A Catalog of Reddened Field Stars in the Corona Australis Molecular Cloud

Joseph Spizuco¹, David Horne¹, Douglas Whittet¹, Paul Mayeur¹, Sachindev Shenoy²

¹. Rensselaer Polytechnic Institute (Troy NY 12180)
². NASA Ames Research Center

Abstract

Two regions of the Corona Australis molecular cloud (CrA) were surveyed using JHK photometry data from the Two Micron All Sky Survey (2MASS) Point Source Catalog. Each possible source was subject to quality assurance checks and constraints to ensure only highly reddened stars were included in our sample. Color constraints were calculated for each source in the survey area and used to find highly reddened stars. The color constraints were then used to formulate accurate estimates of the extinction (A) for each field star. The final catalog contains 344 possible field stars across both regions surveyed along visual extinction values in the range 3 < A < 20 mag.

Methods and Observations

Two user defined regions of CrA were designated to be surveyed for highly reddened field stars. The larger piece (CrA Body) contains the densest part of the cloud, the Coronet and the bulk of the cloud. The compliment piece (Object 42) is about 1.1 degrees away from CrA Body but also appears to be notably dense. The 2MASS Point Source Catalog was used to survey both areas for possible reddened sources. To limit the results to only highly reddened sources, constraints were added.

- A limit of magnitudes of H-K > 14 was imposed, as well as other photometric constraints: Query sources with ph_flag="AAA", ce_flag="0", and any combination of 1s or 2s in the rd_flag were considered. This assured that the possible sources had the best photometry with no saturation and no nearby artifacts affecting them.
- To distinguish the reddened stars and those with divergent colors from reddened field stars, color constraints were implemented and adapted for CrA:
  - (H−K) = 1.1(H+K) + 0.4
  - (H−K) = 0.8

The value of 1.0 constant is effectively the reddening ratio for this cloud. This calculated by determining the slope at which the majority of sources crossed the intrinsic color lines when reddened. Using a slope that encompasses the majority of sources provides evidence for an accurate trend for each source can be assumed, the actual reddening ratio of CrA. The determination of this constant allowed for accurate A estimation to be found for each source. The constraint on the H-K values corresponds to the threshold extinction for the detection of ionized dust clouds.

Results

- Figure 1: Color-color diagram for reddened field stars
- Figure 2: CrA Body Extinction Map
- Figure 3: Object 42 Extinction Map

Inverted contours of A, the 311 highly reddened sources in the larger of the two surveyed regions. The top right corner is the Coronet region, which our results confirmed that it is one of the densest regions of the cloud.

Object 42

Although not as dense as some regions in CrA Body, Object 42 is noticeably dense near its center with A up to 13 (Figure 3). This map of the extinction was cross referenced with the emission lines of CO(J=1−0, J=2−1, and J=3−2) from Spitzer observations of molecular gas and dust. The SST telescope in an attempt to further understand the chemistry occurring in Object 42.

Future Work

Currently, data from the infrared Array Camera (IRAC) database is being analyzed in order to obtain information pertaining to higher wavelengths (3.5 − 8.0 microns). From this data, in conjunction with the 2MASS data, spectral energy distributions (SEDs) will be constructed for each source. By benchmarking these SEDs with the shape of the blackbody curve of a typical main sequence star and a known reddened field star, we will be able to provide evidence for or against the possibility of candidate YSOs among other phenomena that may be occurring.

References