Calibrating a color-magnitude relationship of M dwarf stars with known distances

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What is an M dwarf?

- **A cooler, dimmer, and less massive star than our Sun**
- **Most common type of star in the Milky Way, making up about 70% of the Galaxy's stars[3]**
- **Have lifetimes that can last trillions of years, far longer than the current age of the Universe**

Why study M dwarfs?

- **Most abundant hosts of terrestrial exoplanets**
- **Planets are easier to detect around less massive and cooler stars**
- **Great indicators of Galactic evolution because of long lifetimes and ubiquity**

What is a color-magnitude diagram?

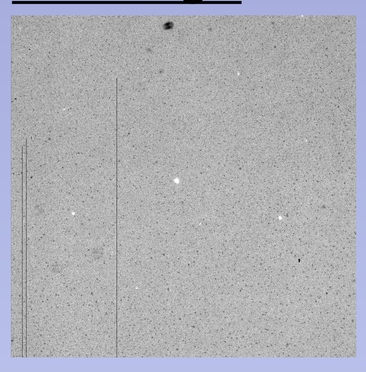
- **Measure stellar colors by finding the differences in their intensities in two separate filters**
- **Plot stellar colors versus their absolute magnitudes (intrinsic brightness)**

Data were collected at the Cerro Tololo Inter-American Observatory 0.9 meter telescope in Chile. M dwarf stars were imaged using the Sloan *griz* filters.

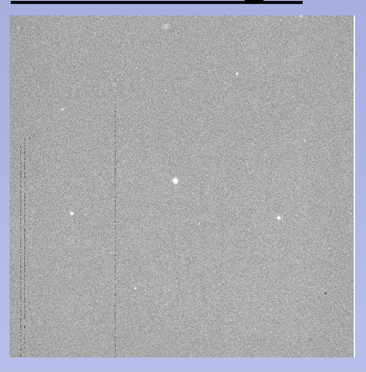
Image Reduction

- **Accounted for irregularities in the CCD as well as imperfections in the mirror**

Raw image:



Science image:



Calibration

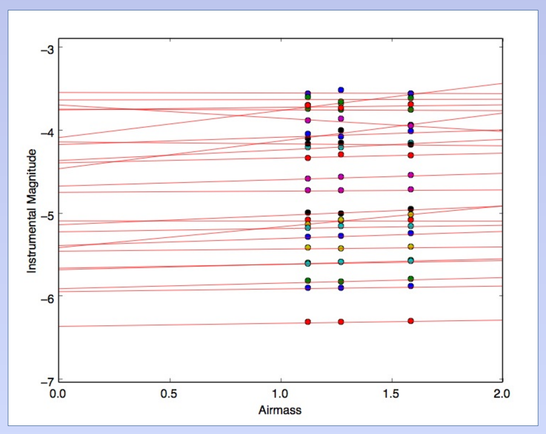


Figure 1: Airmass is the path length through which light from a celestial object must pass through the atmosphere to reach the ground. This is a plot to correct for the effect of airmass on the instrumental magnitudes of the stars.

Data Analysis

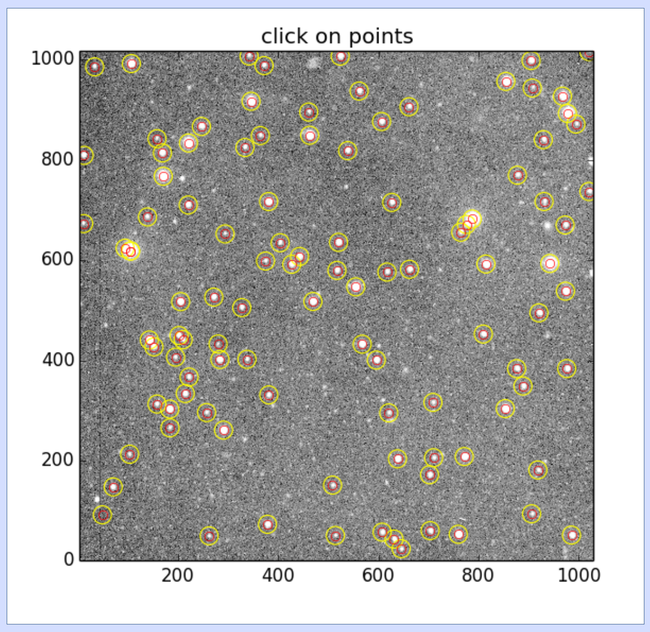


Figure 2: A source detection program was written to identify the stars in each image. Aperture photometry was performed to determine the magnitude of each star.

Color-magnitude Diagram

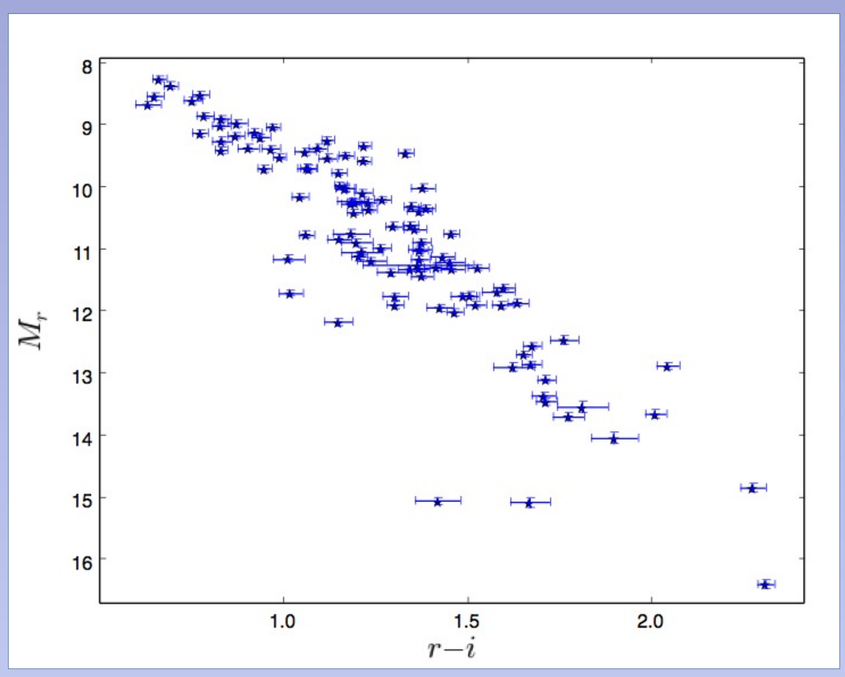


Figure 3: Clear trend among the stars was shown when using *r-i* color versus absolute *r* magnitude.

- **Distances to millions of other stars in the Galaxy can be determined with this relationship**

Magnetically Active M Dwarfs

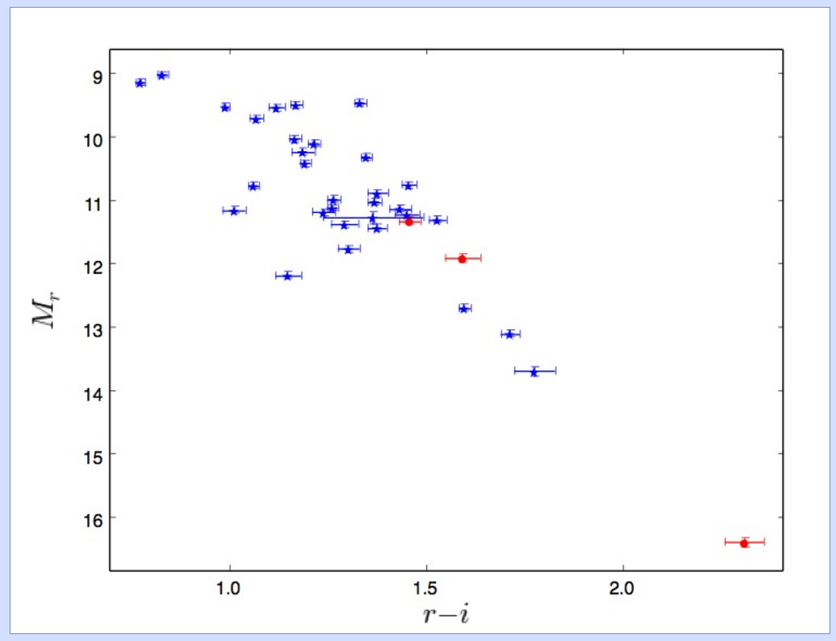


Figure 4: Investigated if magnetically active stars (in red) had a specific trend on a color-magnitude diagram.

- **No general trend was found due to the smaller number of active stars near Earth**
- **Less active stars tend to be older, showing the lack of younger M dwarfs near Earth[4]**

Acknowledgements

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References

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