White dwarfs with infrared excess within 100 pc: Gaia and the Virtual Observatory

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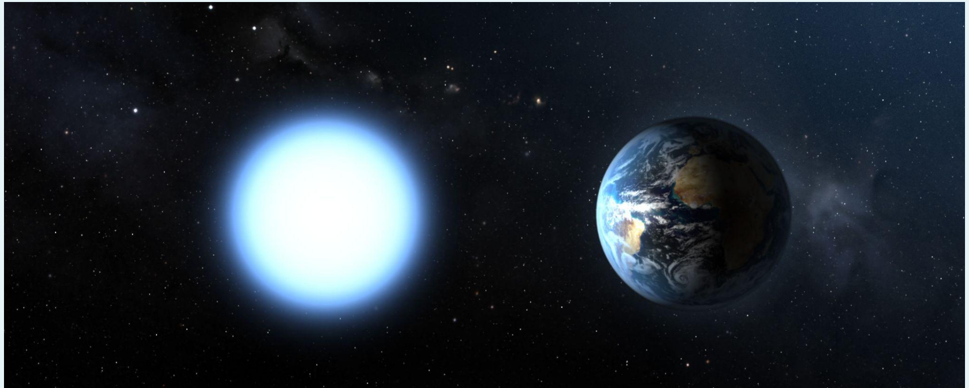
What are white dwarfs?

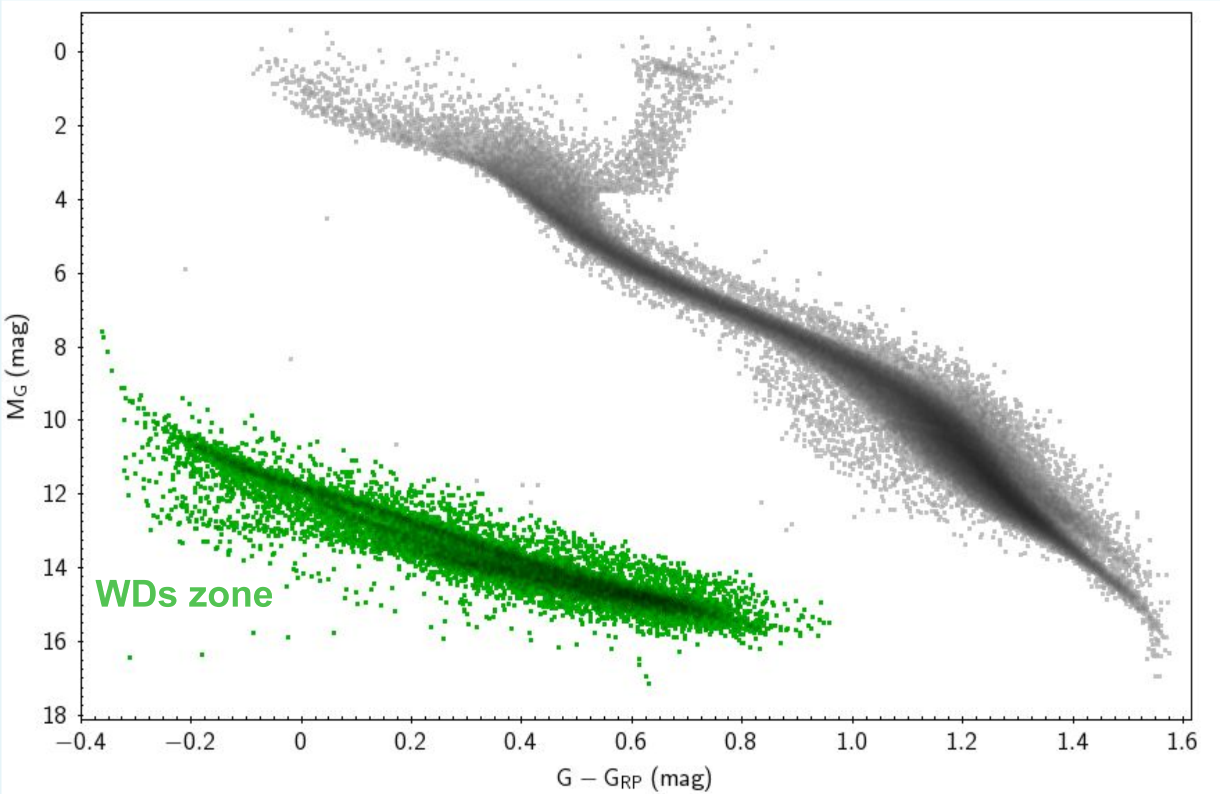
White dwarfs (WDs) are stellar remnants of low and intermediate mass stars, as the Sun. Therefore, WDs are one of the most common objects in the Galaxy.

WDs are compact objects, with typical masses around half a solar mass and planetary sizes.


ARTIST'S IMPRESSION OF THE SIZES OF SIRIUS B AND THE EARTH. Credits: ESA and NASA

Recently, and thanks to Gaia data, the number of WDs has gone from few thousands to several hundreds of thousands. Now we can study different types of WDs in the Galaxy, such as WDs with debris disks or substellar companions.

Hertzsprung-Russell Diagram



My PhD thesis

The final goal is to identify and characterise white dwarfs with substellar companions.
To do this, we need:

- To look for WDs with infrared flux excess (without contamination).
- To determine the cause of the excess: circumstellar dust disk, substellar companion, etc.
- To characterise both WDs and companions.
- To create a WD with substellar companion catalogue.
- To study the most interesting and peculiar sources.

Initial sample: 100 pc catalogue

This work aimed at identifying nearby (< 100 pc) WDs with infrared excess.

We used the data of the so far most complete volume-limited WD sample built from Gaia DR3 (Jiménez-Esteban et al. 2023). We also used archive data.

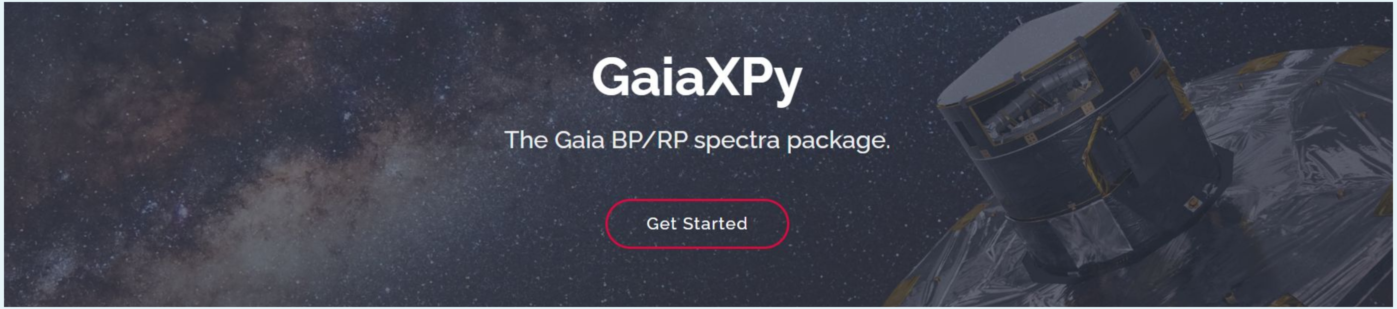
We applied the same method as in Rebassa-Mansergas et al. 2019 to identify the infrared excesses.

The work is based on Gaia DR3 and the Virtual Observatory (VO) methodology (public archive data and VO tools such as VOSA and Aladin).

Optical photometry

We used the **GaiaXPy** tool to generate the **J-PAS synthetic photometry** of the WD candidates with spectroscopic information in Gaia DR3.

We built the spectral energy distributions (**SEDs**) with the J-PAS reliable photometry with at least three photometric points.

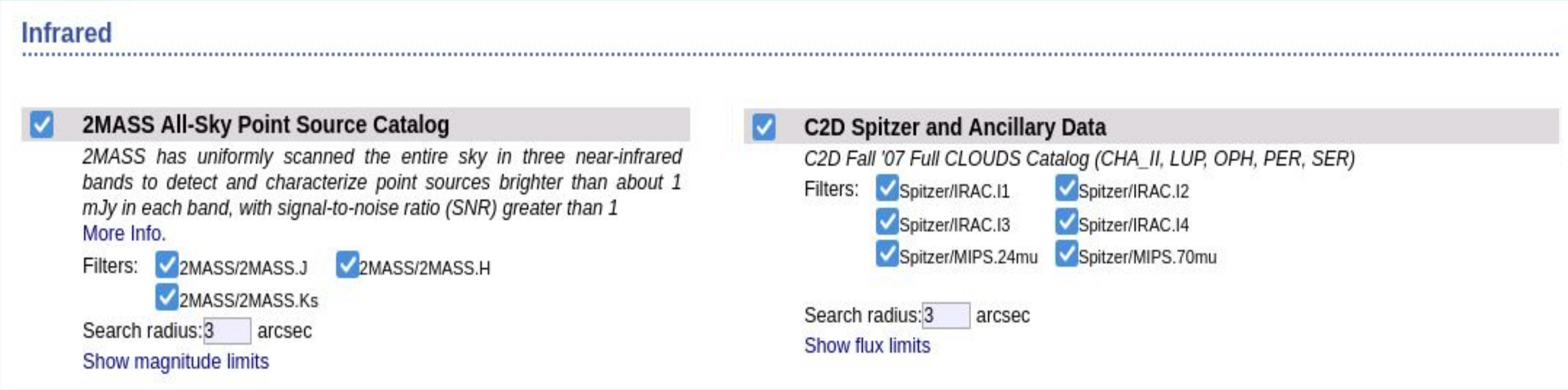


IR photometry

We searched for all available **VO photometry in the IR** (λ > 1.2 microns) and we selected the ones that had at least three reliable data points.

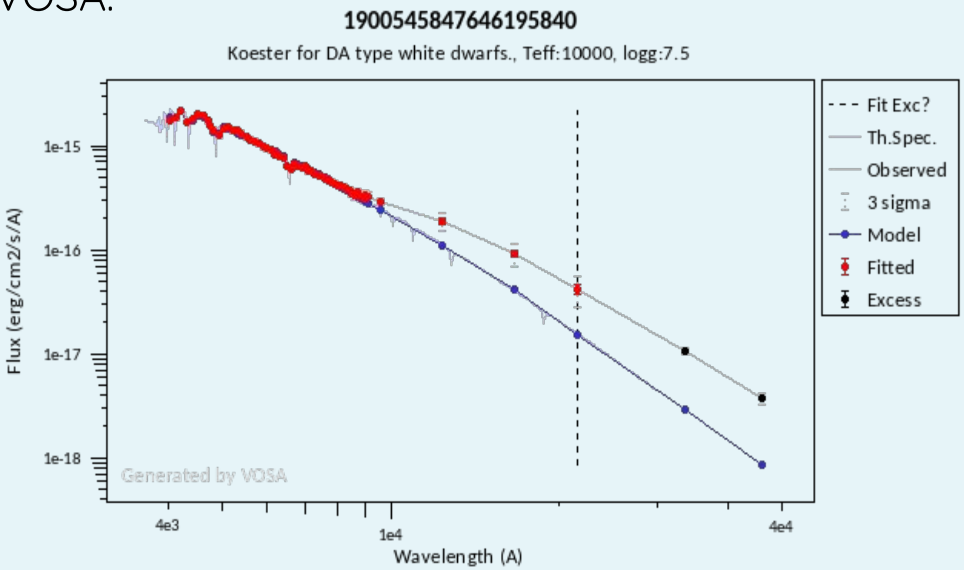
We did this with **VOSA**.

We got photometric data from **2MASS, WISE, UKIDSS, VISTA and Spitzer**.



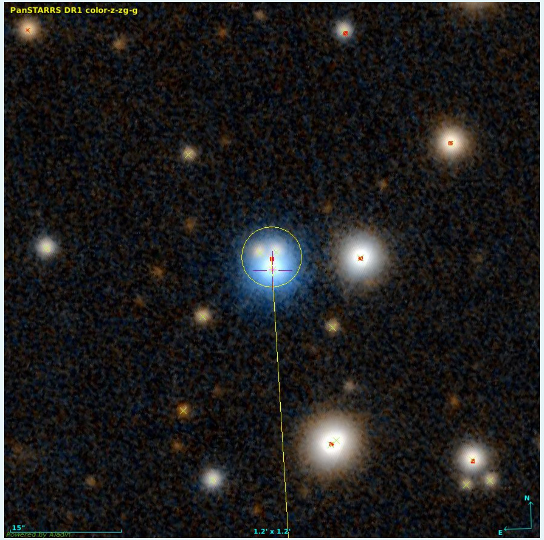
IR excess detection

We built the SEDs with the optical and infrared photometric points.
We fit them with Koester DAs (hydrogen pure) and DBs (helium pure) atmosphere models with **VOSA**.
We looked for the SEDs with IR excesses taking advantage of the automatic detection of VOSA.

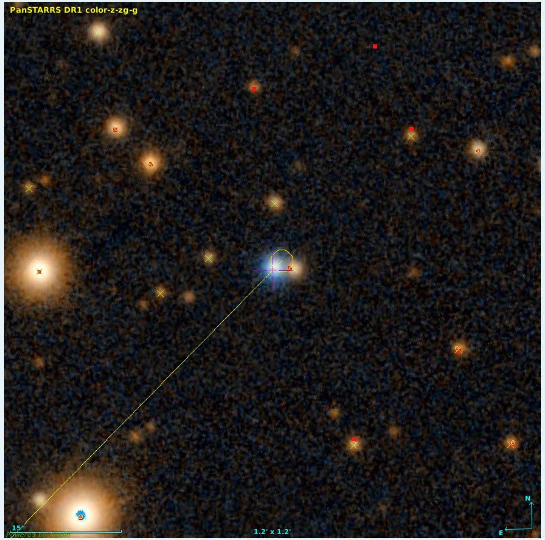


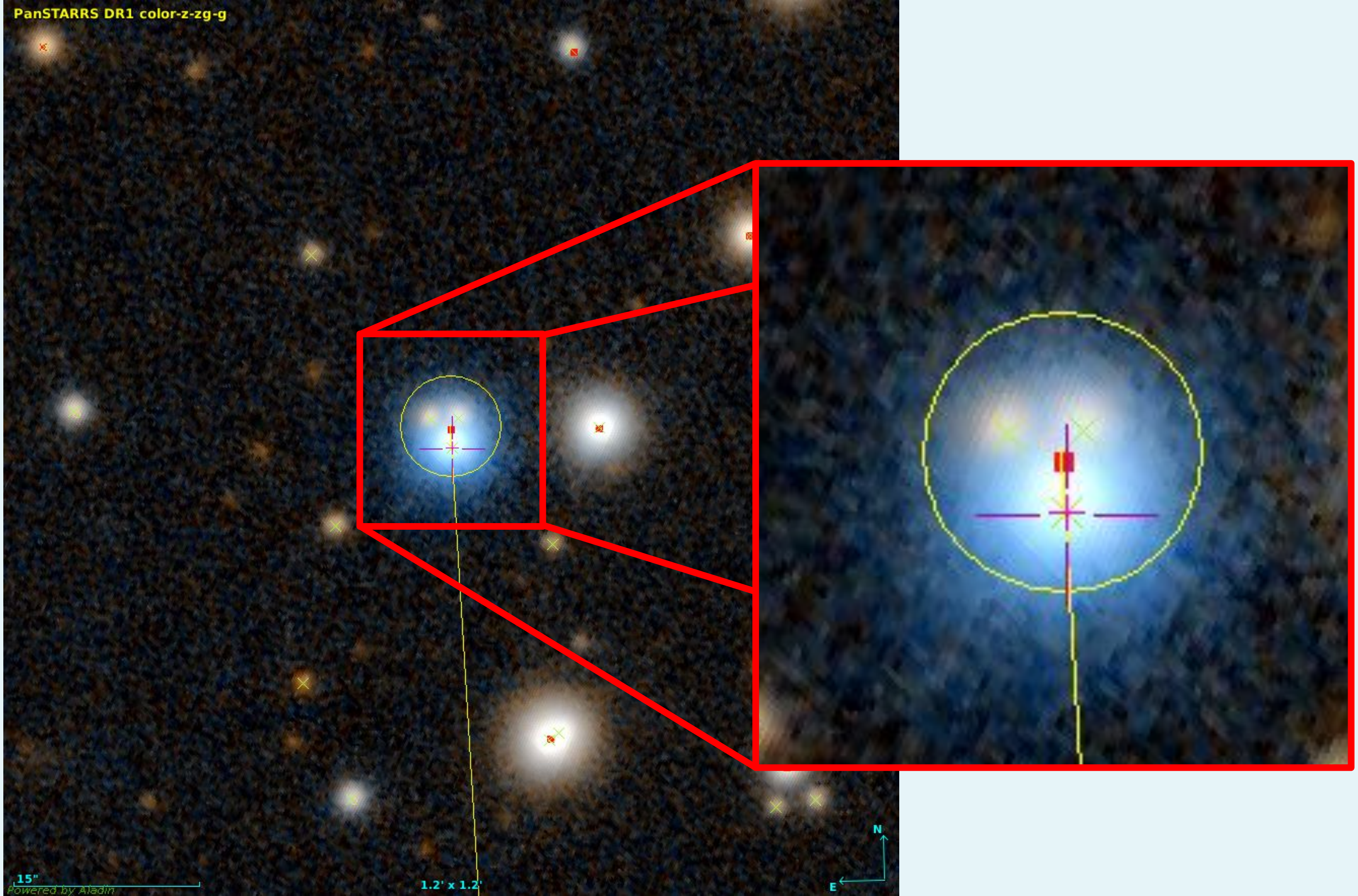
Contamination

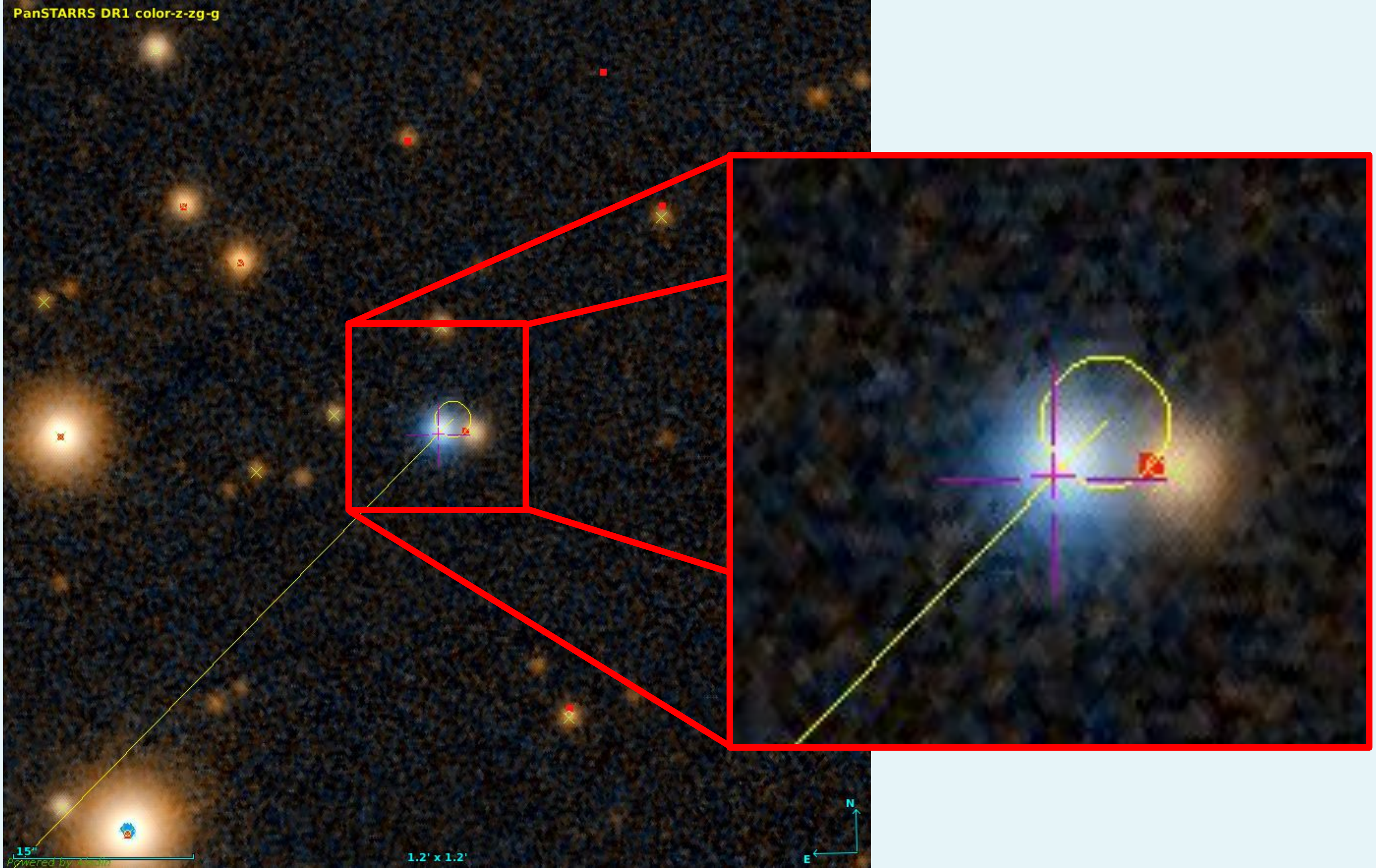
Then, we had to verify the IR excesses were not due to contamination from nearby objects. For this checkup we used **Aladin**.
Once we have discarded all the candidates with contamination, we kept those that have a reliable IR excess.



Examples of Aladin charts with contaminated photometry

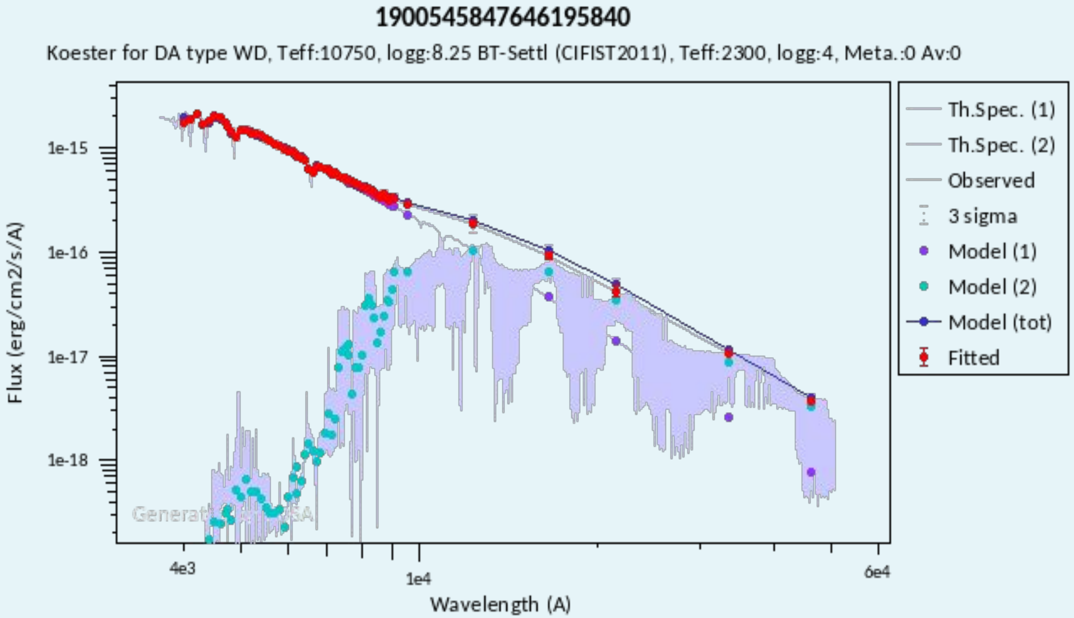



PanSTARRS DR1 color-z-zg-g
15"
1.2' x 1.2'
Powered by Aladin
N
E


PanSTARRS DR1 color-z-zg-g
15"
1.2' x 1.2'
N
E

Physical characterisation of the systems

We fit the IR excess SEDs with a two bodies fit (fitbin). We combined two different models: Koester and the BT-Settl (CIFIST).



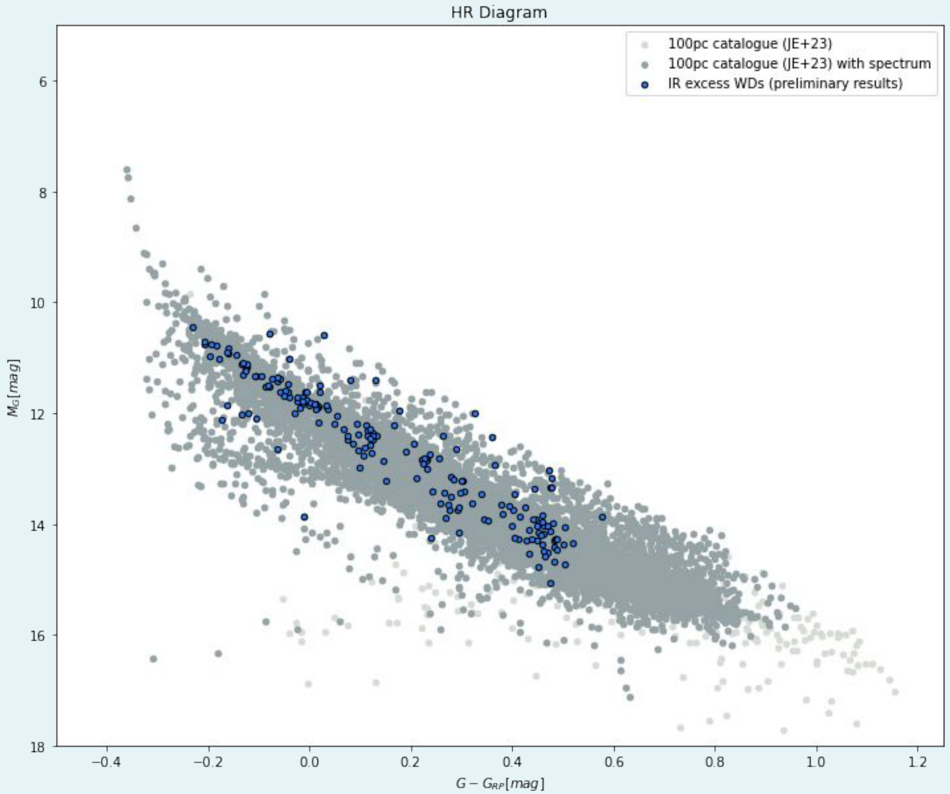
Preliminary results

Finally we got **185 WDs with reliable IR excess** within 100 pc:

- **61 already known** (Rebassa-Mansergas 2019)

- **124 new discoveries**

Paper in preparation (Murillo-Ojeda et al.).



Thanks for your attention