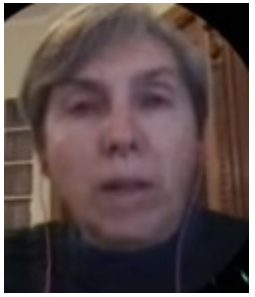
Ummi Abbas Martin Barstow Beatrice Bucciarelli Jos de Bruijne Josep Manel Carrasco William Cooper






Nigel C. Hambly

Simon Hodgkin

The *Gaia* Catalog of Nearby Stars

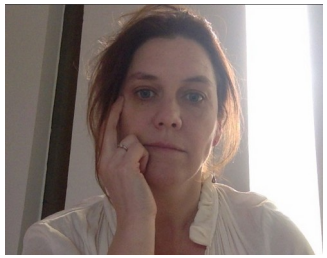

Eduard Masana

Richard Smart

Daniel Michalik

Gaia Collaboration


Céline Reylé Annie Robin Jan Rybizki Johannes Sahlmann Luis Sarro Alessandro Sozzetti






GCNS overview

The GCNS is a catalog of 331K objects within 100pc of the Sun based on EDR3 described in arXiv:2012.02061.

A science overview: https://www.youtube.com/watch?v=rEEMzYhnA_Q

Resources (posters, videos…): https://gucds.inaf.it/projects/gcns/
Note very nice poster and application from Kevin Jardine

Get catalogs:
wget -r -np -nH -e robots=off -R 'index*' -I GCNS https://gucds.inaf.it/GCNS

GAVO TAP: https://dc.g-vo.org/browse/gcns/q
Still not on CDS….

Join discussion group send email to gaiacns+subscribe@googlegroups.com

Here I talk about what GCNS says about EDR3 and what is new
Structure of talk: 10pc Sample
WD population
GCNS Cleaning
GCNS cited uses

10pc sample

Object	Total	Remain
Known objects inside 10pc (in 339 systems).	540	540
Planets from RV / Transit searches and too faint for Gaia.	78	462 [A]
BDs too faint for Gaia, G larger than 21.	51	411
In un-resolvable binaries, separation < 0.5”, many will be in DR4	42	369 [B]
Too bright for Gaia, G smaller than 3.	7	362
In EDR3 with parallax	312	50
In EDR3 with no parallax	34 [C]	16 [D]

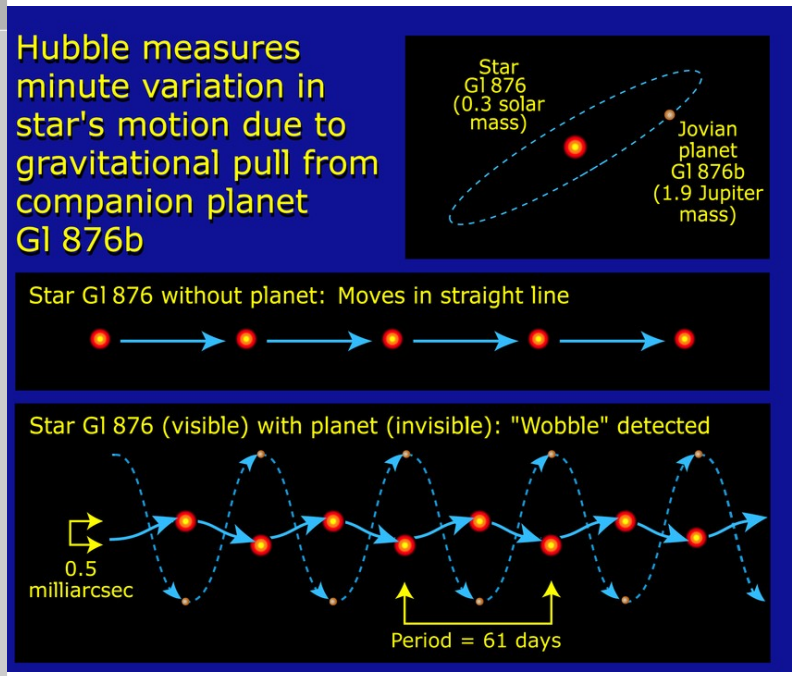
[A] Some planets will be seen
[B] 316 of the 369 are earlier than M8, e.g. with abs G > 15.5
[C] 11 of the 34 were in Gaia DR2
[D] 16 resolvable objects not in EDR3 that should be.

10pc sample [A] Planets

Of 70+ known planets perhaps 10 detected by Gaia. Others have very short periods or have very low mass ratios. Some may be seen transiting.

Planet	α	Comment
Proxima Cen c	170	Candidate
GJ15Ac	570	Long period -> acceleration sol.
Eps Eri b	1000	Very bright, V=3.7
Eps Indi Ab	10000	Long period, very bright V=4.9
GJ 649 b	65	Detectable if small inclination
GJ 3512 b	130	
GJ 849 b	500	Maybe also GJ 849 c
GJ 433 c	100	
HD 219134 g	>100	Period long, very bright V=5.6
GJ 876 b	300	Detected by HST/FGS
GJ 876 c	80	On HST but scanning law aliases
GJ 832 b	1000	
GJ 9066 c	200	

GJ 876 b from HST



Benedict et al 2002

10pc sample [B] To M8

316 resolved objects <M8, e.g. abs G > 15.5, in 10pc

- Considering only volume → expect 316,000 in 100pc
- Simulation with unresolved objects → 277,511+/-8911
- We find 282,652, so GCNS complete for systems
- Considering objects the GCNS becomes more like 20% incomplete.

10pc sample [C] In DR2

11 of the 34 without parallaxes had 5 parameter solutions in Gaia DR2

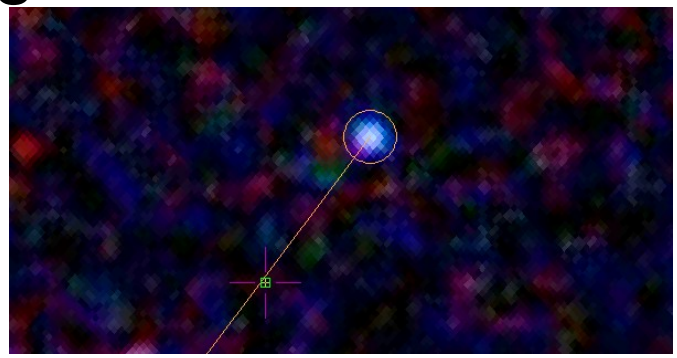
Target	Parallax	Error	DR2 SourceID	EDR3 SourceID
HD 239960 A	249.3926	0.1653	DR2 2007876324466455424	EDR3 2007876324466455040
HD 239960 B	249.9668	0.7414	DR2 2007876324472098432	EDR3 2007876324472098432
Ross 614 A	242.9659	0.8833	DR2 3117120863523946368	EDR3 3117120863523946368
GJ 1245 A	213.1329	0.5737	DR2 2079073928612819840	EDR3 2079074130463898624
GJ 623 A	127.4785	0.4818	DR2 1411178510887026048	EDR3 1411178510887026048
IRAS 21500+5903	123.0568	0.5944	DR2 2202703050388170880	EDR3 2202703050388170880
SCR J1546-5534 A	119.0962	0.7032	DR2 5884382654716110848	EDR3 5884382654716110848
ksi UMa Ba	114.4867	0.4316	DR2 756853643637996160	EDR3 756853643637996160
HD 115953 Aa	109.9837	0.8292	DR2 1552921051659352960	EDR3 1552921051659352960
GJ 748 A	106.2794	1.0634	DR2 4268226078065241600	EDR3 4268226078065241600
BPS CS 22879-0089 A	105.1555	0.2656	DR2 6678510081826546048	EDR3 6678510081826546048

All binary systems so the residuals with more observations have gone up and probably no longer meet AGIS QA cuts, in particular astrometric_sigma5d_max > 1.2 mas.

10pc sample [D] no EDR3

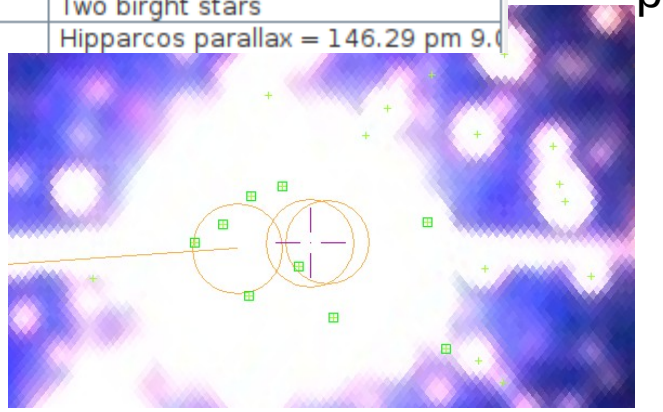
16 Resolved objects with an estimated G magnitude that should be visible to Gaia are not in EDR3

NAME	PARALLAX	SP_TYPE	GAIA_G_MAG	COMMENT
GJ 105 C	138.34			3.27" from 5th mag Gl 105A
GJ 1230 C	100.685			4.82" from bright GJ 1230 A/B
2MASSI J0937347+293142	162.85	T7	20.507	? maybe at limit
WISE J223617.59+510551.9	102.8	T5.5	20.411	Is this 2MASS J22361685+5105487
eps Ind C	270.65803	T6V	19.3	Binary system
2MASS J06523073+4710348 B	109.76506	L6.5	19.	un resolved
Luhman 16 B	501.557	T0.5	16.962	In DR2 5353626573562355584
LP 881-64 C	129.31674	L0	15.61	Very close triple
LP 881-64 B	129.31674	M9.5V	15.43	Very close triple
GJ 1245 C	213.1329	M8	12.16	Seperation small
GJ 53 B	130.28807	M4?	11.129	Spectroscopis binary
alf CMi B	284.56	DQZ	10.92	bright primary
GJ 783 B	166.3272	M3.5V	8.2	EDR3 6697578465310948992 com
GJ 570 C	168.77		7.2492	Complicated system
GJ 667 B	138.06627	K5V	6.46	Two birght stars
GJ 667 A	138.06627	K3V	5.46	Hipparcos parallax = 146.29 pm 9.(



2MASSI J0937347+293142
One EDR3 object no parallax and color wrong.

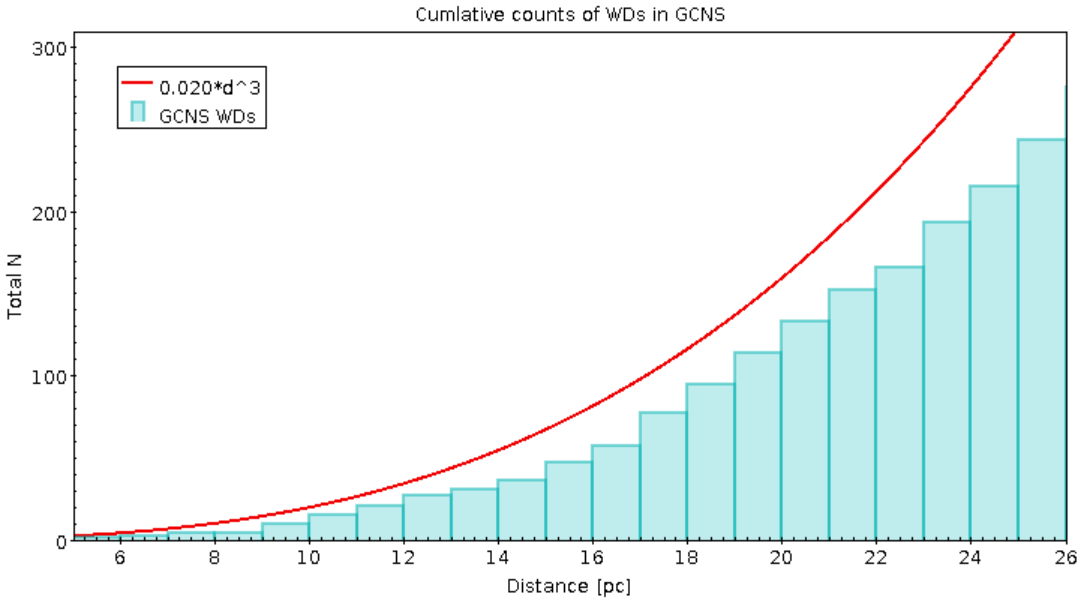
Only one, Luhman 16B, in DR2 but not in EDR3



GJ 667 A/B, may actually be there but we cannot identify it

WD Population

Inside 10pc currently 20 WDs, therefore N(WD)~0.02*$d^{3,}$
at 25pc we expect ~312,
(we expect WDs to start being magnitude limited at 40pc).



Inside GCNS we find 249, compared to Subasavage et al (2017) found 179.

20% incompleteness consistent with missing WDs being in systems.

GCNS Cleaning

- Discussion group set up to share improvements
- Currently 50+ EDR3 entries found to have been incorrectly dropped mostly faint M/L dwarfs “manually” found
- Compared to Rybizki et al arXiv:2101.11641 feed-forward neural network procedure there are 74 good that are found to be bad and 5244 bad that are found to be good. Internal followup being carried out.
- Missing many known bright objects (e.g. 7 in 10pc)
- Most missing objects can be put down to being in binaries
- Procedures being developed to make a “living” version of the GCNS. Will be made available as stand alone file and via TAP at GAVO
- Also expected a significant update from binary information included in DR3 and for DR4 the number of removed source will be reduced and there will be more binary information.

GCNS Cited uses

- *Interstellar Objects in the Solar System: 1. Isotropic Kinematics from the Gaia EDR3,* Eubanks+ arxiv:2103.03289: Used GCNS to estimate the expected frequency of InterStellar Objects, e.g. Oumuamua, passing through the solar system.
- *A classifier for spurious astrometric solutions in Gaia EDR3*, Rybizki arXiv:2101.11641: Compared new spurious source classification technique to GCNS procedure, found upper 90% consistency.
- Cited as example procedural support or confirmation result in
  - *Mapping Luminous Hot Stars in the Galaxy*, Zari+ arXiv:2102.08684;
  - *The Gaia DR2 halo white dwarf population: the luminosity function, mass distribution, and its star formation history*, Torres+ 2021MNRAS.502.1753T;
  - *Weighing the Galactic disk using phase-space spirals I: Tests on one-dimensional simulations*, Widmark+ arXiv2102.08955.
  - *A million binaries from Gaia eDR3: sample selection and validation of Gaia parallax uncertainties*. El-Badry+ 2021MNRAS.tmp..394E:

Work being carried out to make 10pc catalog and improve brown dwarf classification component.

Conclusions

- 10pc good test sample, indicates 12% system and 22% objects incompleteness
- Objects in binaries missing for various reasons, may also be worse case scenario, in DR3 we will have first binary solutions and DR4 will have improved bright components.
- Most missing objects can be put down to being in binaries
- Objects to M8 and WDs consistent with this result

GCNS Resources

A video overview: https://www.youtube.com/watch?v=rEEMzYhnA_Q

Resources (posters, videos…): https://gucds.inaf.it/projects/gcns/

Join discussion group send email to gaiacns+subscribe@googlegroups.com