

MALT-45

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The Galactic plane in 7mm

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1. Introduction

MALT-45 is an untargeted Galactic plane survey, searching for tracers of high mass star formation (HMSF) at 7mm. This survey is conducted on the Australia Telescope Compact Array (ATCA). With the recent upgrade to the ATCA correlator, we are able to map the Galactic plane with high sensitivity for 12 spectral lines simultaneously. Additionally, this survey uses the autocorrelation data from the multiple antennae. Compared to the cousin H₂O southern Galactic Plane Survey (HOPS) on Mopra, MALT-45 is much more efficient, as we use the 6 antennae of the ATCA in autocorrelation mode effectively as a 6-element multibeam system. This gives excellent sensitivity to extended emission with a beam resolution of about 1 arcminute. MALT-45 will allow us to build statistics on the regions of emission detected, and identify less obvious sites of HMSF.

MALT-45 is the first multi-degree-scale untargeted survey of Class I methanol masers at 44 GHz. This is motivated by a comparison to maser emission from other surveys, such as water masers from HOPS, Class II methanol masers from the Methanol Multibeam project (exclusively associated with HMSF), and OH masers from SPLASH. In doing so, we will build a better understanding of an evolutionary timeline for HMSF through masers.

Simultaneously, MALT-45 maps bright CS (1-0) emission, as well as other thermal lines associated with HMSF. The CS data collected is useful in probing optically thick clumps, as C³⁴S emission can be used to measure the optical depth in these regions.

SiO (1-0) maser lines have rarely been detected towards regions of HMSF, but are generally associated with evolved stars. MALT-45 will also observe multiple SiO (1-0) lines to reveal more SiO masers in an untargeted way.

3. Results

Extended CS (1-0) emission is detected throughout the survey region. This emission is generally found towards warm dust traced by extended IR emission (eg. GLIMPSE), cold regions such as IRDCs, but also CS is found in regions where there is no IR counterpart. Many clumps are identified through CS that do not show HOPS NH₃ (1,1) emission.

MALT-45 has detected 48 new Class I methanol masers on top of the 20 previously known within the survey region. Two of the previously known masers are very bright and have been known for many years, while the other 18 are associated with Class II masers or an extended green object (EGO). The nature of each of the new Class I masers not associated with EGOs or known Class II counterparts is yet to be investigated. With follow-up observations, we hope to gain better insight into their nature and driving mechanisms.

Of the 51 SiO masers detected, none have previously been reported. All maser regions appear to be associated with evolved OH/IR stars rather than star forming regions. All but two SiO maser regions contain the v=1 line, while 13 regions lack v=2 emission. The v=3 transition is rare, weak, or a combination of both, as it is only detected towards two regions. Two regions appear to contain only the v=2 transition and are not detected in either the v=1 or v=3 lines.

As the survey was only recently completed (April 2013), the full survey results are still in infancy and data reduction techniques have been improving with time. The full survey results will be published later this year.

Further details on the MALT-45 survey can be found in the pilot paper (Jordan et al., 2013, MNRAS).

2. Survey Parameters

Region covered so far:

- $330 < l < 335$, $|b| < 0.5$
- Our aim is to map 30 square-degrees of the Galactic plane with MALT-45

Spectral lines mapped:

Spectral Line	GHz	Maser or Thermal?
SiO (1-0) v=3	42.519	Maser
SiO (1-0) v=2	42.820	Maser
H ₅₃ α	42.952	Thermal (Recombination line)
SiO (1-0) v=1	42.519	Maser
SiO (1-0) v=0	43.424	Thermal
CH ₃ OH 7(0,7)-6(1,6)	44.069	Maser (Class I)
H ₅₁ α	48.154	Thermal (Recombination line)
C ³⁴ S (1-0)	48.207	Thermal
CH ₃ OH 1 ₀ -0 ₀ A+	48.372	Thermal
CH ₃ OH 1 ₀ -0 ₀ E	48.377	Thermal
OCS (4-3)	48.652	Thermal
CS (1-0)	48.990	Thermal

Survey technique:

- On-the-fly mapping
 - Orthogonal scanning (Nyquist sampling)
 - 6 seconds per pointing
 - Collects both interferometric and single-dish data simultaneously
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- Each spectral line is mapped with a CABB 64M-32k zoom window
 - This means each spectral line has 64 MHz of bandwidth, with a channel resolution of 32 kHz
 - At this wavelength, this channel resolution is approximately 0.2 km/s per channel
 - Two 2 GHz continuum spectra are also collected, and will allow us to discriminate between dust continuum emission and free-free emission
 - This also allows us to identify new HCH_n or UCH_n regions

4. Figures

Top: MALT-45 CS (1-0) emission overlaid with **blue** HOPS NH₃ (1,1) contours.

Middle: GLIMPSE 3-colour (3.6, 4.5, 8.0μm) image with **white** MALT-45 CS (1-0) contours

Bottom: GLIMPSE 3-colour (3.6, 4.5, 8.0μm) image with locations of methanol (cross symbols) and SiO (circles) masers. **Green** crosses represent previously unknown Class I methanol maser regions, while **blue** represent previously known regions.

