User Manual: B_{LOS} Mapping Code

Terminology

- B_{LOS}: Line-of-sight component of magnetic field
- ROI: Region of Interest
- RM: Rotation Measure
- Reference Point: Points representing "off positions"

1 Introduction

This code determines the line-of-sight component of magnetic fields (B_{LOS}) associated with molecular clouds using the technique described in Tahani et al. (2018).

1.1 Overview of Steps

The B_{LOS} Mapping method is conducted over 7 total steps, as detailed in Tahani et al. (2018).

Step 0: The necessary folders, configuration files, and sub-folders are created.

Step 1: The rotation measure points are read from the Taylor et al. (2009) catalog and plotted over a map of the region of interest in order to get a sense of the rotation measure coverage. Note that any rotation measure can be included.

Step 2: The rotation measure data is matched to visual extinction values using a map of the region of interest.

Step 3: The reference points are chosen. These points represent "off positions" on the cloud, as defined in Tahani et al. (2018).

Step 4: The B_{LOS} directions and values are determined and calculated for the rotation measure points in the region of interest using the reference points found in step 3.

Steps 5 & 6: The B_{LOS} uncertainties that result from using different density (step 5) and temperature (step 6) values as input parameters to the chemical code are determined.

Step 7: The total uncertainty in B_{LOS} values is calculated (resulted from RM, RM_{off}, extinction values, and input parameters to the chemical code).

2 Installation and Configuration

2.1 Minimum Python Version

The minimum Python version is 3.6.1.

2.2 Required Modules

The following packages must be installed:

- astropy
- adjustText
- matplotlib
- numpy
- pandas

2.3 Configuration

The "Classes" directory is intended to be used as the starting point for resolving imports.

3 Conducting the analysis

3.1 Setting Up

Once the files have been installed and configured, we can begin to prepare for conducting the analysis.

1. Run 00aConfigureDirInfo.py.
2. Check that the global variables defined in the 'configConstants.ini' file are correct.
3. Check that the directory file naming scheme is to your satisfaction in the 'configDirectoryAndNames.ini' file.
4. Check that the various starting settings and judgment parameters are to your satisfaction in 'configStartSettings.ini'.

The following will need to be done for every given region of interest.

1. Check that your region of interest is correctly defined its 'Region.ini' file (located in Data/CloudParameters).
   - If your region of interest is not defined, create a new region.ini data file in the Data/CloudParameters folder.
   - An example template has been placed in the folder for you. It is called '0 - template.ini'
2. Run the file '00MakeDir.py'.

3.2 Running the analysis

Each step of the analysis corresponds to a specific file. These files are meant to be run in the order indicated by their name. For example, file '01RMMapping.py' corresponds to the first step of the analysis and is meant to be run before the file '02RMMatching.py'.

The steps of the analysis require input from the user:

- When running each file, the user is asked to type the name of the region of interest they wish to analyze.
- Some steps might ask the user to enter values or indicate their preferences.

Each step of the analysis will produce output either in the form of a figure or a table of data. Output will be saved to a folder with the same name as the region of interest. It is strongly recommended that the output be critically examined before moving onto the next step.

3.3 A note on Step 3

Step 3 requires the most input from the user, as this is the step in which reference points are chosen. Reference points are meant to sample "off positions" around the cloud in order to estimate the Galactic contribution to the observed rotation measure.

The primary criterion for determining reference points is visual extinction. The program will list all points with extinction less than a specified threshold value, numbered in order of increasing extinction, as "potential reference points". Depending on the distance (and location) of the cloud, this threshold value should be modified. The map of these points should be reviewed to ensure that all sides of the cloud are sampled properly by their selected reference points.

The program will then recommend an optimal number of points to take as reference points using a trend stability analysis.

The program will also flag points that are too close to the cloud and points that have odd anomalous rotation measure values. Points with either of these properties require additional consideration from the user as to whether they are suitable reference points.

References

Tahani, M., Plume, R., Brown, J. C., & Kainulainen, J. 2018, A&A, 614, A100

Taylor, A. R., Stil, J. M., & Sunstrum, C. 2009, ApJ, 702, 1230