THE HOMOGENEOUS CHARACTERISATION OF

HOST STARS

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& the ARIEL stellar characterisation WG

An accurate, precise and **HOMOGENEOUS** determination of the fundamental properties of host stars is a crucial step towards a comprehensive characterisation of planetary system.

THE STELLAR CHARACTERISATION WG

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Study on parameters precision through ExoSim
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G. MORELLO poster N.40 "ExoTETHyS"

REFERENCE SAMPLE OF STARS

ARIEL TIER 1

(Edwards et al., 2019)

X

SWEET-CAT CATALOGUE

(Santos et al., 2013)

An (incremental) catalog of stellar parameters for stars with planets.

See also:
SWEET-Cat in python with PyAstronomy

Download Data

Name	HD number	RA	Dec	Vmag	σ(Vmag)	π	σ(π)	Source of π	Teff	σ(Teff)	logg	σ(logg)	LC logg	σ(LC logg)	Vt	σ(Vt)	[Fe/H]	σ([Fe/H])	Mass	σ(Mass)	Reference	Homogeneity flag
11 Com	107383	12 20 43.02	+17 47 34.33	4.74	0.02	10.71	0.22	GAIADR2	4830	79	2.61	0.13	–	–	1.70	0.10	−0.34	0.06	2.14	0.28	Mortier et al. 2013a	1
11 UMi	136726	15 17 05.88	+71 49 26.04	5.01	0.01	7.95	0.12	GAIADR2	4255	88	1.80	0.26	–	–	1.79	0.08	−0.13	0.04	3.40	0.76	Sousa et al. 2015	1
14 And	221345	23 31 17.41	+39 14 10.30	5.22	–	13.23	0.12	GAIADR2	4709	37	2.44	0.12	–	–	1.51	0.03	−0.29	0.03	2.38	0.29	Sousa et al. 2015	1
14 Her	145675	16 10 24.31	+43 49 03.52	6.67	–	55.74	0.02	GAIADR2	5286	58	4.24	0.11	–	–	0.80	0.09	0.38	0.04	0.99	0.09	Sousa et al. 2018	1
16 Cyg B	186427	19 41 51.97	+50 31 03.08	6.20	–	47.28	0.02	GAIADR2	5783	19	4.42	0.03	–	–	0.96	0.03	0.09	0.01	1.01	0.08	Sousa et al. 2018	1
18 Del	199665	20 58 25.93	+10 50 21.42	5.51	0.01	13.09	0.11	GAIADR2	5076	38	3.08	0.10	–	–	1.32	0.04	0.00	0.03	1.76	0.18	Mortier et al. 2013a	1

Homogeneity flag

When == 1: parameters are derived with the same technique

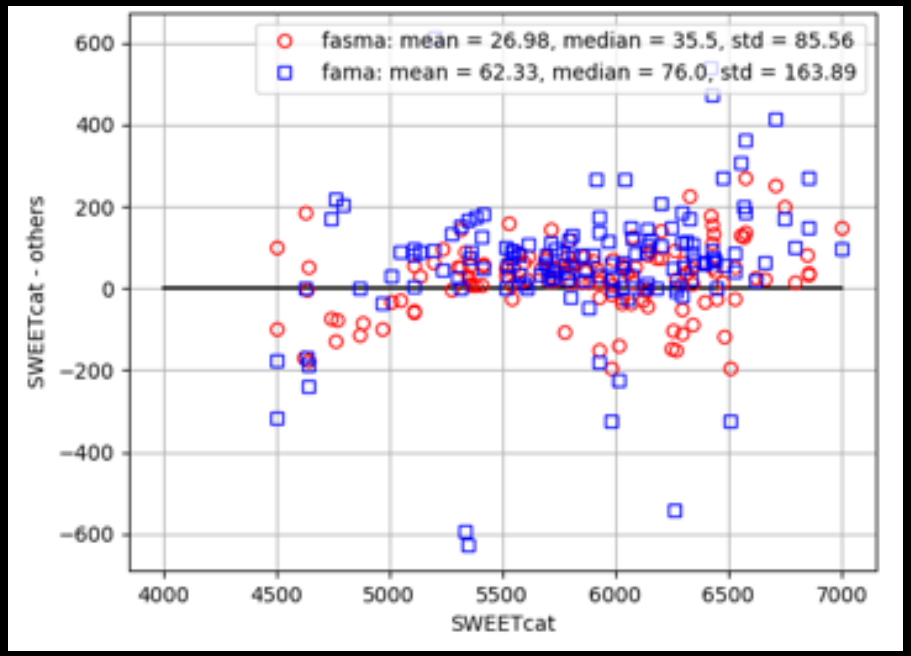
155 stars in the ARIEL target list are already homogeneously estimated

STELLAR PARAMETERS

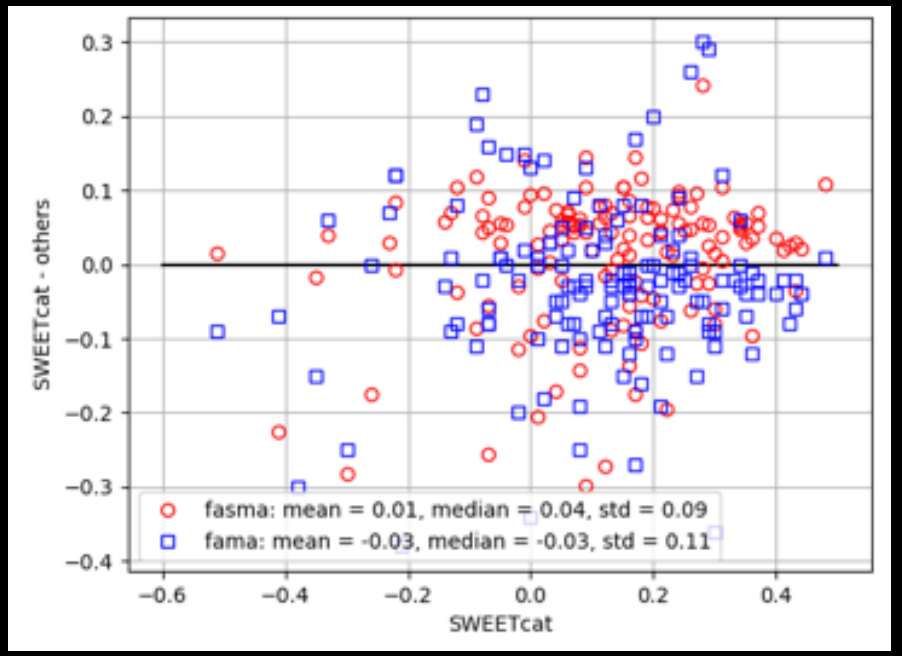
Comparison between three different methods

1. SWEET-Cat: Santos et al. 2013
2. Fast Automatic MOOG Analysis (FAMA): Magrini et al., 2013
3. Fast Analysis of Spectra Made Automatically (FASMA): Tsantaki et al., 2018

Teff



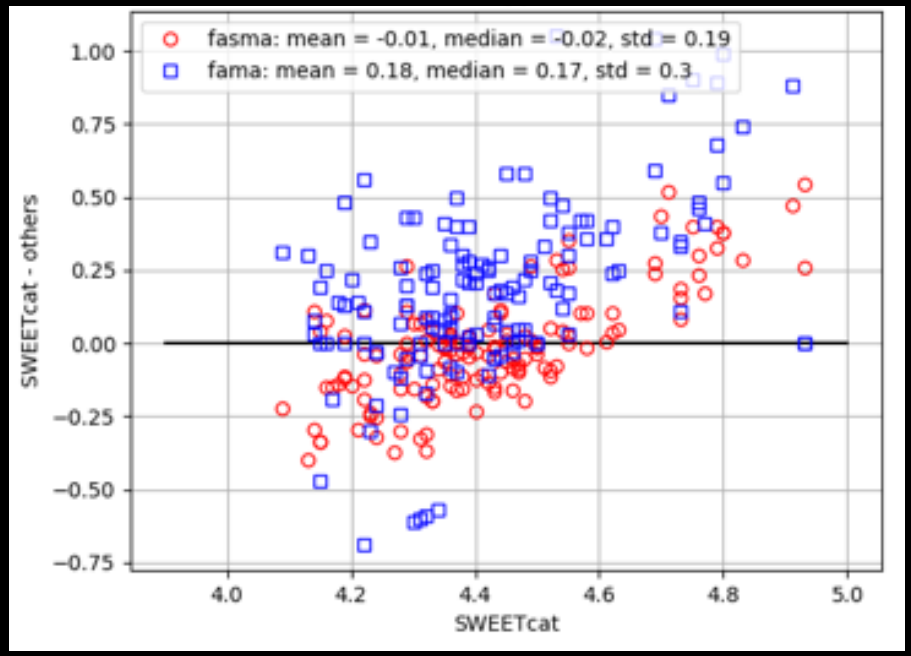
FeH



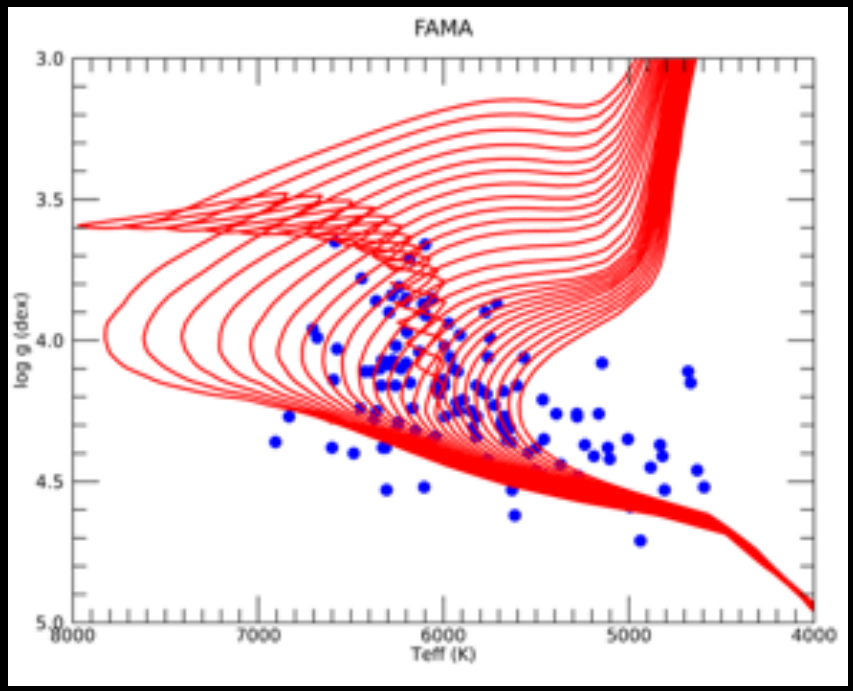
STELLAR PARAMETERS

Good agreement: Teff=5000-6500 K, log g=4.2-4.6 dex

log(g)



External comparison will be used to evaluate the results of the different methods e.g. Gaia, isochrones.



PADOVA isochrones

STELLAR ABUNDANCES

The abundances of the elements **Na, Al, Mg** and **Si** was determined by both:

1. ARES —> equivalent widths (EWs): Adibekyan et al., 2012.
   MOOG 2014 radiative transfer code + Kurucz stellar model atmospheres.
2. Fast Automatic MOOG Analysis (FAMA): Magrini et al., 2013

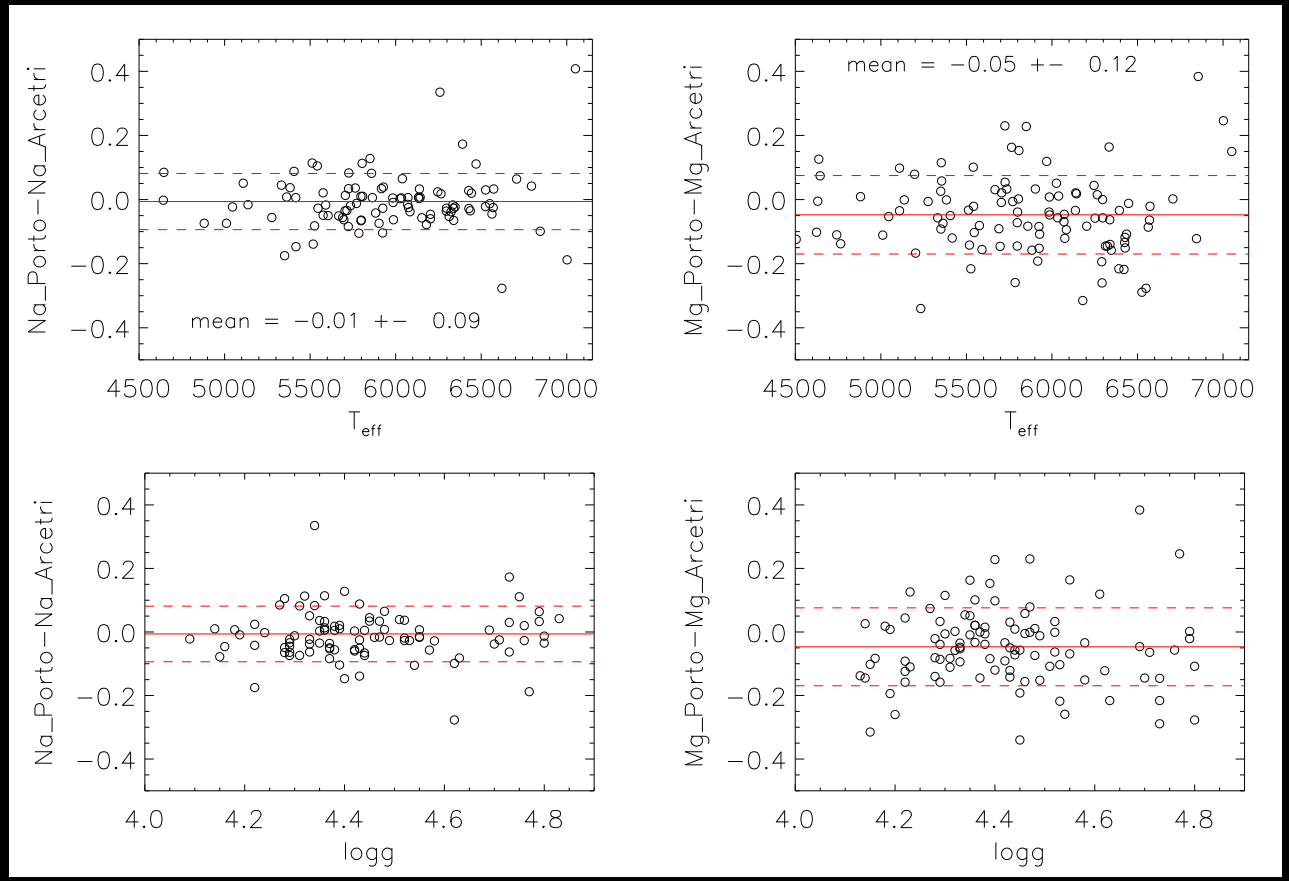
Abundances were normalised to a Vesta solar spectrum (HARPS, high S/N)

we provide the [X/H] ratios,

$$[X/H] = A(X) - A(X)_{\odot}$$

↓

absolute logarithmic abundances



STELLAR ABUNDANCES

RESULTS:

Sample of homogeneous stellar abundances for which the difference between the methods < 2 MAD

Homogeneous catalogue of

Stars with reliable abundances:

Na: 91

Al: 86

Mg: 92

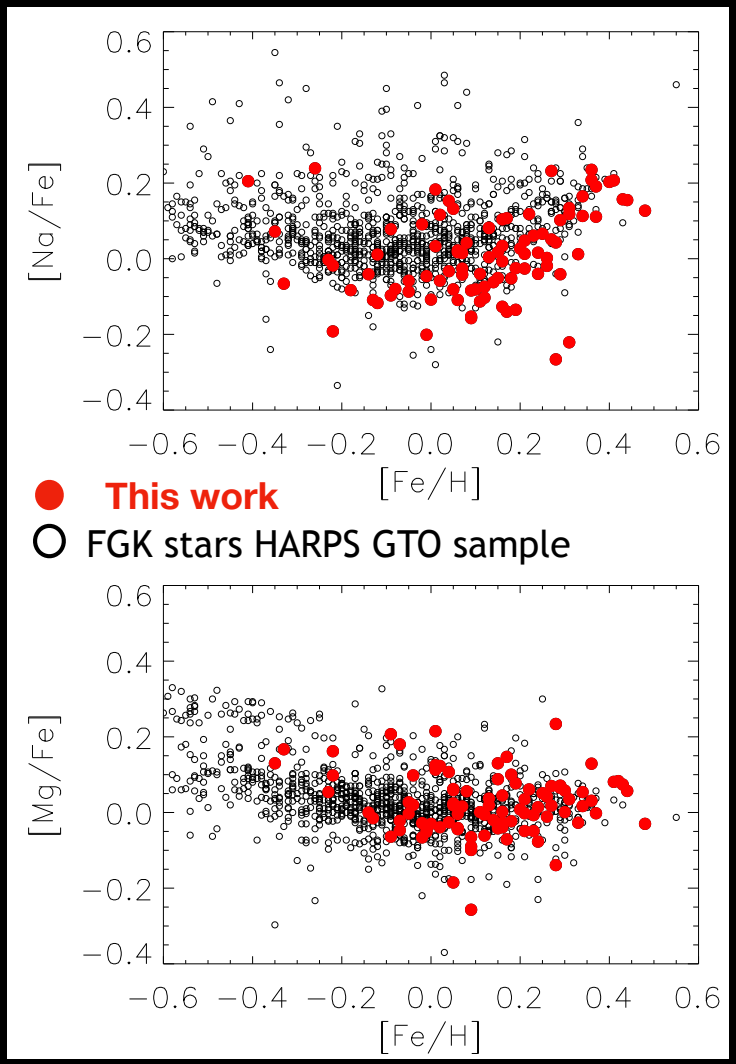
Si : 51.

Average errors for [X/H] is for

Na and Si: 0.06 dex

Mg and Al: 0.07 dex

In general the stars follow the expected Galactic chemical evolution.



SYNERGY with PLANETARY FORMATION WG

STELLAR AGE

STATE OF THE ART: ages found in the literature are a case-by-case analysis performed by different teams. These results in an inhomogeneous census of stars with planets.

ISOCHRONE FITTING METHOD

Bayesian code PARAM (da Silva et al., 2006; Rodrigues et al., 2014, 2017) to determine stellar fundamental properties following a grid-based approach, whereby observed quantities are matched to a well-sampled grid of stellar evolutionary tracks.

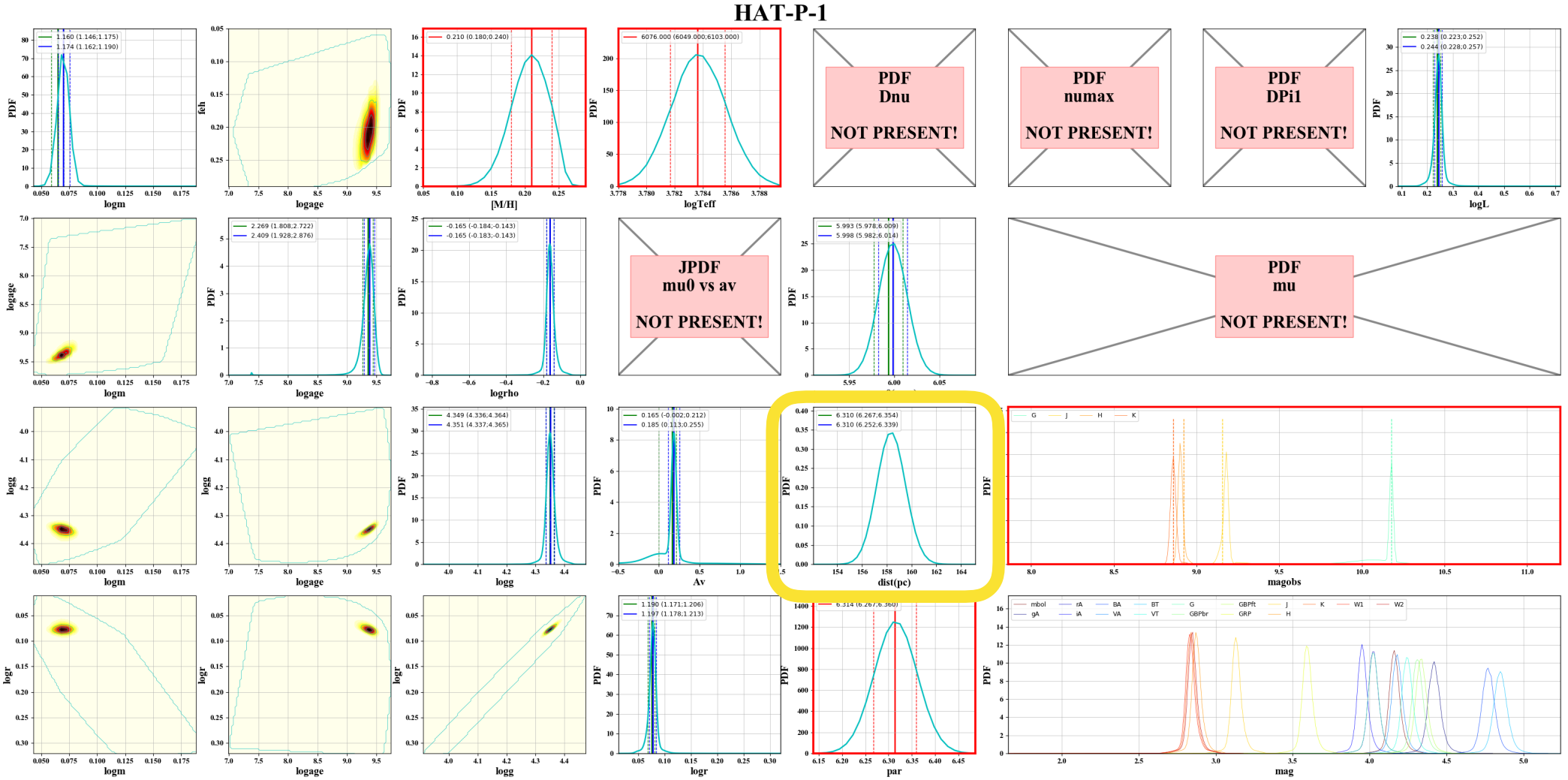
Observational constraints:

1. spectroscopy from SWEET-Cat (Teff and [Fe/H]),
2. astrometry from Gaia (GDR2 parallax)
3. photometry in a number of different bandpass: 2MASS (J, H, Ks), AllWISE (W1, W2), SDSS (g,r, and i), and Tycho-2 (BT and VT).

Final list of 281/327 stars with age determination (Bossini et al., in prep.)

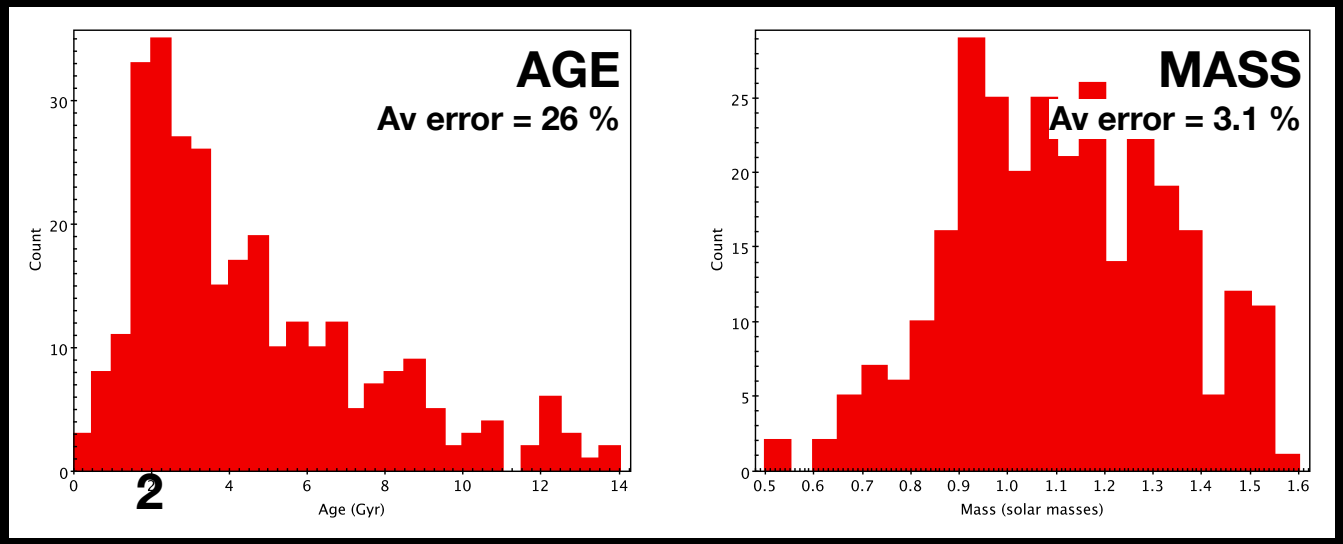
STELLAR AGE

(Bossini et al., in prep.)

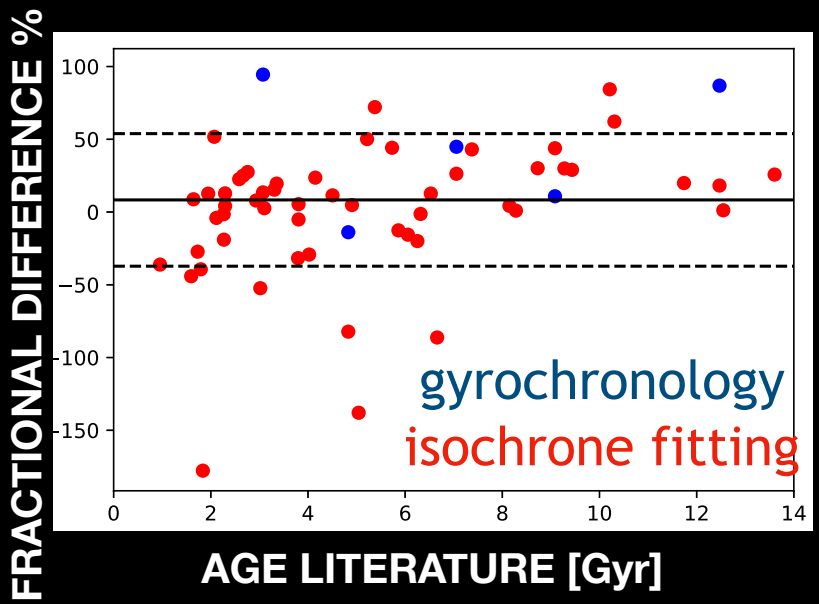


Posterior PDFs and associated Bayesian credible regions of a number of stellar properties (e.g., age, mass, and radius), as well as their joint distributions. Framed in red are the posterior PDFs of those parameters used as observational constraints.

STELLAR AGE AND MASS



(Bossini et al., in prep.)



Comparison with the literature

Percentage fractional difference in age as a function of the age reported in the literature for a subsample of 65 stars.

μ = 8 %, σ = 45 %.

SYNERGY with UPPER ATMOSPHERE/STAR-PLANET INTERACTION WG

STELLAR ACTIVITY INDICATORS

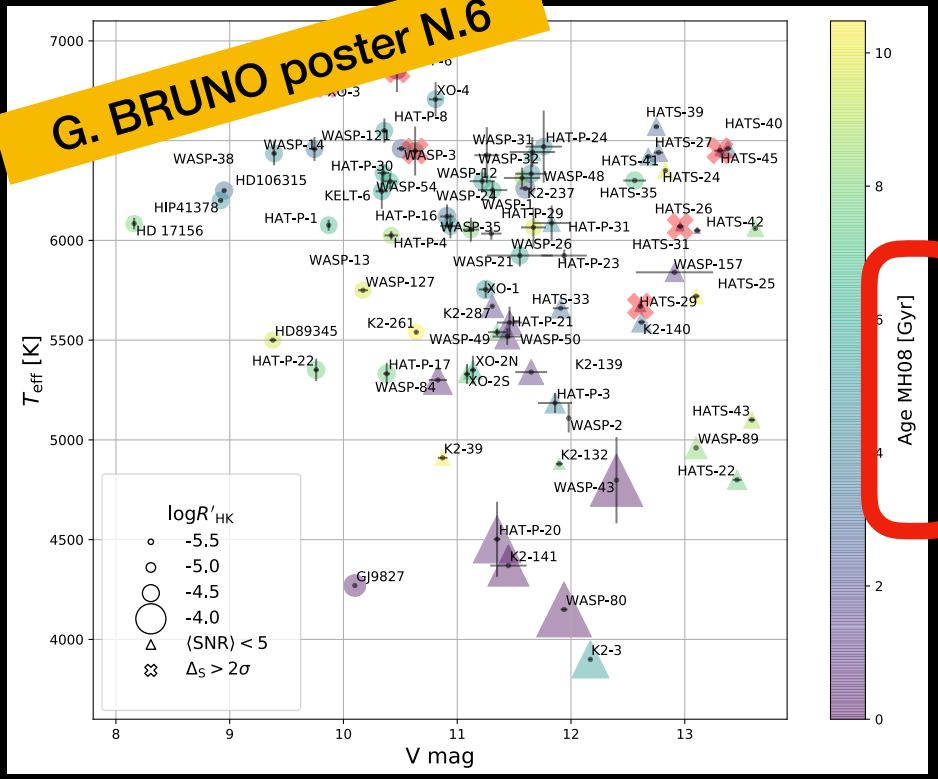
1. **Activity level from CaII H&K lines** (3933.664 and 3968.470 Å) : through the Mt Wilson S index and converted to the log R'HK when colour information was available.

2. **CCF Asymmetry indices** (Lanza et al. 2018) can be used to define the effects of the activity on the stellar spectral lines due to processes occurring in the photosphere

3. **Rotation periods**

SuperWASP survey and HATNet database.
Periodograms & ACF

G. BRUNO poster N.6



Good agreement between the rotation period obtained from the 3 methods

OBSERVATIONAL CAMPAIGN

1. NORTHERN HEMISPHERE —> TNG/HARPS-N (3.6 m)

2. SOUTHERN HEMISPHERE —> UVES (8 m):
   Programme accepted P105, Program ID 105.20P2
   20 V>12 - stars with no high precision characterisation yet

Abundances precision errors: < 0.05 dex for S/N > 150
> 0.1 dex for S/N < 100

3. Monitoring with Telescope Live: Global network of robotic telescopes for stellar rotational periods

4. Testing simultaneous photometric and spectroscopic observation of one/two targets.

SUMMARY

1. Benchmarking the stellar parameters determination methods to find an optimal method analysis depending by the stellar sample

2. Homogenous list of abundances for ARIEL stars.

3. Homogenous list of ages for ARIEL stars and validating results with empirical methods

4. Determination of activity indicators with various methods

5. Telescope campaigns north and south

Global and homogeneous approach to planet-hosts is extremely useful for the whole exoplanet community