



Gaia-ESO Survey



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EUROPEAN
SCIENCE
FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

Outline

- Background
- Survey overview
- Targets, strategy, products
- Core science
- Data management
- First light and spectra
- What the Survey will not do

Background

Need for spectroscopic surveys identified in several strategic papers

- **ESO-ESA WG** report 4 “Galactic populations, chemistry, and dynamics”
- **ASTRONET** SV & Infrastructure Roadmap
- ESO Workshop **on wide field spectroscopic surveys**

*large public spectroscopic surveys, using current ESO VLT instrumentation, “could place the **European community** in a favourable situation ... generating the data required to complement *Gaia* if the surveys begin soon”.*

- Science Users Information
- Observing Facilities
- Future Facilities and Development
- Observing with ESO Telescopes
- Policies and Procedures
 - Science Operations Policy
 - Director's Discretionary Time
 - Target of Opportunity
 - Guaranteed Time Observations
- Public Surveys**
- Publications with ESO Data
- Telescope Time Allocation
- Phase 1 Proposals
- Phase 2 Preparation
- Phase 3
- Observing Tools and Services
- Visiting Astronomers
- Phase 2 Preparation
- Science Software
- Data Handling and Products
- Science Archive Facility
- Science Activities
- Scientific Meetings
- IT Services
- ESO Libraries
- Publications
- Job Opportunities

Public Surveys Projects

Here is the presentation of the ESO public surveys in the ESO messenger by the ESO Survey Team ([Messenger 127, 28](#)).

- **VST Public Surveys**
 - [P89 Protected Targets/Regions](#)
 - [P90 Protected Targets/Regions](#)
- **VISTA Public Surveys**
 - [P87 Protected Targets/Regions](#)
 - [P88 Protected Targets/Regions](#)
 - [P89 Protected Targets/Regions](#)
 - [P90 Protected Targets/Regions](#)
- **Public Spectroscopic Surveys**
 - [P89 Protected Targets/Regions](#)
 - [P90 Protected Targets/Regions](#)

VST Surveys

KIDS The Kilo-Degree Survey
PI Konrad Kuijken (Leiden)

This survey aims to image 1500 square degrees in 4 bands (to be complemented in the near-infrared with data from the VIKING survey). The survey aims to cover this large area to a depth 2.5 magnitudes deeper than the Sloan Digital Sky Survey (SDSS), with considerably better image quality. The primary science driver for the design of this project has been weak gravitational lensing. The science goals of the KIDS project are numerous, including: studying dark matter halos and dark energy with weak lensing, investigating galaxy evolution, searching for galaxy clusters, and looking for high redshift quasars. The KIDS project fills an important niche in lensing surveys between smaller, slightly deeper surveys, such as the CFHT Legacy Survey, and larger, shallower surveys like the SDSS.

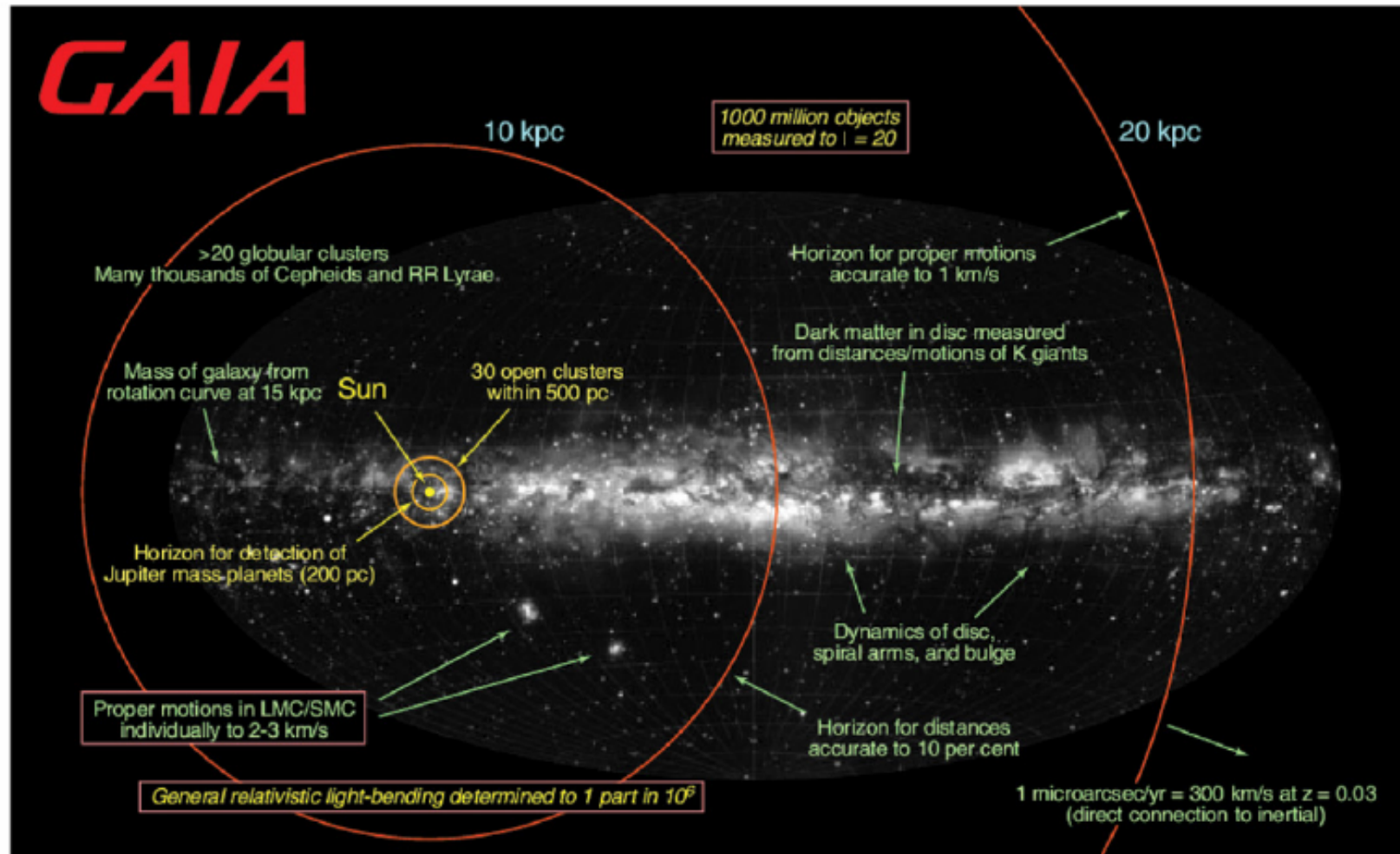
The VST ATLAS
PI Tom Shanks (Durham)

This survey is targeting 4500 square degrees of the Southern Sky in 5 filters to depths comparable to the SDSS. This survey will also be complemented with near-infrared data from the VHS VISTA survey. The primary science driver is to determine the dark energy equation of state by examining the 'baryon wiggles' in the matter power spectrum, via surveys of luminous red galaxies using both photometric and spectroscopic redshifts. But this survey will also provide the imaging base for many other future spectroscopic surveys, both at the VLT and also via wide-field fibre spectrographs such as the new AAOmega instrument at the Anglo-Australian Observatory. For example, the VST ATLAS will be valuable in the hunt for high redshift galaxies and quasars.

homepage: <http://astro.dur.ac.uk/Cosmology/vst atlas/>

VPHAS+ - The VST Photometric H- α Survey of the Southern Galactic Plane
PI Janet Drew (Imperial)

Gaia is just around the corner (2013)



Gaia science is transformational – the first 3-D galaxy accurate distances and motions for 1 billion stars

Gaia can do many things ...

- parallaxes
- proper motions
- radial velocities (only for $G_{RVS} < 17$, limited accuracy)
- astrophysical parameters and $[Fe/H]$ (good T_{eff} , limited for $\log g$ and $[Fe/H]$)
- detailed chemistry (only for very bright stars)
- additional information (e.g, Li, $H\alpha$)

... but is going to need some help

- ➡ Accurate radial velocities
- ➡ Accurate astrophysical parameters, metallicity,
- ➡ detailed chemistry
- ➡ additional properties

The Gaia-ESO Spectroscopic Survey

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&
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The Gaia-ESO Spectroscopic Survey

- Original initiative from two GREAT WGs.
- Long process involving Letters of intent, pre-acceptance, proposal review, survey management plan, ...
- Now around 300 Co-Is in project

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Gaia-ESO survey (GES) overview (1)

- **Public** large spectroscopic survey with FLAMES@VLT; contract signed Feb/12
- **300 nights** (30n/semester) over **5 (4+1) years**; start 1/2012 (P88), end 9/2016 (P97)+; visitor mode
- **All stellar populations in the Milky Way:** Halo; Bulge; Thick & Thin discs; open clusters and associations

Gaia-ESO survey overview (2)



Giraffe (130 fibers)
for faint targets

UVES (8 fibers)
for ‘bright’ stars ($V < 16.5$)

- **> 10^5 Giraffe** spectra ($R \sim 16,000 - 25,000$)
- **> 10^4 UVES** spectra ($R \sim 47,000$)
- **+ ESO archive** exploitation/re-analysis

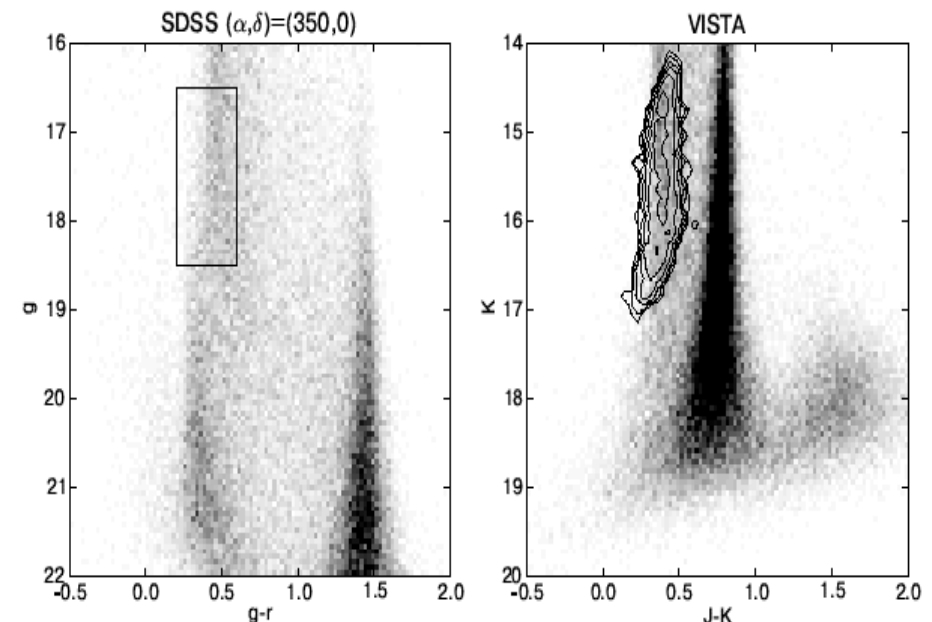
Gaia-ESO survey overview (3)

- Accurate **RVs** and good **APs** down to $V \sim 19$
[Fe/H] & [X/Fe] for several species with Giraffe; precise **multi-element abundances** with UVES
- First homogeneous overview of the kinematics and chemical element abundance distribution in the Galaxy
- Exceptional **stand-alone value**; will benefit from and add value to Gaia: **Gaia-ESO spectroscopy complements and completes Gaia astrometry and viceversa**

Targets: stellar samples

- **Bulge:** mostly giant stars (clump and RGB), $I=15$
- **Halo /thick disc:** FG turnoff stars ($17 < r < 18$); giants in known streams
- **Thin disc** –only RVs for dynamics; $I < 19$
- **Solar neighborhood** ($d > 1\text{kpc}$ from Sun); UVES in parallel
- **Calibration fields**

Selection based on
CMDs using VISTA



All phases of cluster evolution

All cluster types



PMS clusters
(10-100 Myr)



Intermediate-age
and old clusters
(100 Myr – 8 Gyr)

Very young clusters,
star forming regions,
associations



Nearby (< 1.5 kpc) and distant
Relevant populations covered

Set-ups and spectral ranges

- **Limiting mag. (R):** 16.5 (UVES), 19 (Giraffe)
- **UVES:** CD3 - 520/580 (416-617/475-678 nm) for hot/cool stars; **S/N > 60-70** → precise abundances
- **Giraffe:** *Cluster/field stars:* HR03/05A /06/14A (403-476, 631-670 nm) for hot stars; HR10/15N/21 (534-562; 647-679; **848.4-900**) for cool stars: T_{eff} /gravity indicators, H α , Li, Fe I and II lines, Ca IR triplet, a few lines from other elements
- **S/N > 10-30;** → RVs, APs, rotation, activity, accretion; [Fe/H], a few [X/Fe] (Ca, Ti, Mg at least)

Survey data products/errors

- Reduced, 1D, λ calibrated, spectra
- RVs: 0.1-1 km/s for cool stars;
3-5 km/s for hot stars
- Rotation: 10 %
- T_{eff} : 50-200 K; $\log g$: 0.15-0.3 dex
- [Fe/H], [X/Fe]: ~0.1 (UVES), ~0.2 (Giraffe)
- Average [Fe/H], [X/Fe] for the clusters
better than 0.03 dex
- Semester, annual, and final data releases

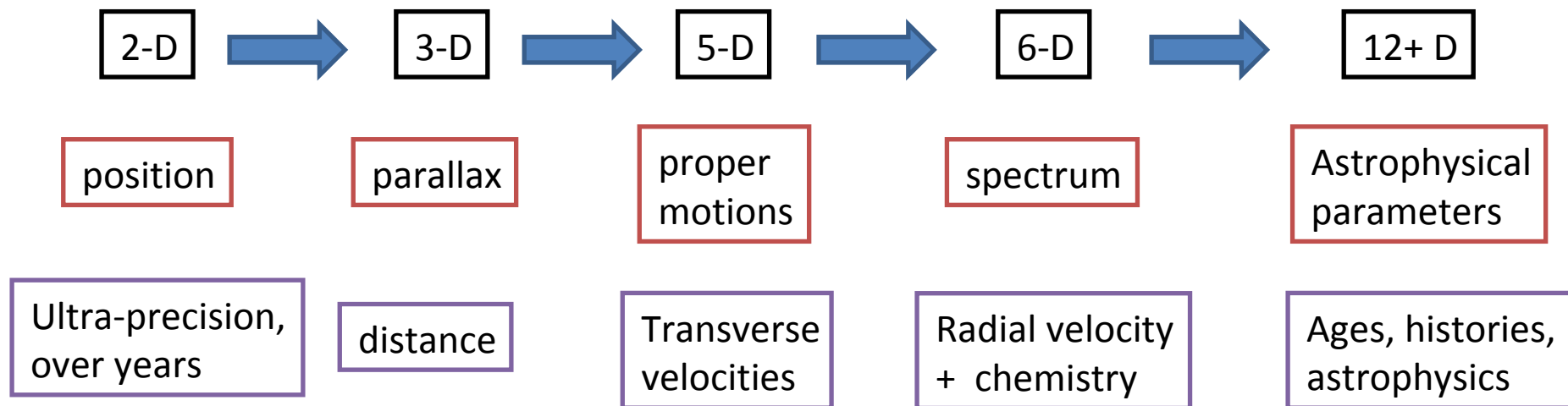
CORE SCIENCE

The formation and evolution of the Milky Way and its component stars and stellar populations

- The (dynamical) evolution of clusters: from birth to disruption
- Stellar evolution (ages, masses)
- Halo substructure, Dark Matter, Extreme stars
- Nature of the bulge
- Formation of the thick and thin discs (field stars and clusters)

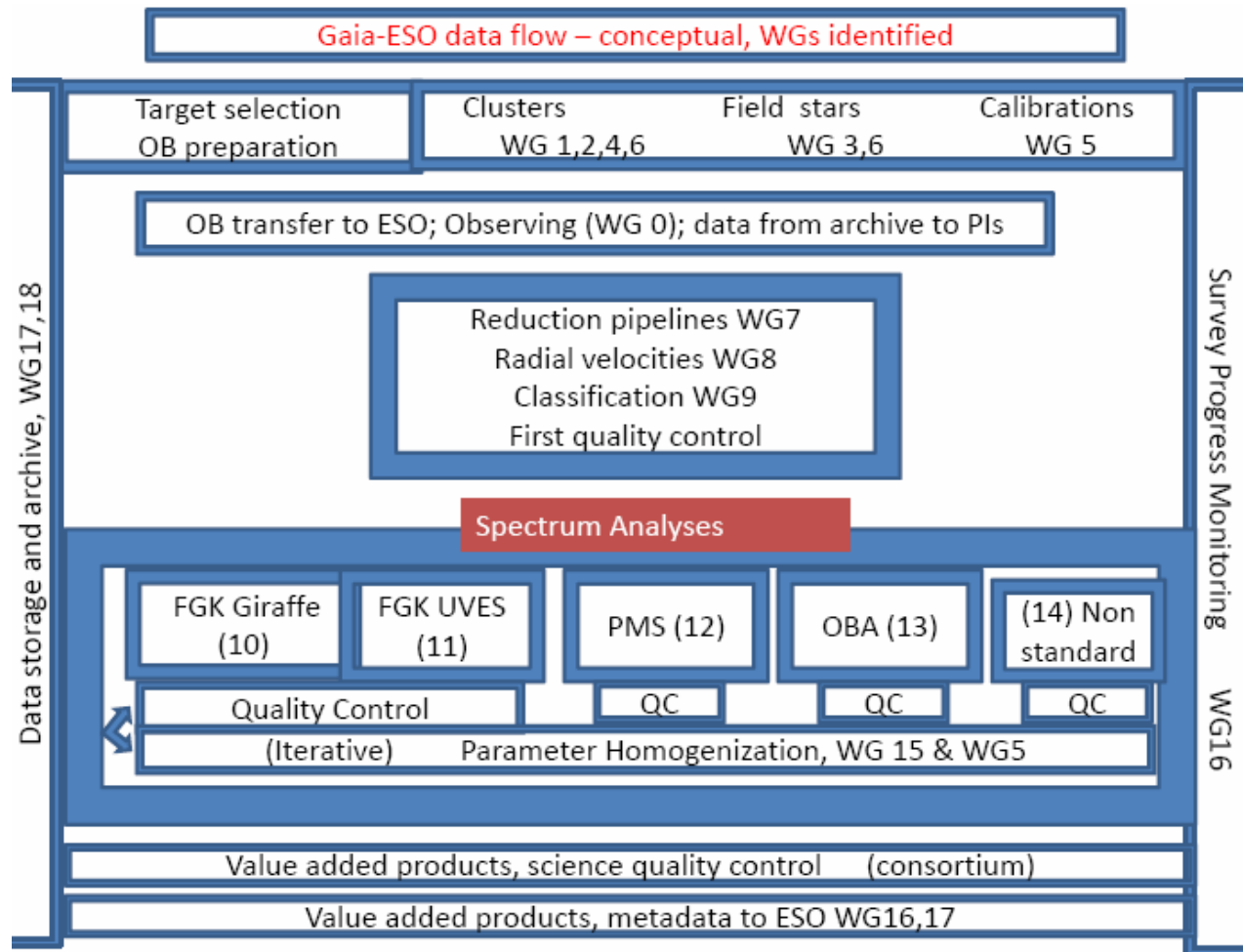
Complementarity with Gaia

**First *Gaia* data releases in 2016,
Just when Gaia-ESO finishes**



Stellar orbits, Star formation histories, Origin of the elements, Galaxy assembly,....
Dark Matter, Cosmological initial conditions, etc

Data flow & survey management



Steering Group

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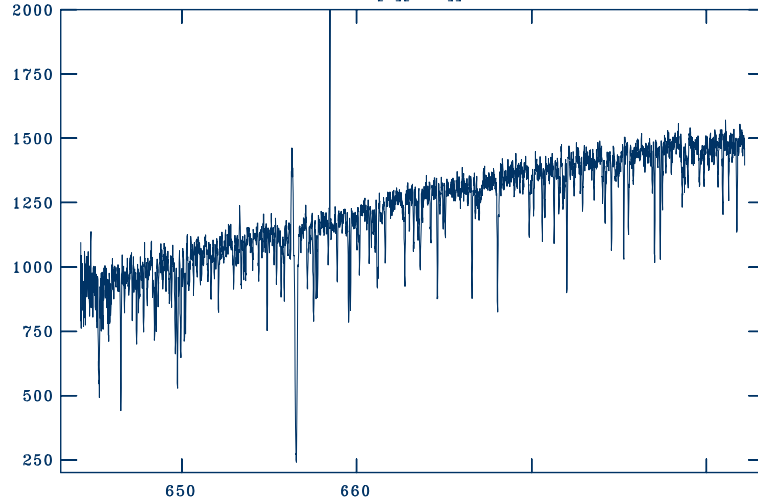
First light

Dec. 31 2011-Jan 5 2012

- ❖ Young cluster γ Vel
- ❖ Outer disc

First spectra -Giraffe

NOAO/IRAF V2.14.1 astuser2@wgsoff2 Tue 04:57:25 03-Jan-2012
IRAF.2012-01-03T04:17:54.288-A01_0005.fits[0][35,*]: GAM2VEL_HR15N_580_1_0h_8



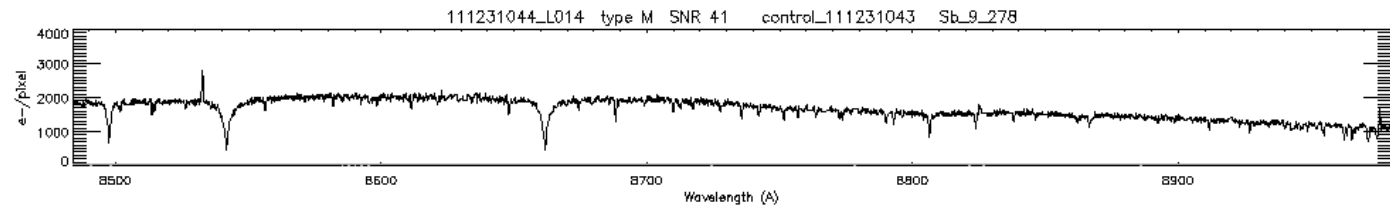
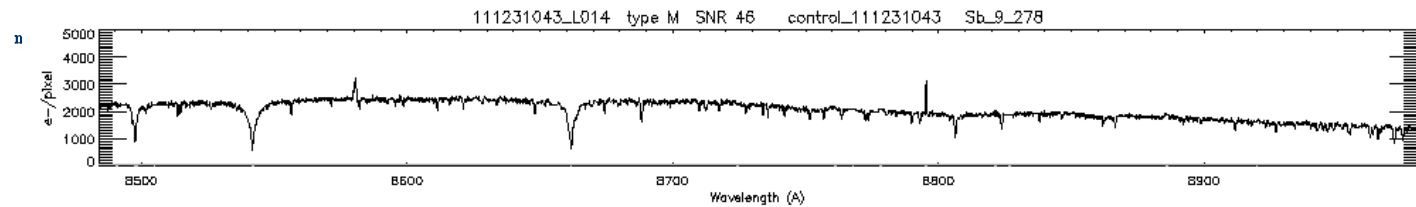
Gamma 2 Vel member



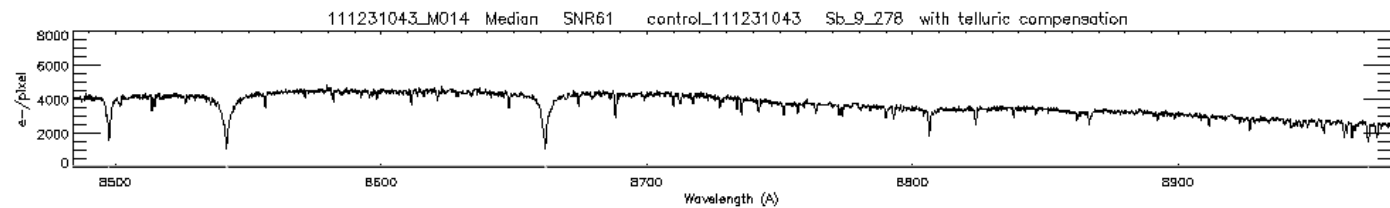
MW outer disc target



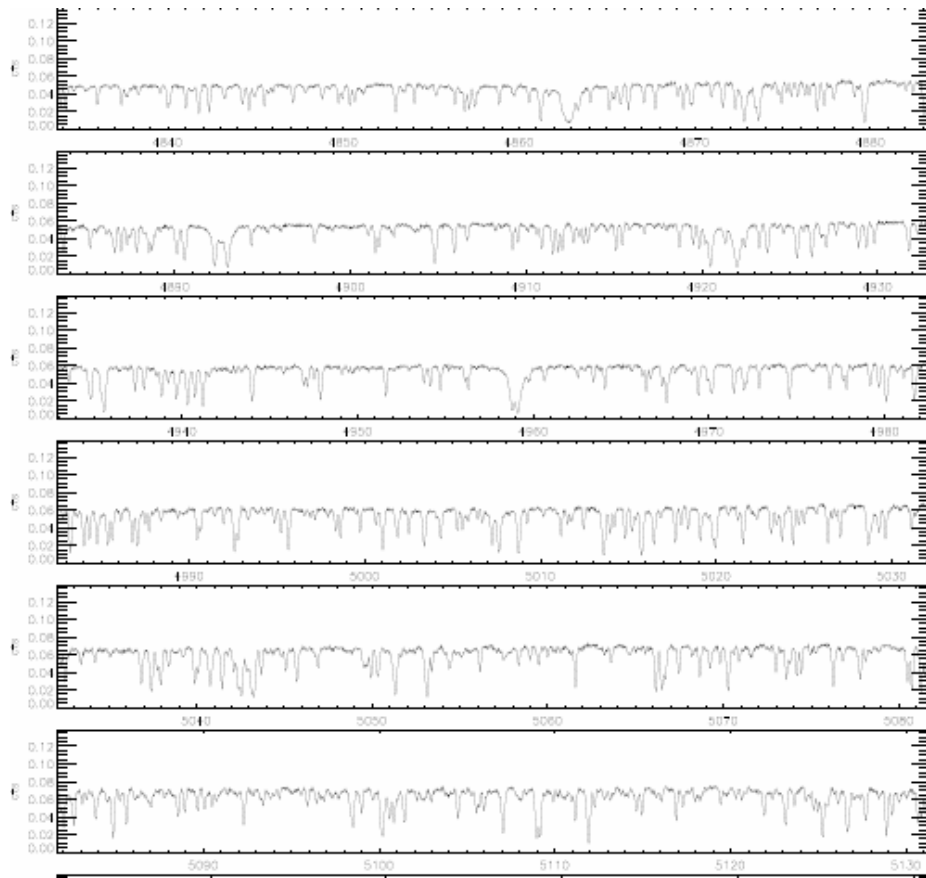
HR15N



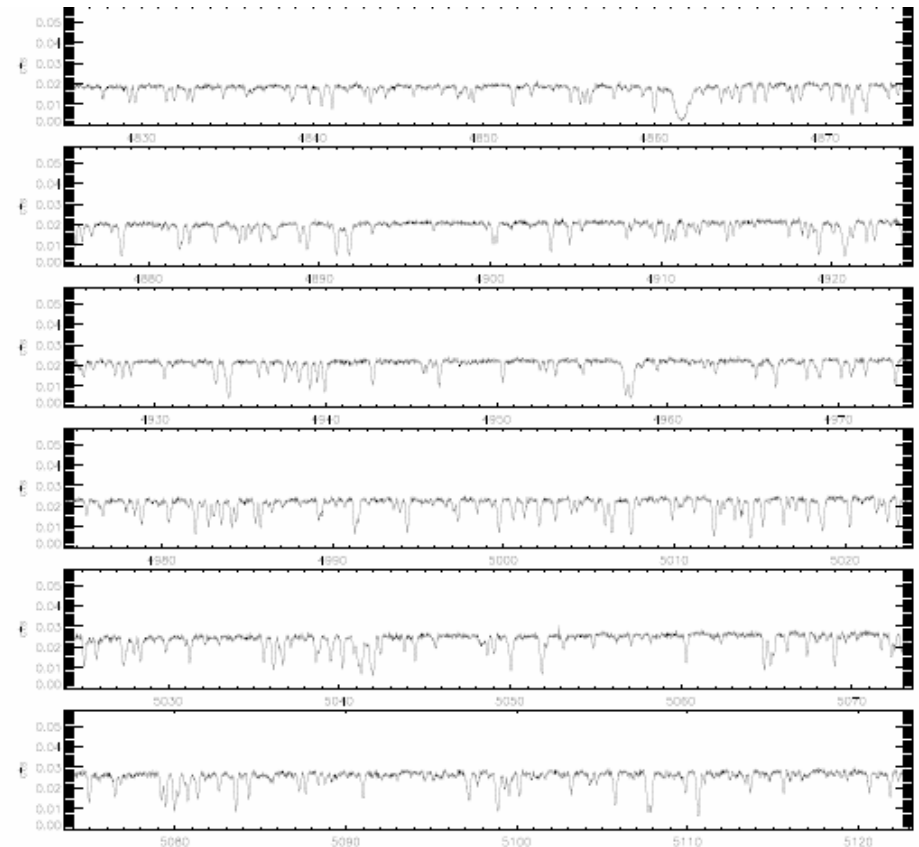
HR21



First spectra - UVES



Gamma 2 Vel member



MW targets

Beyond GES

- Systematic coverage of stars with $V > 17$
(selected targets, selected regions on the sky)
 - Stars fainter than $V \sim 19$ (wrt $G = 20$, Gaia limit)
 - Northern Sky
(limited to $\delta < +20$)
 - Follow-up of e.g. new cluster members or of
Gaia detected/identified objects

THANK YOU!