

Big Maser Data: Methanol Maser Database

Why we need a methanol maser database?

Currently in the astronomy there is a trend to use large astronomical catalogs and databases in order to study different classes of the astrophysical objects. The recent development includes databases of exoplanets (EXO.MAST, Exoplanets.org), The Mikulski Archive for Space Telescopes (MAST) focused on scientific data sets in the optical, ultraviolet, and near-infrared parts of the spectrum, and others. All these databases were created with the focus on some specific phenomena, wavelength of detection or class of an astronomical object. However, the database of methanol masers is still missing to date, thus it is not possible to search across the observations of methanol masers available in literature. Methanol masers provide us with unique information on the properties of the interstellar medium and found both in galactic and extragalactic objects. The creation of the unified database solve the problem of methanol masers data access thru rich opportunities of the SQL-queries.

Class I methanol masers data

The data entry for Class I methanol masers is currently complete and contains both **single-dish** and **interferometric data**. The number of included observations is **~7500** for **~650 maser sites**. The **interferometric maser spot data** is available for **~460 maser groups** with **~15 000 maser spots** archived in the database. The database includes the published papers with class I masers observations from the beginning of 1990. The **total amount** of papers included to the database for class I methanol masers is **106**.

Class II methanol masers data

To date the cIIMMs database is **not complete**. But it already contains **~8500** observations in **~3400 source groups** and provides extensive information on the overall distribution of class II masers. The database contains most of the recent large surveys of class II masers, including the full 6.7 GHz methanol multibeam maser catalogue and the 6.7 GHz methanol maser survey with the Shanghai Tianma Radio Telescope. Total amount of currently covered papers for class II methanol papers is **35**.

Methanol Masers	
Class I (cIIMM)	Class II (cIIMM)
Source of Pumping:	
Shock waves [Sobolev et al. 2007, IAU242, 81]	IR-radiation of dust heated by young stars [e.g. Sobolev et al. 2005, IAU227, 174]
Associated with:	
<ul style="list-style-type: none"> High-mass star forming regions Supernova remnants [Pihlstrom et al. 2014, AJ, 147, 73] Colliding molecular clouds [Salii et al. 2002, ARep, 46, 955] 	<ul style="list-style-type: none"> High-mass star forming regions

Overview

Methanol Maser Database is the first specialized web-interface database collecting the most up to date data on the sources of methanol molecule maser emission. The methanol maser database is equipped with a search tool allowing an unified access to the cataloged maser data, as well as to the external data, including images and catalogs of well-known sky surveys. An ample functionality of statistical analysis is included to the web interface.

Objectives

The overall objective of the methanol maser database is creation of **the complete up-to-date database of all available line observations of the methanol molecule with confirmed maser emission**.

We split this objective into the subtasks:

100% done	Design of a database structure
100% done	Class I methanol masers data entry
40% done	Class II methanol masers data entry
100% done	Data processing for statistical studies
100% done	Development of the web-interface

Catalogue description

Each entry of the main catalogue **met1_data** contains information about **a single spectral component of methanol maser at specific position in sky and radial velocity**.

Main search page

The main page of the web interface provides several search options:

- Cone search** by coordinates or source name.
- List search** allows to input the list of sources to perform simultaneous search of masers and other sources within each list entry.

The web system allows access to **external data**, including images and catalogs of well-known sky surveys. The results of catalog and image search are displayed at the same search results window together with the "local" maser database search results, allowing to examine the sources with the different wavelengths.



Please visit
Methanol Maser Database

<http://maserdb.net>

The following columns are available
for each entry:

obs_id	observation identifier
source_name	source name
grp	source identifier using short galactic coordinates
ra, dec	right ascension and declination in J2000 coordinates (deg)
l, b	galactic longitude and latitude (deg)
detected	detection flag
vpeak	peak velocity (km s ⁻¹)
fwhm	FWHM of spectral line (km s ⁻¹)
peak	peak intensity (Jy or K)
int	integrated intensity (Jy km/s or K km/s)
dist	distance to the source (kpc)
beam	columns for beam information
rms	root mean square noise of observation
ref	reference to the paper

Creating the database

For creation of the maser database we use the **PostgreSQL database management system** suitable for large datasets and complex SQL-queries. The database was modified with **PgSphere plugin** required for work with sky coordinates. Data entry to the database was done using online **VizieR archive** from the Strasbourg astronomical Data Center and Optical Character Recognition (OCR) system **FineReader** in the cases when online data is not available. **DBSCAN algorithm** of Python SCIKIT-LEARN package is used for source grouping. Matching with the external datasets is done with **x-match service** of the Strasbourg astronomical Data Center. The online web-interface is written in **Perl/CGI** language with the support of the **Javascript** (including AJAX technology). Online plots in the web-interface are plotted using **Plotly Python Graphing Library**.

The entered data are divided
into three main classes:

Targeted single-dish surveys	Blind surveys	Targeted interferometric observations
<ul style="list-style-type: none"> ✓ No information about maser spots ✓ Criteria of the source selection 	<ul style="list-style-type: none"> ✓ No criteria of the source selection (only sky region defined) 	<ul style="list-style-type: none"> ✓ Information about maser spots ✓ Criteria of the source selection
★	★ ★ ★	★

Data completeness

The presented database is **complete for known to date class I methanol masers sources**. We checked database completeness using the list of papers produced with **NASA ADS system** (<https://ui.adsabs.harvard.edu/>) and list of the methanol class I maser line catalogs available at **Strasbourg archive** (<http://vizier.u-strasbg.fr/viz-bin/VizieR>). **We found no papers** published since 1990 and containing original observations of class I methanol masers that were **not included in our database**.

Questions? Feedback?

Please contact me:

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Sorry, can't attend the conference! Email me ;)



To be continued...

We are currently planning to extend the maser database to cover all published observations of **H₂O masers**. Plus **Class II maser data** entry is still in progress.



Questions? Feedback?

Please contact me:

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I'm somewhere here having fun at the conference :)