The Asclepias project

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Astronomy Astrophysics

Testing the chemical tagging technique with open clusters*

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ABSTRACT

Context. Stars are born together from giant molecular clouds and, if we assume that the priors were chemically homogeneous and well-mixed, we expect them to share the same chemical composition. Most of the stellar aggregates are disrupted while orbiting the Galaxy and most of the dynamic information is lost, thus the only possibility of reconstructing the stellar formation history is to

cauxy and most of the dynamic information is lost, thus the only possibility of reconstructing the stellar formation history is to analyze the chemical abundances that we observe today.

Alms. The chemical agging technique aims to recover disrupted stellar clusters based merely on their chemical composition. We evaluate the viability of this technique to recover co-natal stars that are no longer gravitationally bound.

Methods. Open clusters are co-natal aggregates that have managed to survive together. We compiled stellar spectra from 31 old and intermediate-age open clusters, homogeneously derived atmospheric parameters, and 17 abundance species, and applied machine learning algorithms to group the stars based on their chemical composition. This approach allows us to evaluate the viability and efficiency of the chemical tuesient technique.

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*Results. We found that stars at different evolutionary stages have distinct chemical patterns that may be due to NLTE effects, atomic diffusion, mixing, and biases. When separating stars into dwarfs and giants, we observed that a few open clusters show distinct chemical signatures while the majority show a high degree of overlap. This limits the recovery of co-natal aggregates by applying the chemical tagging technique. Nevertheless, there is room for improvement if more elements are included and models are improved.

Key words. stars: abundances - techniques: spectroscopic - Galaxy: abundances

1. Introduction

Understanding the formation and evolution of galaxies and their structure (e.g., disks) is an open issue in near-field cosmology. One approach to tackle this problem is to study our own Galaxy by unravelling the sequence of events that took place in the formation of the Galactic disk (where most star formation occurs). Unfortunately, most of the dynamical information is lost since the disk was formed in a dissipative process and it evolved dy-namically. Nevertheless, the chemical composition of the stars

* Based on observations obtained at the Telescope Bernard Lyot (USR5026) operated by the Observatoire Midi-Pyrénées, Université de Toulouse (Paul Sabatier), Centre National de la Recherche Scientifique of France, and on public data obtained from the ESO Science Archive Facility under requests number 81252 and 81618.

Stars are born in aggregates from molecular clouds (Shu et al. 1987; Meyer et al. 2000; Lada & Lada 2003). Hydrodynamical simulations indicate that the progenitor cloud undergoes fragmentation preventing contraction onto a single star (Jappsen et al. 2005; Tilley & Pudritz 2004; Larson 1995). Hundreds to thousands of stars can be formed from one single cloud. If we assume that the progenitor cloud was chemically well-mixed (Feng & Krumholz 2014), then we expect to observe homogethe disk was formed in a dissipative process and it evolved dynamically. Nevertheless, the chemical composition of the stars an potentially help us to recover the history of our Galaxy (Freeman & Bland-Hawthorn 2002).

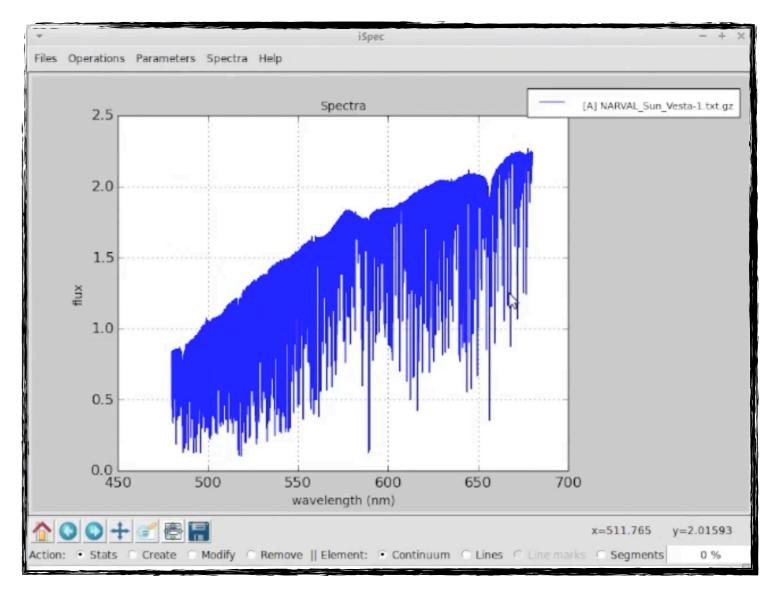
* Based on observations obtained at the Telescope Bernard Lovi.

The viability of this approach depends on two critical issues: do stars born together have the same chemical signature? And, are the chemical signatures different enough to distinguish stars formed from different molecular clouds

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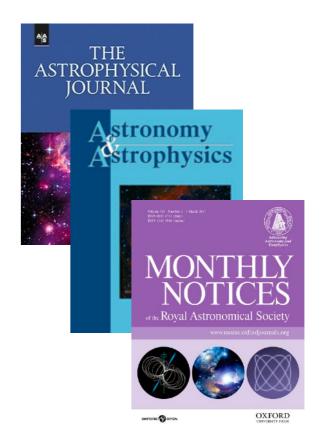


Determining stellar atmospheric parameters and chemical abundances of FGK stars with **iSpec** (Blanco-Cuaresma et al. 2014a)



www.blancocuaresma.com/s/



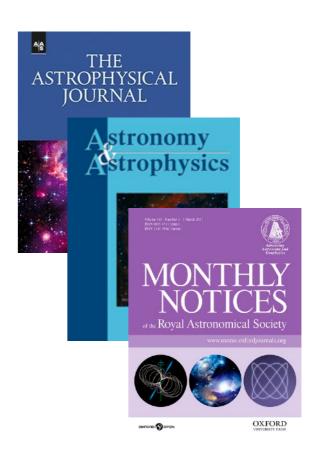


















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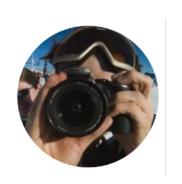
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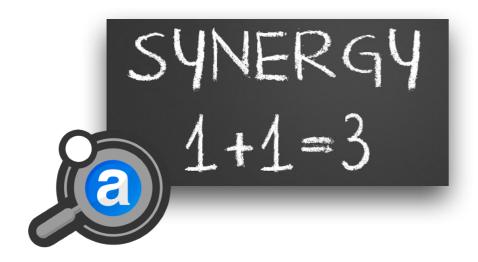


Thomas Robitaille

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- New tech and workflows
- Create a webhook service to emit events
- Adaptable to other sources (e.g., data)



