Censo de estrellas frías hacia en el disco galáctico

Miriam Cortés Contreras
Departamento de Física de la Tierra y Astrofísica

Mayo 2025

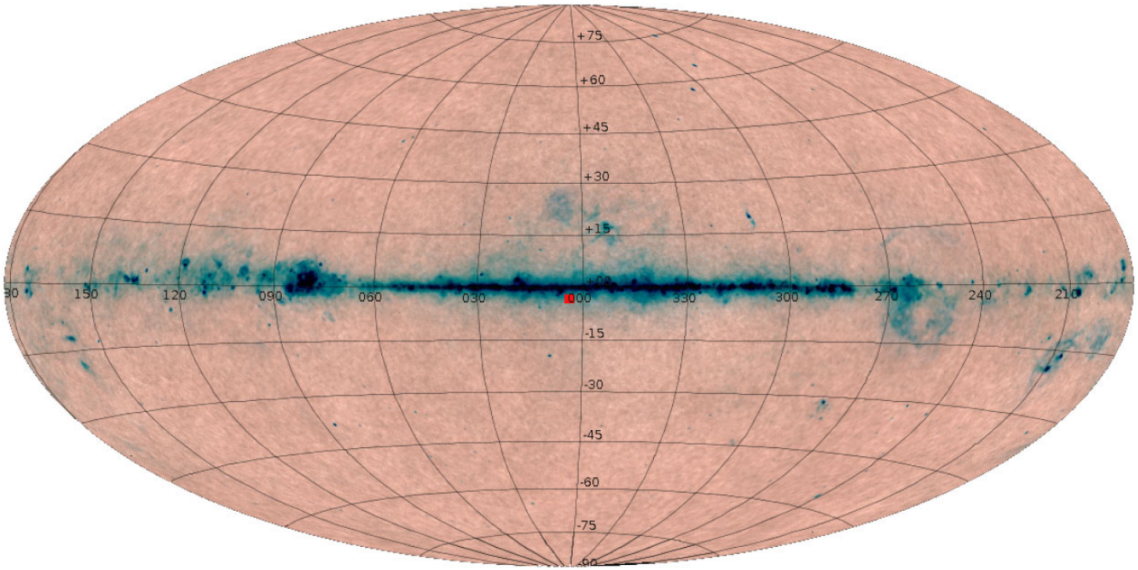
Proyecto

Crear un censo de estrellas de tipo solar y estrellas frías en dirección al centro galáctico a 500 pc.

- Alta densidad estelar
- Polvo interestelar

} Proporción de estrellas con parámetros físicos determinados en estrellas de baja masa «

- Composiciones químicas, edades, multiplicidad...
- Catálogo para submuestras de trabajo: exoplanetas, enanas marrones, subenanas...



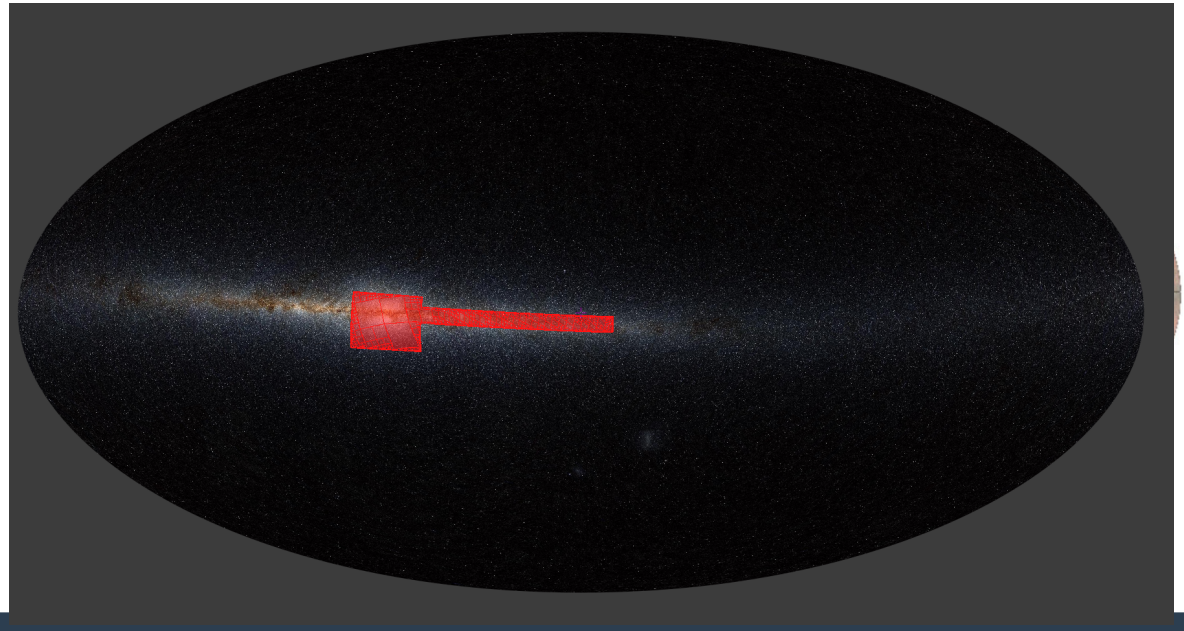
Proyecto

Crear un censo de estrellas de tipo solar y estrellas frías en dirección al centro galáctico a 500 pc.

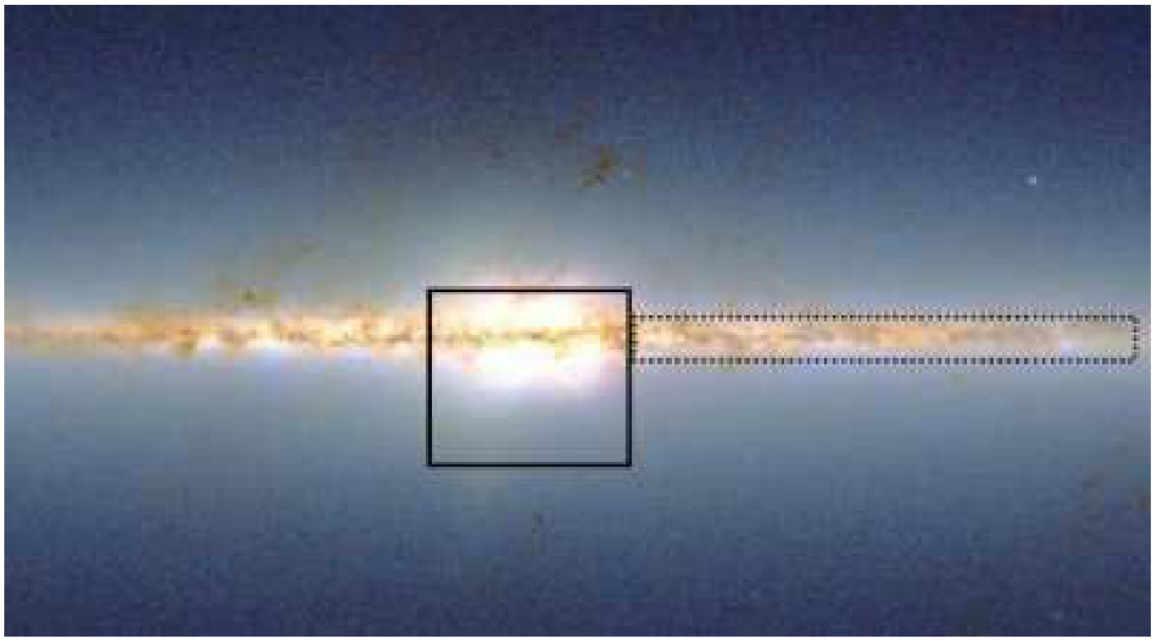
- Alta densidad estelar
- Polvo interestelar

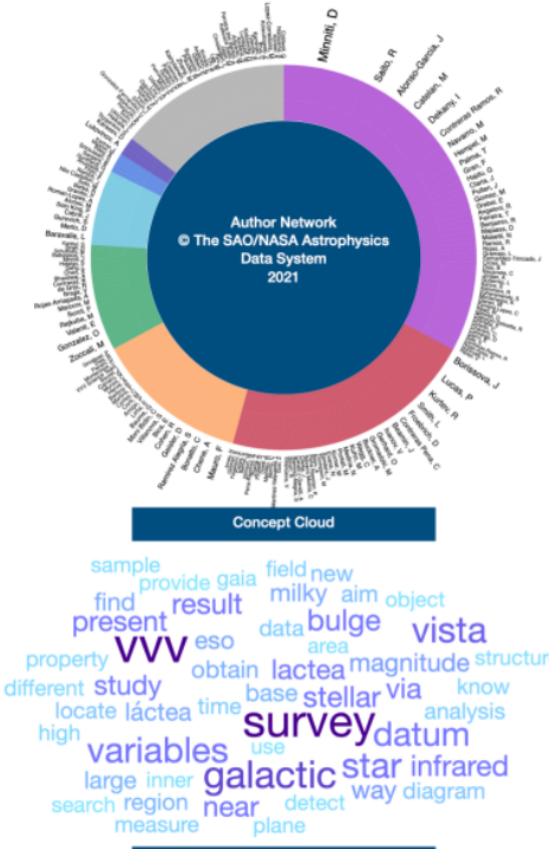
} Proporción de estrellas con parámetros físicos determinados en estrellas de baja masa «

- Composiciones químicas, edades, multiplicidad...
- Catálogo para submuestras de trabajo: exoplanetas, enanas marrones, subenanas...



VVV/VVVX





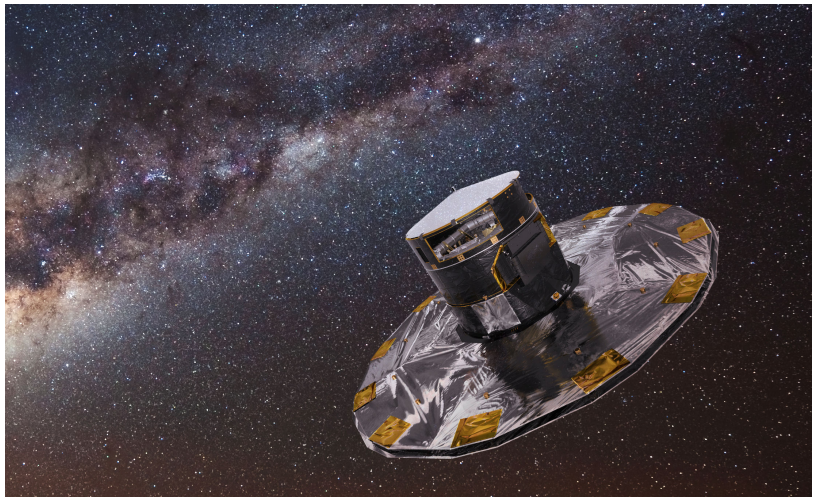
VVV - VISTA Variables in the Vía Láctea

VVVX – VVV eXtended

- Near-IR multi-colour multiepoch

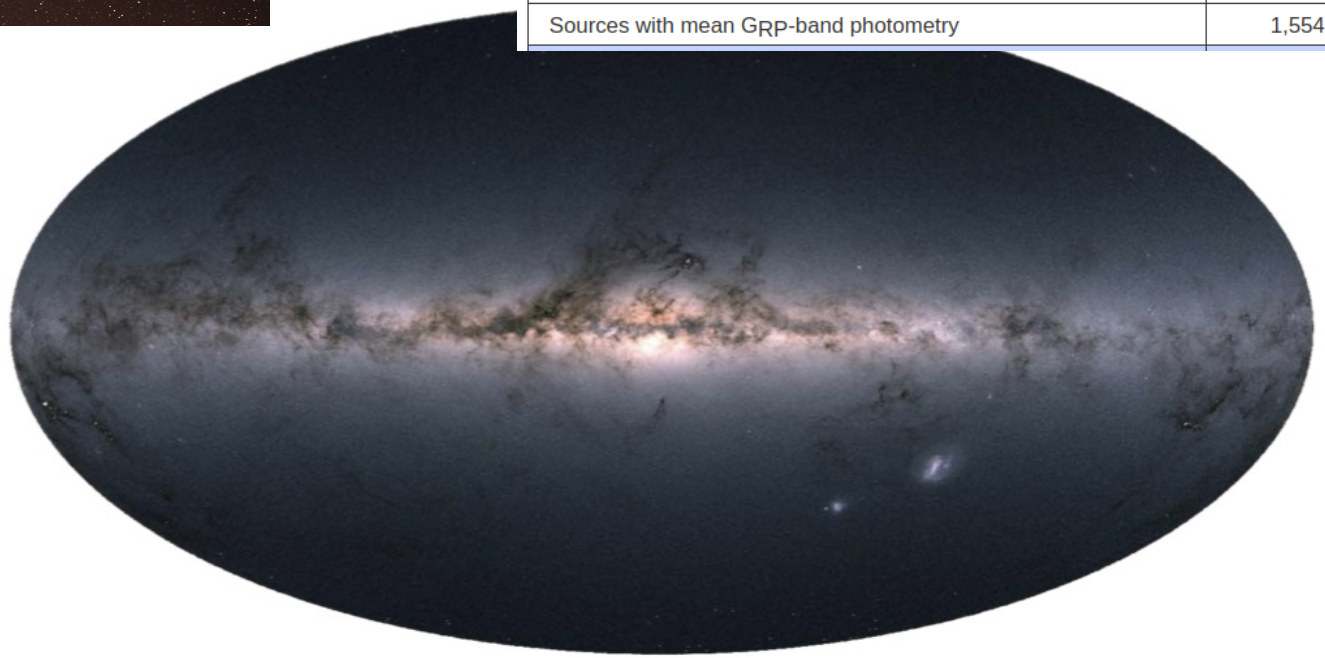
	VVV	VVVx
Campo sq. deg	520	1174
filtros	ZYJHKs	JHKs
#detecciones	325 517 800	751 989 000

Gaia DR3

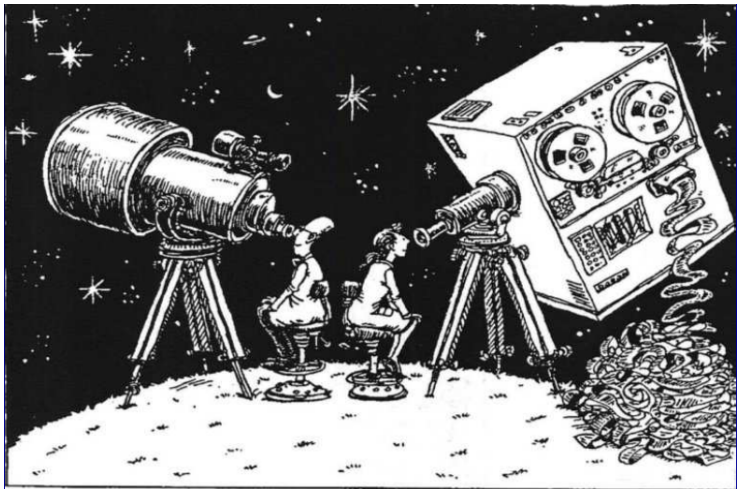


Gaia

	# sources in Gaia DR3
Total number of sources	**1,811,709,771**
	Gaia Early Data Release 3
Number of sources with full astrometry	1,467,744,818
Number of 5-parameter sources	585,416,709
Number of 6-parameter sources	882,328,109
Number of 2-parameter sources	343,964,953
Gaia-CRF sources	1,614,173
Sources with mean G magnitude	1,806,254,432
Sources with mean G_{BP}-band photometry	1,542,033,472
Sources with mean G_{RP}-band photometry	1,554,997,939



Observatorio Virtual

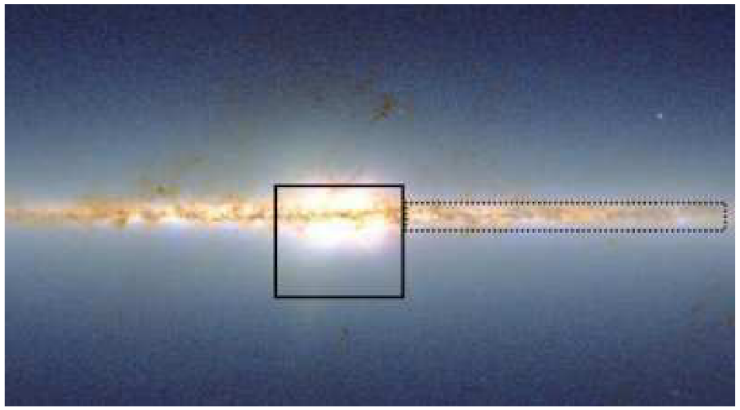




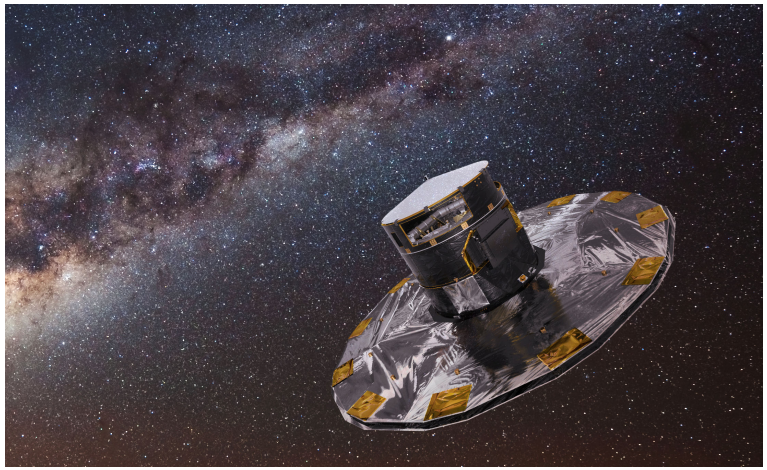
Findable Accessible Interoperable Reusable

Goal: Easy and efficient access and analysis of the information hosted in astronomical archives.

VVV + Gaia + Observatorio Virtual



+



+

TOPCAT

VizieR

ALADIN

STILTS

X-MATCH

VOSA

Ms en VVV (Cruz et al. 2023)

7925 M-dwarf stars identified

1) Through Gaia parallaxes

→ Cross-match with Gaia DR3, with a 1" search radius
→ Good astrometric solution (RUWE < 1.4)
→ Relative G and RP magnitude errors below 10%
→ Good parallax measurements (pi > 0 and pi_err/pi < 0.2)

→ Stars within 500 pc

2) Through colour cuts and PMs

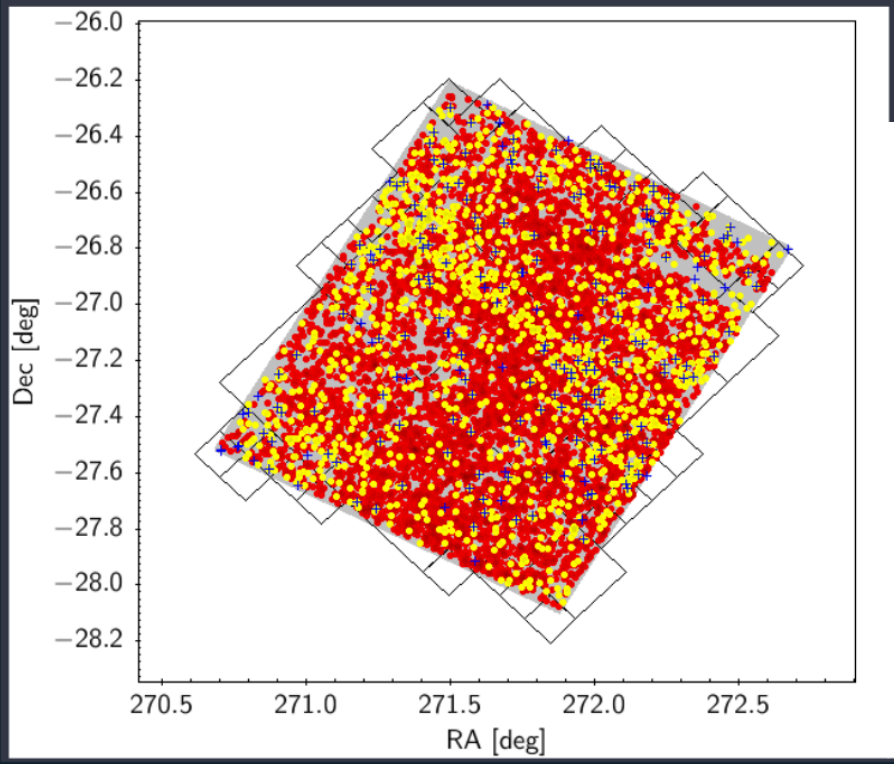
→ VISTA ZYJHKs bands and relative errors of less than 5%
→ Colour cuts for M dwarfs from Rojas-Ayala et al. (2014)
→ Gaia DR3 for proper motion (PM), 1" search radius
→ Relative PM_RA and PM_Dec errors below 20%
→ Reduced PM crite
→ PM > 10 mas/yr
→ G mag and go
1.4)

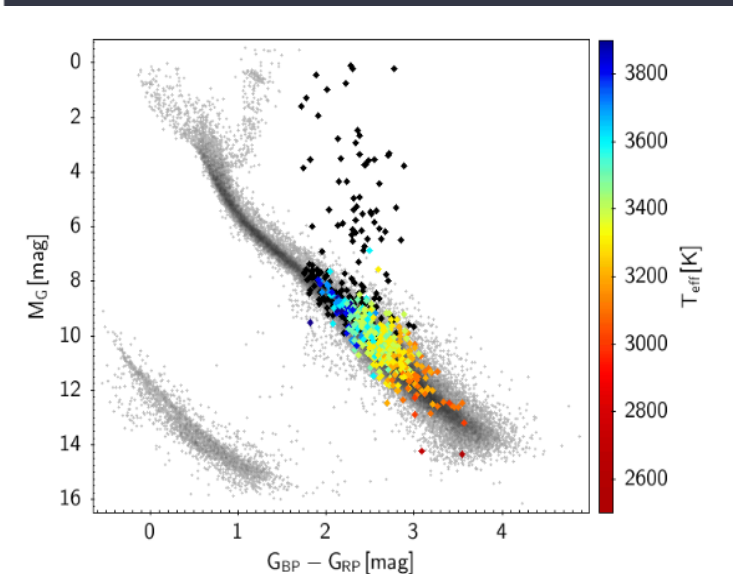
→ Stars within 500
from empirical solu

Patricia Cruz – SVO science meeting – March 2023

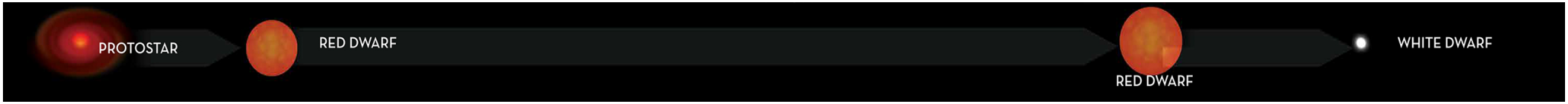
M dwarfs in Gaia DR3: 208
M dwarfs VVV+Gaia+VOSA: 7925

Comparison to Gaia M dwarfs

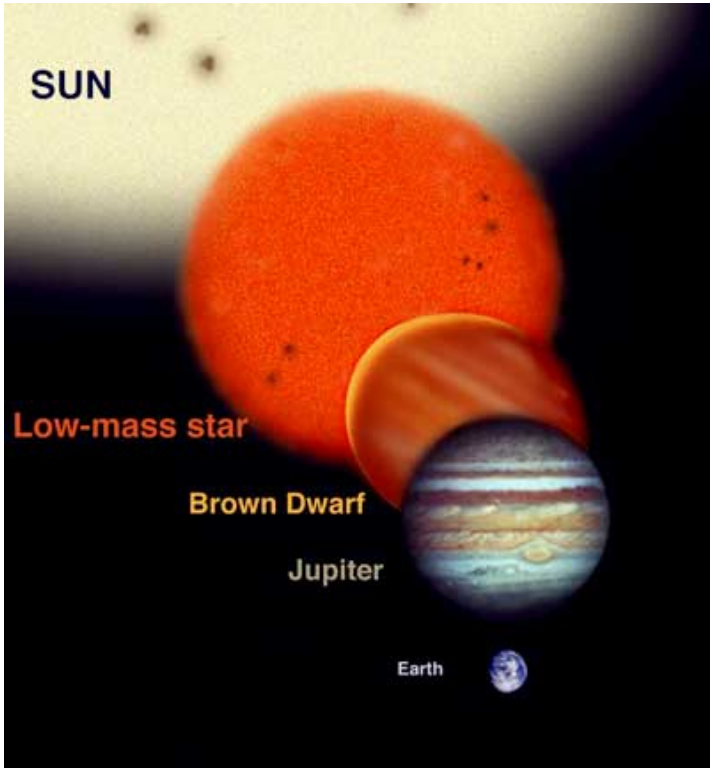




Ms



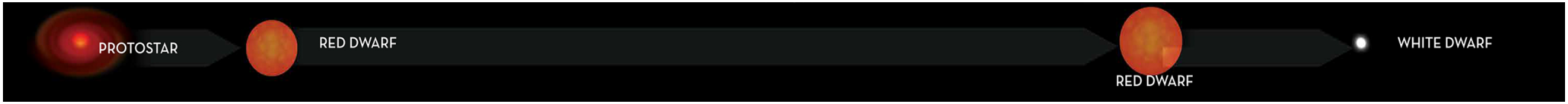
0.6-0.1 $M_{\odot}$ → Time



Convective envelopes & radiative cores -> full convection

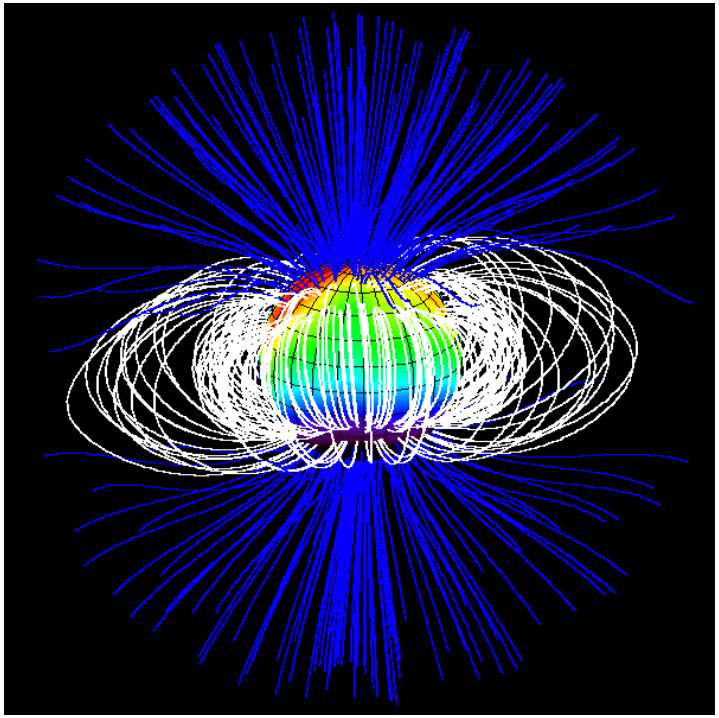
- Long lifetimes → tracers of the structure, kinematics, and evolution of the Galaxy
- M – LTY → formation and evolution processes involving stellar objects at the end of the HRD
- Prime targets of exoplanet surveys as possible hosts or habitable Earth-like planets

Ms



0.6-0.1 $M_{\odot}$

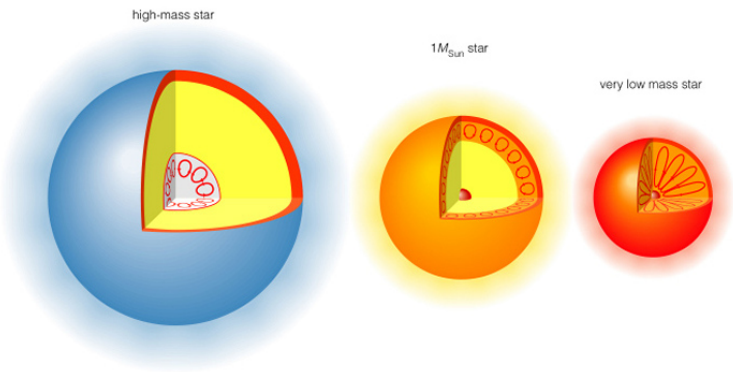
Time



Donati et al. 2006

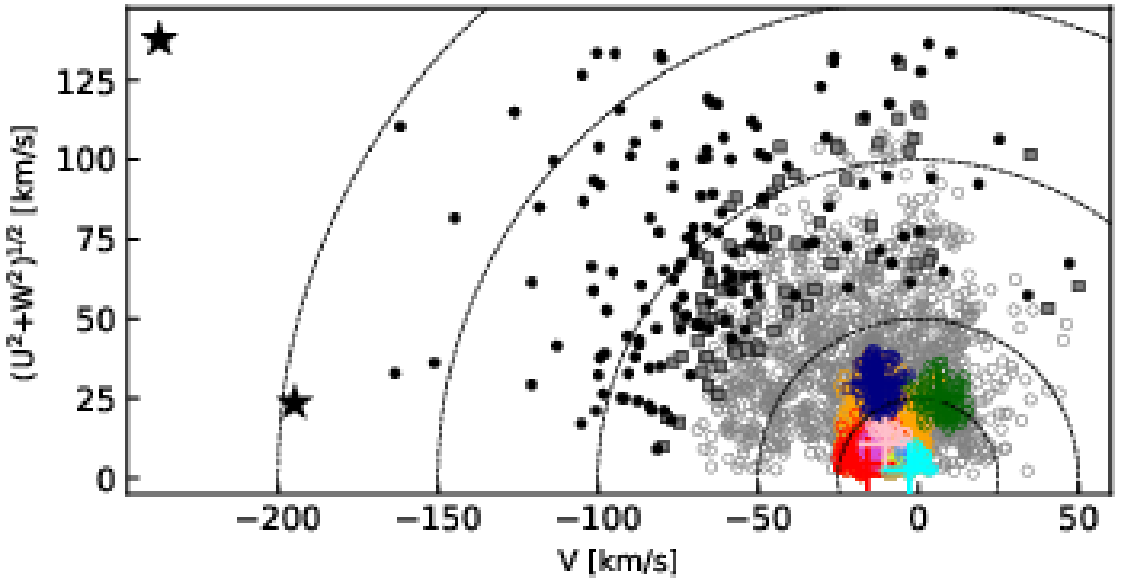
Convective envelopes & radiative cores -> full convection

- Dynamo generation of magnetic flux
- Activity - rotation conection
- Activity – age conection
- M dwarf companions of:
  - FGK → metallicity
  - WD → age



Caracterización

- Poblaciones estelares:
    1. Cinemática
        - » Subenanas (viejas, pobres en metales)
        - » Enanas (MS) – jóvenes?



CC et al. 2024

RA, DEC, plx, pmra, pmdec, RV -> UVW

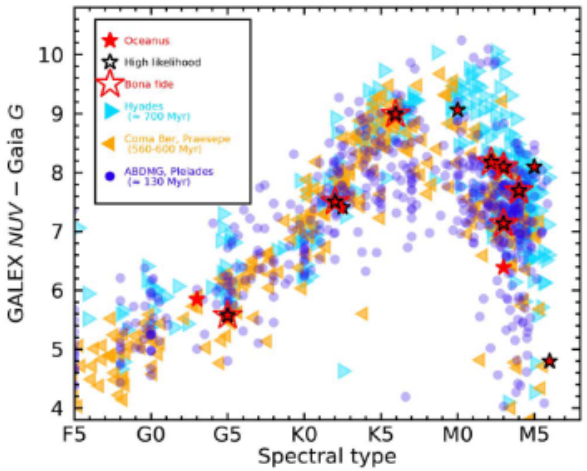
SteParKin (update from Montes+, 2001) -> Galactic populations

SteParKin, LACEwING, BANYAN sigma -> SKGs

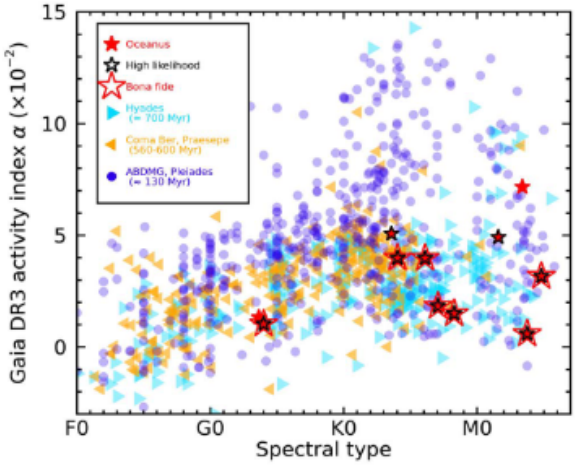
Caracterización

- Poblaciones estelares:
  1. Cinemática
     - » Subenanas (viejas)
     - » Enanas (MS) – jóvenes?
  2. Determinación de parámetros
     - » Actividad

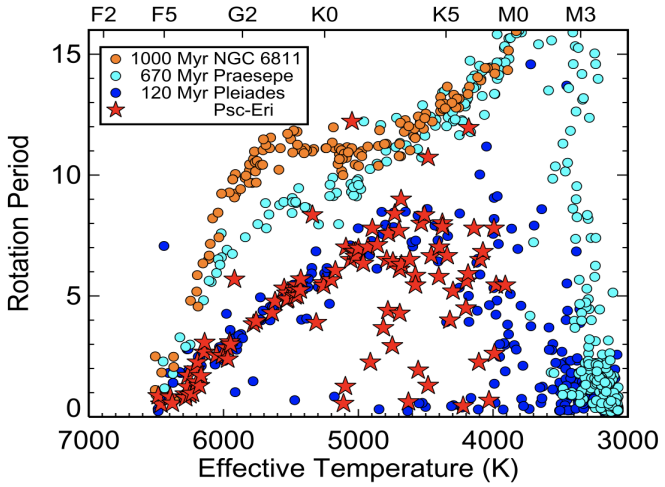
Gagné et al. 2023



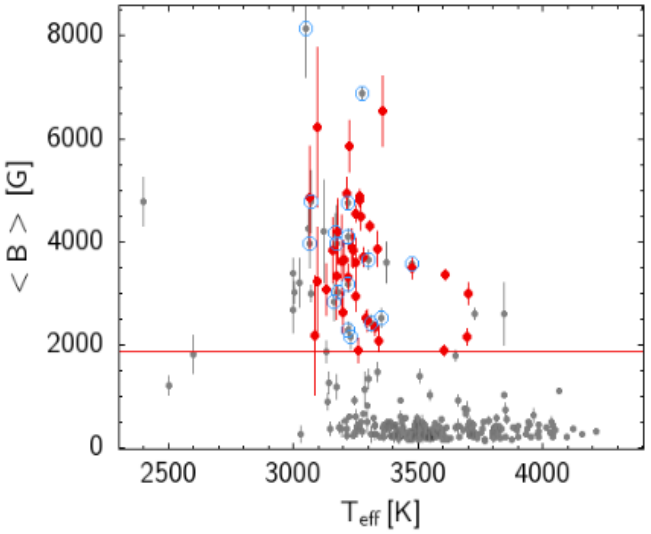
(c)Galex

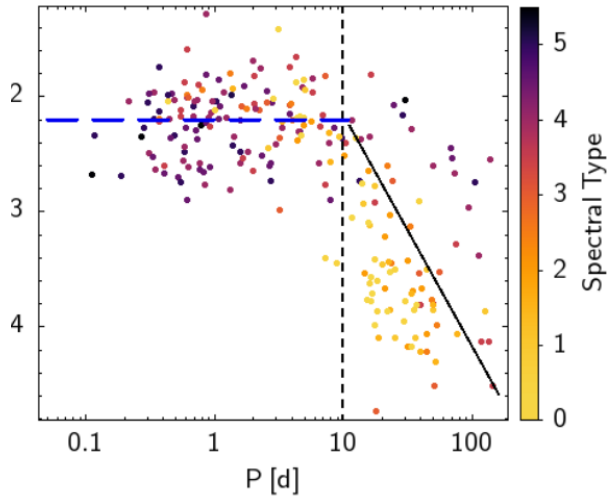


(b)Activity



Curtis et al. 2019





al. 2024

Caracterización

- Poblaciones estelares:
    1. Cinemática
    2. Determinación de parámetros
- Multiplicidad en Ms hasta 500pc
    - Enanas: ~ 25% (↑ ~40% Cifuentes+2025)
    - Subenanas: ~ 3% (↑ ~20% simulaciones)

Table 1. Stellar multiplicity fractions.

Reference	Investigated spectral type	d_{lim} [pc]	Multiplicity fraction [%]	Projected physical separation, s [au]	Survey method[a]
Duquennoy & Mayor 1991	F7–G9	22	~ 65	~ 0.01–225	RV, WI
Raghavan et al. 2010	~ F6–K3	25	44 ± 3	~ 0.005–100 000	RV, AO, S, WI
Reid & Gizis 1997	K2–M6	8	32	~ 0.1–1800	RV, S, WI
Leinert et al. 1997	M0–M6	5	26 ± 9	~ 1–100	S
Fischer & Marcy 1992	M	20	42 ± 9	[illegible]	RV, WI
Jódar et al. 2013	K5-M4	25	$20.3^{+6.9}_{-5.2}$	~ 0–80	LI
Ward-Duong et al. 2015	K7–M6	15	23.5 ± 3.2	~ 3–10 0[illegible]	AO, WI
Bergfors et al. 2010	M0.0–M6.0	52	32 ± 6	3–[illegible]	LI
Janson et al. 2012	M0.0–M5.0	52	27 ± 3	3–[illegible]	LI
Law et al. 2008	M4.5–M6.0	¡15.4¿	$13.6^{+6.5}_{-4.0}$	~ [illegible]0	LI
Siegler et al. 2005	M6.0–M7.5	30	9^{+4}_{-3}	⩾ 5	AO
Janson et al. 2014a	M5.0–M8.0	36	21–27	~ 0.5–100	LI
Close et al. 2003	M8.0–L0.5	33	15 ± 7	¡15	AO
Bouy et al. 2003	M7.0–L8.0	20	10–15	1–8	HST
Reid et al. 2008	L	20	$12.5^{+5.3}_{-3.0}$	¡3	HST
Burgasser et al. 2003	T	¡10¿	9^{+15}_{-4}	1–5	HST

Explotación científica

- Cinemática y estructura de la MW
- Clasificar y caracterizar UCDs -> mecanismos de formación?
- Multiplicidad:
  - Formación y evolución?
  - Determinación de parámetro estelares (R, M)
- Simetría en 500pc
- Proporcionar:
  - muestras bien caracterizadas para testear modelos de formación y evolución
  - Muestras búsqueda exoplanetas



¡Gracias!