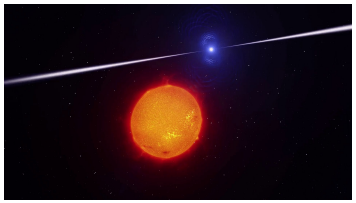
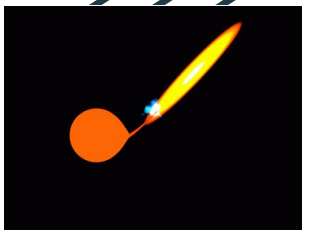
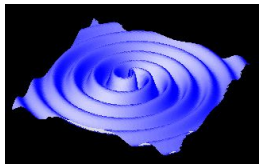


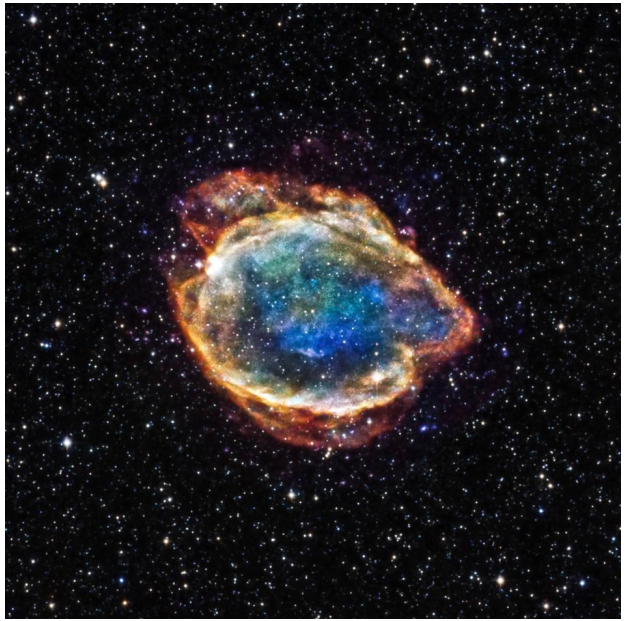


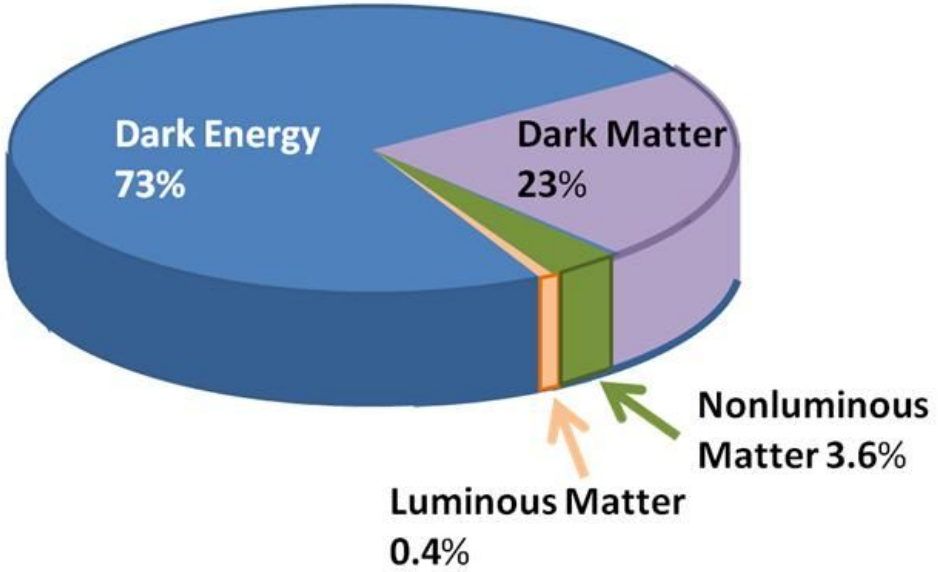
Understanding the evolution of ~~close~~ white dwarf binaries (C**WDBs**)

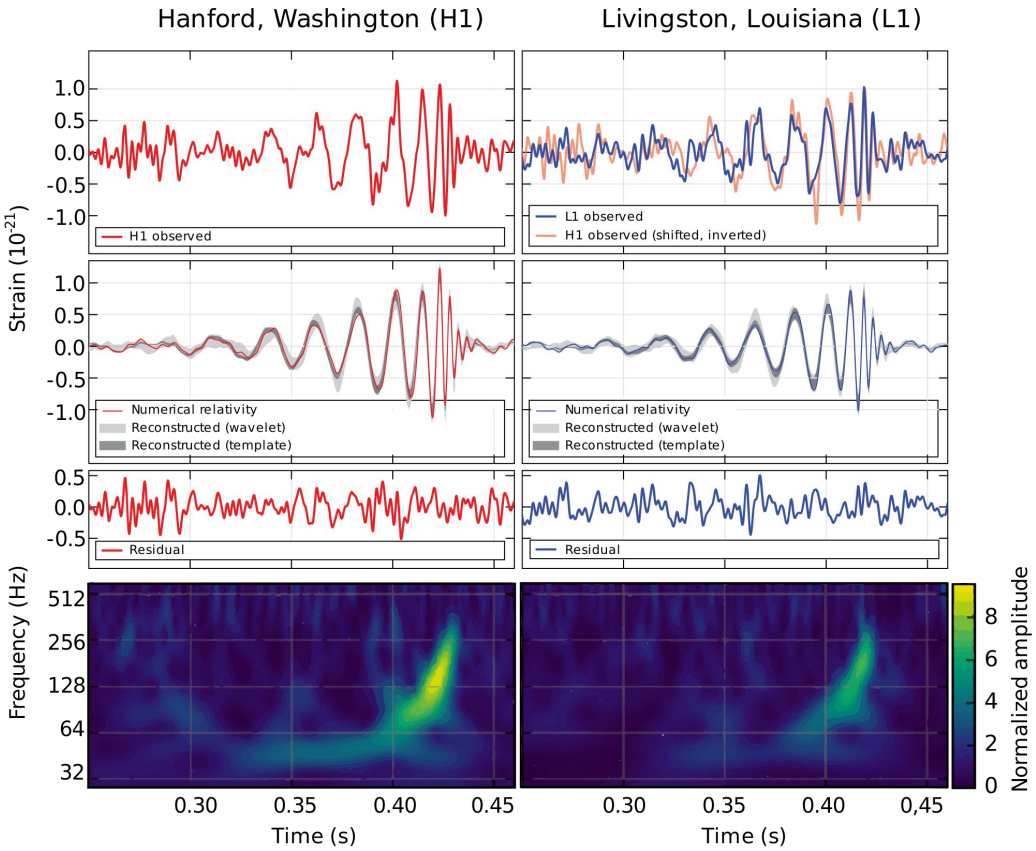


Odette Toloza

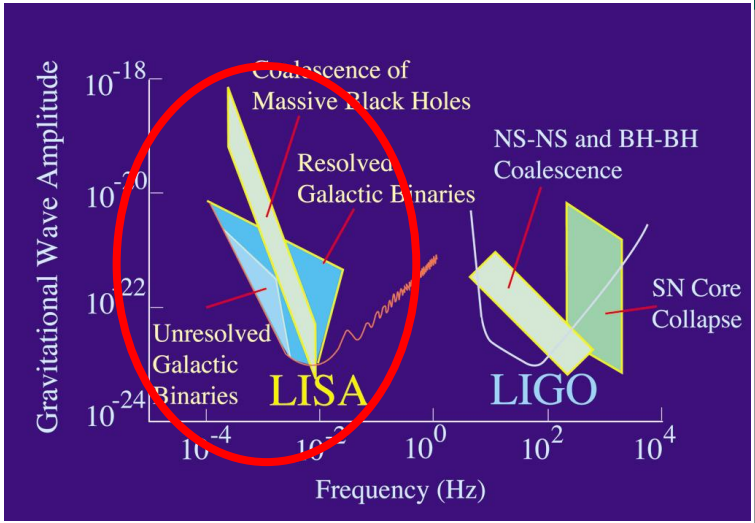
White dwarf plus main sequence binaries as astrophysical tools in modern astronomy
(Monday 13 July, 2020)



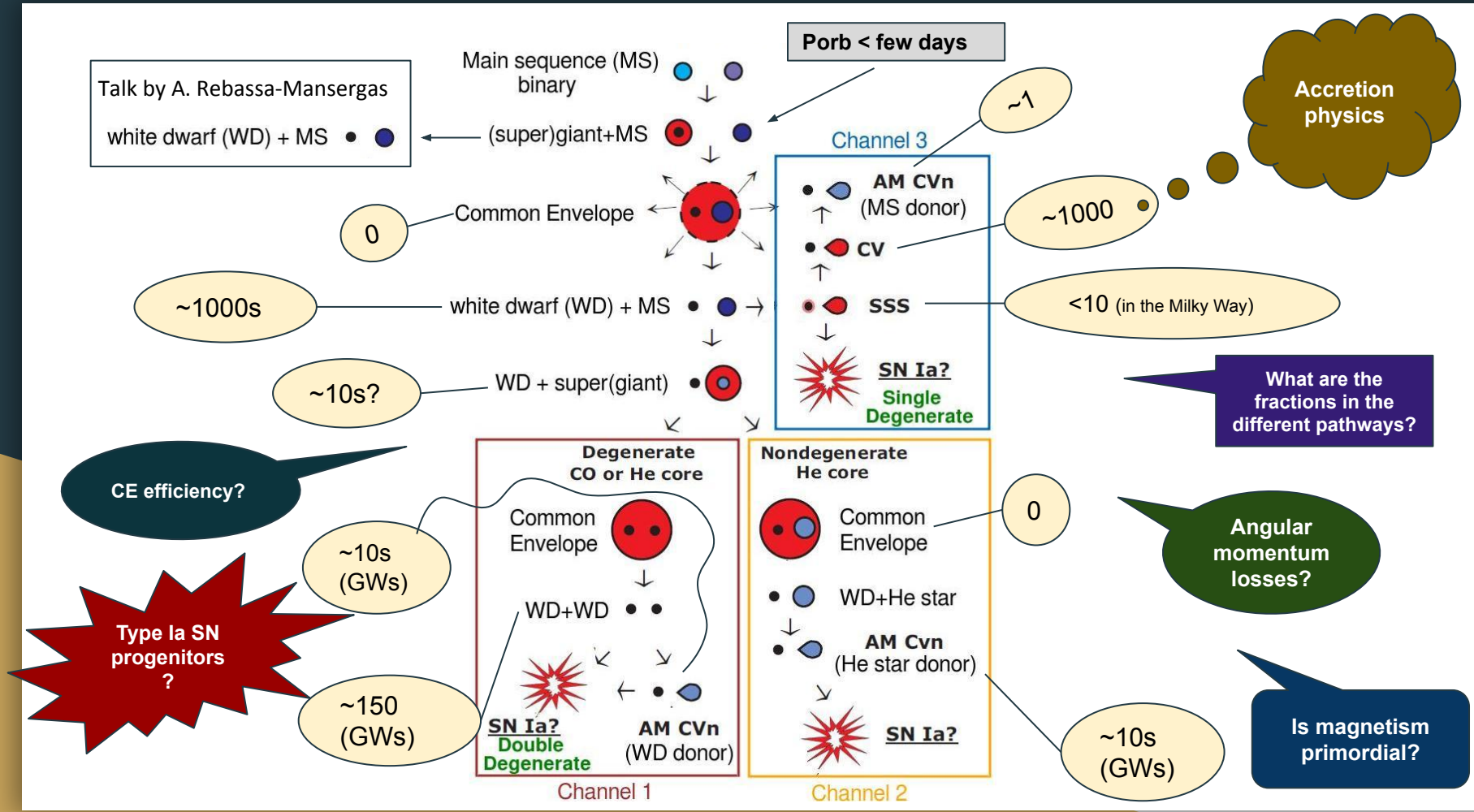

Dark Energy
73%
Dark Matter
23%
Nonluminous
Matter 3.6%
Luminous Matter
0.4%



Abbott, B. P. et al. 2016, Phys. Rev. Lett., 116, 061102

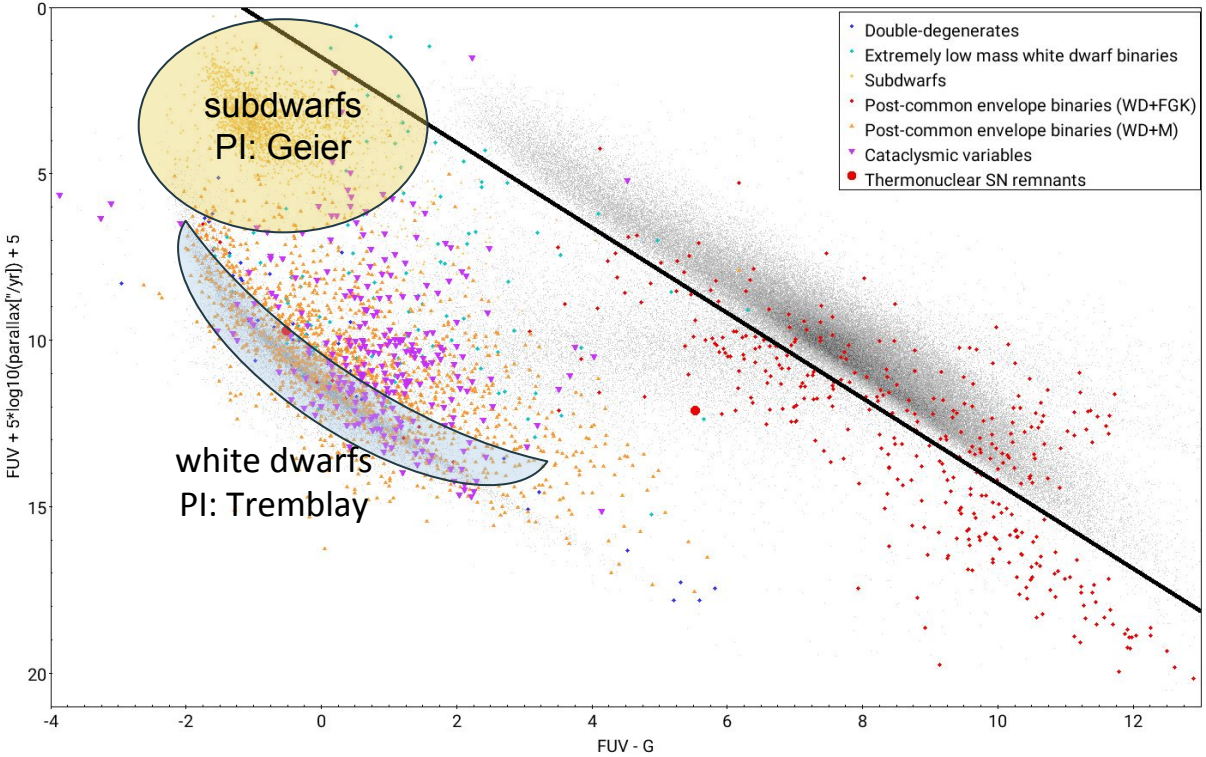


Akerib et al. 2001, Particle Astrophysics and Cosmology: Cosmic Laboratories for New Physics, P4001

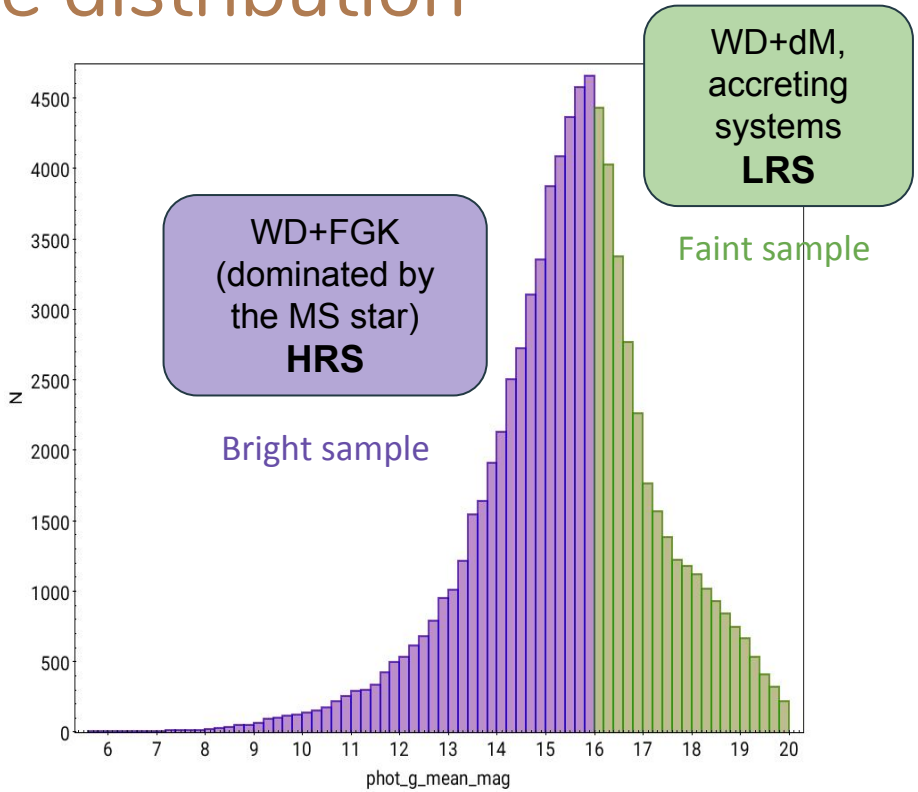

Talk by A. Rebassa-Mansergas
white dwarf (WD) + MS
Main sequence (MS) binary
(super)giant+MS
Porb < few days
Common Envelope
0
~1000s
white dwarf (WD) + MS
~10s?
WD + super(giant)
Channel 3
~1
AM CVn
(MS donor)
CV
~1000
SSS
<10 (in the Milky Way)
SN Ia?
Single Degenerate
Accretion physics
What are the fractions in the different pathways?
CE efficiency?
Degenerate CO or He core
Common Envelope
WD+WD
~10s (GWs)
~150 (GWs)
SN Ia?
Double Degenerate
AM CVn
(WD donor)
Channel 1
Nondegenerate He core
Common Envelope
0
WD+He star
AM Cvn
(He star donor)
SN Ia?
~10s (GWs)
Channel 2
Type Ia SN progenitors ?
Angular momentum losses?
Is magnetism primordial?

Larger unbiased samples and as complete as possible of all sub-types!

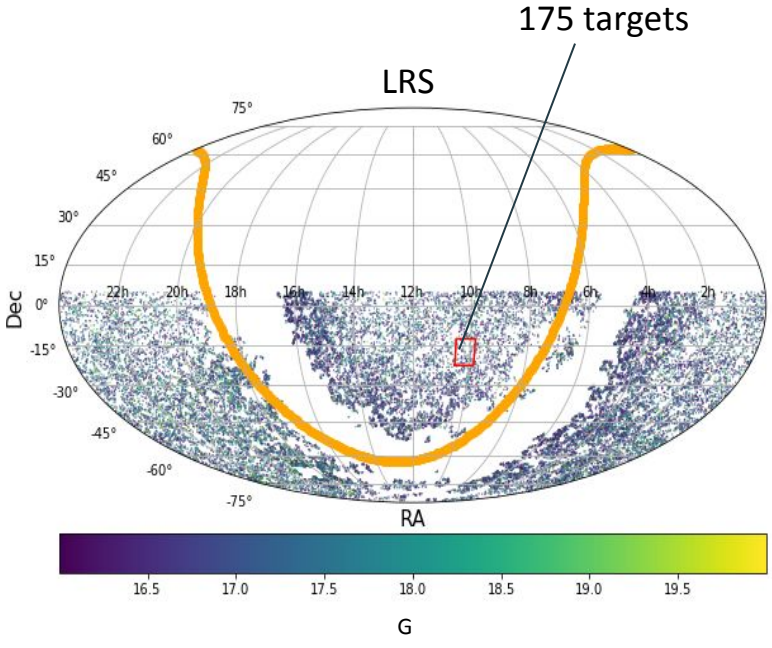
Gaia-GALEX X-match: ~80500 targets

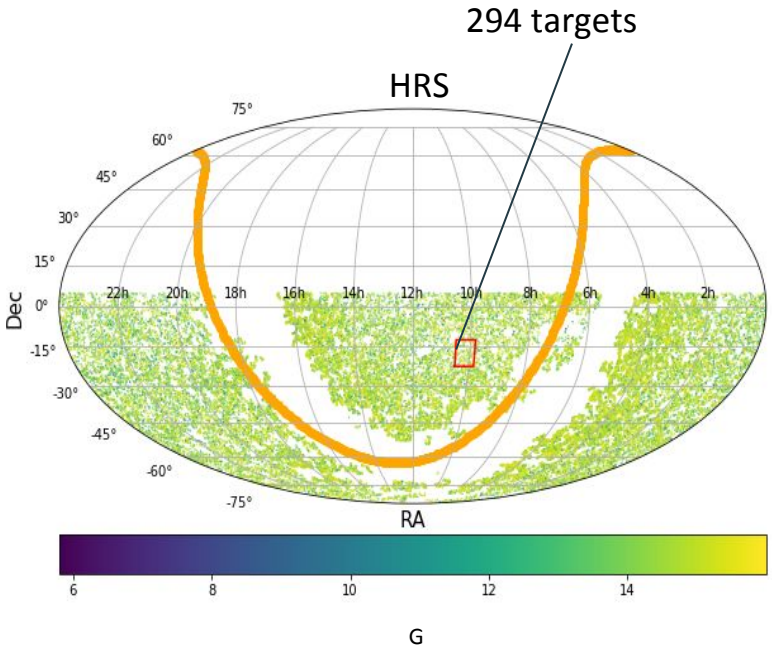


Magnitude distribution



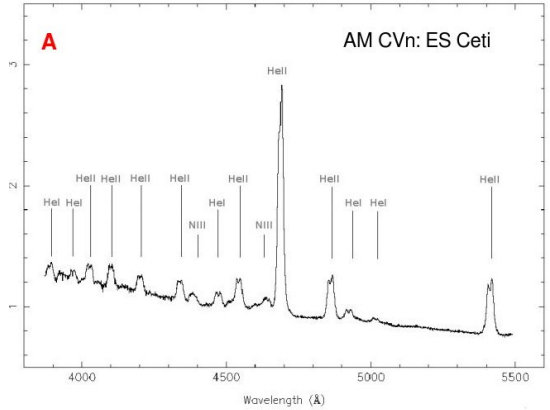
Scope of the CWDB survey: ~80500 targets (4.7 targets/sq. deg -- <1% of fibre hours)

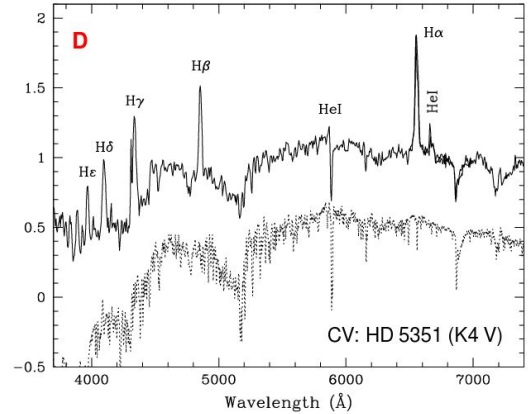


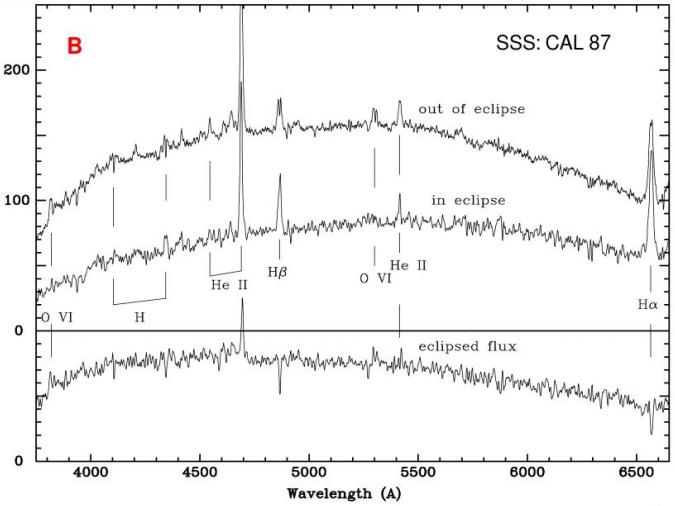


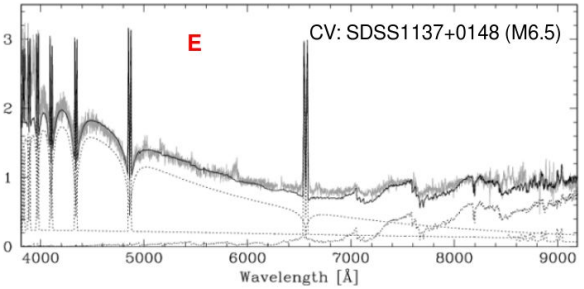
What do we get from optical spectroscopy?

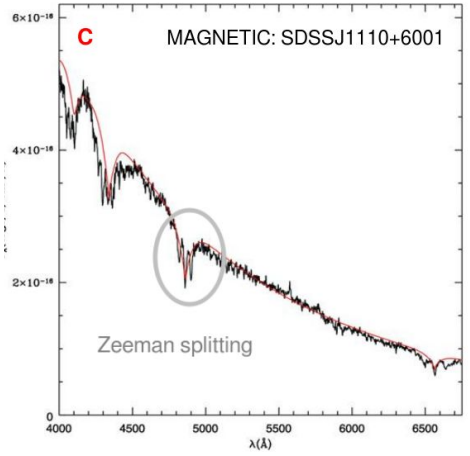
- Guaranteed: stellar parameters (effective temperatures, surfaces gravities, masses, radii and chemical abundances e.g. NaI, CaII, Fe)
- Plus extra data (e.g. *Gaia* and long-term photometry from *TESS* and LSST) will provide binary parameters: orbital periods, rotation periods, accretion rates (*eROSITA*-joint compact binaries survey).

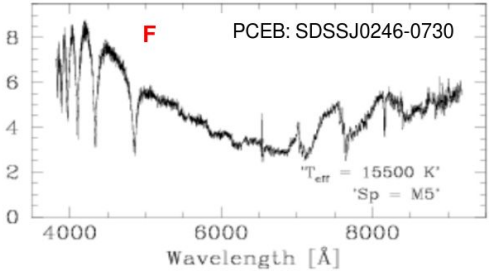

A
AM CVn: ES Ceti
HeII
HeI HeI
HeII HeII HeII
HeII
NIII
HeI
HeII
NIII
HeII
HeI HeI
HeII
4000
4500
5000
5500
Wavelength (Å)


D
Hα
Hβ
Hγ
Hδ
Hε
HeI
HeI
CV: HD 5351 (K4 V)
4000
5000
6000
7000
Wavelength (Å)


B
SSS: CAL 87
out of eclipse
in eclipse
eclipsed flux
O VI
H
He II
Hβ
O VI
He II
Hα
4000
4500
5000
5500
6000
6500
Wavelength (A)

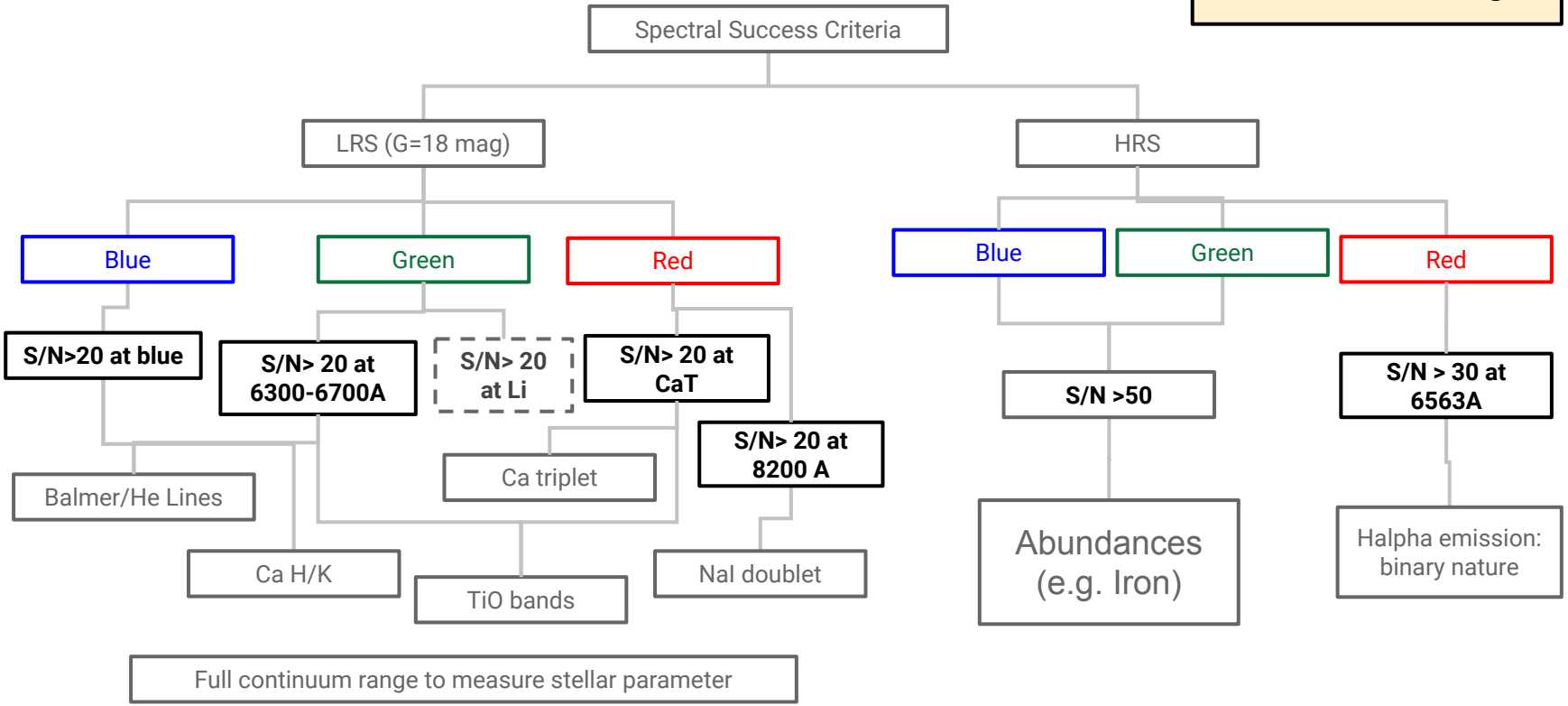

E
CV: SDSS1137+0148 (M6.5)
4000
5000
6000
7000
8000
9000
Wavelength [Å]


C
MAGNETIC: SDSSJ1110+6001
Zeeman splitting
4000
4500
5000
5500
6000
6500
λ(Å)

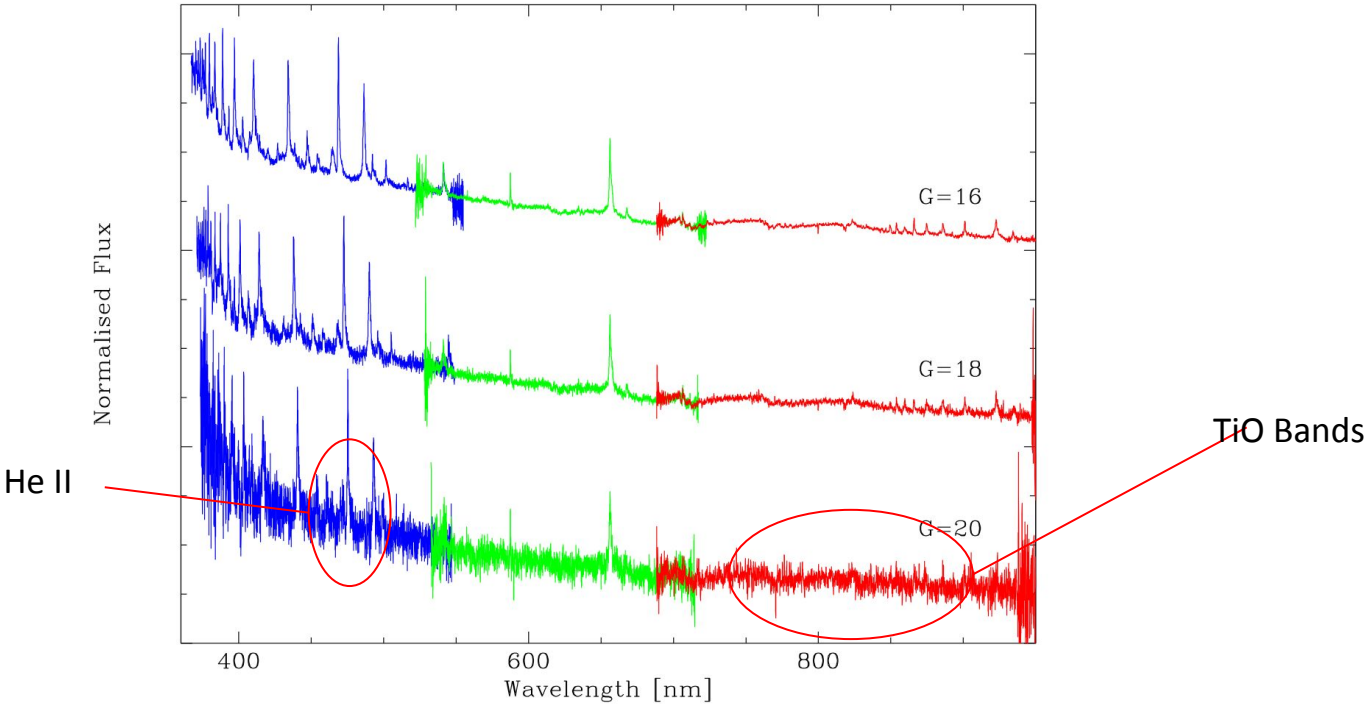

F
PCEB: SDSSJ0246-0730
'T_eff = 15500 K'
'Sp = M5'
4000
6000
8000
Wavelength [Å]

Science Requirements (S/N)

WD+MS binaries
PI: Rebassa-Mansergas

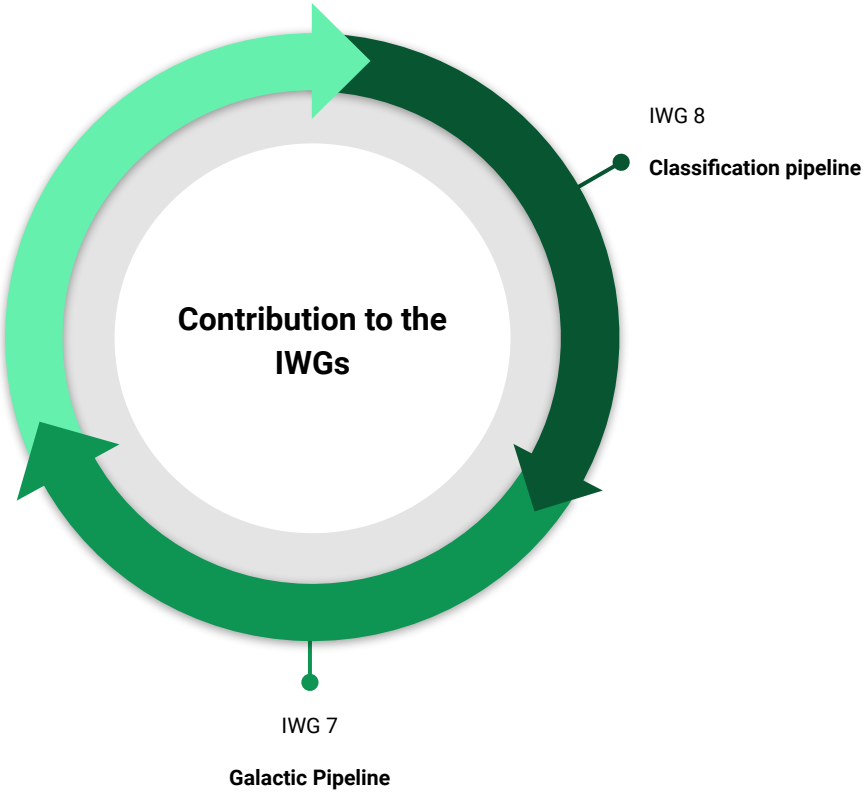


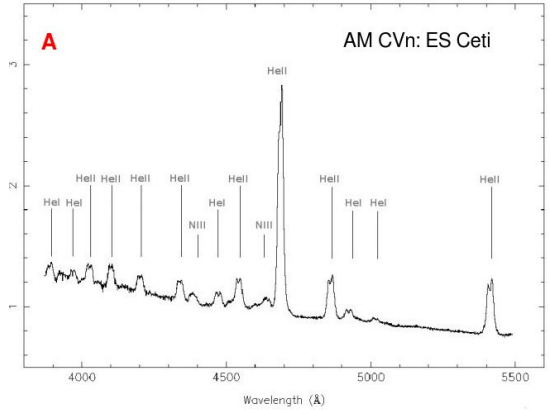
Example: Binary with a magnetic white dwarf (SDSSJ020348.61+295925.70)

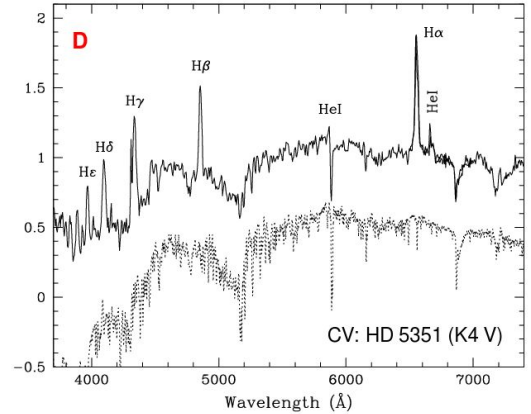


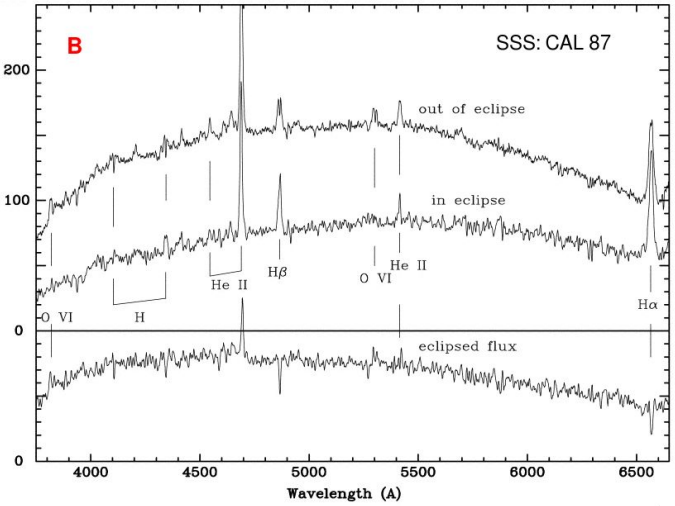
Calibration

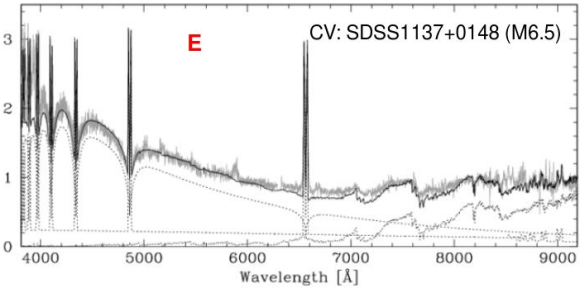
- Standard i.e. wavecal and flux calibration

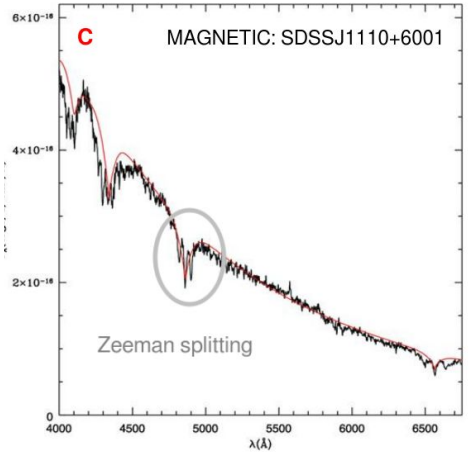

Contribution to the IWGs
IWG 8
Classification pipeline
IWG 7
Galactic Pipeline

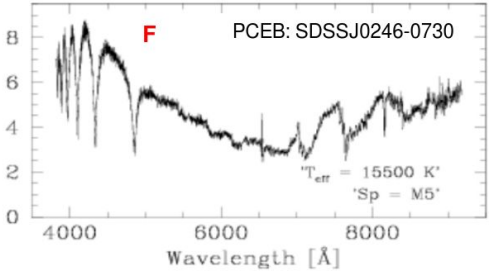

A
AM CVn: ES Ceti
HeII
HeI HeI
HeII HeII HeII
HeII
NIII
HeI
HeII
NIII
HeII
HeI HeI
HeII
4000
4500
5000
5500
Wavelength (Å)

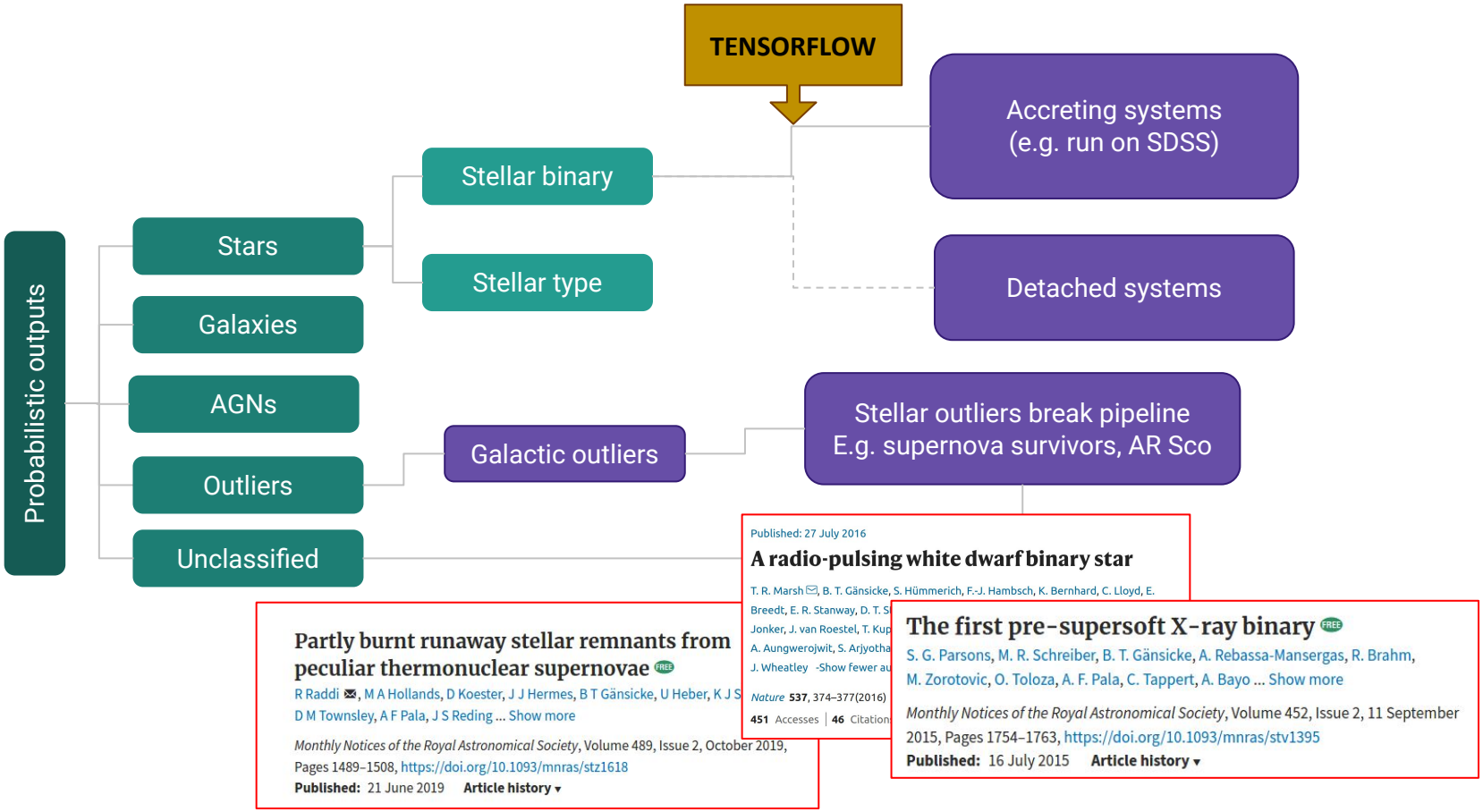

D
Hα
Hβ
Hγ
Hδ
Hε
HeI
HeI
CV: HD 5351 (K4 V)
4000
5000
6000
7000
Wavelength (Å)


B
SSS: CAL 87
out of eclipse
in eclipse
eclipsed flux
O VI
H
He II
Hβ
O VI
He II
Hα
4000
4500
5000
5500
6000
6500
Wavelength (A)

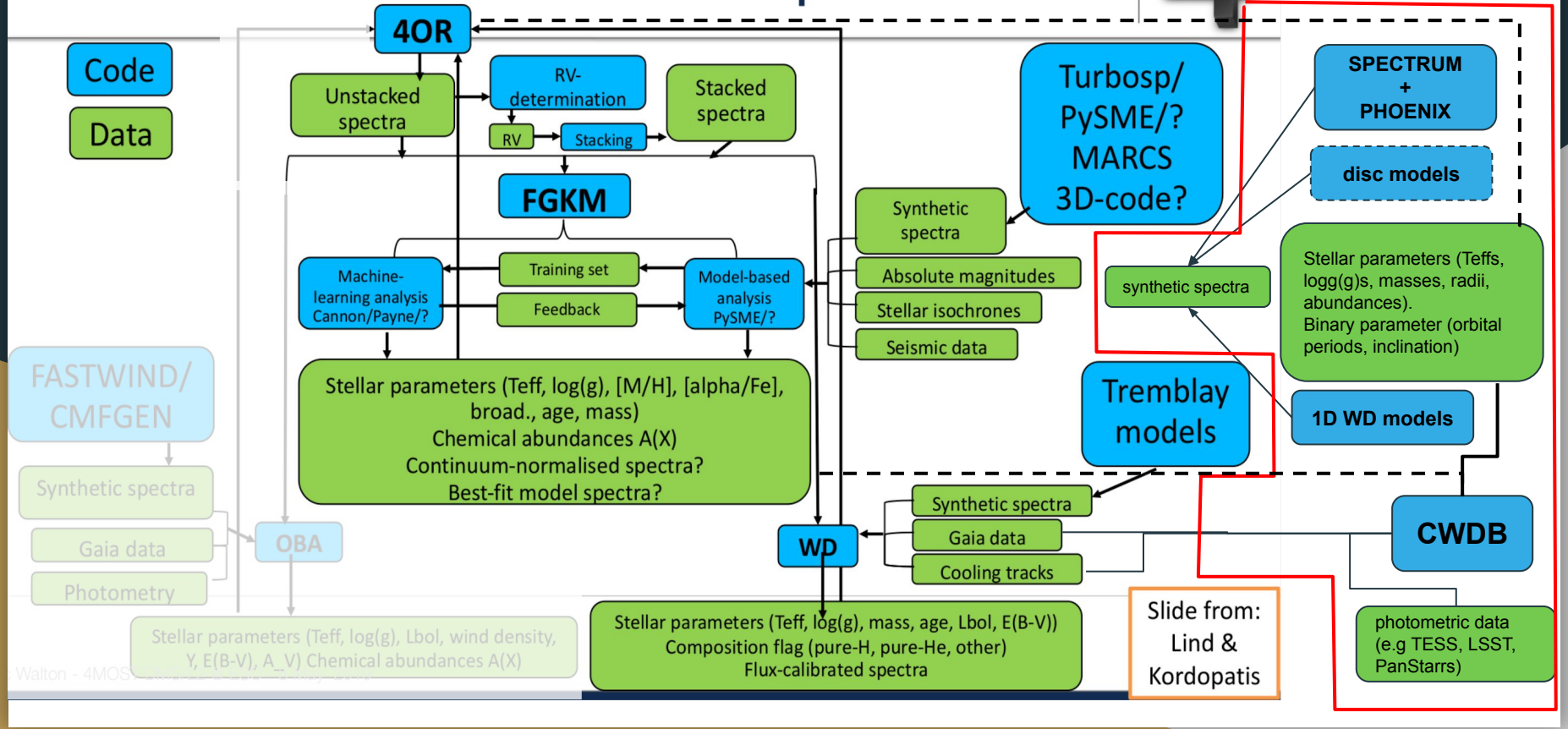

E
CV: SDSS1137+0148 (M6.5)
4000
5000
6000
7000
8000
9000
Wavelength [Å]


C
MAGNETIC: SDSSJ1110+6001
Zeeman splitting
4000
4500
5000
5500
6000
6500
λ(Å)


F
PCEB: SDSSJ0246-0730
'T_eff = 15500 K'
'Sp = M5'
4000
6000
8000
Wavelength [Å]


TENSORFLOW
Accreting systems
(e.g. run on SDSS)
Detached systems
Probabilistic outputs
Stars
Galaxies
AGNs
Outliers
Unclassified
Stellar binary
Stellar type
Galactic outliers
Stellar outliers break pipeline
E.g. supernova survivors, AR Sco
Published: 27 July 2016
A radio-pulsing white dwarf binary star
T. R. Marsh, B. T. Gänsicke, S. Hümmerich, F.-J. Hambsch, K. Bernhard, C. Lloyd, E.
Breedt, E. R. Stanway, D. T. S
Jonker, J. van Roestel, T. Kup
A. Aungwerojwit, S. Arjyotha
J. Wheatley -Show fewer au
Nature 537, 374–377(2016)
451 Accesses | 46 Citation
Partly burnt runaway stellar remnants from peculiar thermonuclear supernovae
R Raddi, M A Hollands, D Koester, J J Hermes, B T Gänsicke, U Heber, K J S
D M Townsley, A F Pala, J S Reding ... Show more
Monthly Notices of the Royal Astronomical Society, Volume 489, Issue 2, October 2019, Pages 1489–1508, https://doi.org/10.1093/mnras/stz1618
Published: 21 June 2019 Article history
The first pre-supersoft X-ray binary
S. G. Parsons, M. R. Schreiber, B. T. Gänsicke, A. Rebassa-Mansergas, R. Brahm,
M. Zorotovic, O. Toloza, A. F. Pala, C. Tappert, A. Bayo ... Show more
Monthly Notices of the Royal Astronomical Society, Volume 452, Issue 2, 11 September 2015, Pages 1754–1763, https://doi.org/10.1093/mnras/stv1395
Published: 16 July 2015 Article history

GP: The 4MOST Galactic Pipeline



Accreting systems

+Keith Inight

Theory

Detached systems

Double degenerates

Targets selection and pipeline development

Accretion physics

Joint collaborations