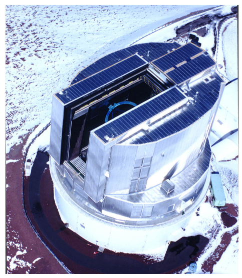
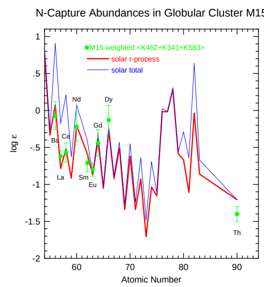
Neutron-Capture Elements in the Metal-Poor Globular Cluster M15

Globular cluster M15
(NOAO/AURA/NSF)



Subaru Telescope



From Sneden et al.
ApJL536,85,(2000)

The abundances of heavy elements (e.g. iron peak and r-process elements) in globular clusters have generally been believed to be quite uniform. The dispersion in [Fe/H] for cluster stars is generally found (with a few notable exceptions) to be less than ∼ 10 percent. This is in contrast to some lighter elements, whose abundances in cluster stars can have been complicated by the effects of stellar evolution. Recently, however, observational studies have reported a significant spread in the r-process abundances of stars in M15, even though their [Fe/H] are almost identical.

In order further to explore this behavior, we have observed six giants in M15 using Subaru/HDS. Our abundance analysis, based on high-quality blue spectra, confirms the existence of significant scatter in heavy r-process element abundances for stars in M15. Furthermore, we have found, for the first time, that there exist trends in abundance ratios of neutron-capture products with the total heavy element enrichment: specifically, the [Y/Eu] ratio decreases with increasing heavy (r-process) element enrichment, as reflected in [Eu/Fe]. Our results indicate that the light neutron-capture elements in these stars cannot be explained by a single r-process event which also enriched the heavy neutron-capture elements: a second r-process contribution is clearly required. Similarly, it has been pointed out that two distinct r-processes contributions are also required to explain the observed neutron-capture elemental abundance patterns in metal-poor field stars.

To date, heavy r-process element patterns have been observed for stars in several metal-poor globular clusters, but their exists little data concerning lighter r-process elements (in the region A ≤ 130). Further observations of r-process elements in globular clusters can provide important information concerning both the sites and processes of r-process synthesis and the formation and early evolution of globular clusters.

This work is based on data collected at the Subaru Telescope, which is operated by the National Astronomical Observatory of Japan.
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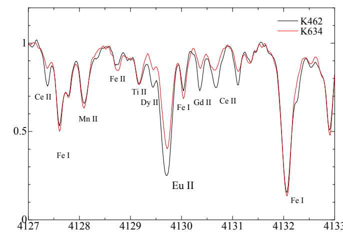
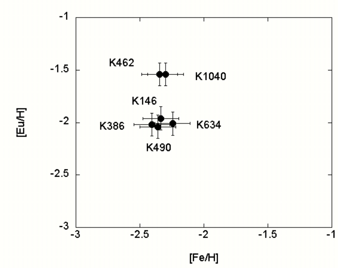
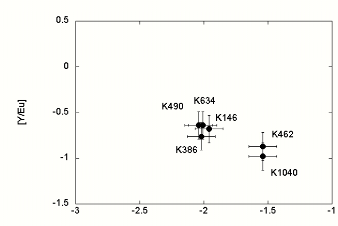


Examples of spectra of M15 stars.



Observed [Eu/H] vs. [Fe/H] of M15 stars. There are high Eu stars and low Eu stars though [Fe/H] are nearly identical within ∼ 10%.



[Y/Eu] vs. [Eu/H]. High Eu stars show low [Y/Eu] ratios.

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