

MoonBEAM: A Beyond Earth-orbit Gamma-ray Burst Detector for Multi-Messenger Astronomy

Moon Burst Energetics All-sky Monitor (MoonBEAM) is a CubeSat concept of deploying gamma-ray detectors in cislunar space to increase gamma-ray burst detections and improve localization precision with the timing triangulation technique. A gamma-ray instrument in cislunar orbit will have greatly reduced sky blockage compared to instruments in low Earth orbit. Working in conjunction with another instrument in low Earth orbit, MoonBEAM can also help constrain the arrival direction of the wavefront to an annulus on the sky by utilizing the light arrival times between the different orbits. This method has been demonstrated by the Interplanetary Gamma-Ray Burst Timing Network. However, delays in data downlink for instruments outside the Tracking and Data Relay Satellite network prevent rapid follow-up observations. We present here a gamma-ray CubeSat concept in Earth-Moon L3 halo orbit that is capable of faster response and provide a timing baseline for localization improvement. Such an instrument would aid in the gravitational wave follow-up observations in other wavelengths to identify the gamma-ray burst afterglow and kilonova emission. Reducing the region of interest makes identifying afterglows much faster, allowing for rapid on-source observations and monitoring of the rise and decay times. It will also prevent source confusion between two transients and enable robust association. A gamma-ray detection could also increase the confidence of a simultaneous but marginal gravitational wave signal, extending the detection horizon.

2 line summary:

MoonBEAM is a 12U CubeSat concept of deploying gamma-ray detectors in cislunar space to increase gamma-ray burst detections and improve localization precision with the timing triangulation technique. Such an instrument would probe the extreme processes in cosmic collision of compact objects and facilitate multi-messenger time-domain astronomy to explore the end of stellar life cycles and black hole formations.
