Photometric calibration of multi-filter surveys: J-PLUS, J-PAS & *Gaia*

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A. Marín-Franch, A. J. Cenarro, A. Ederoclite,
and the J-PLUS collaboration

CEFCA
Centro de Estudio de Física del Cosmos de Aragón

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Large-area multi-filter surveys

Vázquez Ramió's talk about OAJ & *Gaia* synergies this morning

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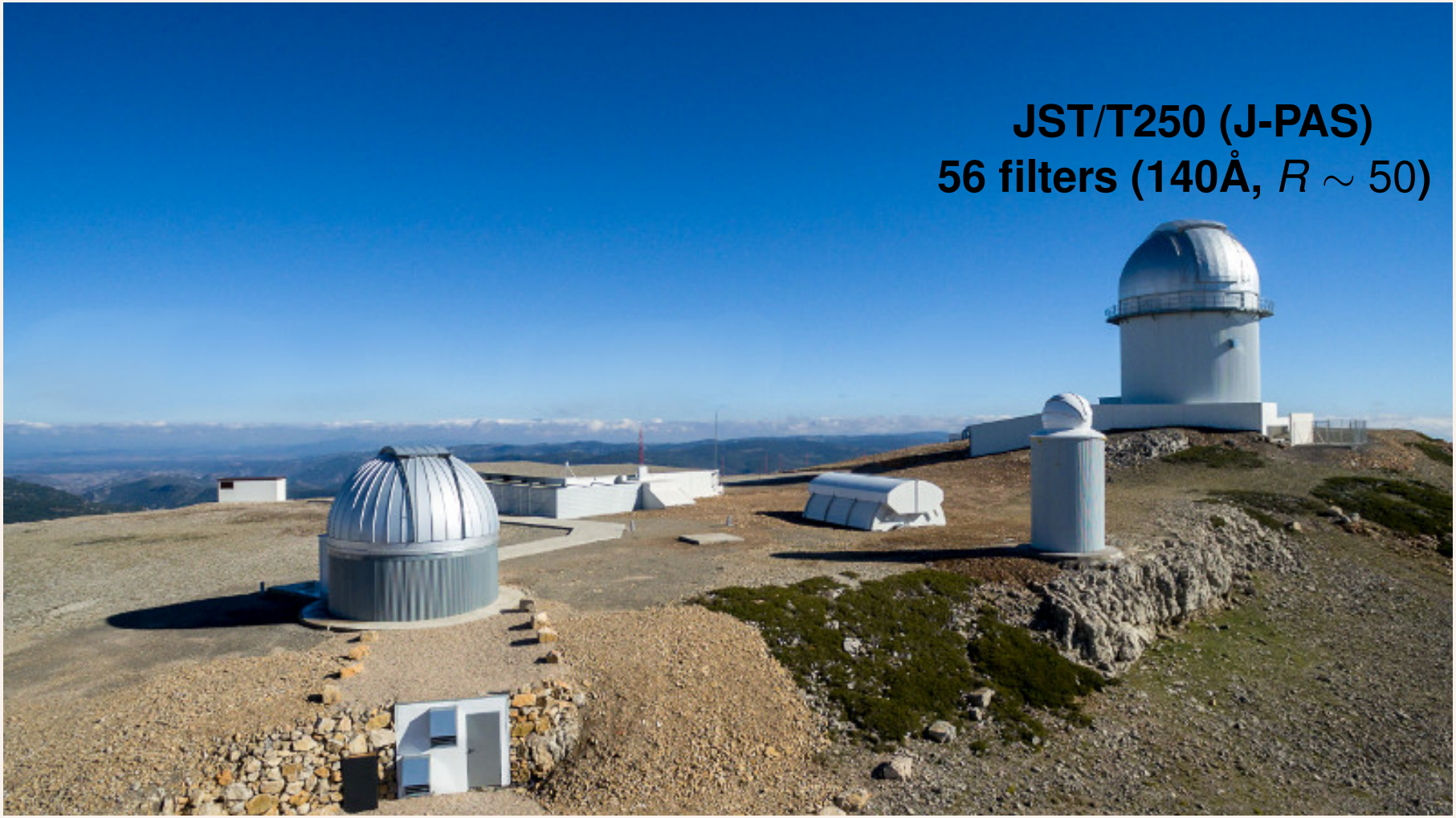

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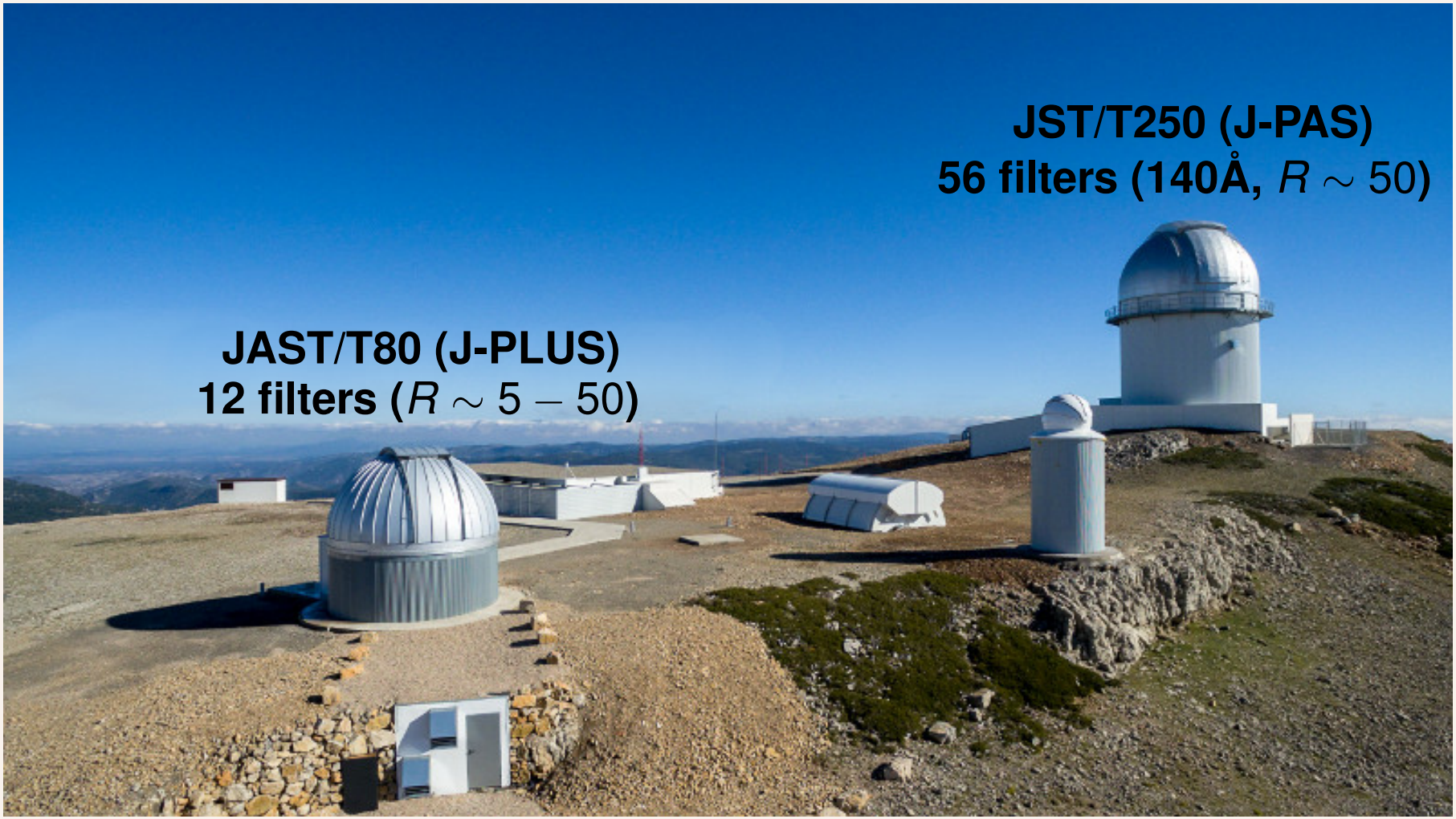

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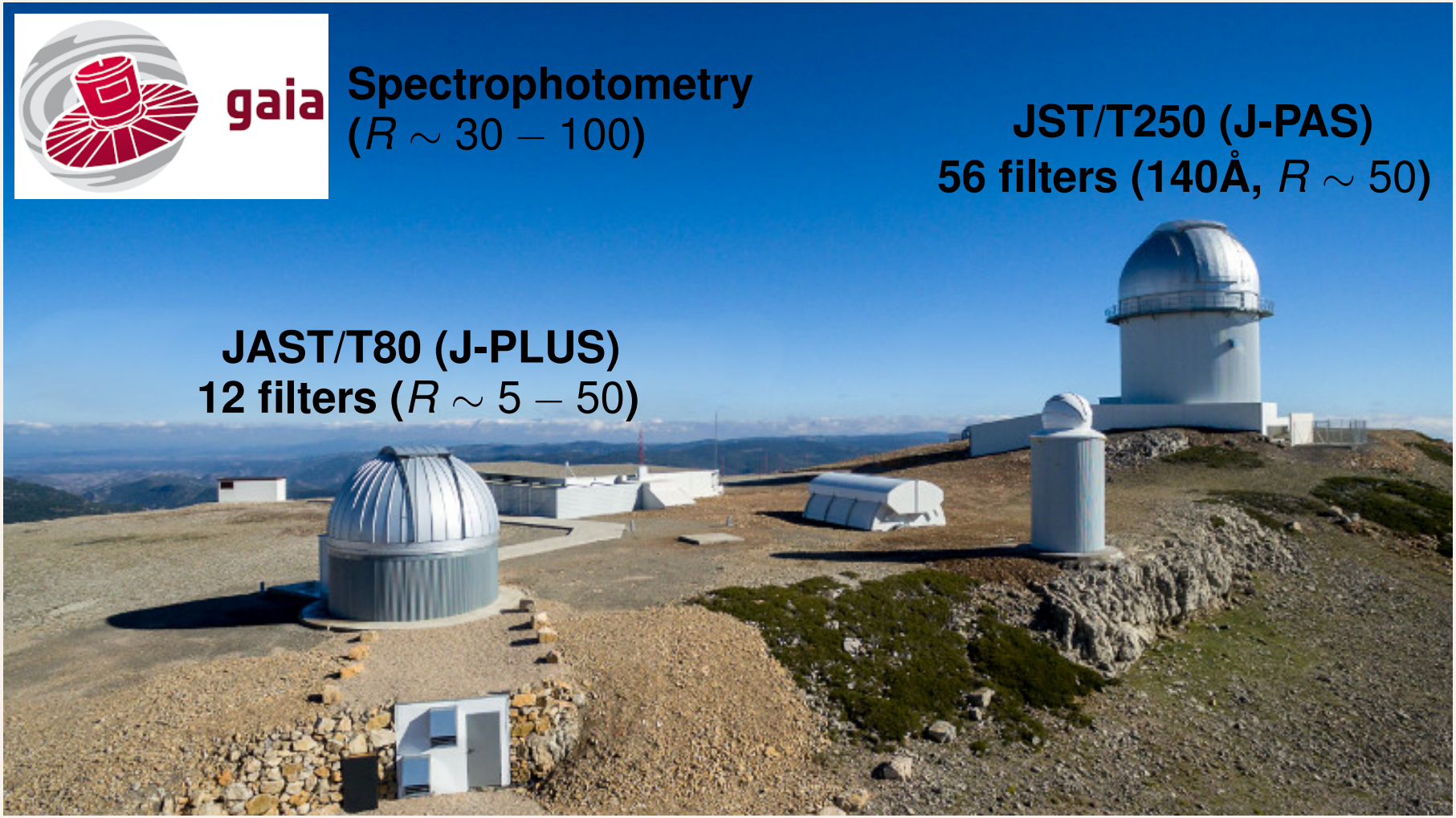

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Photometric calibration

Relative calibration

Ensure an homogeneous photometic solution across the surveyed area

Overlapping areas (Glazebrook+94)
Übercalibration (Padmanabhan+08)
Hypercalibration (Finkbeiner+16)
Stellar locus regression (High+09)
Stellar colour regression (Yuan+15)
Forward global calibration (Burke+14)
Funtional analytic formulation
(Weiler+20, Carrasco's talk)

Absolute calibration

Provide the physical flux scale of the observations on top of the atmosphere

White dwarfs (WDs) are the best astronomical objects to derive an absolute calibration.

All about WDs science
in Torres' talk this morning.

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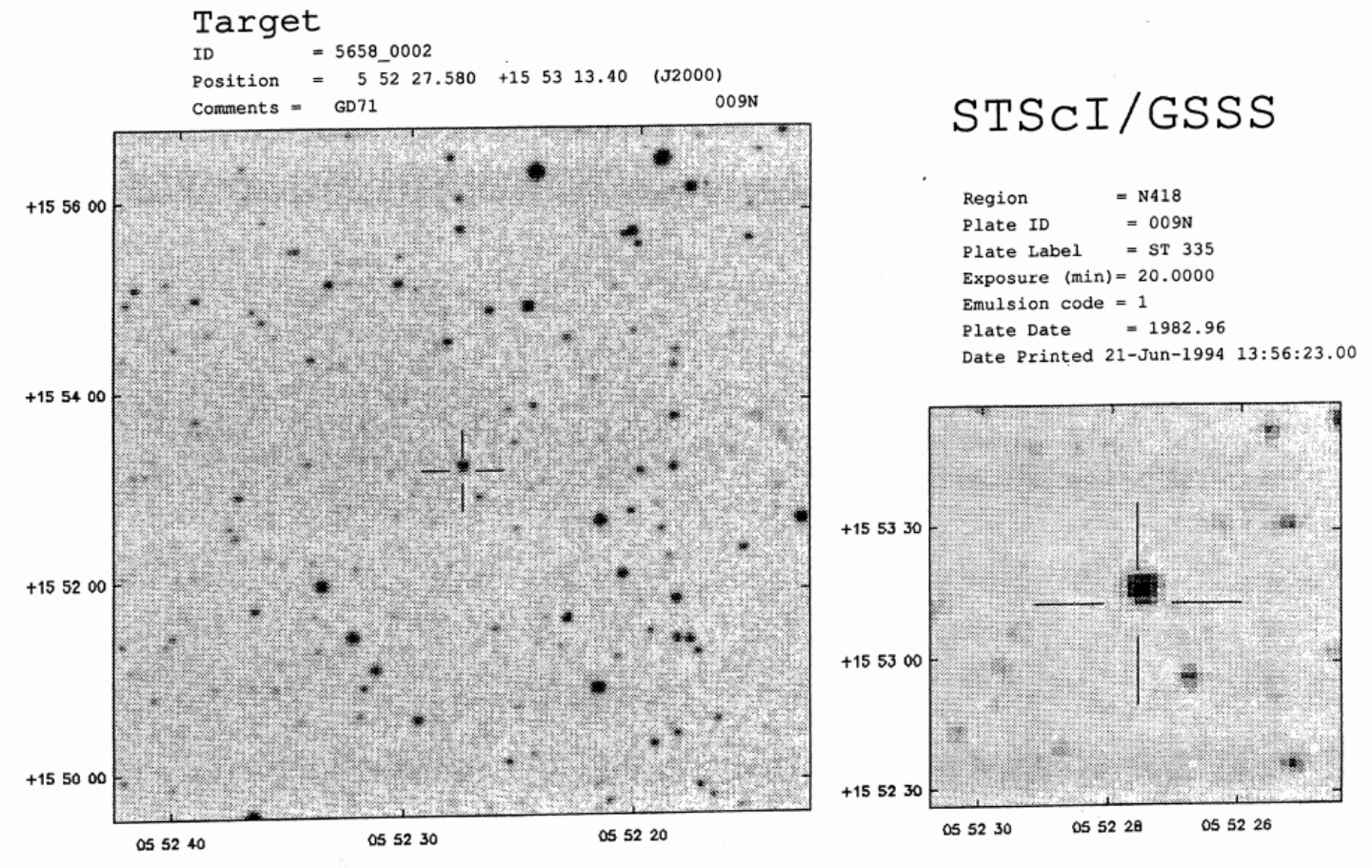
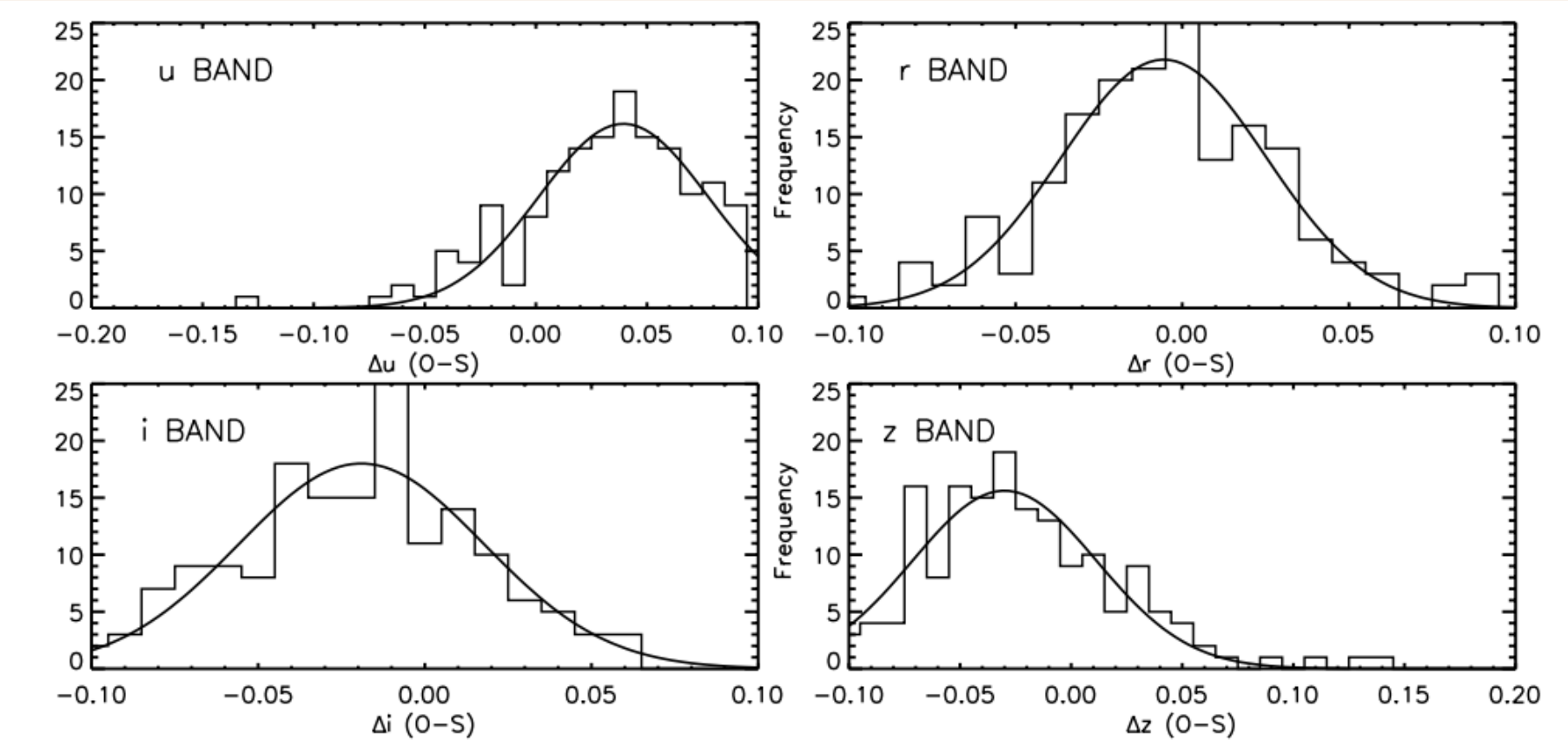
Spectro-photometric standard stars



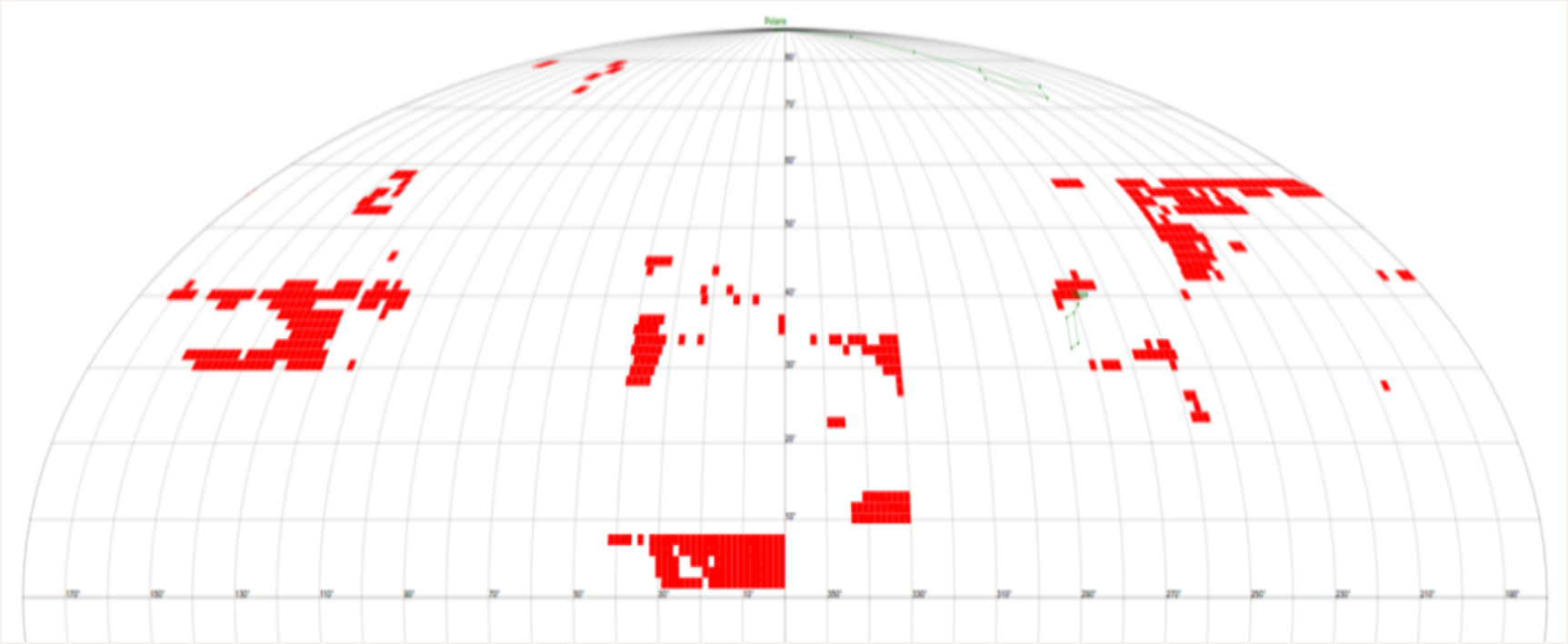
WDs as spectro-photometric standard stars (e.g. Bohlin+95).
A significant telescope time because of the large number of filters.

Synthetic photometry with WDs



WDs models from ($T_{\rm eff}$,log g) as reference (Holberg & Bergeron 06).
Spectroscopy is needed to estimate these parameters.

White dwarf locus

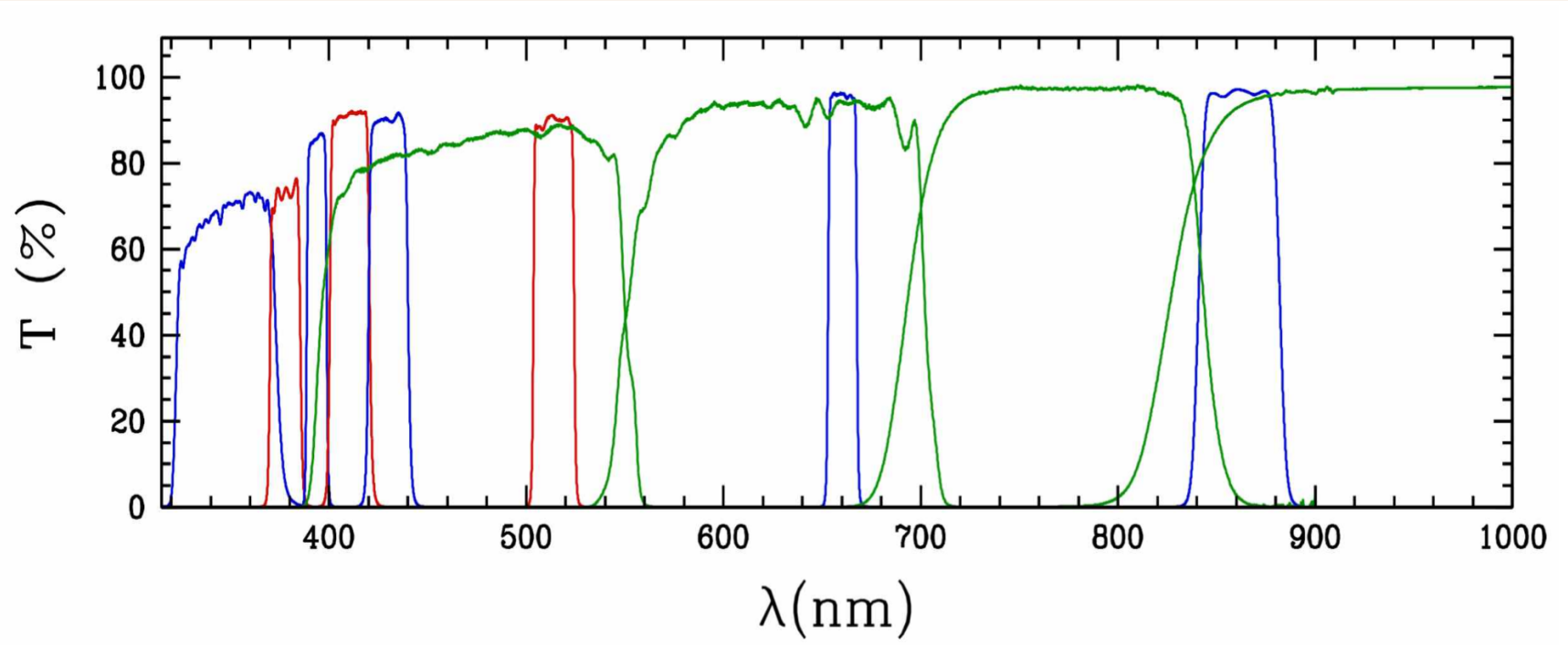


Absolute colour calibration with the **white dwarf locus**
(López-Sanjuan et al. 2019c)

J-PLUS

DR1 (1 022 deg^2, Cenarro+19)

White dwarf locus



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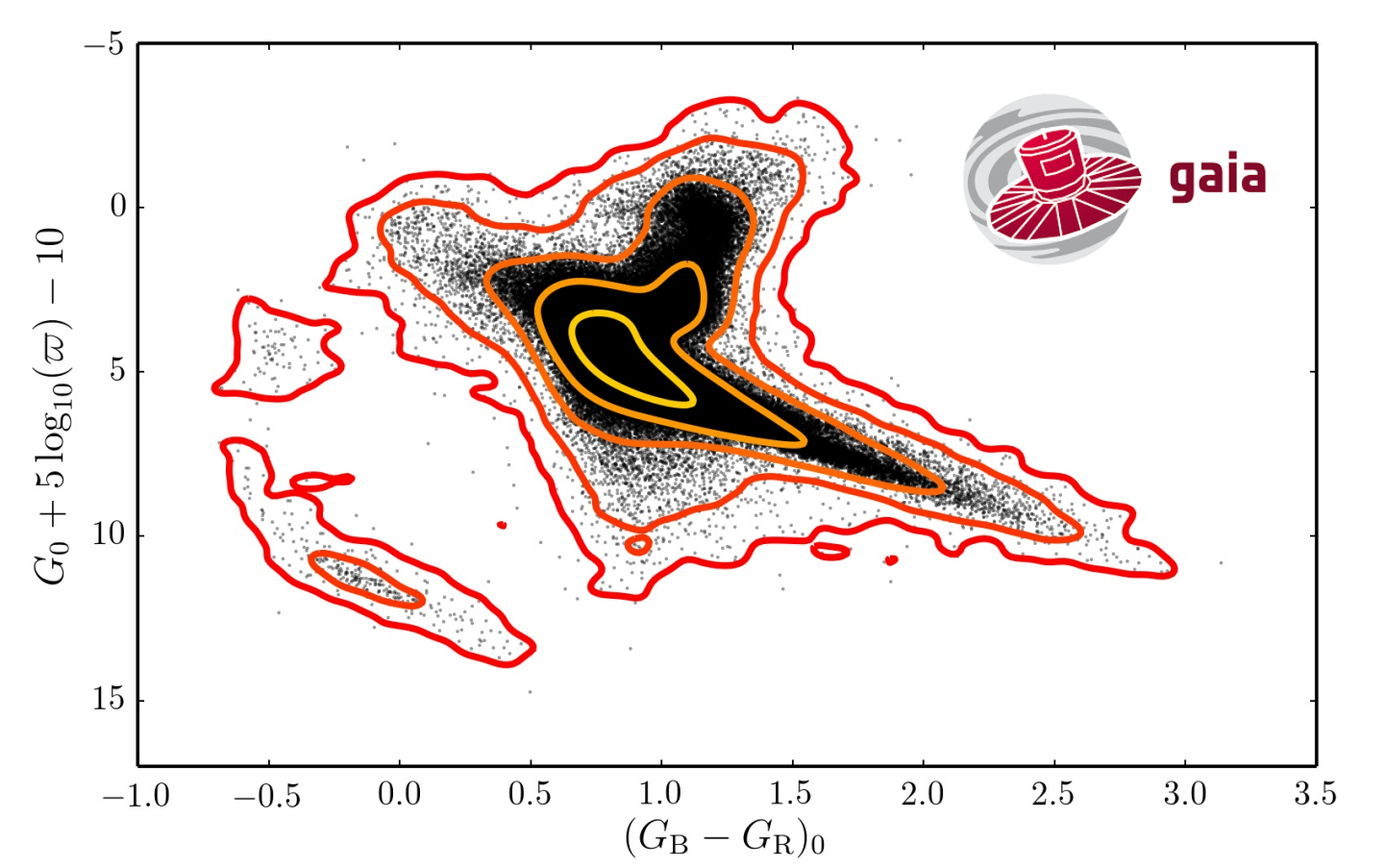
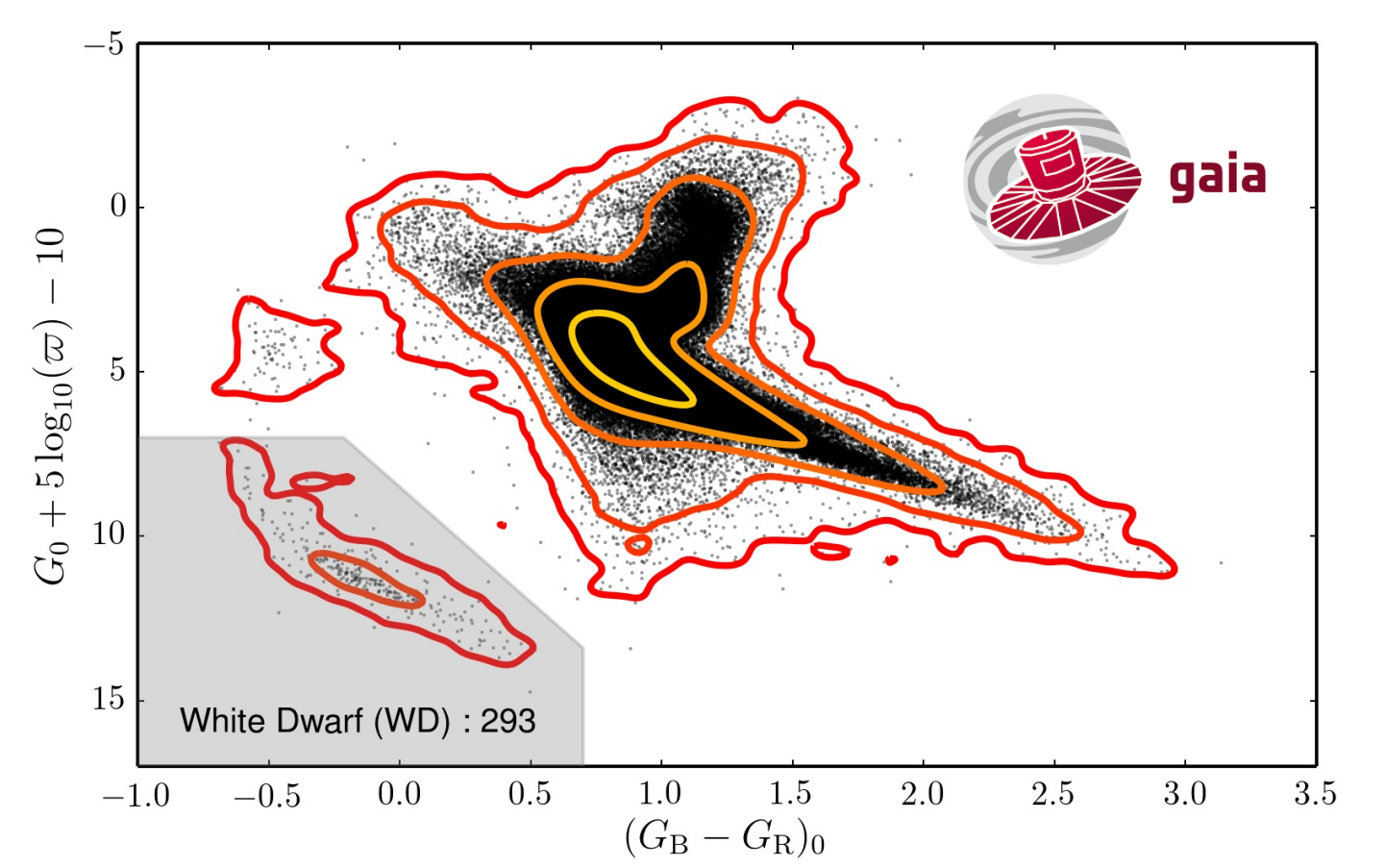
WD locus : selection



J-PLUS DR1 ($S/N > 10$) + *Gaia* (S/N > 3) : 496 798 sources.
We use the *Gaia* luminosity-colour diagram to select **293 WDs**.

WD locus : selection



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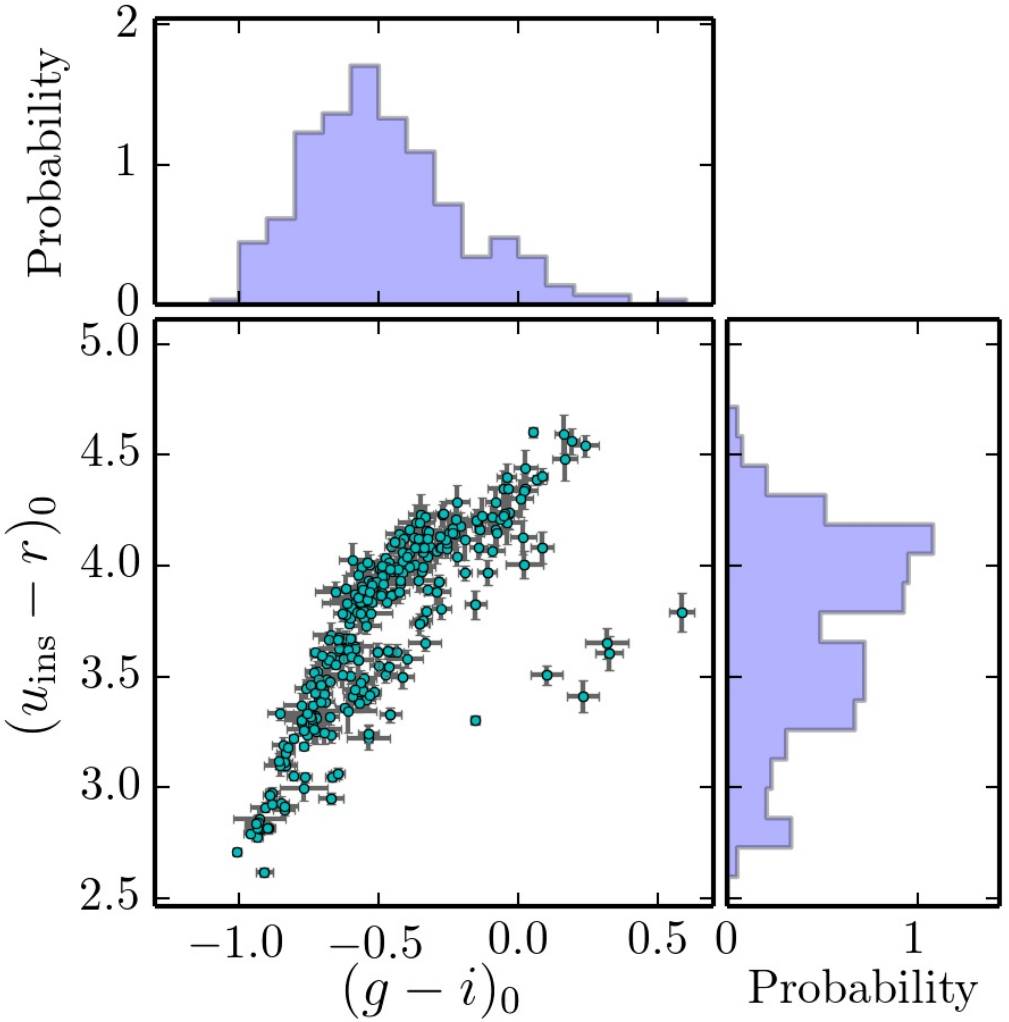

$\mathcal{X}_0$ are dust de-reddened magnitudes with Bayestar17 (Green+18)

gri broad-bands anchored to

$u = u_{ins} + \Delta u_{\rm WD}$

$\Delta u_{\rm WD} \rightarrow$ offset to match the theoretical (Tremblay+13 and Cukanovaite+18) WD locus.

1. Remove outliers
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   $f_{\rm DA} = 0.85 \pm 0.01$
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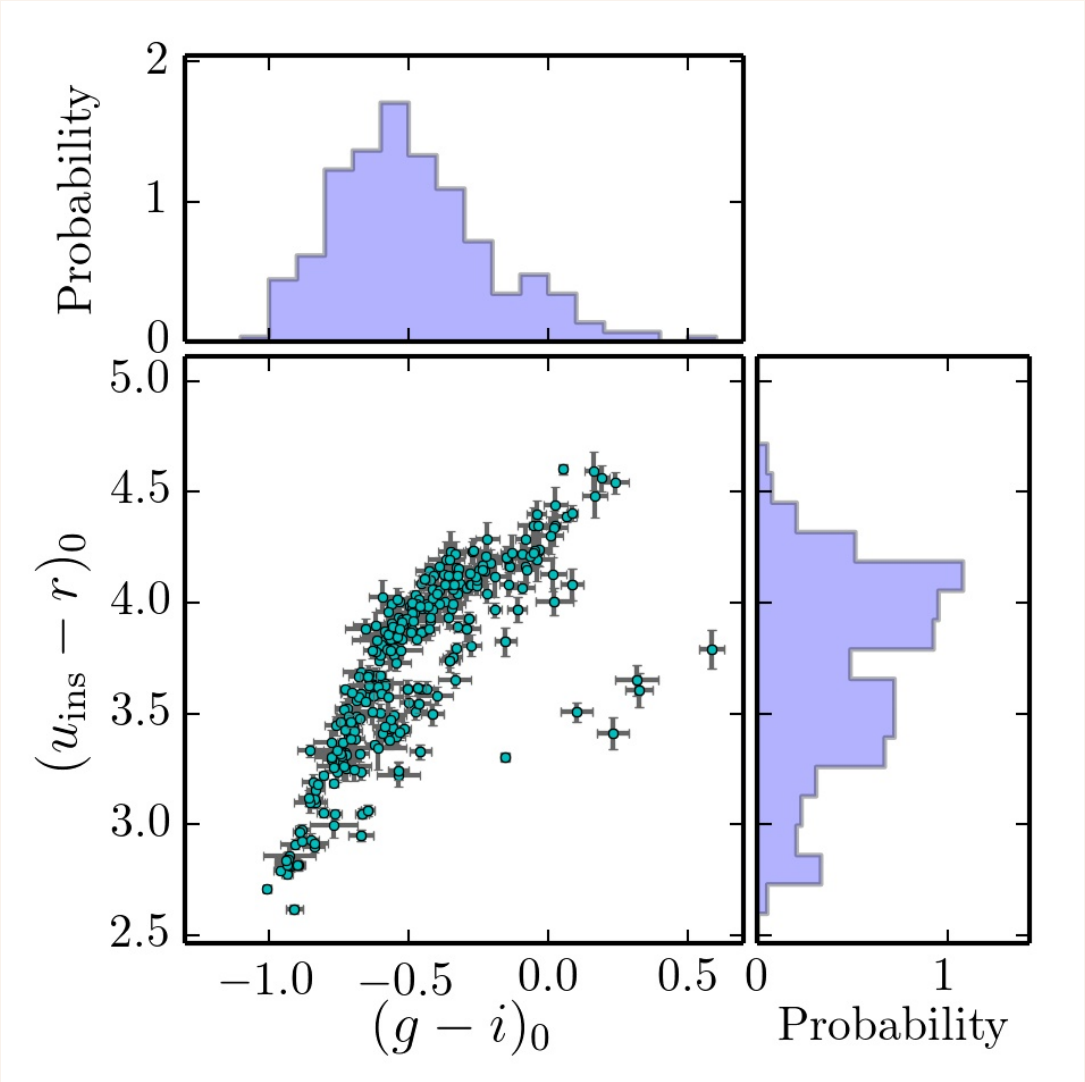

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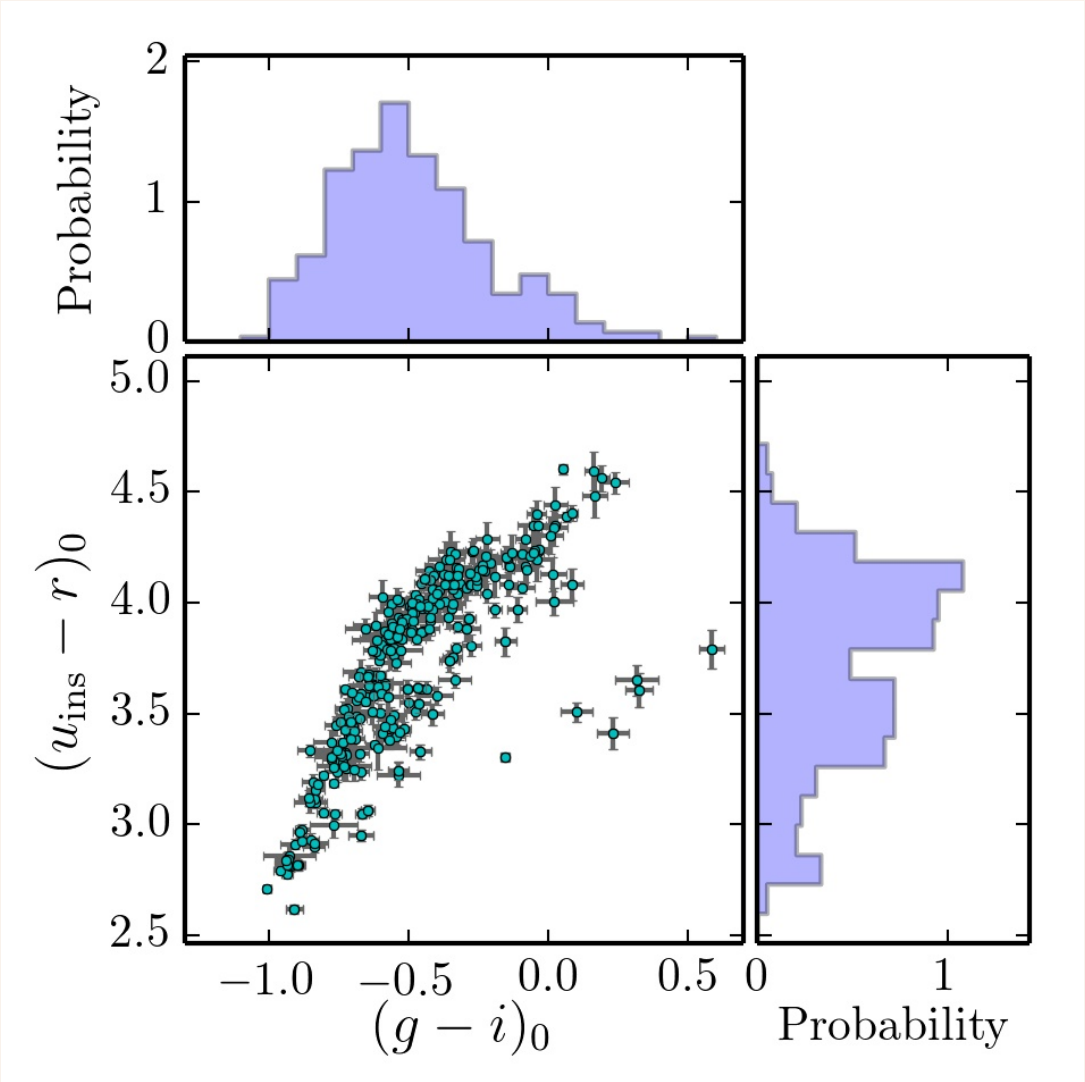

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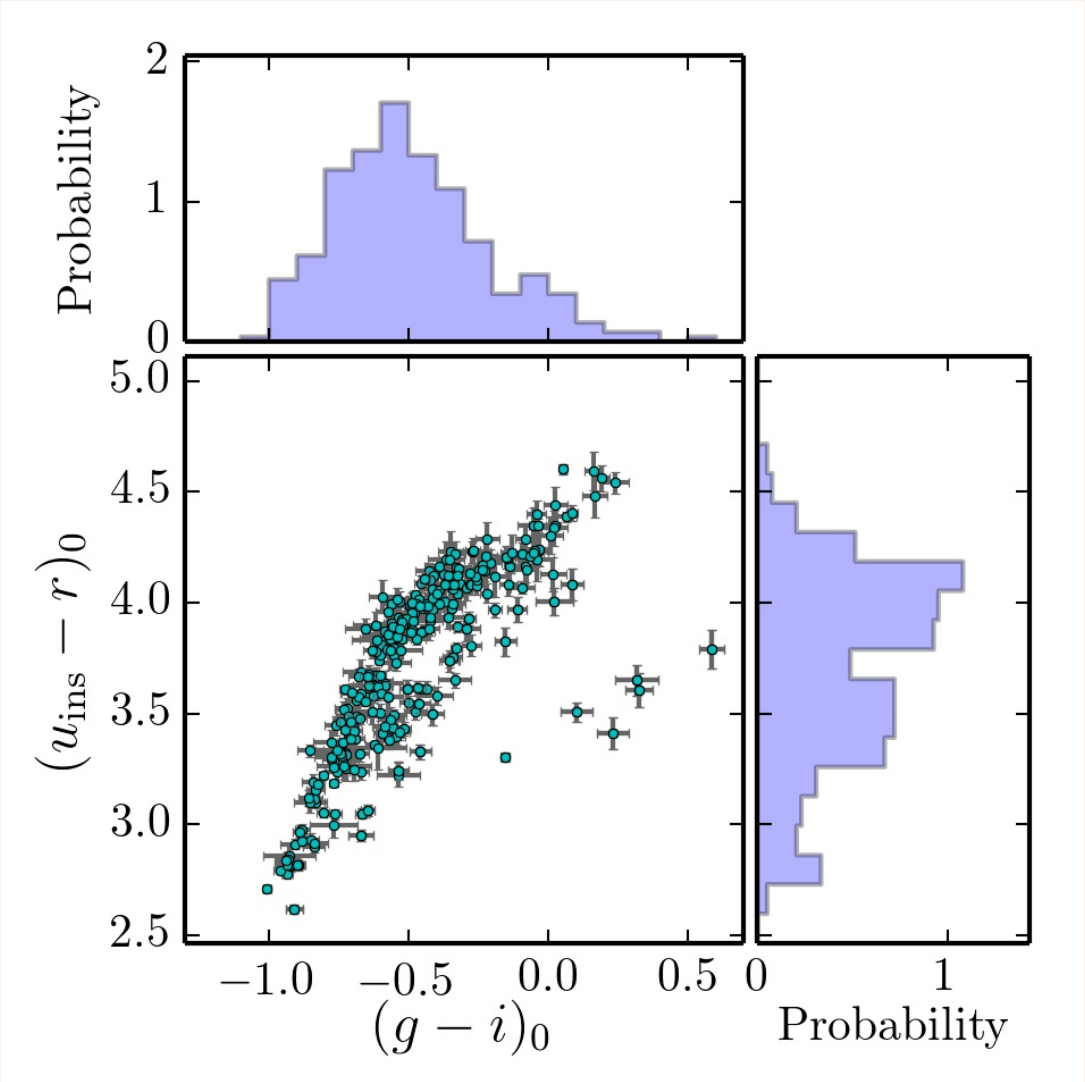

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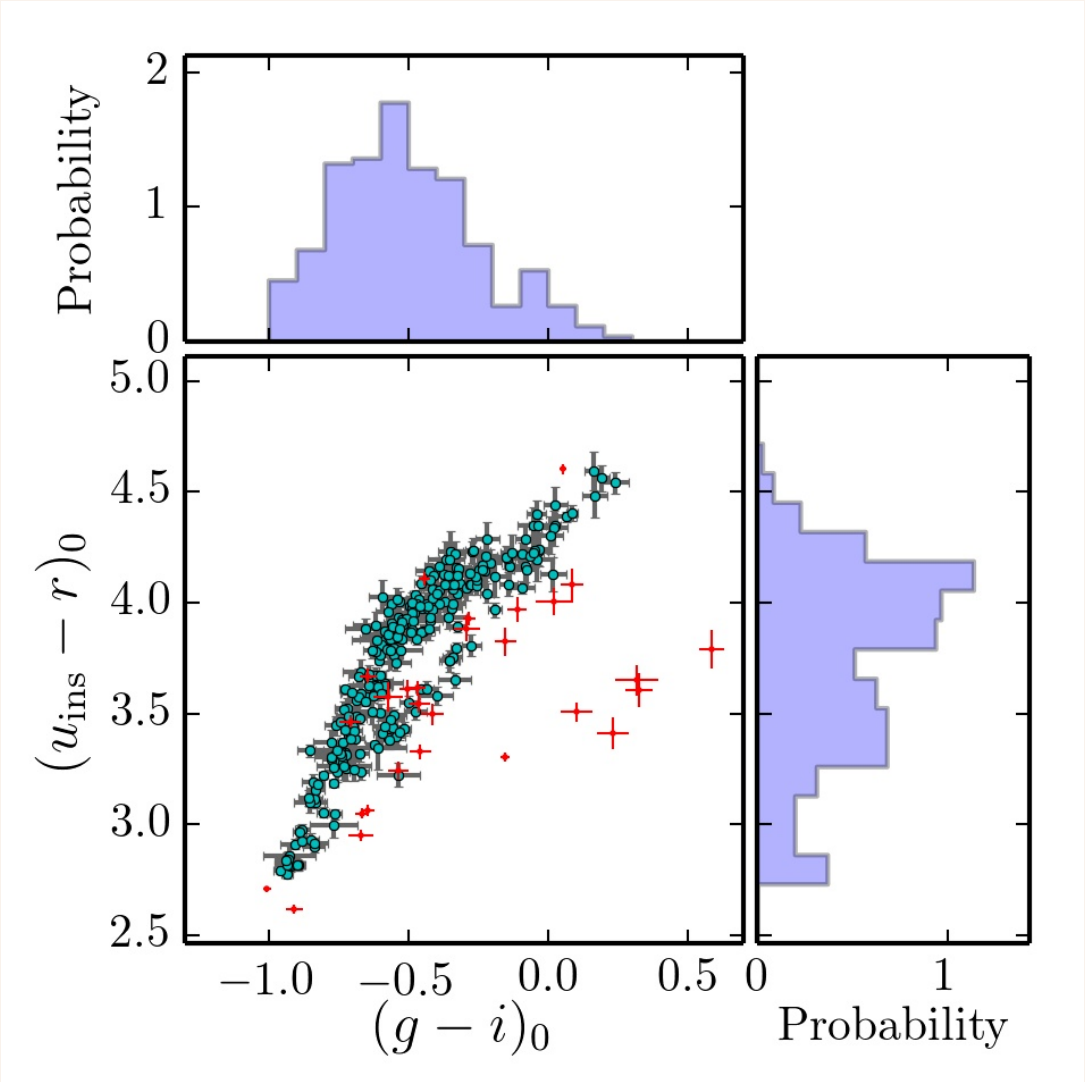

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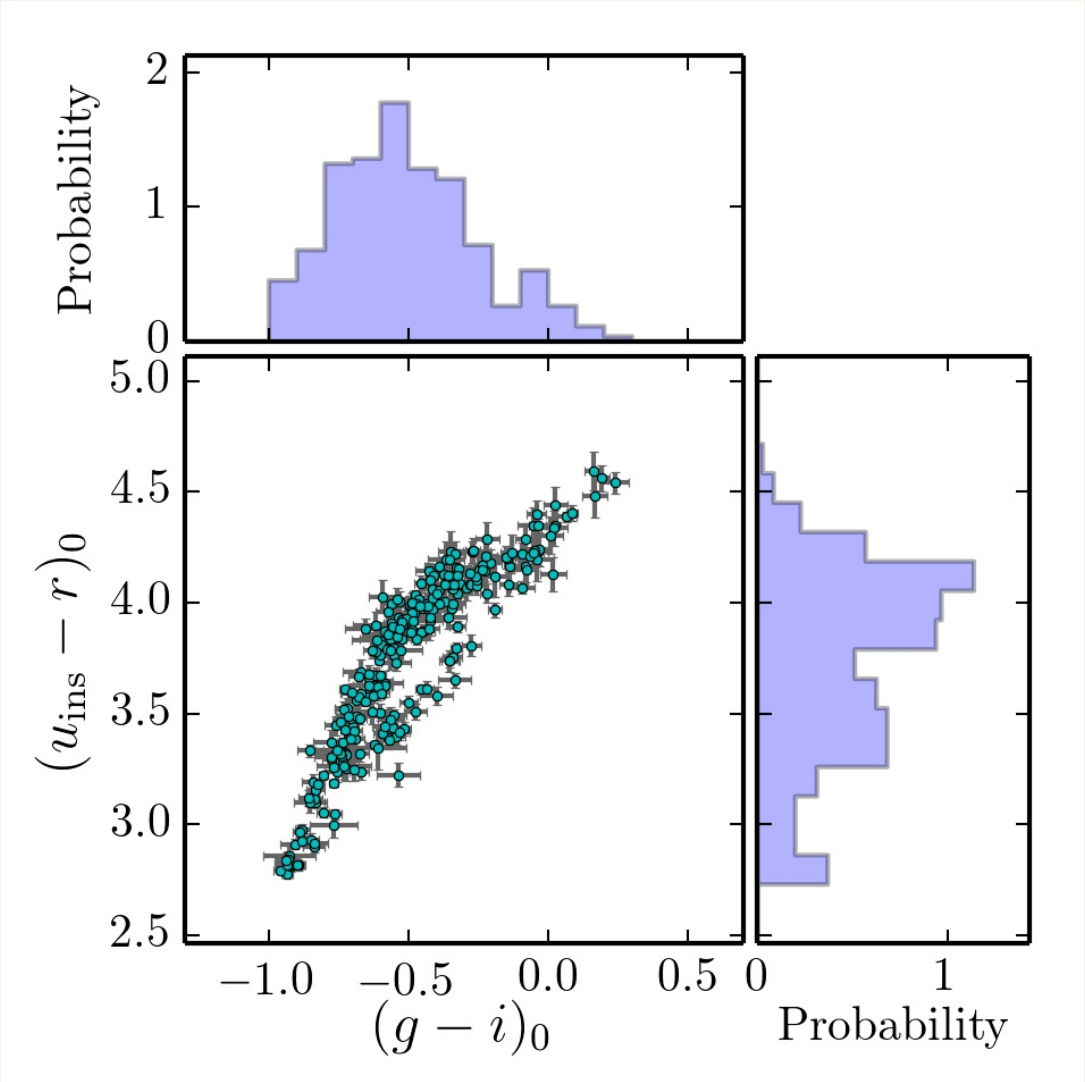

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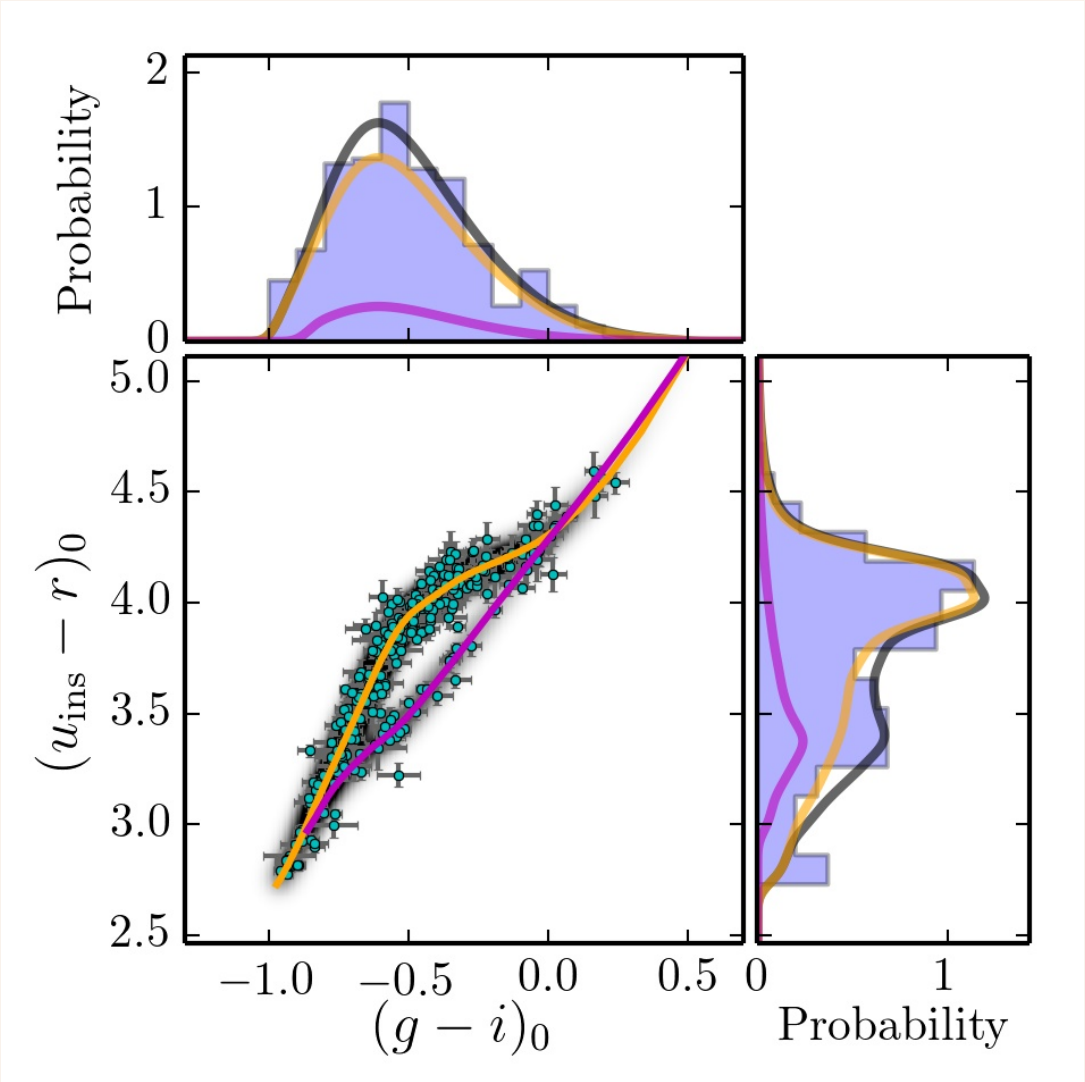

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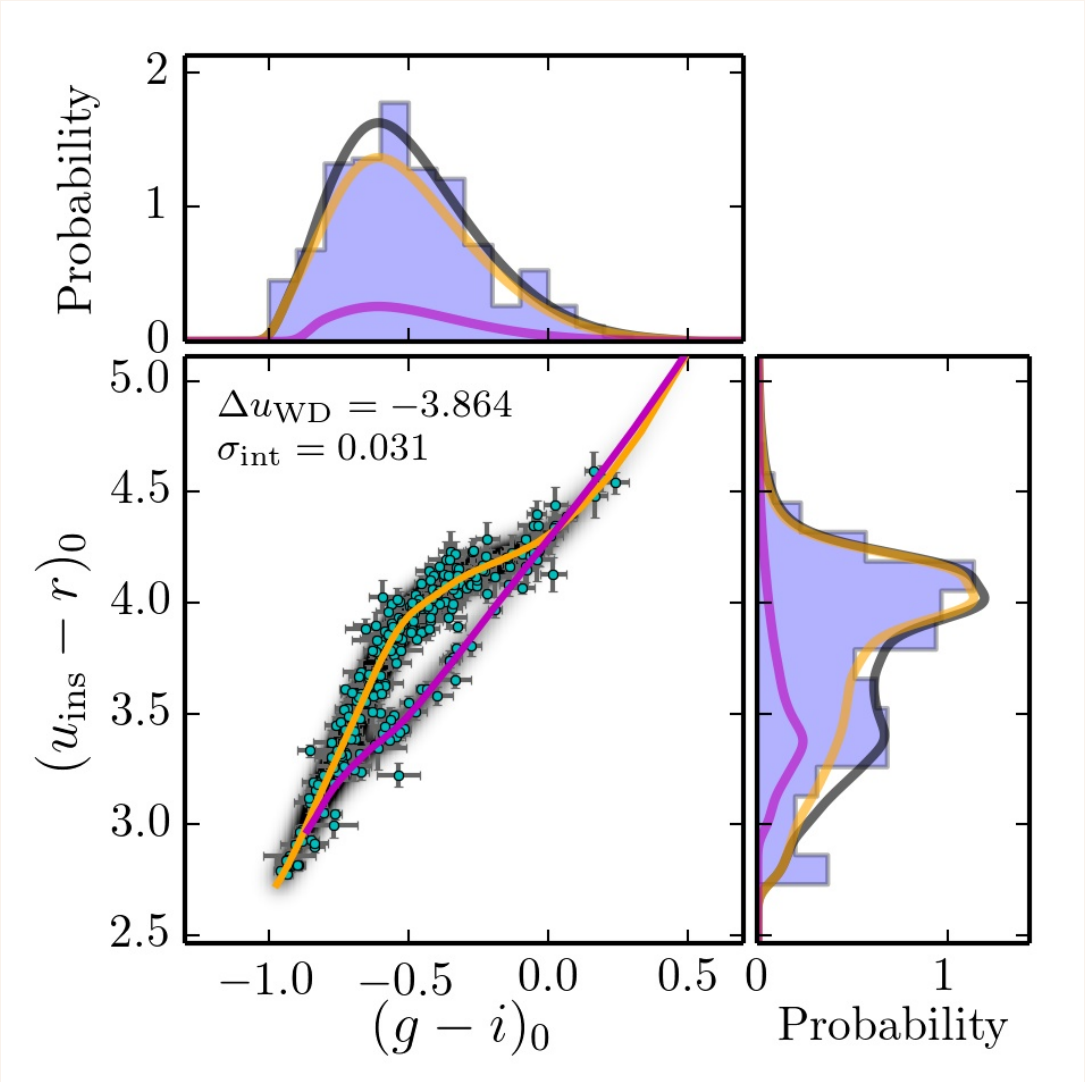

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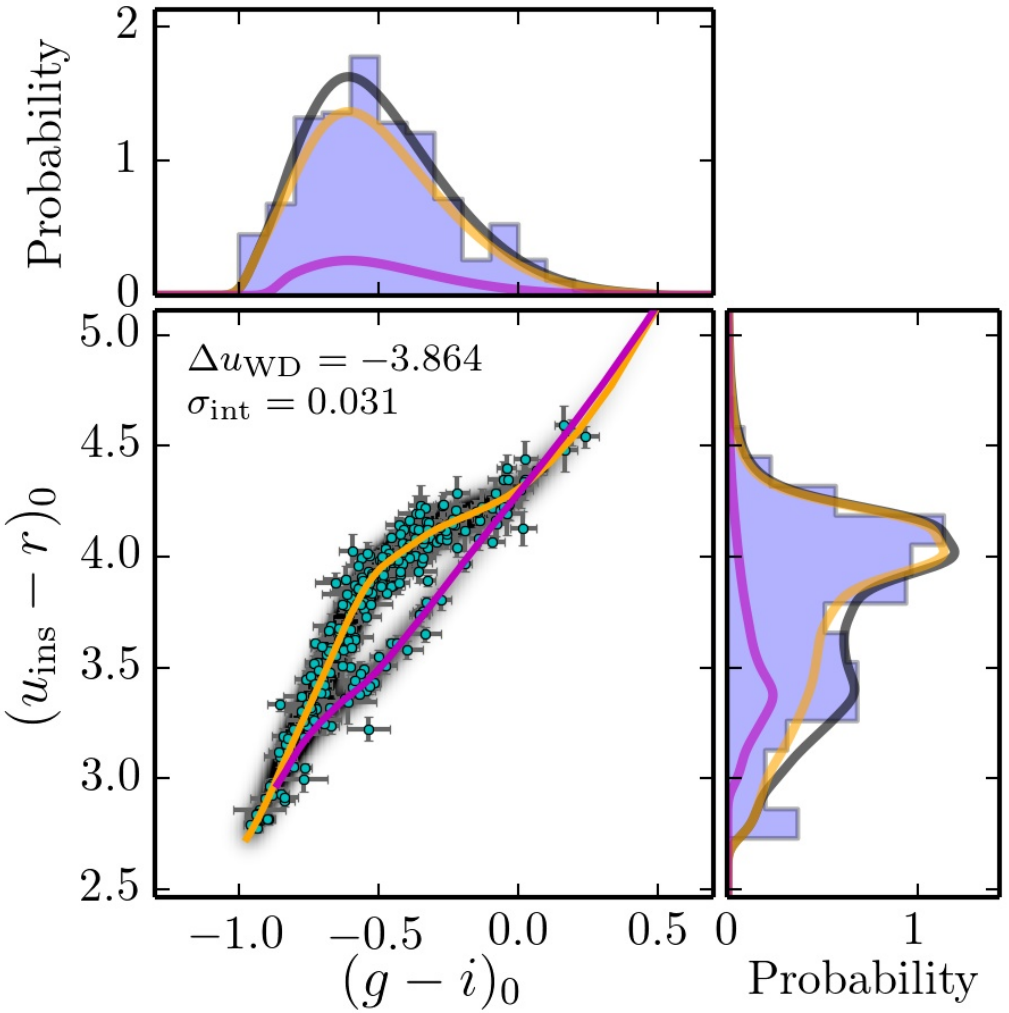

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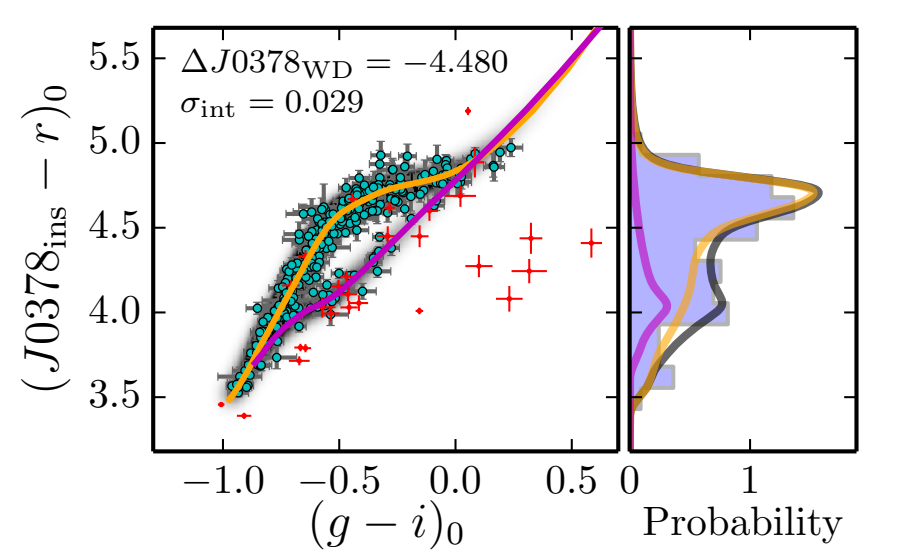
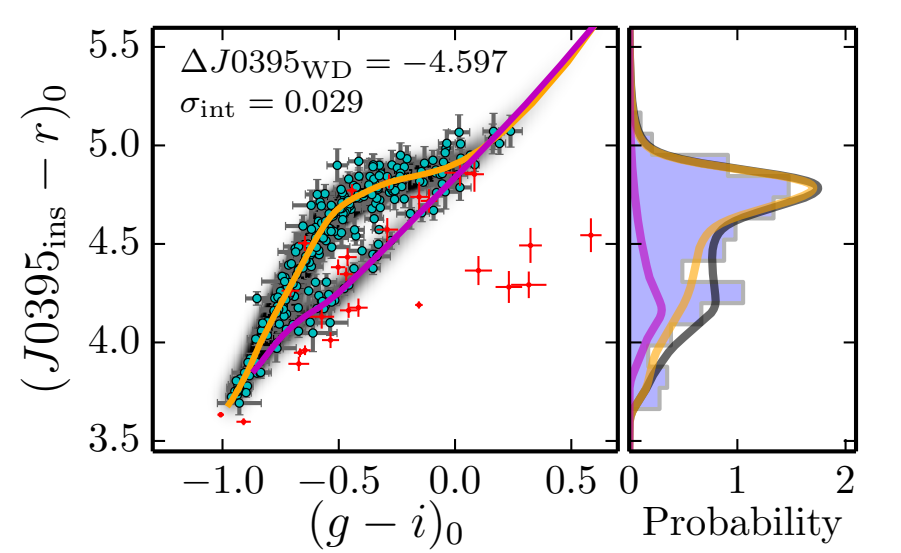
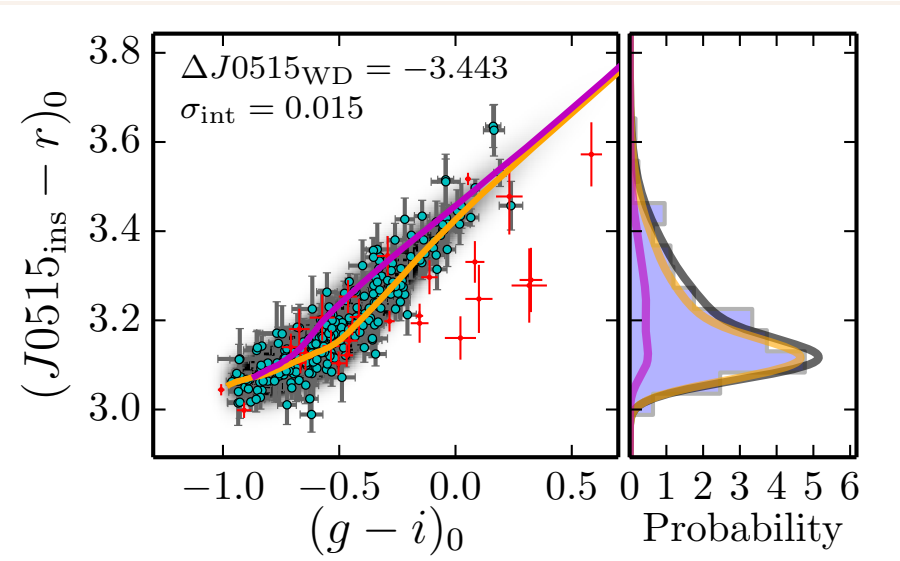
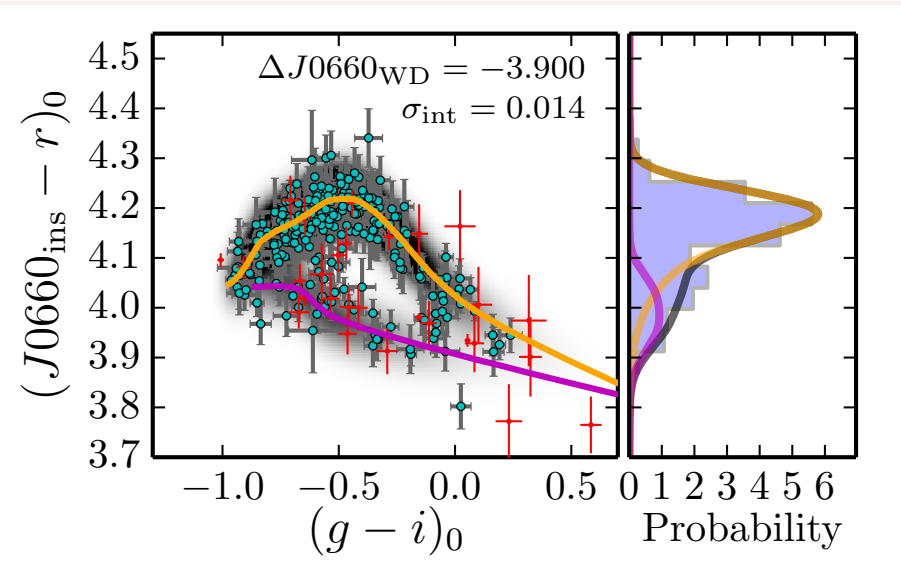
WD locus : extra colour-colour plots

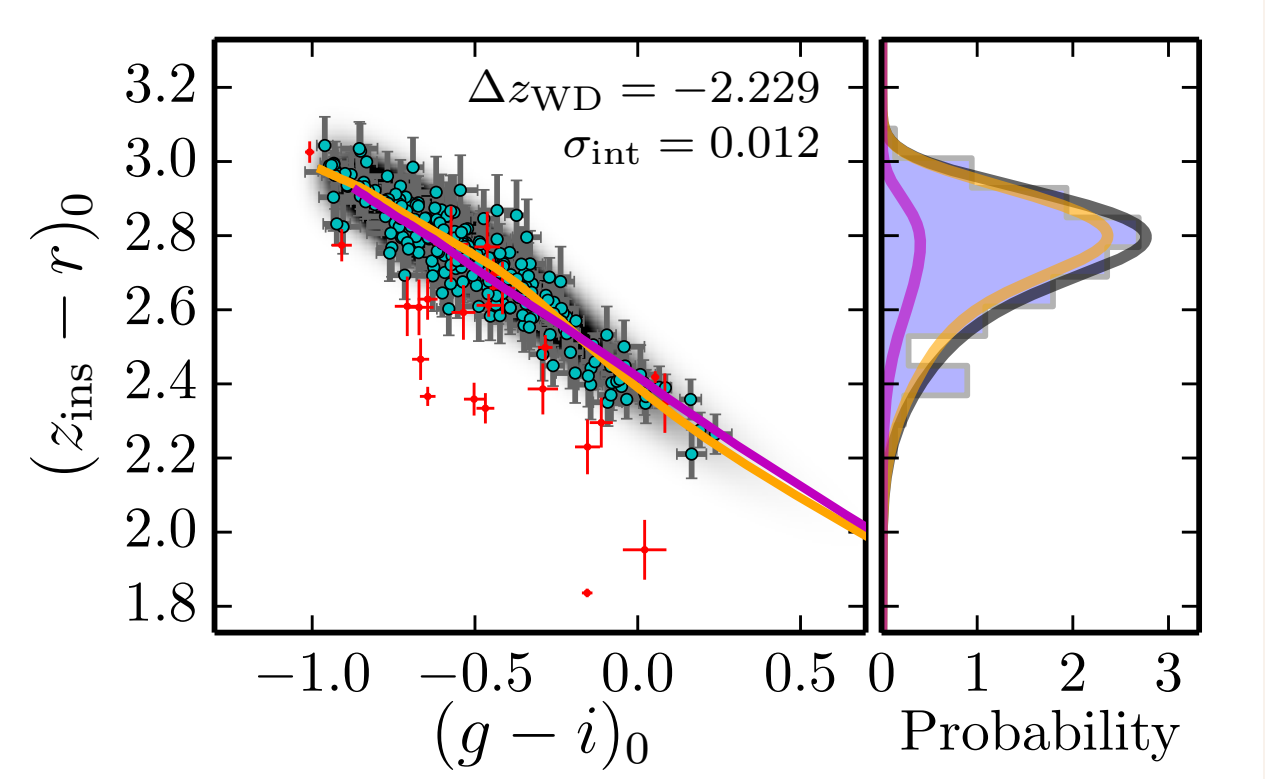








WD locus : testing the calibration



$$\mathrm{ZP}_z = z_{\rm ins} + \Delta z_{\rm WD}$$

$$\Delta \mathrm{ZP}_z = 0 \pm 5 \text{ mmag}$$

ZP_z from Pan-STARRS

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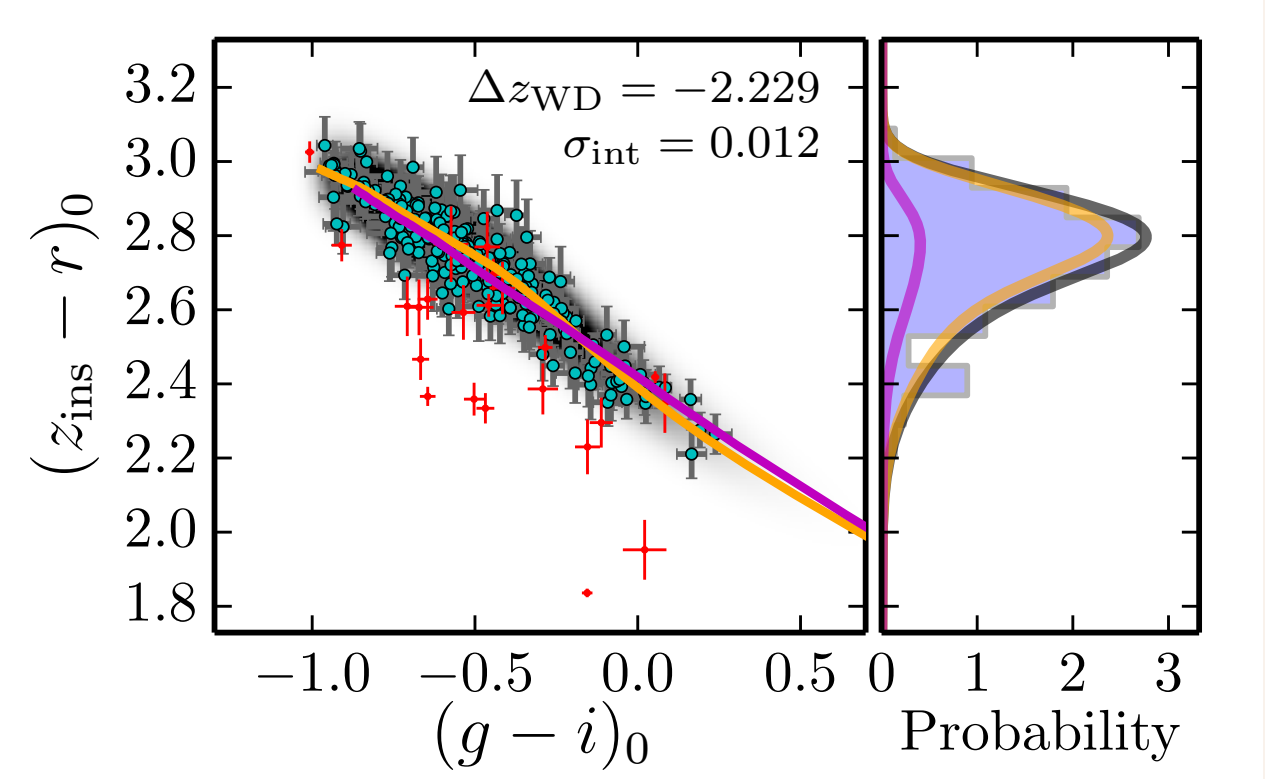

$$\mathrm{ZP}_z = z_{\rm ins} + \Delta z_{\rm WD}$$

$$\Downarrow$$

$$\Delta\mathrm{ZP}_z = 0 \pm 5 \text{ mmag}$$

$$\Uparrow$$

ZP_z from Pan-STARRS

Conclusions

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to J-PLUS and J-PAS

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