

Astronomy 731 Term Project 3 (M51)

Spring 2009

Project Summary

The subject of your project is a well-known galaxy M51. You will reduce and analyze the L-band (1.4 GHz) C-array ($\theta \sim 20''$) data and the C-band (5 GHz) C-array ($\theta \sim 6''$) data from the VLA obtained in the continuum mode.

For the L-band data (M51.LBAND.UVFITS), your flux calibrator is 1328+307 while the gain calibrator is 1409+524. Your main science target is named NGC5194 in this data file – ignore all other sources.

For the C-band data (M51.CBAND.UVFITS), your flux calibrator is 1331+305 (same as 1328+307 but its J2000 epoch name) while the gain calibrators are 1219+484. Your main science target name is M51 in this data.

Data Reduction and Analysis

- Calibrate the data using AIPS, following the instruction posted on the project web page and the AIPS Cookbook.
- Produce the L-band and C-band images of M51 using (1) natural weighting; (2) uniform weighting; and (3) Robust weighting with robust factor R=1. Determine the resolution and the rms noise of each images produced. Compute the total continuum flux recovered in each case.

Science Analysis

1. Download a **8 μ m Spitzer IRAC fits image of M51 from the Public Post-BCD Data Webserver at IRSA** and make an RGB color image by combining it with your 1.4 and 5 GHz images. [One of the radio images have B1950 coordinates, which you can change to J2000 using AIPS program **EPOSW**.] This figure should be presented and discussed as one of your results in the report.
2. Compute and produce a spectral index map using the 1.4 and 5 GHz images. You cannot just divide one image by the other and scale to produce the SI map. Think about this a little bit before jumping onto this task.

Questions for Your Final Report (10 pages + Figures/Tables)

1. First, summarize your data and the reduction and analysis procedures in some detail.
2. What are the brightest features found in your images? Identify the five brightest features in each image and tabulate their coordinates, peak and integrated flux density, peak brightness temperature, and spectral index.
3. Discuss quantitatively the trade-off between the weighting of the uvdata and the resulting resolution and sensitivity. What is Robust weighting and what are the advantages and disadvantages?
4. Calculate the expected sensitivity of the VLA in each of these bands assuming a total bandwidth of 100 MHz and an integration time of 1 hr. How do they compare with the actual sensitivity achieved (how did you estimate the “sensitivity achieved”)? What are the main reasons for the difference?
5. What are the mean and the range of spectral index you derived? What can you conclude about the origin of the radio emission in M51 from this spectral index information?
6. Discuss quantitatively the total flux recovered by the three different weighting schemes. Why does the amount of total flux recovered change with different weighting? How does this affect your scientific conclusions?