Following Balloons, Questioning Gravitational Waves, and Small Number Statistics

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Remembering Neil – 2018 May 22
Following Balloons

• Compton Spectrometer and Imager (COSI)
• Correspondence with Neil on May 19, 2016

Hi Neil,

COSI successfully launched with the superpressure balloon about 2.5 days ago, and the instrument is working well. Although we’ve been following the GCN notices and circulars, there has not been a detectable GRB in our field of view yet. SGR 1935+2154 is near the edge of our field of view, and we’ve also been looking for those flares.

At the Goddard gamma-ray meeting, you and I talked about Swift/BAT following COSI for a few days. If that is a possibility, then we might want to start planning that.

John

Hi John,

Congratulations on having COSI at float and working well! It would be awesome to get a simultaneous GRB with COSI and BAT. If you get a strong burst with a good polarization measurement, it will be one of the hallmark GRB discoveries. We will need to sell this to the Swift ops team (and ourselves) in the face of large TOO oversubscription this week. The way this would work is that we would aim the BAT in the COSI pointing direction during the ~40% of the time that Swift is on the right side of the earth and the pointing direction is above the horizon constraint.

What is the detection rate you expect for GRBs? What fraction will be bright enough for a good polarization measurement? We can certainly do some co-pointing during the flight, recognizing that it is a low-probability but high-pay-off observation. How long are you expecting to fly? Are there any particular times during the flight that would be better for Swift co-pointings?

Neil

Photo prior to superpressure balloon flight from New Zealand in 2016
Following Balloons

- Compton Spectrometer and Imager (COSI)
- Correspondence with Neil on May 19, 2016

Me: COSI launched...can Swift/BAT cover our field of view?

Neil: Great! I’d love to have Jamie do that... and, by the way, can you tell him where BAT should point?
• Succeeded in having BAT follow COSI from May 23-27
2016 Flight Path

- Landed in Peru (46 day flight)
- Launch from New Zealand on May 17th
- GRB 160530A
- BAT following
GRB 160530A

• Found in real time
  – reported in GCN#19473

• Also detected by AstroSat, INTEGRAL, and Konus-Wind
  – Absolute timing
  – Localization capabilities
  – Energy spectrum

• COSI spectral parameters and fluence agree with Konus-Wind (Svinkin et al. 2016, GCN#19477)
COSI polarization capabilities and GRB result

• Calibration with a partially polarized source (Lowell, PhD thesis)

Azimuthal Scattering Angle Distribution for Compton events from GRB 160530A (Lowell et al. 2017ab)
• Clemson meeting in October 2015 to get ready for the 2016 Senior Review
• My naïve question: why would following up GWs be the top priority for Swift when we have never detected one?

“Only 300 XRT pointings to cover this region”
Questioning Gravitational Waves

• GW 150914: Merger of 36 and 29 solar mass BHs
  – First GW event was detected about a month before the Clemson meeting
• Secret until February 2016
Questioning Gravitational Waves

2016 NASA Astrophysics Senior Review

22-25 February, 2016

Table 3: Programmatic and scientific ranking of all missions ranked 1-6.

<table>
<thead>
<tr>
<th>Mission</th>
<th>Ranking</th>
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<tbody>
<tr>
<td>Swift</td>
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<tr>
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<td>NuSTAR</td>
<td>3</td>
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<td>XMM</td>
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<td>Fermi</td>
<td>5</td>
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<td>Spitzer</td>
<td>6</td>
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• What is Neil’s 2nd most cited paper?
Small Number Statistics

CONFIDENCE LIMITS FOR SMALL NUMBERS OF EVENTS IN ASTROPHYSICAL DATA

NEIL GHEHREL

Laboratory for High Energy Astrophysics, NASA/Goddard Space Flight Center

Received 1985 August 5; accepted 1985 September 30

TABLE 1
POISSON SINGLE-SIDED UPPER LIMITS

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1450 citations!

• An early example of Neil’s service to the community that continued throughout his career