Current & Future High Frequency Continuum Capabilities of the GBT for Studying Star Formation in Molecular Clouds

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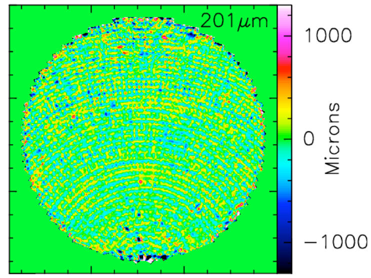


1. The GBT: a 3mm Mapping Machine

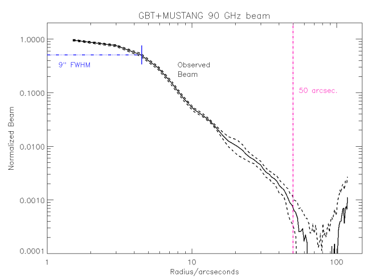
Pointing: The GBT pointing errors for purposes of on-the-fly mapping are under 1.7" (RMS of 2D pointing offset).

Collecting Area: The GBT has a 240 µm Ruze-equivalent surface accuracy, giving it a 35% aperture efficiency at 90 GHz; or a collecting area equivalent to 30, high-efficiency, 12-m antennas.

Scheduling: The GBT is dynamically scheduled in order to match science project requirements to available conditions.

Instrumentation: The GBT has several receivers operating in the 3mm range: MUSTANG, a 64-pixel, 90 GHz (3.3mm) bolometer array, soon to be replaced by MUSTANG-2; a 4mm (68-92 GHz), 2-beam spectral line receiver; and, soon, an 8-beam, 3mm spectral line camera, ARGUS.

Beam: The GBT's active surface, combined with quasi-realtime measurements of low-order aberrations with Out of Focus Holography (Nikolic et al. 2007) give the GBT a stable, well-behaved beam suitable for mapping large areas and extended objects. **Left**: the mean and RMS beam over the course of a typical 8h observing run. Data are unreliable and noisy at radii greater than ~50".



3. MUSTANG-2

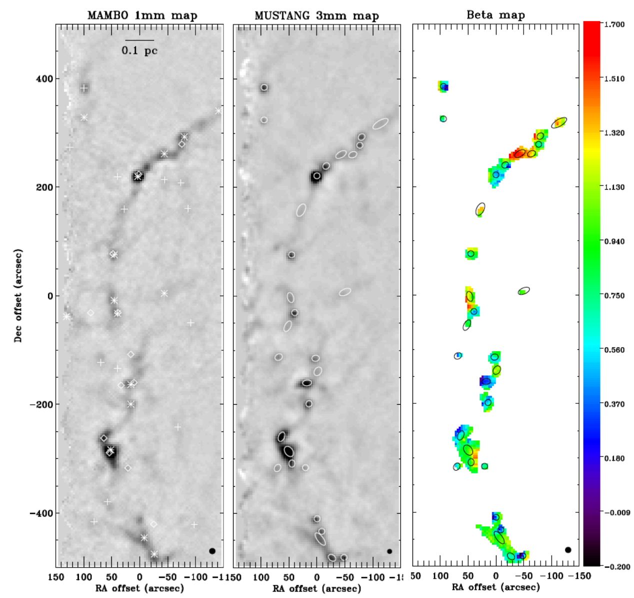
A collaboration between NRAO, the University of Pennsylvania, NIST, the University of Michigan, and Cardiff University is building MUSTANG's successor **(MUSTANG-2**: Dicker et al. 2014**)** for use on the GBT. Key features of this instrument are :

- Feedhorn+microstrip coupled TES detectors will increase per-detector sensitivity by at least 3.5x
- 4' diameter FOV improves recovery of extended structures
- Significantly more robust cryogenic stability
- Although not currently funded to fabricate and deploy all 223 detector modules, all components (optics, cryostat, readout electronics) directly support this as a straightforward upgrade.
- ***A version of MUSTANG-2 with 64 feedhorns populated ("MUSTANG-1.5") is available for shared risk observing on the GBT in collaboration with the science team.***
- Although not optimized for polarimetry, the MUSTANG-1.5 detectors are sensitive to linear polarization. A future upgrade/successor to MUSTANG-2 could provide a powerful capability to **sensitively map polarized dust emission at long wavelengths in molecular clouds, providing information about the role of magnetic fields in MCs and filaments** (*e.g.*, Crutcher et al. 2012)

See MUSTANG-2 project web page for more info.
http://www.gb.nrao.edu/mustang/ →

Holographic Map of GBT Surface Errors *(Hunter et al. 2011)*
The GBT typically delivers a 240 µm surface (Ruze-equivalent RMS) in routine 3mm observations.

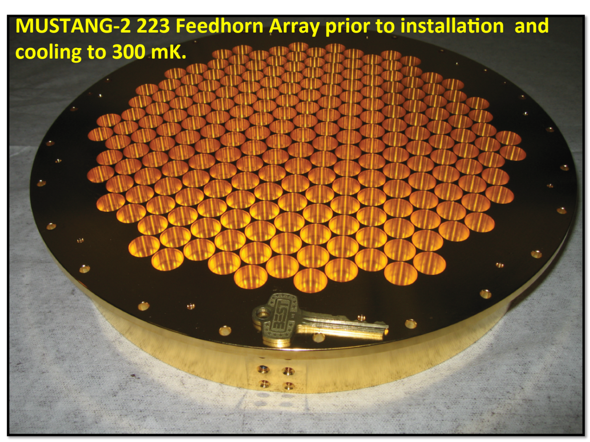
2. Science Highlight: Grain Growth in OMC 2/3



A recent GBT+MUSTANG observation (Schnee et al. 2014, **center**) of the "Integral-shaped Filament" (OMC 2/3) in Orion reveals surprisingly high 3.3mm emissivity (β~ 1) in comparison with shorter wavelength maps of the region (MAMBO, **left**). Symbols in each map show the locations of starless and protostellar cores. The β map is on the **right.** This analysis also used kinetic temperature information derived from an Ammonia map of this region made with the VLA and the GBT K-band Focal Plane Array (Li et al. 2013, not shown).

Read the press release! →

https://public.nrao.edu/news/pressreleases/dust-grains-orion



References

Crutcher et al. 2012, ARA&A 50, 29 • Dicker et al. 2014, JLTP 176, 808 • Hunter et al. 2011, PASP 123, 1087 • Li, Kauffmann, Zhang, & Chen 2013, ApJL 768, 5 • Nikolic et al. 2007, A&A 465, 685 • Schnee et al. 2014 MNRAS 444, 2303