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

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Abstract

Two regions of the Corona Australis molecular cloud (CrA) were surveyed using JHK_s 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 color excess values. The color excesses were then used to formulate accurate estimates of the extinction (A_v) for each field star.

The final catalog contains 344 possible field stars across both regions surveyed along visual extinction values in the range $3 < A_v < 20$ mag.

Introduction

At a distance of about 130 pc, the Corona Australis molecular cloud (CrA) is one of the closest regions of ongoing and recent star-formation[2]. Infrared analysis of CrA allows us to accurately observe low-mass young stellar objects (YSO's) and provide insight into the chemical processes that occur in such early-age stars. The chemistry pertaining to YSO's are generally governed by gas-phase reactions, grain surface reactions, and the accumulation of molecules on dust grains in the cloud. In order to infer these physical conditions within the cloud one must first be able to distinguish the highly reddened field stars behind the cloud from embedded YSO's.

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 limited magnitude of K_s=14.4 was imposed, as well as other photometric constraints. Only sources with ph_flag= 'AAA', cc_flag = '0', and any combination of 1's or 2's 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 unreddened stars and those with divergent colors from reddened field stars, color constraints were implemented[1] and adapted for CrA.

- $(J-H) = 1.6(H-K) + 0.56$
- $(J-H) = 1.6(H-K) - 0.04$
- $(H-K) > 0.4$

The value of 1.6 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 dereddened. Using a slope that encompasses the majority of sources provides evidence for an accurate trend line. This line can be associated with the actual reddening ratio of CrA. The determination of this constant allowed for accurate A_v estimations to be found for each source. The constraint on the H-K values corresponds to the threshold extinction for the detection of ices in a dark cloud[3].

Results

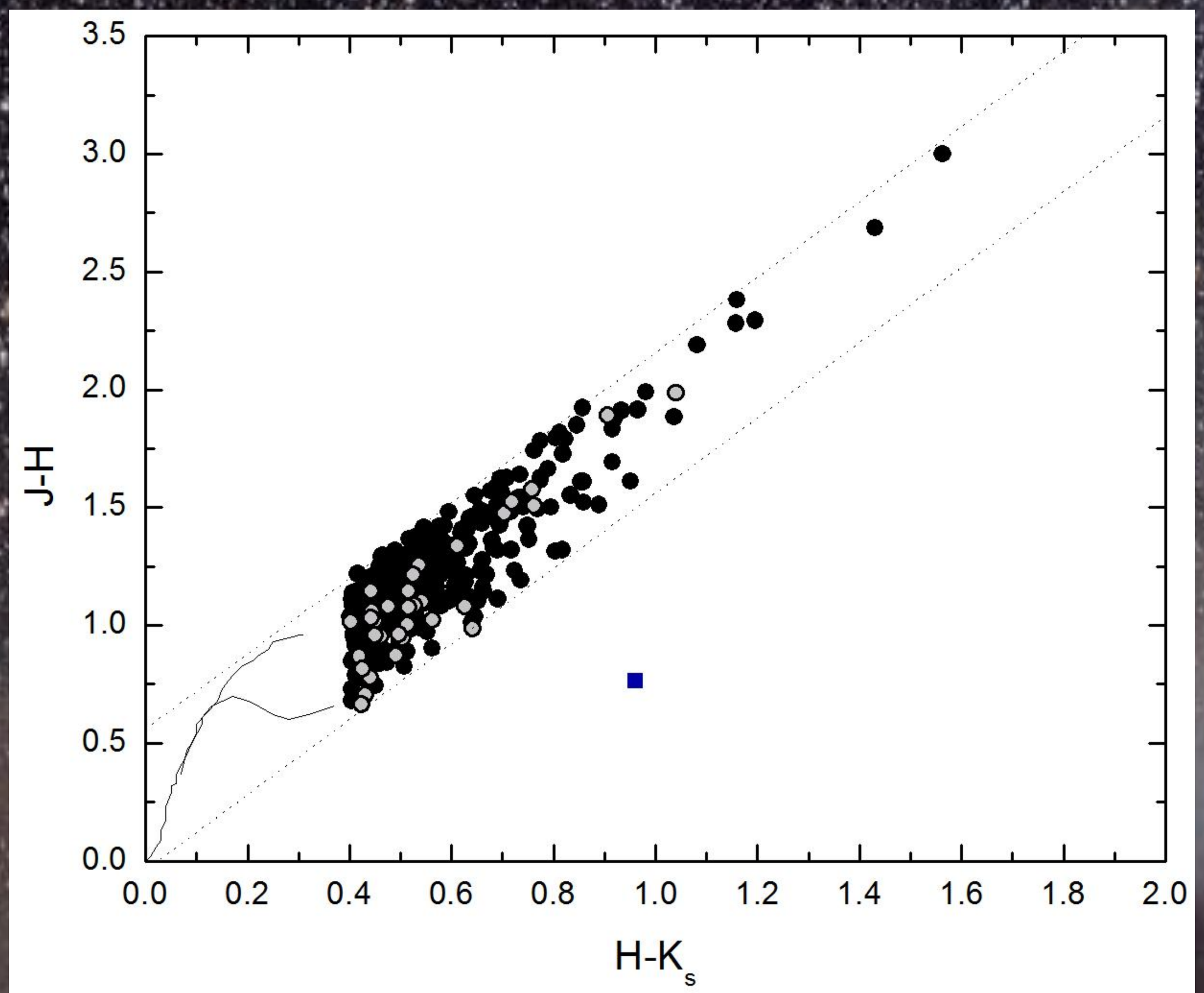

Figure 1: Color-color diagram for reddened field stars

Solid circles represent reddened field stars (Black = CrA Body; Gray = Obj.42). The blue square show an anomalous source that greatly deviated from the others. We can infer that this source has an infrared excess in the K_s band and could be a possible YSO candidate. Further research using higher wavelengths will be required to confirm this assumption. Two other similar sources were found, but were already confirmed T Tauri stars[4].

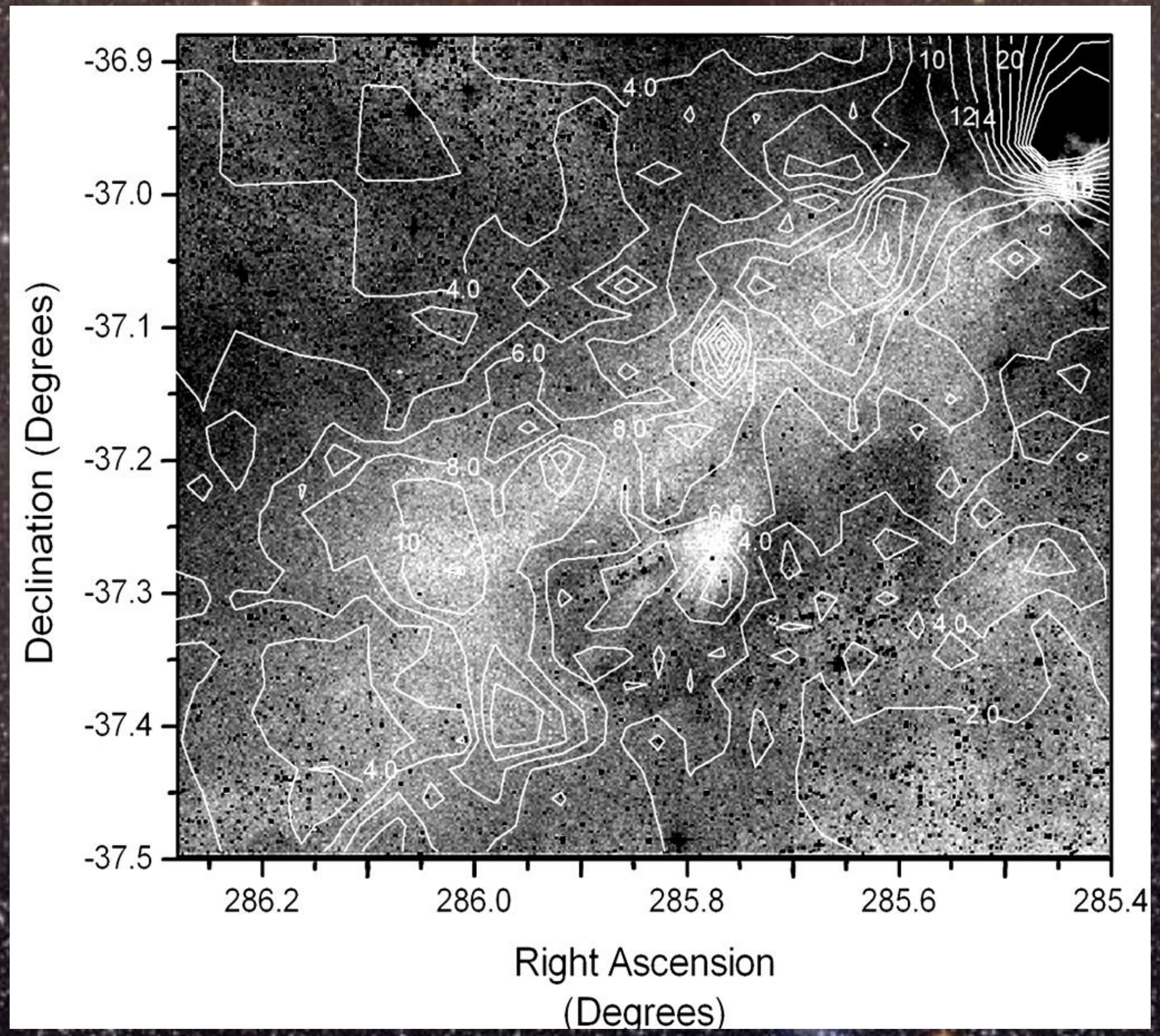

Figure 2: CrA Body Extinction Map

Inverted contours of A_v's of 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_v's upwards of ~ 13 (Figure 3). This map of the extinction was cross referenced with the emission lines of $C_{18}O$ J=1-0, $C_{18}O$ J=2-1, and N_2H+ J=1-0 from radio observations of molecular gas obtained by our group from the SEST telescope in an attempt to further understand the chemistry occurring in Obj. 42.

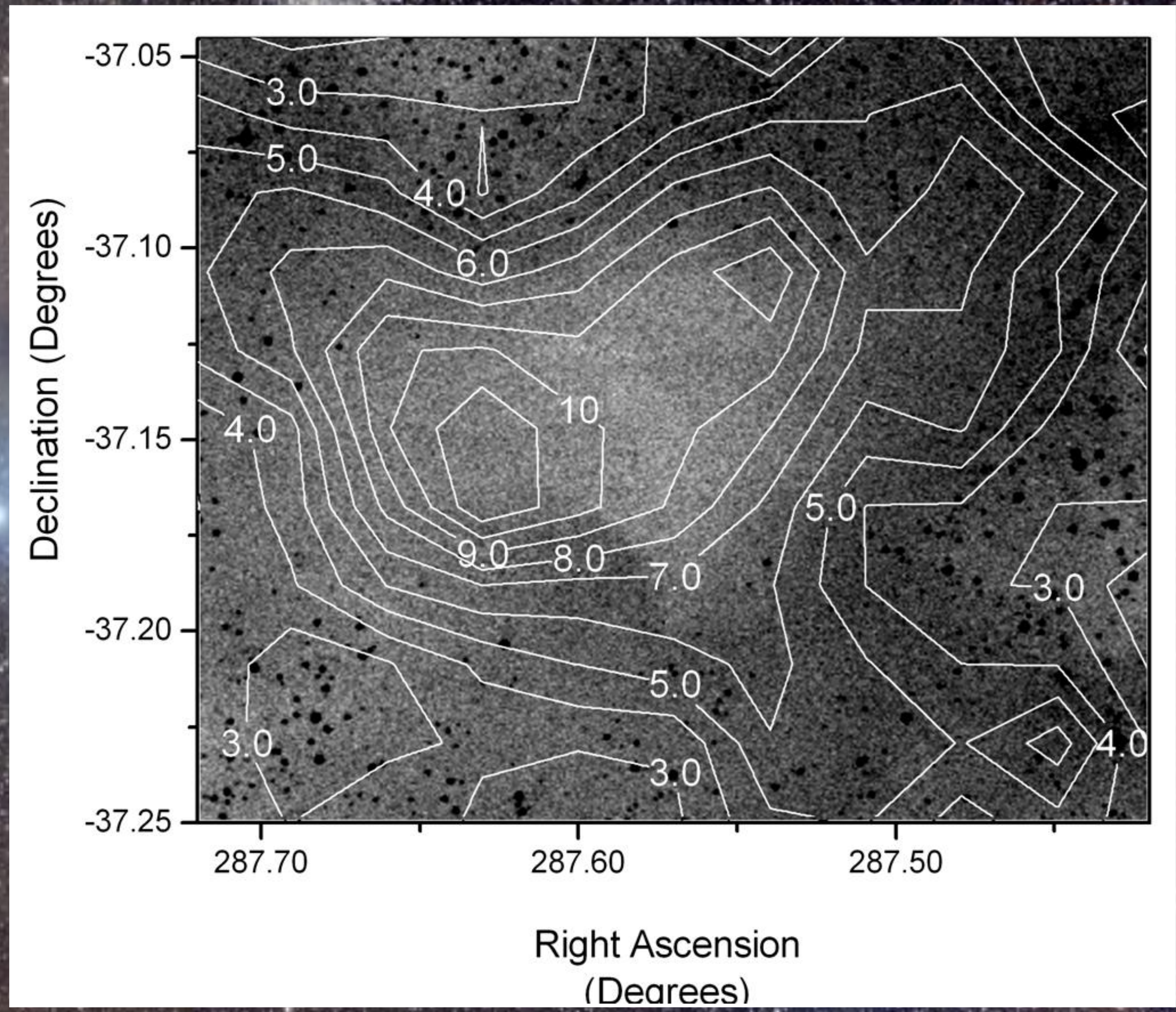

Figure 3: Object 42 Extinction Map

Inverted contours of A_v's of the 33 highly reddened sources in Object 42. Only 33 sources were detected in Obj. 42 (compared to the 311 in CrA Body), but the general trend of extinction can be inferred. The densest region of Obj. 42 appears to be slightly offset to the left of the center as well as in the upper right corner.

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 (SED's) will be constructed for each source. By benchmarking these SED's with the shape of the blackbody curves of a typical main sequence star and a known reddening field star, we will be able to provide evidence for or against the possibilities of candidate YSO's among other phenomena that may be occurring.

References

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