Time-Domain Studies
(Some Plans)

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First Light Science Requirements Example

“First Protostellar Variables Uncovered at 860 GHz”

• 860 / 350 GHz preferred modules
• 100 / 10 mJy bm\(^{-1}\) RMS per epoch
• 10 sq deg field of Orion Star-forming Region
  • 2 sq deg 860 / 350 GHz commensal
  • 8 sq deg extra for full 350 GHz coverage
• 1 hr (850 GHz) + 0.8 hr (350 GHz) per epoch
  with early science instrumentation
• 7 day cadence (14 days ok if epochs are deeper)
  • 50 hrs (850 GHz) + 40 hrs (350 GHz) per yr
• Relative calibration scheme to a few percent
First Light Science Requirements Example

“First Protostellar Variables Uncovered at 860 GHz”

• 860 / 350 GHz preferred modules
• 100 / 10 mJy bm$^{-1}$ RMS per epoch
• 10 x 1 sq deg fields of Galactic star-forming regions
  • 10 x 1 sq deg extra for full 350 GHz coverage

• 1 hr (860 GHz) + 1 hr (350 GHz) per epoch
  *with early science instrumentation*
• 7 day cadence (14 days ok if epochs are deeper)
  • 50 hrs (860 GHz) + 50 hrs (350 GHz) per yr
• Relative calibration scheme to a few percent
• Efficient observing strategy for ‘small’ maps
Microquasar V404 Cyg in 2015

Tetarenko et al. 2017
First Light Science Requirements Example

“Rapid 860 GHz Flaring of the Microquasar TBD”

• 860 / 270 GHz modules [Q2 weather]
• ~500 / 30 mJy bm\(^{-1}\) RMS time bins every 1-min
  • 2 X lower than that of JCMT 666 GHz
• 1 x 4 sq deg fields of a Southern Galactic Microquasar per yr
  • 270 GHz will be simultaneous with 850 GHz
• 6 hr per epoch *with early science instrumentation*
  • Set by source variability timescales
• 1 Day cadence for 10 days per trigger
  • 60 hrs / yr
• Special requirements on next page
First Light Science Requirements Example

“Rapid 860 GHz Flaring of the Microquasar TBD”

• Target of Opportunity / Targeted Followup Mode
  • Commensally creates intermediate tier “survey” data
• Typical (SMA/JCMT/ALMA-like) response (< 72 hrs)
• Preferred: Coordination with other facilities
GRB 120326a (z = 1.8)

~19000 times brighter at 100 Mpc

SMA: 230 GHz

Urata et al 2015
First Light Science Requirements Example

“100 Mpc-distant GW Source Localization Enabled by its Evolving Reverse and Forward Shock”

• 270 / 350 / 850 GHz modules [Q3 / Q3 / Q2 weather]
• ~125 / 140 / 160 mJy bm$^{-1}$ RMS time bins every 1-min / 7.5-min / 75-min) observing time
  • SNR~10-20 at t < 12 hrs scaled to GRB 120326a
• 10 x 50 sq deg fields of Binary NS Candidate GW Sources
  • 30 sq deg commensal
  • 4.5 hr per epoch with early science instrumentation
• Daily cadence for 3 days after 10 triggers
• 135 hrs total
• Rapid response / continuum image data delivery (<~ 6 hours / 24 hours)
TXS 0506 +056: Only likely-known Very High Energy Neutrino Source

EM quiet neutrino flaring?

EM + neutrino flare

Full Science Requirements Example

“Secular Variations and Flares in the sub-mm of Blazars associated with Very High Energy Neutrinos”

- 270 GHz modules [Q2 weather]
- ~30 mJy bm\(^{-1}\) per epoch
  - SNR > 5 for > 20% TXS 0506+056 (2017-Sep; \(\frac{\partial f^\nu}{\partial v} = 0\))
- 4000 sq deg blind survey (could go to 12000 sq deg)
- Completely commensal!
- 3 deg / s scanning preferred for eventual 12000 sq deg
- Every 2 day cadence matches existing blazar radio monitoring
- Preference: live, public sub-mm variability catalog of brightest sub-mm point sources
Full Science Requirements Example

“350 GHz Properties of GRBs at Rapid (t<12 hr) Timescales: Characterizing GRB Reverse Shocks”

• 350 GHz modules [Q2 weather]
• ~70 mJy bm\(^{-1}\) per epoch
  • SNR > 5 for d < 1 Gpc GRB scaled to GRB 120326a
• 4000 sq deg blind survey (could go to 12000 sq deg)
• Completely commensal!
• 3 deg / s scanning preferred for eventual 12000 sq deg
• Every 2 day cadence provides a 25% chance of catching the GRB at the right time
• Preference: Astronomer’s Telegram or VOEvent announcement when each is detected
The Unknown Sub-mm Landscape
Full Science Requirements Example

“The Variable Sub-mm Universe: Paper N”

• 860 / 405 / 350 / 270 / 220 GHz modules [Q2 weather]
• \( \sim 470 / 140 / 70 / 30 / 25 \) mJy/bm RMS per epoch
• 4000 sq deg blind survey (could go to 12000 sq deg)
• Completely commensal!
• \( \sim 1 \) s on source-per epoch
• \( \sim 520 \) epochs to reach 20-min per sq deg on-source time
• 3 deg / s scanning
• Every 2 day cadence -&gt; a wide survey takes \( \sim 3 \) years to complete
Full Science Requirements Example

“The Variable Sub-mm Universe: Paper N”

- 860 / 405 / 350 / 270 / 220 GHz modules [Q2 weather]
- ~235 / 70 / 35 / 15 / 13 mJy/bm RMS per epoch
- 4000 sq deg blind survey (could go to 12000 sq deg)
- Completely commensal!
- ~4 s on source-per epoch
- ~175 epochs to reach 20-min per sq deg on-source time
- 1 deg / s scanning
- Every 8 day cadence -> a wide survey takes ~4 years to complete