Serendipitous discovery of a dusty disk around a DAZ white dwarf

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Abstract

We have found a dusty disk around a white dwarf, confirmed with an infrared (IR) excess in the photometry and absorption metal lines in its optical spectrum. We present here the results of a blackbody model to the IR excess and the debris composition estimation. The accreted material is similar to the bulk Earth composition, suggesting the possibility that a rocky Earth-like planet was tidally destroyed into forming the dusty disk around this white dwarf.

Context

- ★ White dwarfs (WD) photospheres should only show spectral lines of H (for a DA WD spectral type) or He (DB WD), as due to their high surface gravities, heavier elements are diffused from the convective envelope to the interior in timescales much shorter than the WD's cooling time.

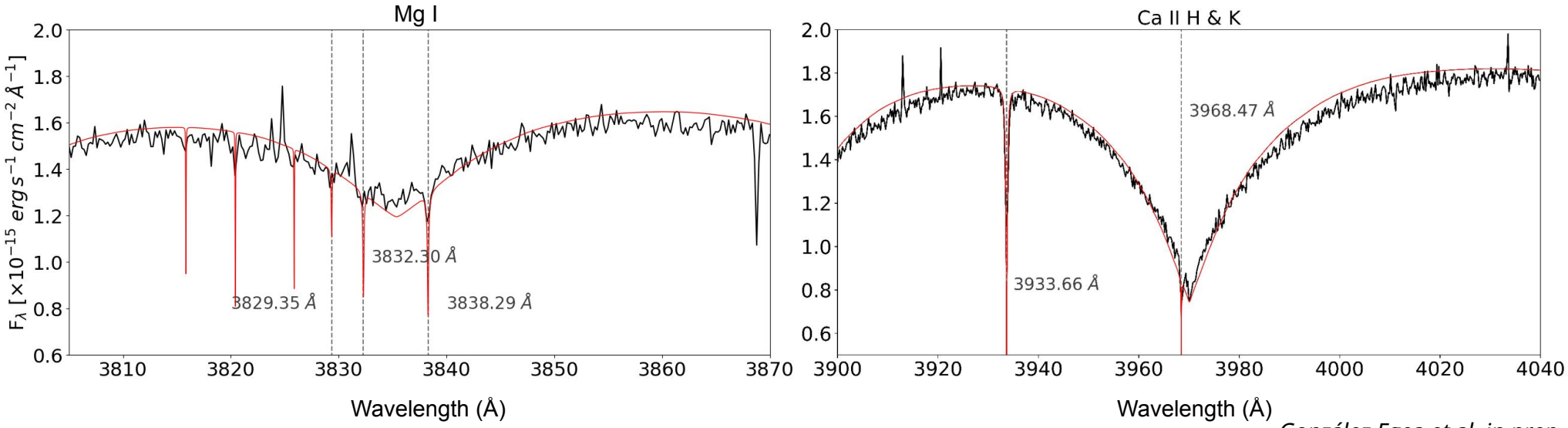
- ★ Atmospheric metal lines in the WD spectrum (DAZ, DBZ or DZ WD spectral type), accompanied by IR excess in some cases), are evidence of exoplanetary material around WDs, that is accreted into the WD from a circumstellar disk of dust and debris.

- ★ The current widely accepted explanation for the creation of disks around WD is the so-called asteroid disruption model, introduced by Jura et al. (2003). In this model, either a large asteroid or several small ones are tidally destroyed when entering the Roche region of the white dwarf, forming an opaque flat ring or rings of dust with an extension of less than 1 solar radius, in a Saturn's rings alike system. This scenario includes also the possibility of planetesimals or any other exoplanetary material to be the parent bodies of these disks.

- ★ Thus, the analysis of the metal lines and disks found in white dwarfs can give us unique information about compositions of terrestrial exoplanets. The dust composition is in many cases consistent with carbon-deficient and rocky material, likely similar to the material of the inner Solar System.

Discovery and observations

★ We present the serendipitous discovery of metal absorption lines (see figure below) when analyzing a X-shooter spectrum of a WD from a sample of WD + ultracool dwarf candidates.



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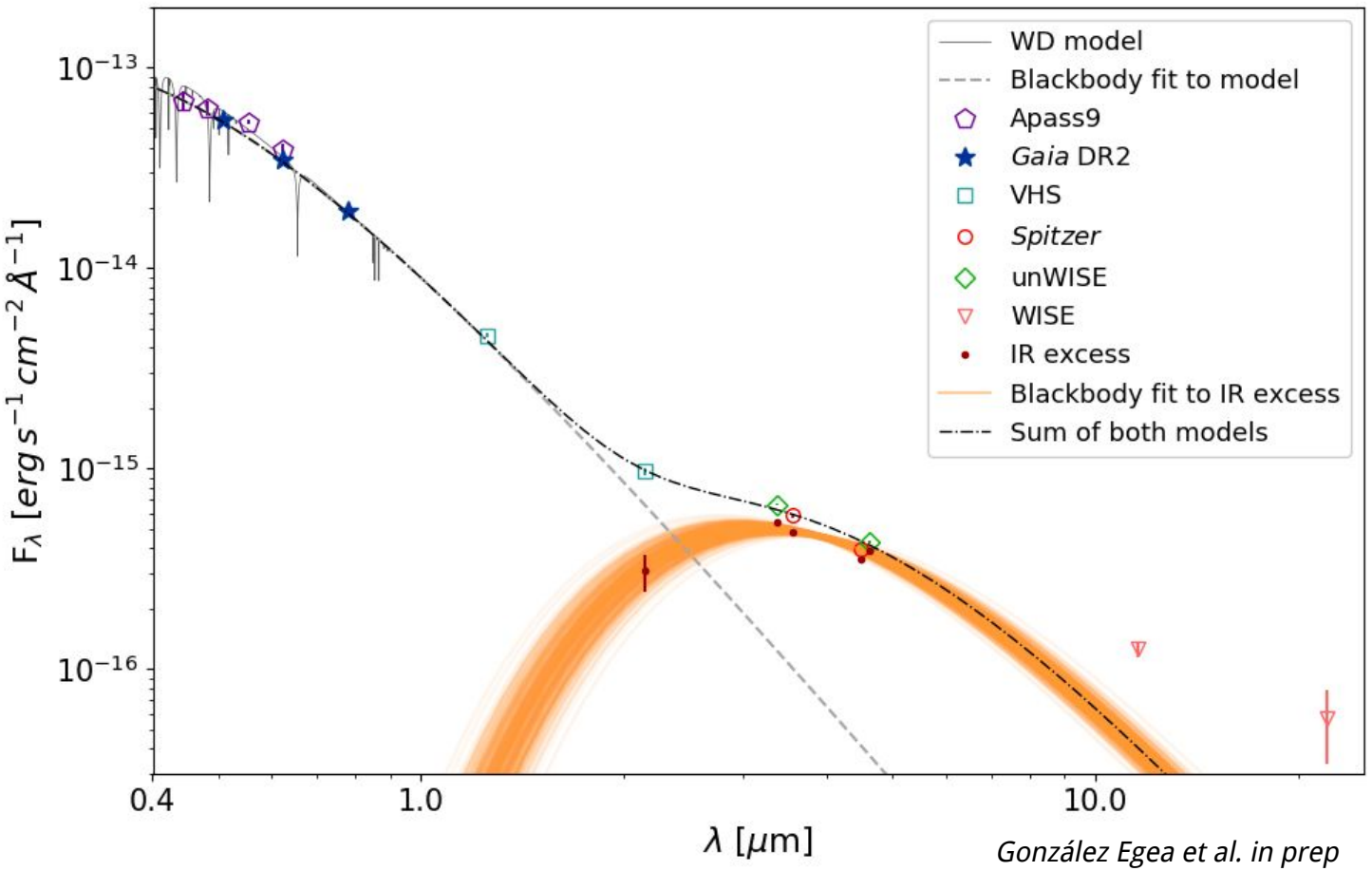
★ This finding was accompanied with a strong IR excess in VHS, un*WISE* and *Spitzer* photometries.

Results

- ★ A blackbody model to the IR excess gives an effective temperature of 915±50 K to the circumstellar disk (see figure to the right).
- ★ The dusty disk is among the brightest and coldest ones detected with *Spitzer.*



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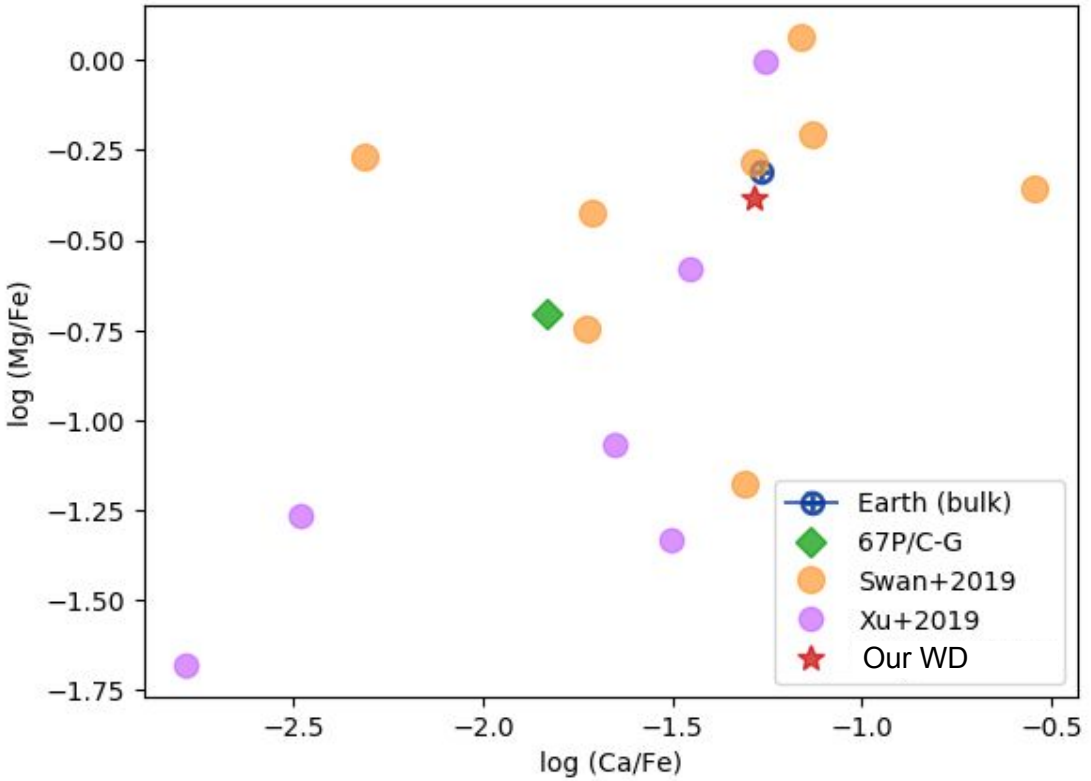
In the figure, WISE fluxes are much larger than the rest of the IR excess due to background contamination. unWISE and Spitzer photometries are de-blended..

Impact

- ★ The total accretion flux estimated for this object is higher than the average for DAZd WDs.

- ★ Abundance analysis gives a composition similar to the bulk Earth (see figure to the right).



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