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# GAMMA SWARM – COMPACT CUBESAT SYSTEM FOR GRAVITATIONAL WAVE COUNTERPARTS' DETECTION

**Abstract**

We present Gamma Swarm - a compact distributed 3U Cubesat system, aimed to detect and localize gamma-ray transients in the low Earth (LEO) orbit and relying on real-time direct intersatellite communication. The Swarm will detect Terrestrial gamma-ray flashes (TGFs) from the Earth's atmosphere, which are generated during thunderstorms and are not fully studied yet, as well as Gamma-ray Bursts (GRBs), which come from the outer space. GRBs are classified as long, which originate during the collapse of massive stars, and short (sGRBs), attributed to binary neutron star (BNS) mergers. The latter are of particular mission interest, since sGRBs are proven to be counterparts of BNS gravitational wave (GW) events, detectable by Virgo and LIGO.

Joint detection of sGRBs and GW has a lot of scientific implications, like measuring delay between gravitational and electromagnetic radiation and understanding details of BNS merger. Low detection rate of these events arises necessity of new instruments, since existing large gamma-ray observatories, like Fermi-GBM and INTEGRAL, do not provide a full sky coverage. Fortunately, detectors of comparable sensitivity may be placed on the Cubesats. Plenty of projects around the world have been started in this direction, scheduled for launch in the early 2020s.

The novelty of our approach is that Swarm is a truly distributed system. Unlike others, we are not building a simple array of similar individual instruments. We make an emphasis on the system behavior: overall swarm abilities are more than just a sum of individuals, and mission goals may be achieved only with continuous intersatellite communication - the key enabling technology in the swarm. By cooperation within the swarm, the satellites are able to efficiently extract signal from noise (single Cubesat faces EM shower events); calculate GRB/TGF origin coordinates by analyzing overall intensities and signal delays analysis; relay scientific data to the ground. The swarm is capable of signal triangulation. Its satellites have identical hardware, utilizing 5 CsI scintillators combined with Silicon photomultiplier arrays (SiPMs) as main sensors and exploiting UHF intersatellite link for communication. Various components of the system are currently at TRLs ranging from 4 to 9. We expect the launch of first 4 satellites from the ISS to take place in 2021.