The s- and r- process in Solar Twins

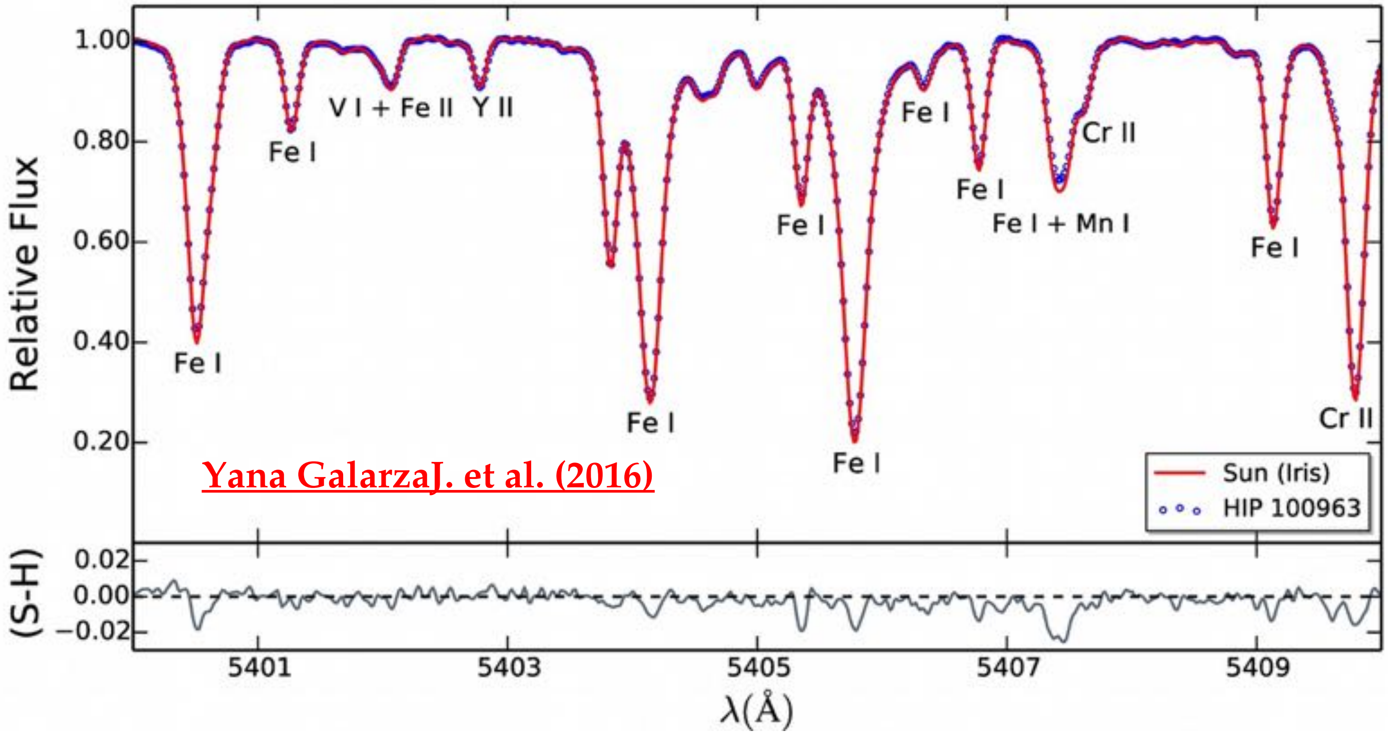
Jhon Yana Galarza

Jorge Meléndez

September 2016

SAMPA
Stellar Atmospheres, Planets and Abundances

Observations



HIP 100963	**Iris**
Texp = 180 s	720 s
S/R = 400	650

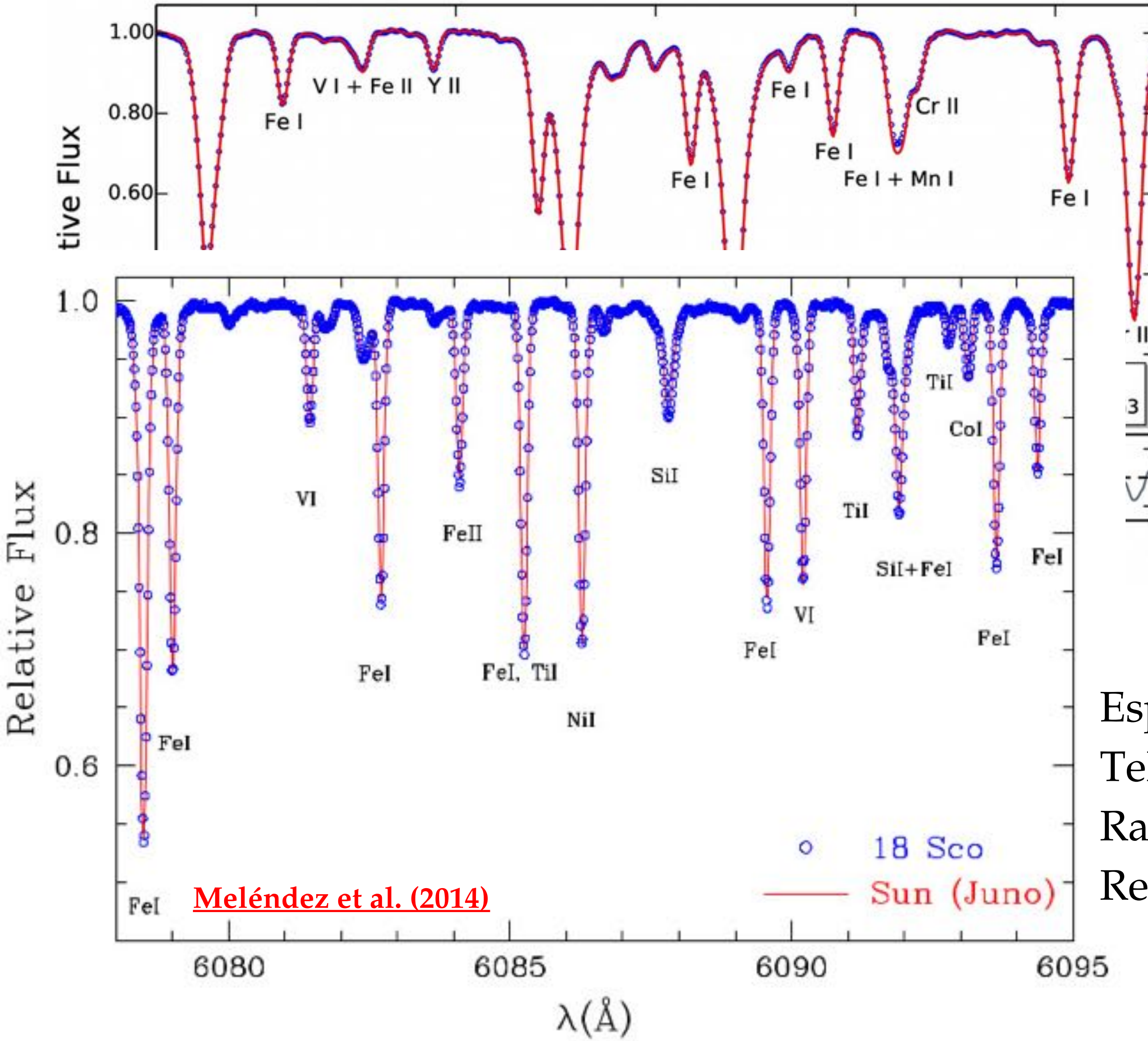
Espectrograph : HIRES

Telescpe : Keck I

Range : 3940– 8350Å

Resolution : 70 000

Observations



Meléndez et al. (2014)

HIP 100963 **Iris**

Texp = 180 s 720 s

S/R = 400 650

Espectrograph : HIRES

Telescpe : Keck I

Range : 3940–8350Å

Resolution : 70 000

18 Sco

S/R = 400-800

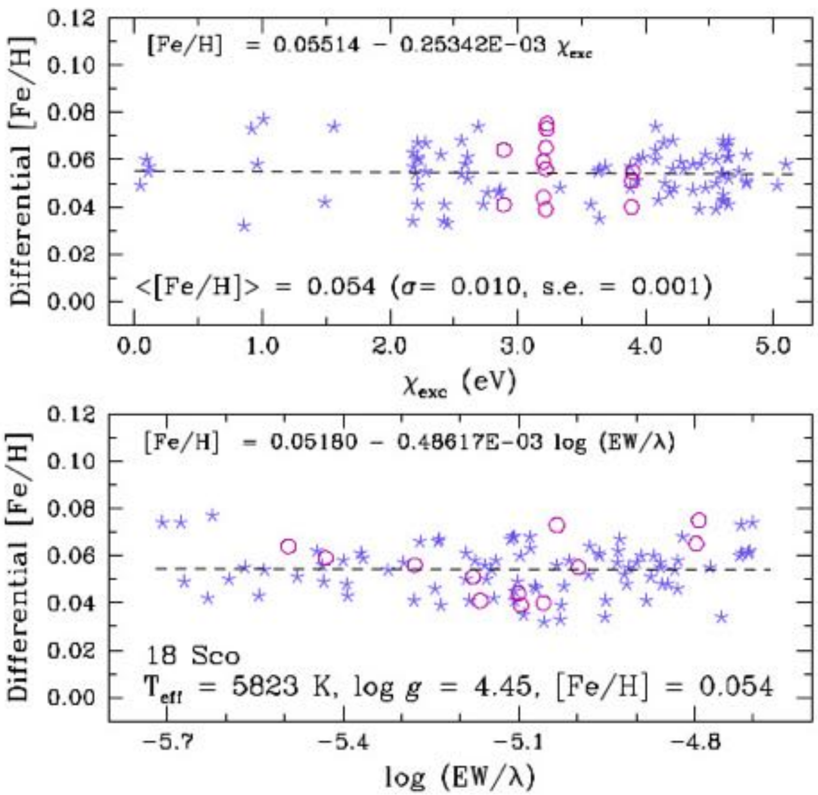
Espectrograph : UVES, HIRES

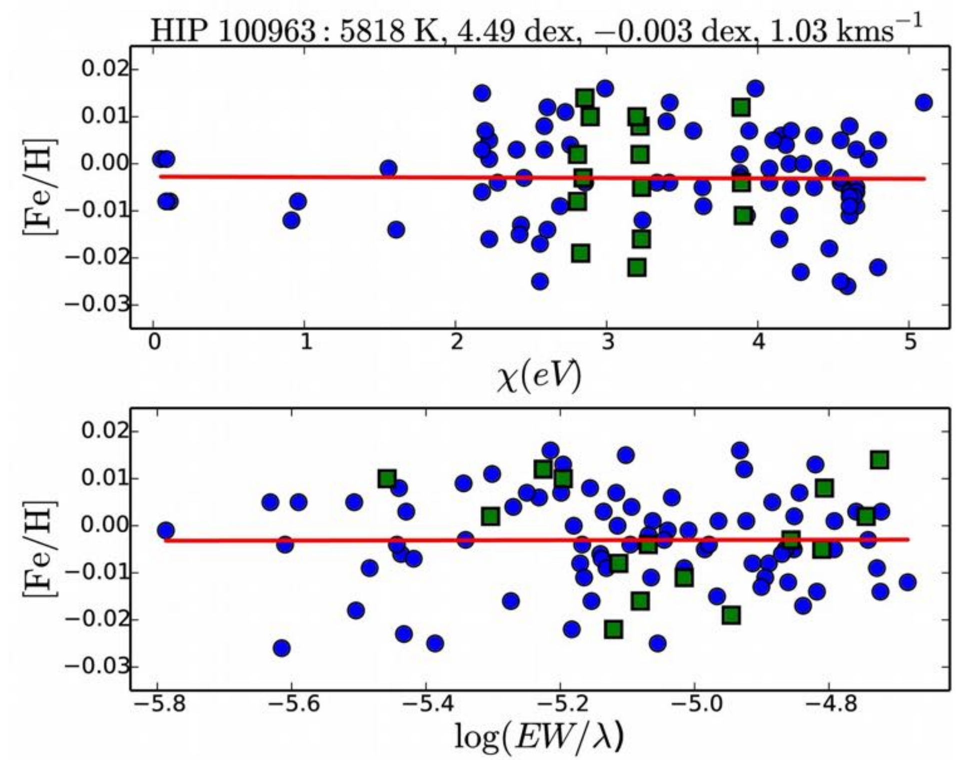
Telescope : VLT, Keck

Range : 3060–10200Å

Resolution : 100 000

Stellar Parameters



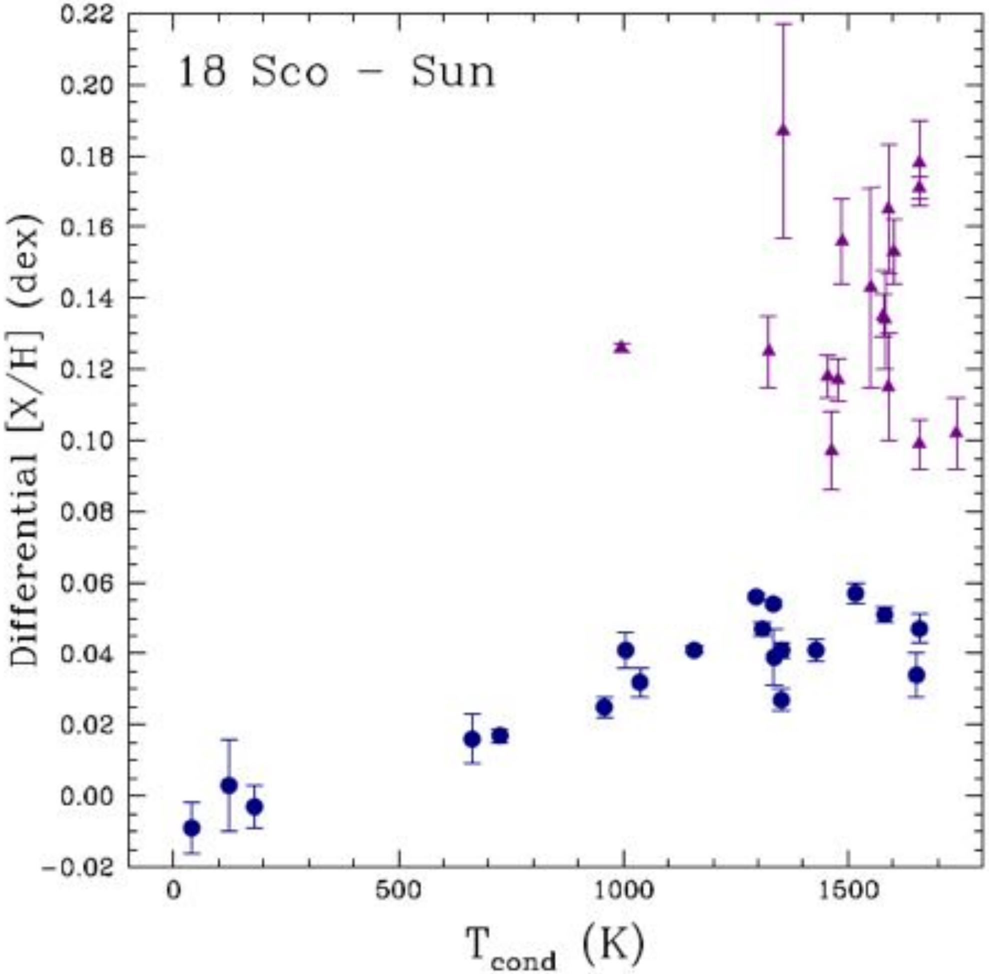


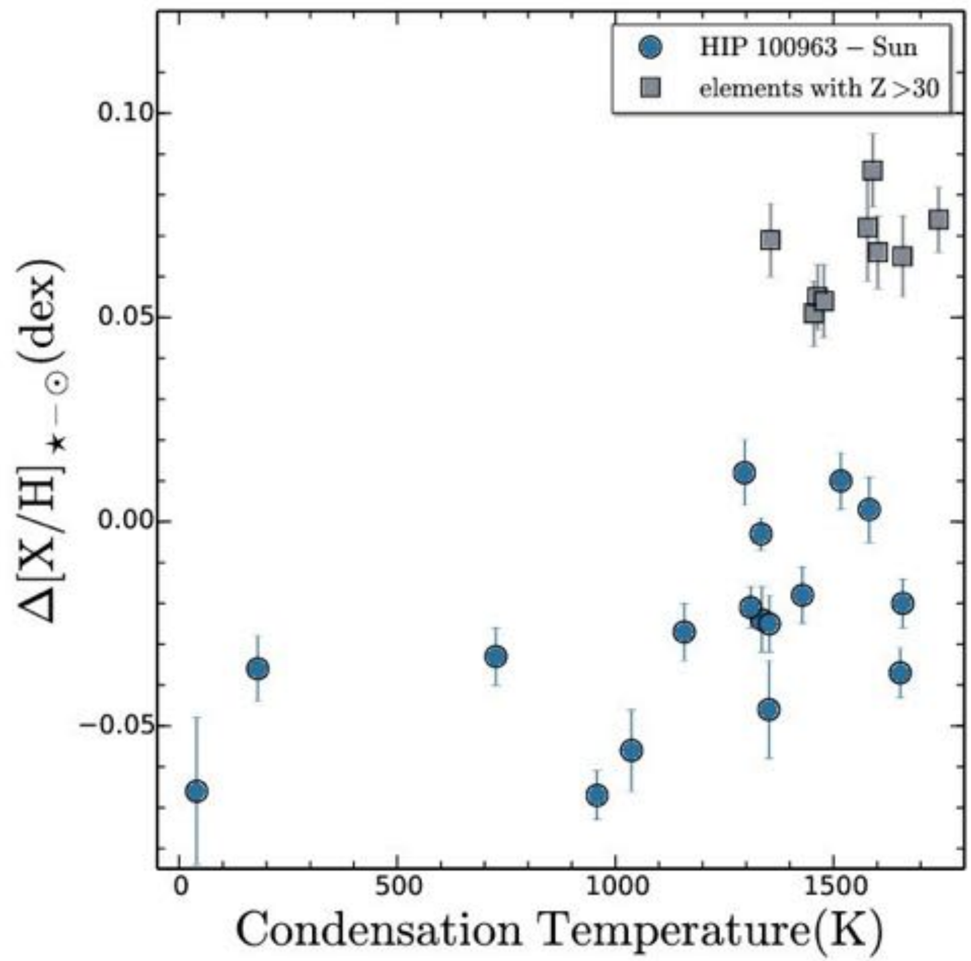
Spectroscopic equilibrium

$$\mathrm{T_{eff}} = 5823 \pm 6\ \mathrm{K}$$
$$\log g = 4.425 \pm 0.02\ \mathrm{dex}$$
$$[\mathrm{Fe/H}] = 0.054 \pm 0.005\ \mathrm{dex}$$
$$\mathrm{v}_t = 1.02 \pm 0.01\ \mathrm{kms}^{-1}$$

$$\mathrm{T_{eff}} = 5818 \pm 4\ \mathrm{K}$$
$$\log g = 4.44 \pm 0.01\ \mathrm{dex}$$
$$[\mathrm{Fe/H}] = \text{-}0.003 \pm 0.004\ \mathrm{dex}$$
$$\mathrm{v}_t = 1.03 \pm 0.01\ \mathrm{kms}^{-1}$$

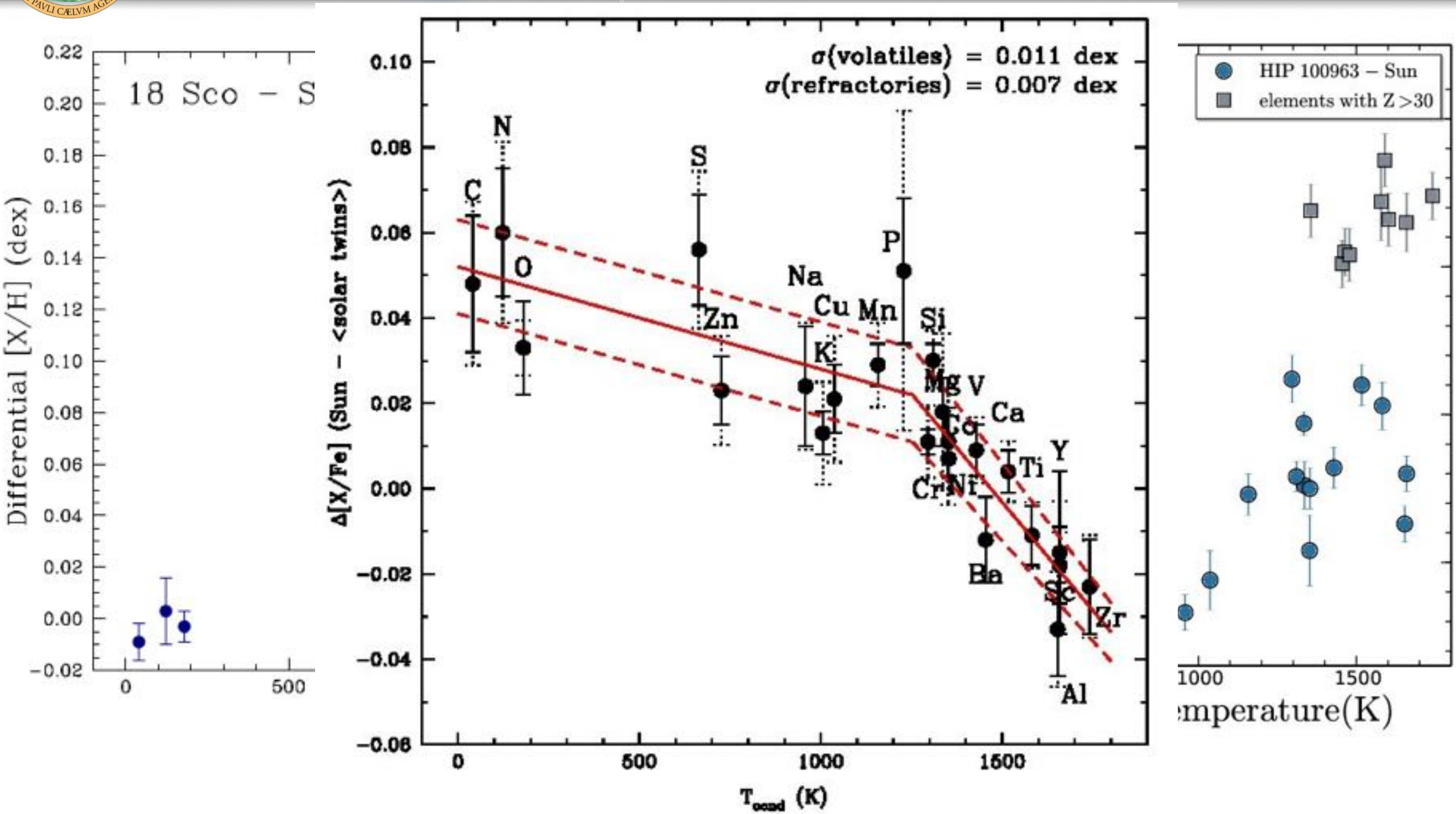
Abundance pattern





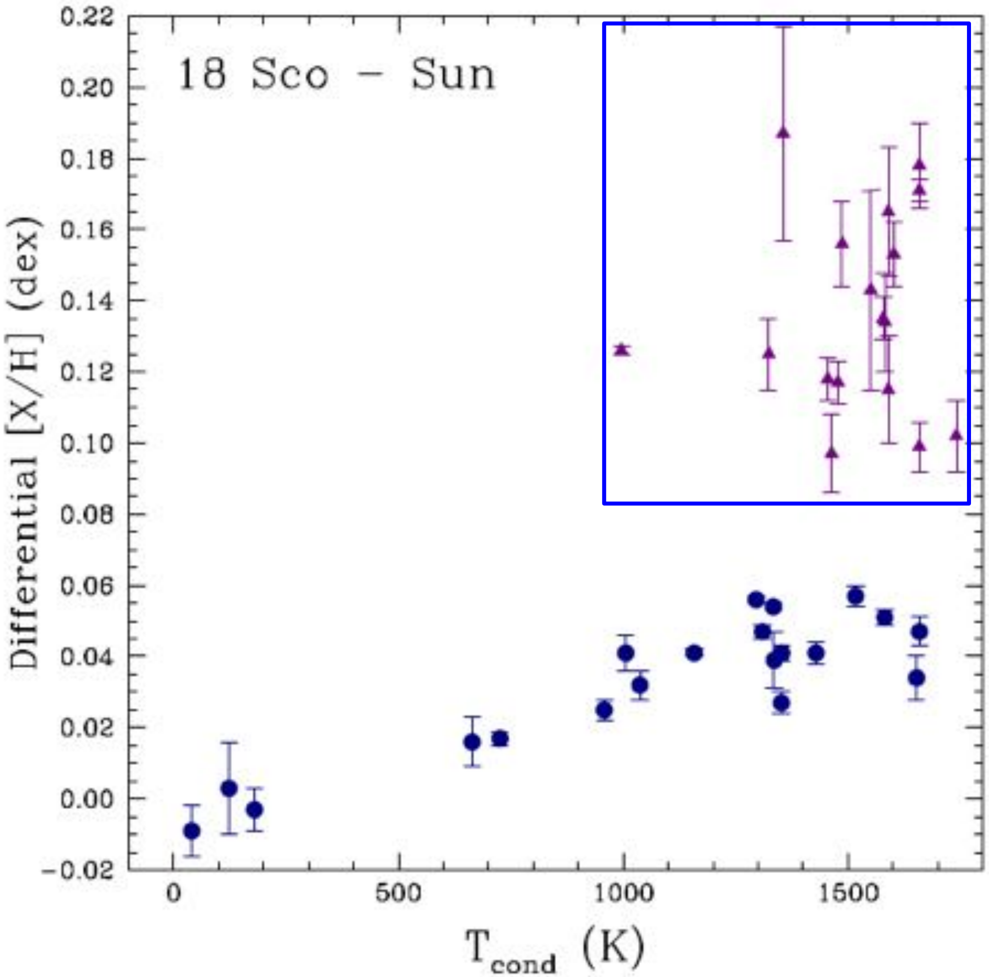
18 Sco and HIP 100963 present a complex abundance patterns

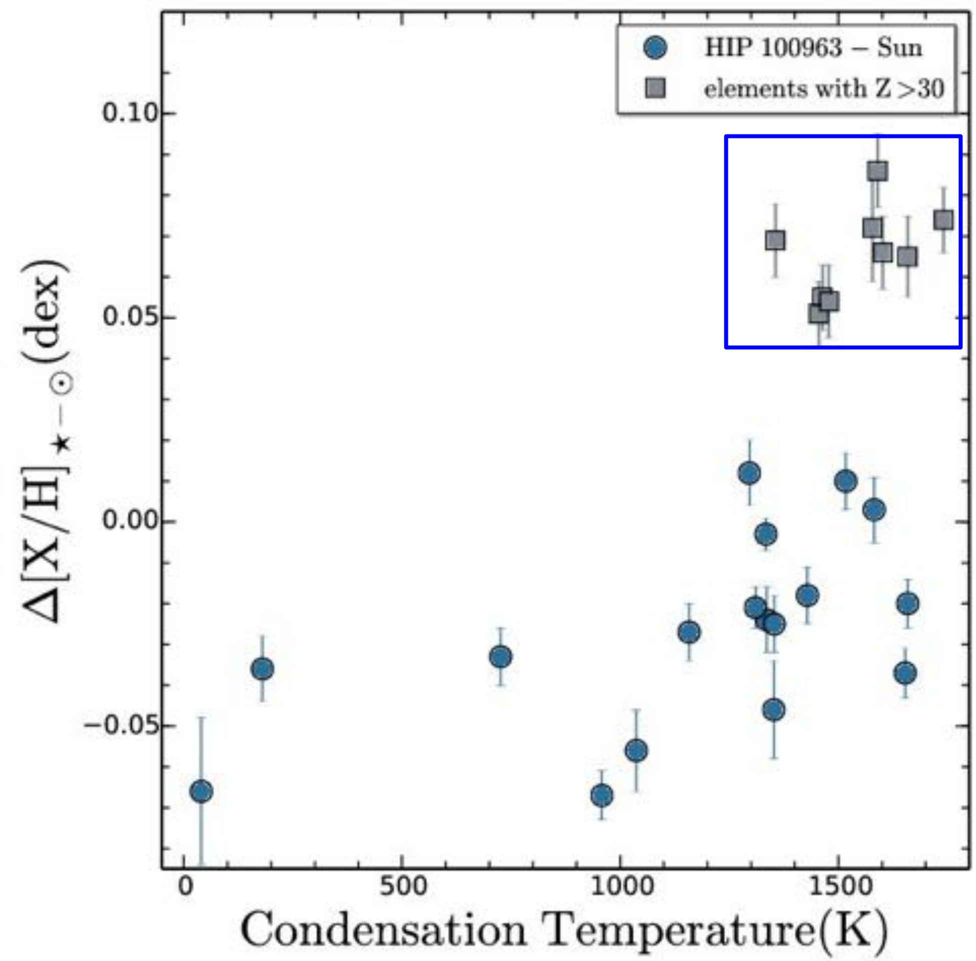
Abundance pattern



However they show the same abundance patterns with the condensation temperature as other solar twins.

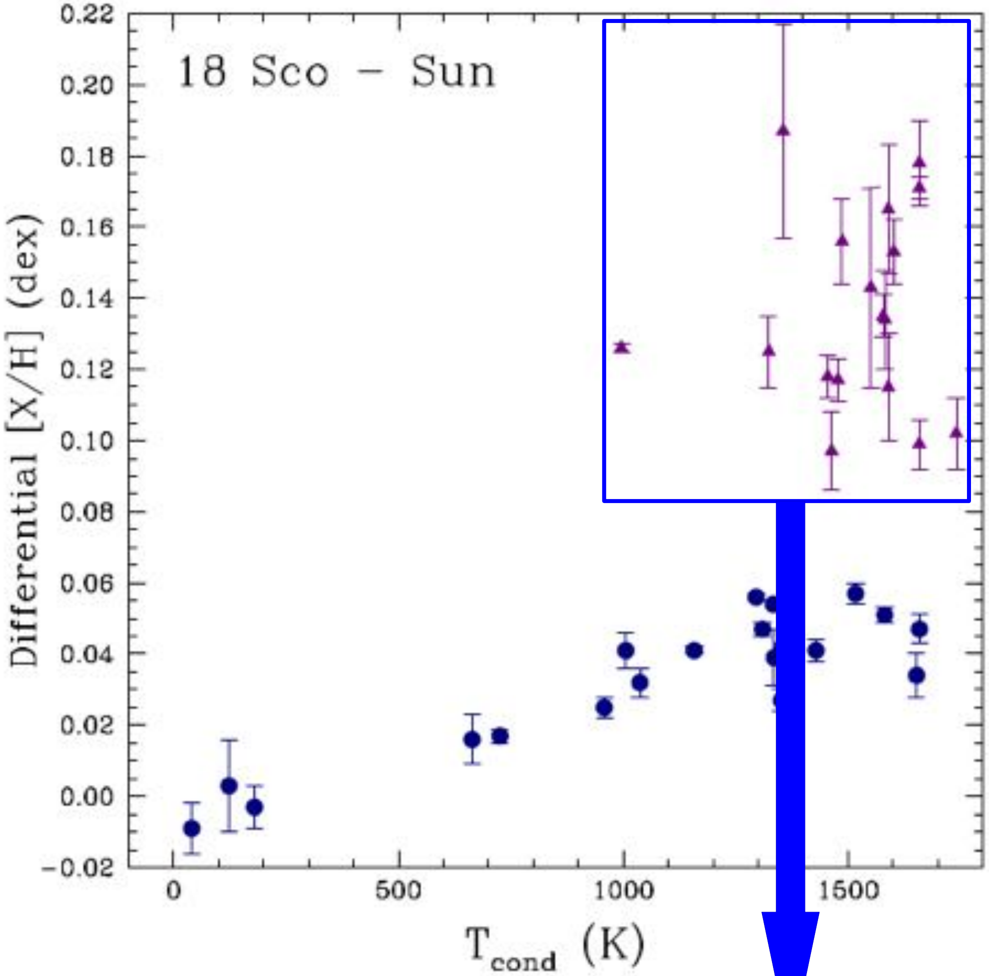
Neutron-capture elements

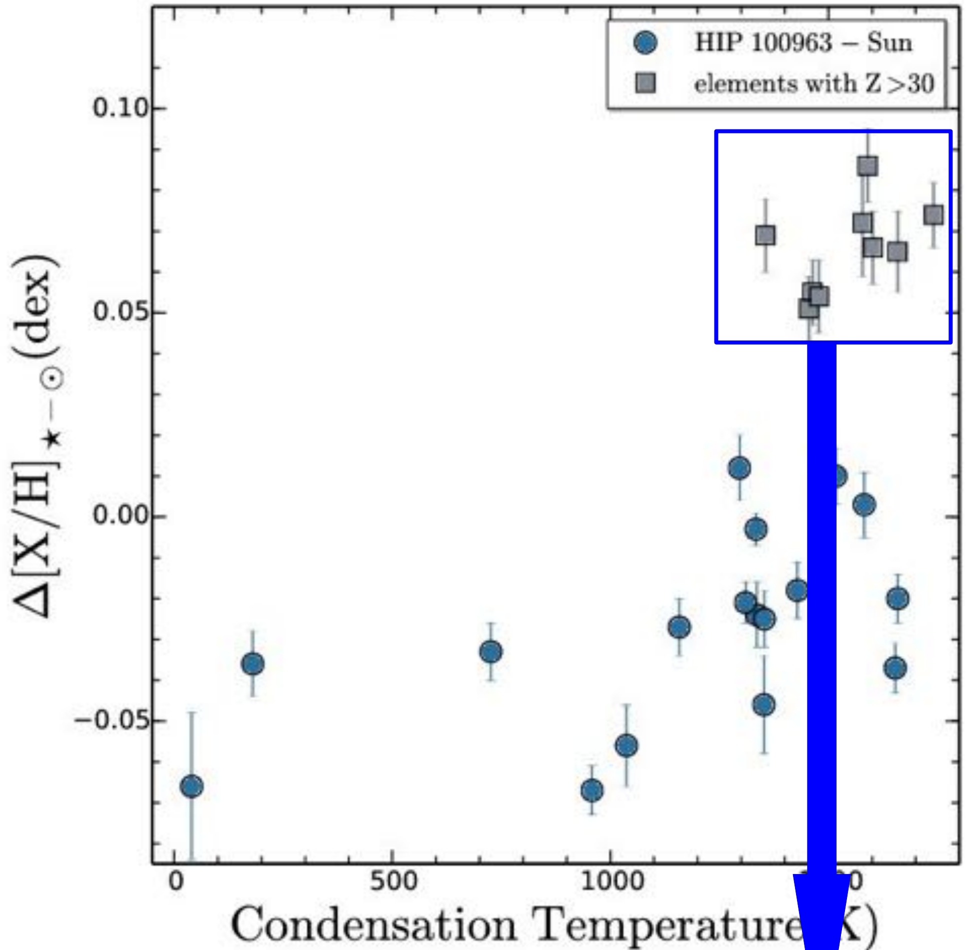




Both stars, that 18 Sco and HIP 10963 shown a large enhancements in Netron-capture elements.

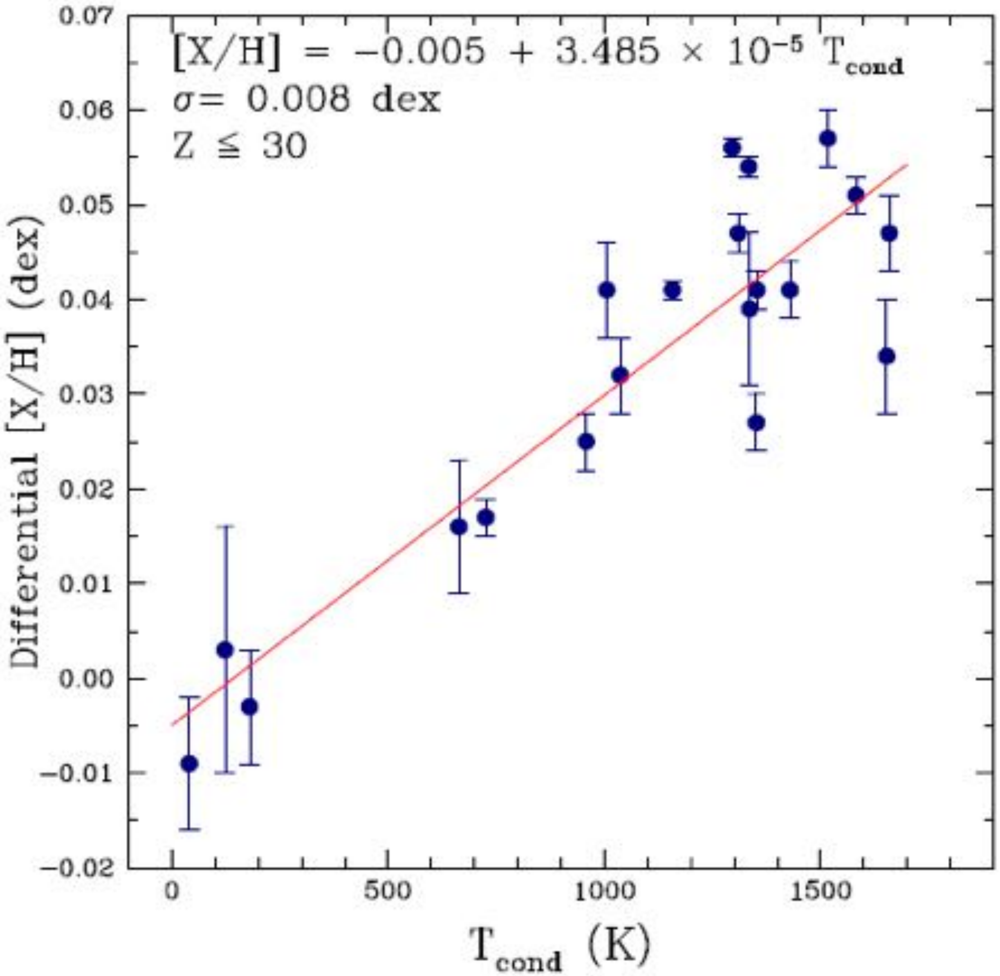
Neutron-capture elements

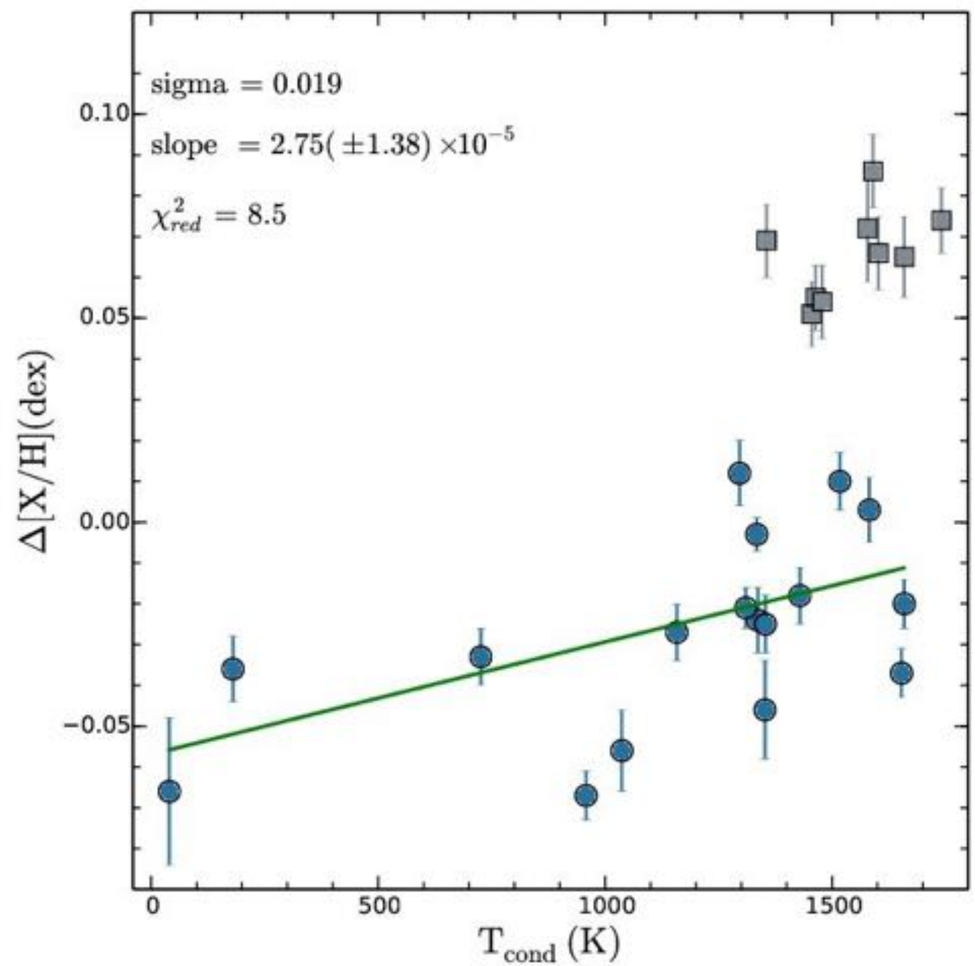




AGB stars and r-process elements

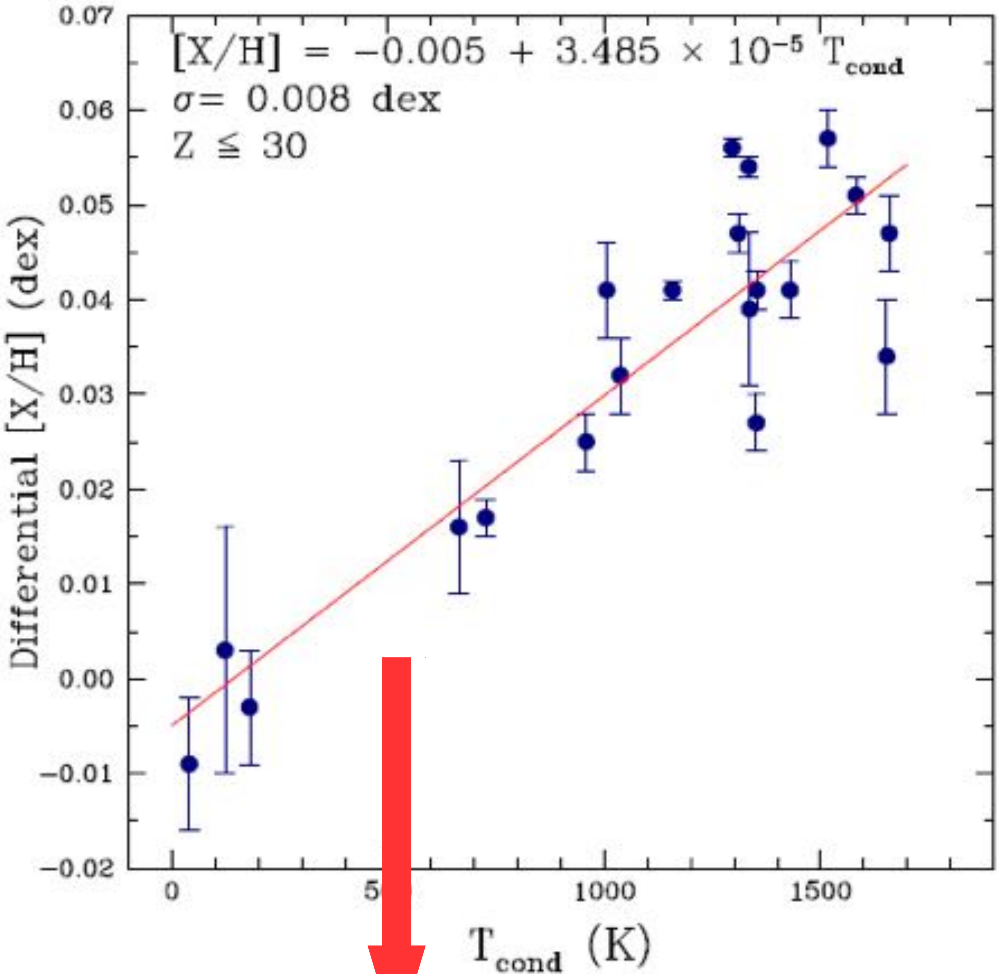
Neutron-capture elements

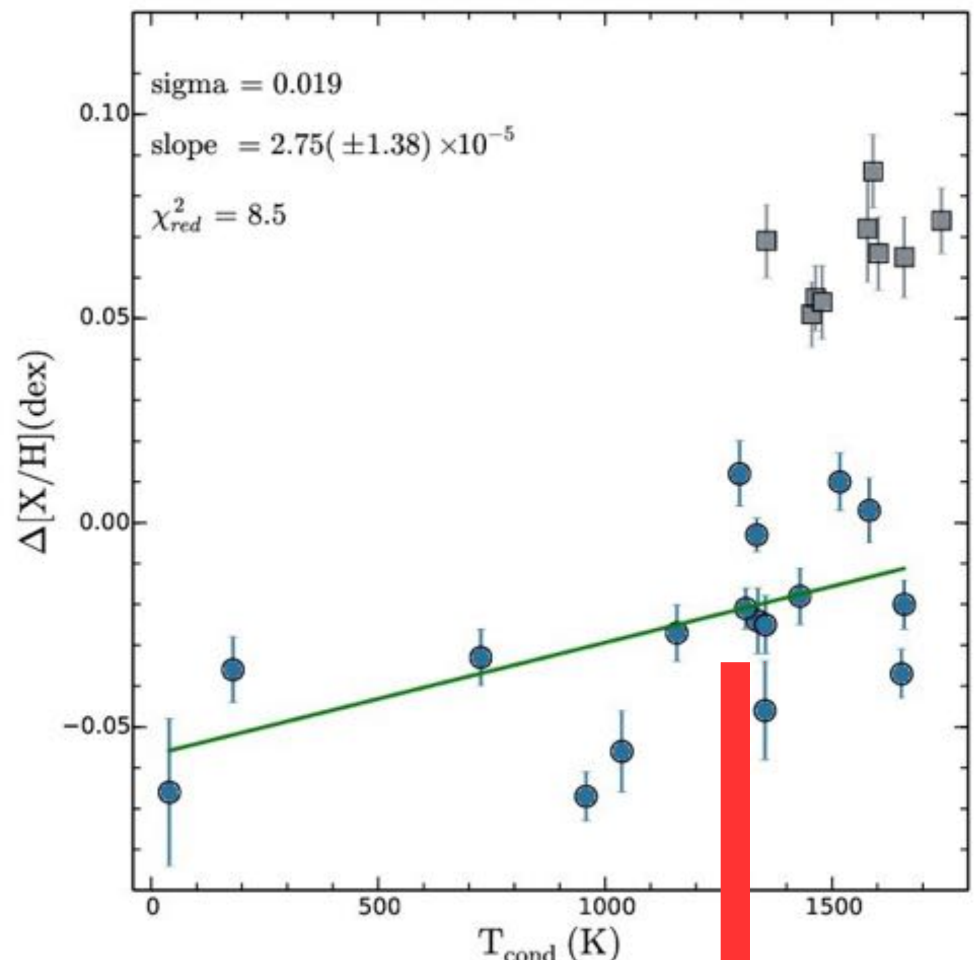




First we need to substract the trend with condensation temperature!!

Neutron-capture elements



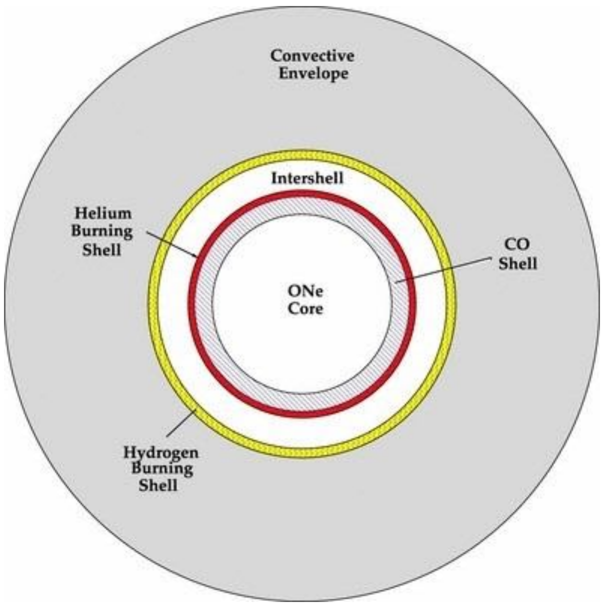


$$[X/H]_{Tcond} = [X/H]_{Z>30} - (-0.005 + 3.485 \times 10^{-5} T_{cond})$$

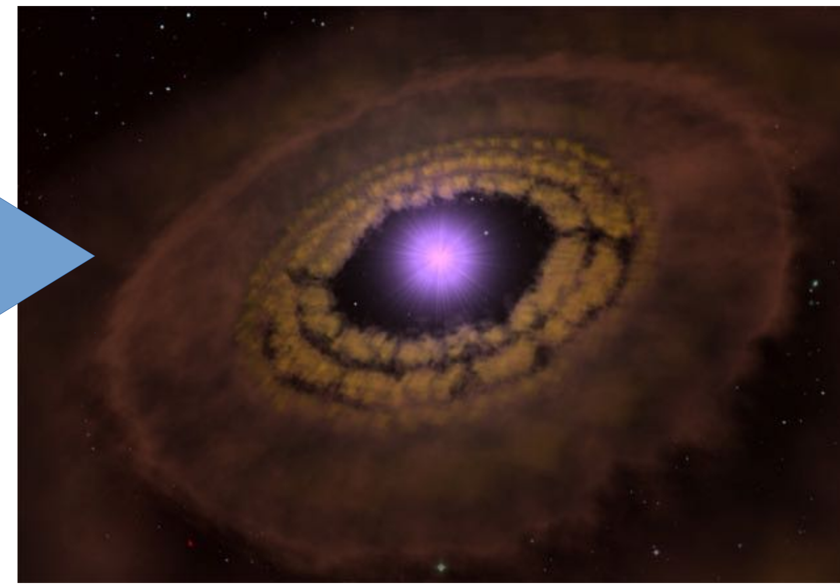
$$[X/H]_{Tcond} = [X/H]_{Z>30} - (-0.056 + 2.753 \times 10^{-5} T_{cond})$$

Neutron-capture elements

Karakas 2010



Ejecta



AGB star

$3M_\odot$

$Z = 0.01$

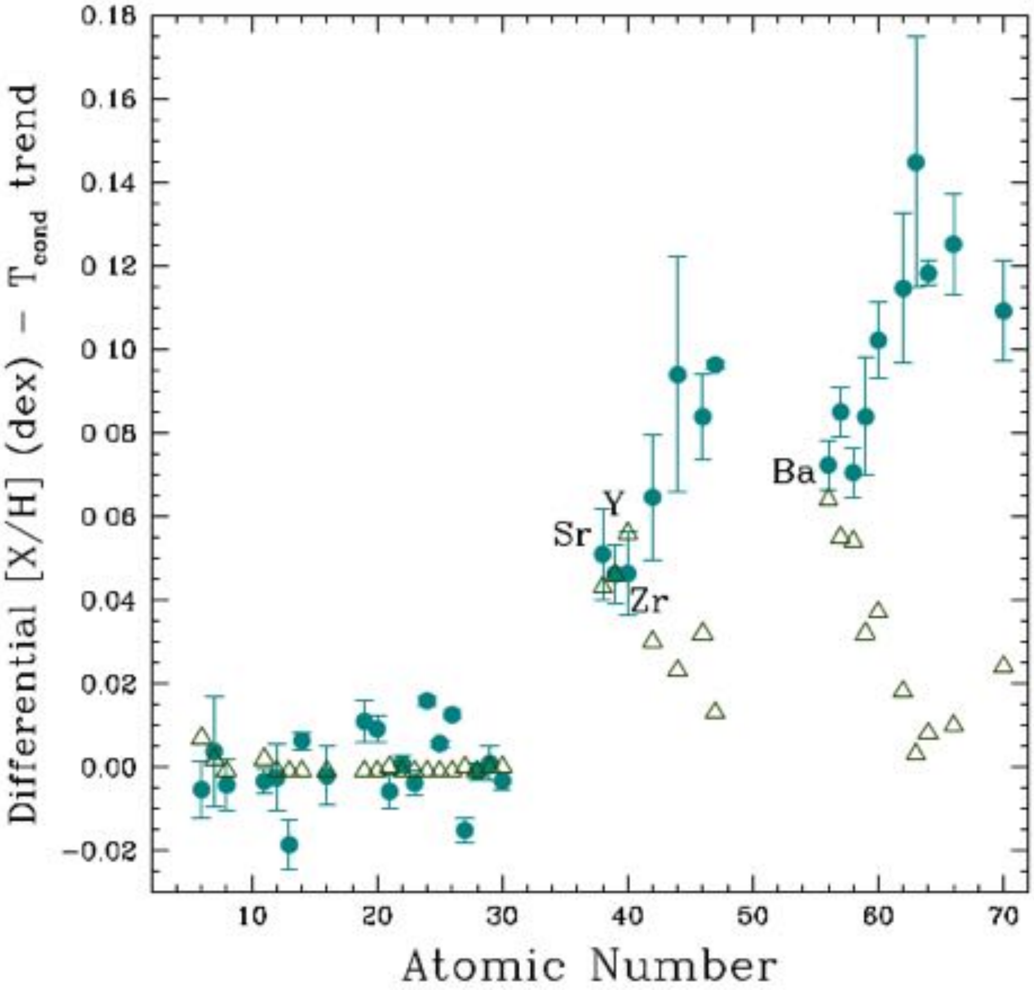
Protocloud

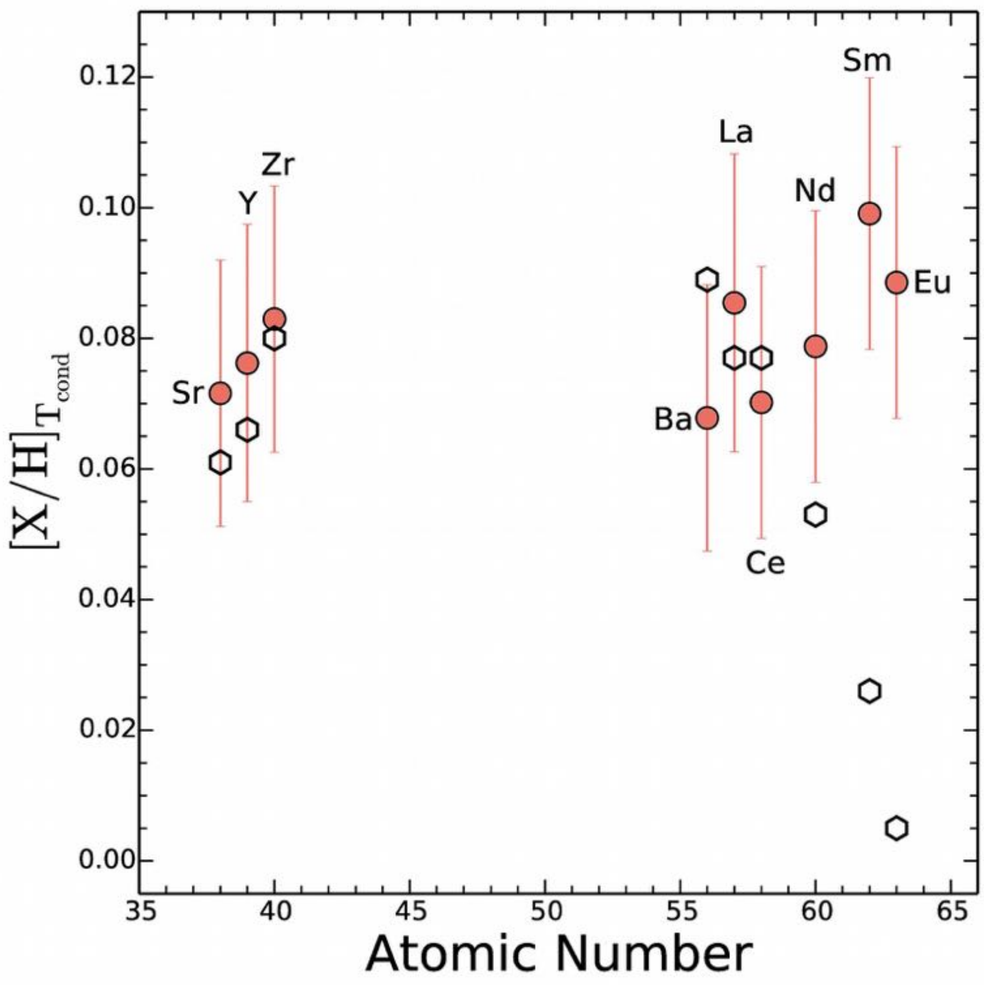
$1M_\odot$

Solar composition

Asplund et al. (2009)

Neutron-capture elements

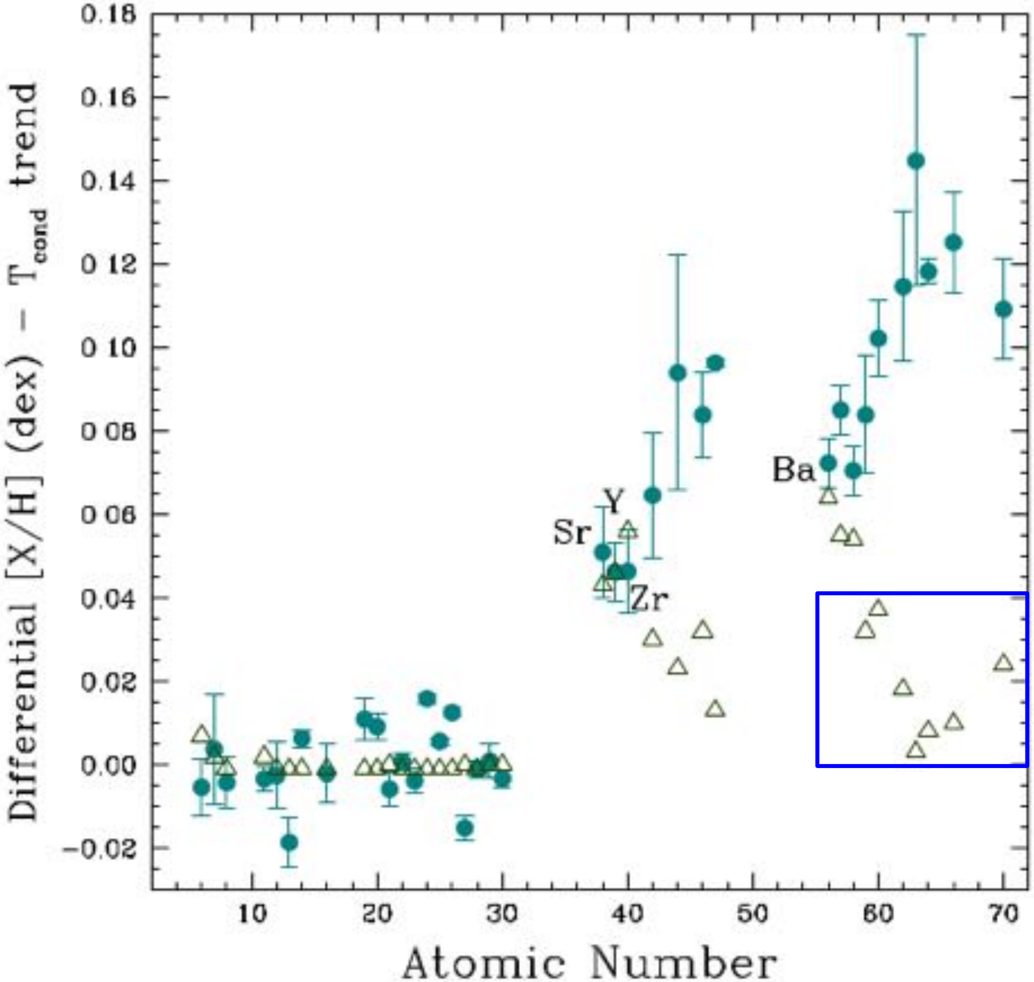


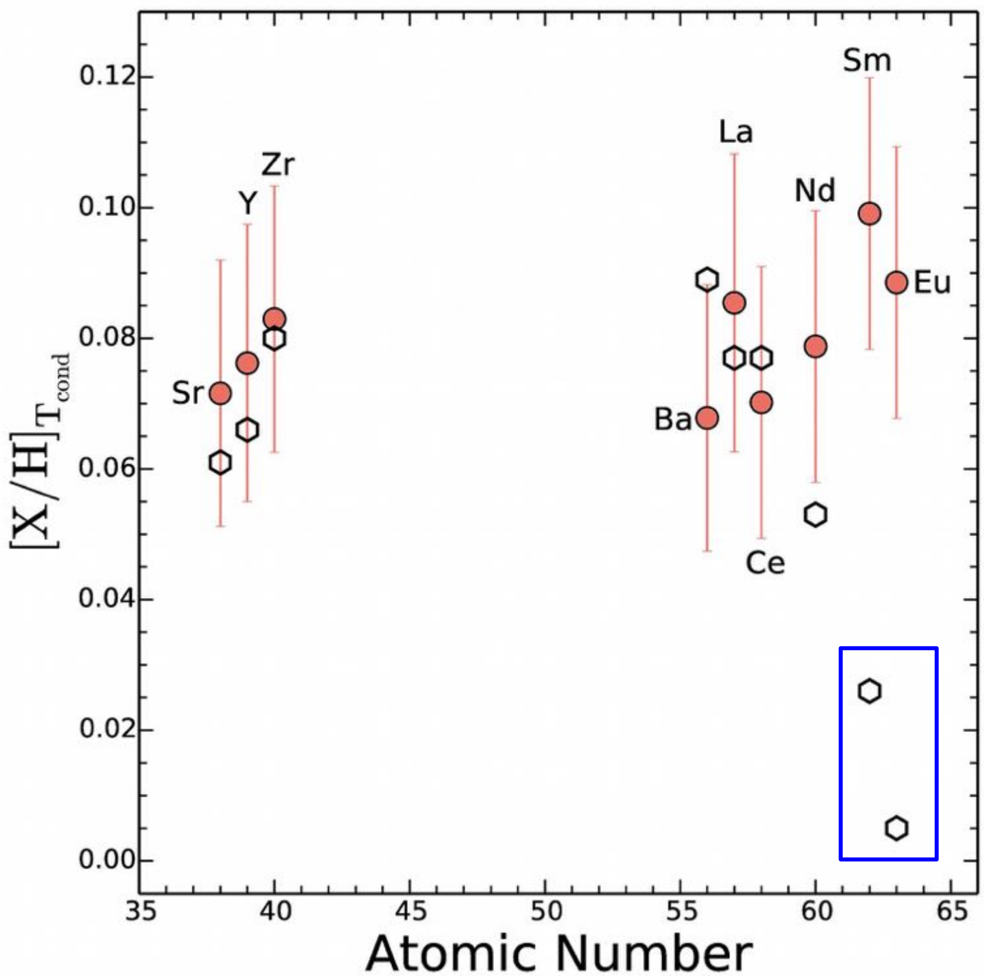


Dilution : 0.23%

Dilution : 0.34%

Neutron-capture elements





Dilution : 0.23%

Dilution : 0.34%

Neutron-capture elements

We have to subtract the AGB contribution from heavy element:

$$[\mathrm{X/H}]_{\mathrm{r-process}} = [\mathrm{X/H}]_{\mathrm{Tcond}} - [\mathrm{X/H}]_{\mathrm{AGB}}$$

Then compare these with the predicted enhancement based on r-process:

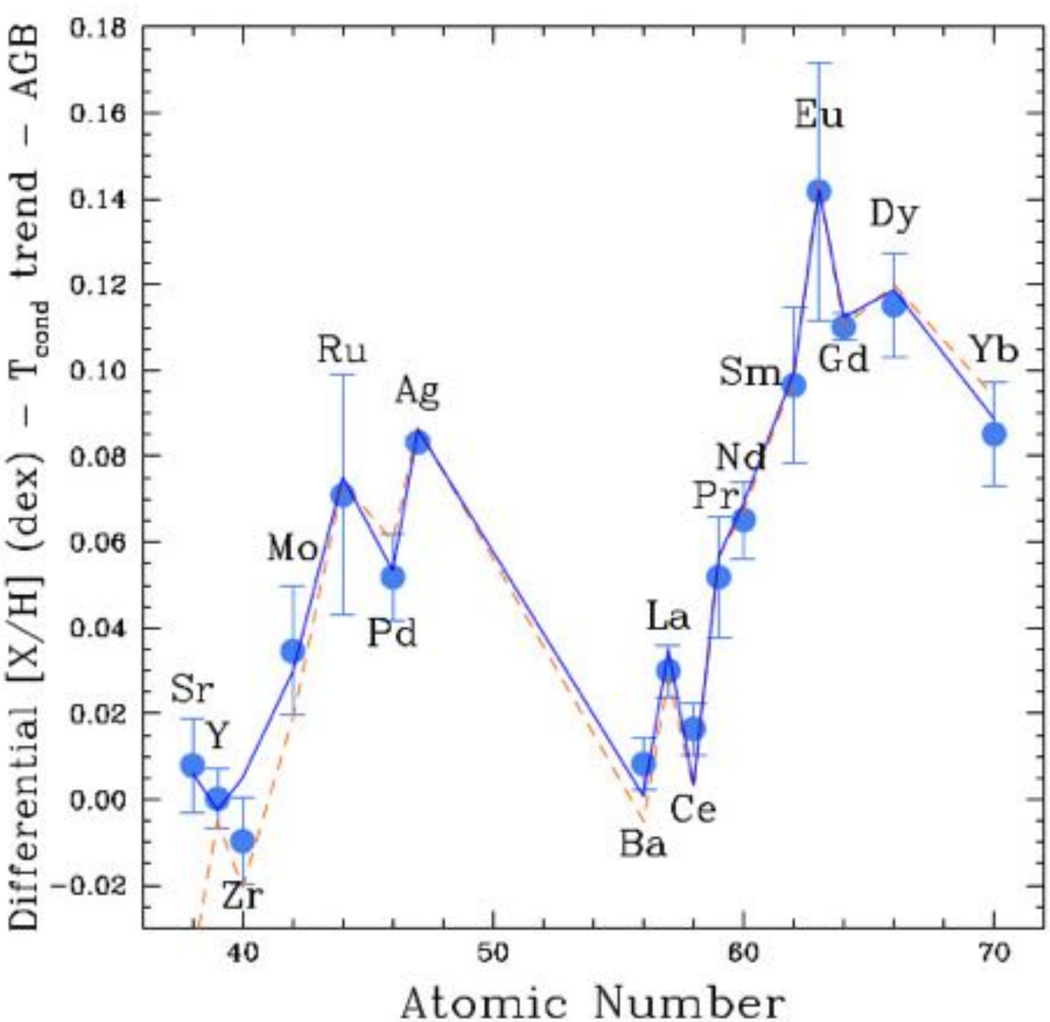
$$r_{SS} = \frac{10^{\frac{[\mathrm{X/H}]_{\mathrm{SS-r}}}{\Delta\tau}}}{10^{\frac{[\mathrm{X/H}]_{\mathrm{Tcond}}}{\Delta\tau}}} \rightarrow r_{SS} = 1 - S_{SS}$$

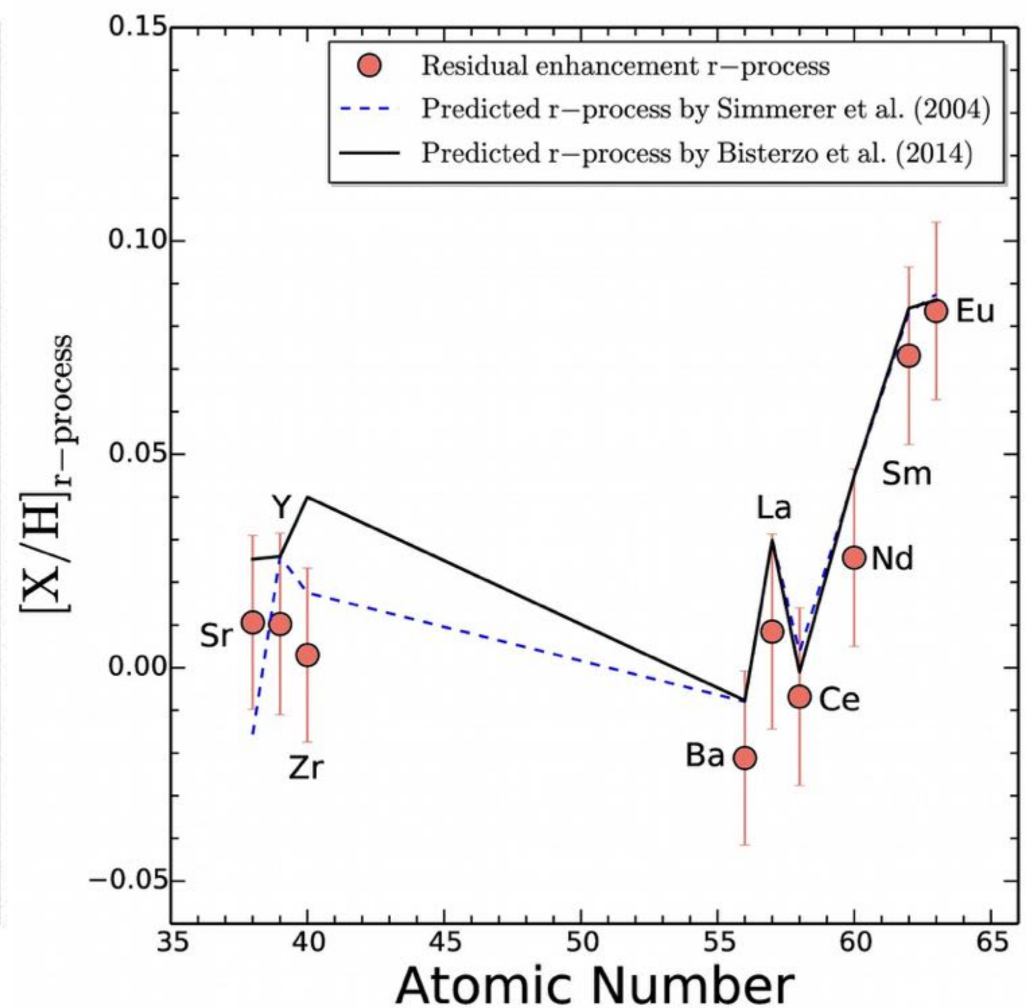
$$[\mathrm{X/H}]_{\mathrm{SS-r}} = \Delta\tau \log_{10} \mathrm{r_{SS}} + [\mathrm{X/H}]_{\mathrm{Tcond}}$$

The average of s- and -r process

Using the s fractions by
Simmerer et.al (2004)
Bisterzo et al. (2014)

Neutron-capture elements





$\Delta\tau = 0.093$ dex

$\Delta\tau = 0.091$ dex

HIP 100963: Paper

A&A 589, A17 (2016)
DOI: 10.1051/0004-6361/201527912

Astronomy & Astrophysics

High-precision analysis of the solar twin HIP 100963

Jhon Yana Galarza[1], Jorge Meléndez[1], Ivan Ramírez[2], David Yong[3], Amanda I. Karakas[3], Martin Asplund[3], and Fan Liu[3]

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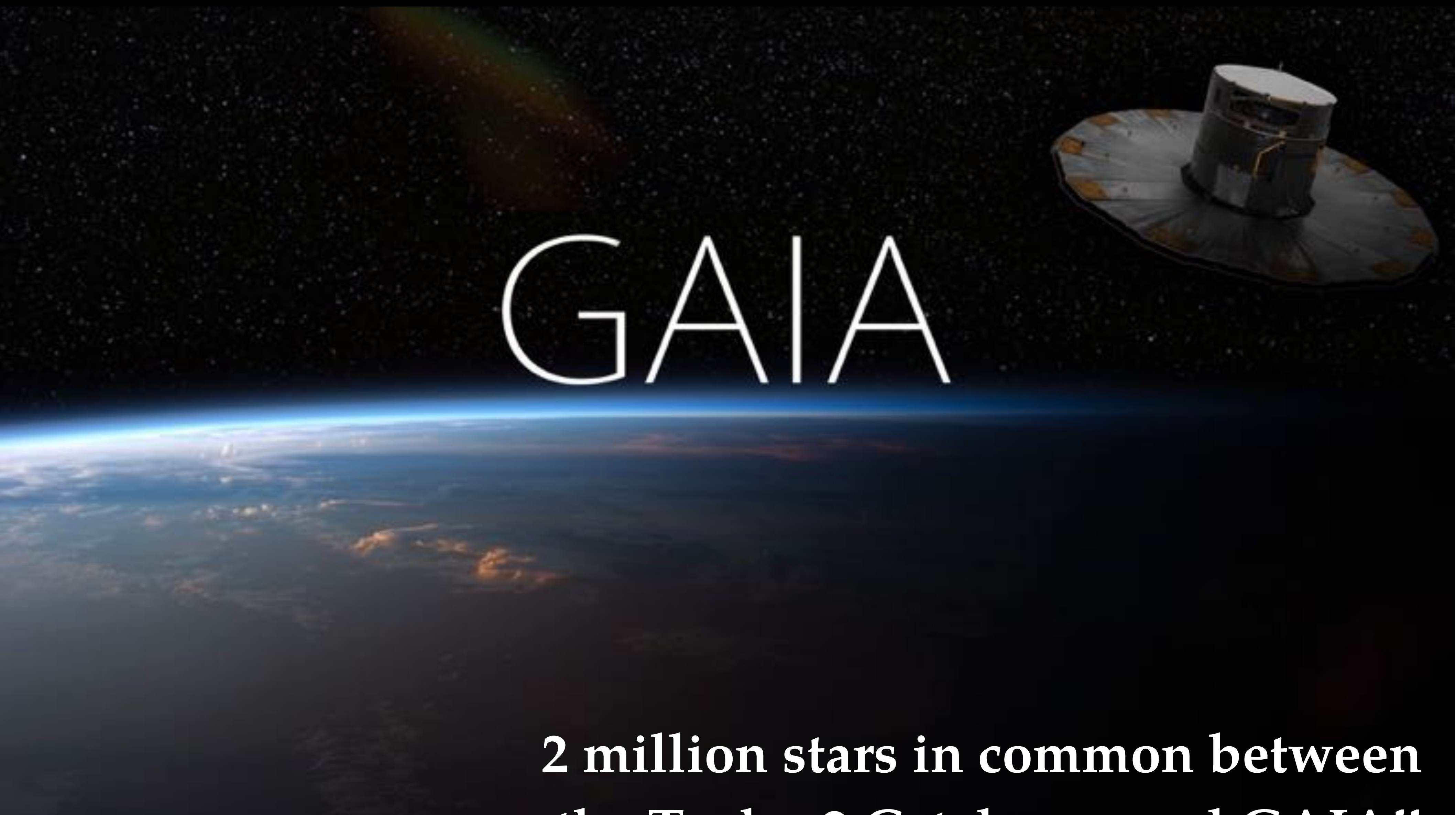
e-mail: ramstojh@usp.br
[2] University of Texas at Austin, McDonald Observatory and Department of Astronomy, 2515 Speedway, Austin, TX 78712-1205, USA
[3] Australian National University, Research School of Astronomy and Astrophysics, Mt. Stromlo Observatory, via Cotter Rd., Weston, ACT 2611, Australia

Received 7 December 2015 / Accepted 24 February 2016

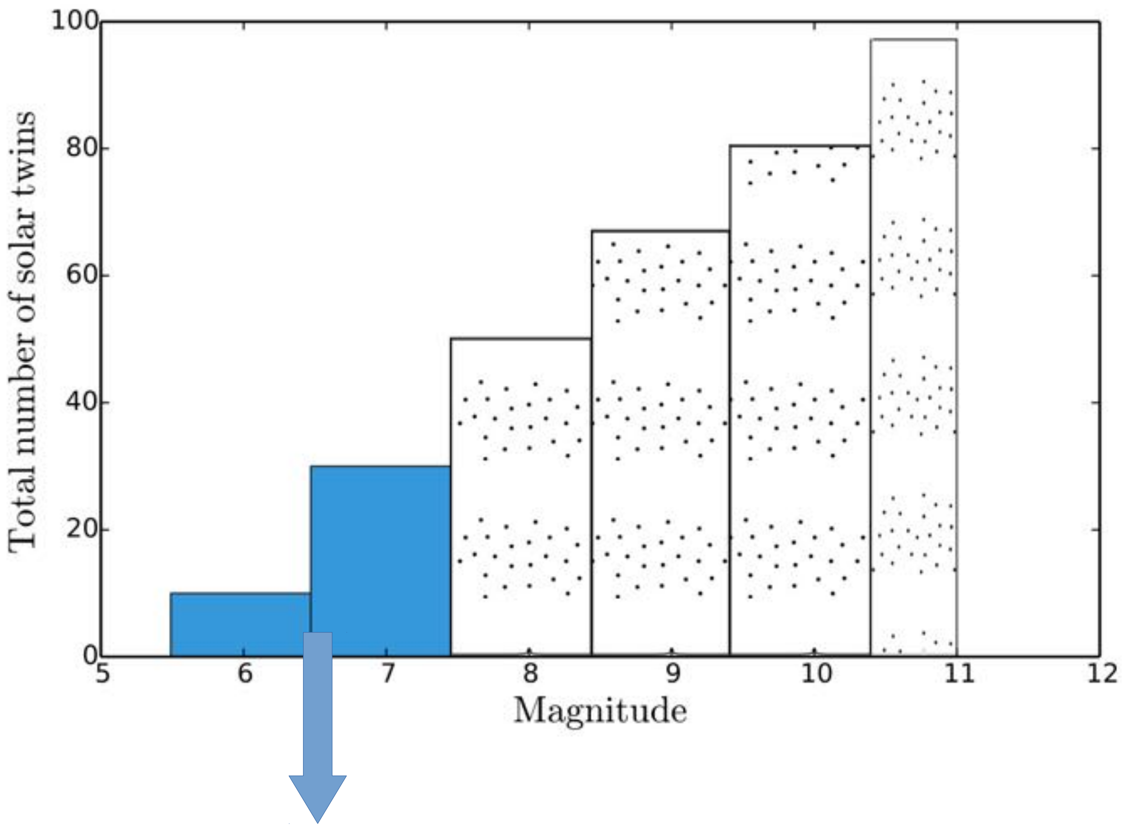
The search of new solar twins

Sunset in the peruvian andes

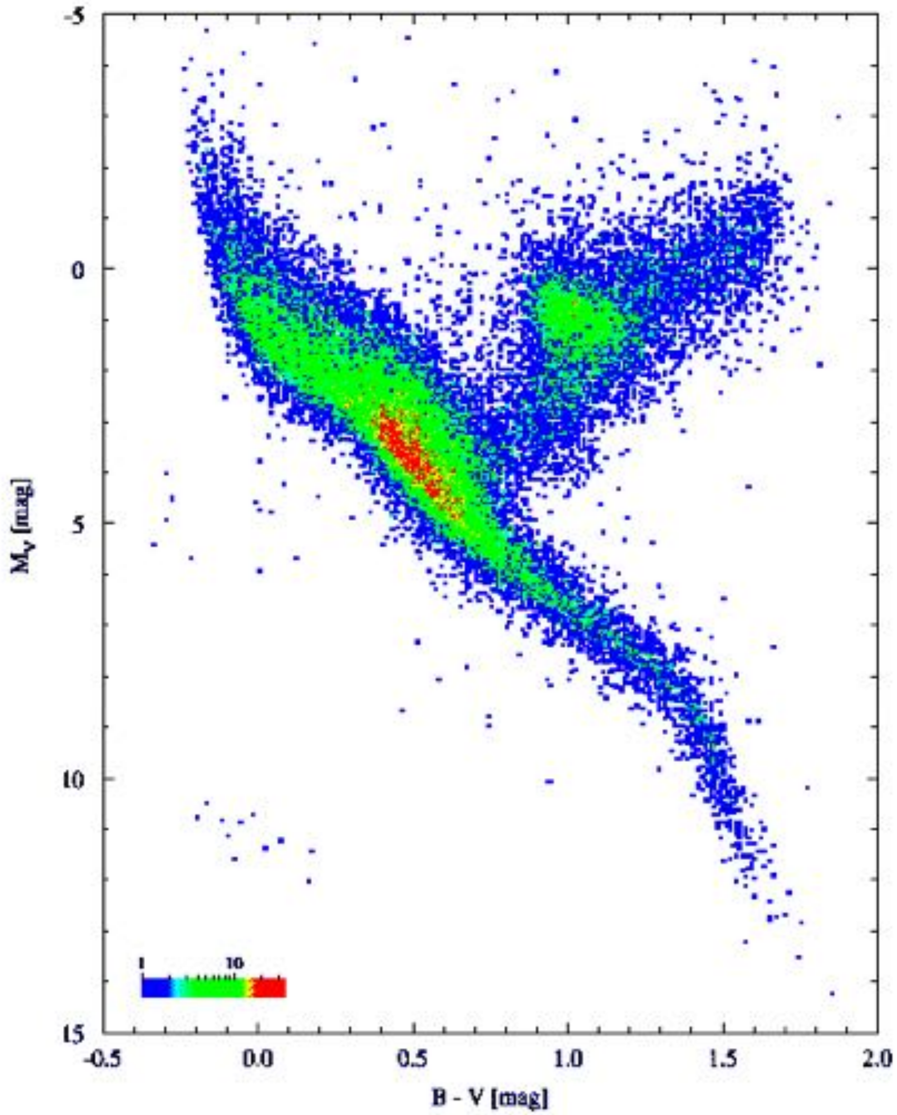
The GAIA Mission



2 million stars in common between the Tycho-2 Catalogue and GAIA!!



Ramirez et al. (2010)



We hope to find approximately 300 solar twins!

Faint solar twins

Precision Spectroscopy
Abundances, nucleosynthesis and chemical evolution
19-21 September 2016

A&A 589, A65 (2016)
DOI: 10.1051/0004-6361/201527477

Astronomy & Astrophysics

Serendipitous discovery of the faint solar twin Inti 1★

Jhon Yana Galarza[1], Jorge Meléndez[1], and Judith G. Cohen[2]

[1] Universidade de São Paulo, IAG, Departamento de Astronomia, São Paulo, Rua do Matão 1226, 05508-090 SP, Brasil
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ABSTRACT

Context. Solar twins are increasingly the subject of many studies owing to their wide range of applications from testing stellar evolution models to the calibration of fundamental observables; these stars are also of interest because high precision abundances could be achieved that are key to investigating the chemical anomalies imprinted by planet formation. Furthermore, the advent of photometric surveys with large telescopes motivates the identification of faint solar twins in order to set the zero point of fundamental calibrations.
Aims. We intend to perform a detailed line-by-line differential analysis to verify whether 2MASS J23263267-0239363 (designated here as Inti 1) is indeed a solar twin.
Methods. We determine the atmospheric parameters and differential abundances using high-resolution ($R \approx 50000$), high signal-to-noise ($S/N \approx 110$–240 per pixel) *Keck*/HIRES spectra for our solar twin candidate, the previously known solar twin HD 45184, and the Sun (using reflected light from the asteroid Vesta).

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Portal Simbad VizieR Aladin X-Match Other Help

SIMBAD Astronomical Database

Basic data :

NAME Inti 1 -- Star

Other object types:	IR (2MASS,WISE), * (Ref)
ICRS coord. *(ep=J2000) :*	23 26 32.673 -02 39 36.36 (Near-IR) [200 180 90] B 2003yCat.2246....0C
FK5 coord. *(ep=J2000 eq=2000) :*	23 26 32.673 -02 39 36.36 [200 180 90]
FK4 coord. *(ep=B1950 eq=1950) :*	23 23 58.41 -02 56 07.2 [200 180 90]
Gal coord. *(ep=J2000) :*	079.5990 -58.2002 [200 180 90]
Fluxes (6) :	B 13.517 [~] D 2016yCat.2336....0H
	V 12.857 [0.028] C 2016yCat.2336....0H
	I 12.045 [0.072] D 2016A&A...589A..65G
	J 11.559 [0.023] C 2003yCat.2246....0C
	H 11.247 [0.023] C 2003yCat.2246....0C
	K 11.168 [0.024] C 2003yCat.2246....0C

Faint solar twins

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Astronomy & Astrophysics

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CDS | Portal | Simbad | VizieR | Aladin | X-Match | Other | Help

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	K 11.168 [0.024] C 2003yCat.2246....0C

We will create the Inti catalogue!!

Thanks so much for your attention

Jhon Yana Galarza
ramstojh@usp.br