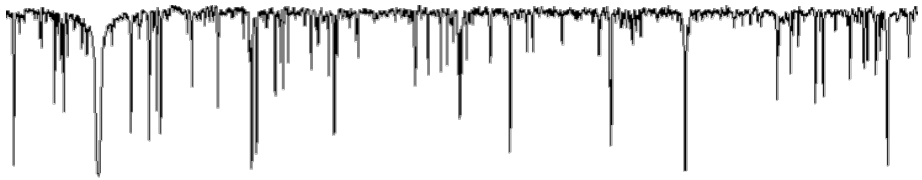
GES/UVES
Phisical parameter determination



Gaia ESO Spectroscopic Survey (**GES**)

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Gaia:
III Reunión Científica de la REG
On ground surveys: status and future plans
Sitges 23-25 enero 2013

Gaia ESO Spectroscopic Survey (GES)

Will start to provide large amount of data

- Public large spectroscopic survey with **FLAMES@VLT**
- **300 nights** (30n/semester) over 5 (4+1) years;
  start 1/2012 (P88), end 9/2016 (P97)+; visitor mode

- Stellar atmospheric parameters (T_{eff}, log g, ξ and **[Fe/H]**)
- Abundance determination.

- Different tests with UVES archive spectra already started.

- **WG1**: Cluster Membership Analysis
- **WG11**: UVES FGK-star Spectrum Analyses
- **WG12**: Pre-Main-Sequence Stars Spectrum Analyses

→ Combined Gaia and homogeneous spectroscopic dataset full 6D phase space f(x,y,z,vx,vy,vz), plus stellar parameters, and chemistry for a very large number and variety of stars down to the 19 mag: core science plus legacy science

GES WG11:
UVES FGK-star Spectrum Analyses

WG Coordinators: Rodolfo Smiljanic & Andreas Korn

Table 1. Summary per node

Allocation of resources within WG11 - UVES analysis FGK stars			
Node	**Contact**	**Number of members**	**Total FTEs**
Arcetri-ESO	Laura Magrini	6	1.30
Bologna	Elena Pancino	3	0.45
Bologna/Padova	Angela Bragaglia	2	0.40
Brussels/ULB	Sophie Van Eck	3	0.30
Catania	Antonio Frasca	3	0.5
Concepcion	Sandro Villanova	2	0.40
Groningen	Bertrand Lemasle	1	0.20
Hertfordshire	Sean Ryan	1	0.10
IAC-Alicante-AIP	Carlos Allende Prieto	5	0.80
Indiana	Eileen Friel	2	0.50
Liege	Thierry Morel	2	0.20
Lund-Uppsala-MPA-Bordeaux	Sofia Feltzing	13	3.00
Nice	Vanessa Hill	5	1.10
Paris-Heidelberg	Luca Sbordone	6	0.85
Porto	Sergio Sousa	4	0.45
UCM	David Montes	3	1.0
Vilnius	Grazina Tautvaisiene	5	3.0
Total	-	66	14.25

Stellar parameters

T_{eff}, log g, ξ and [Fe/H]

Stellar atmospheric parameters (T_{eff}, log g, ξ and **[Fe/H]**)

StePar (Tabernero Montes, González Hernández 2011):

- 2002 version of the MOOG code (Sneden 1973).
- a grid of Kurucz ATLAS9 plane-parallel model atmospheres (Kurucz 1993).

- The EW determination of the Fe lines with the ARES code (Sousa et al. 2007).
- 263 Fe I and 36 Fe II lines (Sousa et al. 2008).

The code iterates until obtain:
- **excitation equilibrium**:
  the slopes of χ *vs* log(ϵ**(Fe I)**)
  and log(EW/λ) *vs* log(ϵ**(Fe I)**) where zero
- **ionization equilibrium**:
  log(ϵ**(Fe I)**) = log(ϵ**(Fe II)**).

- 2-σ rejection of Fe I and Fe II lines after a first determination of the parameters

- **Limitations**: spectral types F6 to K4, slow rotators, no veiling.

Chemical abundances

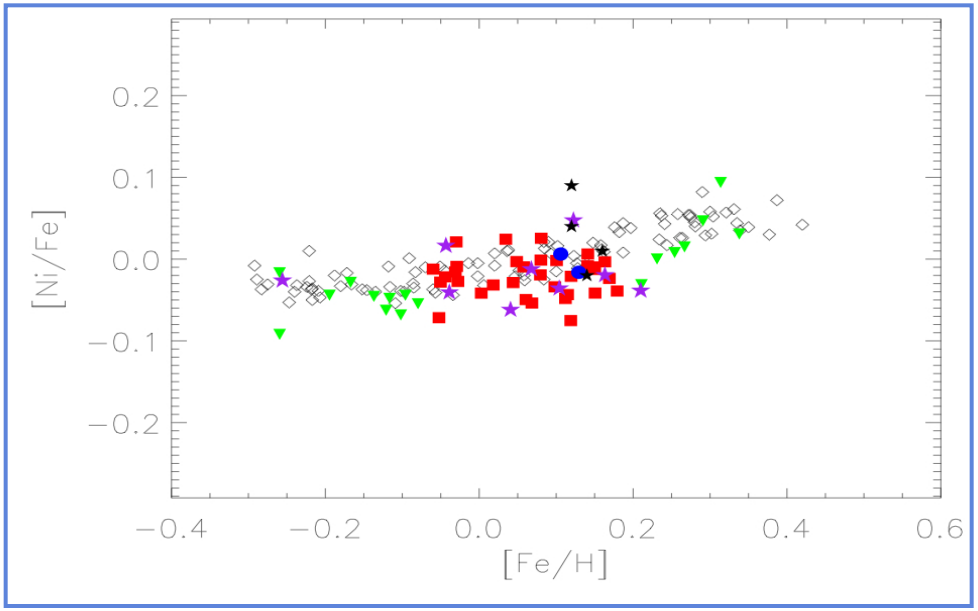
Fe, Na, Mg …..

Fe, Na, Mg, Al, Si, Ca, Sc, Ti, V, Cr, Mn, Co, and Ni

- **EW** method in a line-by-line basis with *ARES* code (Sousa et al. 2007).

- Line lists and atomic parameters from (Neves et al. 2009; González Hernández et al. 2010).

- Abundance analysis with *MOOG* (Sneden 1973) using our determined atmospheric parameters and a **solar spectrum** taken with the same instrumental configuration.



[Ni/Fe] vs [Fe/H]: open diamonds represent the thin disk data (González Hernández et al. 2010), black filled triangles represent Hyades cluster data (Paulson et al. 2003). Red points are our stars compatible with Hyades Fe abundance, and the green ones not compatible. BZ Cet and HD19902 Hyades cluster members are marked with blue circles. Purple starred points represent the giant stars. Black starred points are the candidates selected stars in De Silva et al. (2011), black circles are those selected in Pompéia et al. (2011).

GES WG11:
UVES FGK-star Spectrum Analyses

GES Science Verification Project:

"A large scale comparison of the analysis of UVES spectra of FGK-type stars"

- All the nodes
- Different analyses methodologies under somewhat controlled conditions. I
- Paper in preparation

→ to present and discuss the many analyses tests we have done in preparation for the spectrum analysis. The paper will report the results of the three tests we performed within WG11 (with observed spectra, with synthetic spectra, and with some benchmark stars).

GES WG12:

Pre-Main-Sequence Stars Spectrum Analyses

WG Coordinators: Alessandro Lanzafame

Node	Name	email	FTE
OA Catania	Alessandro Lanzafame	Alessandro.Lanzafame @ oact.inaf.it	0.2
	Antonio Frasca	Antonio.Frasca @ oact.inaf.it	0.1
	Sergio Messina	Sergio.Messina @ oact.inaf.it	0.1
	Elisa Brugaletta	Elisa.Brugaletta @ oact.inaf.it	0.3
OA Arcetri	Sofia Randich	randich @ arcetri.astro.it	0.05
	Elena Franciosini	francio @ arcetri.astro.it	0.5
	Francesco Palla	palla @ arcetri.astro.it	0.2
	Germano Sacco	gsacco @ arcetri.astro.it	0.4
	Lorenzo Spina		0.8
OA Naples	Juan Manuel Alcalà	alcala @ oacn.inaf.it	0.2
	Elvira Covino	covino @ oacn.inaf.it	0.2
	Katia Biazzo	kbiazzo @ na.astro.it	0.1
OA Palermo	Giusi Micela	giusi @ astropa.inaf.it	0.05
	Ettore Flaccomio	ettoref @ astropa.inaf.it	0.05
	Costanza Argiroffi		0.05
	Beate Stelzer		0.05
	Rosaria Bonito		0.1
	Loredana Prisinzano	loredana @ astropa.unipa.it	0.1
	Jorge Sanz Forcada		0.05
	Mario Guarcello		0.05
UCM	David Montes	dmg @ astrax.fis.ucm.es	0.1
	Alexis Klutsch	klutsch @ astrax.fis.ucm.es	0.1
	José Antonio Caballero	caballero @ astrax.fis.ucm.es	<0.1
	F. Javier Alonso-Floriano	fjalonso @ fis.ucm.es	0.2
	Hugo Tabernero	htg @ astrax.fis.ucm.es	0.2
	Javier López Santiago	jls @ astrax.fis.ucm.es	0.1
CAB	David Barrado	barrado @ cab.inta-csic.es	0.1
	Nuria Huélamo	nhuelamo @ cab.inta-csic.es	0.05
	Alcione Mora	alcione.mora @ esa.int	0.1
	Jesus Maldonado		0.1
	Ignacio Mendigutia	imendig @ clemson.edu	0.2
	Francisco Galindo		1.0
	Amelia Bayo	bayo @ mpia-hd.mpg.de	0.1
CAUP	Sergio Sousa	sousasag @ astro.up.pt	0.1
	Jorge Filipe Gameiro	jgameiro @ astro.up.pt>	0.2
	Daniel Folha	Daniel.Folha @ astro.up.pt	0.1
Zurich	Michael Meyer	mmeyer @ phys.ethz.ch	0.1
	TBD		0.1
Keele	Rob Jeffries	rdj @ astro.keele.ac.uk	0.2
	Alex Binks		TBD
	Amy Dobson		TBD
Exeter	Tim Naylor	timn @ astro.ex.ac.uk	0.1
	TBD		0.2

GaiaESO

GES WG12: **PMS** Stars Spectrum Analyses

Table 3: GES-WG12 UVES analyses

ID	Type	Method / Code	Producers	Consumers
[U.1]	$T_{\rm eff}$, $\log g$, [Fe/H]	ROTFIT, AUTOMOOG, StePar/ARES	OACt, Arcetri, UCM	GES-DB
[U.2]	micro-velocity	AUTOMOOG, StePar/ARES	Arcetri, UCM	GES-DB
[U.3]	Li EW		OACt	GES-DB
[U.3]	Li abundance	—	—	GES-DB
[U.4]	elemental abundances	—	—	GES-DB

GES WG12: **PMS** Stars Spectrum Analyses

Gamma 2 Velorum

Stellar atmospheric parameters (T_{eff}, log g, ξ and **[Fe/H]**) using ***StePar***

FITS FILE	OBJECT	Teff		logg		micro		[Fe/H]	
uvu_08063616-4748206_580	tyc3589	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08064772-4659492_580	U1715	5764.	120.	4.20	0.24	0.857	0.167	0.01	0.09
uvu_08065592-4704528_580	U3574	4295.	161.	1.98	0.58	1.002	0.141	0.14	0.15
uvu_08065688-4717247_580	tyc487	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08070521-4734401_580	U5672	5554.	97.	4.32	0.21	0.615	0.200	0.28	0.07
uvu_08070717-4721463_580	U6144	5319.	81.	3.12	0.23	1.251	0.114	0.19	0.06
uvu_08071363-4725156_580	U7633	5849.	130.	4.46	0.26	0.597	0.251	0.02	0.09
uvu_08071383-4736156_580	U7679	4350.	111.	2.07	0.41	1.190	0.103	0.00	0.09
uvu_08071501-4658153_580	U7969	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08071937-4710143_580	U8974	4482.	125.	2.37	0.43	1.103	0.119	0.03	0.09
uvu_08072516-4712522_580	U10252	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08073209-4746433_580	U11833	6128.	103.	4.43	0.19	0.916	0.146	0.13	0.07
uvu_08073237-4722119_580	U11916	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08073315-4744513_580	U12117	5156.	105.	3.08	0.31	1.062	0.132	0.13	0.08
uvu_08073447-4716569_580	U12423	6128.	116.	4.52	0.23	1.129	0.156	0.24	0.08
uvu_08073722-4705053_580	U13038	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08074016-4721020_580	U13721	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08074019-4730403_580	U13727	5058.	75.	3.77	0.20	0.800	0.116	-0.12	0.05
uvu_08074278-4659566_580	U14345	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08074671-4658173_580	U15411	4714.	175.	2.60	0.56	1.002	0.169	0.49	0.12
uvu_08075167-4706085_580	U17044	4512.	138.	2.61	0.45	0.914	0.147	0.24	0.10
uvu_08080053-4702145_580	U19741	5648.	117.	4.53	0.25	0.666	0.244	-0.02	0.08
uvu_08080431-4716272_580	U20794	5199.	98.	4.55	0.25	0.506	0.247	-0.07	0.05
uvu_08080526-4722060_580	U21030	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08080690-4715075_580	tyc5512	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08080882-4736515_580	U21951	4482.	131.	2.41	0.44	1.008	0.132	0.13	0.10
uvu_08081245-4705593_580	U22870	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08081445-4701498_580	U23424	5984.	104.	4.15	0.18	1.390	0.125	-0.20	0.07
uvu_08082630-4721083_580	U26482	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08083232-4722553_580	U28102	4549.	122.	2.31	0.43	1.056	0.123	0.23	0.09
uvu_08083707-4727371_580	U29271	9999.	999.	9.99	9.99	9.999	9.999	9.99	9.99
uvu_08083759-4736060_580	U29423	6018.	76.	4.01	0.14	1.218	0.091	-0.28	0.05
uvu_08083990-4741513_580	U30040	5661.	112.	4.22	0.25	0.510	0.260	-0.33	0.09
uvu_08085306-4704067_580	U33566	6097.	111.	4.53	0.19	0.828	0.170	0.13	0.08
uvu_08085455-4700053_580	U34116	4967.	90.	2.71	0.27	1.510	0.138	-0.45	0.07

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GES WG12: **PMS** Stars Spectrum Analyses

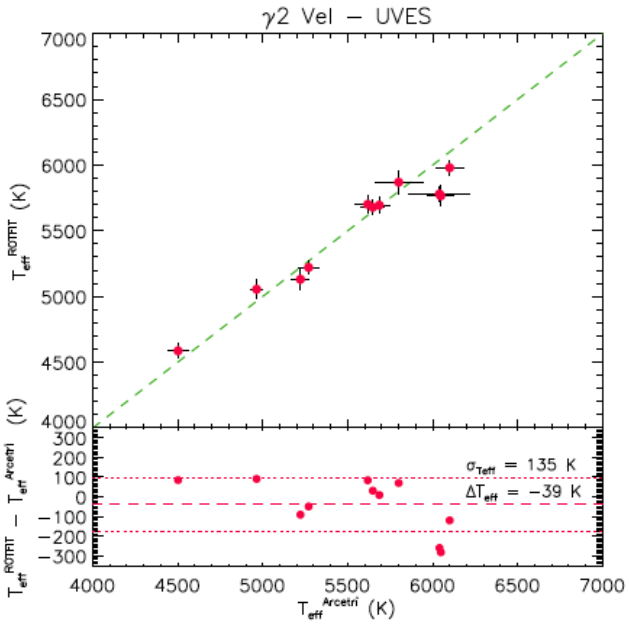
Gamma 2 Velorum

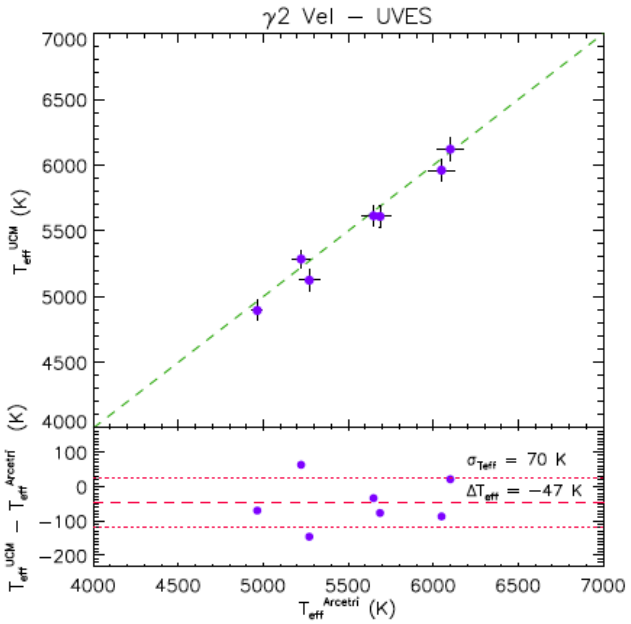
Total UVES single spectra: 80
Analysed: **44**

Chamaeleon I

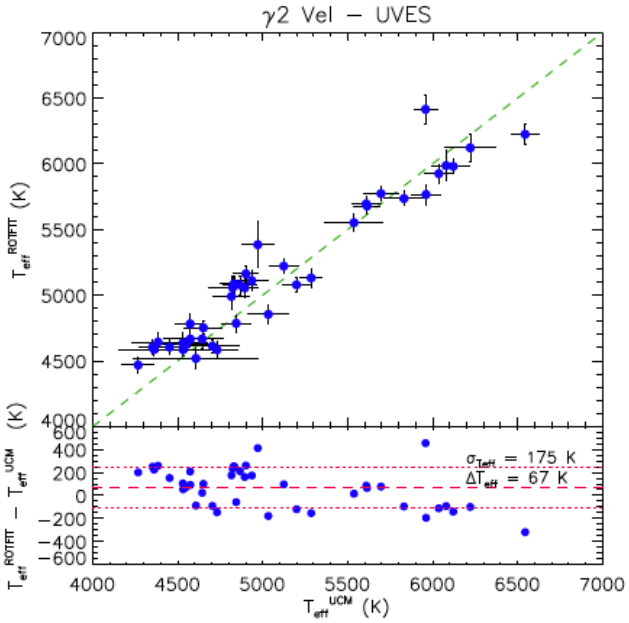
Total UVES single spectra: 49
Analysed: **24**

GES WG12: **PMS** Stars Spectrum Analyses

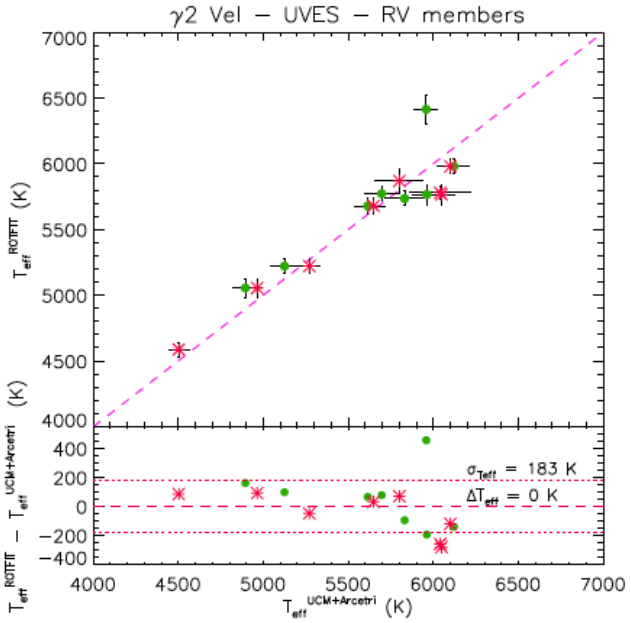




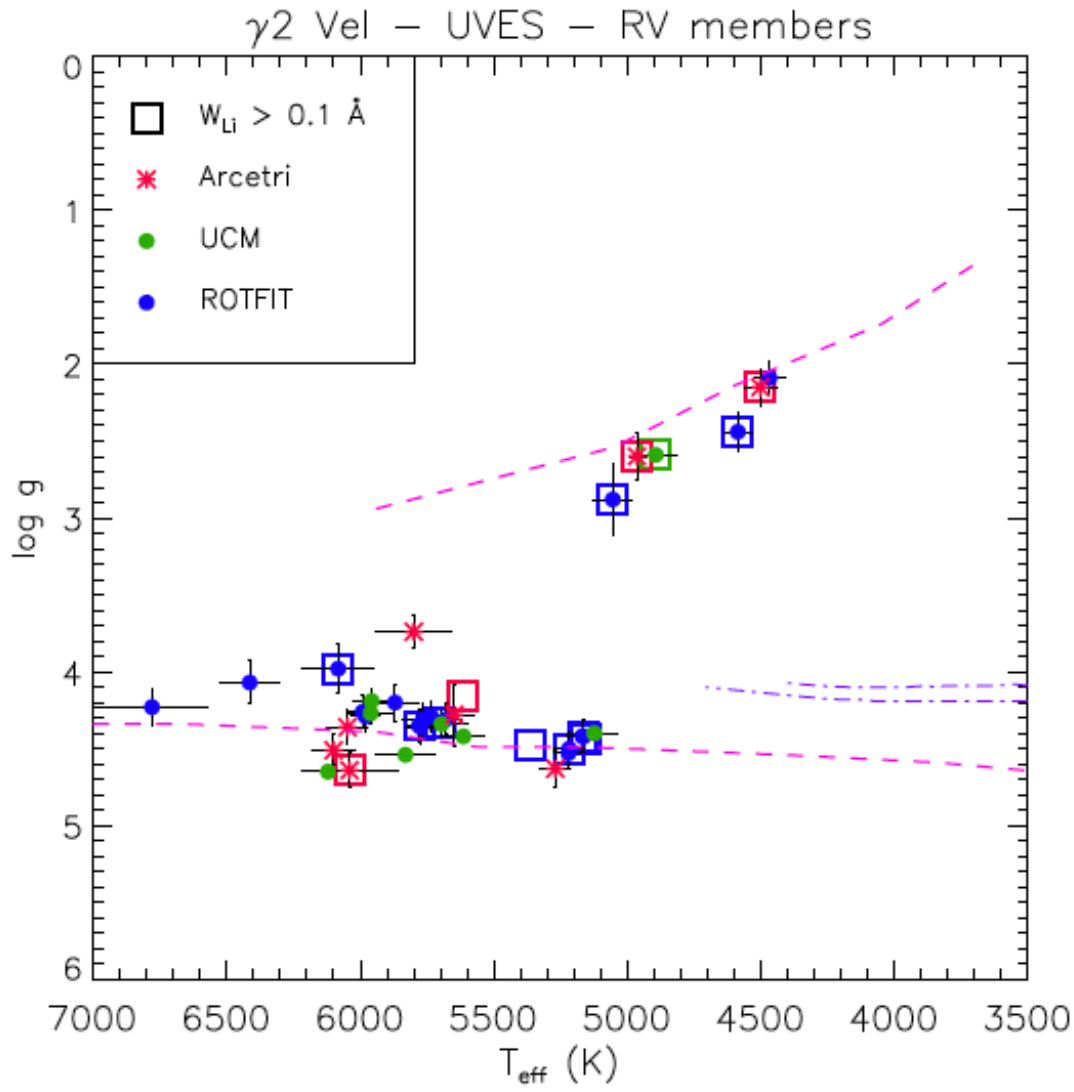
UCM - Arcetri



ROTFIT - UCM.



GES WG12: **PMS** Stars Spectrum Analyses



GES Science Verification Project:
Intra- and inter-survey links via **Benchmark stars**

Participants

- Paula Jofré, Caroline Soubiran, Sergi Blanco Cuaresma, Ulrike Heiter (LUMBA, SME)
- Clare Worley (Nice, MATISSE)
- Laura Magrini, Antonella Vallenari, Rosanna Sordo, Tristan Cantat-Gaudin (Epinarbo, AUTOMOOG)
- Elena Pancino (Bologna, GALA)
- David Montes, Hugo Tabernero (UCM, StePar)
- Thomas Masseron, Sophie van Eck (ULB, Bacchus)
- Maria Bergemann, Greg Ruchti, Karin Lind (LUMBA) - vmacro tests, individual abundances with SME, NLTE corrections

-The goal of this project is to see what is the best agreement that we can obtain between different methods. The outcome will be the reference metallicity for the survey.

- A side effect will be that we will be improving our methods and/or the linelist with the help of the benchmark stars.

- Assume that **Teff** and log **g**, and some other parameters are "known" and we fix them. However, this will be an iterative process, since not all of the parameters are final.

GES Science Verification Project:

Intra- and inter-survey links via **Benchmark stars**

Primary selection criteria

- Dwarf and giant stars – F, G, K, M – at least two stars with different metallicities each
- Angular diameter measurements and bolometric fluxes available, for **direct T_{eff}**
- Accurate parallax measurement available, for **direct log g**
- Large number of spectroscopic analyses published, e.g. >=10 entries in PASTEL catalogue

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GES Science Verification Project:

Intra- and inter-survey links via **Benchmark stars**

Early F dwarfs
Procyon
HD 84937
HD 49933
FGK subgiants
del Eri
HD 140283
eps For
eta Boo
bet Hyi
Solar type stars
alf Cen A
HD 22879
mu Cas A
tau Cet
alf Cen B
18 Sco
mu Ara
bet Vir

Red giants
Arcturus
HD 122563
mu Leo
bet Gem
eps Vir
ksi Hya
alf Tau
psi Phe
gam Sge
alf Cet
HD 220009
HD 190056
HD 107328
HD 148897
HD 173819
bet Ara
nu Hyi

Candidate benchmark stars

40 stars including the Sun and two M dwarfs – sample to be extended/reduced depending on purpose

K dwarfs
eps Eri
Gmb 1830
61 Cyg A
61 Cyg B
M dwarfs
GJ 628
GJ 544 B

GES Science Verification Project:

Intra- and inter-survey links via **Benchmark stars**

name	Teff		logg		microv		[Fe/H]	
18Sco	5653	94	4.22	0.22	0.85	0.17	-0.03	0.09
61CygA	4498	146	4.16	0.64	0.89	0.36	-0.51	0.08
61CygB	9999	999	9.99	9.99	9.99	9.99	9.99	9.99
alfCenA	5779	90	4.33	0.18	0.96	0.16	0.22	0.08
alfCenB	5030	185	4.21	0.44	0.74	0.62	0.09	0.18
alfTau	9999	999	9.99	9.99	9.99	9.99	9.99	9.99
Arcturus	4274	97	1.75	0.39	1.28	0.15	-0.41	0.11
betAra	4793	999	1.93	9.99	0.71	9.99	0.78	9.99
betGem	4937	95	3.17	0.26	1.12	0.15	0.18	0.08
betHyi	5889	70	4.24	0.20	1.20	0.11	-0.11	0.06
betVir	6254	77	4.40	0.15	1.46	0.12	0.18	0.06
delEri	5011	101	3.79	0.26	0.85	0.16	0.07	0.08
epsEri	4909	129	4.44	0.35	0.65	0.38	-0.17	0.09
epsFor	5048	60	3.62	0.18	0.91	0.09	-0.64	0.05
epsVir	4962	138	2.68	0.40	1.54	0.20	0.02	0.12
etaBoo	6134	128	4.06	0.26	1.97	0.23	0.19	0.10
gmb1830	5120	67	4.62	0.40	0.86	0.20	-1.29	0.05
HD107328	4374	98	1.80	0.40	1.56	0.16	-0.46	0.10
HD122563	9999	999	9.99	9.99	9.99	9.99	9.99	9.99
HD140283	5373	39	2.44	0.10	1.07	0.10	-2.85	0.03
HD220009	4299	82	2.01	0.37	1.42	0.17	-0.66	0.09
HD22879	5770	66	4.17	0.12	1.00	0.09	-0.94	0.06
HD84937	6094	64	3.13	0.20	0.84	0.27	-2.35	0.05
ksiHya	5091	86	3.13	0.22	1.20	0.12	0.16	0.08
muAra	5748	80	4.41	0.18	1.17	0.14	0.19	0.07
muCas	5344	84	4.57	0.18	0.44	0.24	-0.83	0.07
muLeo	4468	263	2.55	0.76	0.74	0.33	0.69	0.23
Procyon	6700	87	4.06	0.14	1.74	0.08	-0.01	0.06
Sun	5631	89	4.28	0.22	0.83	0.18	-0.09	0.08
tauCet	5265	115	4.43	0.26	0.55	0.31	-0.56	0.09

Stellar atmospheric parameters ($T_{\rm eff}$, log g, ξ and **[Fe/H]**) using ***StePar***

GaiaESO

GES Science Verification Project:

Intra- and inter-survey links via **Benchmark stars**

name	Teff	logg	micro		[Fe/H]			
			run1	run2	run1		run2	
18Sco	5747	4.43	1.20	1.20	−0.06	0.02	−0.02	0.05
61CygA	4339	4.49	1.10	1.10	−0.45	0.05	0.04	0.26
61CygB	4045	4.61	1.10	1.10	−0.45	0.06	0.67	0.44
alfCenA	5840	4.31	1.20	1.20	0.18	0.02	0.07	0.02
alfCenB	5260	4.54	1.10	1.10	0.07	0.02	−0.02	0.06
alfTau	3927	1.22	1.51	1.55	−0.32	0.07	−0.45	0.12
Arcturus	4247	1.59	1.48	1.59	−0.53	0.02	−0.98	0.28
betAra	4073	1.01	1.52	1.37	−0.06	0.19	0.35	0.32
betGem	4858	2.88	1.03	1.07	0.20	0.02	0.08	0.02
betHyi	5873	3.98	1.30	1.30	−0.15	0.01	−0.18	0.07
betVir	6083	4.08	1.40	1.40	0.08	0.01	0.06	0.01
delEri	5045	3.79	1.20	1.20	−0.07	0.02	−0.19	0.07
epsEri	5050	4.60	1.10	1.10	−0.25	0.02	−0.18	0.12
epsFor	5069	3.45	1.20	1.20	−0.73	0.02	−0.79	0.05
epsVir	4983	2.77	0.97	0.91	0.33	0.03	0.48	0.03
etaBoo	6105	3.80	1.40	1.40	0.31	0.02	0.16	0.12
Gmb1830	4827	4.60	1.10	1.10	−1.52	0.01	−1.07	0.16
HD107328	4590	2.20	1.27	1.40	−0.21	0.02	−0.61	0.13
HD122563	4608	1.61	1.79	1.79	−2.75	0.02	−2.47	0.01
HD140283	5720	3.67	1.30	1.30	−2.50	0.03	−2.42	0.05
HD220009	4266	1.52	1.57	1.57	−0.86	0.02	−0.89	0.14
HD22879	5786	4.23	1.20	1.20	−0.97	0.01	−0.92	0.02
HD84937	6275	4.12	1.50	1.50	−2.23	0.02	−2.12	0.05
ksiHya	5044	2.87	1.01	1.07	0.24	0.02	0.09	0.03
muAra	5845	4.27	1.20	1.20	0.24	0.02	−0.03	0.09
muCas	5308	4.41	1.10	1.10	−0.94	0.02	−0.98	0.07
muLeo	4433	2.50	0.85	1.13	0.61	0.03	−0.08	0.33
Procyon	6545	3.99	1.80	1.80	−0.11	0.01	−0.02	0.04
Sun	5777	4.4381	1.20	1.20	−0.08	0.02	−0.11	0.07
tauCet	5331	4.44	1.10	1.10	−0.61	0.02	−0.61	0.06

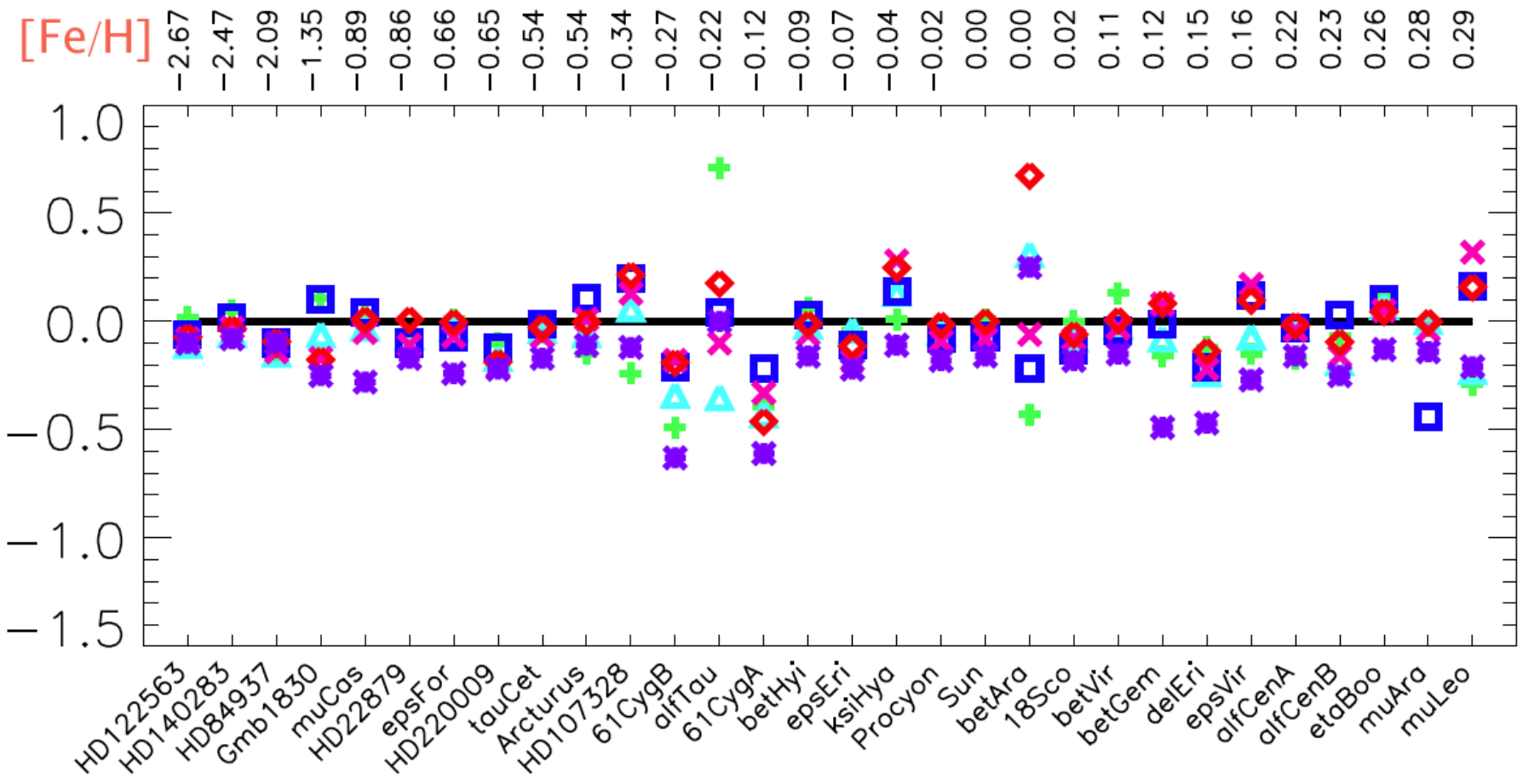
Fixed $T_{\rm eff}$ and $\log g$,

ξ and **[Fe/H]**) using ***StePar***

GES Science Verification Project:

Intra- and inter-survey links via **Benchmark stars**

Metallicities obtained when using one spectrum per star
(according to Run0 instructions), minus average literature value



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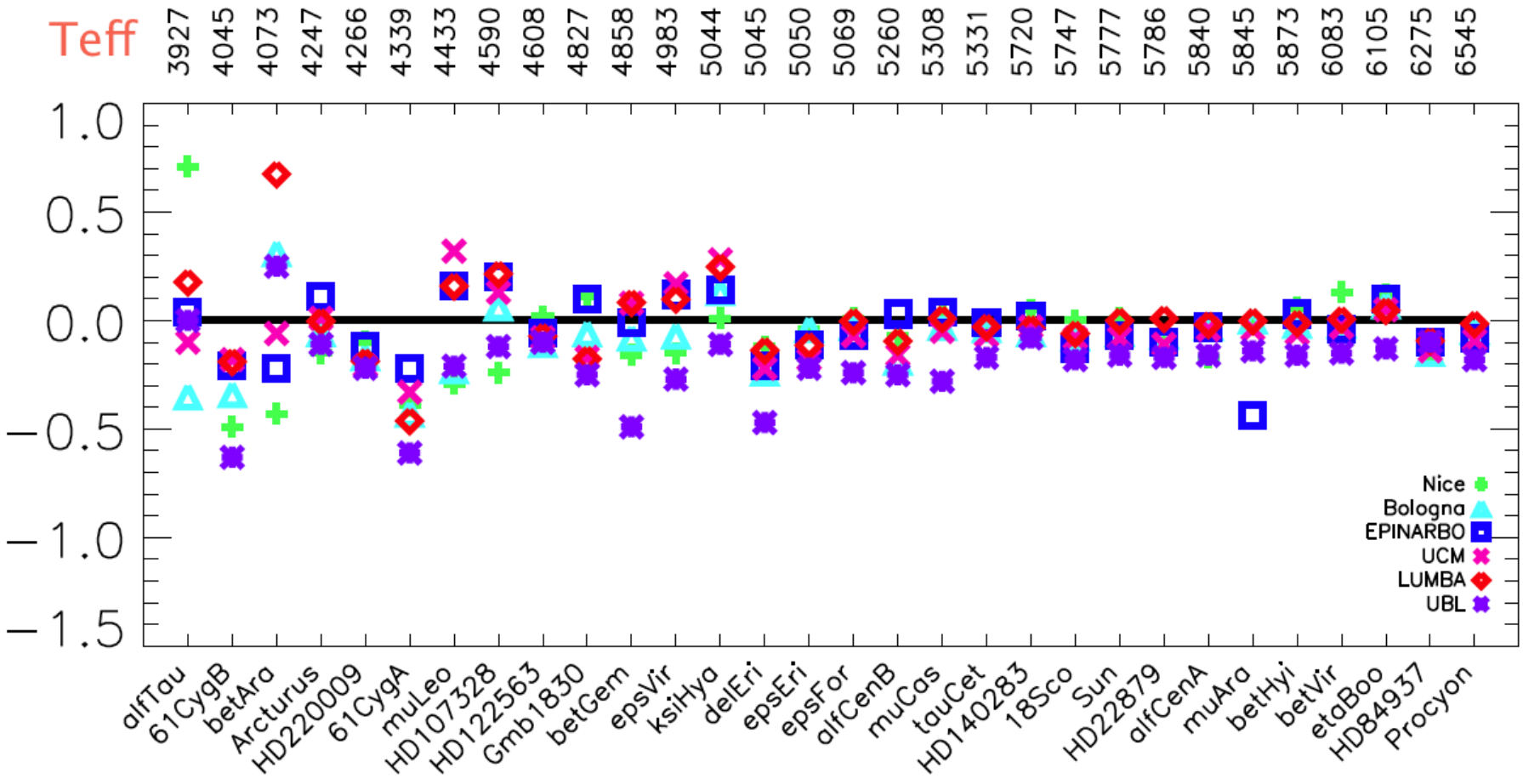


GES Science Verification Project:
Thin disk kinematics

Project: **Stellar associations and moving groups: young field stars in the solar neighborhood**

Proposers: Javier López-Santiago, David Montes, Giusi Micela, Laura Affer, Beate Stelzer

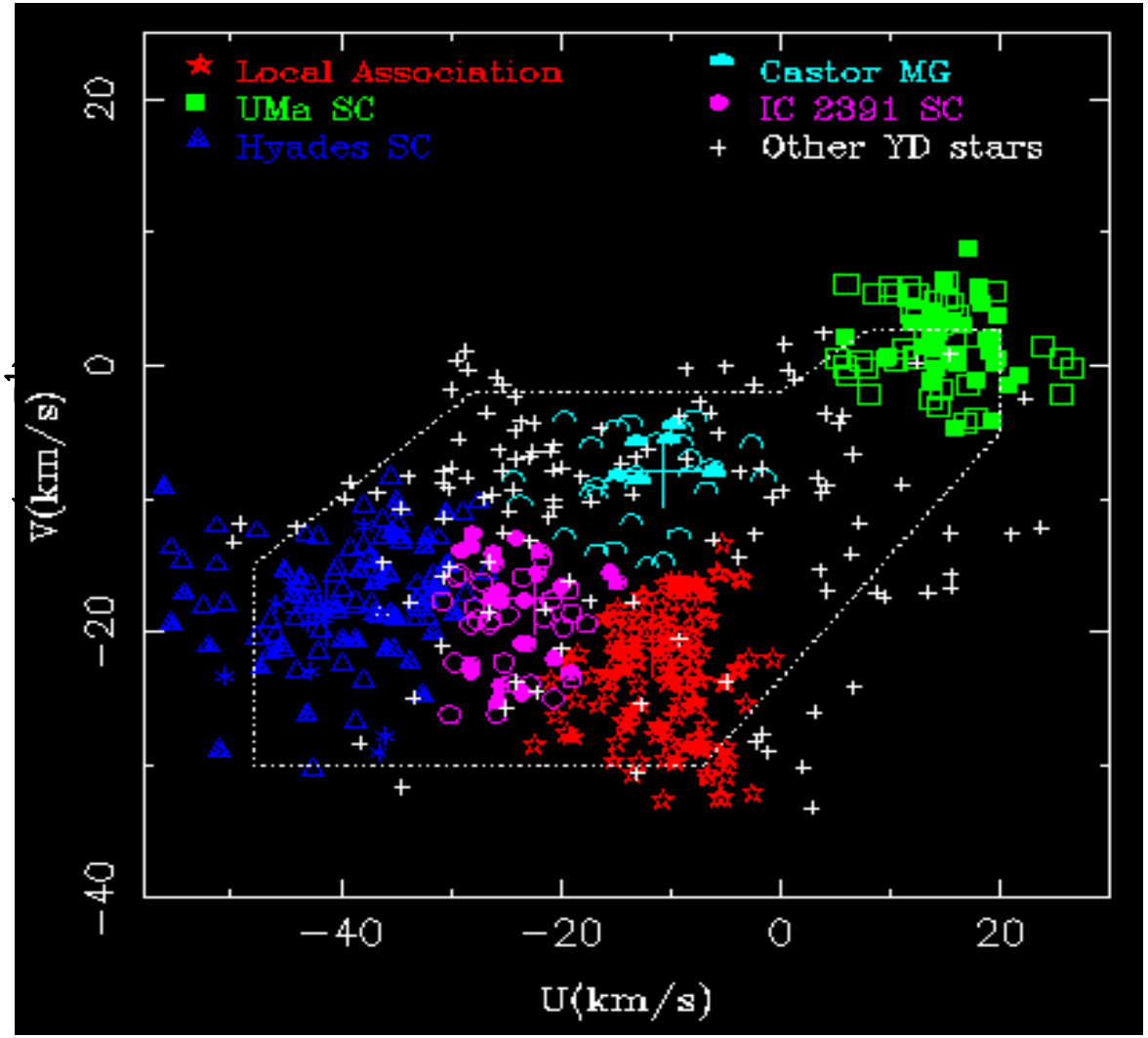
Outline: The Gaia ESO Survey will produce a large amount of data from field stars, not only from specific pointed observations but also in cluster fields. The Galactic Besancon model predicts more than a hundred field late-type stars in an area of 2x2 sq. deg, in the line of sight of a cluster in the Galactic plane at a typical distance of 300 pc. Many of these field stars have been likely selected as cluster candidates and will be observed with GIRAFFE. We aim to look for possible nearby young stars in the samples of discarded candidates among the stars observed in cluster fields. The division between young and old stars will be performed in base of their Halpha emission and lithium abundance. Radial velocities determined for those stars will be used to calculate their space motion. A study on their possible membership in any young stellar association or moving group will be carried out. (Overlaps with Cluster-Field Analyses).

Other researchers joined to this project: Alexis Klutsch, José A. Caballero, Antonio Frasca, Sergio Messina

Stellar Kinematics Groups

- **Moving group (Supercluster)** Eggen (1994)

Group of stars gravitationally unbound that share the same kinematics and may occupy extended regions in the Galaxy



Montes et al. 2001 MNRAS.328...45

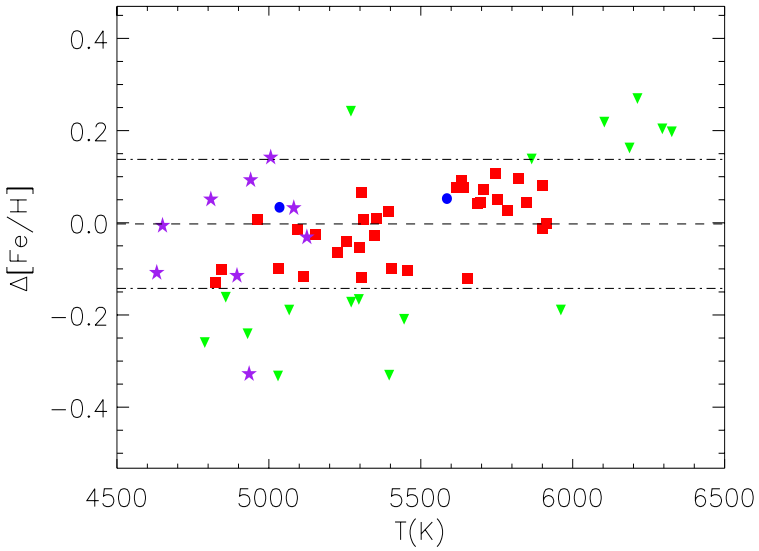
Chemical Tagging FGK stars

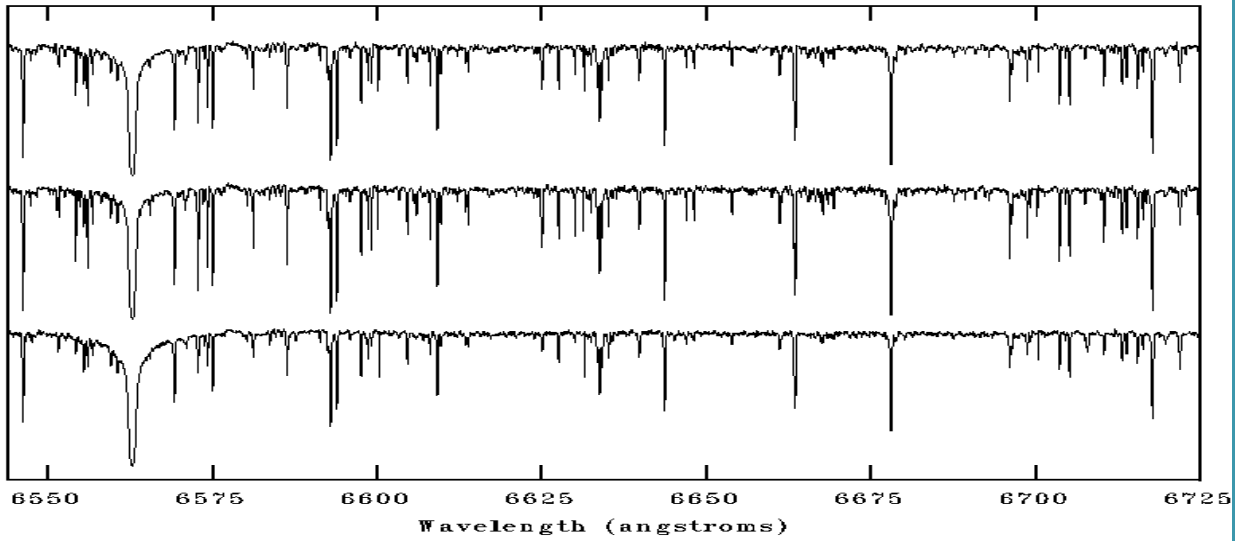
★ Survey for Chemical Tagging of FGK stars in MGs

Hyades and Ursa Major MGs

2010- 2011 – 61 F6-K4 stars

- **Tabernero, Montes, González Hernández** 2012, 2012A&A...547A..13T;
- **Tabernero, Montes, González Hernández** 2013, A&A, in preparation





Chemically tagging the Hyades Supercluster.

A homogeneous sample of F6-K4 kinematically-selected northern stars⋆

H.M. Tabernero,[1] D. Montes[1] and J.I. González Hernández[1,2]

Work in progress

First Results from the Gaia-ESO Survey: all-hands meeting
Nice, France 8-11 April 2013

http://ges2013.sciencesconf.org/