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A White Dwarf catalogue from Gaia-DR2 and the VO

F. Jiménez-Esteban et al.

CAB / SVO (INTA-CSIC)

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Collaboration between the UPC and the CAB

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A White Dwarf catalogue from *Gaia*-DR2 and the Virtual Observatory

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White dwarfs

- Very common: the result of stellar evolution $M_{MS} < 10\ M_{\odot}$
- Structure
  - Degenerated core (He – CO – ONe)
  - Thin layer of He
  - Even thinner layer of H
- Classification
  - ~80% DA with H lines
  - ~20% non-DA, including DB with He lines
- Why WDs?
  - Retain the past history of the Galaxy
  - Study of stellar clusters
  - Test no-standard physics

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White dwarfs

- Gaia theoretically provides us with an unprecedented number of WDS
  - 12,000 up to 100 pc
  - 400,000 up to 400 pc

- We also need to estimate their stellar parameters

- VO provided us with the ideal framework
  - easy and fast access to multi-λ deep photometry → SED
  - VO tools permit the study of thousands of objects at once
    → VOSA & Topcat

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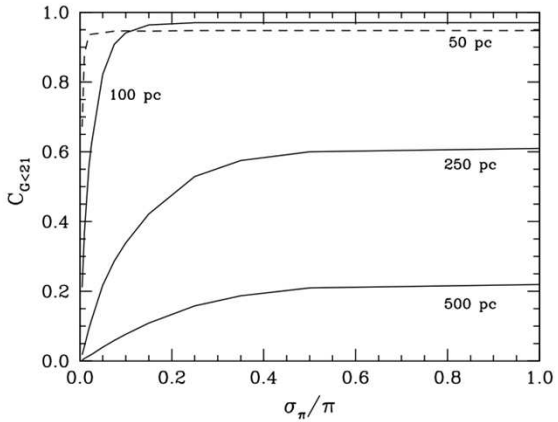
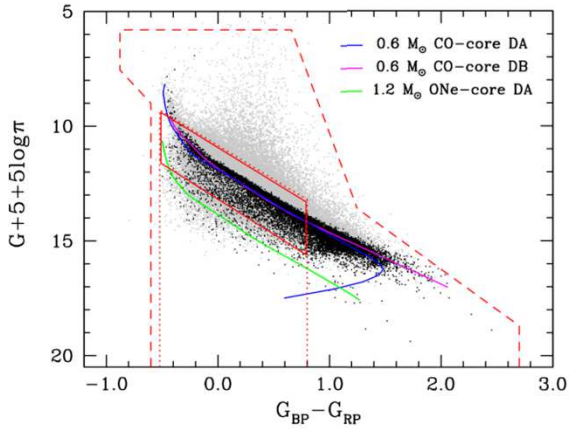
Search methodology

Population synthesis code

- Based on Monte Carlo
- 3 populations: thin disc, thick disc, and halo (80:15:5)
- 80% DA and 20% non-DA
- Gaia photometric and astrometric errors added
- State-of-the-art WDs evolution models





Selection cut	50 pc	100 pc	250 pc	500 pc
$G < 21$	0.95	0.97	0.61	0.22
$\sigma_\pi/\pi<0.1$	0.95	0.94	0.34	0.08
6 kK< $T_{\rm eff}$ <80 kK	0.43	0.44	0.27	0.04

Criteria:

- $\sigma_\pi < 10\%$
- 6 kK < T_{eff} < 80 kK
  $-0.52 < G_{BP}-G_{RP} < 0.8$
- $\sigma\,(F_{BP})$ & $\sigma\,(F_{BR}) < 10\%$
- $\varepsilon < 1.3+0.06\times(G_{BP}-G_{RP})^2$
  (Evans et al 2018)

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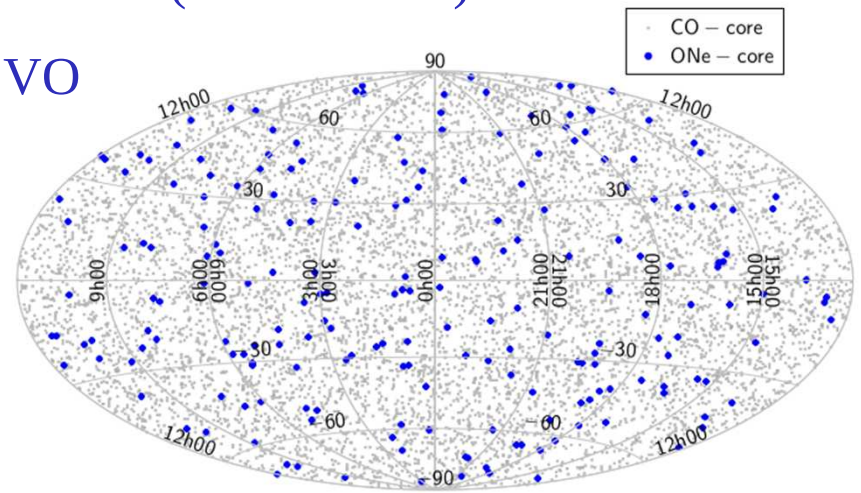
The Gaia WD catalogue

- 72,178 CO-core and 1,043 ONe-core WDs
- 8,343 CO-core and 211 ONe-core were within 100 pc
  - **The most complete volume-limited sample to date**
  - WD spatial density of $(4.9 \pm 0.4) \times 10^{-3}\,\mathrm{pc}^{-3}$
- Very low (< 1%) contamination (sdBs & CVs)
- Available online at the SVO



100 pc

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Physical characterization of the catalogue

- Used VOSA to:
  - built the SEDs from VO (UV-NIR)
  - Fit to DA white dwarf model spectra (Koester 2010)
  - T_{eff} and L for ~91% of sources
- $L = 4\pi R^2 \sigma T^4 \rightarrow R$
- Log*g* & M from evolutionary sequences (Renedo et al. 2010)

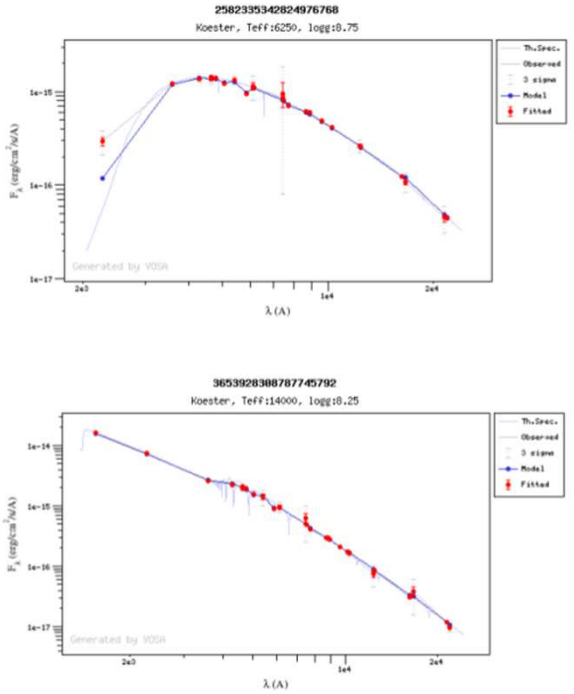

Figure 8. Examples of observational SEDs and their fit to the synthetic spectra done by VOSA for two of our white dwarfs. The observational photometric points are shown in red joint by gray lines, blue dots joint by blue lines are the synthetic photometry, and the cyan line corresponds to the theoretical model.

High reliable estimate of physical parameter for ~59%

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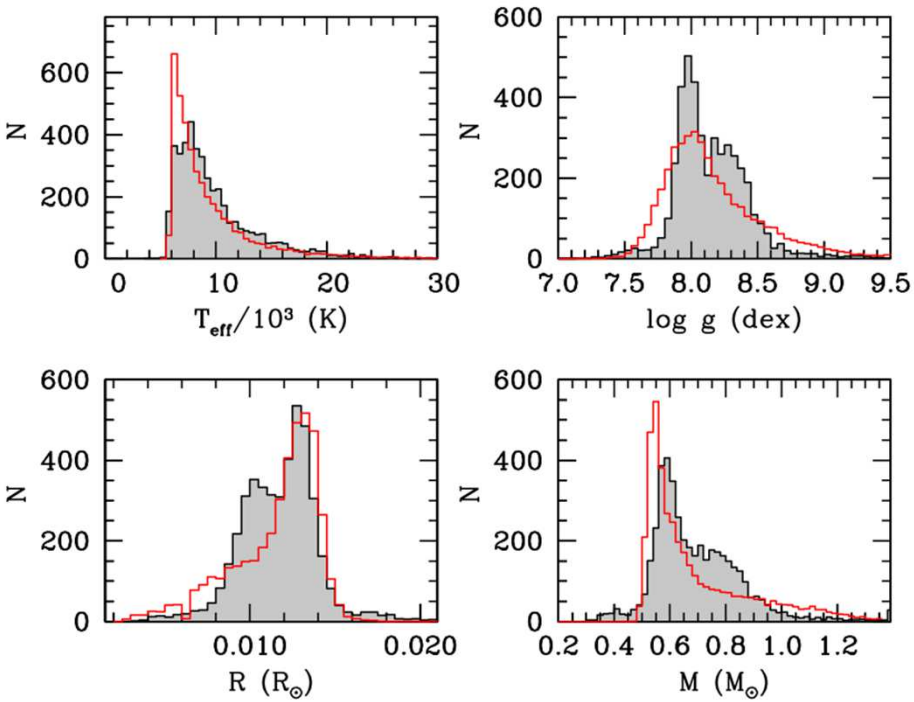
Physical parameters (100 pc)

- Concentration at T_{eff} ~ 8kK (**first time**)
  - Lack T_{eff} < 8kK
    Due to selection and/or bad fit
- **Bimodal-like** distribution for R, log*g*, M
- Unexpected ~0.8 $M_{\odot}$
  - Binary mergers.
  - A recent burst of star formation
  - Initial-to-final mass relationship
- Small fraction of He-core
  (~0.45 $M_{\odot}$ - 0.017 $R_{\odot}$ - 7,6 dex)



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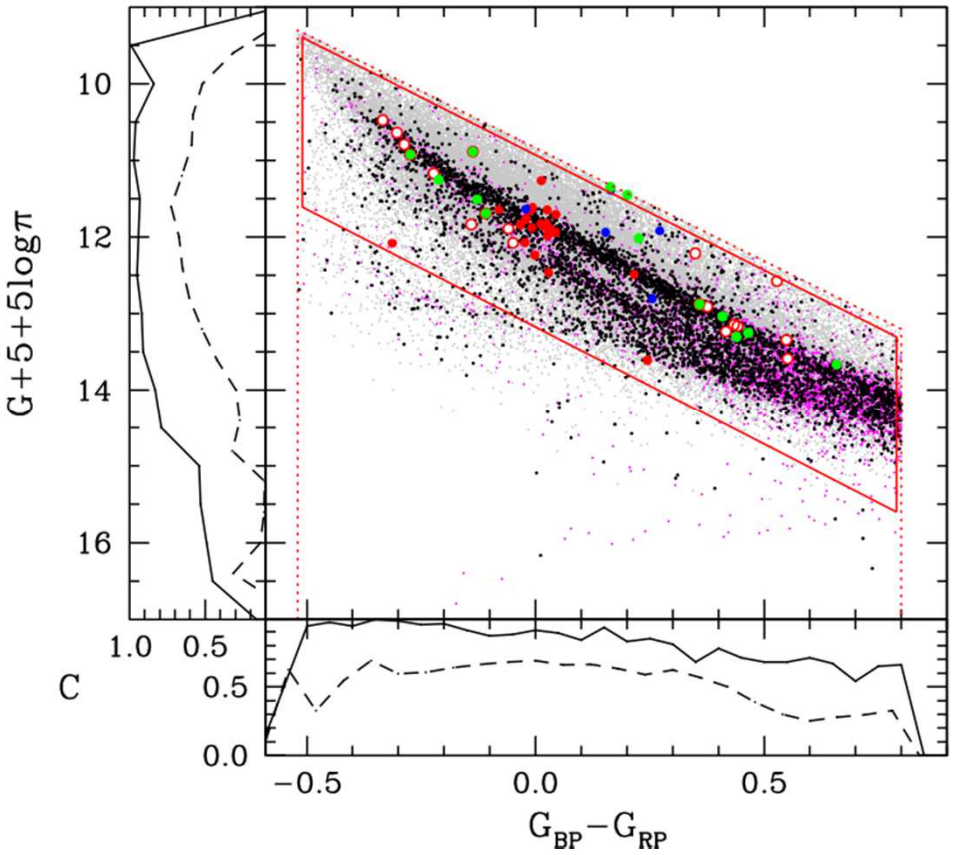
The WDs HR diagram (100 pc)

- The average completeness ~93%
- ~63% good stellar parameter, lower for T_{eff} < 8kK.
- bifurcation $0.0 < G_{BP} - G_{RP} < 0.3$ → more massive objects.
- He-core or unresolved double-degenerate binaries.



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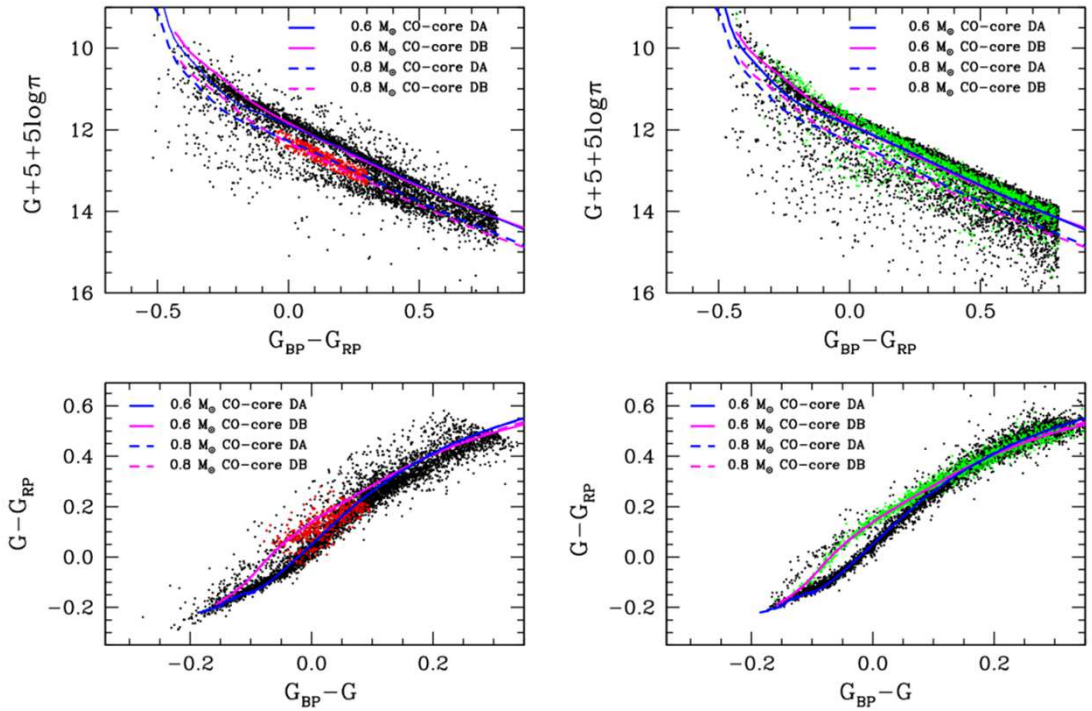
The WDs HR diagram (100 pc)

- Good agreement with our model of the Galactic
- Bifurcation:

  Not all of them are WD-DB

  30 − 40 % of DB



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Conclusions

- **The largest white dwarf catalogue to date (>73,000)**
  - 8,343 CO-core and 212 ONe-core within 100pc
    - **Most complete volume-limited sample WDs uptodate**
    - WD spatial density of $(4.9 \pm 0.4) \times 10^{-3}\,pc^{-3}$
  - contamination < 1% (sdBs & WD)
  - Reliable physical parameters for ~59%

- We demonstrated the majority of **WDs in the solar neighbourhood are cool**

- We identified **bimodal-like distributions of R, log*g* and M**

- **Bifurcation** $0.0 < G_{BP} - G_{RP} < 0.3$
  - more massive objects → ~0.8 $M_{\odot}$ peak
  - discrepancies between **DA** or **DB cannot explain** it

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Thanks!!

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