

# China-CONICYT Postdoctoral Program Joint Research Project Proposal

<b>Name of Principal Investigator:</b>	Doug Geisler (Chile)
<b>Collaborators:</b>	Gang Zhao (China), Sandro Villanova (Chile)
<b>Proposal Title:</b>	Investigating Galactic Formation and Chemical Evolution using Star Clusters
<b>Host Institute in Chile:</b>	Departamento de Astronomía, Universidad de Concepción
<b>Host Institute in China:</b>	National Astronomical Observatories, Chinese Academy of Sciences

## Abstract:

The primary goal of this proposal is to study the formation and chemical evolution of different components of the Galaxy using multiwavelength observations of star clusters (SCs). SCs are of paramount importance in the investigation of a wide variety of fundamental astrophysical phenomena. One of the major goals of modern astronomy is an understanding of galaxy formation. SCs, especially the ancient globular clusters (GCs), are perfect tools for this study, as they were both witnesses to the long-ago epoch of major Galactic formation and are still present today. In addition, we can derive their ages, velocities and detailed chemical abundances to help unravel the process of formation and evolution using both temporal, chemical and kinematical evidence. SCs, including GCs and open clusters (OCs), are present in all major components of the Galaxy, including the halo, bulge, thin and thick disks, and thus can be used to study the histories of all these Galactic structures. We will place special emphasis on Galactic bulge GCs, given their importance, the primordality of the bulge and our growing expertise in this field.

A secondary goal of this project is to further our observational database concerning the fascinating phenomenon of multiple populations in SCs. The longstanding notion that Galactic GCs are quintessential Simple Stellar Populations is now overthrown by the discovery of multiple populations (MPs) in an increasing number of GCs (but so far apparently not in younger and less massive OCs). They appear to be almost ubiquitous in old, massive GCs, thus forcing a paradigm shift in our understanding of their formation. However, before we can formulate a proper theoretical framework for their origin, further detailed, comprehensive observational data, both spectroscopic and photometric, are badly needed to help constrain any models.

Our group at Universidad de Concepcion has been intensely involved in a longterm project aimed at obtaining ages and abundances, as well as velocities, for a variety of SCs in different Galactic components, as well as investigating MPs in a wide variety of SCs. We are currently involved in several ongoing large Galactic spectroscopic surveys that should prove to be even more fruitful and powerful in the study of SCs and their application to the above-mentioned areas of astrophysics. In particular, we are heavily involved in both the APOGEE and Gaia-ESO surveys. Using these ongoing Galactic spectroscopic surveys with high resolution multi-object spectrographs, we will explore the detailed chemical patterns of giant members in GCs and OCs. At the same time, Gang Zhao and collaborators at NAOC are leaders in the use of LAMOST to study many of these same astrophysical goals. Our aim is to join forces and study in particular the chemical abundances of stellar components in SCs using these large surveys that we are part of. Adding a joint postdoc will help us to forge a strong collaboration and allow us to maximize the scientific output.

Our privileged access to the world-class observational facilities in Chile will allow us to obtain follow-up observations of particularly important SCs. The proposed work is observationally oriented, but theoretical models will also be used to guide the astrophysical interpretations.