Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Measuring at Intermediate Metallicity Neutron Capture Elements

MINCE

Gabriele Cescutti

ChETEC INFRA Kick off – WG5 session

Vilnius , ChETEC WG3 Meeting 2019

Focus of the meeting was preparing 2 observational proposals:

r-process

Galactic globular clusters

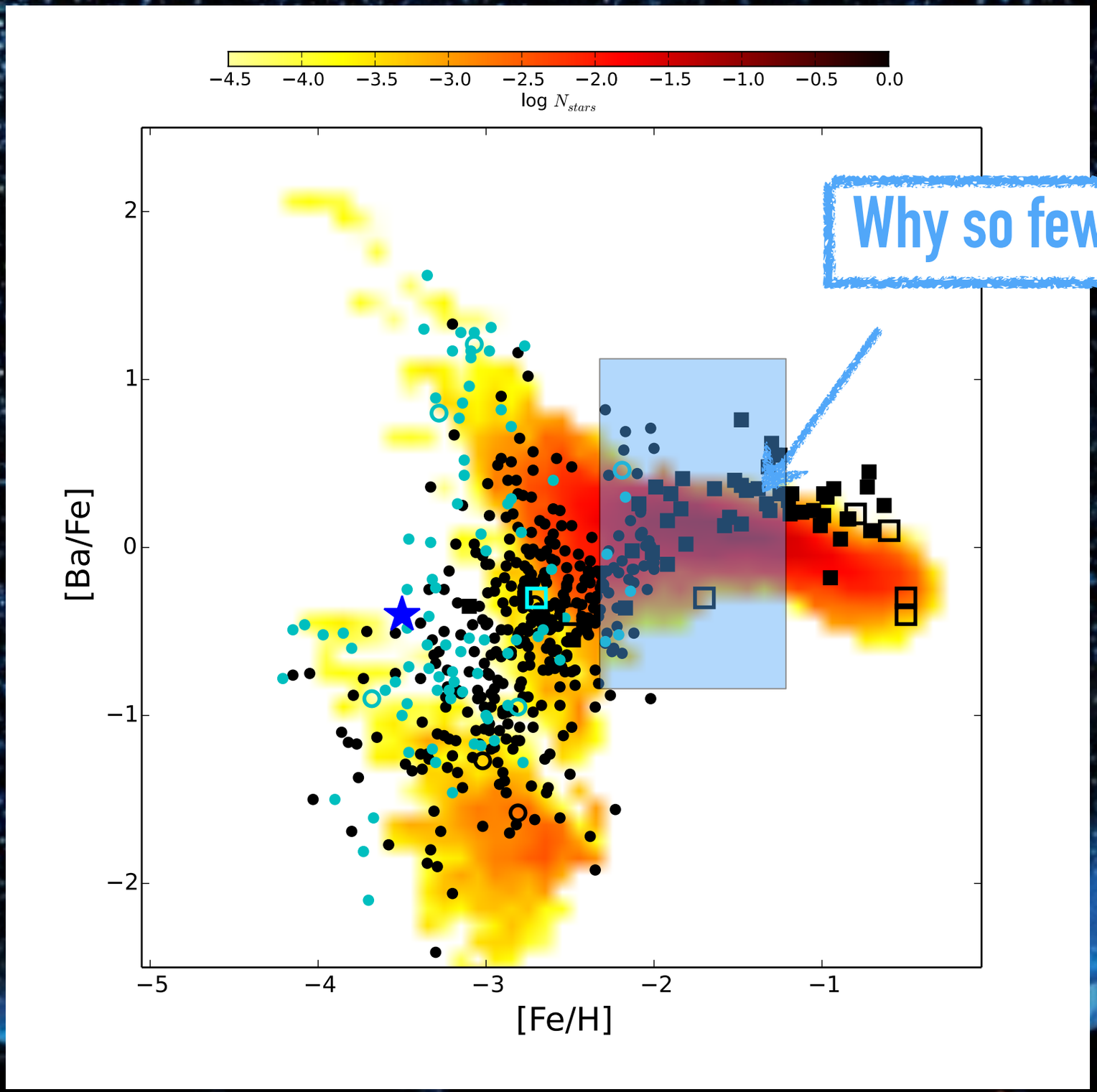
ChETEC INFRA Kick off – WG5 session

r-process team

ChETEC INFRA Kick off – WG5 session

However, during a coffee break …

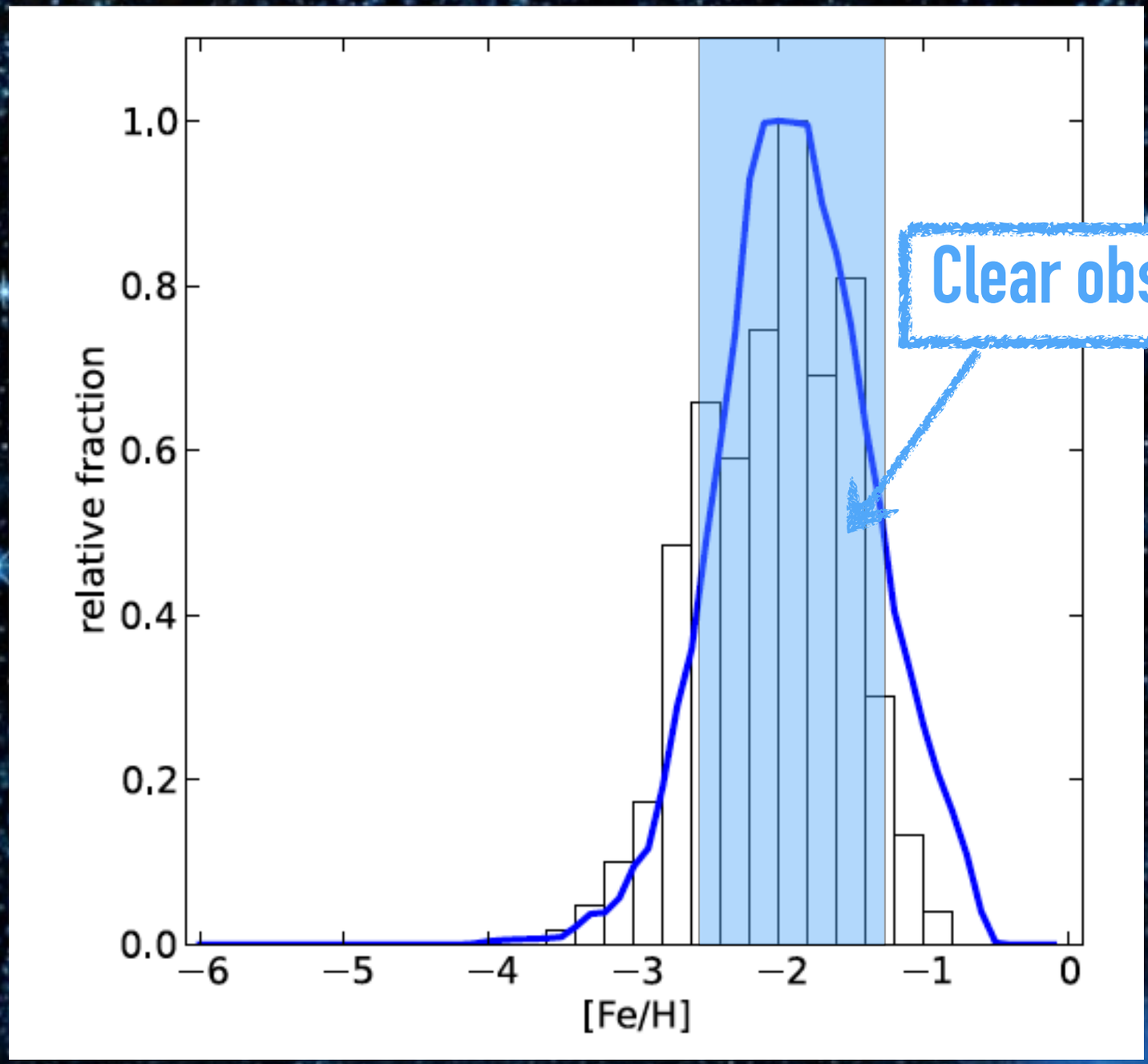
Stochastic model for Ba in the Galactic halo



Why so few stars here?

data from in
Placco+14
Hansen+12
Hansen+16
Cescutti+16

Metallicity distribution function of the Galactic halo



Clear observational bias

Li et al. (2010): main-sequence turnoff stars in the HESS (Hamburg ESO)

How can we achieve this?

Measuring nc elements is demanding
—> HR spectroscopy and high S/N
(at least for most of the nc elements!)

(but see results for Sr and Ba with X-shooter by Camilla Hansen C:J. et al. 2016)

However . . .
we are not looking for the most metal poor stars,
just honest halo giants . . .
(giants better suited for measuring the nc elements lines)

Nature provides a lot of them in our Galaxy, and some (>1000) are close enough to be measured with 2-4m telescopes (V<10-11)
or measured as a filler in top class telescopes!

MINCE project:

P. Bonifacio, G. Cescutti, C. Hansen, L. Monaco, E. Spitoni, A. Kučinskas,E. Kolomiecas, L.Lombardo, A. Mucciarelli, M. Franchini, P. Di Marcantonio, V. S. Cristallo, F. Matteucci, M. Valentini, J. Klevas, M. F. Andersen, M. Hanke, A.M. Matas Pinto, E. Caffau, Dobrovolskas, P. François, M. Spite, F. Spite . . .

TNG 3.58m
Spectrograph HARPS-N

4/4 applications successful 43 stars+15 in summer

PI Cescutti

Period AOT42 (October 2020 — March 2021) **Submit using: www.tng.iac.es/submit.html**

1. Title

Measuring at Intermediate metallicity Neutron Capture Elements (MINCE)

2. Abstract

The abundances of n-capture elements in metal-poor stars are needed to understand the physics of the different n-capture processes (slow, rapid and possibly intermediate) as well as the chemical evolution of the Galaxy. The intermediate metallicity range ($-2.5 \leq [\mathrm{Fe/H}] \leq -1.5$) is particularly interesting because it allows to discriminate different models. Surprisingly there are far less measurements of n-capture elements abundances in this metallicity range than at lower metallicities. The Measuring at Intermediate metallicity Neutron Capture Elements (MINCE) project aims at filling this gap and providing the community with a high quality sample of stars with measured chemical abundances as legacy. The goal is to determine the abundances in about 1000 metal-poor giants in five years using several facilities. We here propose to use HARPS to observe a sample of sixteen metal-poor northern giants.

OHP 1.93m
Spectrograph SOPHIE

2/2 applications successful: 42 stars

PI Bonifacio

CFHT: 3.58m
Spectrograph ESPaDOnS

2 applications successful (filler): 15 stars

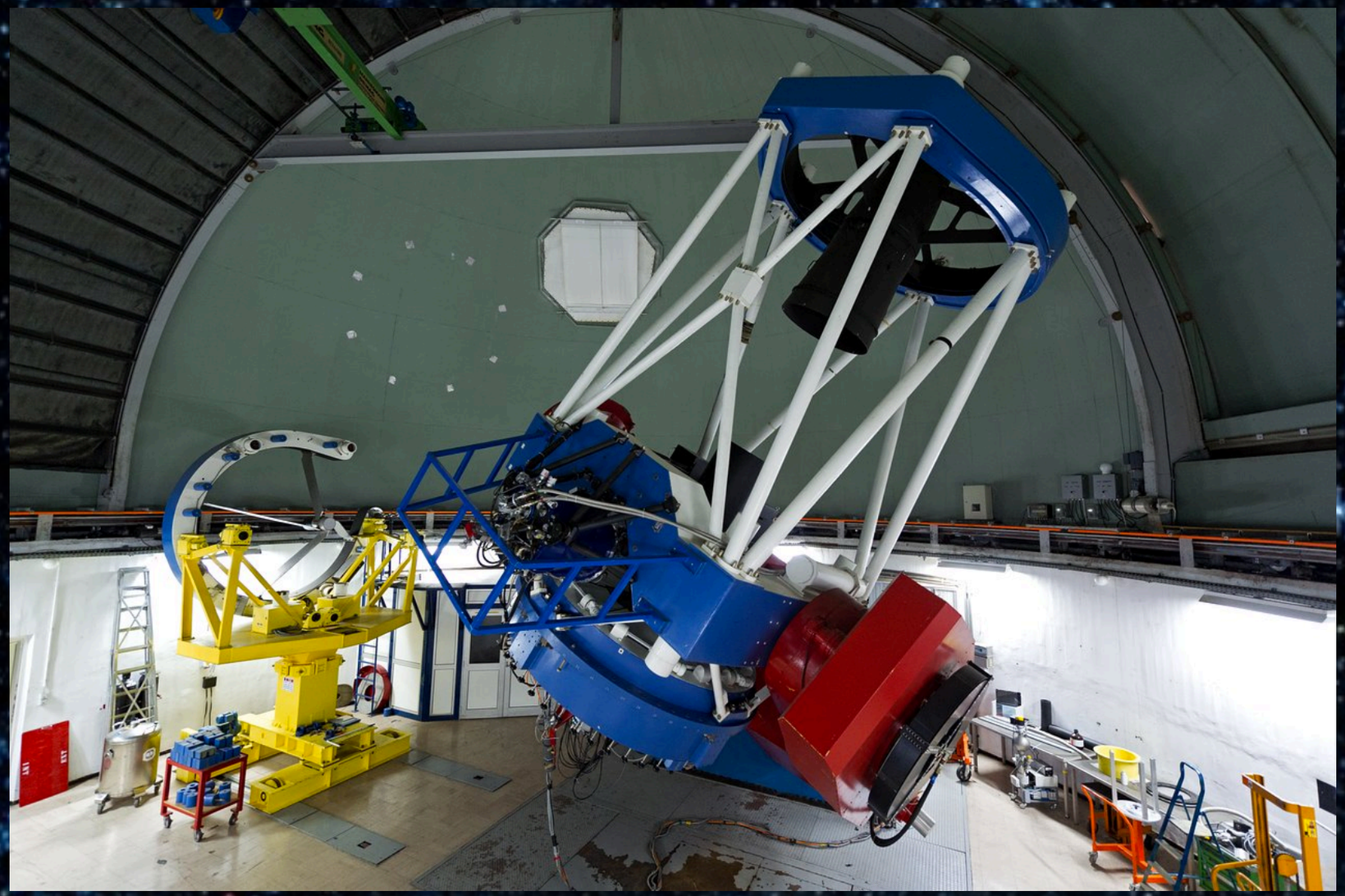
PI Bonifacio

TBL 2m
Spectrograph: NeoNArval

1/1 applications: 12 stars (but problems in the reduction)

PI Bonifacio

MPG/ESO 2.2-metre
FEROS



3/3 application 130 stars
+ 72 cancelled due to
corona virus :(

PI Hansen

NOT 2.2m Spectrograph:FIES

2/4 applications: partially cancelled due to corona virus
14 stars

PI Spitoni + Cescutti

Moletai 1.65m
Spectrograph: VUES

2/2 applications
24 stars

PI Kučinskas

Magellan 6.5m
Spectrograph: MIKE

1/2 applications
14 stars

PI L.Monaco

VLT 8.2m
Spectrograph: UVES

2/2 applications total of 100h (50h+50h, low ranking)
P106 48 stars, P105—>P107 on going (~10 stars)

PI Cescutti

Summary

(missing the 16h awarded with this proposal at TNG!)

Table 1 Awarded time by MINCE project:

telescope	instrument	time	targets	status
A40 TNG	HARPS-N	7.5 h	15	observed
A41 TNG	HARPS-N	13.5 h	16	observed
A42 TNG	HARPS-N	9 h	9	due in January
CFHT 2019B	ESPaDOnS	10h	6	observed
CFHT 2020A	ESPaDOnS	24.5h	6	observed
CFHT 2020B	ESPaDOnS	24.5h	30	accepted
OHP 2019B	Sophie	3n	23	observed
OHP 2020A	Sophie	3n	19	observed
TBL 2020A	NeoNArval	13h	12	observed (reduction problematic)
2019B 2.2m	FEROS	2n	65	observed
2020A 2.2m	FEROS	2n	72	cancelled due to corona virus shutdown
2020B 2.2m	FEROS	2n	65	accepted, due in January
Magellan	MIKE	1n	20	cancelled due to corona virus shutdown
Magellan	MIKE	1n	14	observed in October
VLT ESO period 105	UVES	50h	50	6/50 stars taken (but extended next semester)
VLT ESO period 106	UVES	50h	50	16/50 stars taken up to now (filler)
period 61, NOT	FIES	3n	16	only 7 taken due to corona virus shutdown
period 62, NOT	FIES	8h	8	accepted due in January
2019 winter Moletai 1.65m	VUES	12n	10	total loss due to weather
2020 spring Moletai 1.65m	VUES	26n	15	15 stars observed

9 facilities used!

360 stellar spectra with high S/N and Resolution

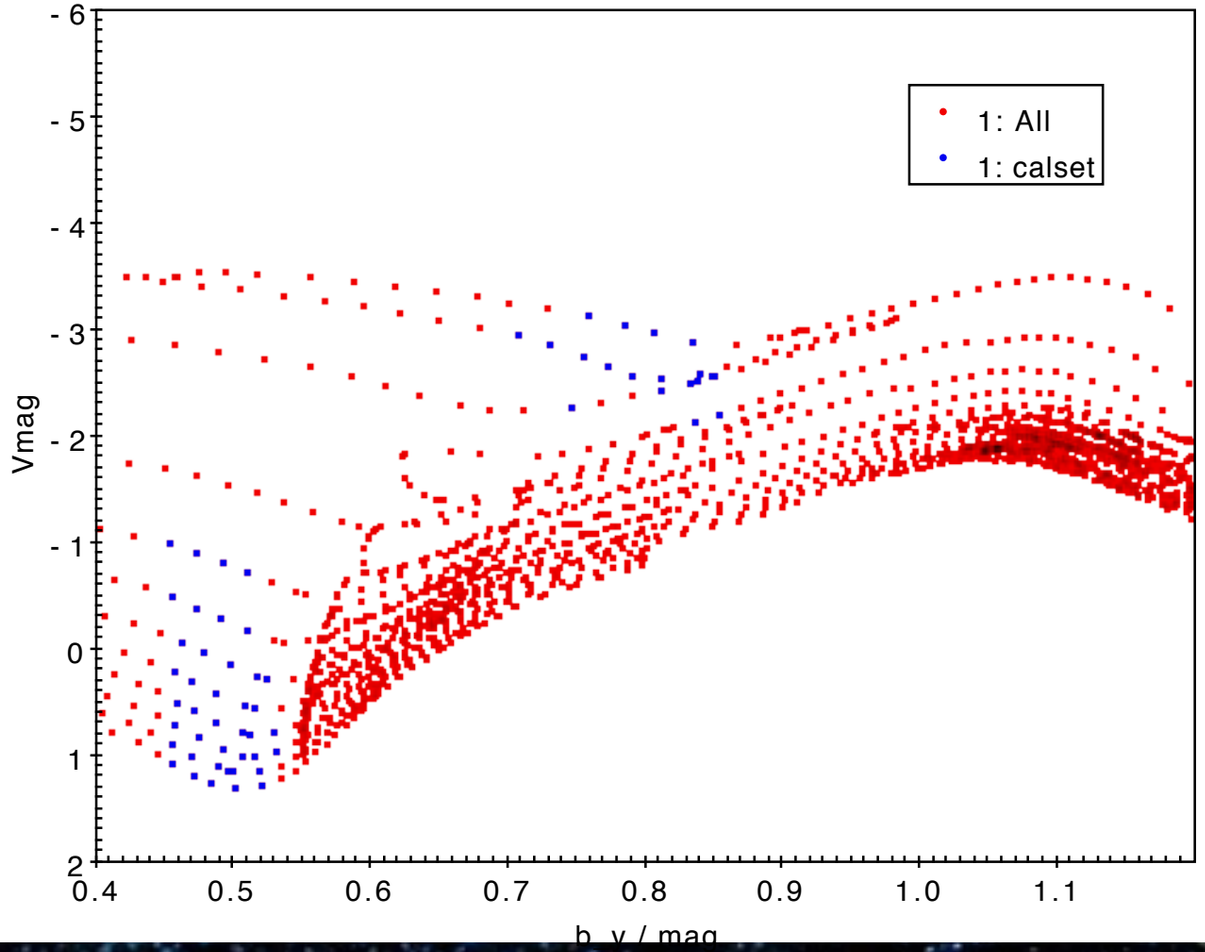
Selection of candidates:

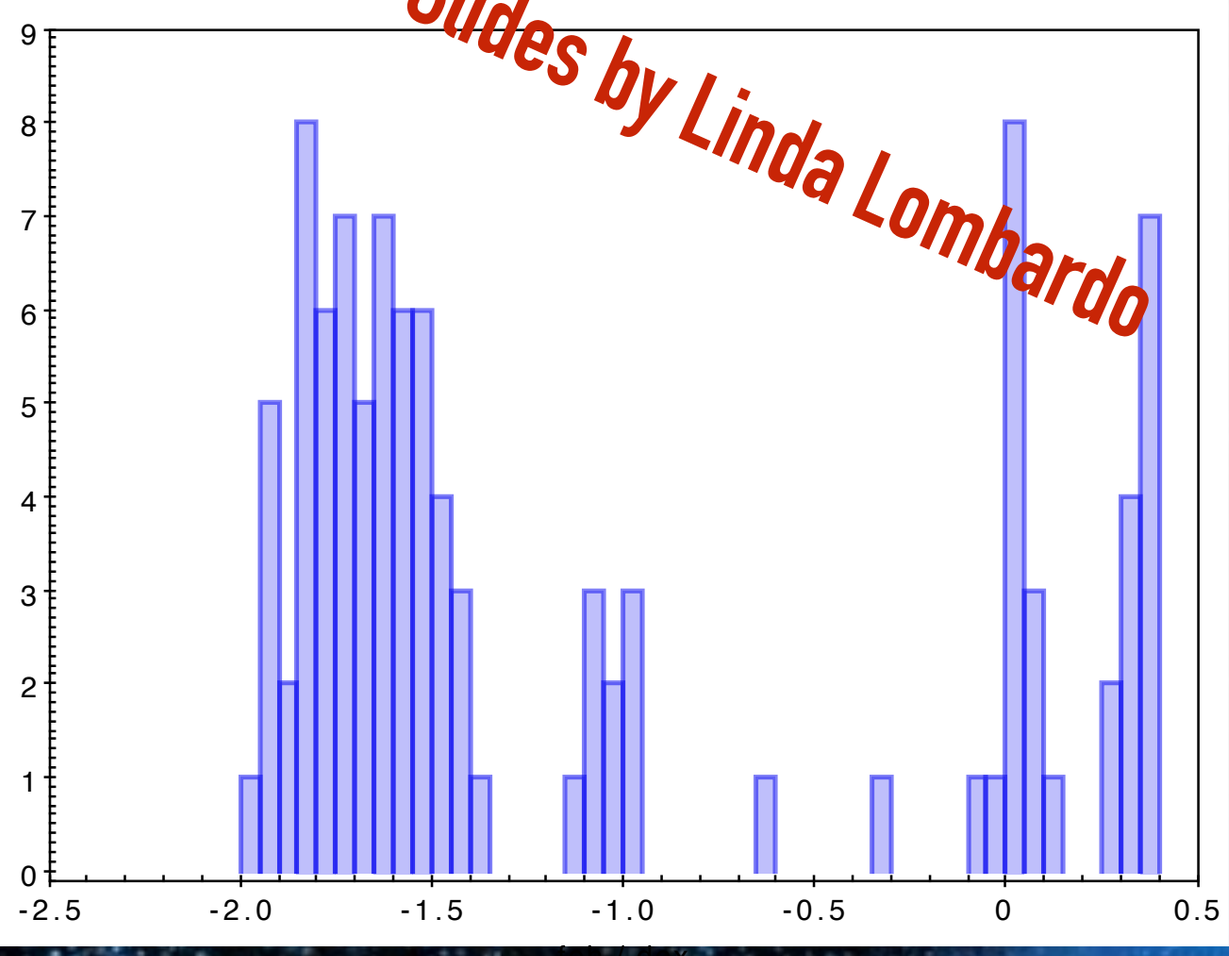
Hard job, particularly in the north.
We started using APOGEE data —> not so bright targets
RAVE data OK, but only for the South

We try to use Strömgren
colours adopting the Paunzen (2015) catalogue
+ metallicity calibration
by Casagrande et al. 2014…

Missing assumption, we are not dealing with old stars!

Slides by Linda Lombardo



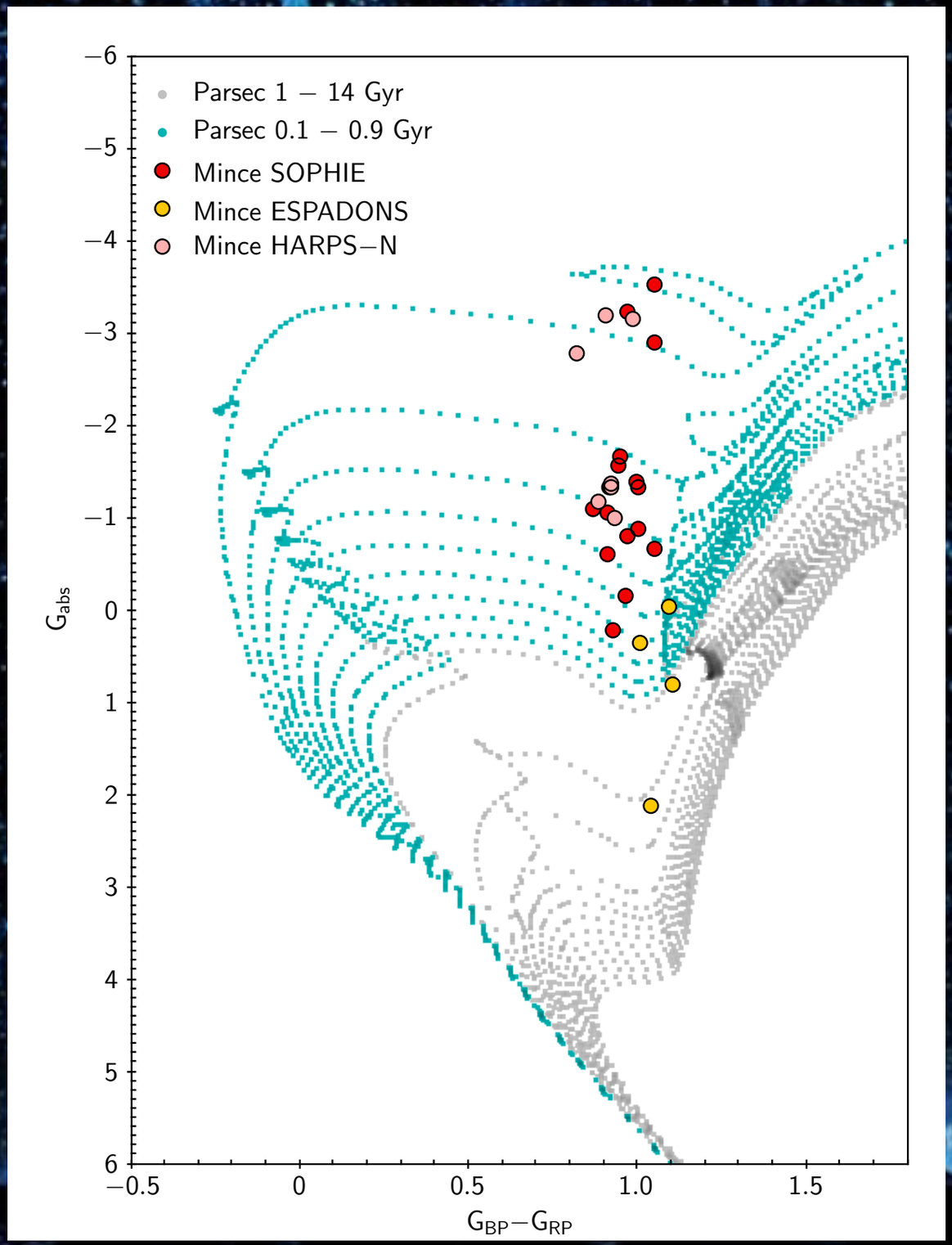


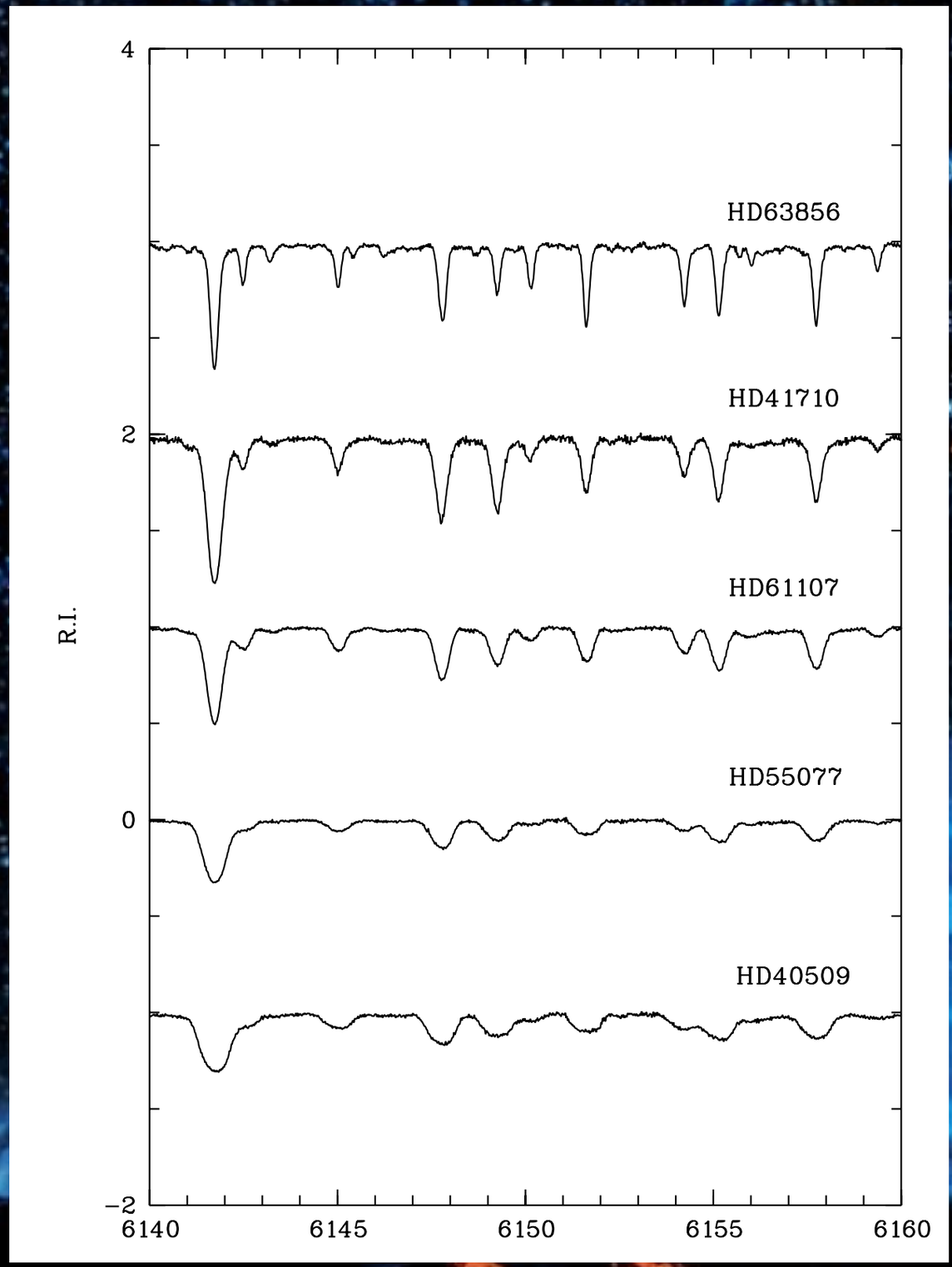
Solar metallicity isochrone in Strömgren colours. In blue the points that fall in the validity range of the Casagrande et al. (2014) metallicity calibration

Applying the metallicity calibration to these colours (of solar metallicity isochrones) one estimates a low metallicity in many cases !

Efficient way of selecting young massive (rotating) giants

Linda Lombardo et al. in preparation





Selection of candidates

Next try: Starhorse (Anders et al. 2019)
based on GAIA data. Perfect for selecting giants,
some problem on the metallicity (expected).

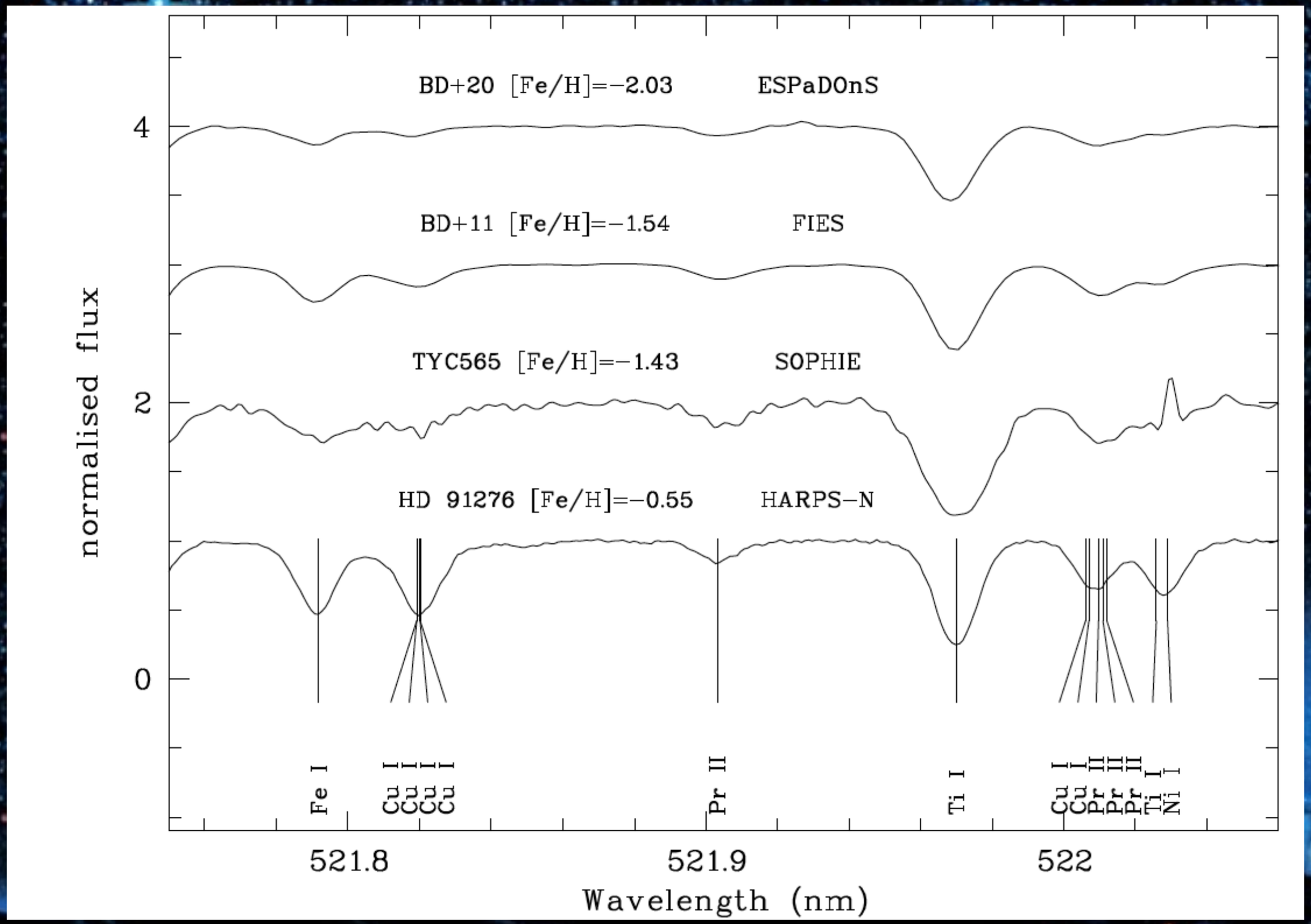
STAR_BD-00_3963/abundances.out:Fe	26	0	33	7.52	7.1	-0.34	1566	0.00	0.2215
STAR_BD+07_4625/abundances.out:Fe	26	0	337	7.52	5		0.1243	0.00	0.1759
STAR_BD+11_2896/abundances.out:Fe	26	0	207	7.52	5	-1.54	0.1875	0.00	0.2651
STAR_BD+35_4847/abundances.out:Fe	26	0	211	7.52	5		0.1559	0.00	0.2205
STAR_HD165400/abundances.out:Fe	26	0	20	7.52	7.2	-0.27	0. 908	0.00	0.2699
STAR_HD346956/abundances.out:Fe	26	0	293	7.52	5.8		1472	0.00	0.2081

NOT data

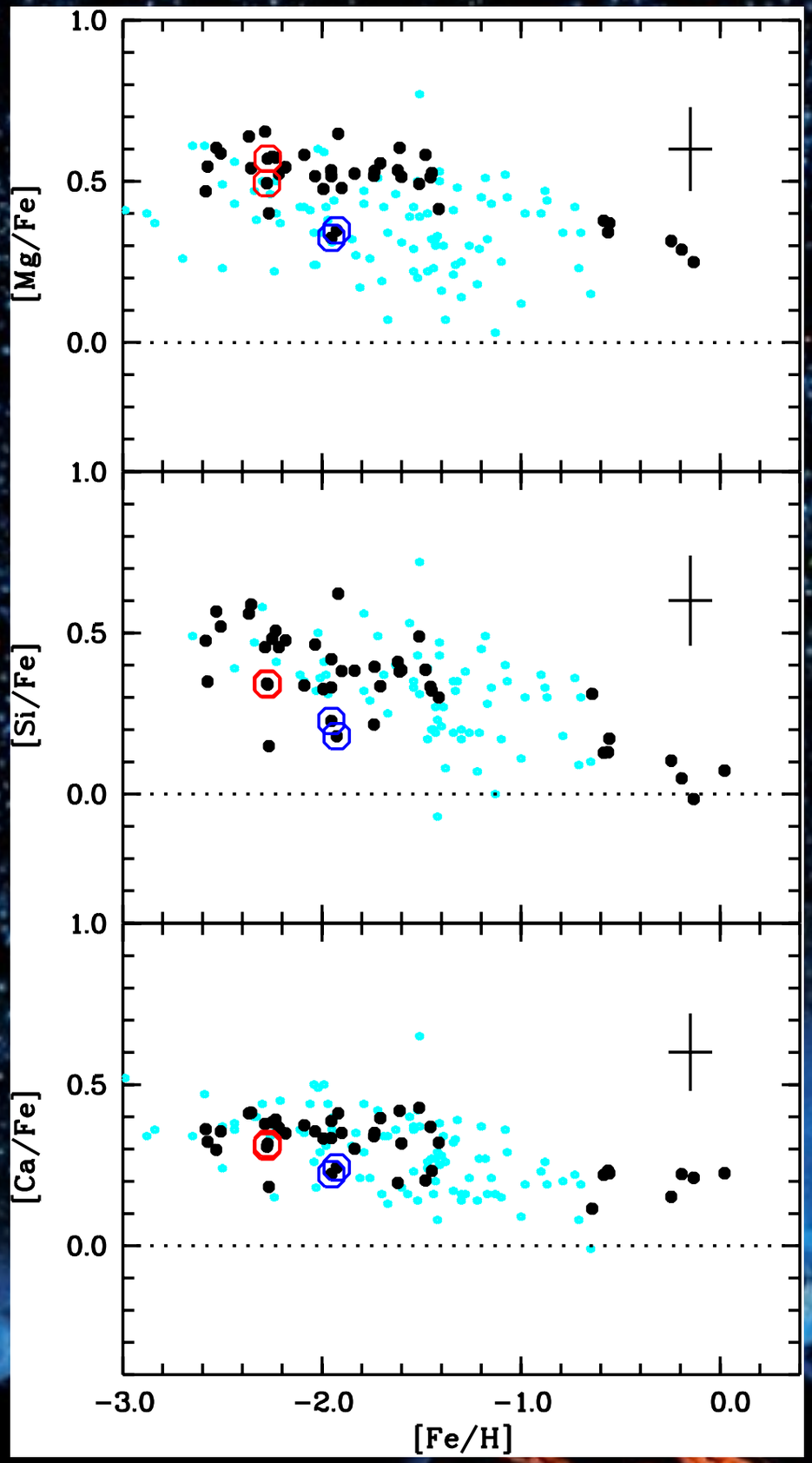
Present selection:
Starhorse + kinematics (v_tot>200km/s)
almost 100%!

# STAR	alpha2000	delta2000	V	Teff	glog	vtm17	met	observed	comment	[Fe/H]	Nlines
TYC____4-369-1	00:08:36.02	+02:58:01.7		4210.0	0.73	1.96	-1.23	Y		-1.83+-0.12	116
BD+04____18	00:12:49.90	+05:37:39.3		4105.0	0.29	2.11	-1.22	Y		-1.48+-0.11	129
TYC___33-446-1	01:54:22.17	+03:41:45.3		4273.0	0.35	2.19	-1.45	Y		-2.14+-0.12	116
TYC_2824-1963-1	01:58:38.93	+41:46:30.4		4085.0	0.18	2.16	-1.23	YY		-1.57+-0.12	134
TYC_4331-136-1	03:57:14.19	+69:44:45.1	10.4	4141.0	0.52	2.04	-1.45	Y		-2.43+-0.10	97
TYC_1008-1200-1	18:06:31.58	+08:44:54.7		4243.0	0.38	2.15	-1.39	YY		-2.17+-0.13	106
TYC_2113-471-1	18:56:41.55	+25:16:50.8		3941.0	0.52	1.93	-1.32	YY		-1.85+-0.15	90
TYC_4221-640-1	19:09:19.27	+63:03:44.2		4225.0	0.51	2.08	-1.35	YY		-2.27+-0.14	114
TYC_4584-784-1	19:22:56.40	+76:32:43.3	10.94	4211.0	0.5	2.06	-1.12	Y		-1.90+-0.09	123
TYC_3944-698-1	20:02:59.61	+58:01:07.1		4044.0	0.18	2.14	-1.31	Y		-2.25+-0.15	83
HD_354750	20:04:29.05	+13:35:31.0	10.9	4690.0	0.61	2.24	-1.06	Y		-2.18+-0.17	71
BD+07__4625	21:07:13.10	+07:44:19.7	8.87	4811.0	1.62	1.82	-1.01	Y		-1.83+-0.12	88
BD+25__4520	21:22:08.32	+25:45:15.8		4327.0	0.22	2.28	-1.56	Y		-2.14+-0.12	118
TYC_4267-2023-1	22:01:46.08	+62:27:40.6		4954.0	0.97	2.22	-1.37	Y		-1.41+-0.18	141
TYC__565-1564-1	22:10:38.77	+05:16:14.6		3797.0	0.24	2.0	-1.36	Y		-1.42+-0.15	101
BD+21 4759	22:28:46.35	+22:09:11.4	9.79	4454.0	0.85	2.01	-1.08	Y		-2.39+-0.15	80
TYC_2228-838-1	22:38:23.28	+27:34:24.7		3742.0	0.23	1.96	-1.22	Y		-1.62+-0.21	82
TYC_4001-1161-1	23:47:30.68	+53:47:16.5		4223.0	0.75	1.96	-1.32	YY		-1.54+-0.12	147
BD+03__4904	23:55:28.37	+04:21:17.9		4449.0	0.87	2.01	-1.24	Y		-2.57+-0.13	76

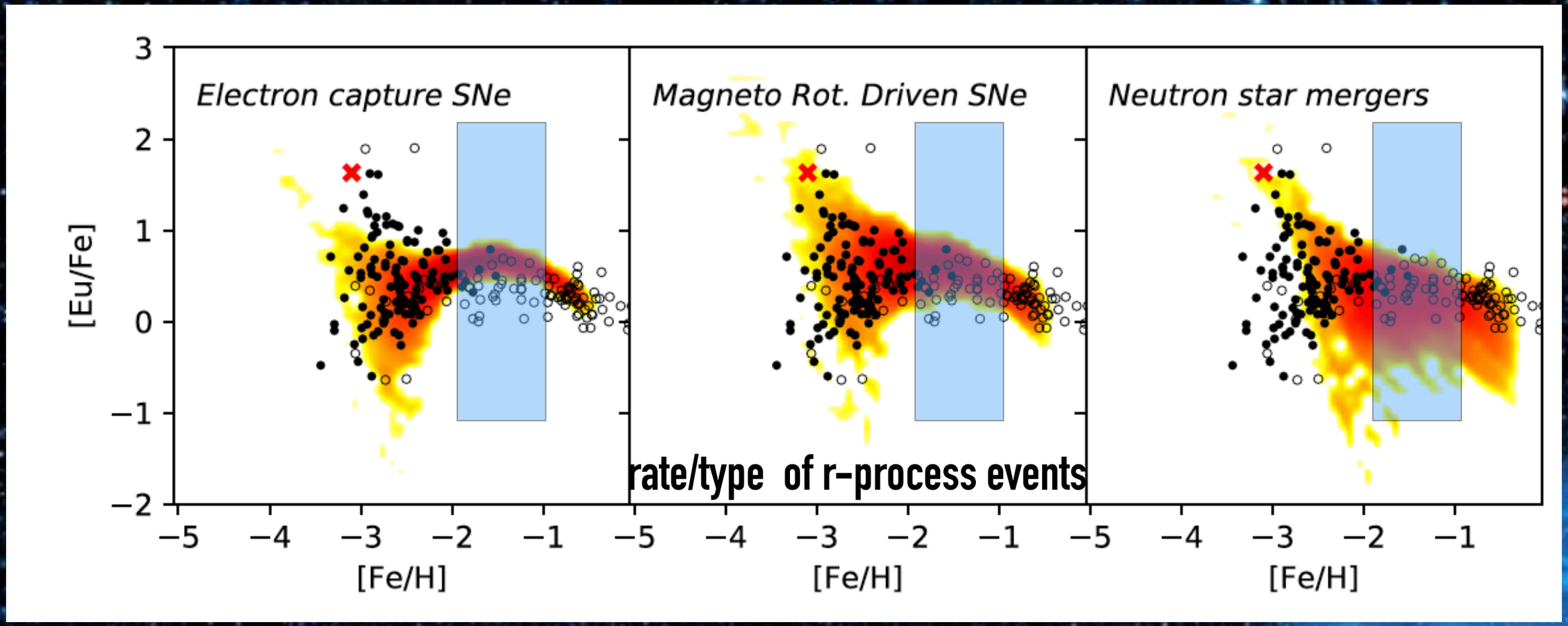
Spectra from different facilities:



Preview of the results for 42 targets (alpha-elements)



MINCE scientific application



. . . GAIA- Enceladus?

The final goal is publish all the MINCE results & data(?) in a public database

IA2 *Italian Center for Astronomical Archives*
Centro Italiano Archivi Astronomici