

Blue stragglers and delta Scuti stars in NGC-2168 (M35)

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Background

'Blue stragglers' is a term applied to stars that are blueward of the turnoff point of a cluster. Their origin is presently unclear: were they born later than the rest of the cluster, or are they the result of a stellar merger?

Blue stragglers are sometimes associated with stars showing delta Scuti pulsations. Because the hottest delta Scuti stars have main-sequence lifetimes of a few hundred million years, many clusters can be found where the main-sequence turnoff corresponds to a mass limit near the delta Scuti instability strip. Therefore, stars that are just bluer than the turnoff could quite easily lie inside that instability strip and pulsate. For younger clusters, blue stragglers will be B-type stars and may pulsate as SPB or beta Cephei variables.

NGC-2168

Otherwise known as M35, this cluster is approximately 95 Myr old and has a slightly subsolar metallicity ($[Fe/H] = -0.16$). It hosts 17 potential blue stragglers, which we have identified as stars brighter than $V = 10.0$ that are not red giants, plus three stars claimed in the literature to be blue stragglers that are slightly fainter and that have published coordinates. The cluster has variable internal reddening, but based on a colour-magnitude diagram we expect most of these candidate blue stragglers to be either delta Scuti, or given the young cluster age, they could also be B-type pulsators.

Why study blue stragglers in NGC-2168?

This cluster has been identified as a target for studies of its red giants in a K2 proposal by S. Basu. We propose to observe the blue stragglers in long-cadence mode as well, because of the constraints the cluster membership offers to the asteroseismology. The biggest uncertainties in asteroseismic modelling of delta Scuti and B-type pulsators come from poorly constrained stellar parameters. Models cannot be improved unless factors like age, metallicity and luminosity (given the known distance) are externally constrained. Furthermore, blue stragglers are only easily identified in clusters, and it is in this dense stellar environment that the collision hypothesis for their formation is most easily tested. A stellar merger will be revealed by a different internal composition – as probed by asteroseismology – and thus asteroseismology will shed light on the origin of blue stragglers.

Our aims are thus two-fold: (1) to test the stellar merger hypothesis for the formation of blue stragglers; and (2) to use pulsators with well-constrained parameters to improve pulsation models of B and A stars.

Since only 50 percent of stars in the delta Scuti instability strip actually pulsate, and we may hypothesise that the same is true for B-type pulsators, we evaluate that 20 stars is a good number to ensure we obtain a handful of stars whose pulsations can be modelled.