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

*not to scale

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

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


Years Covered Number of GRBs Description

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of GRBs</th>
<th>Description</th>
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<tbody>
<tr>
<td>2000–2006</td>
<td>226</td>
<td>HETE-2 supplement</td>
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<tr>
<td>1996–2000</td>
<td>343</td>
<td>BATSE 5B supplement</td>
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<td>1994–2012</td>
<td>271</td>
<td>Konus short bursts</td>
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<td>1992–1993</td>
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<td>1991–1994</td>
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MoonBEAM localization of an average GRB
MoonBEAM + LEO instrument timing annulus
Combined posterior (loc area reduced by factor of 3)