Analysis of a polluted DAZ white dwarf with high metal abundances

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As main sequence stars evolve into white dwarfs, we expect the outer planets and other bodies in the system to survive evaporation by or engulfment into the giant branch star. White dwarf atmospheres are primarily H/He, and so the detection of metals in their spectra is a sign of pollution from the accretion of planetary material. By analysing the photospheric abundances and comparing them to Solar System benchmarks – for example, bulk Earth, mantle or crust compositions, or individual asteroid families – we are able to determine the composition of extrasolar planetary bodies, which in turn provides crucially important information on the formation and evolution of planets.

We present the analysis of WD J0358+2157, a cool and strongly polluted DAZ white dwarf with strong lines of Mg, Al, Si, Ca, Ti, and V. We fitted Koester atmosphere models [1] to the X-Shooter spectra and photometric data of the star using MCMC methods to determine $T_{\rm eff}$, $\log g$ and detailed metal abundances. So far we have estimated these to be $T_{\rm eff} \simeq 6500\,{\rm K}$, $\log g \simeq 8.15$, and overall metal abundance [Ca/H] $\simeq -7.6$. We conclude that WD J0358+2157 is the most heavily polluted cool DAZ, currently accreting planetary debris at a high rate – as such, it is the first equivalent to the large sample of strongly polluted cool helium atmosphere white dwarfs (e.g. [2]) which have very long ($\simeq 10^6\,{\rm yr}$) diffusion timescales compared to hydrogen atmospheres, and so have most likely finished the accretion episode.

References

[1] Koester, D. White dwarf spectra and atmosphere models, *Memorie della Societa Astronomica Italiana*, vol. 81, pp. 921931, 2010.

[2] Hollands, M. et al., Cool dz white dwarfsi. identification and spectral analysis, *Monthly Notices of the Royal Astronomical Society*, vol. 467, no. 4, pp. 49705000, 2017.