The GALAH Survey

Chemical tagging of co-moving stellar pairs

Jeffrey Simpson

and the GALAH collaboration

Australian Astronomical Observatory


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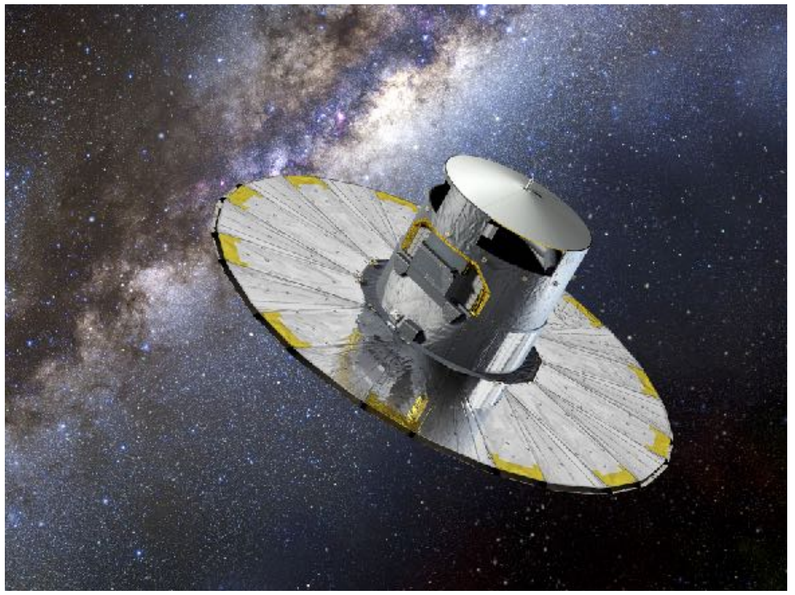


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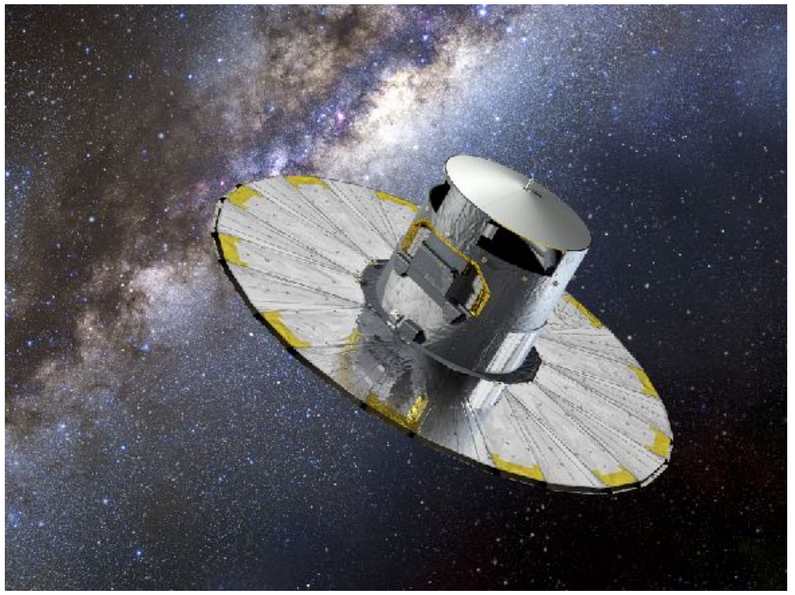
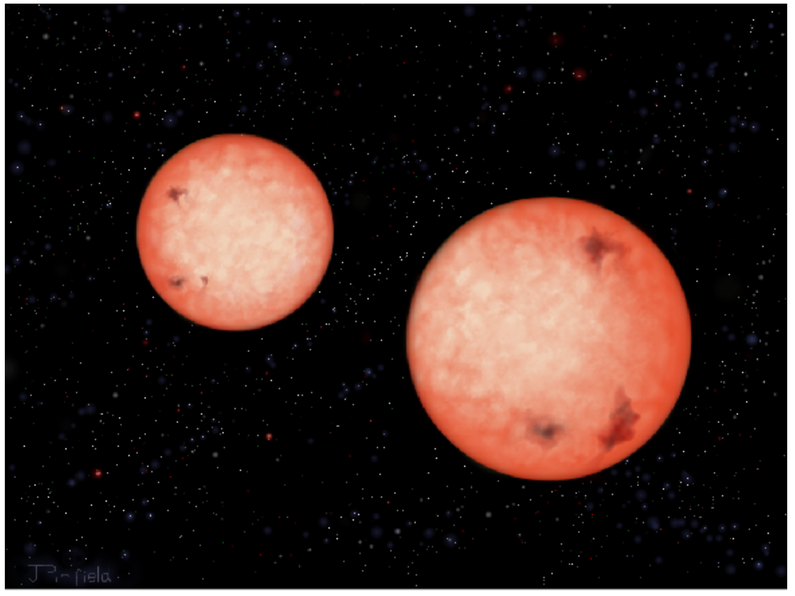





GALAH

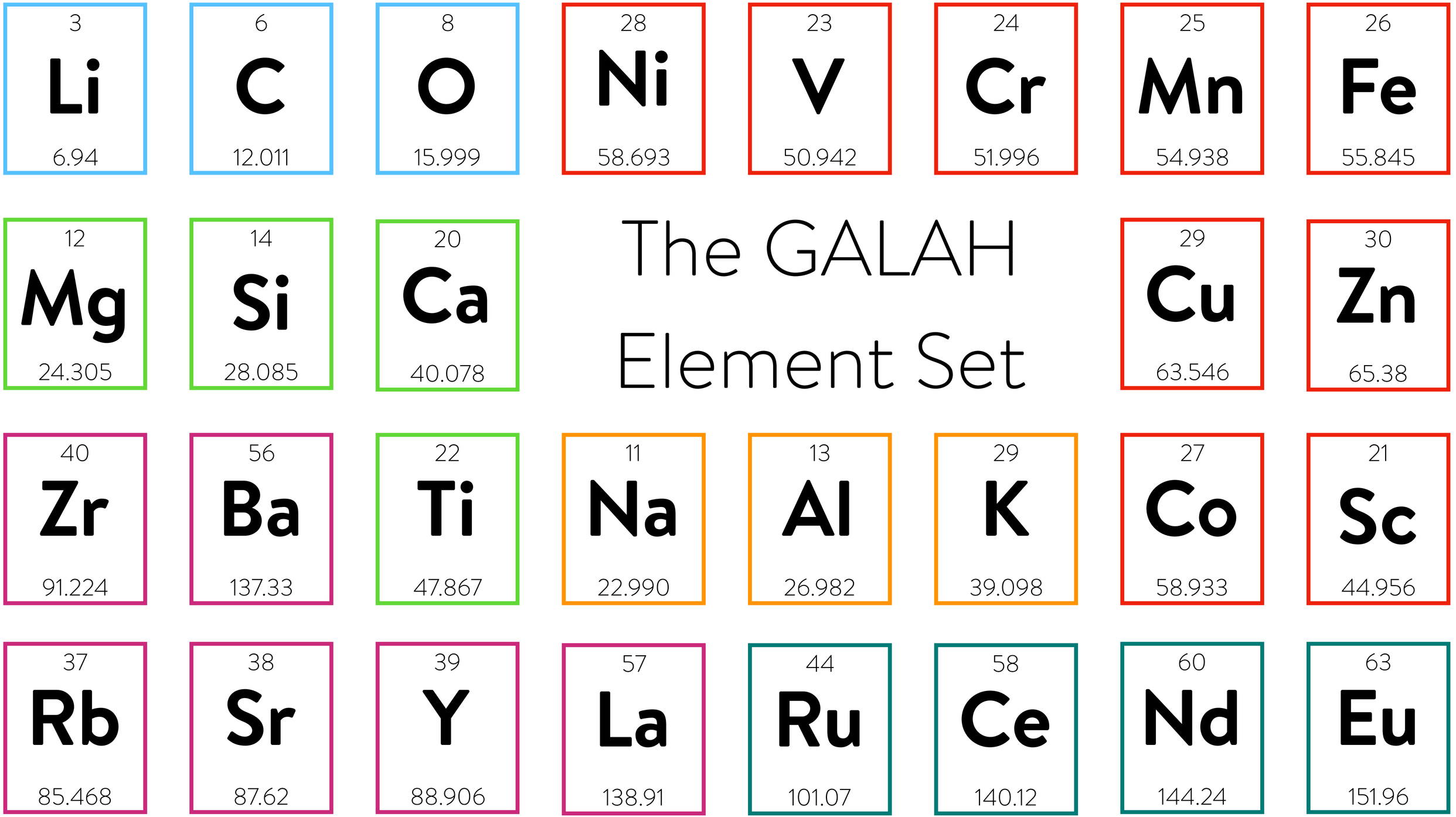
GALAH

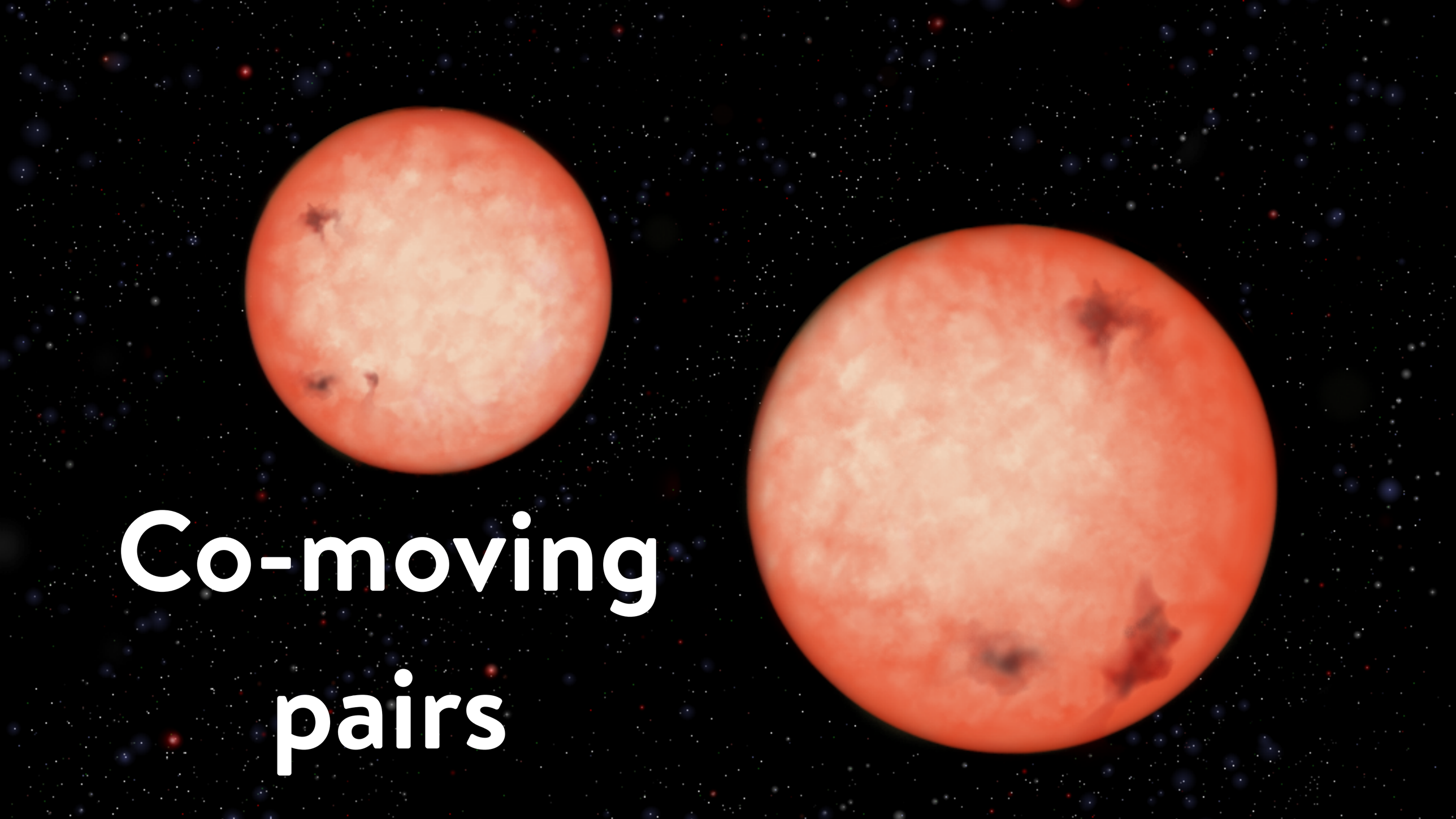
GALactic **A**rchaeology with **H**ERMES

One million stars

29 elements

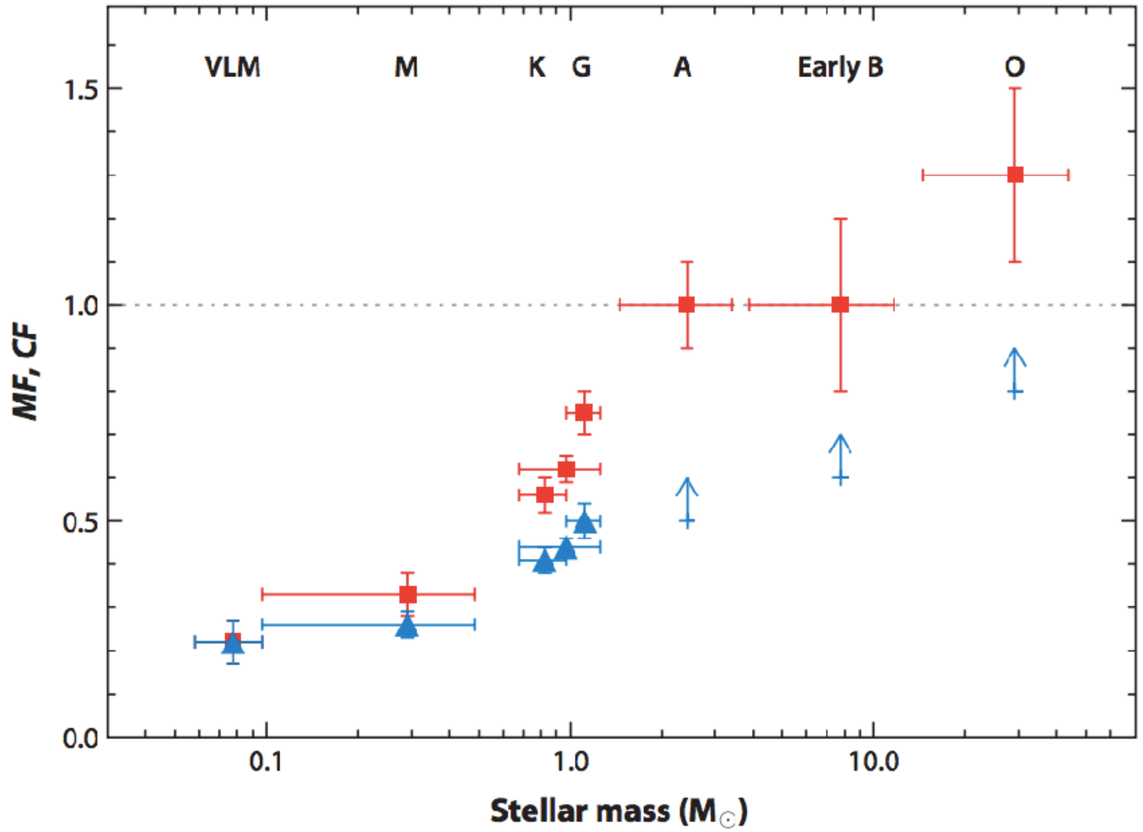
Chemical tagging


3
Li
6.94
6
C
12.011
8
O
15.999
28
Ni
58.693
23
V
50.942
24
Cr
51.996
25
Mn
54.938
26
Fe
55.845
12
Mg
24.305
14
Si
28.085
20
Ca
40.078
The GALAH
Element Set
29
Cu
63.546
30
Zn
65.38
40
Zr
91.224
56
Ba
137.33
22
Ti
47.867
11
Na
22.990
13
Al
26.982
29
K
39.098
27
Co
58.933
21
Sc
44.956
37
Rb
85.468
38
Sr
87.62
39
Y
88.906
57
La
138.91
44
Ru
101.07
58
Ce
140.12
60
Nd
144.24
63
Eu
151.96


Co-moving
pairs

Co-moving stellar pairs

- About 50% of all main-sequence stars are in binary systems of varying separations
- There is a population of very wide separation binaries (>1 pc)
- Some(? Many?) wide binaries are lost of single-age stellar clusters and could be used as a probe of cluster dissolution
- **They could be a floor in our ability to chemically tag stars**



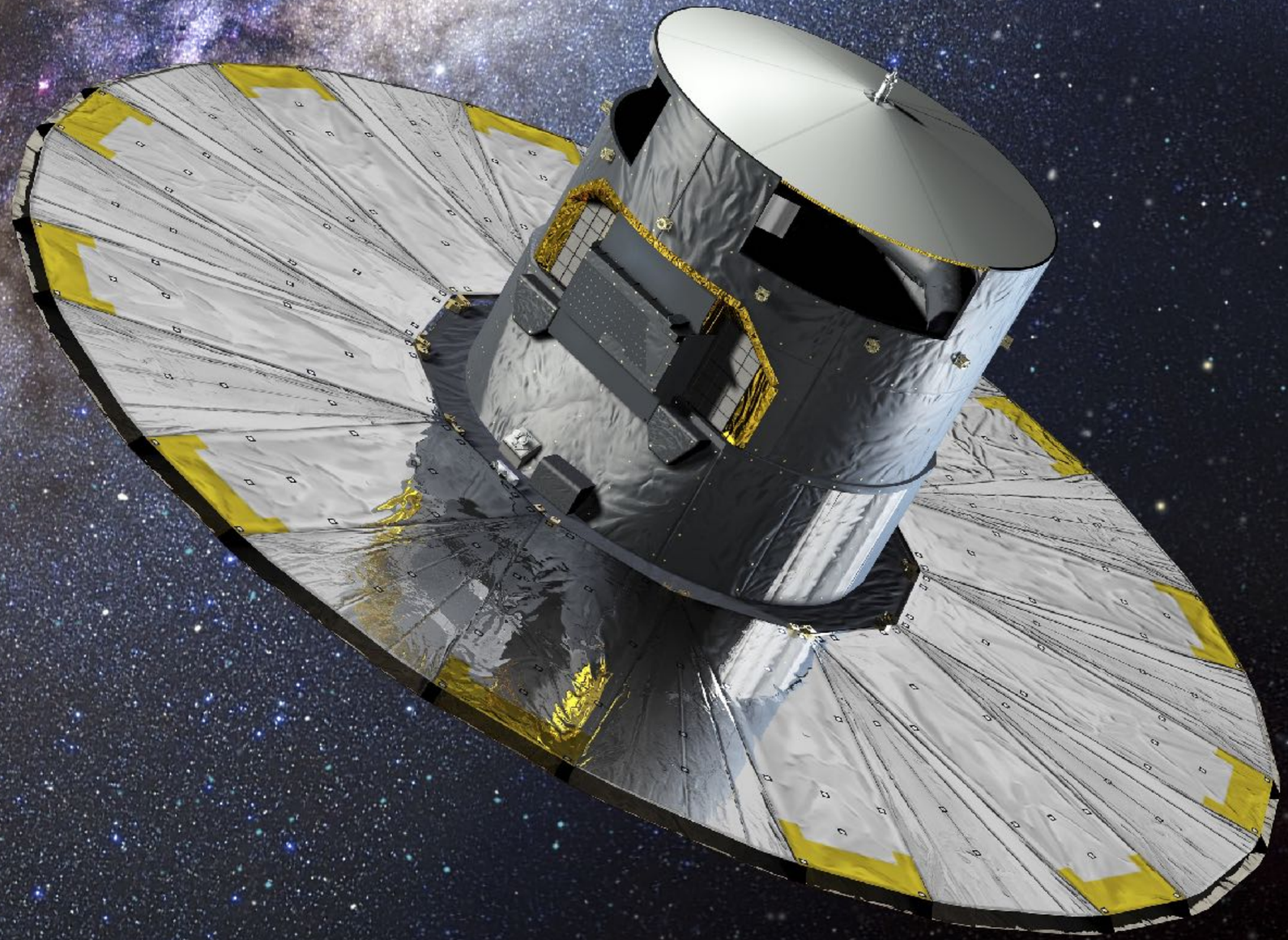
Duchêne & Kraus (2013; ARAA, 51, 1)

Different routes to “same” answer

Find **chemically**-similar stars and then see which are **kinematically**-similar

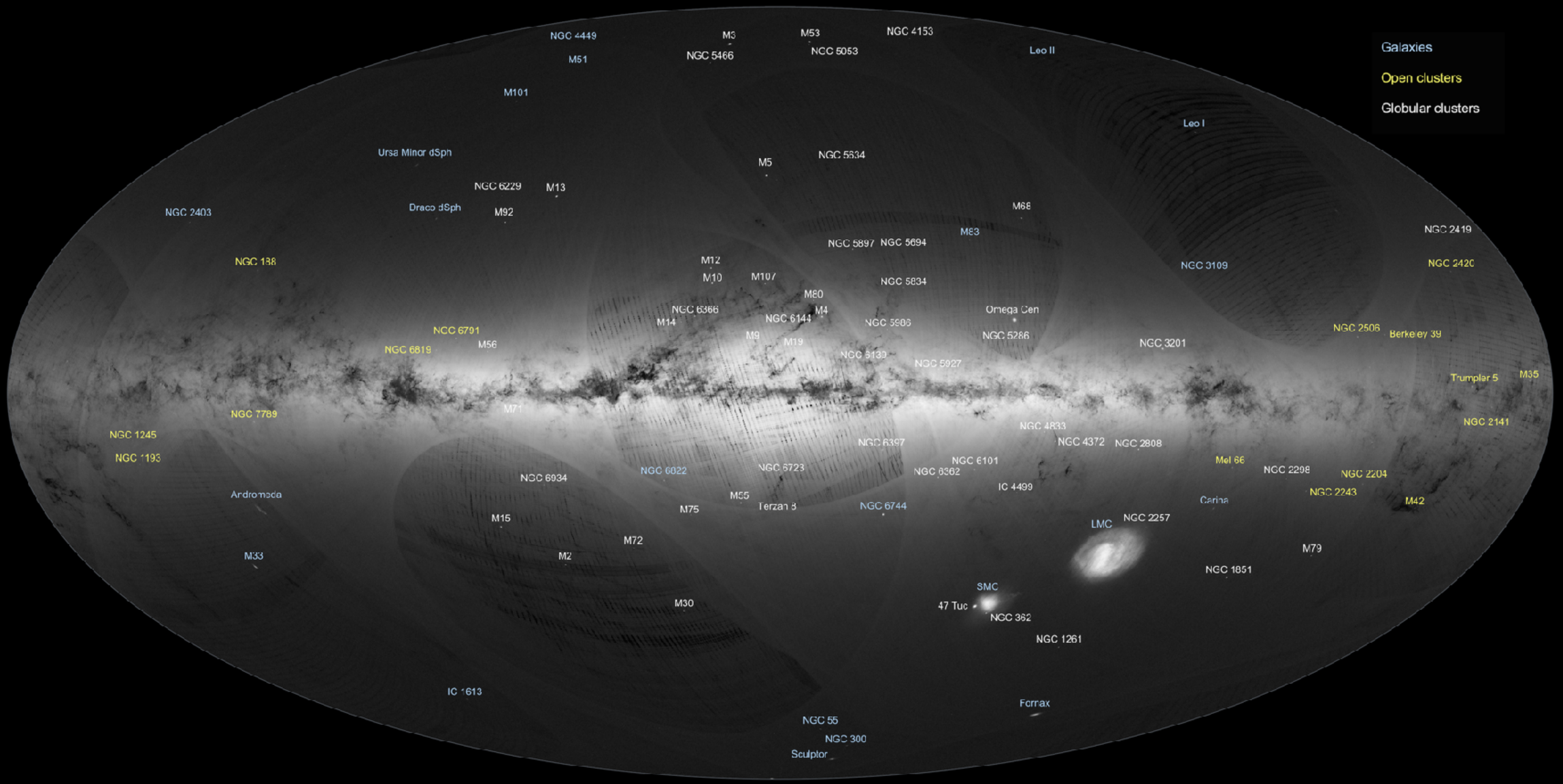
Find **kinematically**-similar stars and then see which are **chemically**-similar

Gaia



"Science with **1.5 billion** objects in three dimensions"

→ GAIA'S FIRST SKY MAP



www.esa.int

Credit: ESA/Gaia/DPAC

European Space Agency

Wide binaries in Tycho-Gaia: search method and the distribution of orbital separations

Jeff J. Andrews ✉, Julio Chanamé, Marcel A. Agüeros

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THE ASTRONOMICAL JOURNAL

Comoving Stars in *Gaia* DR1: An Abundance of Very Wide Separation Comoving Pairs

Semyeong Oh[1], Adrian M. Price-Whelan[1], David W. Hogg[2,3,4], Timothy D. Morton[1], and David N. Spergel[1,4]

Published 2017 May 19 •
The Astronomical Journal, Volume 153, Number 6

THE ASTRONOMICAL JOURNAL

Gaia Assorted Mass Binaries Long Excluded from SLoWPoKES (GAMBLES): Identifying Ultra-wide Binary Pairs with Components of Diverse Mass

Ryan J. Oelkers[1], Keivan G. Stassun[1,2], and Saurav Dhital[1]

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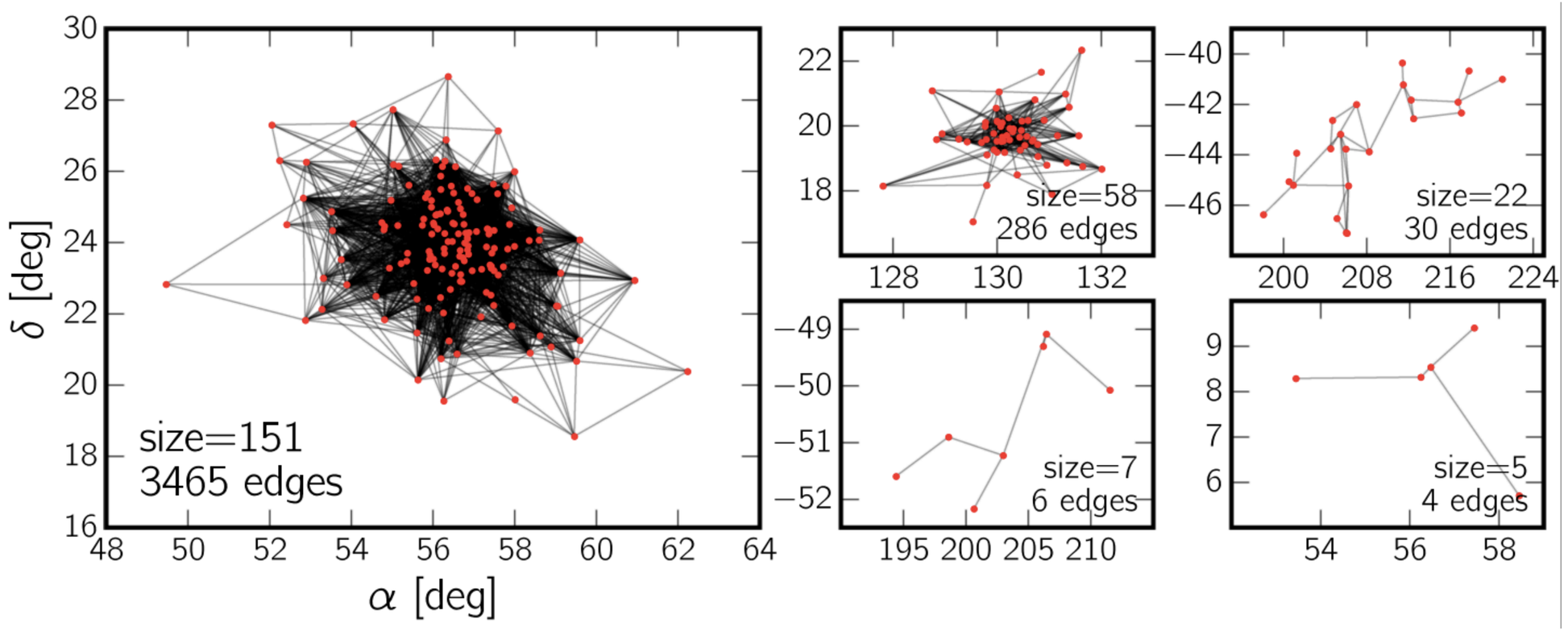
- Considered all pairs of stars within 10 parsecs of each other
- Identified those with high probability of being co-moving from the proper motions
- 10000 possible groups of co-moving stars
- 29 groups have been observed by GALAH

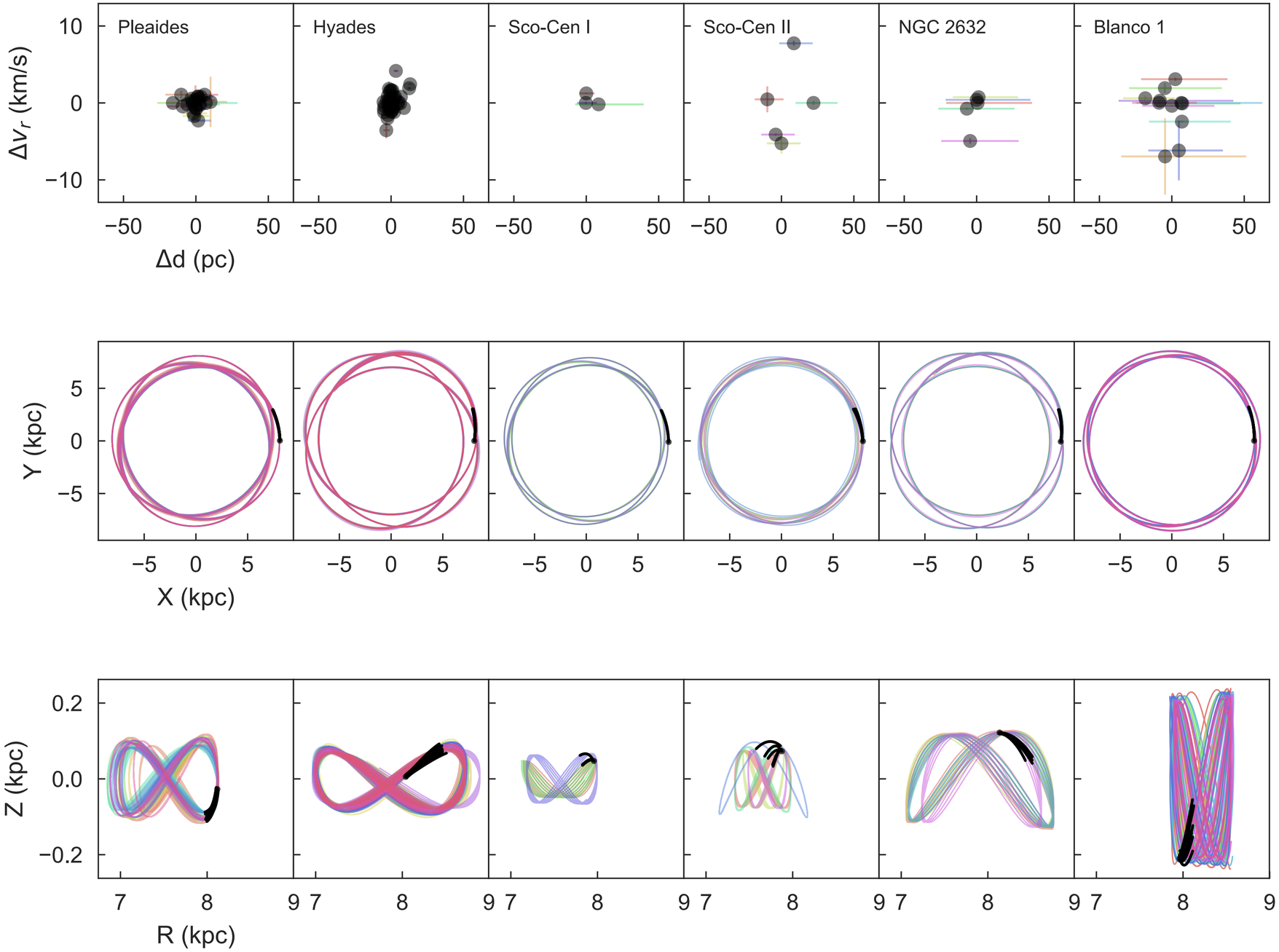
Key test: recovery of known clusters



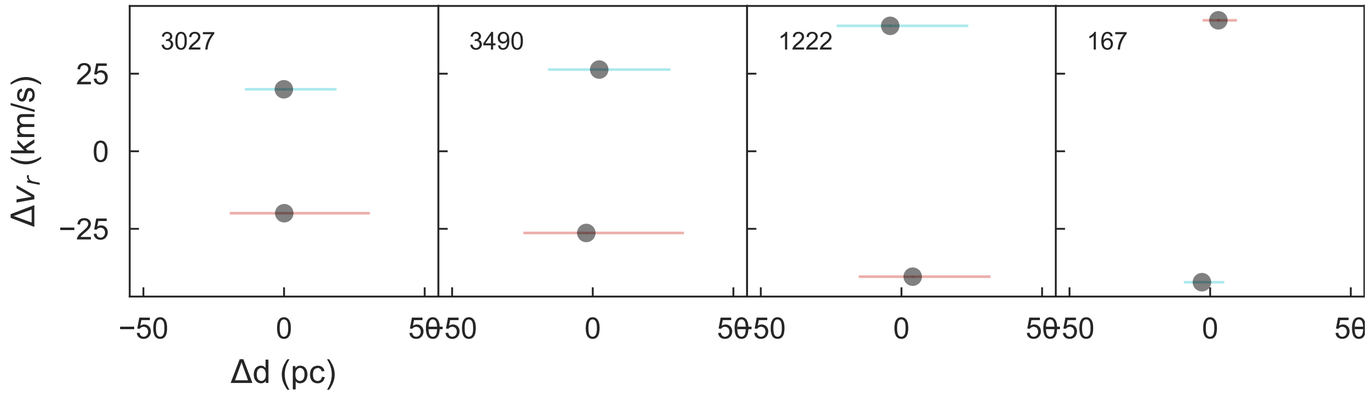
Oh+2017 is able to recover known clusters, e.g., Pleaides

But they lack radial velocities

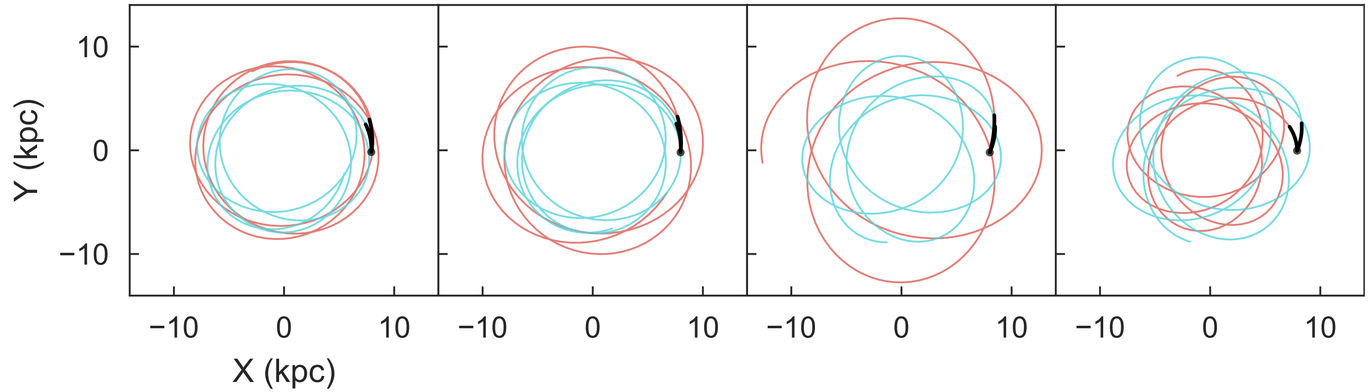
(and abundances)



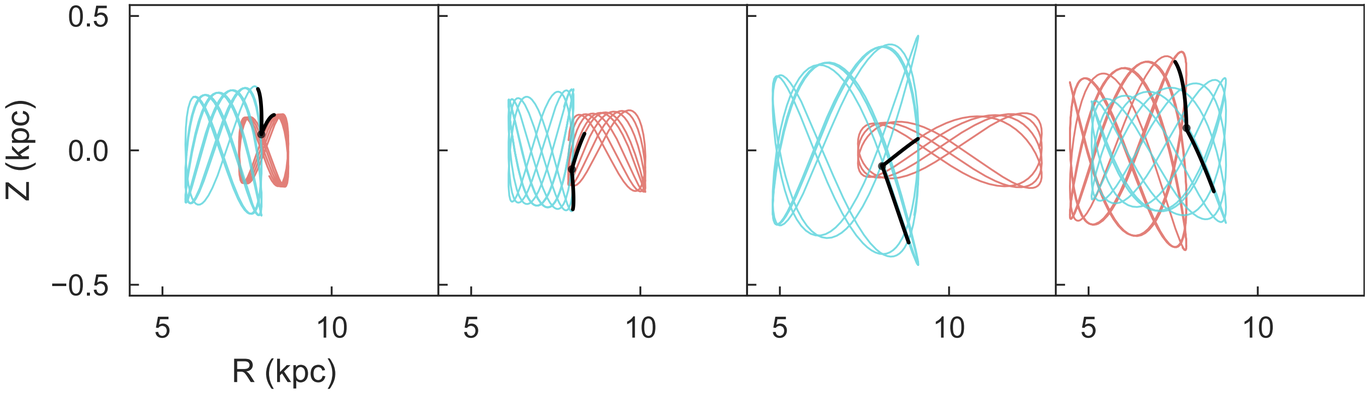
Combining the TGAS results with GALAH RVs gives us believable orbits for the known clusters



Big RV difference

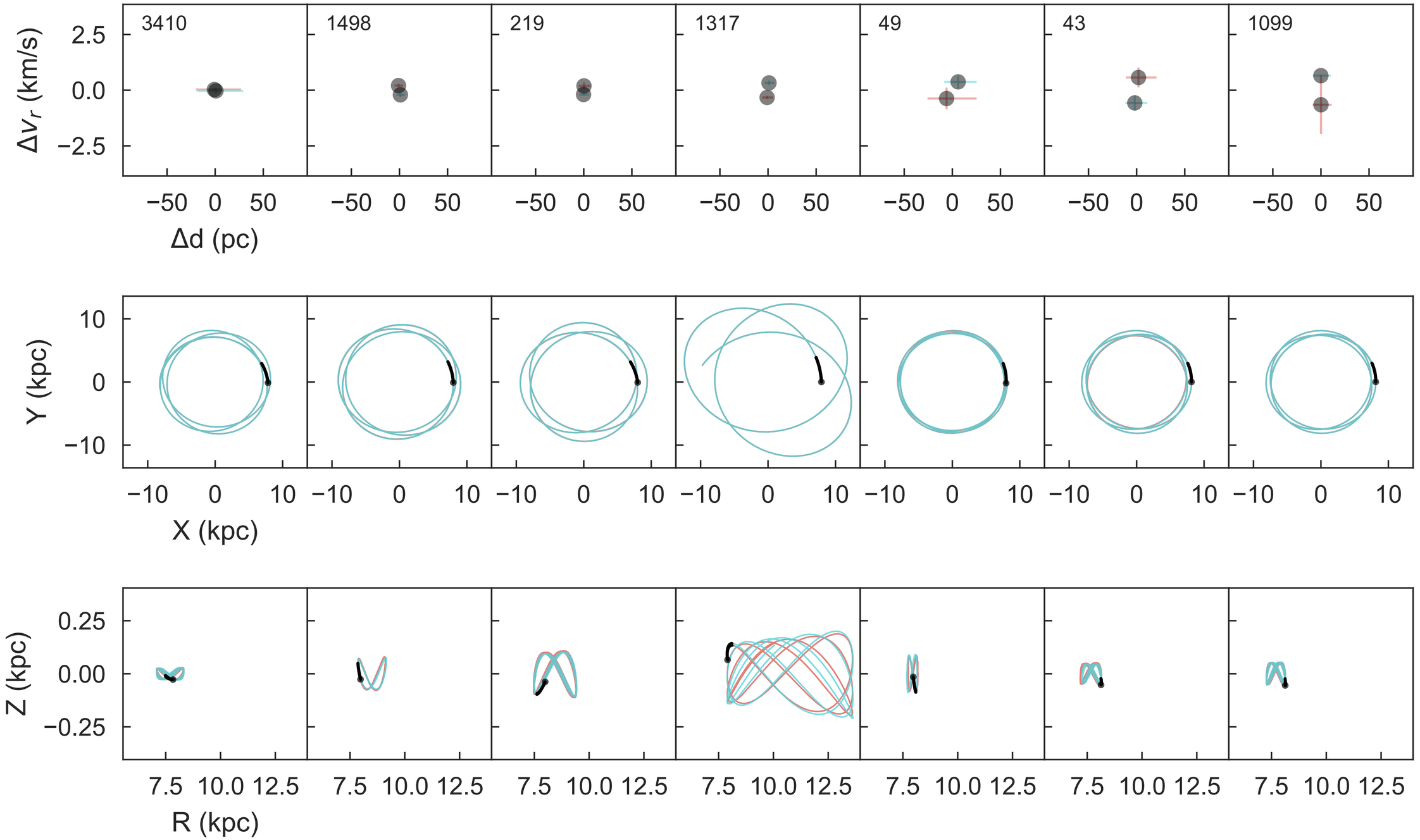


8/29 groups were false positives



Travelling off in different directions

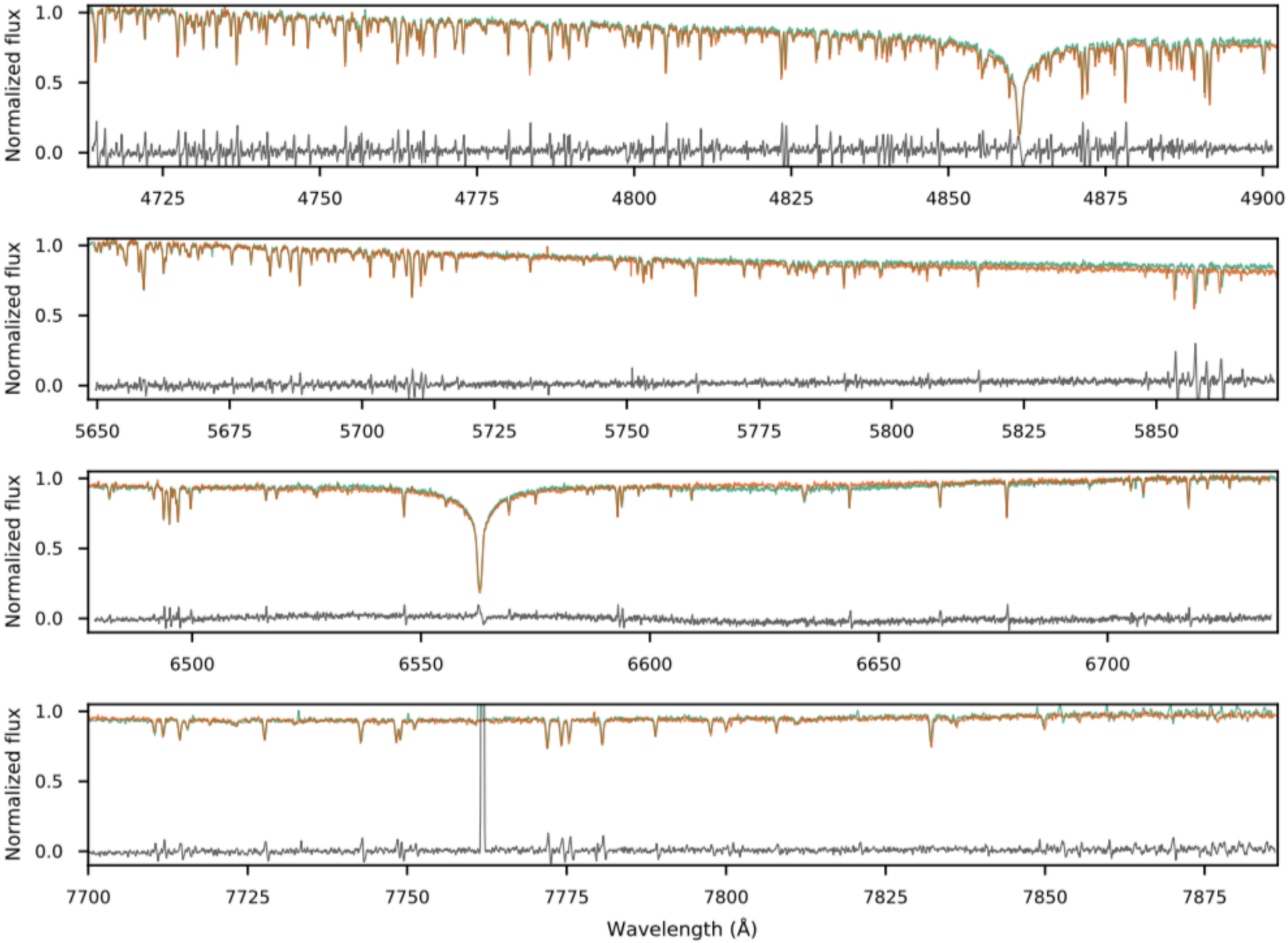
The thing we're here for:
the real co-moving pairs


3410
1498
219
1317
49
43
1099
Δv_r (km/s)
2.5
0.0
−2.5
−50 0 50
Δd (pc)
Y (kpc)
10
0
−10
X (kpc)
Z (kpc)
0.25
0.00
−0.25
7.5 10.0 12.5
R (kpc)

Abundances!

Abundances!

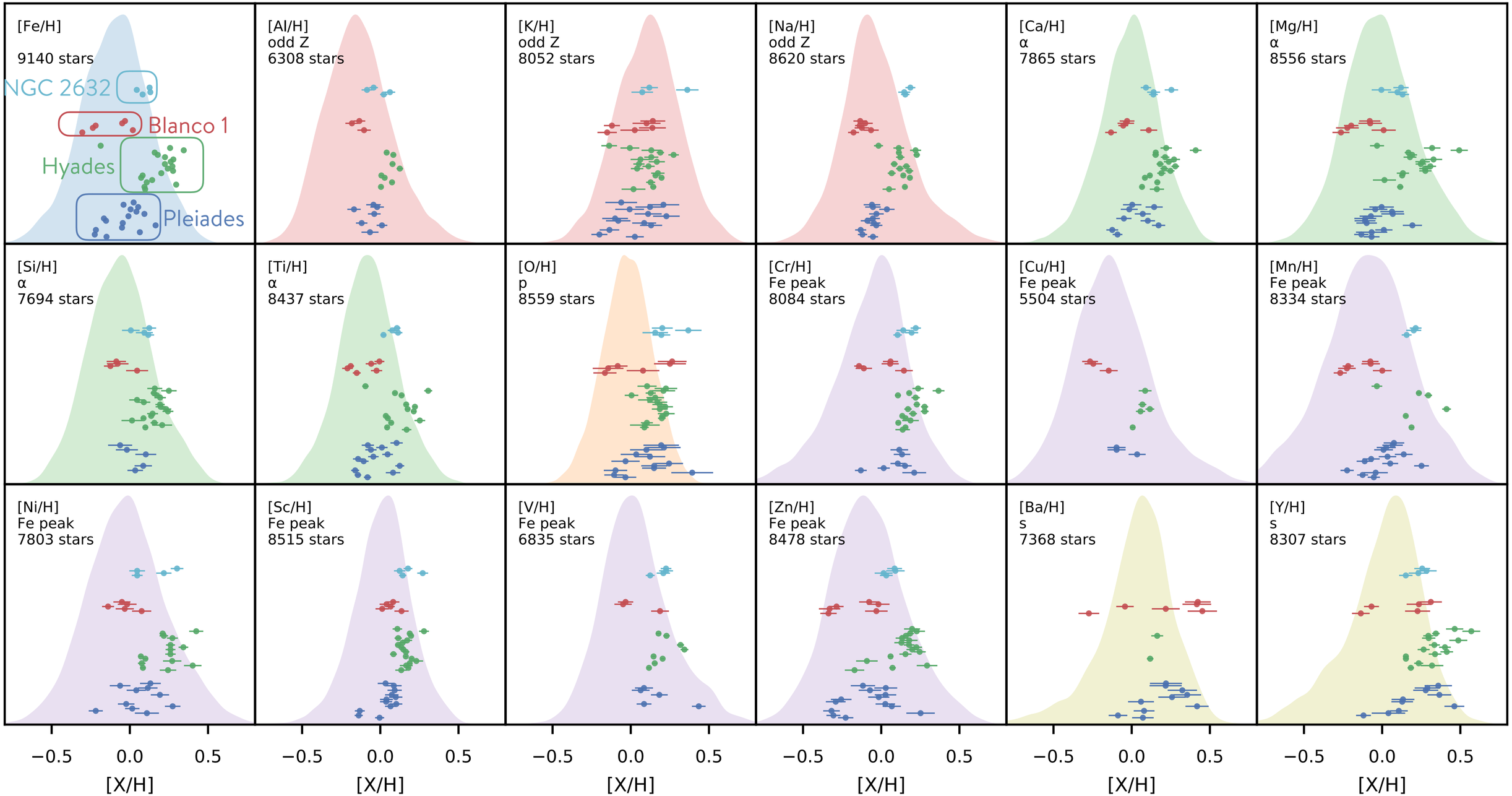
(the raison d’être of GALAH)



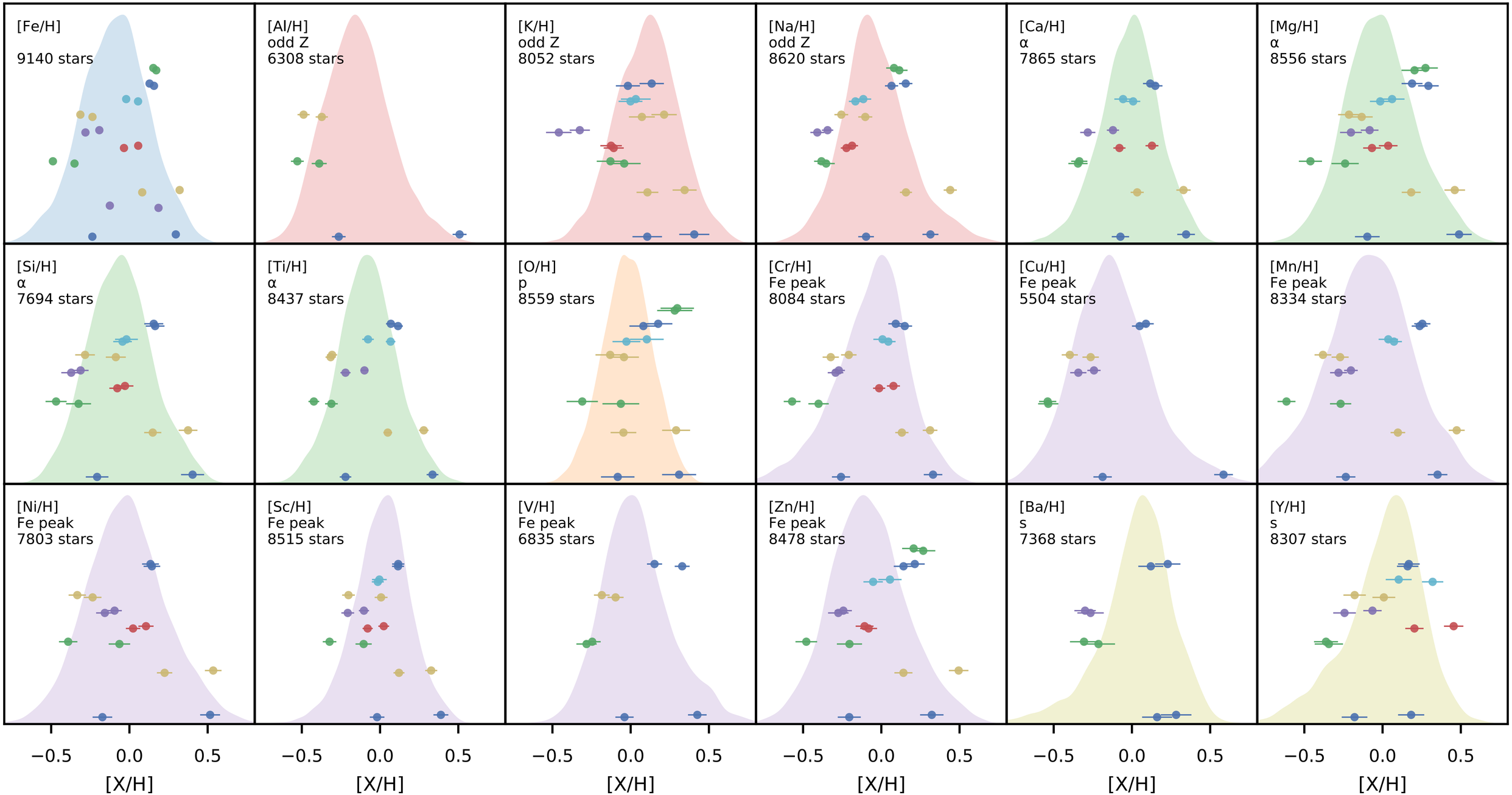
One of the co-moving pairs

They have ~identical spectra

GALAH abundance results from the known clusters

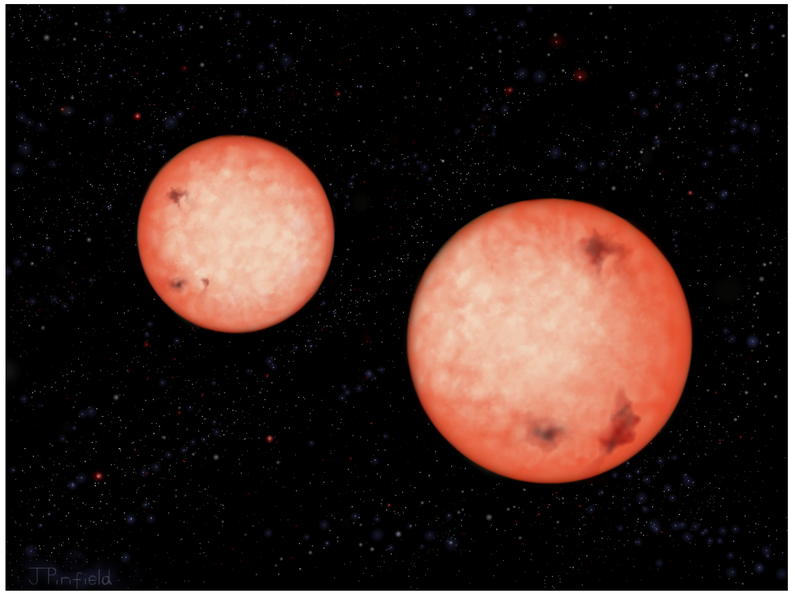


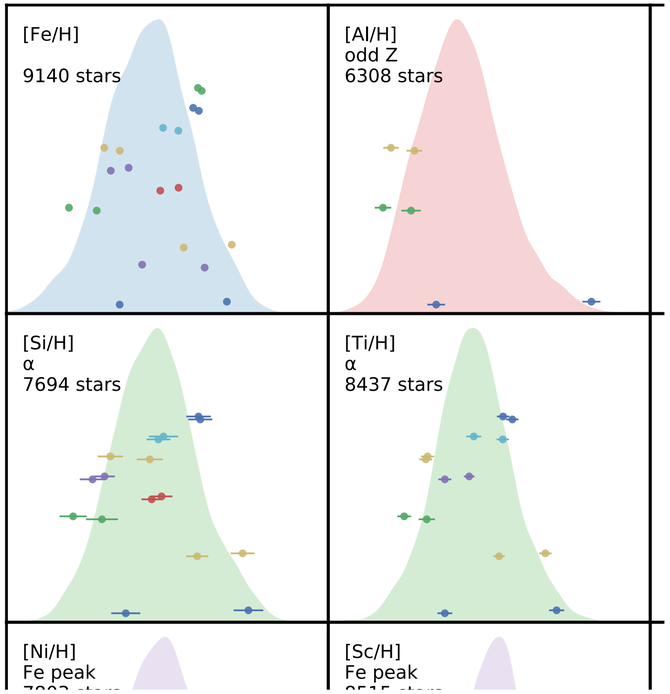
How do the abundances look for the ‘real’ pairs?



Co-moving pairs of stars are

an important test chemical tagging





Showing that **these co-moving pairs are more similar chemically than a random pair** is the next step