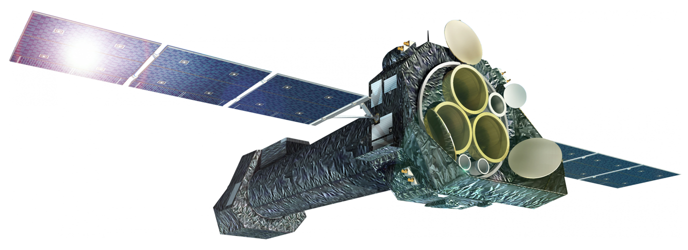

Non-solar chemical composition in the multiphase hot halo of Milky Way

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Introduction

The halo of Milky Way is known to be hot, extended, massive and anisotropic [1, 2, 3]. The halo is pictured as an isothermal sphere at $T = 10^{6.3}$ K, the virial temperature (fig. 1), and is assumed to have solar chemical composition. Shallow observations are unable to probe any finer thermal and chemical information.

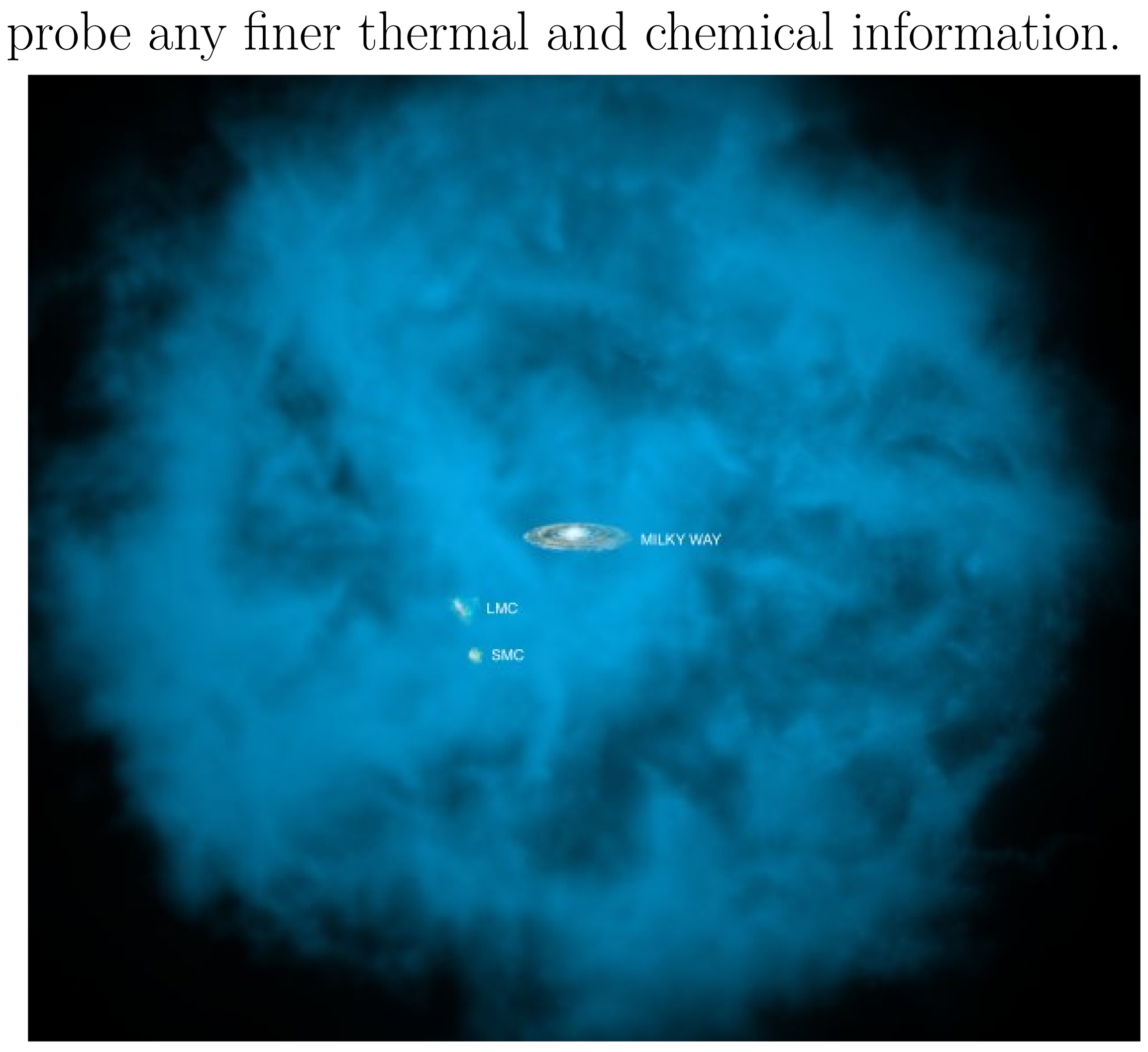

Figure 1:Hot gaseous halo of Milky Way [1] (`https://www.nasa.gov/mission_pages/chandra/multimedia/hot_gas_halo.html`)

Objective

Characterize the hot ($> 10^6$ K) halo of Milky Way using Ms long imaging spectra in emission and grating spectra in absorption

Summary

- **There are 3–4 discrete phases at $10^{5.8}$K $< T \leqslant 10^{7.4}$K coexisting in the halo of Milky Way [5].**
- **The abundance ratios in the hot halo of Milky Way are non-solar. This gives important insights into the chemical evolution of the Galaxy [4].**
- **The mass of the multiple temperature components and the non-solar chemical composition have great implications for missing baryons and missing metals.**

Future directions

Our Chandra archival proposal **to extend this study along many sightlines** has been accepted

Acknowledgements

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References

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[2] Gupta, A., Mathur, S. et al., 2014, Ap&SS, 352, 775
[3] Gupta, A., Mathur, S. & Krongold, Y., 2017, ApJ, 836, 243
[4] **Das, S., Mathur, S. et al. 2019, ApJL, 882, L23**
[5] **Das, S., Mathur, S. et al. 2019, ApJ, in press**

Result-I: The hot halo of Milky Way is NOT a single phase [5]

We analyze **deep (t_{exp} = 1.85 Ms) *XMM-Newton* spectra** toward and around the blazar 1ES 1553+113 **probing the hot Milky Way halo in absorption and emission with unprecedented sensitivity.**

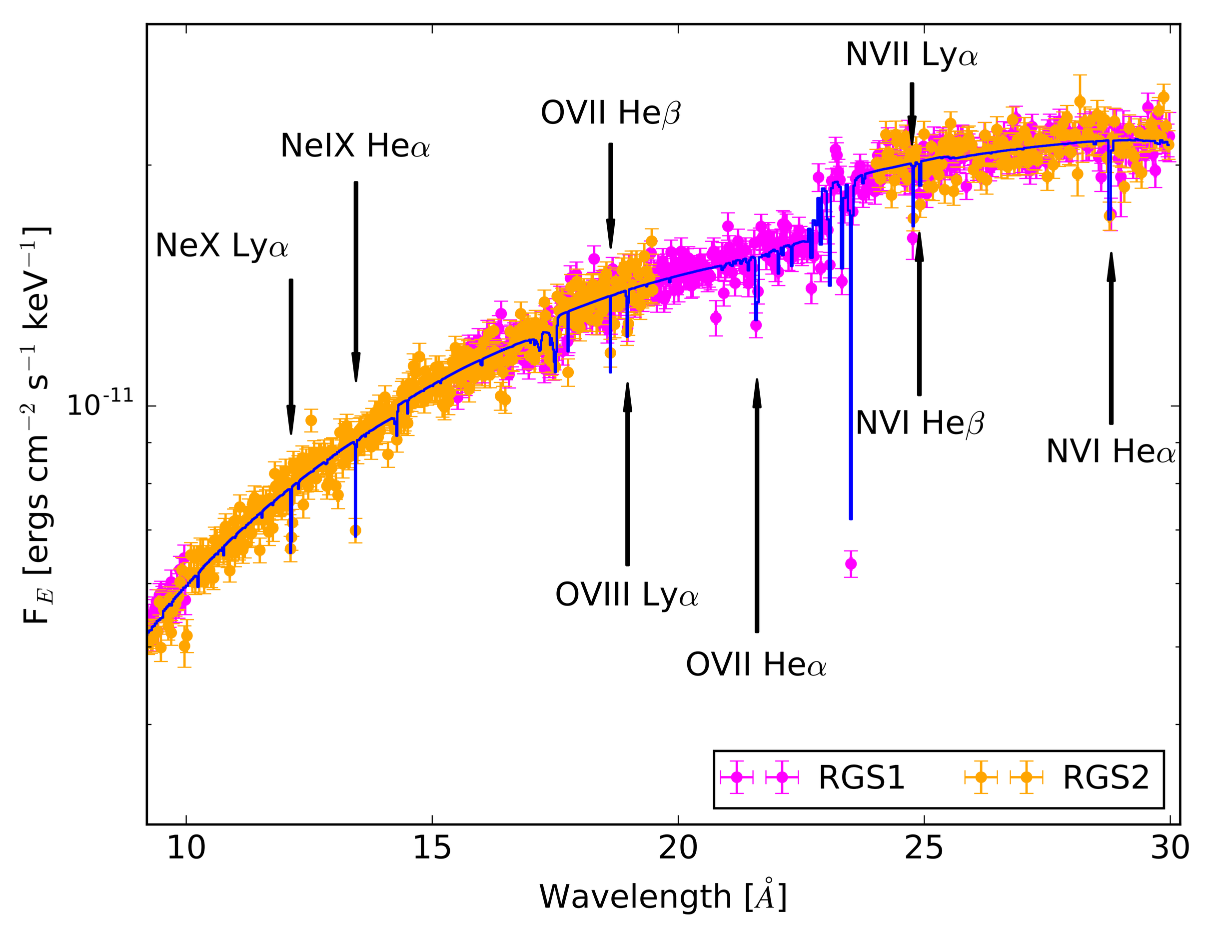

Figure 2:The unfolded spectra of 1ES 1553+113 with the absorption features from the Milky Way halo, and the best-fit model with **two halo components:** T=$10^{6.07-6.13}$K and T=$10^{6.96-7.15}$K.

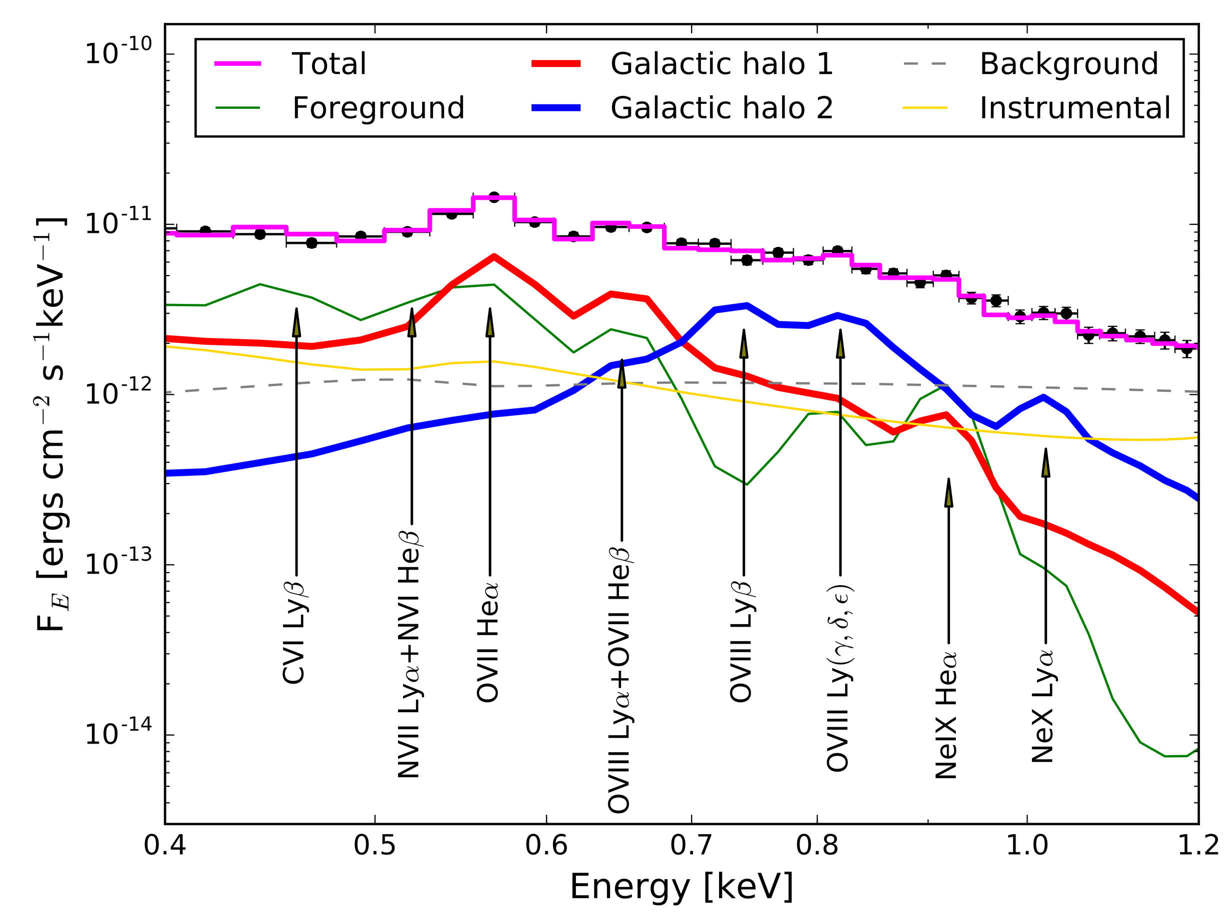

Figure 3:The emission spectra around the sightline toward 1ES 1553+113, and the best-fit model with **two halo components:** T=$10^{6.25-6.42}$K and T=$10^{6.68-6.92}$K.

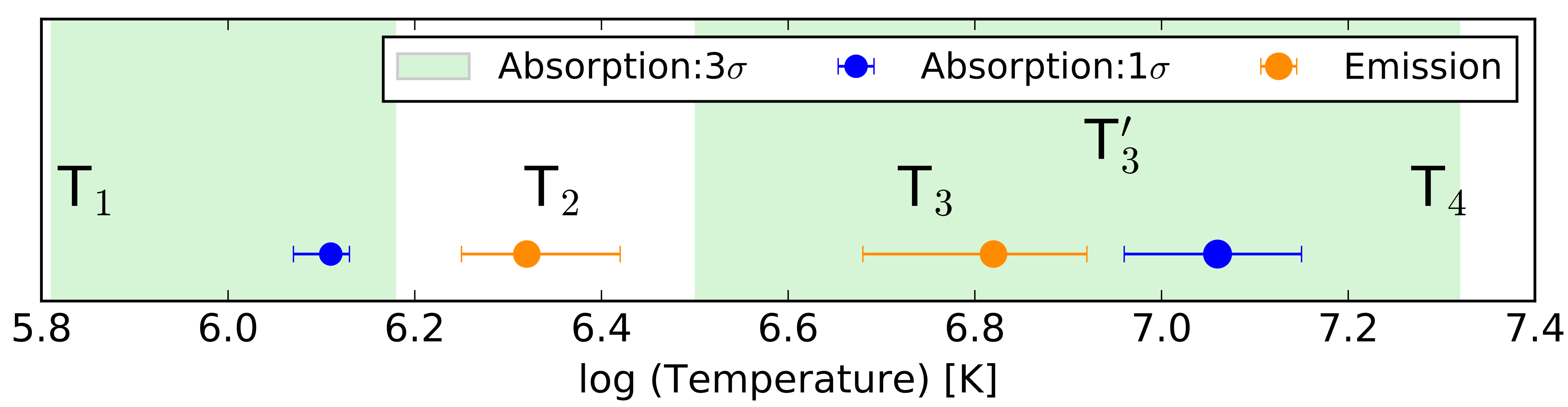

Figure 4:Multiple temperature components in the hot halo of Milky Way [5]

Result-II: The abundance ratios in the hot halo are NOT solar [4]

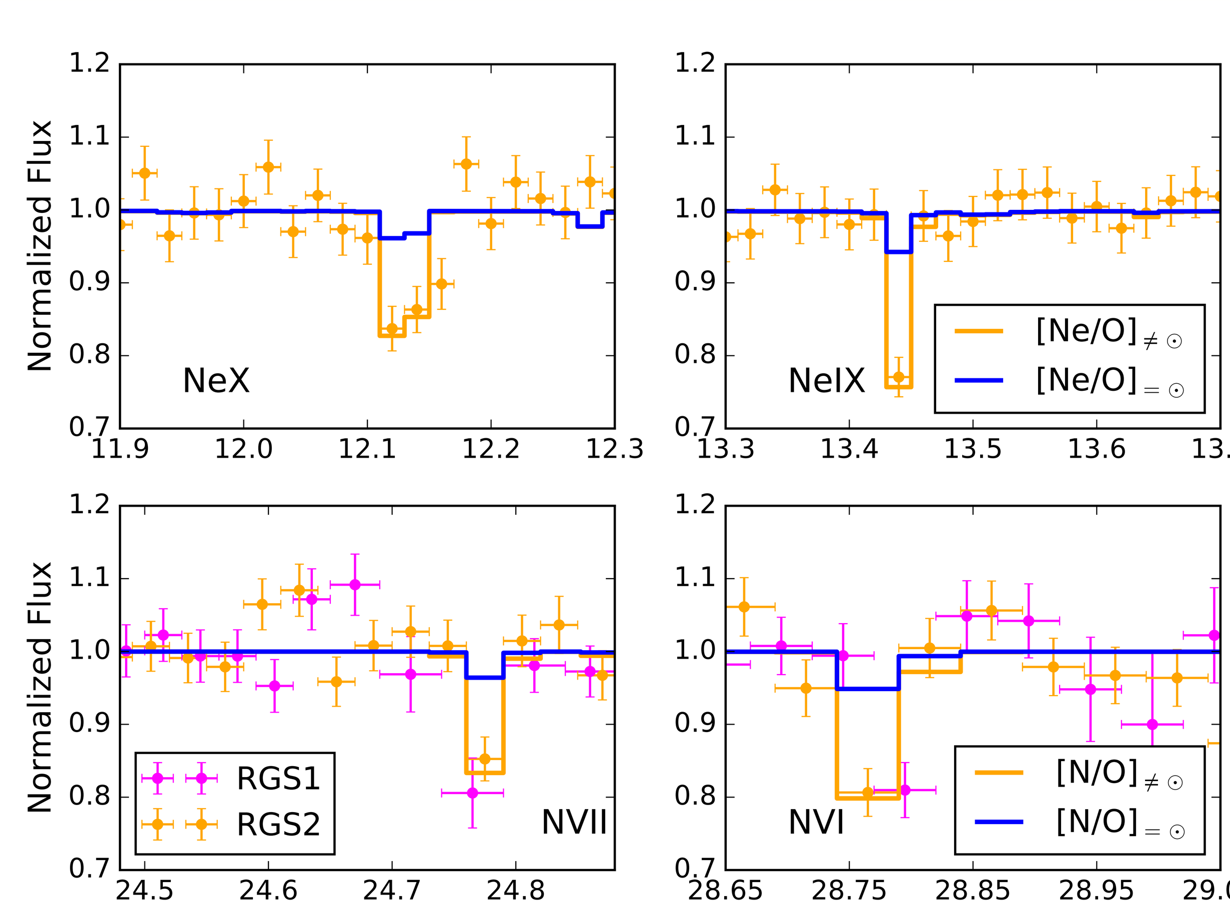

Figure 5:The absorption lines of the detected neon and nitrogen lines for the best-fit non-solar (yellow lines) vs. solar (blue lines) abundance ratios relative to oxygen.

- **[Ne/O] and [N/O] are super-solar, and [Ne/N] is solar**: [Ne/O]=[N/O]=$0.7^{+1.6}_{-0.2}$ (>99.73% confidence). This implies a) Type-II Supernovae enrichment, b) AGB stars enrichment, c) oxygen's efficient cooling and depletion onto dust.

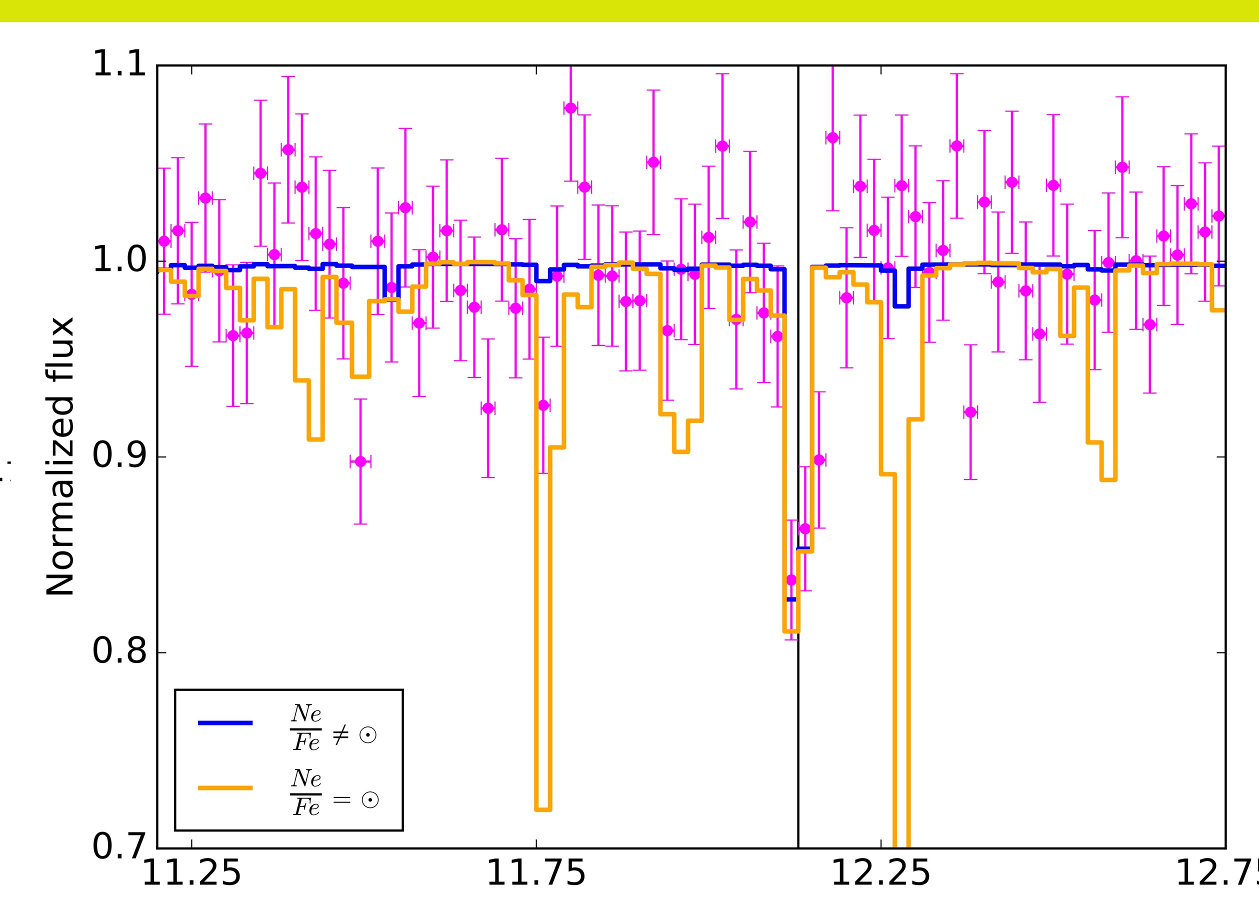

Figure 6:The absorption profile for the solar [Ne/Fe] (yellow lines) vs. the best-fit non-solar [Ne/Fe] (blue lines). The vertical black line at 12.13 Å corresponds to Ne X Ly-α line.

- **[Ne/Fe] is super-solar**: [Ne/Fe] = $1.6^{+1.2}_{-0.4}$ (>99.73% confidence). **[O/Fe]** = $0.9^{+0.7}_{-0.3}$ (>99.73% confidence) **is super-solar** too. This indicates α-enhancement, and possible depletion of iron onto interstellar and/or circumgalactic dust.