IGRINS Anatomy of the iron-deficient Milky Way cluster VVV CL001

Wisthon Haro[1], José G. Fernández-Trincado[1], Sandro Villanova[2],Christian Moni Bidin[1], Dante Minniti[3,4], Timothy C. Beers[5] et al.,

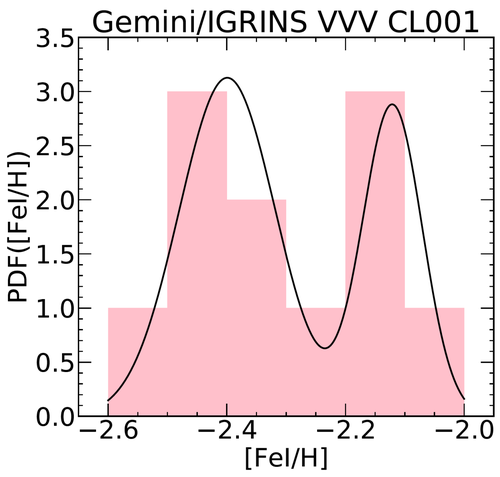
[1]Instituto de Astronomía, Universidad Católica del Norte, Av. Angamos 0610, Antofagasta Chile
[2]Departamento de Astronomía, Casilla 160-C, Universidad de Concepción, Concepción, Chile
[3]Departamento de Ciencias Físicas, Facultad de Ciencias Exactas, Universidad Andres Bello, Fernández Concha 700, Las Condes, Santiago, Chile
[4]Vatican Observatory, Vatican City State, V-00120, Italy
[5] Department of Physics and JINA Center for the Evolution of the Elements, University of Notre Dame, Notre Dame, IN 46556, USA

Context

VVV CL001 (CL1) was discovered in 2011 as a low-mass bulge cluster in the VVV footprint by [1]. More recents studies have suggested that CL1 is likely the most metal-poor cluster ever discovered in the Galaxy [2], or one of the older metal-poor bulge clusters [3] . Here we provides preliminary results of an spectrospic analysis carried-out from *H*-band spectra collected with the Immersion GRating INfrared Spectrometer (IGRINS) for eleven red giant branch stars (RGBs) in CL1.

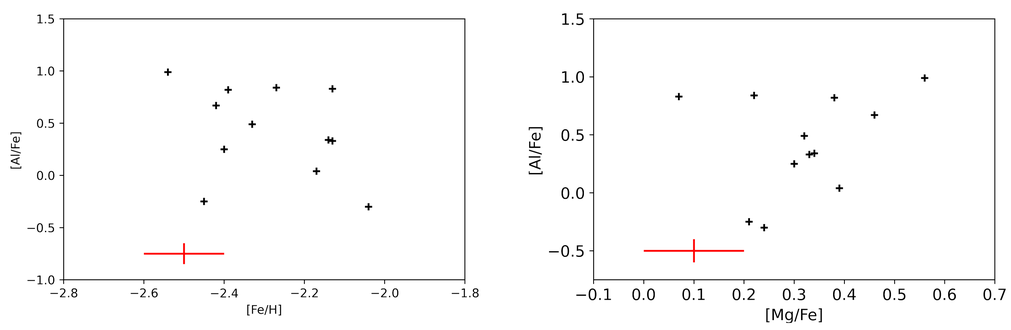
Metallicity Distribution Function (MDF)

Our IGRINS analysis reveal evidence that CL1 has an extended metallicity distribution ([Fe/H] ~ -2.6 to -2.0) composed of at least two distinct stellar populations as can be immediately seen by the two-component GMM fitting in figure below. Therefore, CL1 joins clusters such as ω Cen, M2, and M22 as a new class of iron-complex clusters exhibiting complicated star formation history.



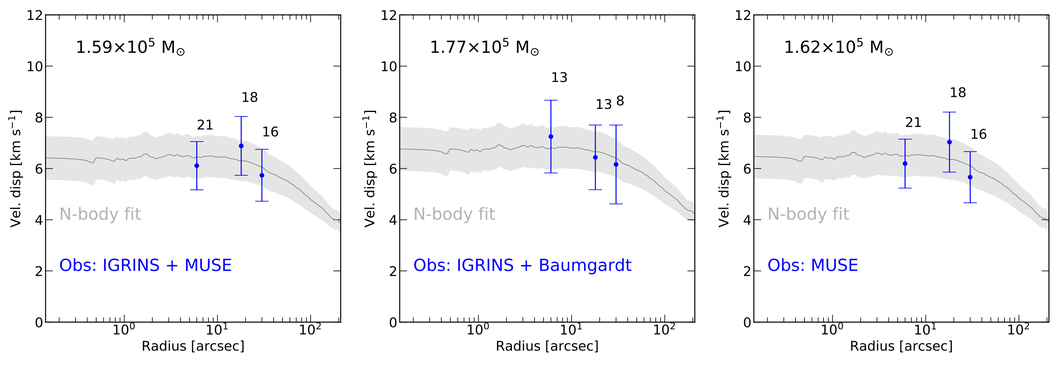
[Al/Fe] spread

We also find IGRINS evidence for a large [Al/Fe]-spread ($>$ 1.1 dex), see Figure below (left-panel). [Al/Fe] is clearly not anti-correlated with [Mg/Fe] – seen in Figure below (right-panel), revealing the complex chemical composition of CL1.



Mass

IGRINS radial velocities (RVs) were derived by cross-correlation with synthetic templates. Coupled with RVs from different sources in the literature and after systematic corrections, these data allow us to better constraint the mass of CL1. Figure below show that different dataset yield a cluster mass in the order of $\sim$0.15 to $\sim$0.17 million solar masses, and high-velocity dispersion. Confiming the intermediate-mass nature of CL1.



Concluding Remarks

The main results of our IGRINS analysis are as follows:

- CL1 exhibits a metallicity spread ($\sim 0.6dex$) with at least two dominant peaks, making it a new class of iron-complex bulge cluster.
- We find a large Al-spread, with not evidence for the typical Mg-Al anticorrelation seen in GCs.
- Precise RV determinations confirm that it is an intermediate-mass bulge fossil system with large velocity dispersion.
- CL1 show a complicated star formation history. We speculate that it could be likely the product of the merge of the nucleus of a dwarf galaxy with GCs at the low-metallicity regime.

References

[1] Minniti D., et al., 2011, A&A, 527, A81; [2] Fernández-Trincado J. G., et al., 2021, ApJ, 908, L42; [3] Carvajal J. O.,et al., 2022, MRAS, 513, 3993-4003

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