# General Introduction

# Organisation

- Only online, but we can also meet in person later on, if needed
- All slides and lessons are accessible via the IS https://is.muni.cz/auth/el/1431/podzim2021/F3501/
- First we go through the basics of the topics and in parallel there are some tasks to do
- When we have all results, we discuss them
- Start writing a paper for Astronomy & Astrophysics

Topic: Seminar - Workingflow
Time: Sep 20, 2021 05:00 PM Amsterdam, Berlin, Rome, Stockholm, Vienna
Every week on Mon, until Dec 13, 2021, 13 occurrence(s)
Sep 20, 2021 05:00 PM
Sep 27, 2021 05:00 PM
Oct 4, 2021 05:00 PM
Oct 11, 2021 05:00 PM
Oct 18, 2021 05:00 PM
Oct 25, 2021 05:00 PM
Nov 1, 2021 05:00 PM
Nov 8, 2021 05:00 PM
Nov 15, 2021 05:00 PM
Nov 22, 2021 05:00 PM
Nov 29, 2021 05:00 PM
Dec 6, 2021 05:00 PM
Dec 13, 2021 05:00 PM
Please download and import the following iCalendar (.ics) files to your calendar system.
Weekly:
https://univienna.zoom.us/meeting/tJUkcuuoqj0jE9xxKvgMwocnWUdIs0MCEPUR/ics?icsToken=98tyKuCppz4oGtCTuRCPRowcHY_4a_TwiCFEj_pFhDTzBA1EbQD4AddGG6EvPfv1

Join Zoom Meeting
https://univienna.zoom.us/j/91952046998?pwd=NE1xeGVNekNsZFk1VVhlV0h3cUFxZz09

Meeting ID: 919 5204 6998
Passcode: 069440
One tap mobile
+4312535502,,91952046998#,,,,*069440# Austria
+436703090165,,91952046998#,,,,*069440# Austria

Join by SIP
91952046998@zoomcrc.com

Join by H.323
162.255.37.11 (US West)
162.255.36.11 (US East)
213.19.144.110 (Amsterdam Netherlands)
213.244.140.110 (Germany)
Meeting ID: 919 5204 6998
Passcode: 069440

# Already published papers

Received: 28 December 2018 | Accepted: 18 January 2019
DOI: 10.1002/asna.201913547

ORIGINAL ARTICLE

Astronomische Nachrichten

## An analysis of four stellar rings

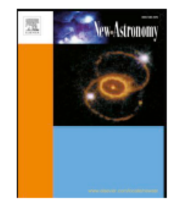
Ernst Paunzen[1,*] | Jan Florian[2] | Anna Gütl-Wallner[2] | Andreas Herdin[2] | Erwin Kralofsky[2] | Kieran Leschinski[2] | Michael Mach[2] | Hans Michael Maitzen[2] | Michal Prišegen[1] | Markus Rockenbauer[2] | Monika Rode-Paunzen[4] | Stefan Wallner[2,3]

New Astronomy 68 (2019) 39–44

Contents lists available at ScienceDirect

New Astronomy

journal homepage: www.elsevier.com/locate/newast




## TYC 3637-1152-1 – A high amplitude $\delta$ Scuti star with peculiar pulsational properties

Ernst Paunzen[*,a], Klaus Bernhard[b,c], Moriz Frauenberger[d], Santiago Helbig[d], Andreas Herdin[d], Stefan Hümmerich[b,c], Jan Janík[a], Andreas Karnthaler[d], Richard Komžík[e], Beatrice Kulterer[d], Hans-Michael Maitzen[d], Stefan Meingast[d], Sebastian Miksch[d], Theodor Pribulla[e], Monika Rode-Paunzen[d], Wolfgang Sakuler[d], Carla Schoder[d], Eugene Semenko[f], Nikolaus Sulzenauer[d]

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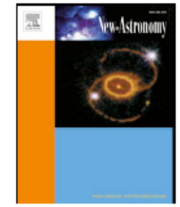


## TYC 3637-1152-1 – A high amplitude $\delta$ Scuti star with peculiar pulsational properties

Check for updates

Ernst Paunzen[*,a], Klaus Bernhard[b,c], Moriz Frauenberger[d], Santiago Helbig[d], Andreas Herdin[d], Stefan Hümmerich[b,c], Jan Janík[a], Andreas Karnthaler[d], Richard Komžík[e], Beatrice Kulterer[d], Hans-Michael Maitzen[d], Stefan Meingast[d], Sebastian Miksch[d], Theodor Pribulla[e], Monika Rode-Paunzen[d], Wolfgang Sakuler[d], Carla Schoder[d], Eugene Semenko[f], Nikolaus Sulzenauer[d]

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[b] *Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Berlin, Germany*
[c] *American Association of Variable Star Observers (AAVSO), Cambridge, USA*
[d] *Institute for Astrophysics, University of Vienna, Türkenschanzstrasse 17, Vienna 1180, Austria*
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A R T I C L E I N F O

*Keywords:*
Stars: variables: delta Scuti
Stars: individual: TYC 3637-1152-1

A B S T R A C T

In some $\delta$ Scuti stars, only one or two radial modes are excited (usually the fundamental mode and/or first overtone mode) and the observed peak-to-peak amplitudes exceed 0.3 mag ($V$). These stars are known as High Amplitude Delta Scuti (HADS) variables.

We here present a detailed photometric and spectroscopic analysis of the HADS star TYC 3637-1152-1. We have derived a metallicity close to solar, a spectral type of F4 V and an age of $\log t = 9.1$. Employing archival time series data from different sources, two frequencies $f_0 = 10.034$ c/d and $f_1 = 12.681$ c/d and their harmonics and linear combinations were identified. The period ratio of $f_0/f_1 = 0.791$ puts this star into a peculiar position in the Petersen diagram, from which we conclude that TYC 3637-1152-1 is a unique object with peculiar pulsational properties that indicate a transitional state between HADS stars pulsating in the fundamental and first overtone modes and stars pulsating in higher overtones.

# Already published papers

*Astronomy & Astrophysics* manuscript no. sdA_v1
February 21, 2020


## A Kepler K2 view of sdA stars

G. Mösenlechner[1], E. Paunzen[2], I. Pelisoli[3], J. Seelig[1], S. Stidl[1], and H.M. Maitzen[1]

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[2] Department of Theoretical Physics and Astrophysics, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic
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**ABSTRACT**

*Context.* The rather inhomogeneous group of subdwarf A-type (sdA) stars come in the focus only in the recent years because of their possible link to extremely-low mass white dwarfs. Still the formation and evolution of these stars are a matter of debate. The confusion with metal-poor main sequence A-type hinders a statistical sound analysis of these objects.
*Aims.* The analysis of variable stars, especially pulsating stars, can help to put further constraints on their evolutionary status. But also the binary ratio, deduced from eclipsing binaries and ellipsoidal variables, for example, is important as input for stellar models. For this, we have extracted all available high precision light curves from the Kepler K2 mission.
*Methods.* We have performed a thorough time series analysis employing three different methods of all available light curves. Frequencies with a signal-to-noise ratio of larger than four have been used for the further analysis.
*Results.* From the 25 targets, 13 turned out to be variables of different kinds, i.e. classical pulsating stars, ellipsoidal and cataclysmic variables, eclipsing binaries as well as rotationally induced variables. For the remaining 12 objects, a variability threshold was determined.

**Key words.** subdwarfs – white dwarfs – binaries: general – stars: evolution – variables: general

# Already published papers

A&A 645, A13 (2021)
https://doi.org/10.1051/0004-6361/202039276


Astronomy & Astrophysics

## White dwarf-open cluster associations based on *Gaia* DR2

M. Prišegen, M. Piecka, N. Faltová, M. Kajan, and E. Paunzen

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Received 27 August 2020 / Accepted 13 October 2020

**ABSTRACT**

*Context.* Fundamental parameters and physical processes leading to the formation of white dwarfs (WDs) may be constrained and refined by discovering WDs in open clusters (OCs). Cluster membership can be utilized to establish the precise distances, luminosities, ages, and progenitor masses of such WDs.
*Aims.* We compile a list of probable WDs that are OC members in order to facilitate WD studies that are impractical or difficult to conduct for Galactic field WDs.
*Methods.* We use recent catalogs of WDs and OCs that are based on the second data release of the *Gaia* satellite mission (GDR2) to identify WDs that are OC members. This crossmatch is facilitated by the astrometric and photometric data contained in GDR2 and the derived catalogs. Assuming that most of the WD members are of the DA type, we estimate the WD masses, cooling ages, and progenitor masses.
*Results.* We have detected several new likely WD members and reassessed the membership of the literature WDs that had been previously associated with the studied OCs. Several of the recovered WDs fall into the recently reported discontinuity in the initial-final mass relation (IFMR) around $M_i \sim 2.0\,M_\odot$, which allows for tighter constrains on the IFMR in this regime.

**Key words.** open clusters and associations: general – white dwarfs – catalogs – surveys

# Already published papers

*Astronomy & Astrophysics* manuscript no. aa41534_arxiv
August 27, 2021



## A case study of ACV variables discovered in the Zwicky Transient Facility survey

N. Faltová[1], K. Kallová[1], M. Prišegen[1], P. Staněk[1], J. Supíková[2], C. Xia[1], K. Bernhard[3,4], S. Hümmerich[3,4], and E. Paunzen[1]

[1] Department of Theoretical Physics and Astrophysics, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic
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[4] American Association of Variable Star Observers (AAVSO), Cambridge, USA

# Topic – this semester

- Find all chemically peculiar (CP) stars which are members of open clusters or stellar associations
- What do we need?
  1. Parallaxes, proper motions, coordinates and diameters of star clusters
  2. Parallaxes, proper motions and coordinates of CP stars
  3. Determination of the true members
  4. Plot the colour-magnitude diagrams as check

# Open Clusters

Textbook

# Open Clusters

Reality

# Definition of Star Clusters

Star clusters are physically related groups of stars held together by mutual gravitational attraction.

The number of all star clusters in the Milky Way is about 10 000 but only 3000 in catalogues. From these, about 170 Globular Clusters ("old", Population II).

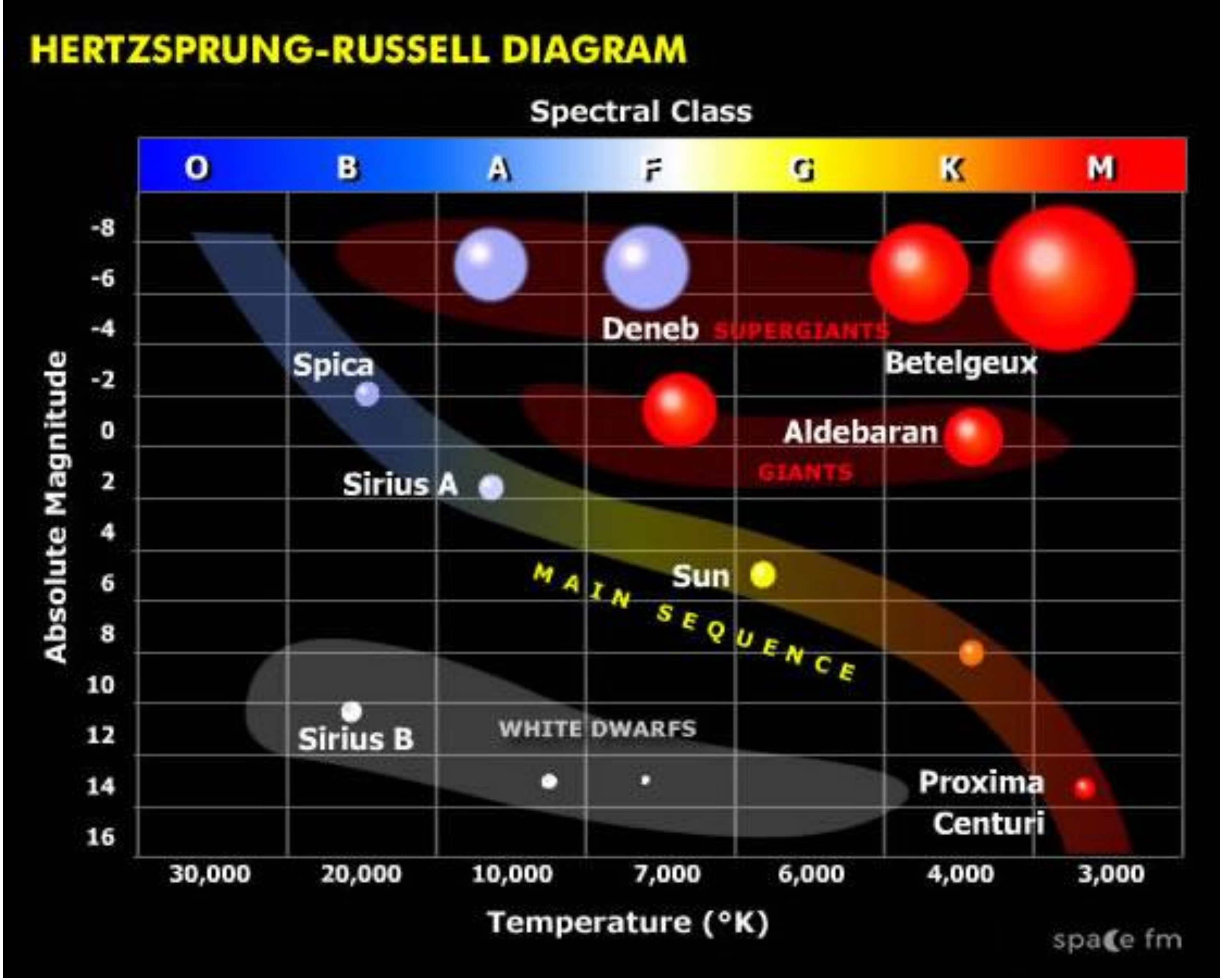
# Working Hypothesis

All members of an individual Star Cluster are born within one Giant Molecular Cloud (GMC) over a time scale of some few Myrs.

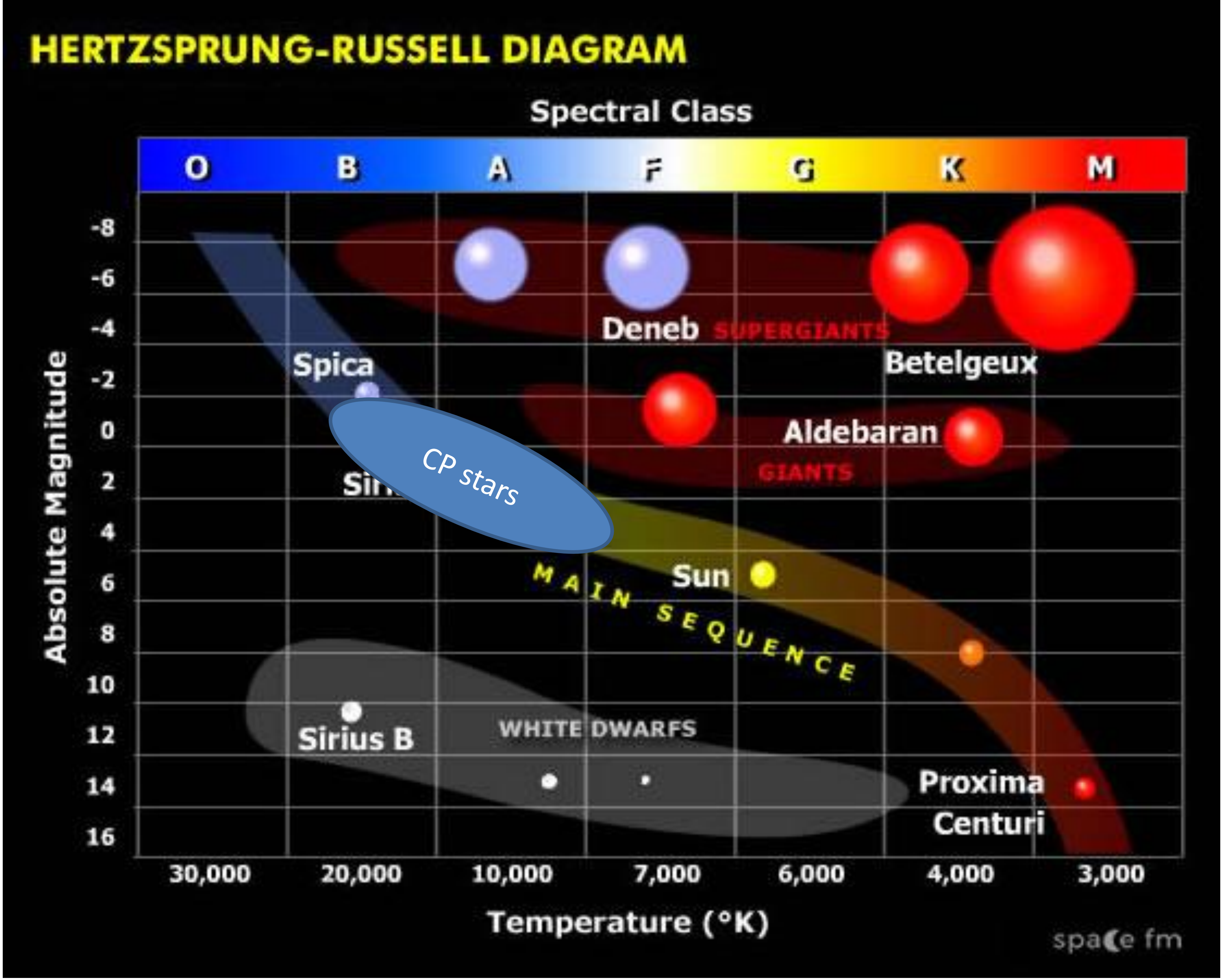
What are the immediate conclusions?

# All members of an individual star cluster have:

- ***Identical distance from the Sun:*** +- The volume expansion of the cluster (diameters < 25 pc)
- ***Identical age:*** +- Time scale of star formation (a few Myrs)
- ***Identical metallicity:*** +- Inhomogeneities of the initial GMC and the chemical evolution of the giant branch
- ***Identical kinematical characteristics:***
  +- Intrinsic spread
  - Radial velocity
  - Proper motion



HERTZSPRUNG-RUSSELL DIAGRAM
Spectral Class
O
B
A
F
G
K
M
Absolute Magnitude
-8
-6
-4
-2
0
2
4
6
8
10
12
14
16
Deneb
SUPERGIANTS
Betelgeux
Spica
Aldebaran
GIANTS
Sirius A
Sun
MAIN SEQUENCE
Sirius B
WHITE DWARFS
Proxima
Centuri
30,000
20,000
10,000
7,000
6,000
4,000
3,000
Temperature (°K)
space fm


HERTZSPRUNG-RUSSELL DIAGRAM
Spectral Class
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G
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Absolute Magnitude
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-6
-4
-2
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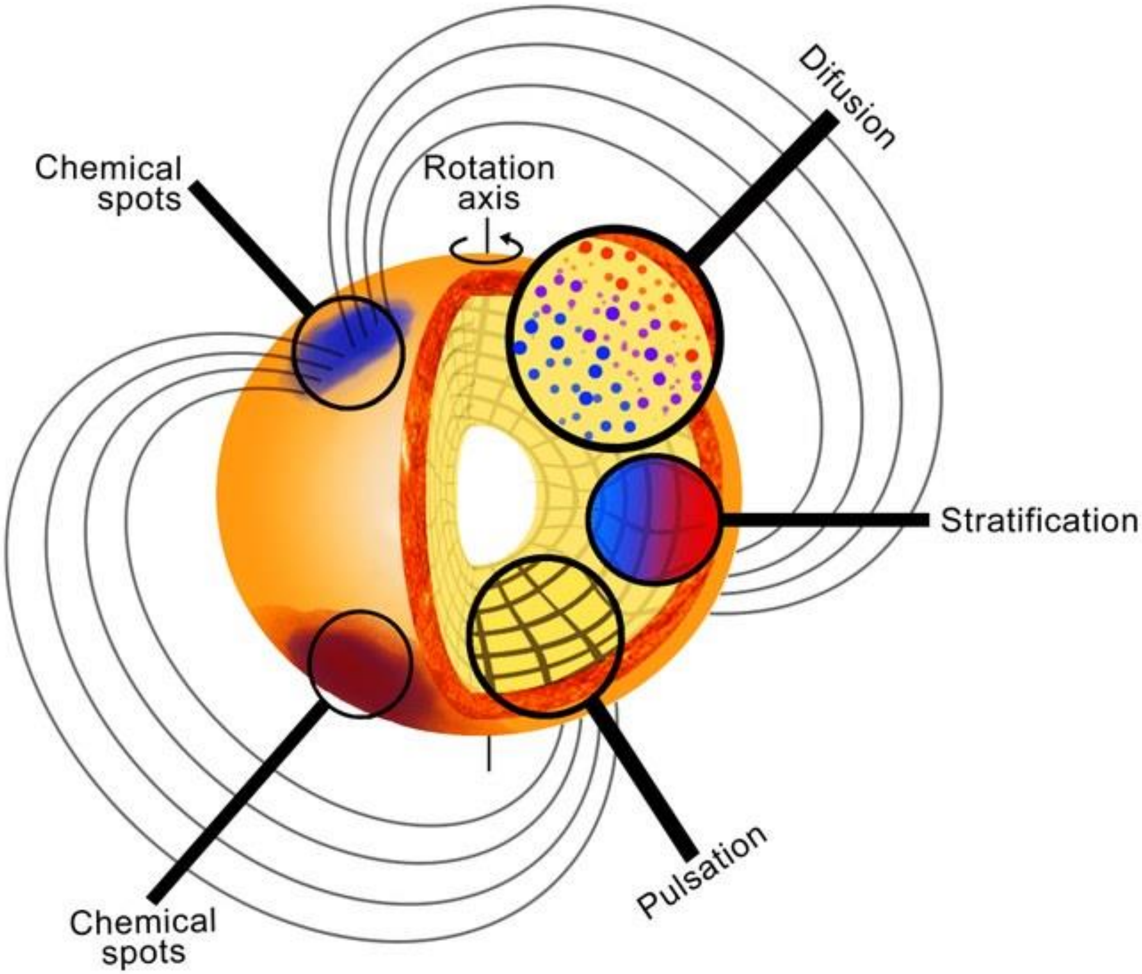
4
6
8
10
12
14
16
Deneb
SUPERGIANTS
Betelgeux
Spica
Aldebaran
GIANTS
CP stars
MAIN SEQUENCE
Sun
Sirius B
WHITE DWARFS
Proxima
Centuri
30,000
20,000
10,000
7,000
6,000
4,000
3,000
Temperature (°K)
space fm

# Classical chemically peculiar stars

- Upper main sequence stars, spectral region B2 to F2
- Low rotational rate (< 100 km/s)
- Some have stable and organized stellar magnetic field
- Diffusion and stratification
- Spots

# Classical chemically peculiar stars



# What can we learn from CP stars in open clusters?

- Do we find CP stars at all ages?
- Are there very young, especially magnetic CP stars existing?
- Timescales for the formation of the local stellar magnetic field and diffusion.
- Is there an influence of the local metallicity on the peculiarity?
- Single star determination correct?