SPA-OC

Stellar Population Astrophysics – Open Clusters

Goals of the workshop

- to present progress of the Open Clusters Work Package of the SPA (Stellar Population Astrophysics) Large Programme at the TNG with GIARPS
  http://nisp.oabo.inaf.it/SPA_TNG_LP/
- discuss on-going projects and plan publications
- hear news on similar projects and future instruments/missions
- propose new ideas to exploit the SPA data
- discuss follow-up projects.

Indico page of the SPA-OC Workshop: https://indico.ict.inaf.it/event/2844/

SPA-OC

Stellar Population Astrophysics – Open Clusters

- SPA is/was a Large Programme @TNG, PI Livia Origlia
- It was approved as A37TAC_31
- SPA run for 74 nights (Jun 2018-Nov 2021)
- SPA uses GIARPS (=GIANO + HARPS-N)
- 3 Work Packages: *Variable Stars* (coord. Giuseppe Bono), *RSG clusters* (coord. Emanuele Dalessandro) & *Open Clusters* (coord. Angela Bragaglia)




http://nisp.oabo.inaf.it/SPA_TNG_LP/

SPA-OC people

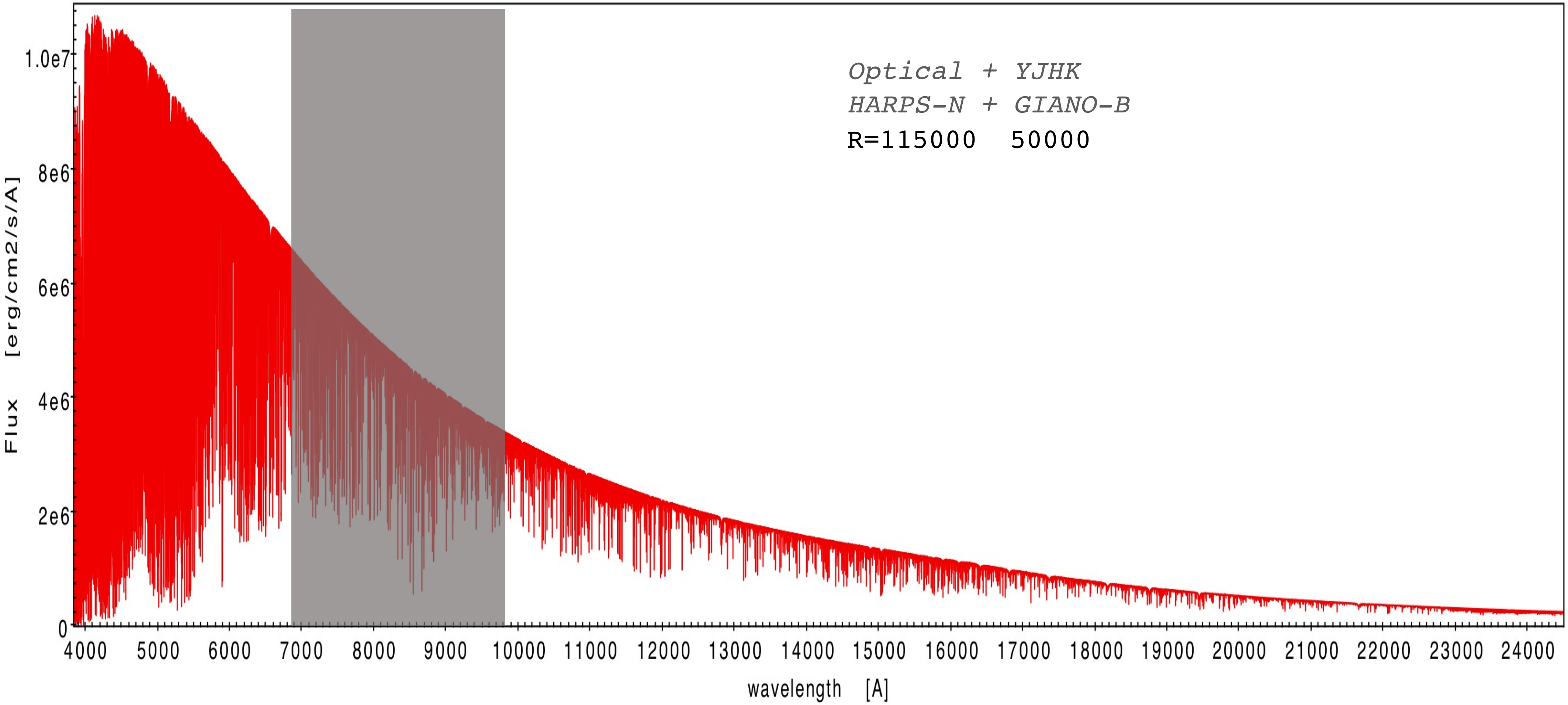
SPA-OC growing participation:

Angela Bragaglia (WG coord.), Javier Alonso-Santiago, Gloria Andreuzzi, Shilpa Bijavara Seshashayana, Ricardo Carrera, Eugenio Carretta, Giada Casali, Giovanni Catanzaro, Marina Dal Ponte, Valentina D'Orazi, Antonio Frasca, Xiaoting Fu, Mingjie Jian, Henrik Jönsson, Sara Lucatello, Laura Magrini, Noryiuki Matsunaga, Andrea Miglio, Donatella Romano, Nicoletta Sanna, Emanuele Spitoni, Monica Tosi, Antonella Vallenari, Nagaraj Vernekar, Ruyuan Zhang …

INAF OAS Bologna, INAF OA Catania, TNG, DIFA U. Bologna, INAF OA Padova, DIFA U. Padova, Uni Tor Vergata, PMO Nanjing, Uni Stokholm, INAF OA Arcetri, ANU, Malmö U., Tokyio U., etc

SORRY if I missed someone !

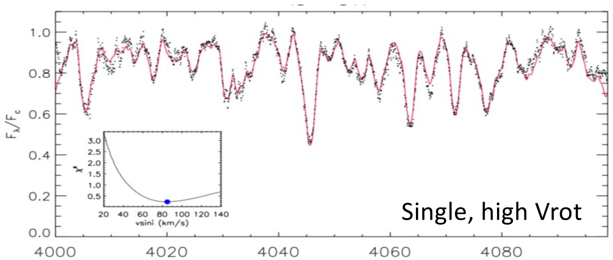
GIARPS

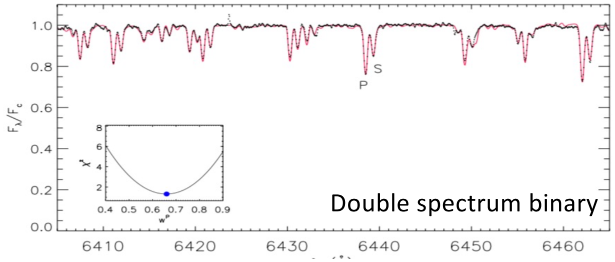

Optical + YJHK
HARPS-N + GIANO-B
R=115000 50000
Flux [erg/cm2/s/A]
wavelength [A]
1.0e7
8e6
6e6
4e6
2e6
0
4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000 19000 20000 21000 22000 23000 24000

GIARPS : what to we (plan to) get

The usual suspects, mostly from the HARPS-N spectra :

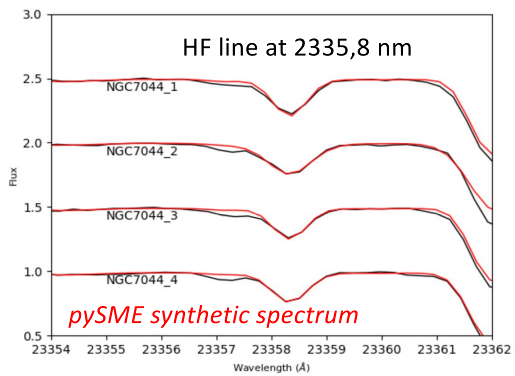
- RV
- Atmospheric parameters
- [Fe/H]
- [X/Fe] e.g. α's, Na, Fe-peak, Li, …
- Vrot
- activity indicators





Working on something more from the GIANO spectra :

- fluorine (HF, K band, all parameters from IR)
- helium (10830 A chromospheric, Y band)
- phosphorus (various lines, Y and H bands)



Tables with results are/will be available at CDS, science-ready spectra (if not already public at TNG archive) will be made public *[working on it …]*

INAF OAS

SPA-OC plan

As part of a wider effort involving Gaia, large surveys (Gaia-ESO, WEAVE, 4MOST), long-running projects (BOCCE) we are obtaining optical & NIR HR spectra of high probability OC members, selected using Gaia

1) a few (giant) stars in a large number of nearby, unstudied OCs ➔ metallicity [abundances]
- → ages (via stellar models)
- → distribution of metallicity, abundances (chemical map of disk)

2) a few ten of stars in key clusters, MS and/or giants ➔ detailed abundances
- → test of stellar models (diffusion, mixing)
- → test of all nucleosynthetic chains (chemical evolution)
- → influence of activity, rotation, binarism

3) "unusual" elements (e.g. He, F, P)

Legacy value : high quality sample to cross-match with large spectroscopic samples (Gaia-RVS, Gaia-ESO, APOGEE, GALAH, WEAVE, 4MOST…) and with asteroseismology samples(Kepler/K2, TESS, and soon PLATO)

Publications SPA-OC

1 2019A&A...632A..16F 2019/12 cited: 14

Stellar population astrophysics (SPA) with the TNG. Characterization of the young open cluster ASCC 123

Frasca, A.; Alonso-Santiago, J.; Catanzaro, G. *and 10 more*

2 2020A&A...633A..38D 2020/01 cited: 26

Stellar population astrophysics (SPA) with the TNG. Revisiting the metallicity of Praesepe (M 44)

D'Orazi, V.; Oliva, E.; Bragaglia, A. *and 8 more*

3 2020A&A...643A..12C 2020/11 cited: 16

Stellar Population Astrophysics (SPA) with TNG. The old open clusters Collinder 350, Gulliver 51, NGC 7044, and Ruprecht 171

Casali, G.; Magrini, L.; Frasca, A. *and 9 more*

4 2021A&A...654A..77Z 2021/10 cited: 15

Stellar Population Astrophysics (SPA) with TNG. Atmospheric parameters of members of 16 unstudied open clusters

Zhang, R.; Lucatello, S.; Bragaglia, A. *and 12 more*

5 2021A&A...656A.149A 2021/12 cited: 6

Stellar Population Astrophysics (SPA) with the TNG. Stock 2, a little-studied open cluster with an eMSTO

Alonso-Santiago, J.; Frasca, A.; Catanzaro, G. *and 14 more*

6 2022A&A...667A.103Z 2022/11 cited: 1

Stellar Population Astrophysics (SPA) with the TNG. α-elements, lithium, sodium and aluminum in 16 open clusters

Zhang, R.; Lucatello, S.; Bragaglia, A. *and 13 more*

7 2024arXiv240109635V 2024/01

Stellar population astrophysics (SPA) with the TNG. Abundance analysis of nearby red giants and red clump stars: combining high resolution spectroscopy and asteroseismology

Vernekar, Nagaraj; Lucatello, Sara; Bragaglia, Angela *and 4 more*

8 A&A, 683, A218 (2024)

Stellar Population Astrophysics (SPA) with TNG, Fluorine abundances in seven open clusters

Bijavara Seshashayana, Shilpa; Jönsson, Henrik; D'Orazi, Valentina *and 9 more*

subm

9 Stellar population astrophysics (SPA) with the TNG: Measurement of the He I 10830 Å line in the open cluster Stock 2

M. Jian, X. Fu, N. Matsunaga, *and 10 more*

Parallell

2024A&A...683A..75A 2024/03 cited: 1

10 **High-resolution spectroscopy of the young open cluster M 39 (NGC 7092)**

Alonso-Santiago, J.; Frasca, A.; Catanzaro, G. *and 5 more*

2023A&A...677A.154F 2023/09 cited: 2

11 **TIC 43152097 The first eclipsing binary in NGC 2232**

Frasca, A.; Alonso-Santiago, J.; Catanzaro, G. *and 5 more*

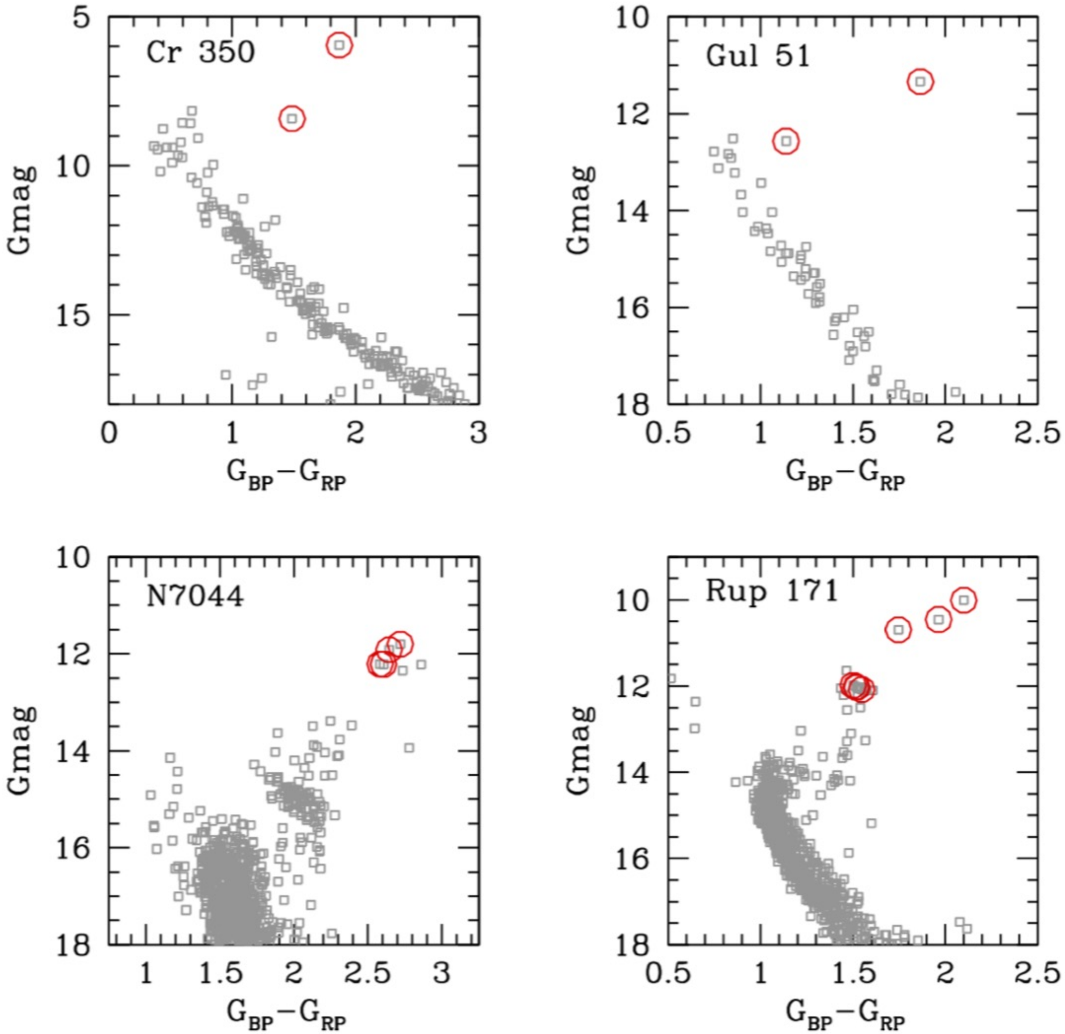
SPA-OC topics : know thy star, know thy cluster

I will only briefly recap the situation about “few stars/many cluster” for the 3 papers published:
-*Casali, Magrini, Frasca et al. 2020* : 4 intermediate-age/old OCs, stellar parameters & abundances
-*Zhang, Lucatello, Bragaglia et al. 2021, 2022* : stellar parameters, alpha & light elements, cf chemev models

Marina will update the situation with the data she’s analysing with Valentina’s help

I expect all the other papers/topics will be discussed by someone during our workshop

Casali+2020, Zhang+2021,2022



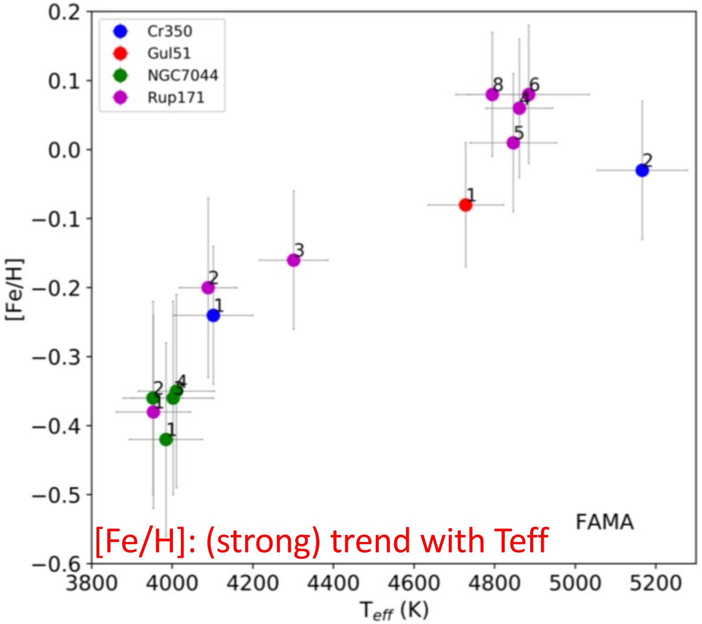
	log(Age) (yr)		A_V (mag)	d (pc)	R_{GC} (kpc)	z (pc)	Stars
Collinder 350	8.77	0.59	0.52	371	8.02	94	1 (+1)
Gulliver 51	8.56	0.36	1.42	1536	9.41	52	1 (+1)
NGC 7044.	9.22	1.66	1.78	3252	8.73	−235	4
Ruprecht 171	9.44	2.75	0.68	1522	9.41	52	4 (+3)

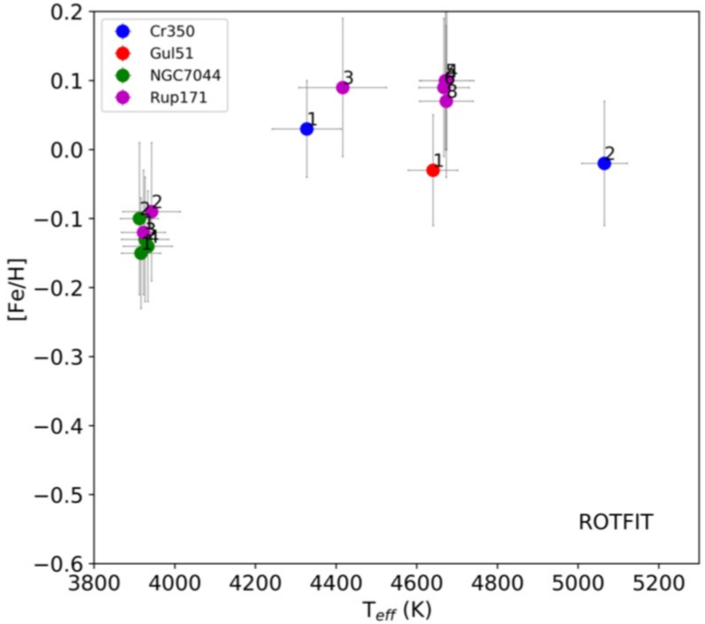
Analysis:

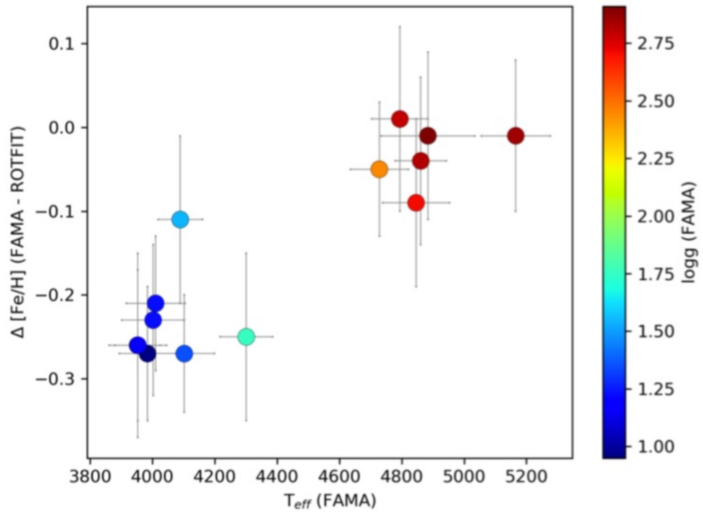
Meth.1 EW DAOSPEC + MOOG (automatised: DOOp, FAMA)
- Gaia-ESO input line list
- Teff, logg, ξ, metallicity
- solar abundances: Ceres HARPS spectrum (+ Grevesse et al. 2007 for a few not measurable on that)
- Li, C, Na, Mg, Al, Si, Ca, Sc, Ti I,II, V, Cr, Fe I,II, Co, Ni, Y, Zr I,II La, Ce, Eu

Meth.2 ROTFIT (χ^2 minimisation vs ELODIE obs. spectra)
- R degraded to 42000
- 28 100 Å-wide regions 4000-6800 Å
- Teff, logg, [Fe/H], v sin*i*, spectral type

Casali+2020, Zhang+2021,2022







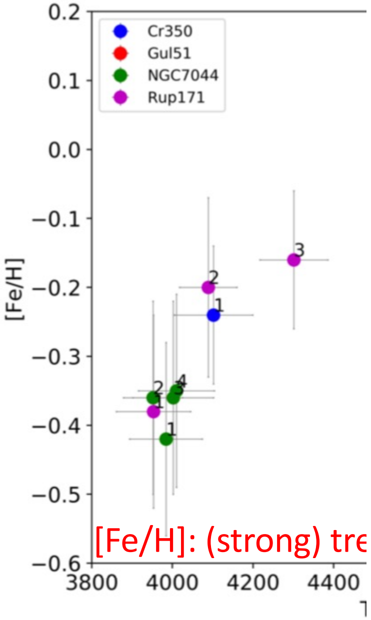
[Fe/H]: offset FAMA-ROTFIT

Why ?
Which one is (more) correct ?
Problem of low(er) metallicity
for cool giants is common

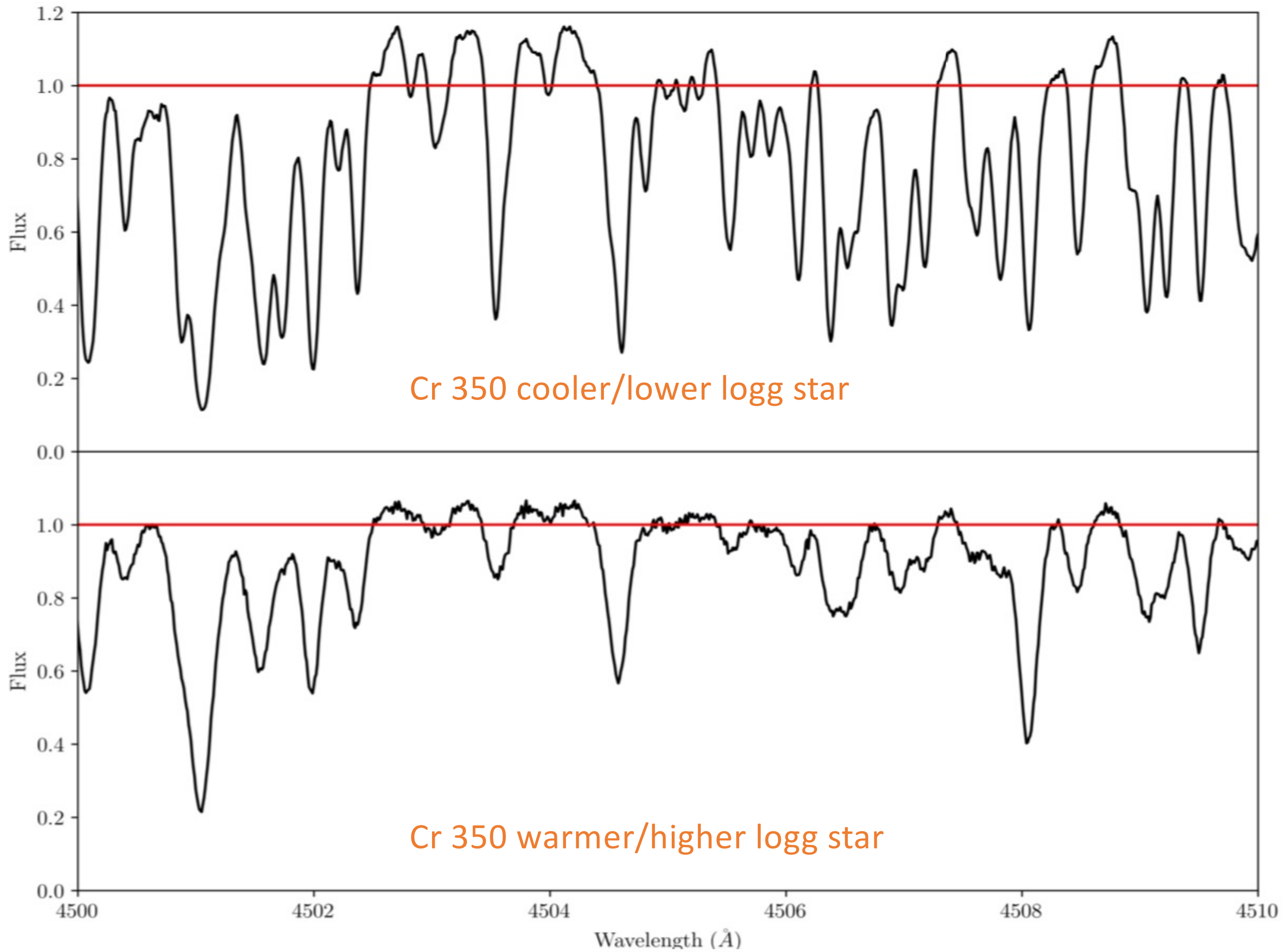
Possible explanation:

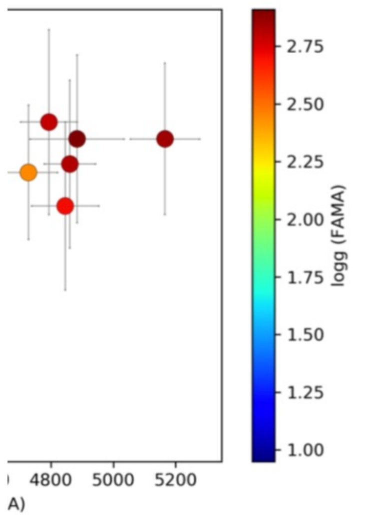
-Stellar parameters from spectroscopy wrong (however, fixing logg using Gaia does not solve)
-NLTE effects (however, DeltaFe < 0.02 dex according to MPIA calculator)
-Line lists (using the list by Tsantaki+2013 does not change situation)
-Model atmospheres (Kurucz instead of MARCS irrelevant) → not good for cool giants
-Continuum placement

Casali



[Fe/H]: (strong) tre



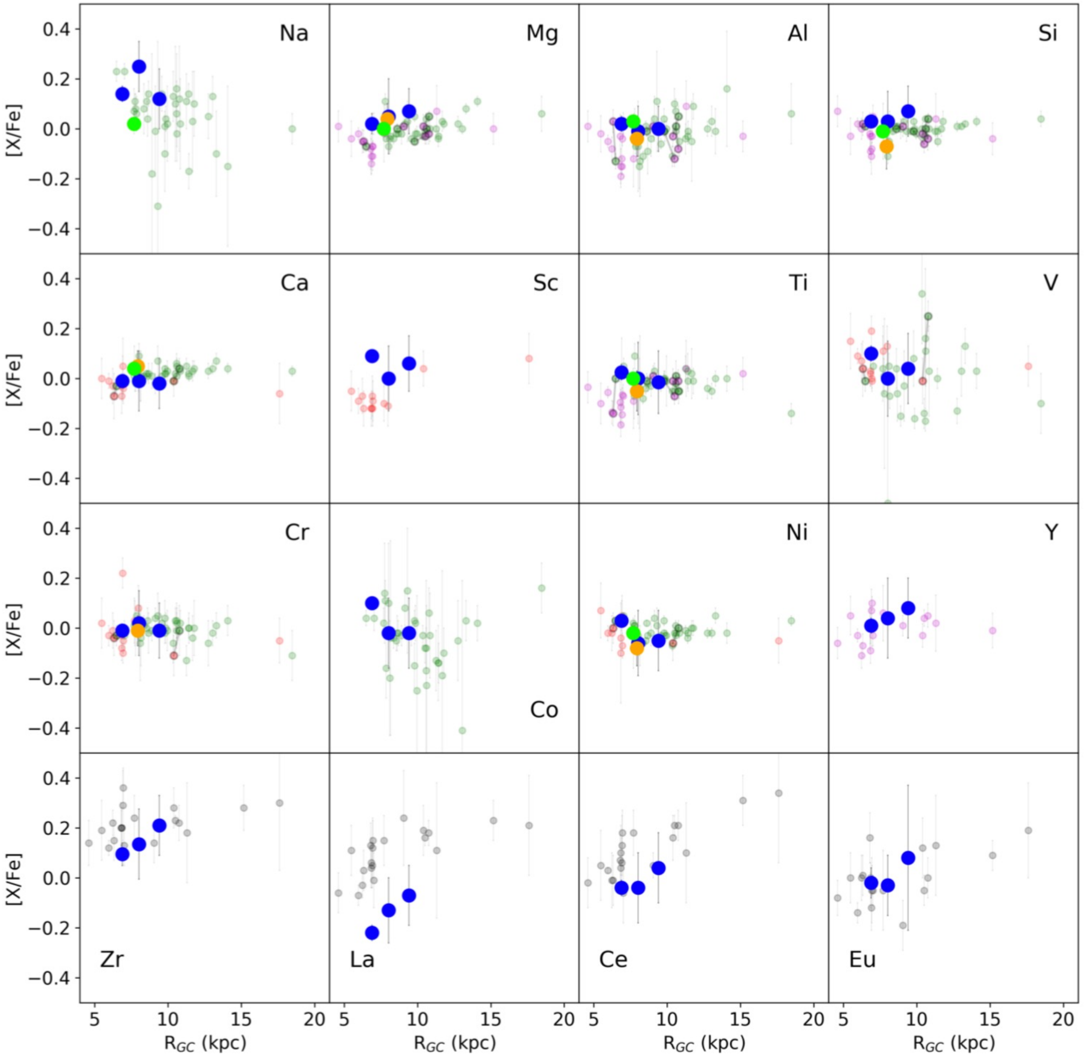


AMA-ROTFIT

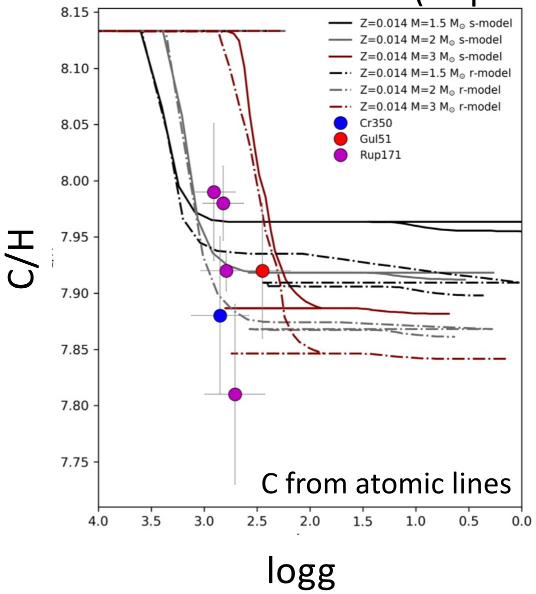
Why ?
Which one is (m

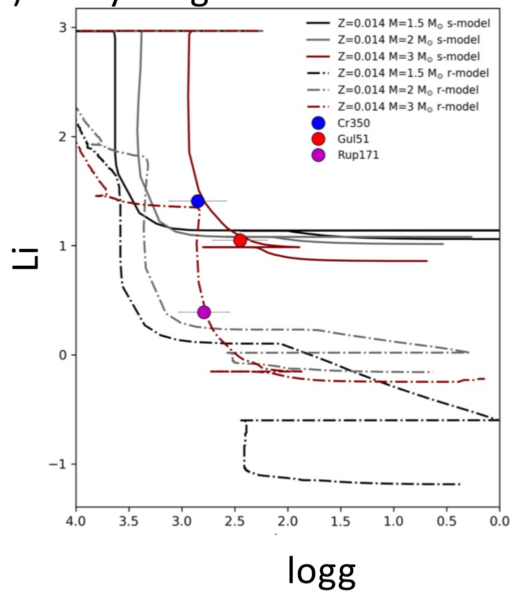
➔ Use FAMA only for Teff>4300 K

Casali+2020, Zhang+2021,2022



Models: standard or mixing induced by rotation
Different for older (Rup 171) and younger OCs

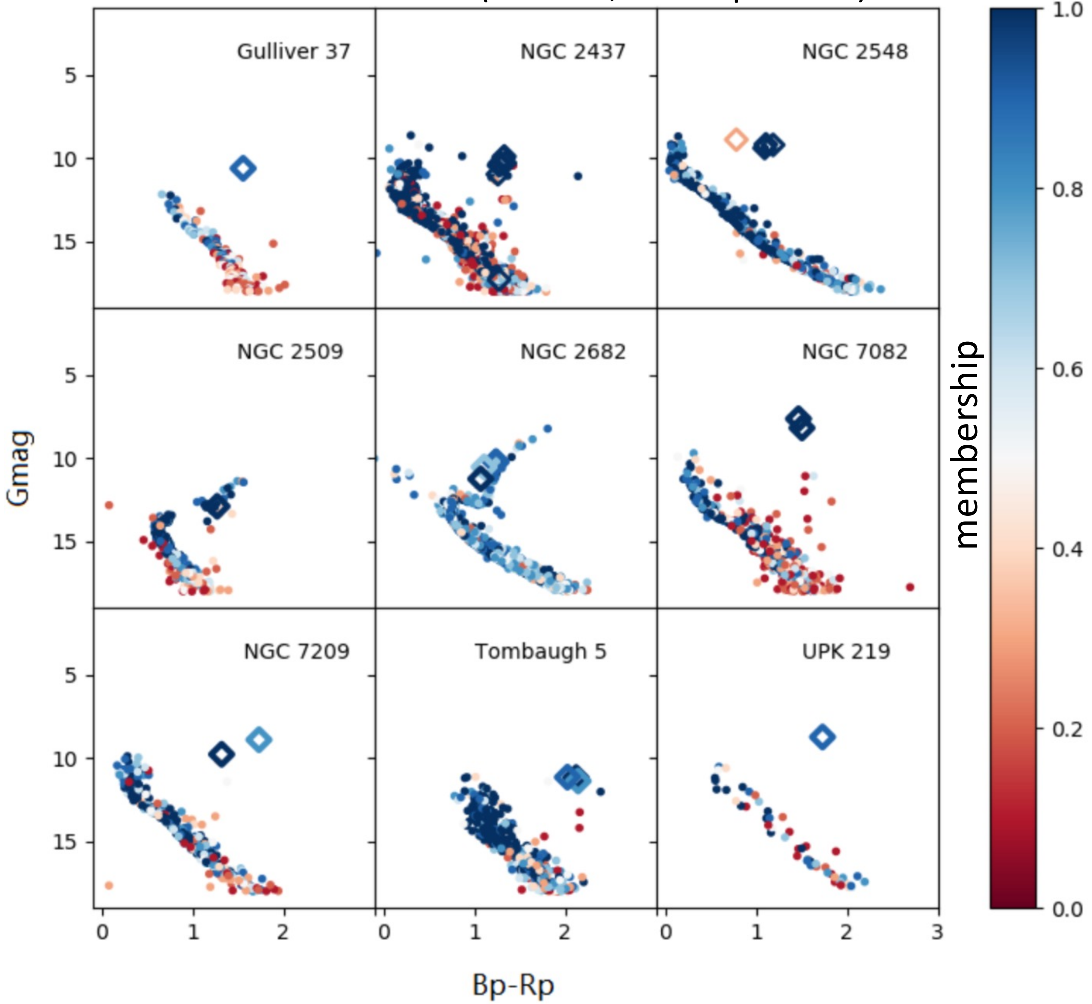




Abundances only with MOOG/FAMA
ROTFIT does not produce them, however we could have done as in other cases (the MS clusters) – see Antonio's and Javier's talks

Casali+2020, Zhang+2021,2022

9 of the 18 OCs (16 new, 2 comparison)



16 new open clusters
age 50 Myr-1.5 Gyr
(+M67 @ 4 Gyr)
Rgc=7.7-10 kpc
40 RGB, RC stars

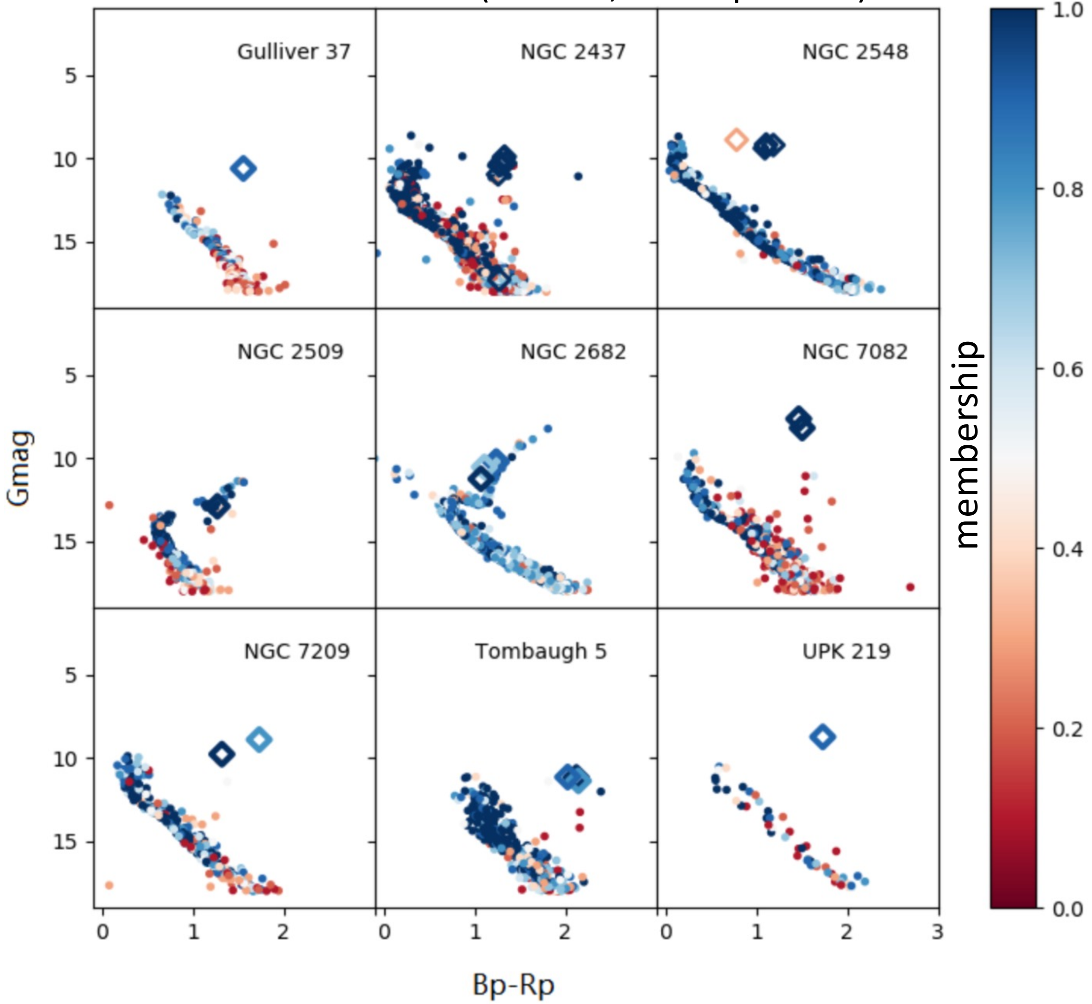
Cluster	Dist (pc)	R_{GC} (pc)	$\|z\|$ (pc)
ASCC 11	867	9095	139
Alessi 1	689	8726	159
Alessi-Teusch 11	634	8335	102
Basel 11b	1793	10121	34
COIN-*Gaia* 30	767	8804	105
Collinder 463	849	8874	138
Gulliver 18	1595	7816	110
Gulliver 24	1498	9131	11
Gulliver 37	1438	7712	95
NGC 2437	1511	9345	106
NGC 2509	2495	9887	254
NGC 2548	772	8857	205
NGC 7082	1339	8472	66
NGC 7209	1154	8525	146
Tombaugh 5	1706	9768	107
UPK 219	873	8735	58
Collinder 350	371	8021	94
NGC 2682	889	8964	470

Method:

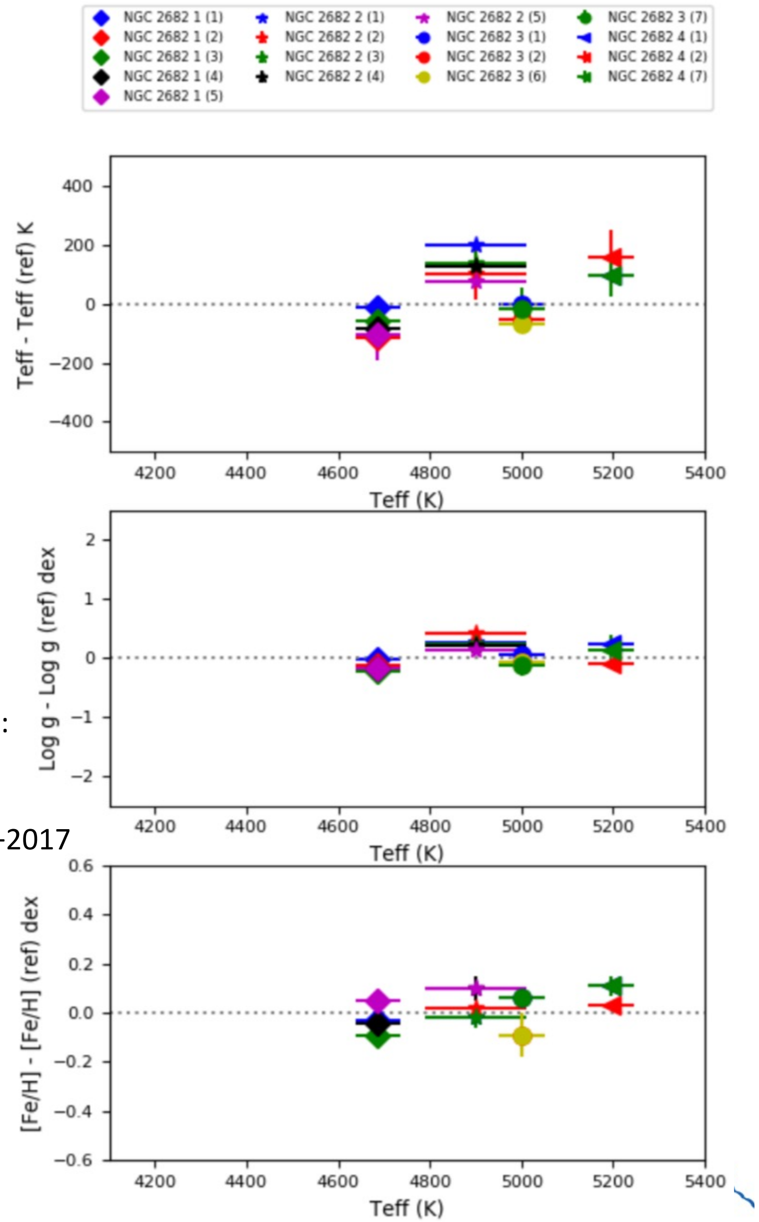
RV with `rvidlines` (IRAF) – cf Gaia RVS for binaries (6)
Lines lists for FeI, FeII NOT Gaia-ESO
EWs with ARES
Photometric input parameters (Teff IRFM, logg isochrones)
MOOG (using pymoogi)
Solar abundances Grevesse& Sauval 1998

Casali+2020, Zhang+2021,2022

9 of the 18 OCs (16 new, 2 comparison)

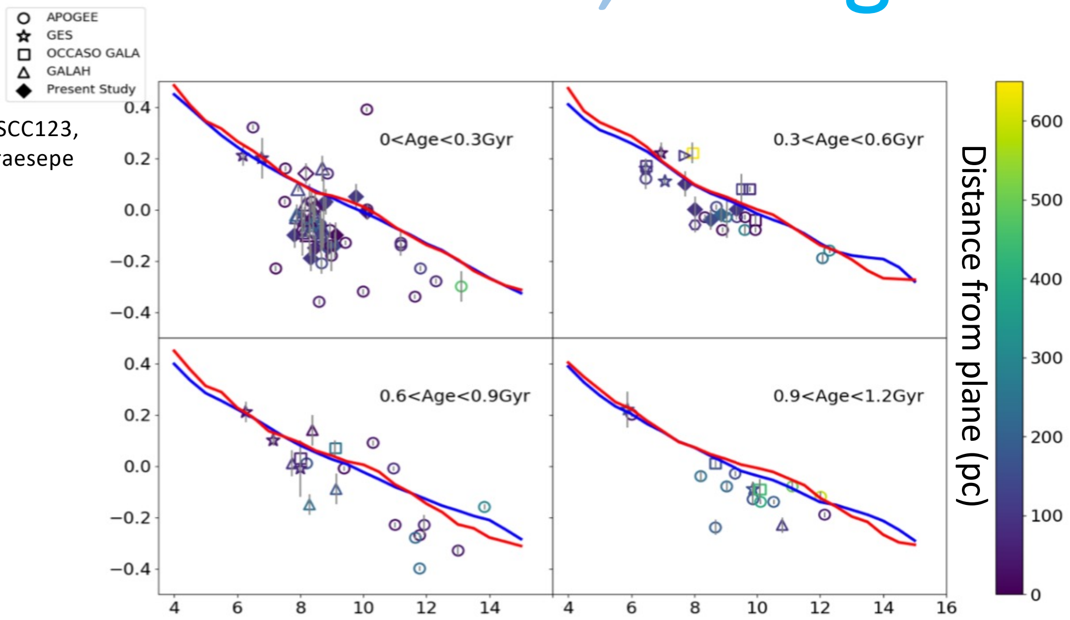


Literature for M67:
1 Jacobson+2011
2 APOGEE DR16
3, 4 Casamiquela+2017
5 Gao+2008
6 Luck 2015
7 Spina+2021



Casali+2020, Zhang+2021,2022

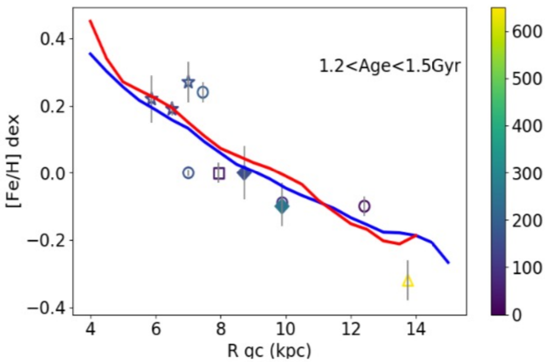
+ASCC123,
Praesepe



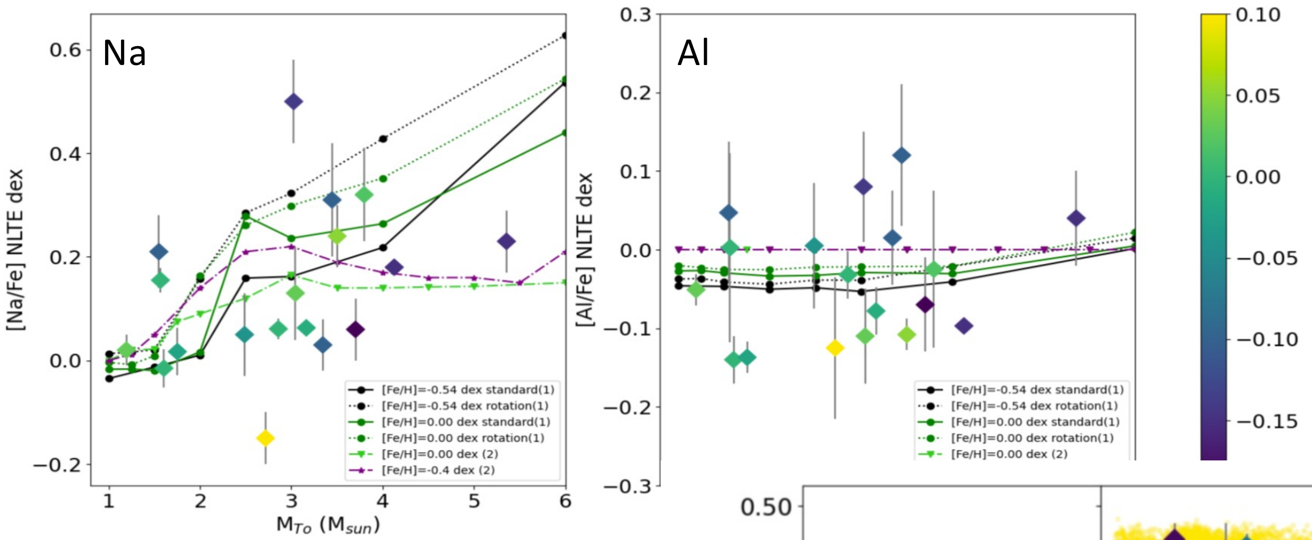
Why a large dispersion in [Fe/H] at young age
Why under-solar
[already noted, e.g. in Gaia-ESO]

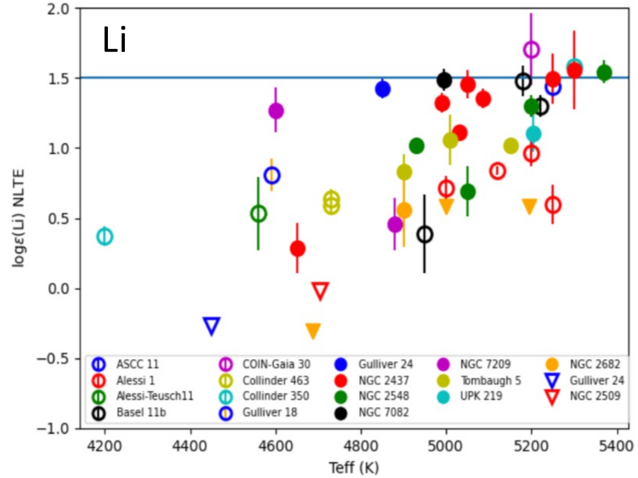
- Age, distance wrong? → Even if true, would not solve
- Some (literature) [Fe/H] wrong (rotation, possible non members, binaries,…) → Not for all
- Literature shows that chromospheric effects and magnetic fields are strong in young dwarfs and activity may influence lines → a traditional 1D LTE analysis is doomed
- New from our work: these problems, always discussed for MS, PMS, also extends to giants

Chemo-dynamical models by Minchev (2014)

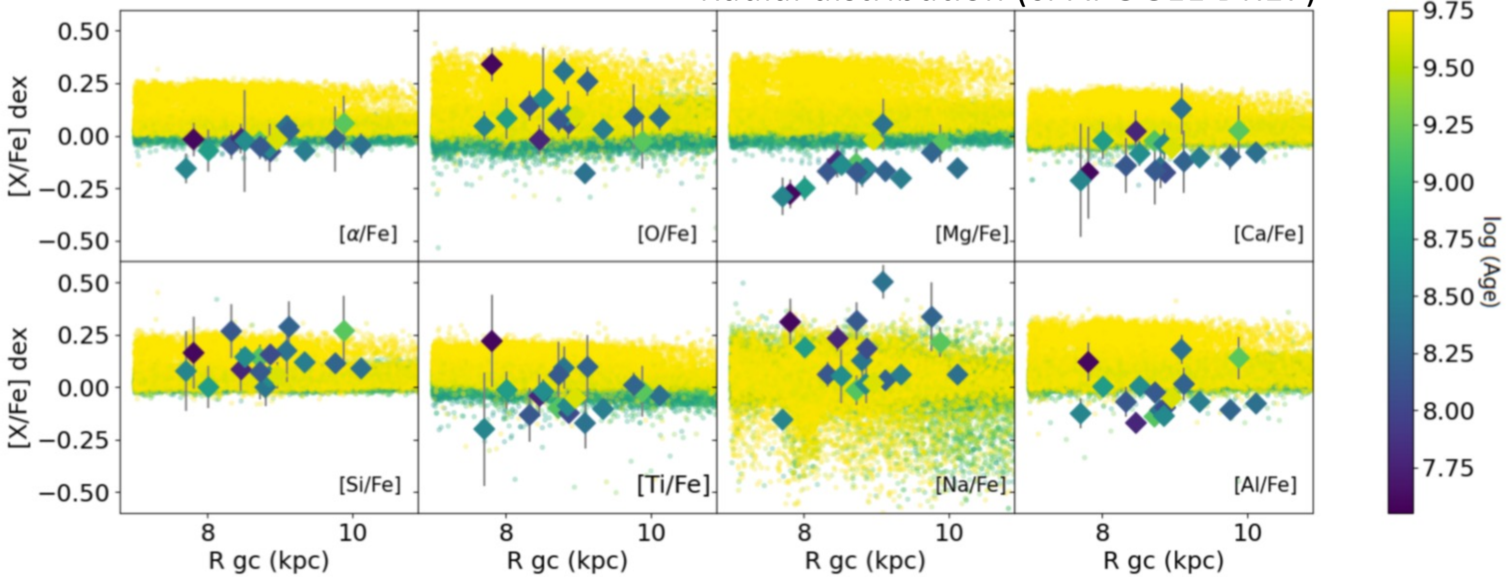


Casali+2020, Zhang+2021,2022





Radial distribution (cf APOGEE DR17)



Work on-going on n-capture elements

Casali+2020, Zhang+2021,2022 “problems”

Analysis not homogenoeus in SPA-OC.
line lists, model atmospheres (minor problem), solar abundances (minor problem)
EWs+MOOG vs ROTFIT, EW measurement DAOSPEC/ARES, MOOG different wrappers
[and Marina is using/trying other methods]
➔ Will need to homogeneise the whole sample, to have a set of 50 clusters (and more, considering OSTTA)

Only HARPS-N used, GIANO spectra untouched for this (used for He, F in a few cases).
➔ Will have to check consistency optical-IR

Young clusters (which are a fair fraction) have problems. Also, cool giants difficult to analyse (lower metallicity than expected)
➔ Solutions ? Open to discussion

Do you spot anything else to improve?

Some numbers

Cluster	Nr stars	Kind	publication
ASCC_123	17	MS	Frasca+
NGC_7092	2	MS	Alonso-Santiago2024 (with pilot)
Stock2	10+20	G+MS	Alonso-Santiago+,Jian+ (GIANO)
Praesepe	10	MS	D'Orazi+
Gulliver_51	2	G	Casali+
Alessi_1	5	G	Zhang+
Alessi-Teutsc	1	G	Zhang+
ASCC_11	1	G	Zhang+
Basel_11b	3	G	Zhang+
COIN-Gaia_30	1	G	Zhang+
Collinder_463	3	G	Zhang+
Gulliver_18	1	G	Zhang+
Gulliver_24	1	G	Zhang+
Gulliver_37	1	G	Zhang+
NGC_2437	6	G	Zhang+
NGC_2509	1	G	Zhang+
NGC_2548	5	G	Zhang+
NGC2681/M67	4	G	Zhang+
NGC_7082	3	G	Zhang+
NGC_7209	4	G	Zhang+
Tombaugh_5	3	G	Zhang+
UPK_219	1	G	Zhang+
Collinder_350	2	G	Casali+,Zhang+
NGC2682/M67	4	G	Zhang+ Ref.OC

(Also) for fluorine

King_11	**5**	**G**	**Shilpa (GIANO)**
NGC_6819	**4**	**G**	**Shilpa (GIANO)**
NGC_6791	**4**	**G**	**Shilpa (GIANO)**
NGC_7044	**4**	**G**	**Casali+,Shilpa (GIANO)**
NGC_7789	**3**	**G**	**Shilpa (GIANO)**
Trumpler_5	**2**	**G**	**Shilpa (GIANO)**
Ruprecht_171	**7**	**G**	**Casali+,Shilpa (GIANO)**
IC_4756	17	G	Dal Ponte+ (in prep)
LP_1800/UBC_170	3	G	Dal Ponte+ (in prep)
NGC_752	5	G	Dal Ponte+ (in prep)
NGC_6991	6	G	Dal Ponte+ (in prep)
Theia_1214	3	G	Dal Ponte+ (in prep)
UBC_60/C-Gaia_11	2	G	Dal Ponte+ (in prep)
UBC_141	2	G	Dal Ponte+ (in prep)
UBC_169	2	G	Dal Ponte+ (in prep)
UBC_194	1	G	Dal Ponte+ (in prep)
UBC_577	4	G	Dal Ponte+ (in prep)
UPK_84/UBC_131	3	G	Dal Ponte+ (in prep)
NGC_6800	1	G	Dal Ponte+ (in prep)
NGC_7086	2	G	Dal Ponte+ (in prep)
Alessi_62	2	G	
Praesepe	4	G	
Ruprecht_147	2+3	BSS+G	
Hyades	4	MS	
IC_4756	10	MSTO	low SNR For rotation
Mel20/alphaPer	3	MS	+archive
NGC_2232	3	MS	
Stock_1	7	MS	
NGC_6991	3	MS	
NGC_7058	12	MS	
ASCC_19	16	MS	

Worp in progress

"orphan" data

Where to find information on SPA targets

Google sheet(s) : clusters, stars observed, stars analyzed

Clusters & individual stars observed (Gaia DR2):
https://docs.google.com/spreadsheets/d/1eRaEC0lhz1RODHXOKmcTR4c6R95IJHEgvfakonFQdWA/edit#gid=0
Sub-sample in use by Marina (Gaia DR3):
https://docs.google.com/spreadsheets/d/1WiXaXFHwk0a-nI8HEHxlj_GZlGU1ig_7u7N482FeqAM/edit#gid=0
Stellar parameters published:
https://docs.google.com/spreadsheets/d/1OeAEchPCnZ3wXqzQ8Cn9HC3Uf_zQRqt0iBzcNctUqXQ/edit#gid=0

Spectra 1d (mostly HARPS-N) : Google drive

https://drive.google.com/drive/folders/0AJHr77Udj7LKUk9PVA

In doubt, ask Angela

IMPORTANT: Please,

- provide TABLES with results in (easily) readable format, e.g. ascii, csv, spreadsheet → sent to CDS if not already there
- provide SCIENCE READY spectra (stacked, normalized, etc) to be made public on Google drive

Where to find information on SPA targets

Clusters & individual stars observed (Gaia DR2):

https://docs.google.com/spreadsheets/d/1eRaEC0lhz1RODHXOKmcTR4c6R95IJHEgvfakonFQdWA/edit#gid=0

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
1	CLUSTER	RA	DEC	G	BpRp	Gaia_DR2_ID	PLX	PMra	PMdec	PROB/	2mass	Jmag	Hmag	Kmag	Qflg	Spectral type	Observed	NOTES
2	**Alessi_1**	paper Ruyuan 1 & 2																
3	Alessi_1_2	13.3143419	49.5315997	9.825	1.188	402506369136008832	1.357	6.460	-6.352	0.9	005315	8.285		7.715			Dec 2018	giant
4	Alessi_1_3	13.3349175	49.4804751	9.808	1.177	402505991178890752	1.419	6.784	-6.401	0.8	005320	8.326		7.739			Dec 2018	giant
5	Alessi_1_4	13.4134382	49.5305720	9.841	0.954	402505819380310016	1.290	6.532	-6.291	0.9	005339	8.647		8.241			Dec 2018	giant
6	Alessi_1_5	13.7127592	49.5880983	9.566	1.186	402867593065772288	1.304	6.388	-6.483	1	005451	8.057		7.514			Dec 2018	giant
7	Alessi_1_6	13.5425023	49.6691353	9.891	1.166	402880684126058880	1.383	7.047	-6.323	0.6	005410	8.415		7.823			Dec 2018	giant
8	**Alessi_62**	done also FIES																
9	Alessi_62_1	284.0693000	21.5486600	9.920	1.339	4519333643079413760	1.601	0.142	-1.102	1	185616	8.212	7.734	7.602	AAA		27 Jun 2019 (Gloria)	giant, FIES COMPENSATIO
10	Alessi_62_2	284.0509600	21.6561400	9.681	1.347	4519335601584434048	1.578	0.300	-0.937	1	185612	7.963	7.462	7.341	AAA		30 Jul 2019 (Gloria)	giant, FIES COMPENSATIO
11	**Alessi_Teutsch_11**	paper Ruyuan 1 & 2																
12	Alessi_Teutch_11	304.0934800	52.1051250	52.105	1.350	2184332753719499904	1.484	-0.193	-1.098	1	2016224	5.367	4.862	4.679	AAA		Aug 2019	giant
13	**ASCC_11**	paper Ruyuan 1 & 2																
14	ASCC_11_1	53.0203114	44.9626091	8.368	1.508	241730418805573760	1.201	0.782	-3.168	1	033204	6.468		5.801			Dec 2018	giant
15	*ASCC_11_2 SKIP NON FARI*	52.3088340	45.0492000	7.941	1.438	241837896063318400	1.041	1.116	-2.954	1	032914	5.961	5.493	5.337	AAA			giant, ha stella molto vicina,
16	**ASCC_19**																	
17	ASCC_19_1	82.0618700	-1.9769753	10.777	0.620	3217109248360315904	2.691	1.234	-1.161	0.7	052814	9.958	9.721	9.609	AAA		Nov 2019	MS rotates
18	ASCC_19_2	81.4320900	-2.1900454	10.617	0.738	3220091879809025792	2.792	0.864	-1.302	0.8	052543	9.7	9.468	9.395	AAA		Nov 2019	MS hot, rotates, low SNR
19	ASCC_19_3	81.2207000	-2.6455000	10.937	0.681	3214057416398183296	2.793	1.028	-1.664	0.7	052452	10.05	9.844	9.755	AAA		Nov 2019	MS hot, rotates, low SNR
20	ASCC_19_4	81.7535500	-1.2993153	10.920	0.780	3220302676802812928	2.767	1.129	-1.243	1	052700	9.97	9.69	9.621	AAA		Nov 2019	MS - only HARPS done & ve
21	ASCC_19_5	82.3282000	-1.3103068	11.296	0.800	3220244986802246400	2.689	0.772	-1.323	0.9	052918	10.26	9.98	9.906	AAA		29 Sep 2020	MS

INAF
OAS

Where to find information on SPA targets

Stellar parameters published:

https://docs.google.com/spreadsheets/d/1OeAEchPCnZ3wXqzQ8Cn9HC3Uf_zQRqt0iBzcNctUqXQ/edit#gid=0

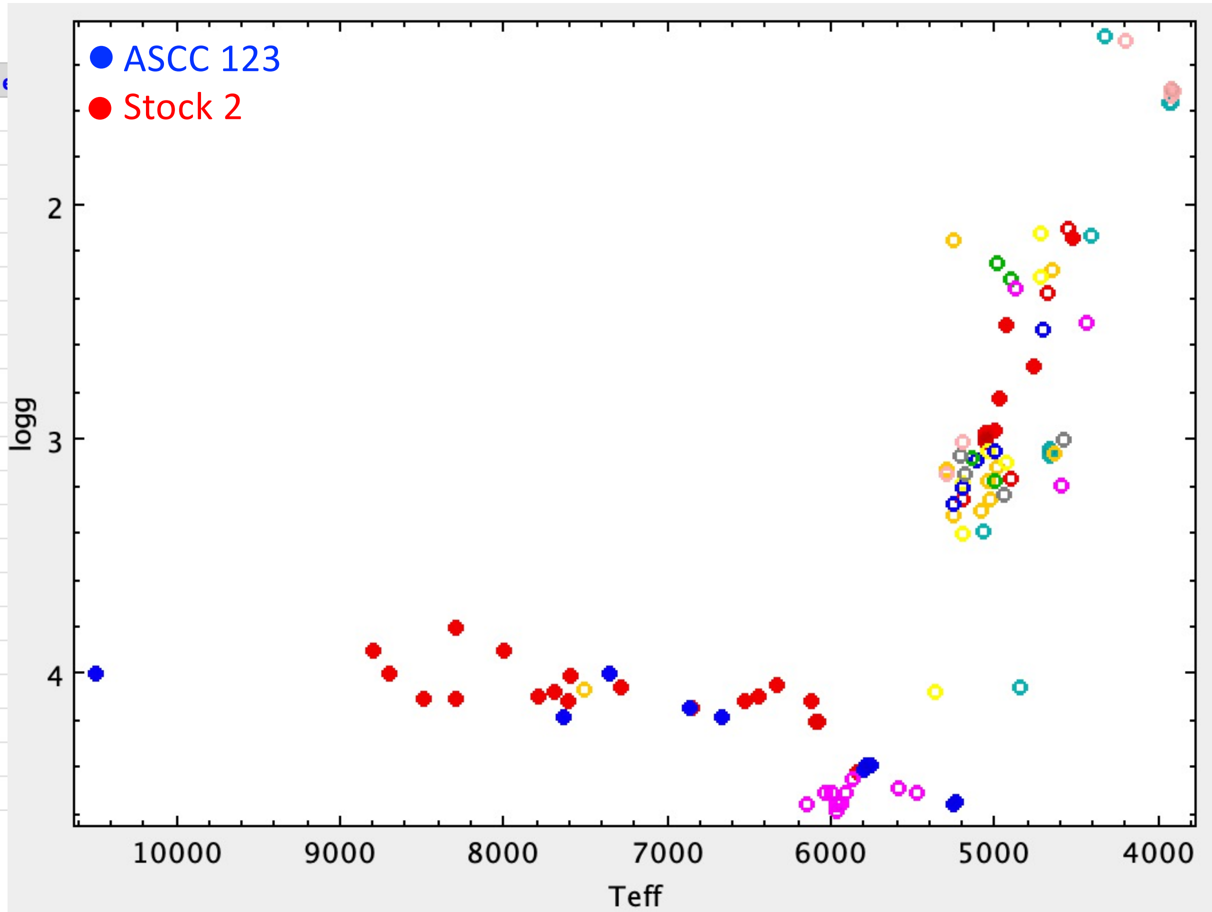
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**paper**	**Star**	**Gaia_DR3**	**Teff**	**eTeff**	**logg**	**elogg**	**[Fe/H]**	**eFe**	**NOTE**								
2	**Frasca+2019**	ASCC_123_39	2003378188041736320	6667	115	4.18	0.13	*0,05*	0.14	ROTFIT		A(Fe)sun=7,45						
3		ASCC_123_214	2003023629898711680	5804	87	4.41	0.12	*0,23*	0.15	ROTFIT								
4		ASCC_123_378	2003132344109912832	7636	293	4.18	0.14	*0,31*	0.18	ROTFIT								
5		ASCC_123_435	2003443437181978240	5758	79	4.39	0.12	*0,16*	0.12	ROTFIT								
6		ASCC_123_466	2003171651651105664	10500	250	4.00	0.20	*0,24*	0.11	ROTFIT								
7		ASCC_123_517	2003161751738142464	5784	81	4.39	0.12	*0,08*	0.11	ROTFIT								
8		ASCC_123_554	2002409483936262016	6871	152	4.14	0.13	*0,17*	0.09	ROTFIT								
9		ASCC_123_731	2003554006818945280	7355	274	4.00	0.20	*0,16*	0.17	ROTFIT								
10		ASCC_123_F1	2002337603362057088	5263	92	4.55	0.10	*0,02*	0.13	ROTFIT								
11		ASCC_123_F2	2006435105245732480	5237	77	4.54	0.10	*0,12*	0.11	ROTFIT								
12											*Teff*	*eTeff*	*logg*	*elogg*	*[Fe/H]*	*eFeh*	*Do not use FAMA for low*	
13	**Casali+2020**	Cr350_1	4372743213795720704	4330	90	1.28	0.24	0,00	0.07	ROTFIT	*4100*	*100*	*1.35*	*0.23*	*-0,02*	*0.10*	*FAMA*	
14		Cr350_2	4372572888274176768	5070	60	3.39	0.19	0,00	0.09	ROTFIT	*5170*	*110*	*3.25*	*0.27*	*0,00*	*0.10*	*FAMA*	
15		Gul51_1	517925575042048384	4640	60	3.06	0.12	0,00	0.08	ROTFIT	*4730*	*90*	*2.45*	*0.26*	*-0,01*	*0.09*	*FAMA*	
16		Gul51_2	517953750028538240	7520	298	4.06	0.23	-0,01	0.13	ROTFIT								
17		NGC7044_1	1969807040026523008	3920	50	1.53	0.16	-0,01	0.08	ROTFIT	*3980*	*90*	*1.35*	*0.20*	*-0,03*	*0.14*	*FAMA*	
18		NGC7044_2	1969807276235623552	3910	50	1.51	0.16	-0,01	0.11	ROTFIT	*3950*	*70*	*1.06*	*0.20*	*-0,03*	*0.14*	*FAMA*	
19		NGC7044_3	1969806073644788992	3930	60	1.50	0.19	-0,01	0.09	ROTFIT	*4000*	*100*	*1.23*	*0.21*	*-0,03*	*0.14*	*FAMA*	
20		NGC7044_4	1969800576086654592	3930	60	1.50	0.17	-0,01	0.08	ROTFIT	*4010*	*90*	*1.23*	*0.20*	*-0,02*	*0.14*	*FAMA*	
21		Rup171_1	4103073693495483904	3920	50	1.56	0.13	-0,01	0.09	ROTFIT	*3950*	*90*	*1.18*	*0.21*	*-0,03*	*0.14*	*FAMA*	
22		Rup171_2	4102882309792631552	3940	70	1.56	0.14	-0,01	0.10	ROTFIT	*4100*	*70*	*1.54*	*0.20*	*-0,01*	*0.13*	*FAMA*	

Where to find information on SPA targets

Stellar parameters published:

https://docs.google.com/spreadsheets/d/1OeAEchPCnZ3wXqzQ8Cn9HC3Uf_zQRqt0iBzcNctUqXQ/edit#gid=0

	A	B	C	D
1	**paper**	**Star**	**Gaia_DR3**	**Teff**
2	**Frasca+2019**	ASCC_123_39	2003378188041736320	6667
3		ASCC_123_214	2003023629898711680	5804
4		ASCC_123_378	2003132344109912832	7636
5		ASCC_123_435	2003443437181978240	5758
6		ASCC_123_466	2003171651651105664	10500
7		ASCC_123_517	2003161751738142464	5784
8		ASCC_123_554	2002409483936262016	6871
9		ASCC_123_731	2003554006818945280	7355
10		ASCC_123_F1	2002337603362057088	5263
11		ASCC_123_F2	2006435105245732480	5237
12				
13	**Casali+2020**	Cr350_1	4372743213795720704	4330
14		Cr350_2	4372572888274176768	5070
15		Gul51_1	5179255750420483 84	4640
16		Gul51_2	517953750028538240	7520
17		NGC7044_1	1969807040026523008	3920
18		NGC7044_2	1969807276235623552	3910
19		NGC7044_3	1969806073644788992	3930
20		NGC7044_4	1969800576086654592	3930
21		Rup171_1	4103073693495483904	3920
22		Rup171_2	4102882309792631552	3940



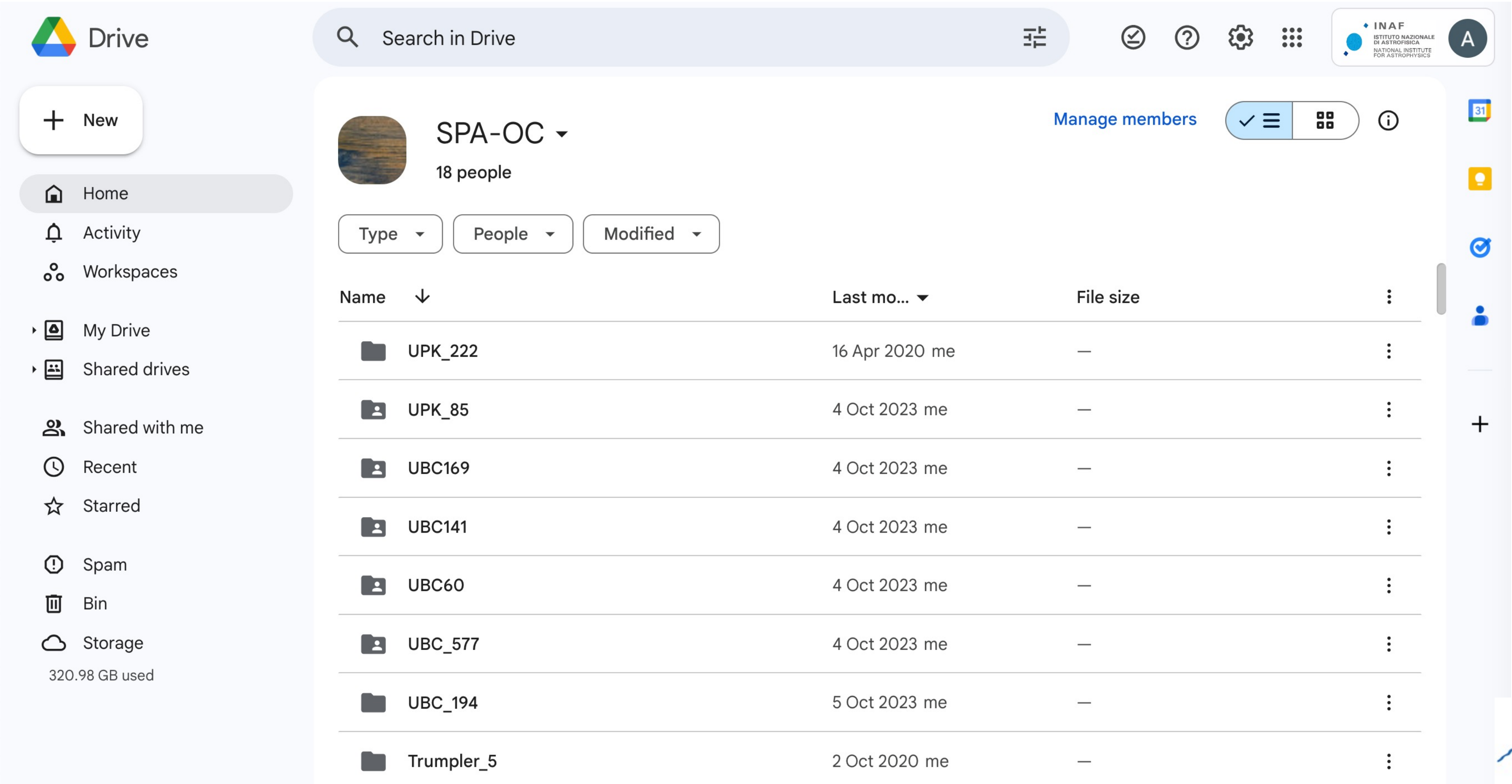
R

MA for low

Where to find information on SPA targets

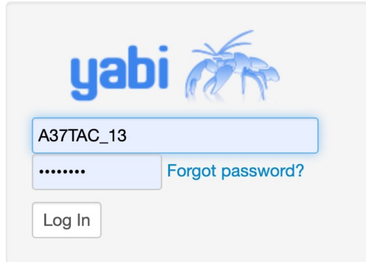
Spectra 1d (mostly HARPS-N) : Google drive

https://drive.google.com/drive/folders/0AJHr77Udj7LKUk9PVA



Data reduction:

HARPS-N spectra:
pipeline reduction



GIANO-B spectra:

1-all SPA data

  Nicoletta Sanna

  Tino Oliva (tellurics)

2-new data

  TBD