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# White dwarf plus main sequence binaries as astrophysical tools in modern astronomy

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Physics Department of UPC – July 2020

# The team (plus O. Toloza's on close binaries)

## Title: White dwarf plus main sequence binaries as astrophysical tools in modern astronomy

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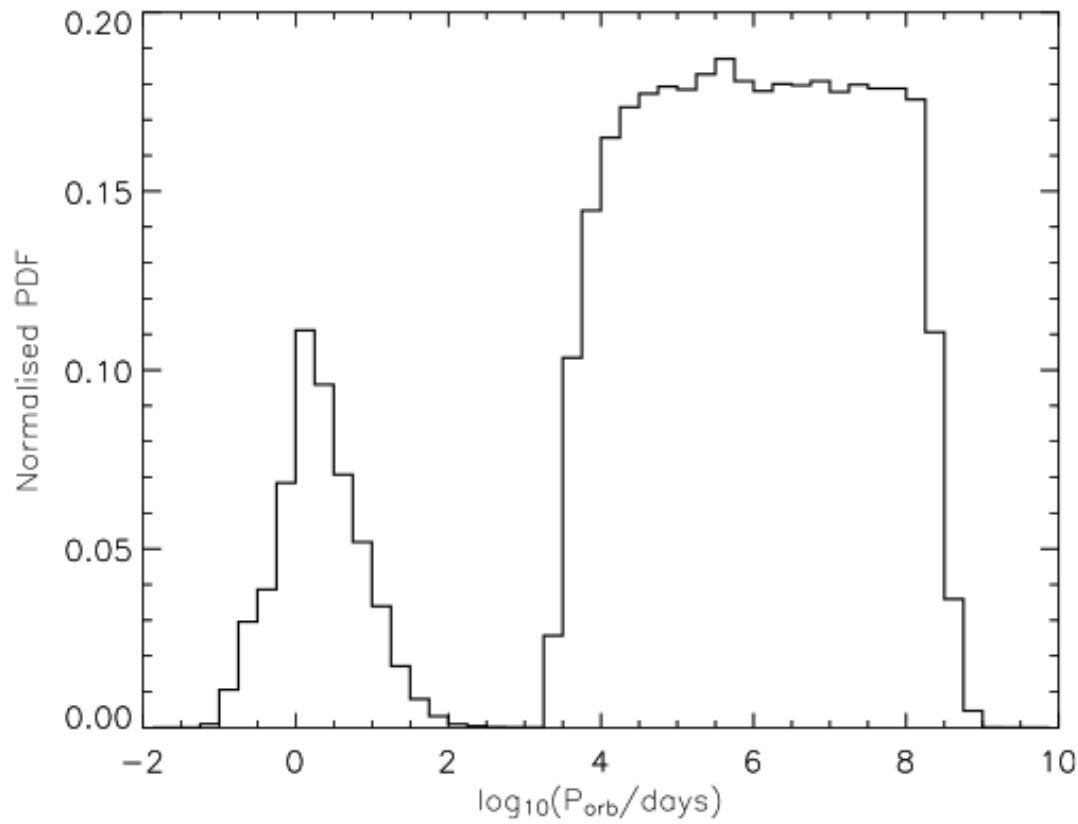
**M. R. Schreiber**, Universidad de Valparaíso, Chile;

**A. F. Pala**, European Southern Observatory, Germany;

**J. J. Ren**, National Astronomical Observatory, Chinese Academy of Sciences, China

# Scope of the survey: white dwarf binaries

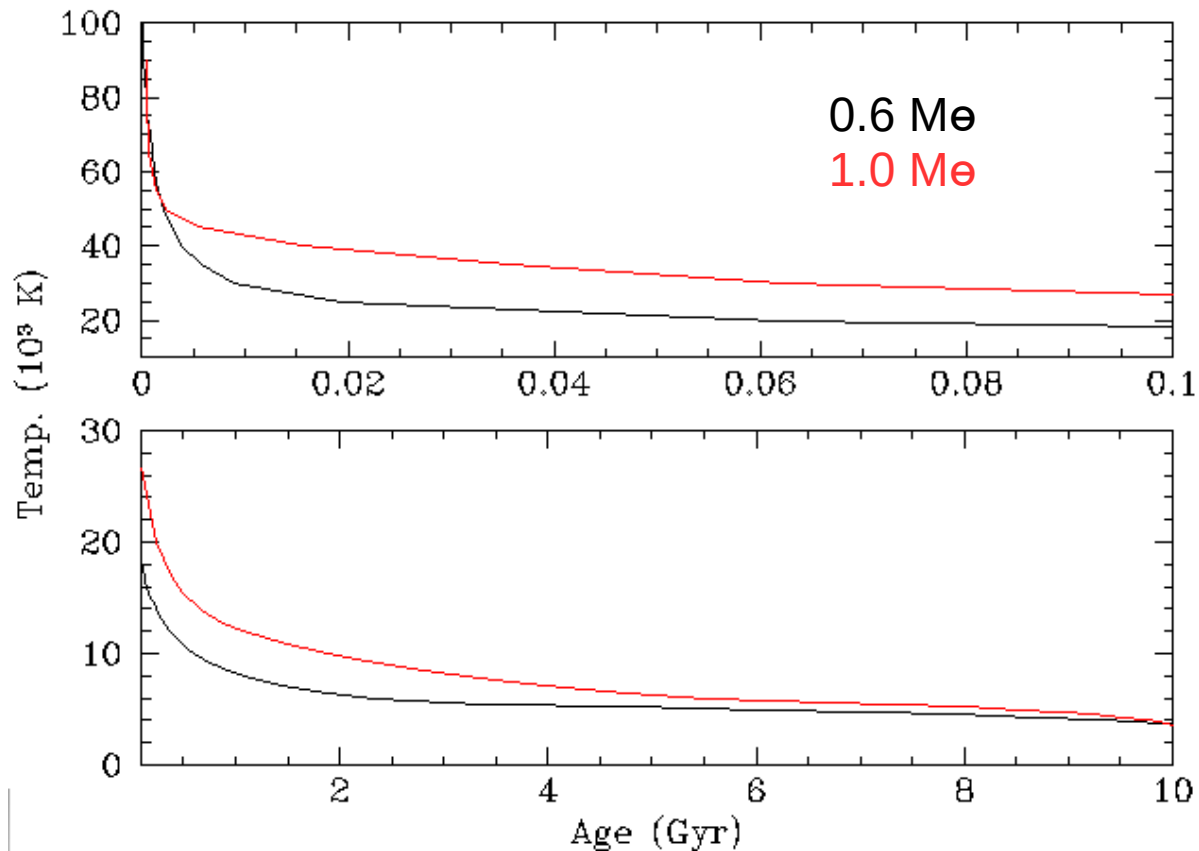
~75% of WD+MS binaries have large separations and ~25% are supposed to have evolved through common envelope evolution (O. Toloza)



# Scope of the survey: target type

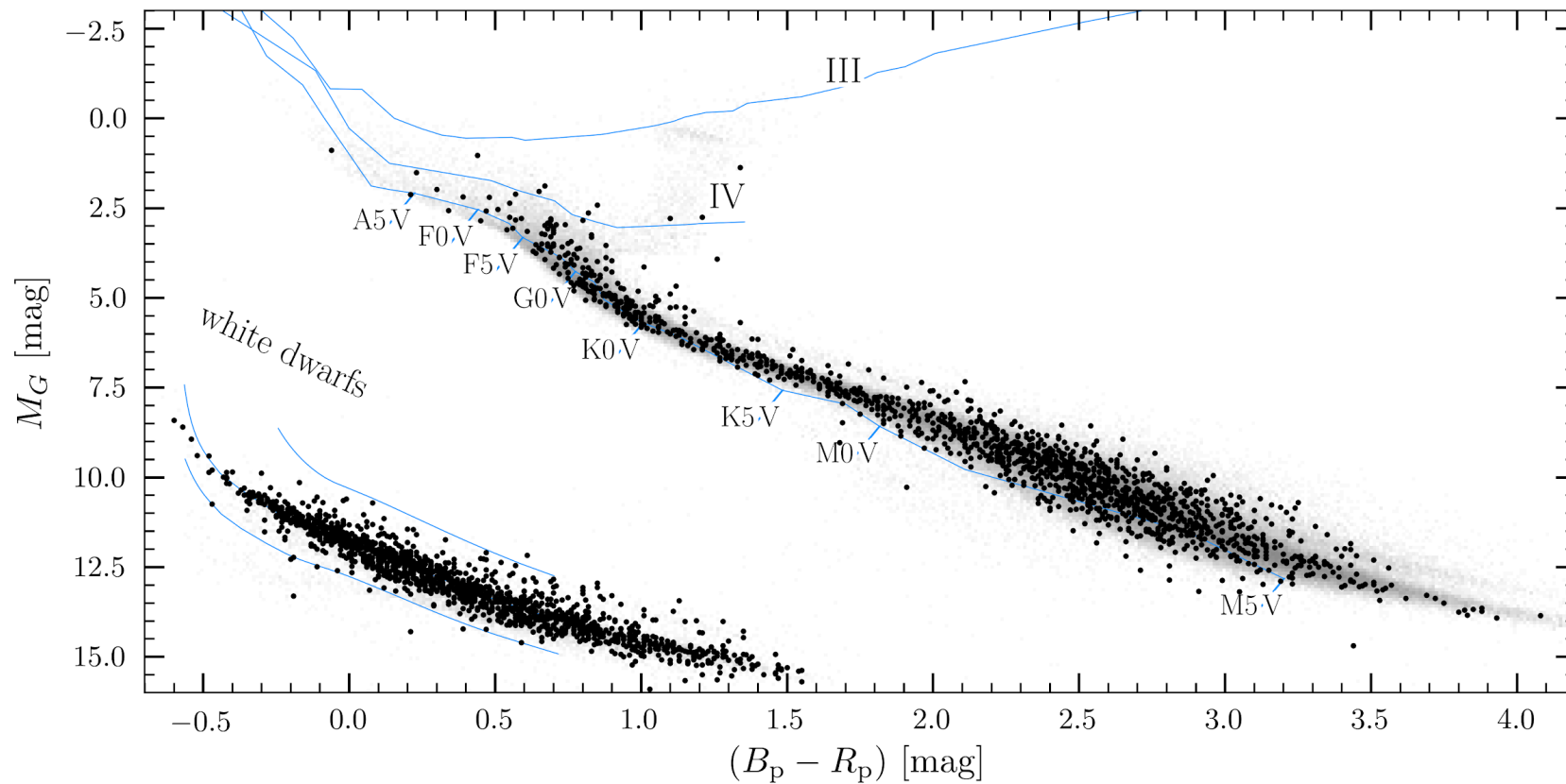
Main sequence (MS) stars that are part of CPMPs with white dwarfs (WDs)

The stellar components evolve like single stars, hence the WDs can be used as cosmochronometers



# Scope of the survey: target type

*Gaia* DR2 has allowed identifying ~3000 WD+MS CPMPs within 200pc;  
1535 observable by 4MOST



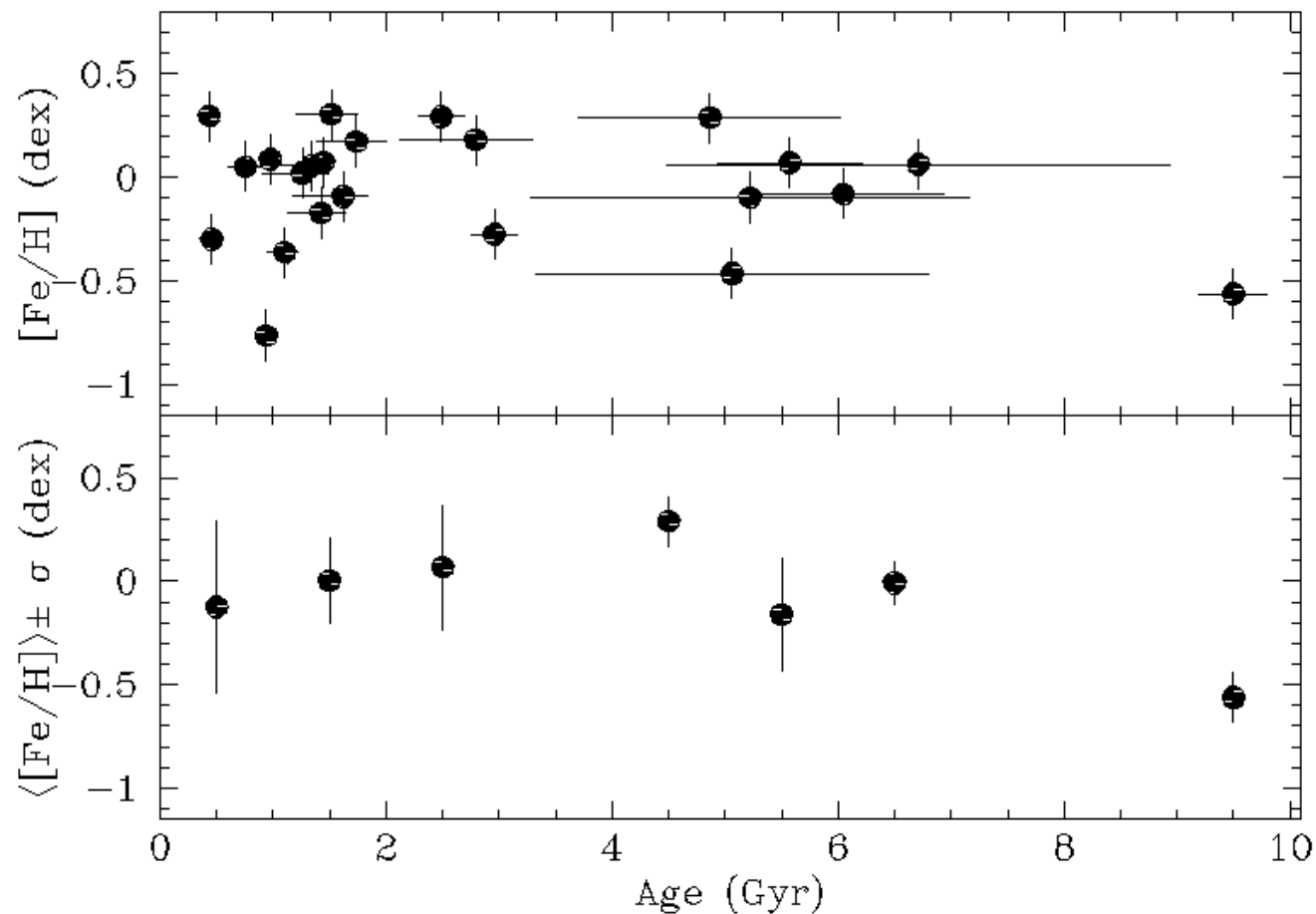
# Scope of the survey: target type

*Gaia* DR2 has allowed identifying ~3000 WD+MS CPMPs within 200pc; 1535 observable by 4MOST.

- Focus on the MS stars; WDs will be observed as part of Consortium sub-survey of 4MIDABLE-LR led by P.-E. Tremblay
- We aim at obtaining  $T_{\text{eff}}$ ,  $\log g$ ,  $[\text{Fe}/\text{H}]$ , RV, activity information of the MS Stars.
- Scientific aim, to constrain (among others):
  - a) The age-metallicity relation of the Galactic disk
  - b) The age-velocity dispersion relation
  - c) The age-activity relation of low-mass MS stars

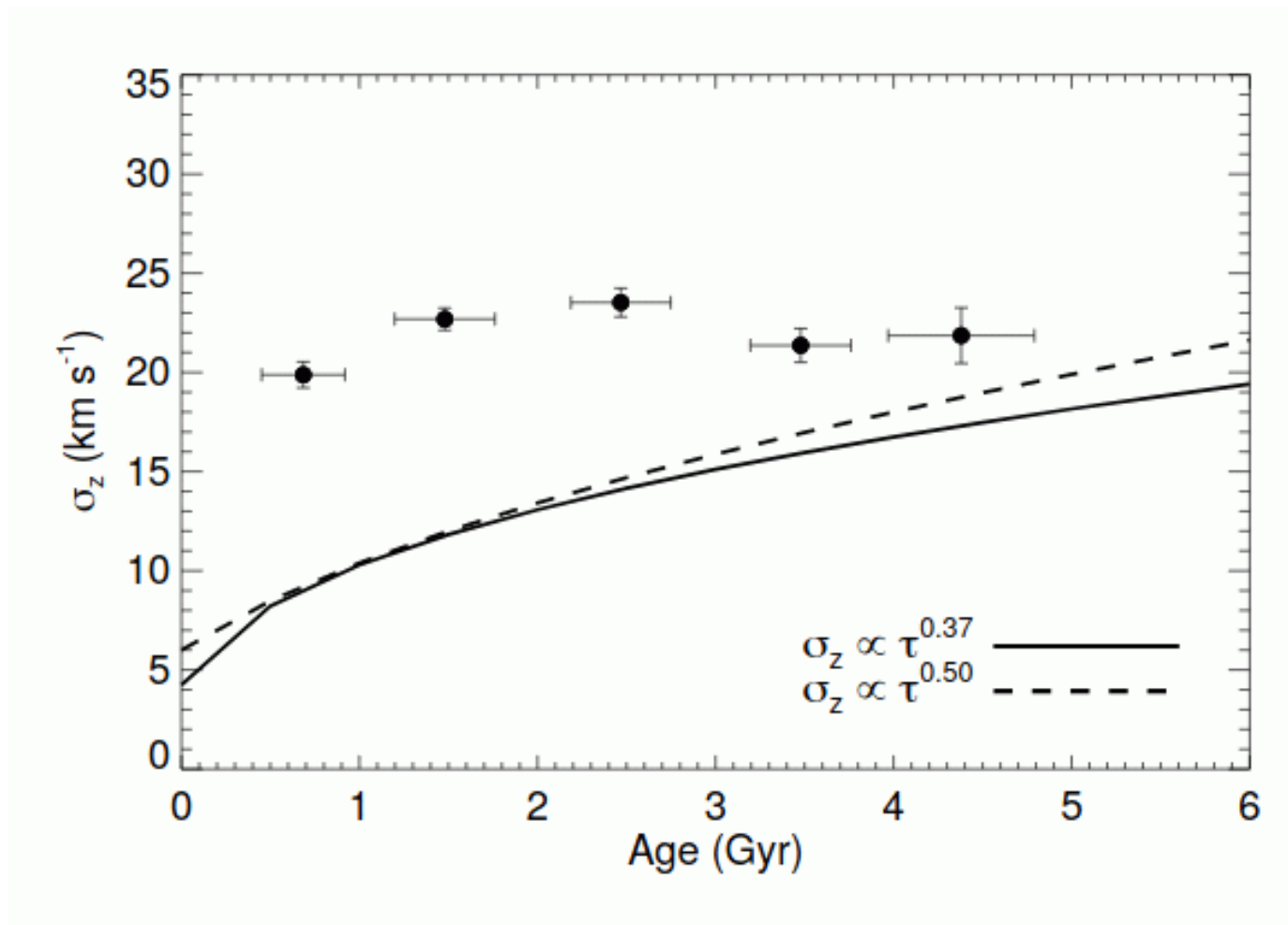
# Scope of the survey: previous results

Age-metallicity relation based on 23 SDSS wide but unresolved WD+MS binaries



# Scope of the survey: previous results

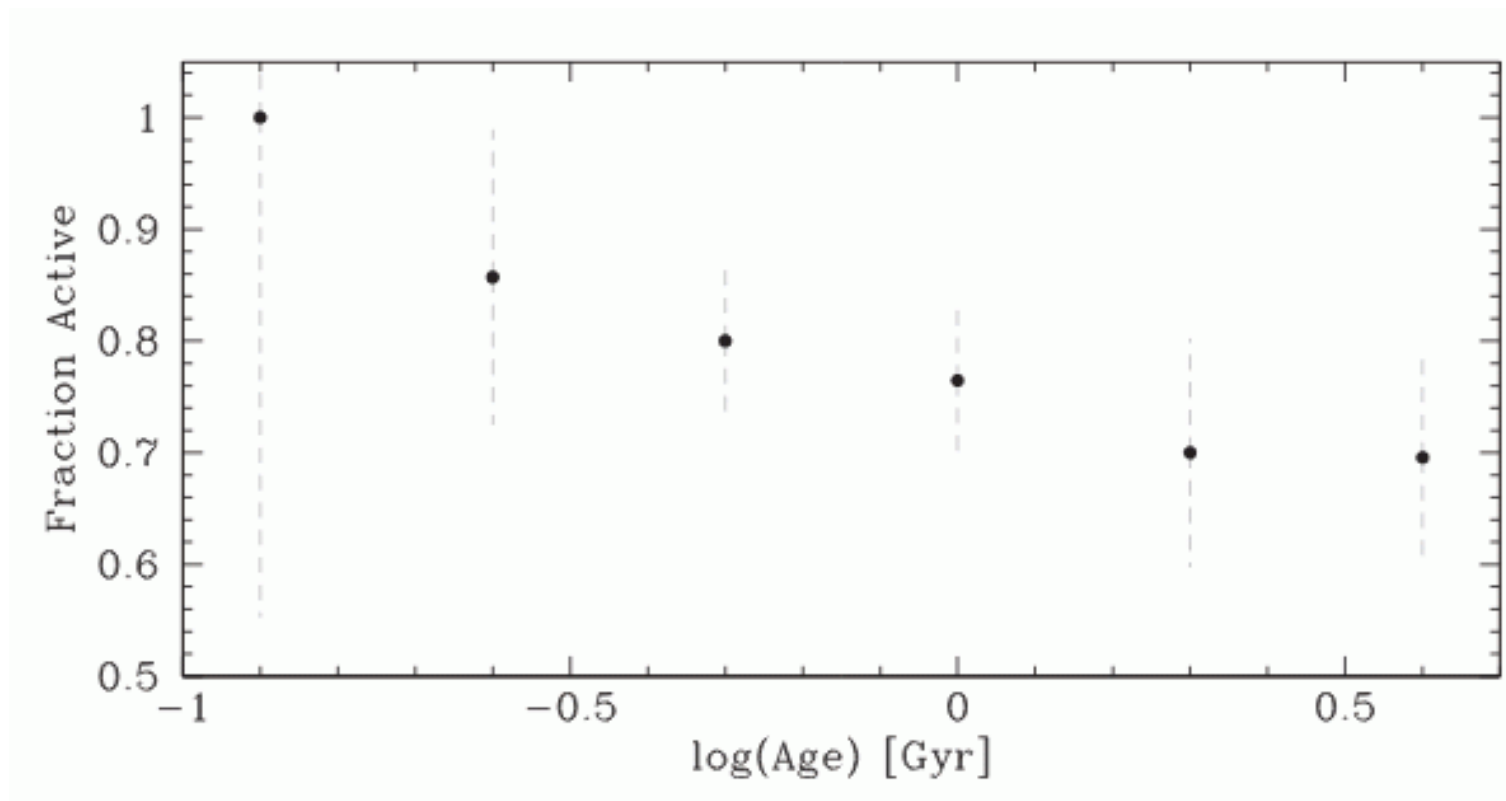
Age-velocity dispersion relation based on ~2000 single SDSS WDs





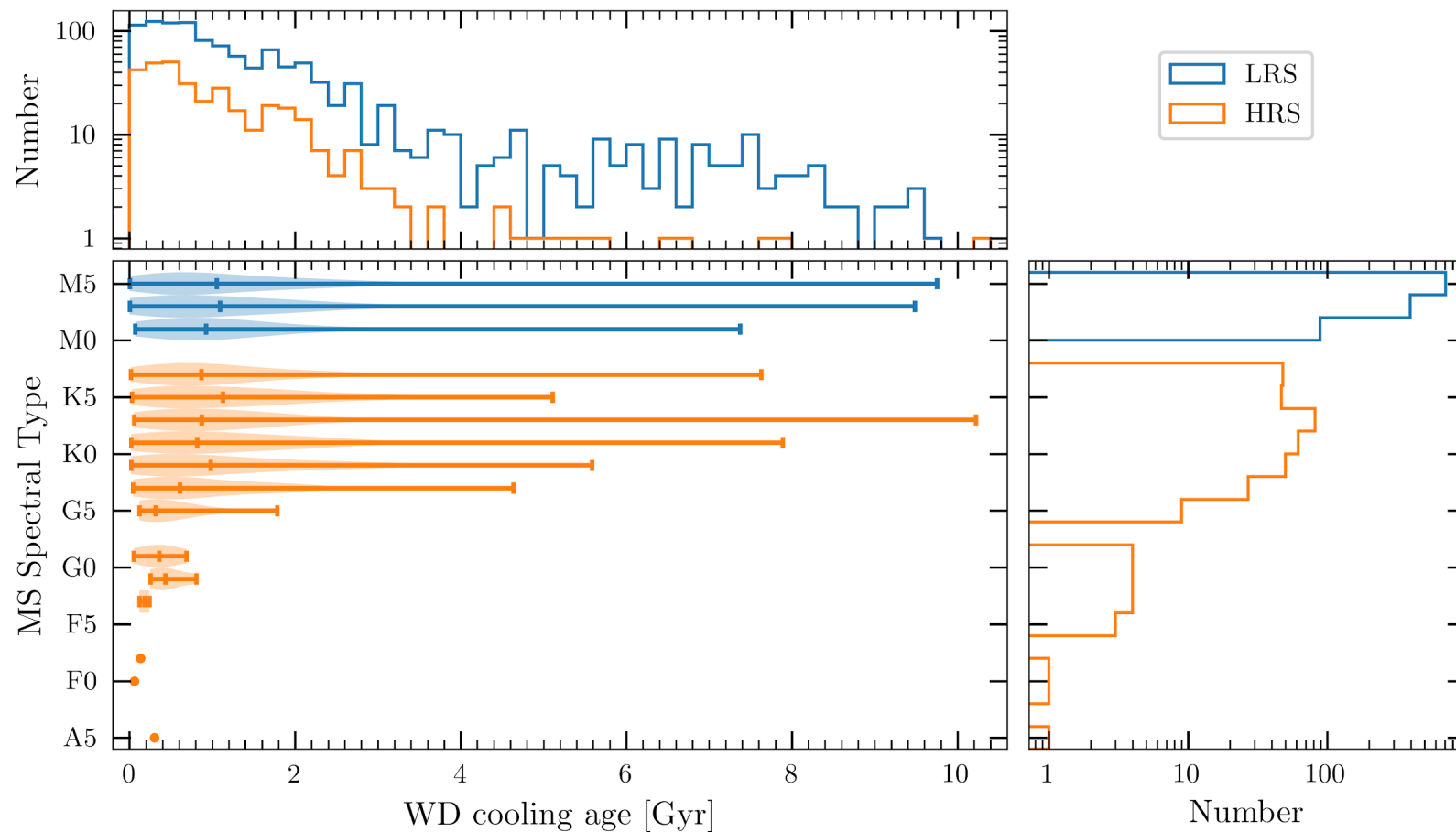
# Scope of the survey: previous results

Age-activity relation based on ~600 SDSS wide but unresolved WD+MS binaries



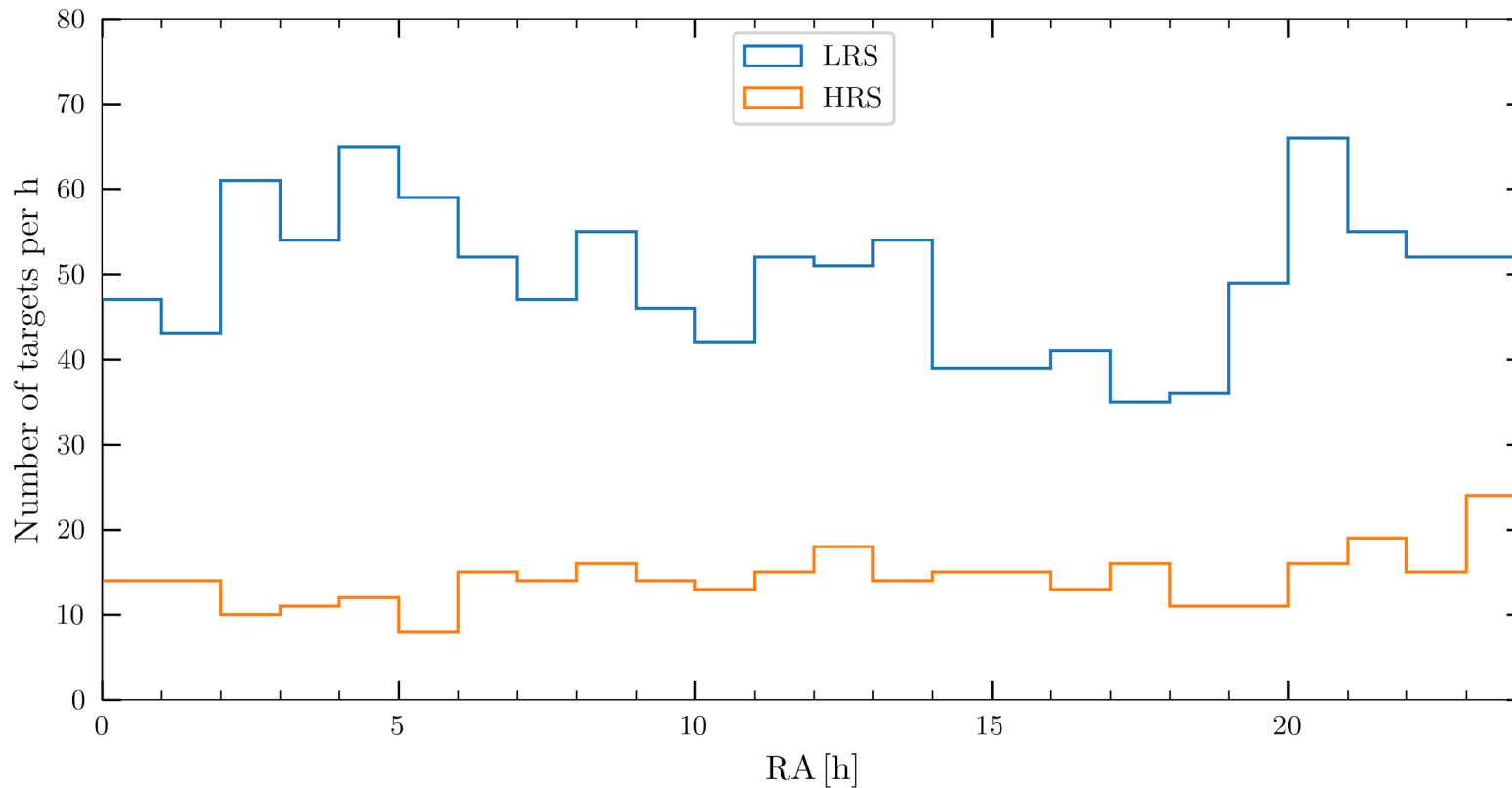
# Scope of the survey: target type

*Gaia* DR2 has allowed identifying ~3000 WD+MS CPMPs within 200pc; 1535 observable by 4MOST.



# Scope of the survey: target density and area

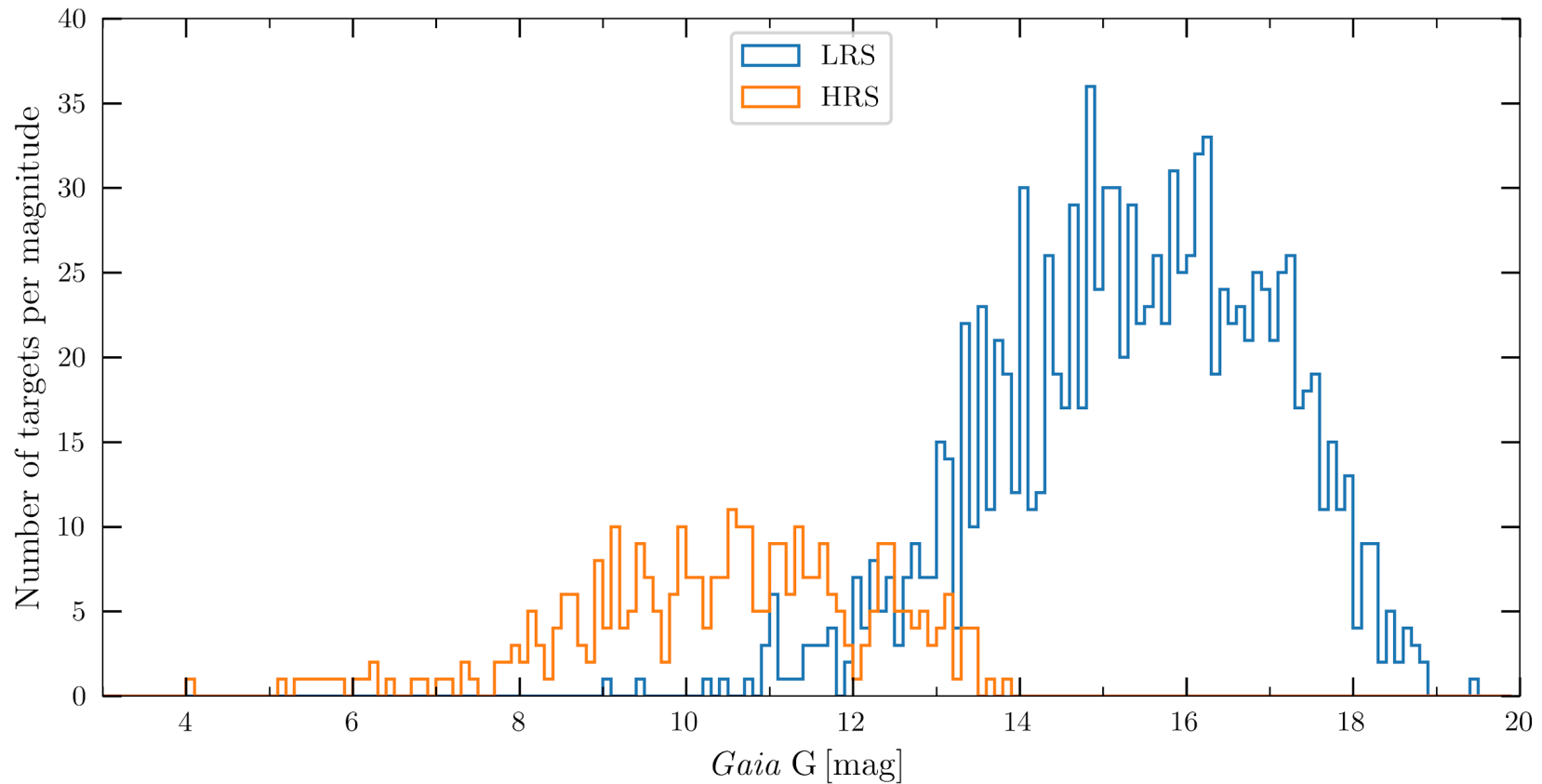
1535 targets equally distributed (no particular area) with  $<1$  target/degree<sup>2</sup>  
→ less than 1 target per 4MOST field-of-view



~60% have separations below 20" and ~40% above 20".

# Scope of the survey: magnitude distribution

343 F,G,K stars (HRS) and 1192 M dwarfs (LRS)



# Spectral resolution, SN and fibre hours and completeness

343 F,G,K stars (HRS) and 1192 M dwarfs (LRS)

HRS required to derive  $T_{\text{eff}}$ ,  $\log(g)$ ,  $R$ ,  $M$ ,  $[\text{Fe}/\text{H}]$  of 343 FGK MS stars (also RVs and activity information)  $\rightarrow$  most (all) of them should be observed

SN  $\sim$  100  $\rightarrow$   
(grey moon)

High Resolution					
Gaia G (mag)	5	7	9	11	13
Exp time (s)	2 x 10	2 x 10 2 x 30	2 x 60 2 x 180	2 x 300 2 x 900	2 x 1200 4 x 1800

LRS required to derive spectral types ( $\sim M$ ,  $T_{\text{eff}}$ ) plus activity indicators (also RVs) for 1192 M stars  $\rightarrow$  at least  $\frac{1}{2}$  should be observed (FoM=0.5  $\rightarrow$  940)

SN  $\sim$  30  
(grey moon)

Low Resolution					
Gaia G (mag)	11	13	15	17	19
Exp time (s)	2 x 30	2 x 120	2 x 900	2 x 1800	4 x 1800

292 hours of HRS and 1132 hours of LRS observations

# Operational requirements

No special requirements

The number of sub-exposures can be taken at any time.

High Resolution					
Gaia G (mag)	5	7	9	11	13
Exp time (s)	2 x 10	2 x 10 2 x 30	2 x 60 2 x 180	2 x 300 2 x 900	2 x 1200 4 x 1800

Low Resolution					
Gaia G (mag)	11	13	15	17	19
Exp time (s)	2 x 30	2 x 120	2 x 900	2 x 1800	4 x 1800

# Use of L2 pipelines and L2 products to be delivered to ESO/public

We will greatly benefit from the data reduction pipeline and advanced data analysis pipeline (4GP), especially for the high resolution data of FGK stars

We will perform the spectral analysis of M-type dwarfs and deliver spectral types ( $\sim M$ ,  $T_{\text{eff}}$ ), activity indicators, RVs, ages (also for the FGK stars)

# Remarks

The data obtained by 4MOST will be complemented with our own follow-up in the northern hemisphere

Expected expansion of the sample to  $>200\text{pc}$  (use of Gaia EDR + DR3)

This project and the one presented by O. Toloza on close white dwarf binaries will be submitted together as a single proposal as recommended by the Public Survey Panel and ESO

We are also open for additional synergies with any other survey