

The detection of lithium in cool white dwarf atmospheres

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Joshua S. Reding, and Antoine Bédard

Pier-Emmanuel Tremblay, Boris Gänsicke,
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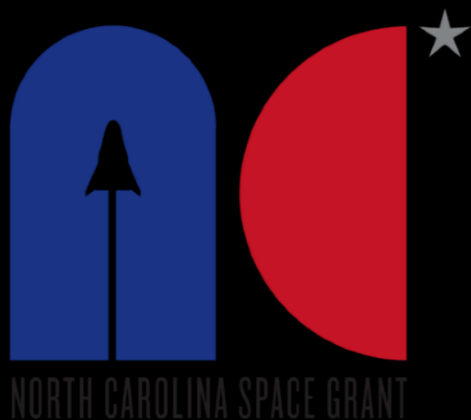


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Part I

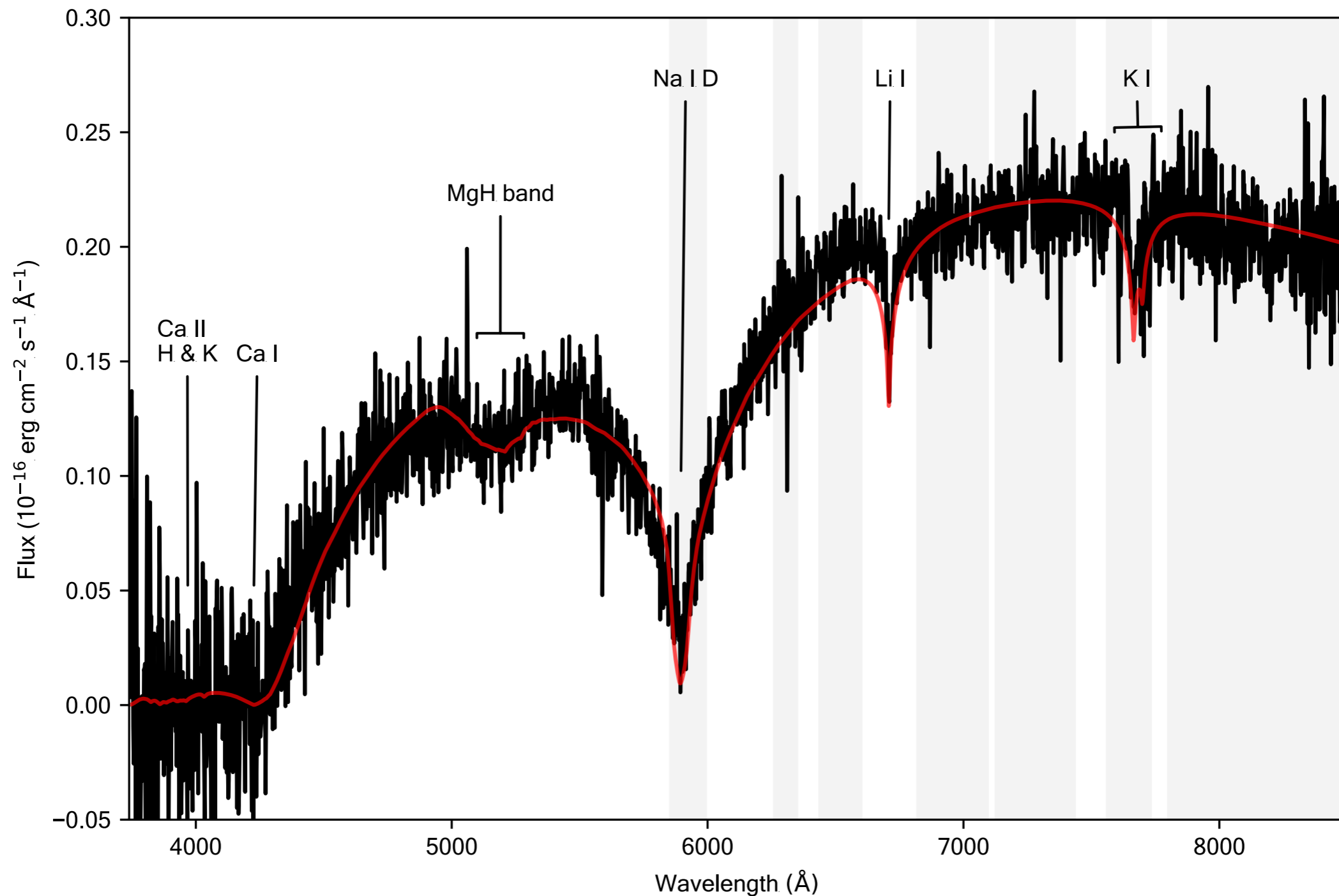
Benjamin C. Kaiser

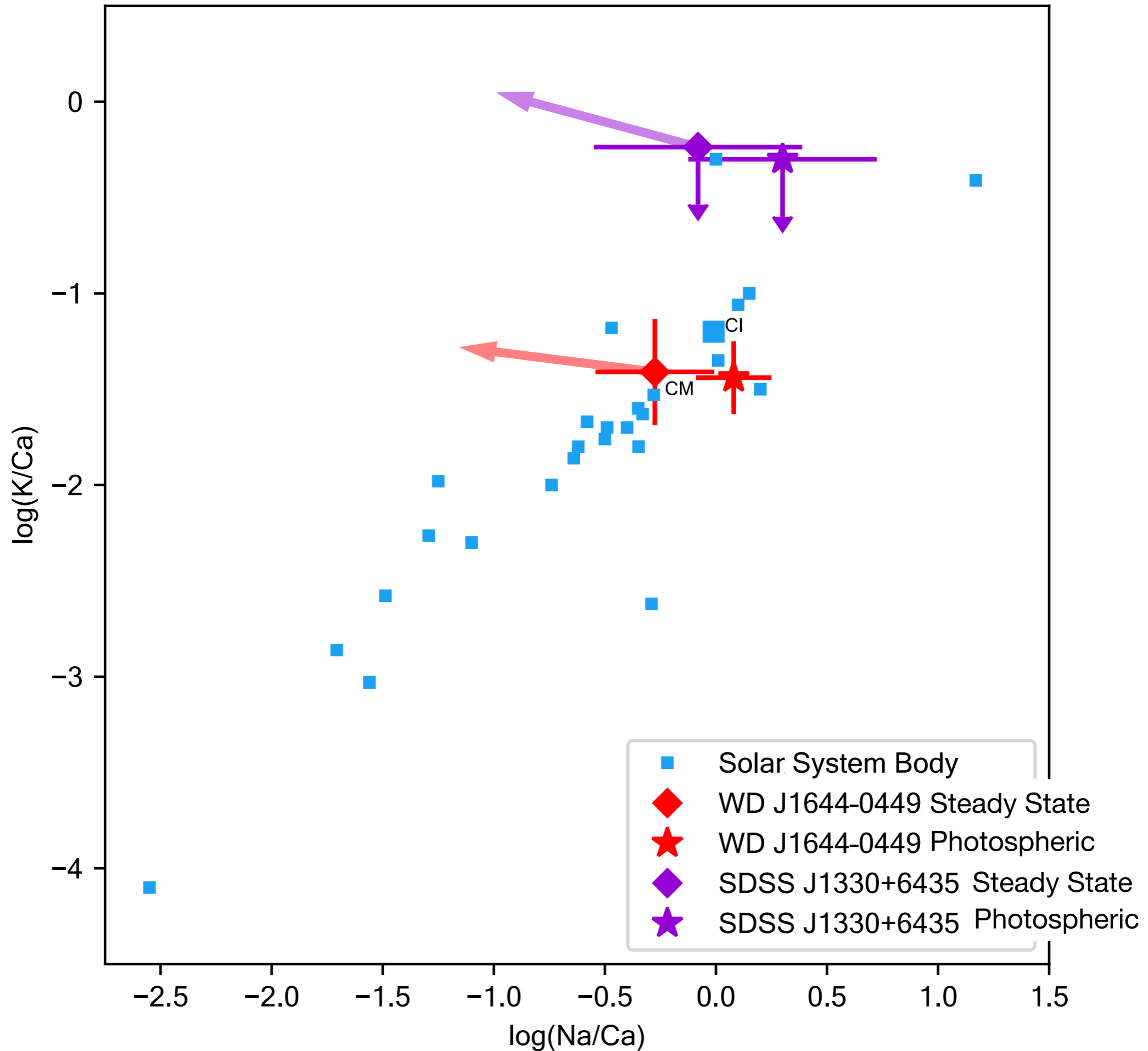
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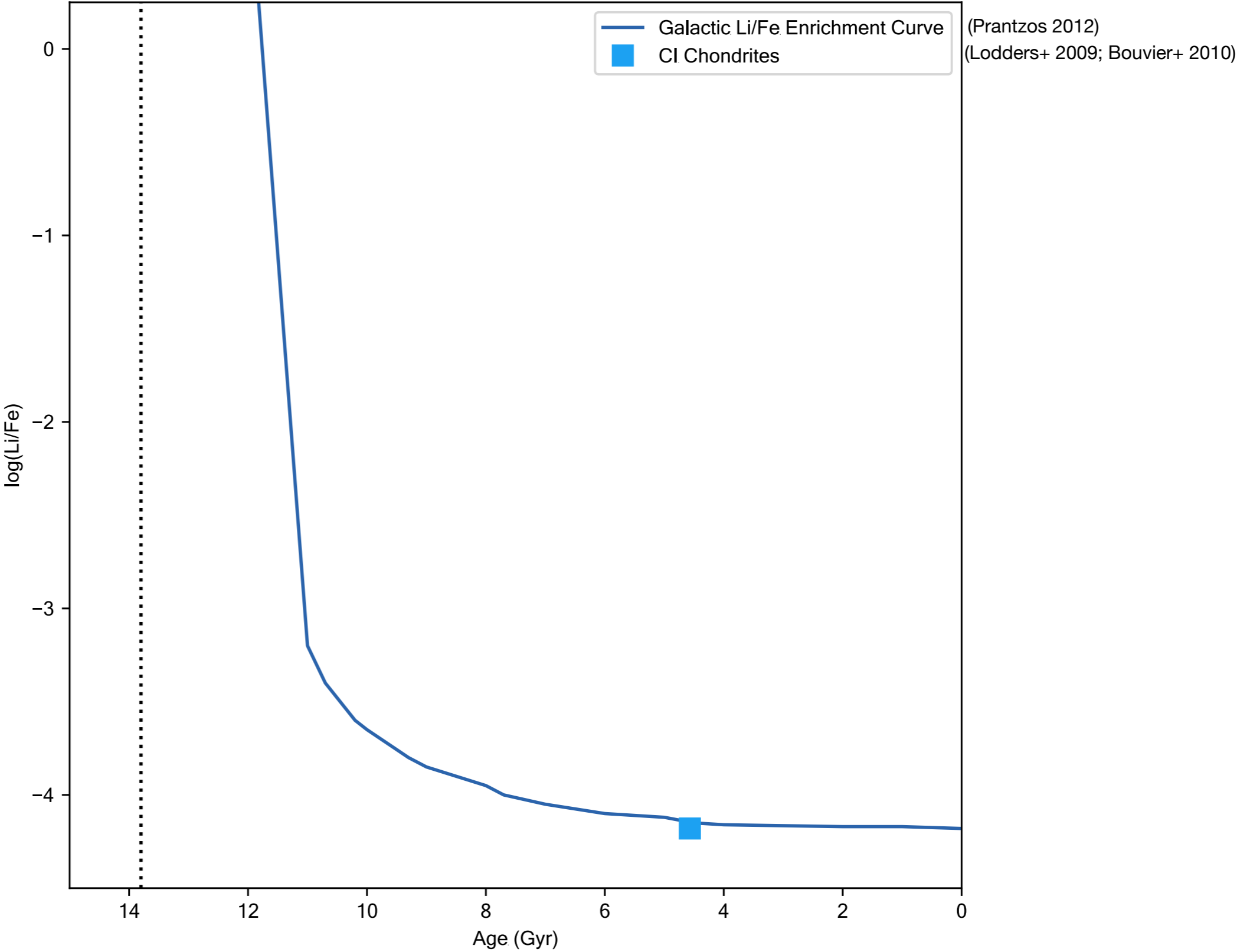
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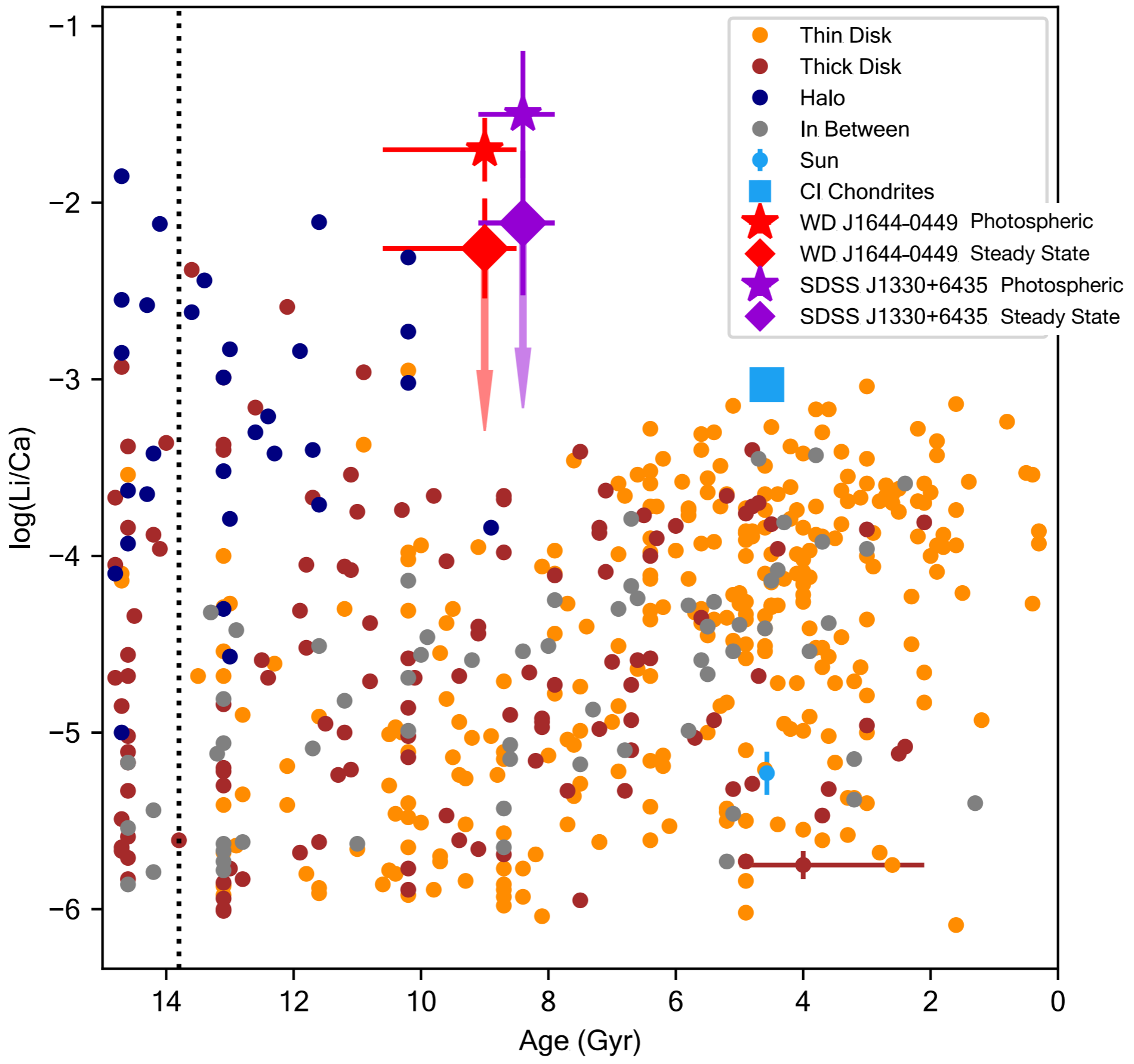
WD J1644-0449

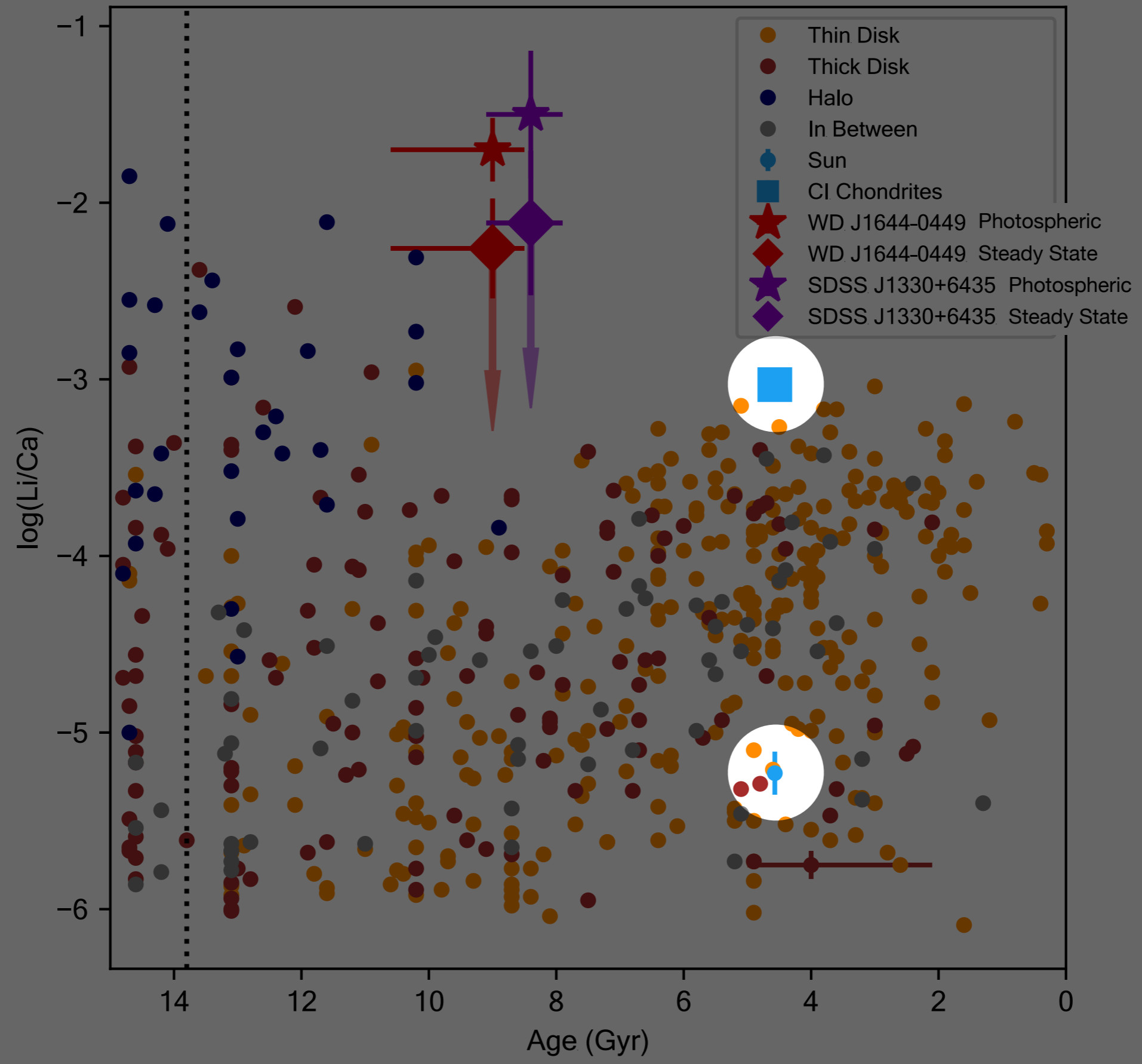




Galactic Li/Fe Expectation from Nucleosynthetic Modeling





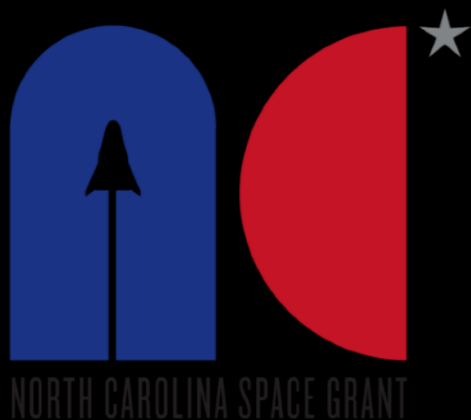


Hand-off to Mark

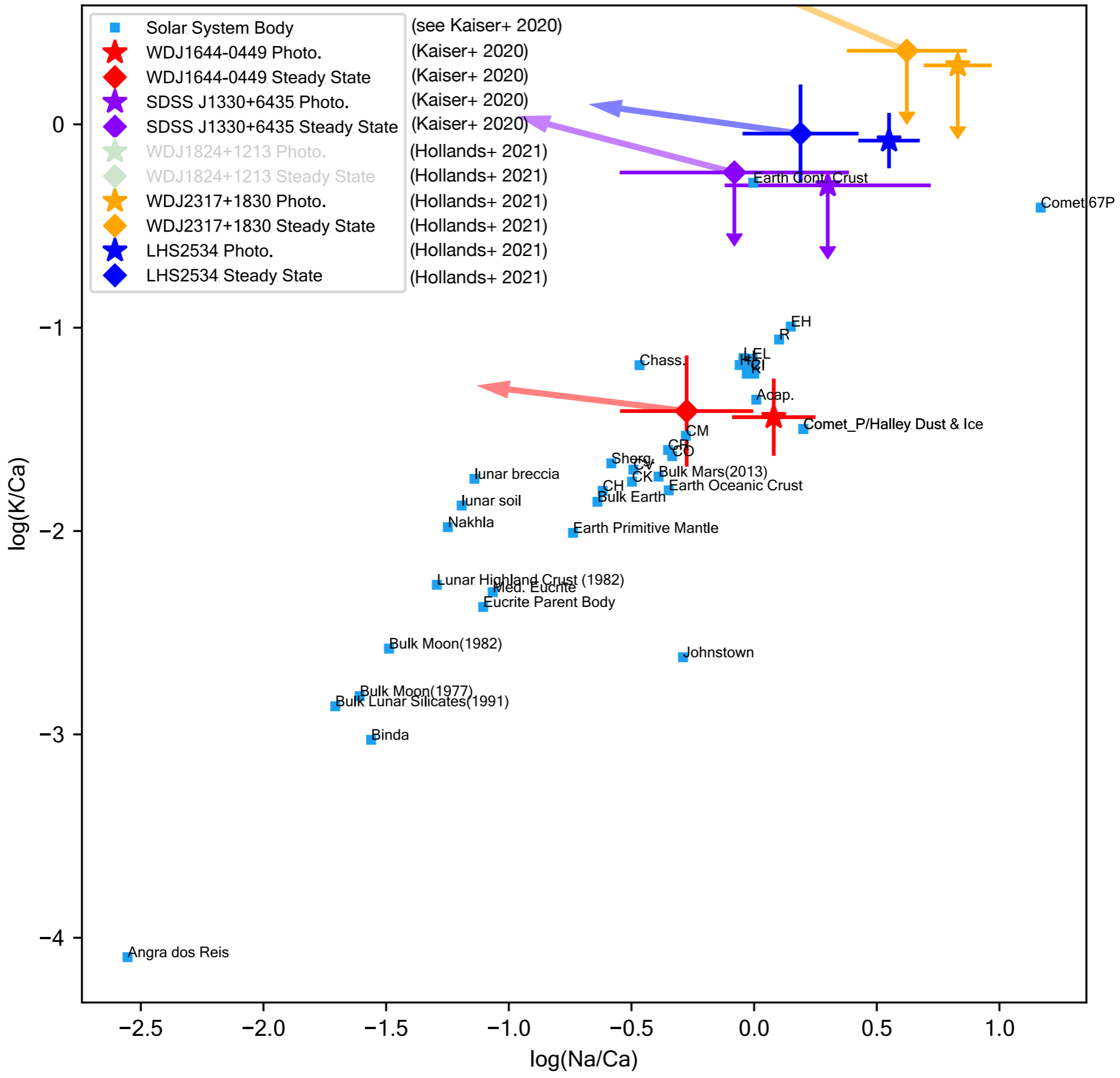
The detection of lithium in cool white dwarf atmospheres Part III

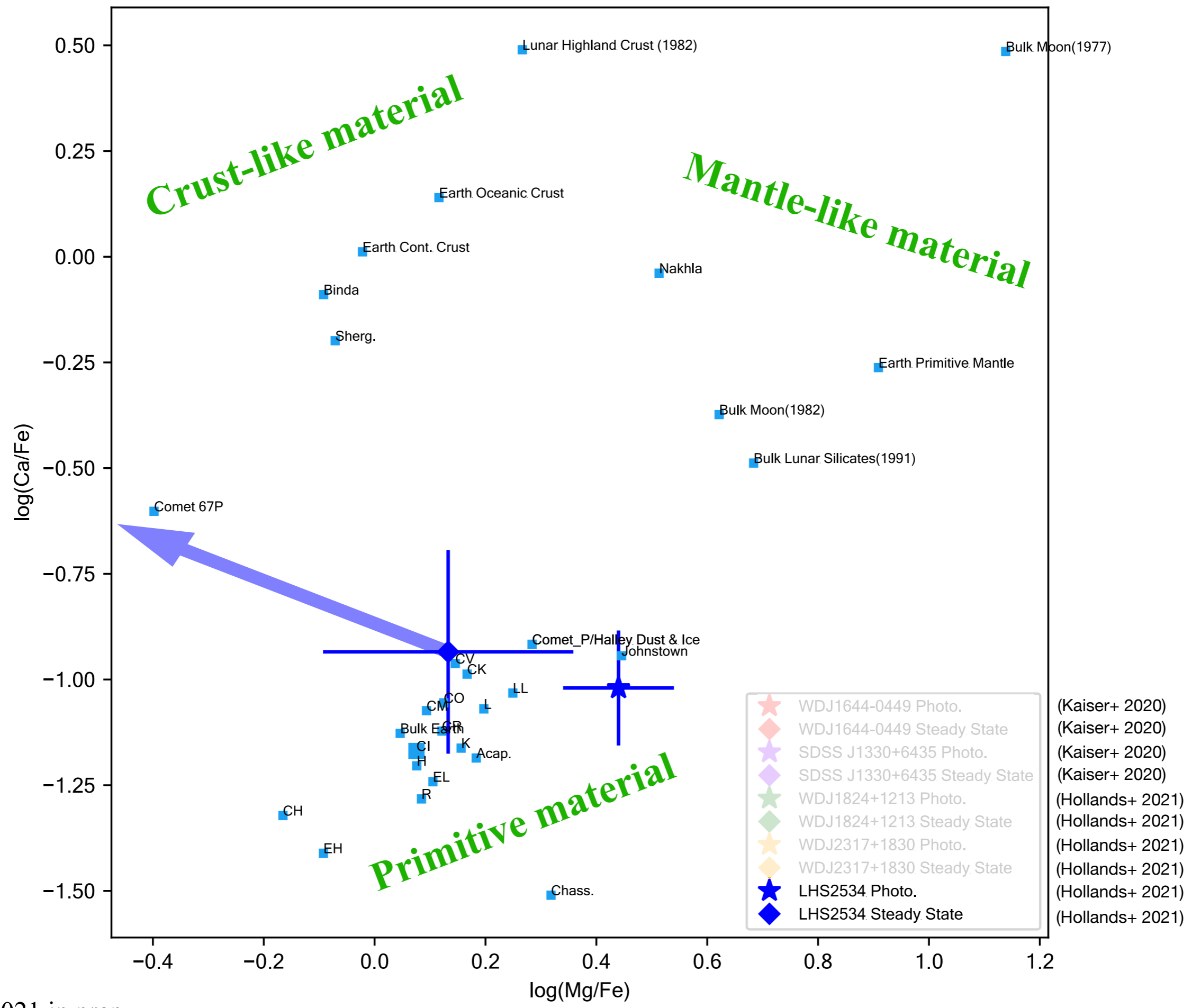
Benjamin C. Kaiser

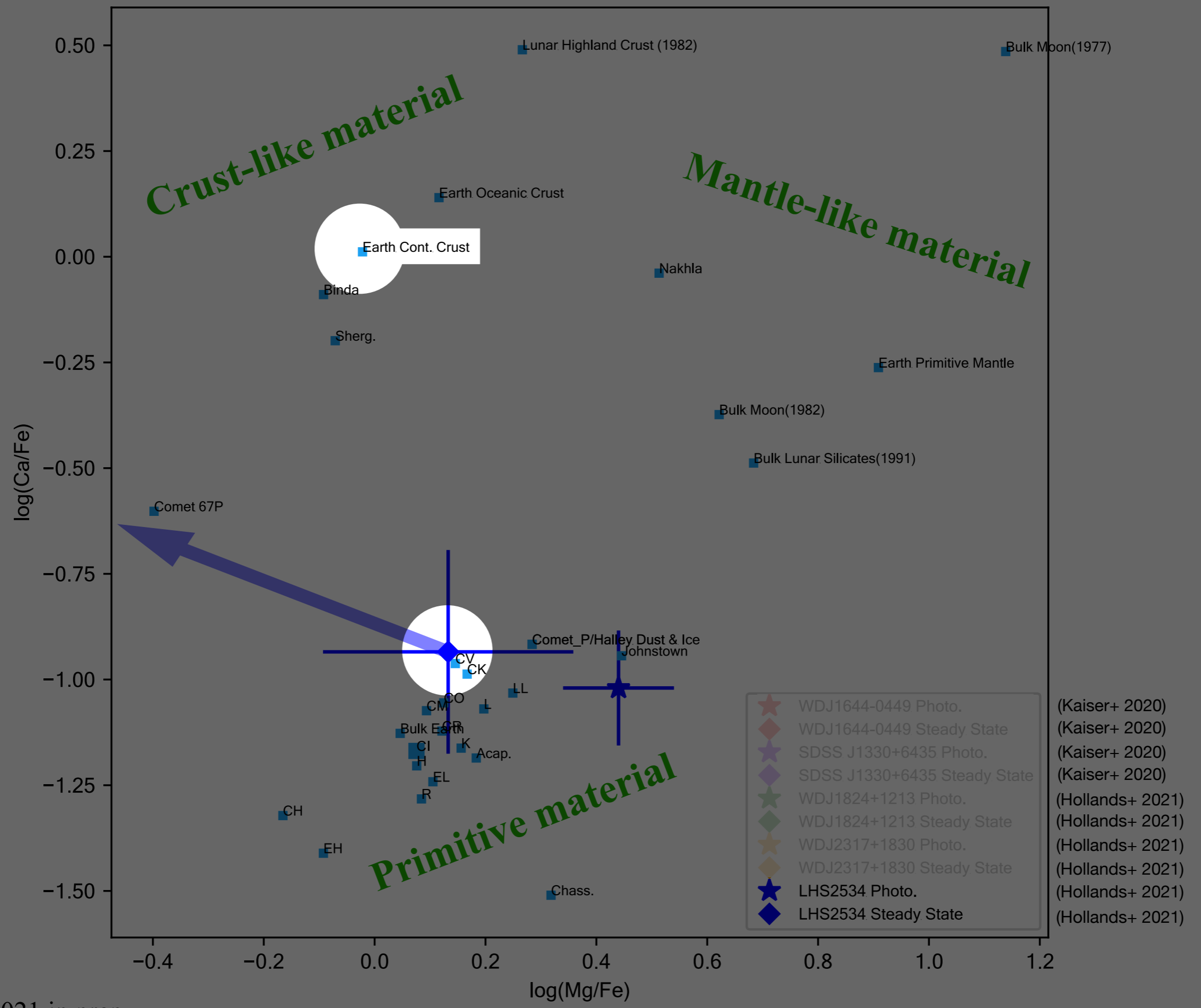
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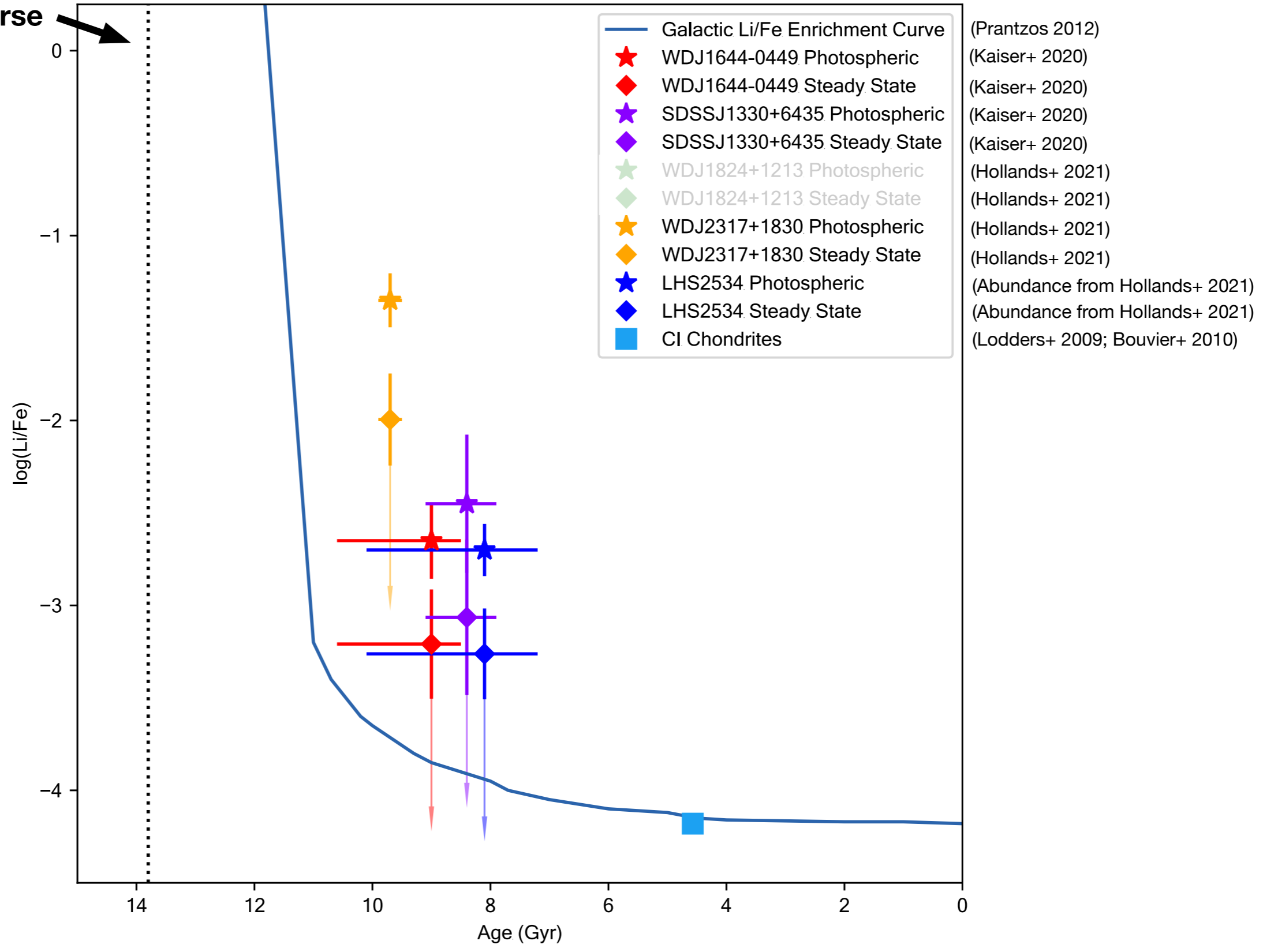
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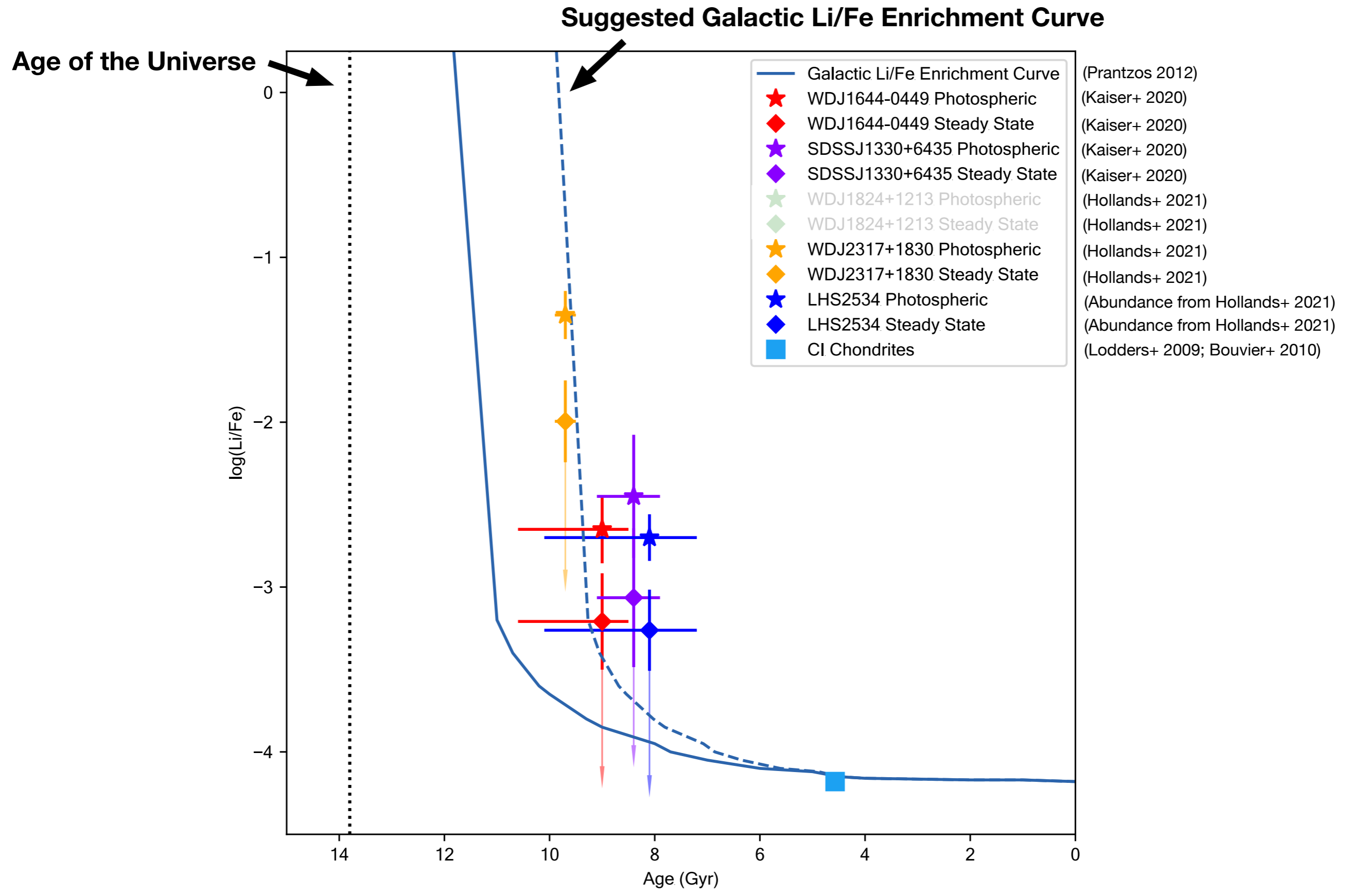






Age of the Universe



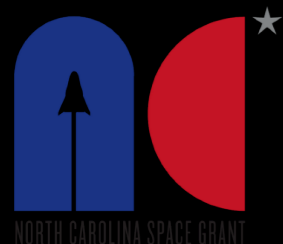


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The detection of lithium in cool white dwarf atmospheres – part 2



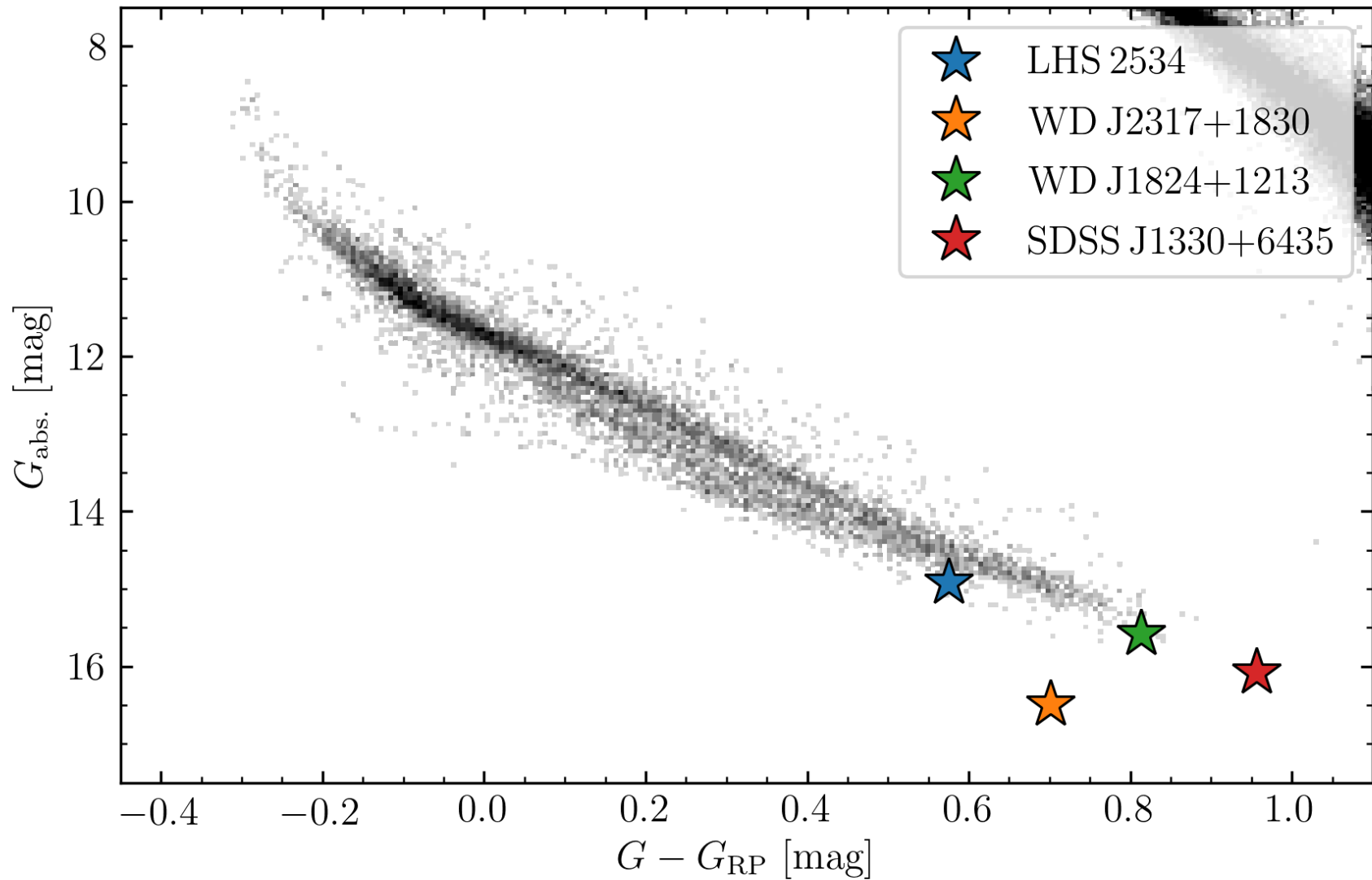
KITP meeting 2021-03-29



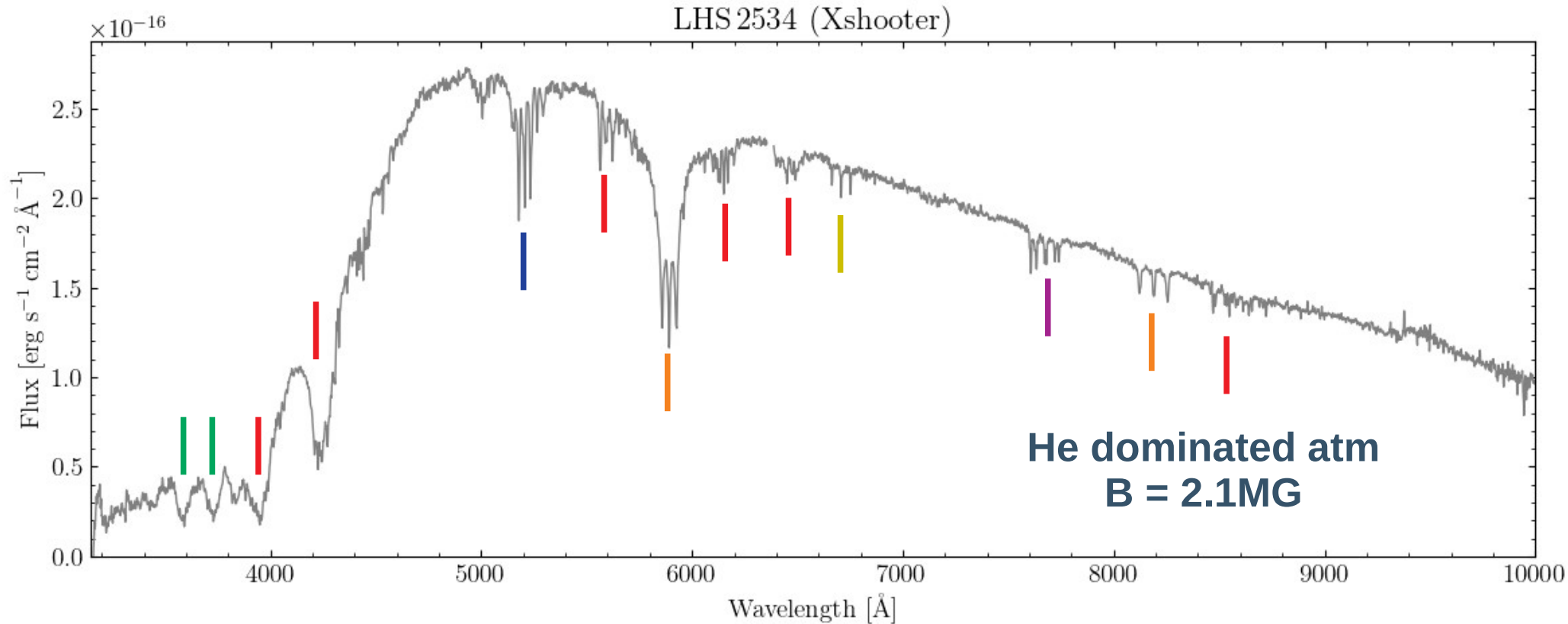
Mark Hollands, Pier-Emmanuel Tremblay, Boris Gänsicke, Detlev Koester, Nicola Gentile-Fusillo

Alkali metals in 4 DZ white dwarfs

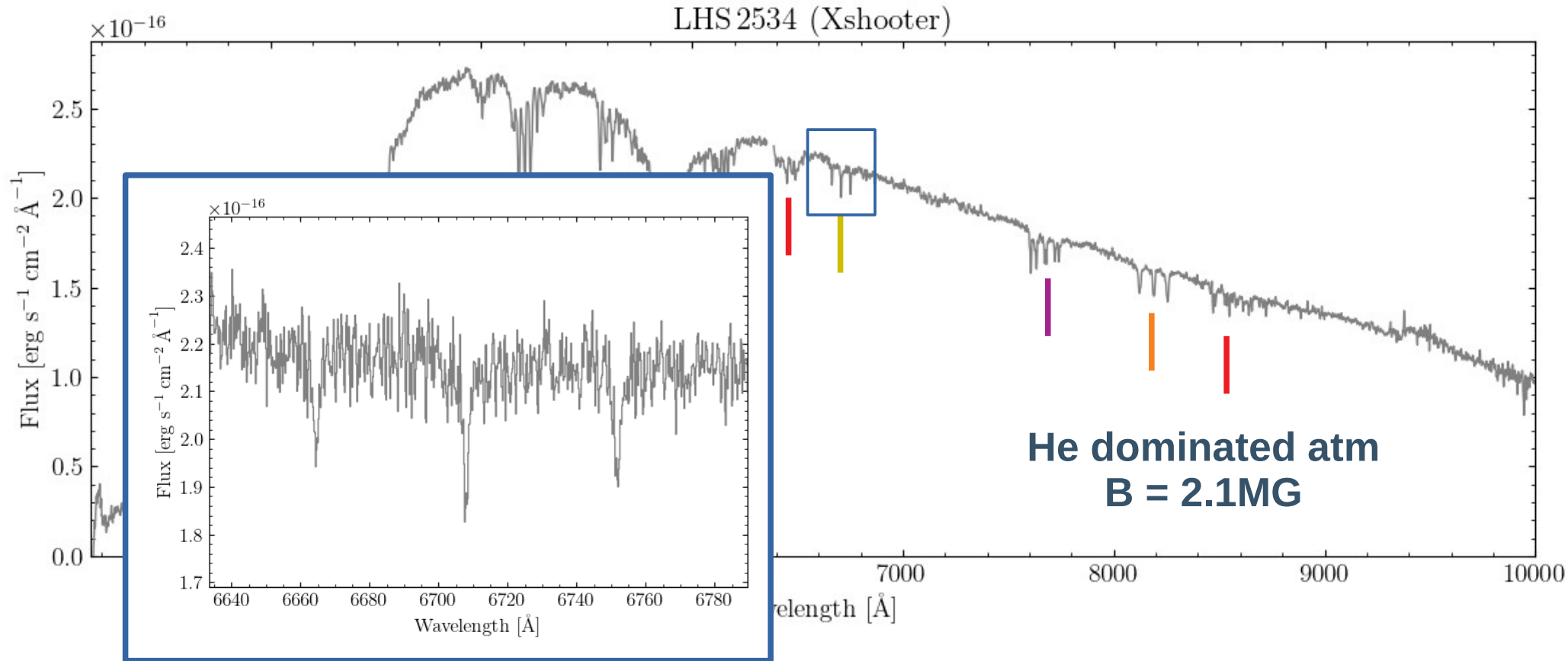
- Building sample of WDs within 40pc of the Sun
 - Tremblay et al., MNRAS 497, 130 (2020)
 - McCleery et al., MNRAS 499, 1890 (2020)
- Found **4 DZs** with **Li**, one with **K**
 - 1 object in common with Kaiser et al.
- T_{eff} 3500–5000 K (t_{cool} 6–10 Gyr)



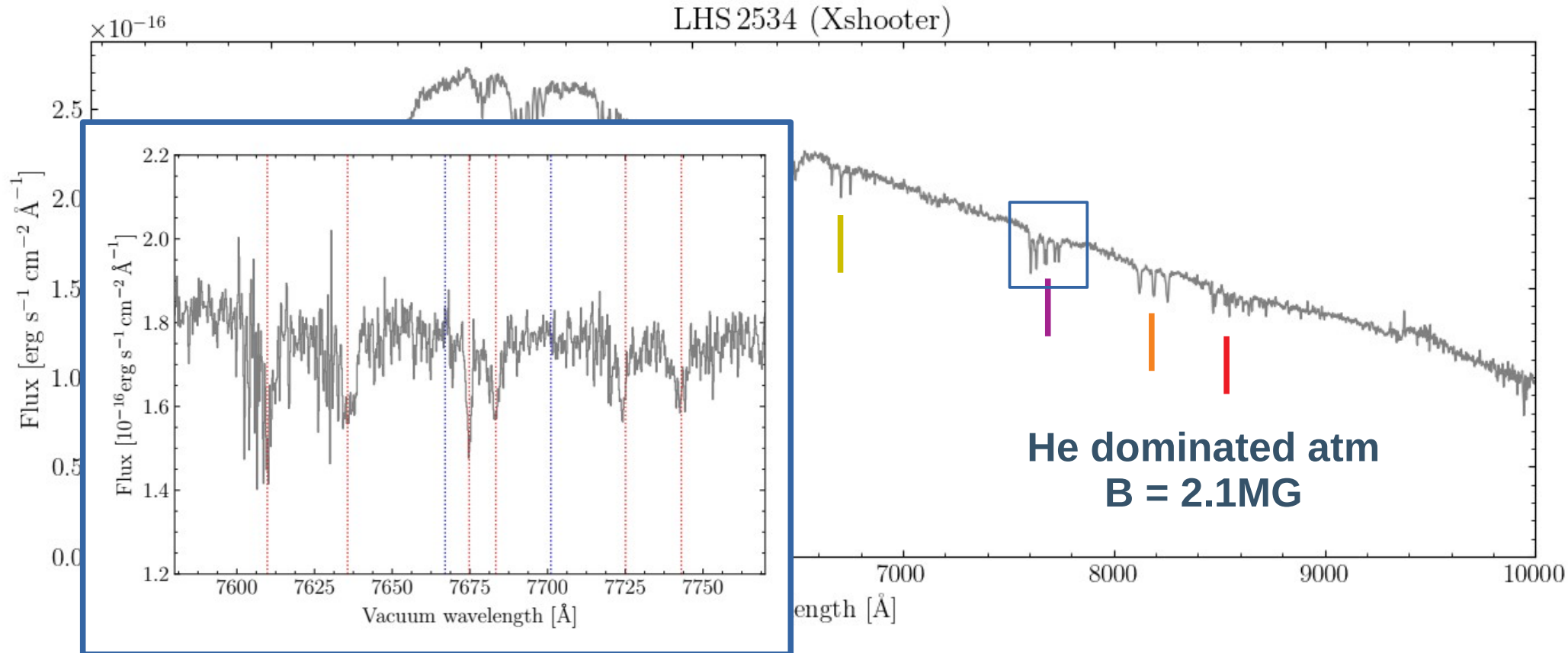
LHS 2534



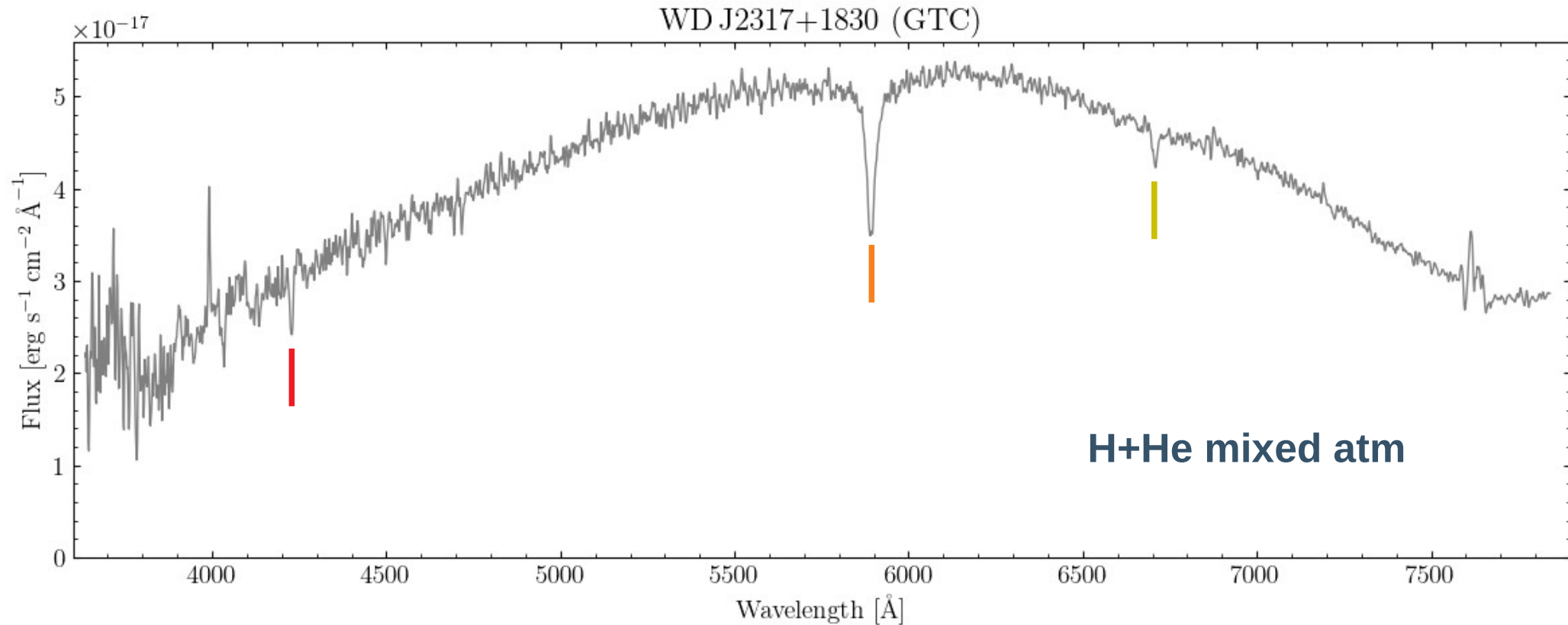
LHS 2534



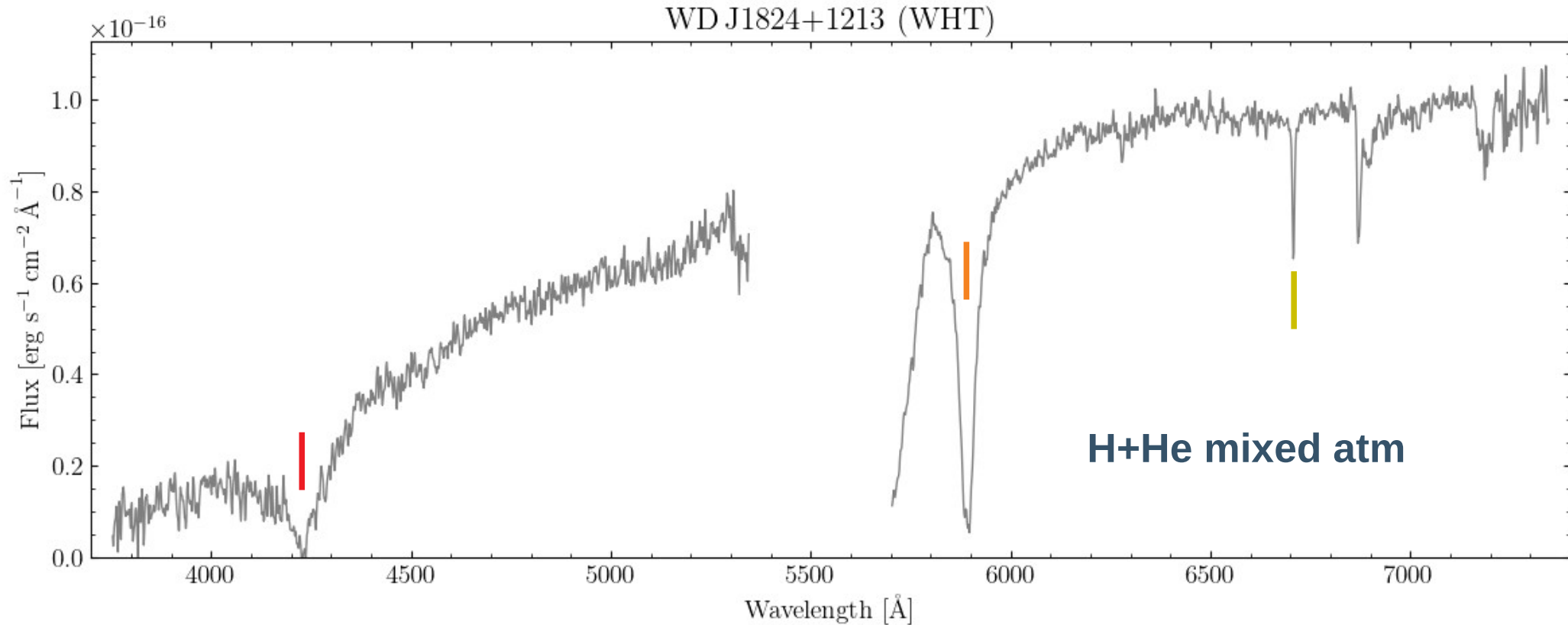
LHS 2534



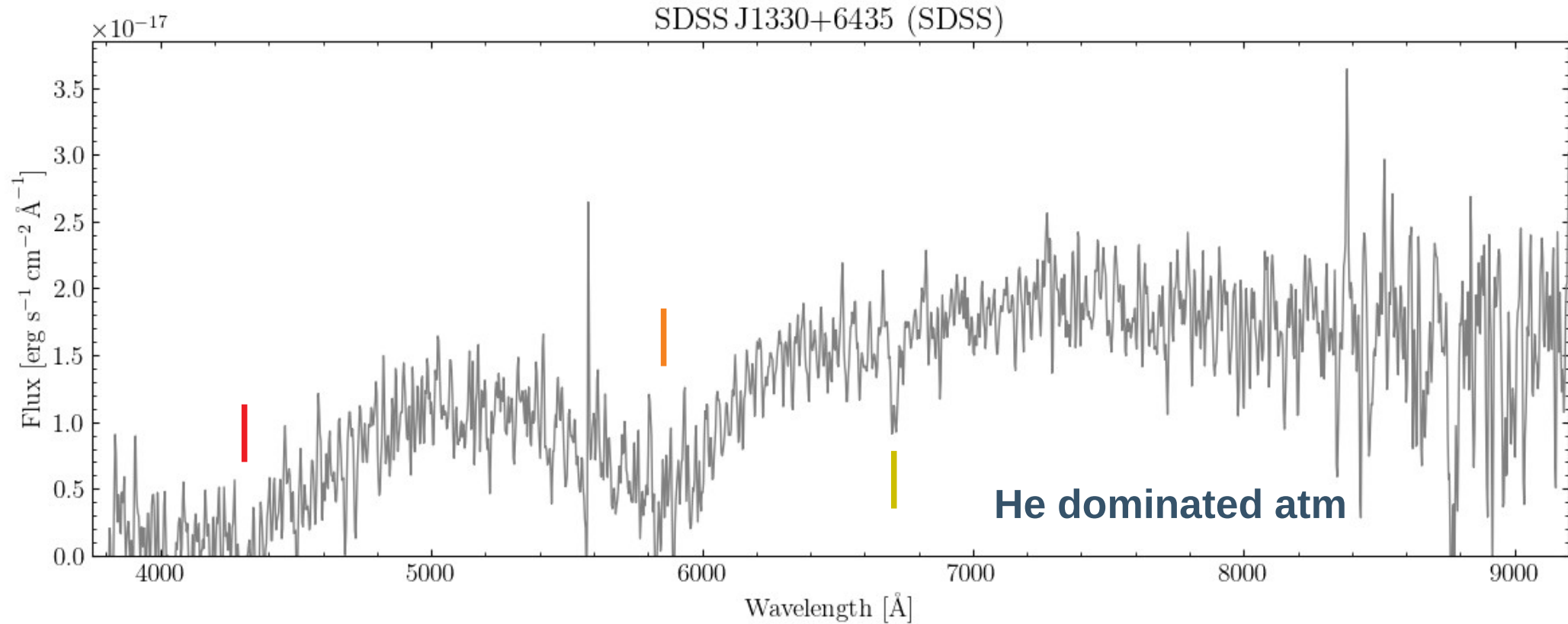
WD J2317+1830



WD J1824+1213

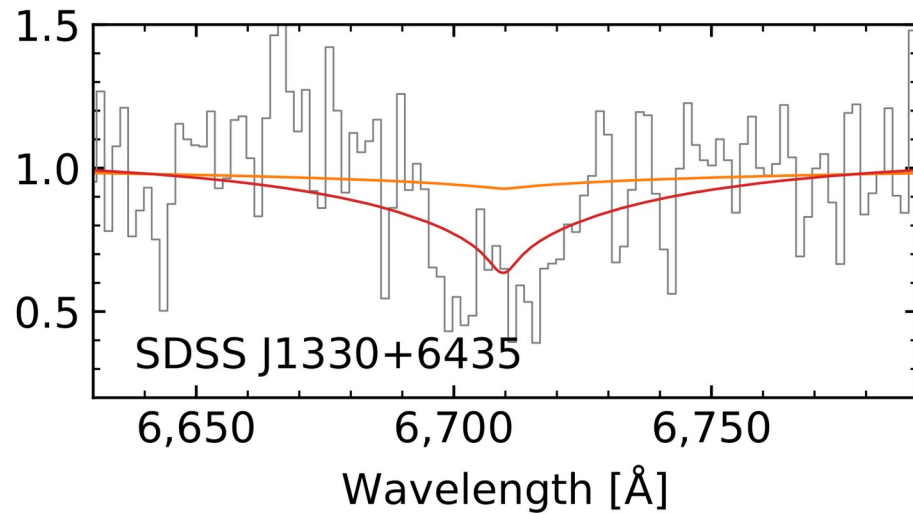
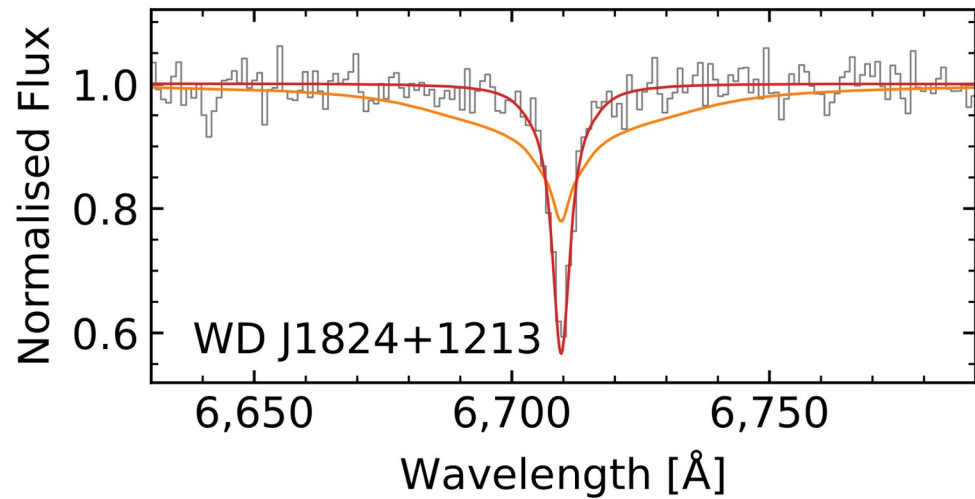
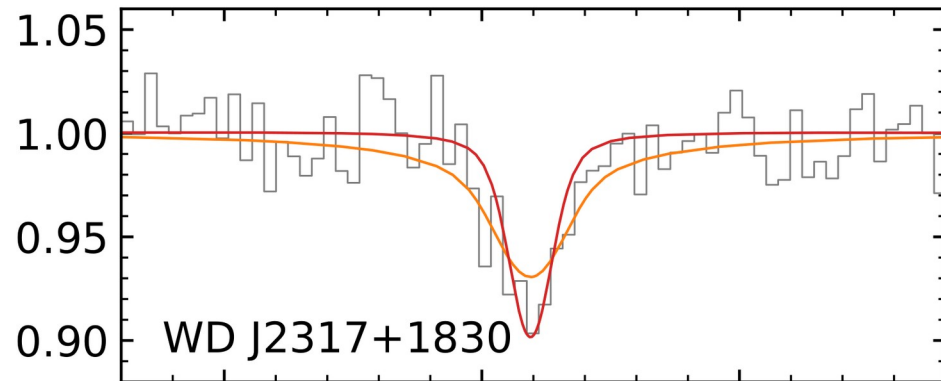
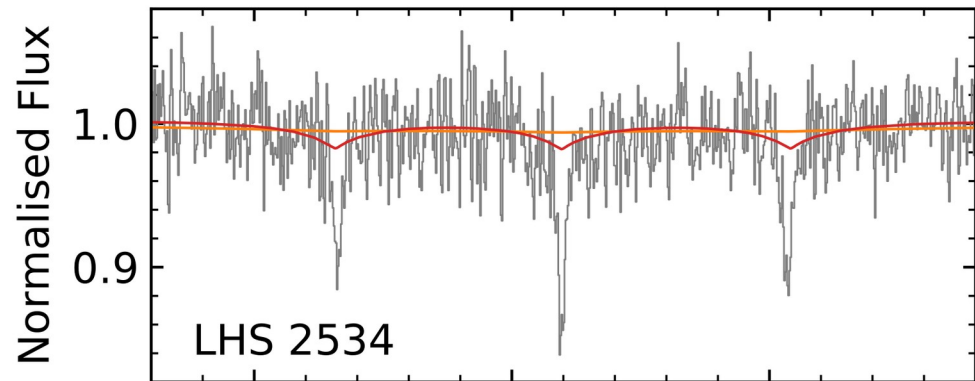


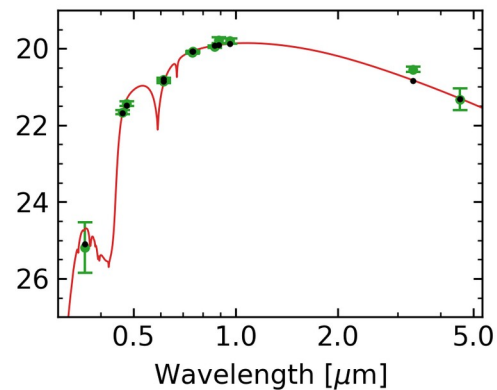
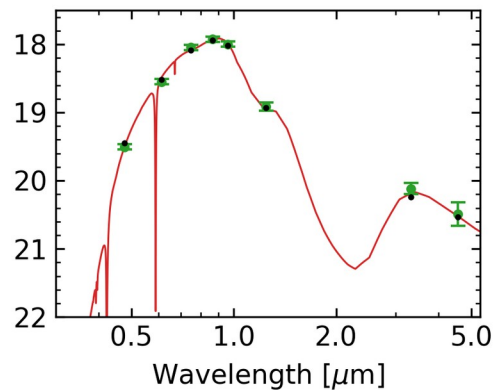
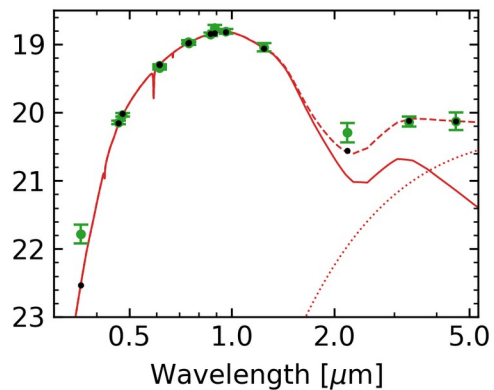
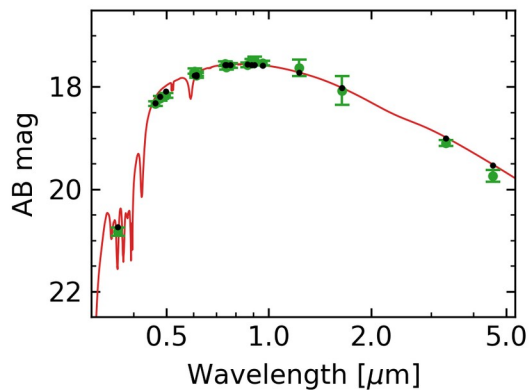
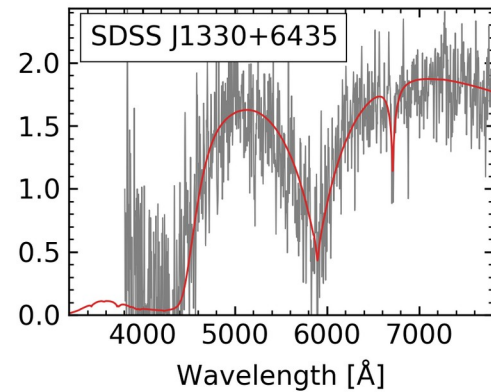
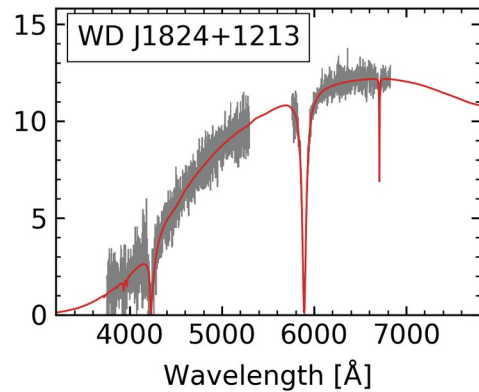
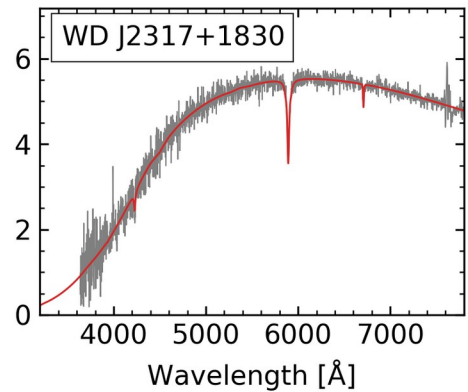
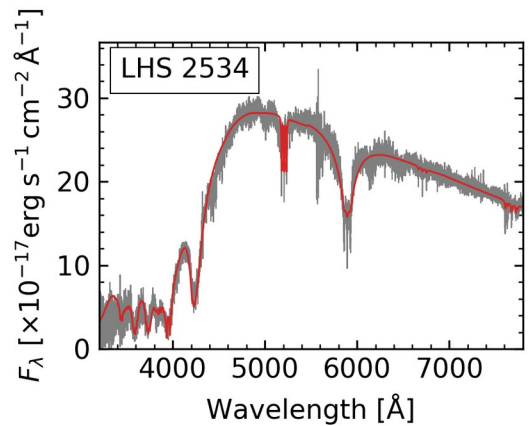
SDSS J1330+6435



Challenges in modelling

- Used Koester model atmospheres
- Objects all very cool (3500–5000K)
 - Very high densities in models
- Molecular opacities (i.e. CIA) v. important:
 - $\text{H}_2\text{-H}_2$, $\text{H}_2\text{-He}$, $\text{H}_2\text{-H}$, H-He , He-He-He
- Coolest WD masses too small
- Li line widths are weird...





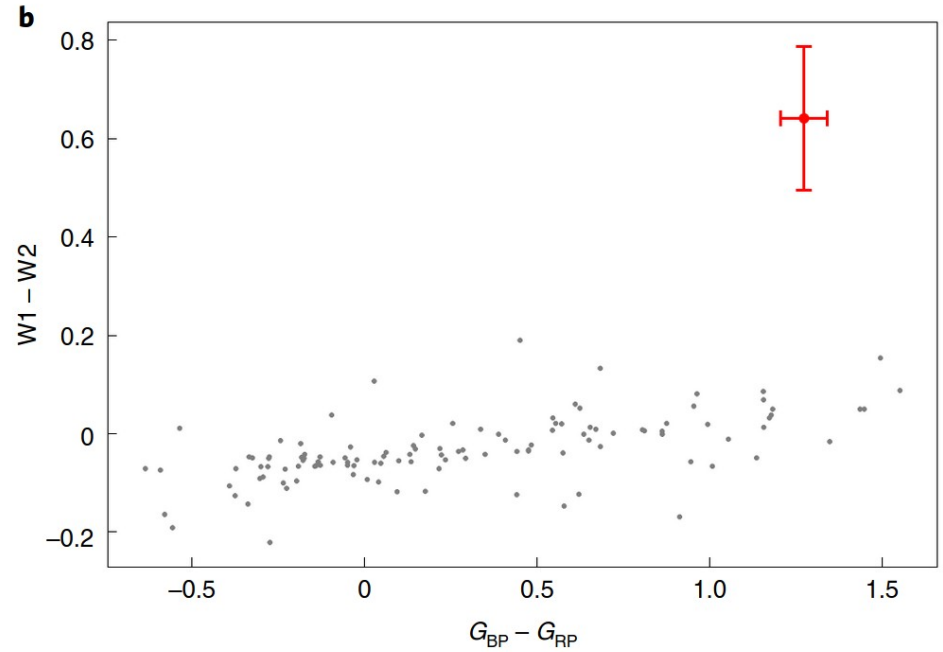
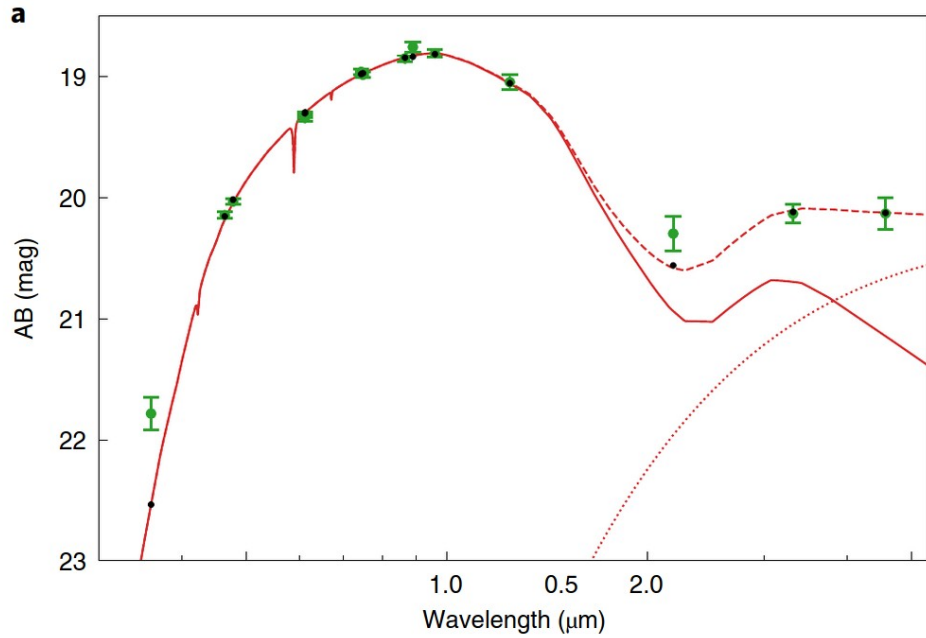
M=0.55 Msun 😊
Teff = 4780 K

M=1.00 Msun 😬
Teff = 4210 K

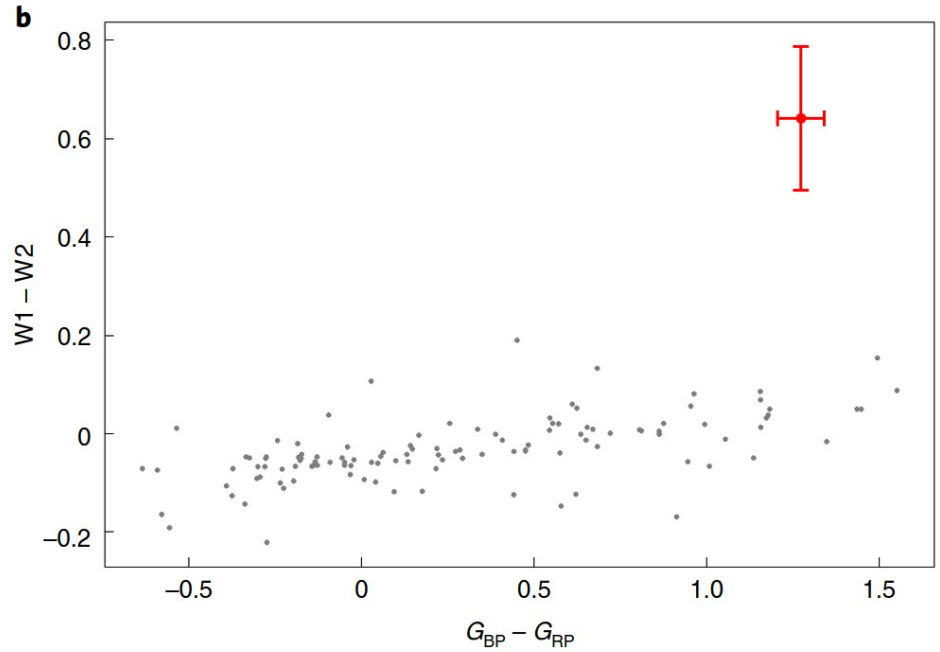
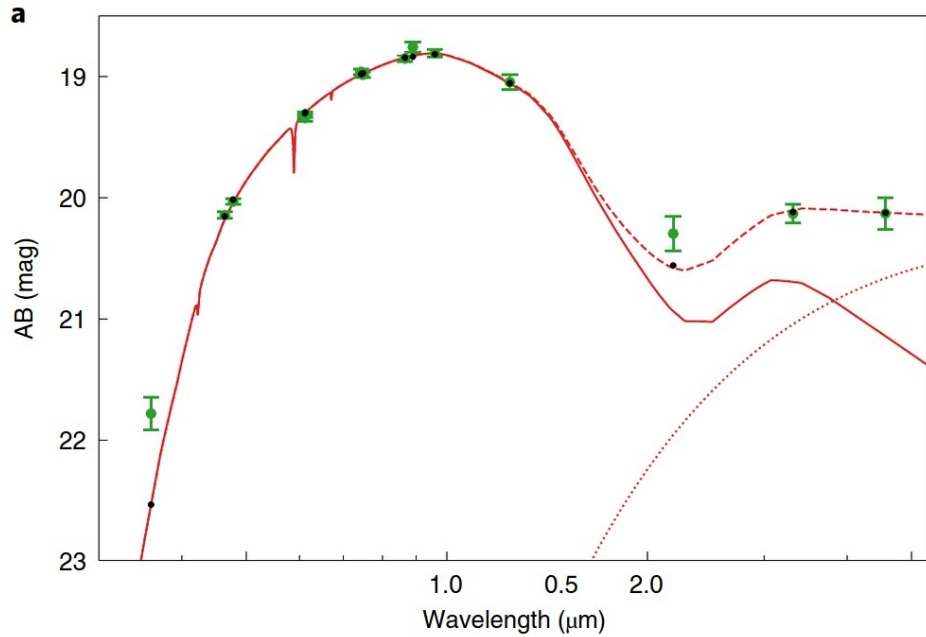
M=0.28 Msun 😬
Teff = 3350 K

M=0.38 Msun 😬
Teff = 3660 K

The oldest WD with a dusty disc



The oldest WD with a dusty disc



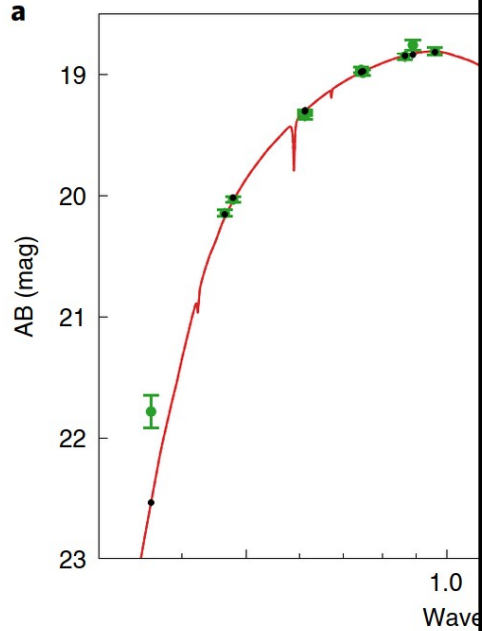
$$\log(M_{\text{cvz}}/M_{\text{wd}}) = -7.9$$

$$\tau_{\text{Na}} = 4000 \text{ yr}$$

$$\tau_{\text{Ca}} = 2000 \text{ yr}$$

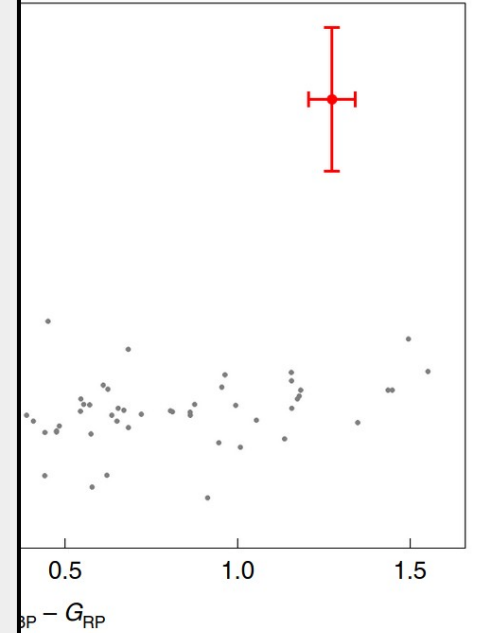
$$\tau_{\text{Li}} = 10,000 \text{ yr}$$

The oldest WD with a dusty disc



$\log(M_{\text{cvz}}/M_{\text{wd}})$

- $\dot{m}_{\text{Li}} = 760 \text{ g/s}$
- $\dot{m}_{\text{Na}} = 92,000 \text{ g/s}$
- $\dot{m}_{\text{Ca}} = 37,000 \text{ g/s}$
- $\dot{m}_{\text{crust}} \sim 3,000,000 \text{ g/s}$
(3 tonne/s)
- $t_{\text{cool}} = 9.5 \pm 0.2 \text{ Gyr}$



$\tau_{\text{Li}} = 2000 \text{ yr}$

$\tau_{\text{Li}} = 10,000 \text{ yr}$

Abundance analysis

