Related surveys to the Gaia mission

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Outline

- **Photometric surveys**

- **Spectroscopic suveys**
  - Gaia-ESO survey
  - New MOS projects

See http://camd08.ast.cam.ac.uk/Greatwiki/WGA2SurveyCensus

Photometric Surveys

Survey	H	Filters	Mag Lim	Area	Dates
GALEX	-	FUV,NUV	20.5	4 π	2003
SDSS	N	u,g,r,i,z	22.0 / 20.5	1.4 π	2000-2009
IPHAS	N	r,i,Hα	20	0.2 π	2003-2006
SkyMapper	S	u,v,g,r,i,z	22.9 / 21.5	2 π	2009-2014
Pan-STARRS	N	g,r,i,z,y	24	3 π	2012-2022
VPHAS+	S	u,g,r,i,Hα	21	0.2 π	2012
LSST	S	u,g,r,i,z,y	24.5	3 π	2015-2025
2MASS	N/S	J,H,Ks	15.8 / 14.3	4 π	1997-2001
UKIDSS	N	(Z,Y),J,H,K	19.4 / 17.8	0.7 π	2005
VISTA	S	(Z,Y),J,H,Ks	20 / 18	2 π	2010
Euclid	-	RIZYJH		2 π	2019
GLIMPSE	-	IR		0.2 π	2004
WISE	-	IR		4 π	2010

Photometric Surveys

! Cross-matching with Gaia !

Gaia pixel size (AL) = 60 mas

Ex : 17x17 pixels Gaia in the 1x1" pixel 2MASS

The needs for a Gaia ground-based spectroscopic follow-up

- **Radial velocities for stars not observed by the Gaia-RVS (17<V<20)**
  - Gaia will bring proper motions, distances, as well as atmospheric parameters and mean metallicities (spectrophotometry).
  - Need for the third velocity dimension

- **Chemical abondances for stars fainter than V>13**
  - Gaia will bring distances to an unprecedented accuracy, but not the chemical abundances
  - Needed not only for chemical tagging and chemical labbelling

  but also for the ages, distance calibrators, stellar evolution...

Which spectroscopic follow-up ?

Resolution	Parameters	Abundances accuracies
> 5,000	Vr Teff, logg, [Fe/H],[α/Fe]?	0.2 dex
~ 20,000	Vr Teff, logg, [Fe/H],[α/Fe], a few additional elements, ISM DIBs	0.1-0.15 dex
> 40,000	Vr Teff, logg, [Fe/H],[α/Fe], iron-peak,r- and s- process elements, ISM DIBs & absorption lines	<0.05 dex

Name	Tel	H	D	λ	R	deg^2	fibres	mag lim	Nb stars	Status
RAVE	UKST	S	1.2	CaII trip	7500	30	130	I=12	1 million	2003 – 2012
SEGUE	Apache	S	2.5	optical	1800	7	640	g=20	360,000	2004 – 2009
LAMOST		N	4	optical	1000	5	4000	V=20	5 million	2009
APOGEE	Apache	N	2.5	1.5-1.7	20000		300	H=12.5	100,000	2011
Gaia-ESO PS	VLT – FLAMES	S	8	HR10 & HR21	20000	0.14	110	V=17.5	100,000	Started 01/01/2012
				UVES	40000	0.14	7	V=15	5,000	
HERMES	AAT	S	4	optical	28000	3.14	400	V=14	1 million	2013
Gaia RVS	Gaia	-		CaII triplet	10000	All	-	V=12/17	370 millions	2013
WEAVE	WHT	N	4.2	400-950nm	5000 / 20000	3.14	1000	V=21/17		
MOONS	VLT	S	8.2	0.8 -1.8 um	5000 / 20000	0.14	500	H=15		phase A @ ESO
4MOST	VISTA | NTT	S	4	optical	5000 / 20000	5	3000			phase A @ ESO
BigBoss	Mayall @ Kitt Peak	N	4	optical	3000	7	5000			Proposal @ NOAO

Gaia – ESO Survey : VLT Spectroscopic Public Survey

- Co-PIs : Gerry Gilmore & Sofia Randish

~ 300 CoIs

Originally from 2 LoIs : Milky Way & Open Clusters

- FLAMES @ VLT (GIRAFFE : R~20 000 + UVES : R = 47 000)
- 300 nights over 5 years

the first observations started : 01/01/2012.

- 10^5 stars and ~100 clusters, covering all the main stellar components of the Milky Way

GES - Survey Observing Strategy

- $+10° > \delta > -60°$
- VISTA astrometry and photometry for field stars
- Set-ups for field stars :
  - GIRAFFE (R~20,000) SNR~30 aimed at
    - HR10 : $534 < \lambda < 562$nm
    - HR21 : $848 < \lambda < 900$nm (CaII triplet)
  - UVES (R=47,000) 580nm SNR~50 aimed at
- Set-ups for open clusters :
  - Young clusters : GIRAFFE HR 03/05A/06/14A/15N/21
  - Intermediate and old : GIRAFFE HR 15N/21
  - UVES 520 nm (young stars) and 580 nm

➢ Halo / thick disc Survey

– Targets :**F/G dwarfs** 17<r<18, [Fe/H] < **-**1.0

→ probing distances ~ 5 kpc for turn-off stars

– 2 setups GIRAFFE (HR10 & HR21), 4 h per field

– At high latitude, some fields with known streams will also be observed

– At low latitude 25% of the fibres could be allocated to K giants.

– Complementarity with the AAOmega AEGIS surveys

70 000 stars within 14<V<18 (selected on SkyMapper)

➢ Bulge Survey

– Targets : **K-giants** I~15, [Fe/H] > -1.5 dex

→ probing between 6 – 10 kpc

– HR21 & HR10

– UVES fibres will observe inner disc K giants

GES - Survey Observing Strategy

➢ Thin disc kinematics Survey

– Targets : **Red Clump giants** I<19

→ probing up to 10 kpc

– HR21, SNR>10, Vr only.

– 6 fields

→ key directions / spiral arms

– 30 pointings per fields

→ several thousand stars per field

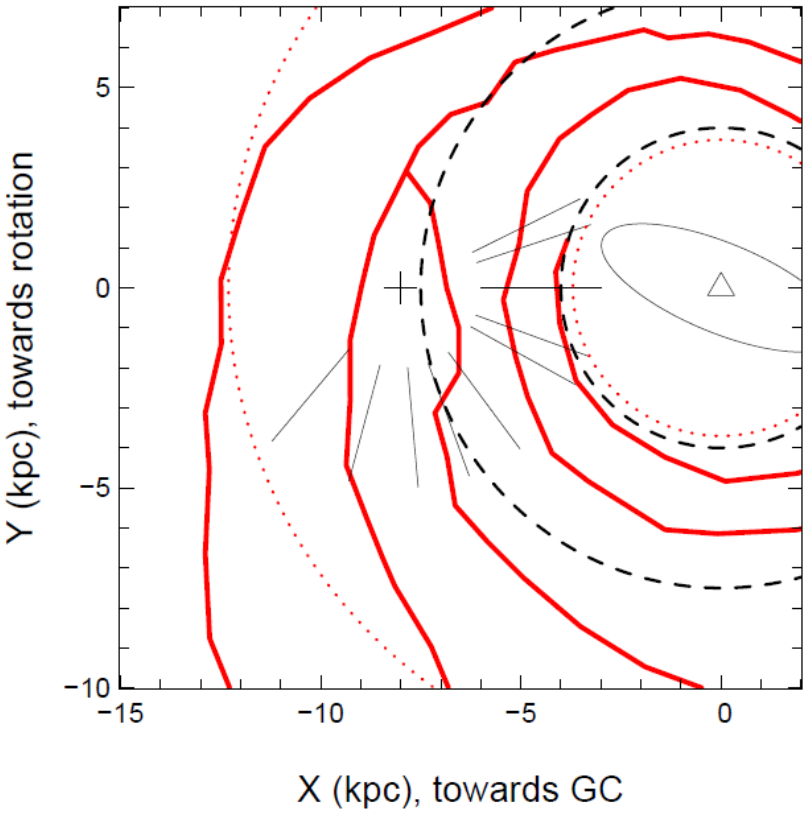


Fig Arnaud Siebert & Benoit Famaey

➢ Solar Neighbourhood Survey

– Targets : **G dwarfs,** V<15.7

→ probing up to 1.6 kpc

– UVES 580nm of the halo/thick disc survey

– Detailed Metallicity Distribution Functions

all ages and all metallicity

Gaia parallaxes accuracy < 5%

➢ Open Clusters

– ~ 100 clusters selected to cover the parameter space

age – [Fe/H] – Galactocentric distance – mass

→ cluster dynamical evolution

→ stellar evolution

– Young clusters (<100 Myr):

For d<1500 pc : Vr accuracy < internal dispersion (id. Gaia pm)

Further : O,B,A stars

– Intermediate and old clusters :

Close: all the populations → M dwarfs

Far: RGB & clump stars, MSTO

– GIRAFFE (I<19) and UVES (V<16.5)

Calibration

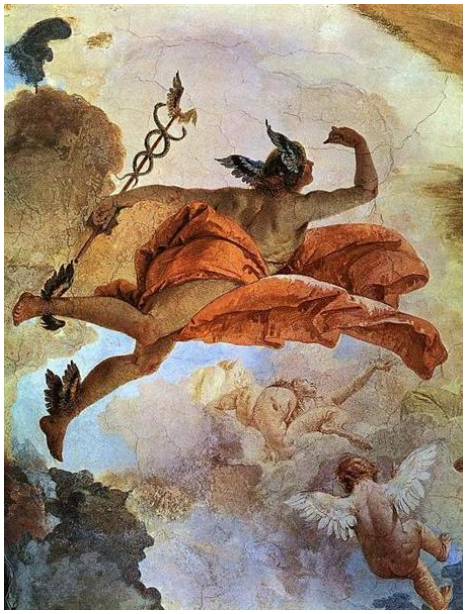
- Clusters (open & globular)
- Specific fields (e.g. COROT)
- Reference stars (e.g. PASTEL)
- Peculiar stars that will be F,G,K selected stars outliers
- ...
- 10 nights planned + twilights
- Archive usage (AMBRE project)

GES - the data

- GIRAFFE spectra for ~ 10^5 stars
- UVES spectra for ~ 10^4 stars
- Raw data automatically public
- Processed data given to ESO :
  - Reduced spectra + variance spectra
  - Radial velocities
  - Complementary information (photometry, classification...)
  - Teff, logg, microturbulence
  - [Fe/H], [α/Fe], individual abundances
- Final data 2 years after the end of the observations

The new Multi-Object Spectrographs

HERMES



- Optical multi-object spectrograph for the AAT (4m)
- PI : Guy Monnet (AAO)
- Chemical tagguing of 1 million stars

  R=30,000 V<14 with a SNR=100
- Commissioning Q3 2012

WEAVE

- Optical multi-object spectrograph for the WHT (4m)
- PI : Gavin Dalton, Oxford Univ. (UK)
- Scientific cases :
  - Milky way
    - radial velocities R=5,000 for 15<V<20
    - Abundances R=20,000 for 12<V<17
  - Galaxy evolution
  - Cosmology
- Phase A study. First light : end 2016.

4-MOST

- Optical multi-object spectrograph for the NTT or VISTA (**4m**)
- PI: Roelf de Jong, AIP (Potsdam)
- Scientific cases :
  - Gaia follow-up (radial velocities, atmospheric parameters, abundances)

    R=5,000 et R=20,000
  - eROSITA follow-up
  - Euclid (and other imaging surveys) follow-up
- Phase A study funded by ESO. Decision in Spring 2013.

MOONS

- Infrared multi-object spectrograph for the **VLT** (8m)
- PI: Michele Cirasuolo, ATC (Edinburgh)
- Scientific cases :
  - Milky Way (R=5,000 and R=20,000)

  in particular extincted regions that cannot be observed in optical

  in the bulge in galactic disc
  - Galaxy evolution
  - The first galaxies
  - Cosmology
- Phase A study funded by ESO. Decision in Spring 2013.