Stellar clusters through the veil of dust

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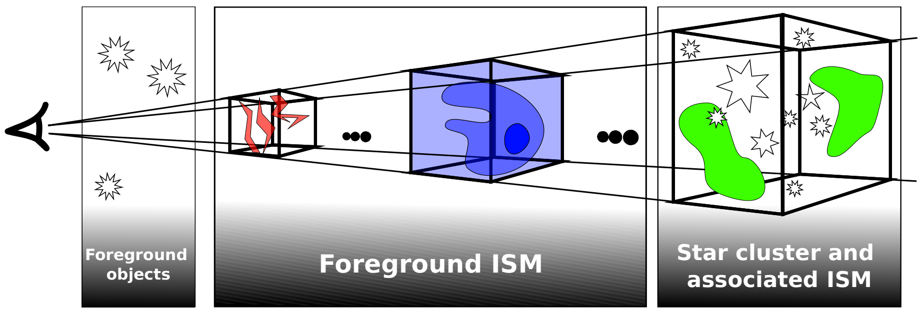
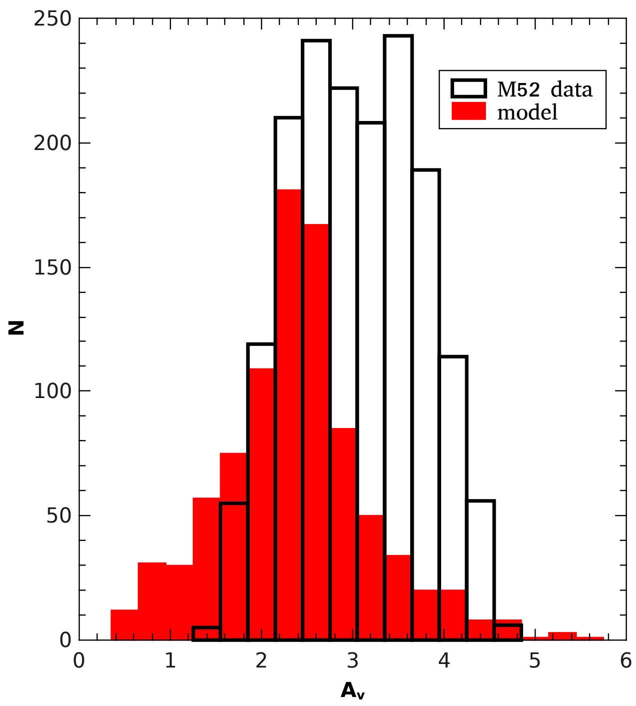
Proper determination of the main parameters of stellar populations is made difficult by intervening interstellar dust which is often interpenetrating young star complexes. We propose a new interactive procedure for gradual refinement of stellar population parameters derived by using synthetic stellar populations and 3D distribution of interstellar dust. We demonstrate capabilities of the method by reconstructing dust cloud structures in front of star clusters observed in the Milky Way.

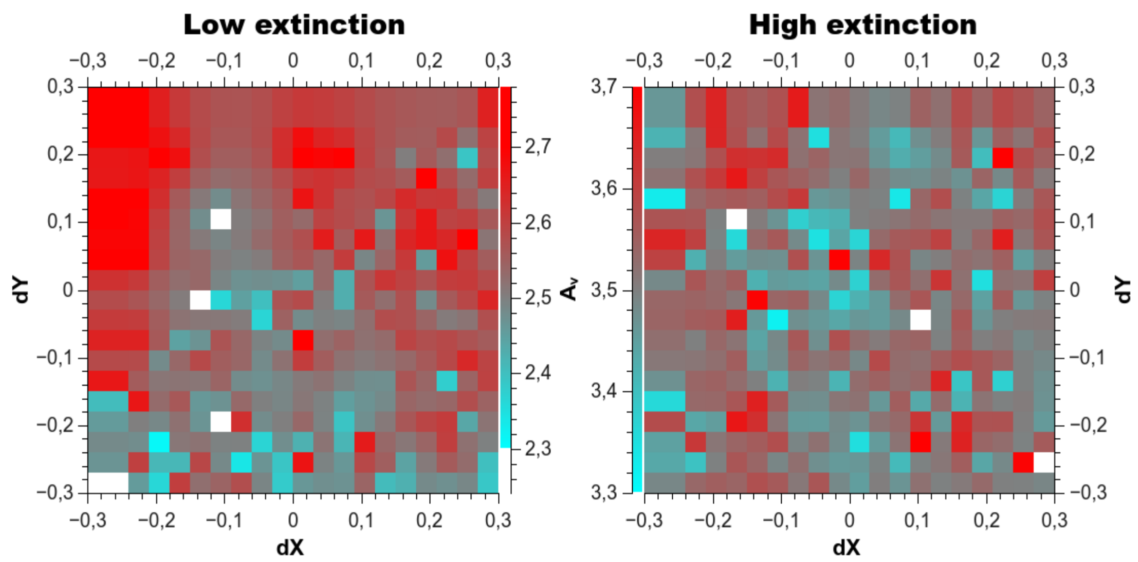


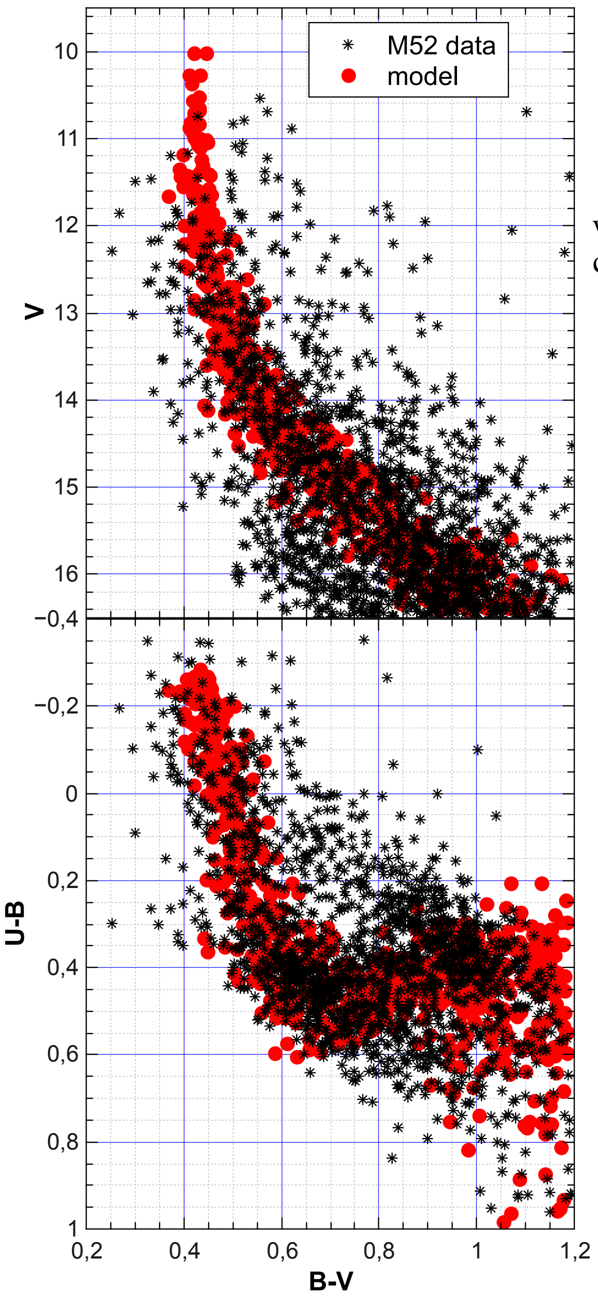
Reconstructing the star formation history of any particular region requires a high quality stellar photometry or a low-resolution spectroscopy of hundreds of objects over an extended field of view. This implies a necessity to account for interstellar extinction, known to be variable on scales comparable to clusters observed at 2-3 kpc distance. In absence of heavily obscuring features such as molecular clouds and globules we may expect to deal with a diffuse extinction A_V up to 4 magnitudes.

While a common view of the diffuse extinction is one of a nuisance, the study of such extinction itself provides an insight into the conditions and evolution of hot mixture of gas and dust remaining after the star formation. Particularly, the investigation of low, variable extinction apparent in observations of galactic open clusters may help to attribute this extinction to mass expulsion during the early stage of cluster evolution, mass accretion from the galactic environment or to a general structure of gas and dust the hot phase of interstellar medium.



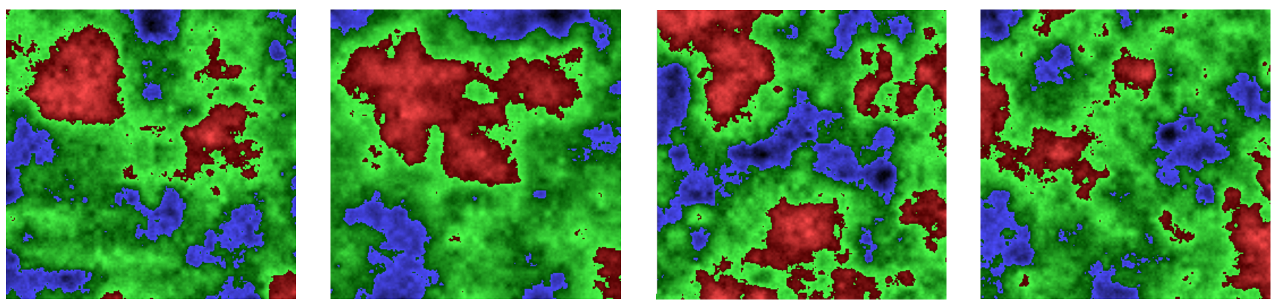
We illustrate our method using a well-studied open cluster M52. Situated at about 1.4 kpc distance it exhibits average reddening of E(B-V) = 0.64 mag. Previous studies (Pandey et al. 2001, Bonatto and Bica 2006) have shown differential reddening to be of the order of $\Delta E(B-V) \leq 0.3 \pm 0.05$ mag. As is apparent from the A_V histogram, obtained using previously published values of cluster distance, age and metallicity, shown on the left, there may be more than one intervening or intermixed dust distribution. This hypothesis is further supported by significantly different spatial distribution of "low" and "high" band (with A_V distribution peaking at around 2.3 and 3.5 mag respectively) extinction (below).





Under assumption that the "low" extinction layer is caused by dust between the observer and the M52 we have explored possible dust and star configurations (example set is plotted in red on the A_V histogram, color-magnitude and color-color diagrams on the left) with following results.

1. Color-color and color-magnitude diagrams are best matched by using clumpy ISM model with angular clump sizes of 0.1 - 0.2 deg, which correspond to clouds with characteristic size less than 2 pc, examples of model extinction distribution shown below. However, the model cloud size distribution requires further investigation as is apparent from differences in A_V histogram shape;
2. Our found extinction values and distribution are in good agreement with previously published studies;
3. "High" extinction layer *may be* associated with M52 itself, however the exact extent and location of dust causing it requires more rigorous modeling of relative distribution of stars and dust.



Acknowledgements

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References

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