

RR LYRAE VARIABLE STAR COLORS:

This research project was made possible through a grant from:



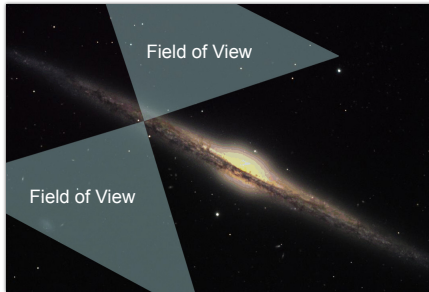
A TOOL FOR MEASURING INTERSTELLAR REDDENING

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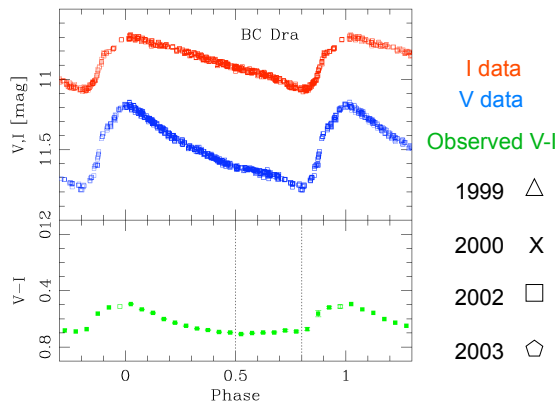
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Region of RR Lyrae Star Observation (Outside the plane of the Milky Way Galaxy)



1. For this project, the 11 RR Lyrae stars we studied were above or below the galactic plane. Although there is dust obscuring RR Lyrae stars in any direction we look, the high concentrations within the plane of the galaxy make accurate measurements of dust with traditional means (COBE data) too error prone.

Folded Light Curve for RR Lyrae Variable Star BC Dra



2. For each of the 11 stars, we plotted V (visual), I (infrared), and V-I (color difference) as a function of phase. This allowed us to compress the pulsation data of the star from 4 years into a phase plot of one pulsation period. By averaging the V-I color measurements for the data points between phase 0.5 and phase 0.8 (the "minimum light range" where color appears constant), we arrive at an observed (apparent) V-I color for this star.

Abstract

RR Lyrae variable stars (RRL) are a common stellar candle for measuring large interstellar distances. Interstellar gas and dust between the target RRL and Earth absorb blue light, reddening the color and diminishing the intensity of starlight. To accurately determine distances to RRL within the plane of our galaxy, we must know the stars' intrinsic V-I color to correct for the interstellar dimming and reddening. *Our research has clarified what this intrinsic color is, based on observations of nearby RRL that are affected only slightly by interstellar reddening.* In the application flowchart below, we give an example for how our results can be used to determine distances to heavily reddened globular clusters

Procedural Flowchart

1. Observe RRL magnitudes in low dust regions in V and I filters
2. Compute V-I value in minimum light period for each star
3. Correct for small reddening (COBE data) to get intrinsic $(V-I)_0$
4. Compute mean $(V-I)_0$ for 11 RRL stars

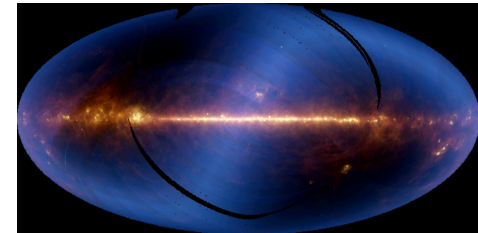
Application Flowchart

1. Observe the apparent V & I magnitudes of an RRL in the plane of the galaxy (as in #1 above)
2. Compute the apparent V-I color at minimum light for the RRL (as in #2 above)
3. Subtract off the intrinsic color of RRL (0.55 mag, from our study) to get the amount of reddening due to dust
4. Compute the amount of dimming due to the dust: it is proportional to the amount of reddening due to the dust
5. Compute the RRL's luminosity (energy output) from the known period-luminosity relationship
6. Use the distance modulus formula to combine observed V magnitude (#1), amount of dimming (#4), and luminosity (#5) to find the RRL's distance

Example: Distance to the globular cluster NGC 6539 containing a newly discovered RR Lyrae star:

Estimate with reddening correction: **22,900 light years**
Without reddening correction: **90,229 light years**

Infrared View: Plane of the Milky Way Galaxy (Dust Concentration)



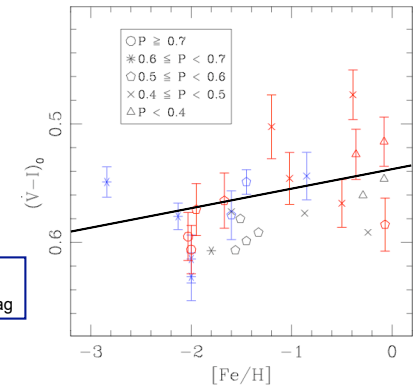
3. To correct for the small amount interstellar reddening for the RR Lyrae stars we observed, dust concentrations were determined by infrared data taken by the COBE satellite. Orange and red areas indicate high concentrations (plane of the galaxy), while blue areas indicate low dust concentrations (above and below the galactic plane).

Intrinsic Color Correction for RR Lyrae Stars

This Project

Guldenschuh et al. (2005)

Prior Studies



Mean $(V-I)_0 = 0.55 \pm 0.012$ mag

4. Once we have calculated the intrinsic $(V-I)_0$ color for each of the RR Lyrae stars we studied, we can then find the average $(V-I)_0$ color intrinsic to **any** RRL, including those within the galactic plane, and check for dependence on composition ($[Fe/H]$) or pulsation period (P).

To the right is a picture of a globular cluster (NGC 104) similar to the one we in the application example at left.

