MoonBEAM
A beyond Earth-orbit GRB detector for multi-messenger astronomy

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*not to scale*
MoonBEAM
Moon Burst Energetics All-sky Monitor

- 2-year SmallSat mission concept to detect gamma-ray bursts.
- Science instrument is 5 detector modules (NaI/CsI phoswich + SiPM) positioned to maximize sky coverage.
- Cislunar orbit at L3 point of Earth-Moon system (95,500 — 665,000 km from Earth).
  ▶ Earth occults < 0.1% of sky at maximum.
  ▶ High duty cycle, no SAA passage.
  ▶ More stable background compared to Low Earth Orbit.
  ▶ Additional localization improvement with IPN-like timing triangulation.

SGRB rate estimate
30-70/year
*assuming single-crystal detector
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MoonBEAM average distance from Earth

Median-bright GRB at 45deg baseline
MoonBEAM average distance from Earth

\[
\cos \theta_{12} = \frac{c \Delta t_{12}}{d_{12}}
\]

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MoonBEAM localization of an average GRB
MoonBEAM + LEO instrument timing annulus
Combined posterior (loc area reduced by factor of 3)