GRBs needed to test the dispersion law theorised by some Quantum Gravity theories, which predict relative discrepancies of the speed of photons w.r.t. the speed of light proportional to the ratio of the photon energy to the Planck energy. This effect is extremely small, and GRBs occurring at cosmological distances represent the ideal target to explore it. We describe a compelling approach to this problem that statistically combines a large number of GRBs for which light-curves of the prompt emission over a wide energy band (keV-MeV) are available, and distances are known. We discuss how a golden sample of ~ 1000 GRBs with known redshift is sufficient to effectively constrain this dispersion law.

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