The TolTEC Camera

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# The TolTEC Imaging Polarimeter

<table>
<thead>
<tr>
<th></th>
<th>2mm</th>
<th>1.4mm</th>
<th>1.1mm</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beam Size</strong></td>
<td>9.5</td>
<td>6.3</td>
<td>5.0</td>
<td>arcsec FWHM</td>
</tr>
<tr>
<td><strong>NEFD</strong></td>
<td>0.5</td>
<td>0.88</td>
<td>1.3</td>
<td>mJy sqrt(s)</td>
</tr>
<tr>
<td><strong># Detectors</strong></td>
<td>1114</td>
<td>2429</td>
<td>3619</td>
<td></td>
</tr>
<tr>
<td><strong>Mapping Speed</strong></td>
<td>11-74</td>
<td>3-22</td>
<td>2-13</td>
<td>Deg²/mJy²/hr</td>
</tr>
</tbody>
</table>

**Approach/Constraints**

- 10+ year facility instrument
- Minimal technology development
- Distributed work load across several institutions
- Heavy student involvement
- Parallel scientific involvement through public surveys
- Cryostat must fit in UMass elevator
Example Nearby Galaxy Map

NGC 3521
- 1 hr
- Photometry mode
Central Milky Way at 1.1mm
10 hours with AzTEC on LMT

Sagittarius B
the brick
central black hole

Tang et al. 2020
Central Milky Way at 1.1mm
10 hours with AzTEC on LMT

Sagittarius B

the brick

central black hole

TolTEC
~15 minutes
3 colors polarimetry

Tang et al. 2020
• 3 hrs to close up
• ~5 days to base temperature
• ~3 days to settle
• 7 days to warm up
• 2 hrs to open

Nat DeNigris (UMass)
TolTEC 1.1mm Detector Array

- 4012 KID detectors
- 2006 pixels
- Design & Fab by Jay Austermann at NIST Boulder
Si detector/horn assembly

1.2K buffer and LP filter

4K magnetic shield

4K field flattening lens

Edgar Castillo (NISR)
Network 0 VNA Sweep (Detector Identification)
Typical data from the VNA sweeps at 5 blackbody temperatures. The yellow line links the same KID resonance.

Nat DeNigris (UMass)  
Miranda Eiben (Harvard)  

Our cryogenic blackbody
TolTEC 4K Optics Bench

Installed
25mm dia. aperture at lyot stop for in-lab optical tests
FTS Passband Measurement
TolTEC 4K Optics Bench
Next Steps

• Verify fix to dichroics (~1 month)
• Ship TolTEC to Mexico
• Install at the LMT
• Commission primary observing modes
• Determine mapping speeds
Observing Modes

- **Lissajous**
  - 6'-10' diameter maps
  - 100% observing efficiency

- **Raster maps (large scale mapping)**
  - arbitrarily large maps
  - turn-around time depends on scanning velocity

- **Rastajous maps**
Planned Data Products

- I, Q, U maps at 1.1mm, 1.4mm, 2.0mm
- corresponding weight (noise) maps
- S/N maps
- PSF maps
- Observation logs

Raw data on request.
Noise realizations on request.
TolTEC Public Legacy Surveys

- Ten-100 hour surveys with LMT
- Survey definition is ongoing in public workshops
- All legacy survey data will be public
- 4 initial surveys concepts now base-lined, new survey concepts welcome.