1 The Gaia-ESO survey: Galactic Astrophysics via VISTA Imaging, Gaia Astrometry, and Eso SpectrOscopy

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1.1 Abstract:(10 lines max)

We propose a massive spectroscopic survey with FLAMES, targeting $\sim 10^5$ red clump giants and F/G stars in all major stellar components of our Milky Way, which will produce the first consistent global view of how the kinematics and the detailed abundances (beyond just [Fe/H]) are related in our Galaxy. This alone will revolutionise knowledge of Galactic evolution; when subsequently combined with Gaia distances, the survey will help quantify the formation history of the mature stellar populations in the Milky Way. Drawing on well-defined samples, we will survey the Galactic Bulge, the inner and outer thick disk, as well as the inner halo and outer halo, with supplementary in-plane bar and spiral arm kinematic maps. Area and wavelength coverage will be sufficient to quantify several individual elemental abundances and kinematic gradients from the inner bulge through the thick disk to the outer halo; sufficient to explore abundance - phase-space sub-structure, deliver a 3-D mass-map of the Galaxy from the bulge out to 15kpc, and add great value to the Galactic VISTA imaging surveys.

2 Description of the Gaia-ESO survey: Scientific rationale (2 pages)

How disk galaxies form and evolve is one of the key questions of contemporary astrophysics. Galaxy formation is believed to be initiated by cold dark matter (CDM), and sophisticated simulations of the aggregation of CDM suggest that galaxies grow through a sequence of infall events. Most events involve accreting an object that is so small that it barely perturbs the system, some events involve an object large enough to produce a mild perturbation, and a handful of events involve an object that causes a major convulsion. Exactly how these events impact on a galaxy cannot be predicted at this time because the extremely complex physics of baryons cannot be reliably simulated: at a minimum it involves interstellar chemistry, magnetic reconnection, radiative transfer in the presence of spectral lines and significant velocity gradients, thermonuclear fusion, neutron absorption, neutrino scattering, radioactive decay, cosmic ray acceleration and diffusion. Consequently, we are far from being able to simulate the coupled evolution of CDM and baryons from ab-initio physics, so predictions of how galaxies are structured are based on crude phenomenological models that require empirical calibration. In these circumstances observations are crucial to learning how galaxies were formed, and what their structure now is.

Observations of high-redshift objects enable us to see galaxies being formed. However, the ability of high-redshift observations to reveal *how* galaxies form is limited by two factors: (i) the observed objects are faint and subtend small angles on the sky, so it is hard to gather detailed information about them, and (ii) it is hard to relate a given object at high redshift to the objects we study nearby: what role did a particular high-redshift event play in the formation of which kind of present-day galaxy? The aim of "near-field cosmology" is to answer some of these questions by sifting nearby galaxies, especially our own, for archaeological evidence of their history. Stars record the past in two ways: (i) in their age and chemical composition, and (ii) in their orbits. The key to decoding the recorded information is the study of the density of stars in the abstract space that has for its coordinates ages, chemical abundances and the values of the star's isolating integrals (ie, functions defining its orbit). Orbit space is fundamentally three-dimensional because generic orbits in typical galaxy potentials admit three isolating integrals. We are moving into an era when we will know the distances to and therefore the ages of millions of F/G stars. The number of chemical abundances one can measure depends on the signal-to-noise ratio (S/N) of the available spectra, but to make progress the S/N should be high enough (≥ 20) for useful constraints to be placed on [Fe/H] and [α/H]. Consequently, we need to map the density of stars in a space that is at least six-dimensional, and will be higher in favourable cases.

Unfortunately, the number of stars that is required to determine the underlying probability density grows rapidly with the dimension of the space in which we have to place them. So in the present case, if we have ten bins along each axis in integral space, corresponding to a resolution in velocity at least as coarse as ~ 6km/s, we have 1000 bins in integral space. Then we will want to distinguish at a minimum between young stars, stars of intermediate age and old stars, and similarly, between stars with solar abundances, with thick disk-like abundances, and with halo-like abundances. Thus each of the age, [Fe/H], and [α/H] axes must be divided into at least three bins, giving us 27 000 bins in the whole six-dimensional space. Even with perfectly adapted bin sizes, an estimate of the density of stars in this space will have Poisson noise of order unity unless we have in excess of 10^5 stars. Thus to make progress with understanding the Milky Way, we require a spectroscopic survey that returns data for a sample that extends to hundreds of thousands of stars. The unique opportunity of a large survey with FLAMES/GIRAFFE-UVES at the VLT meets this ambitious science challenge.

The Gaia mission will produce astrometry, spectrophotometry, and limited spectroscopy for a billion stars. However, this catalogue will provide only part of the data required by near-field cosmology because Gaia is primarily an astrometric mission and its spectroscopy will be inadequate in two respects: (i) it will be restricted to bright stars $V \leq 16.5$, and (ii) it has a narrow wavelength coverage, suitable for measurement of a line-of-sight velocity and a crude measure of metallicity ([Fe/H]) rather than detailed abundance patterns. This proposed VLT survey complements Gaia data by providing abundances for 12 elements (Na, Si, Ca, Ti, V, Cr, Mn, Fe, Co, Zr, Sr, Ba) for stars brighter than $V \sim 16$, and [Fe/H] and line-of-sight velocities with ~ 1km/s precision for stars down to $V \sim 19$. These additional data will hugely enhance the scientific value of the Gaia data by (i) providing the missing phase-space coordinate for, and thus determining the orbits of, survey stars fainter than $V \sim 16$, and (ii) making it possible to identify, on both chemical and kinematic grounds, substructures that bear witness to particular merger or star-formation events. Fig. 1 illustrates one of the key findings of the SDSS surveys, namely how rich the Galactic halo is in substructures. Deep photometric surveys of other Local-Group galaxies have shown that substructure is ubiquitous. Substructures not only define the accretion/assembly history, but have enormous potential as probes of the Galaxy's gravitational field, and are thus tracers of the Galaxy's still very uncertain distribution of dark matter. High-precision line-of-sight velocities will surely lead to the discovery of many more substructures, and abundance patterns will indicate clearly whether a given substructure represents a disrupted object and of which type, or has formed dynamically by resonant orbit-trapping. The kinematics of streams will then place tight constraints on the distribution of dark matter.

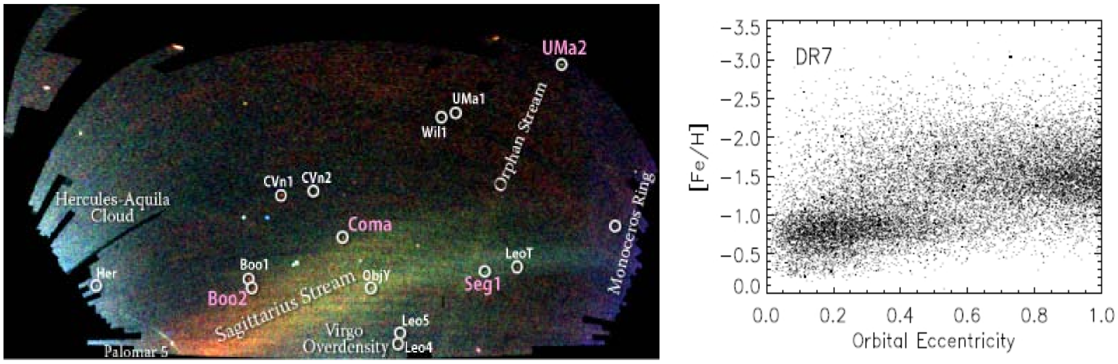

Figure 1: Left: the 'field of streams' revealed by SDSS. The Sgr dSph and its streams are centred in our survey area. Right: SDSS-DR7 spectroscopy hints at discretenesss between halo and thick disk in the outer galaxy. SDSS cannot sample the inner Galaxy, lacks more detailed elemental data, and misses the thin disk and bulge. This Gaia-ESO survey will be the first kinematic and elemental abundance survey of all the Galaxy's populations.

The availability of trigonometric parallaxes for survey stars will revolutionise our ability to determine the ages of F/G stars. Precision ages for stars with known abundance patterns will elucidate the key questions in Galaxy formation and evolution: how did the metallicity of the ISM evolve in time, and how does this evolution vary with Galactocentric distance? To what extent do stars migrate radially? Has the star-formation rate been episodic or rather steady? Does a major infall event occasionally depress the metallicity of the ISM? Did our bulge form through the central disc buckling dynamically (i.e., is it a "pseudobulge")? Is the thick disc just the oldest part of the disc, or is there a clear dynamical dichotomy between the thin and thick discs? We are unlikely to provide secure answers to these questions without measuring the abundance patterns of hundreds of thousands of stars. Hence it is vital to complement the Gaia mission.

The majority of our bulge/thick disk targets were probably formed at look-back times corresponding to redshifts > 2, and we expect some of them to date from the epoch of reionisation. It is enormously important to identify these first stars and study their abundance patterns. To this end we will observe $\geq 10^4$ stars, preferentially halo giants, at high resolution with UVES parallels. The proposed survey with FLAMES/GIRAFFE-UVES at the VLT will be the first large survey that consistently combines the three elements needed to make significant progress with near-field cosmology: (i) kinematics, (ii) detailed elemental abundances, and (iii) a comprehensive, global view of all stellar components of the Milky Way. The survey is complementary to Gaia and has a strong legacy value (see Sect. 5.2), but it is stand-alone and will have a huge impact even if Gaia blows up.

Our input catalogue is based on VISTA surveys, adding value to that ESO facility. It will sample all the Galaxy's major components: the thin and thick disks, the halo and the bulge. Thus it will discover the extent to which the boundaries between these components are continuous or sharp. The abundances measured sample the four fundamental nucleosynthetic channels: nuclear statistical equilibrium (V, Cr, Mn, Fe, Co), α-chain (Si, Ca, Ti), neutron capture (Zr, Sr, Ba) and proton capture (Na). The survey will play a key role in mapping the Galaxy's gravitational field and thus constraining the distribution of dark matter.

3 Observing strategy, including instruments to be used: (1 page)

Our observing strategy is derived from the science goals, from team experience, from specific simulations, from the availability of relevant pipelines, and from analysis of input source catalogues which are available or ESO-controlled. It is optimised to deliver precise radial velocities and accurate elemental abundances for $\geq 10^5$ southern stars, using a very well-defined selection function. The target stars are red clump giants, colour-selected, near V=16, and F/G dwarfs with $14.5 \leq \mathrm{V} \leq 19.5$ for high S/N(~ 60) elemental abundances at the brighter end, changing smoothly to [Fe/H] at the faintest limit, with precise radial velocities at all magnitudes. In addition to our general sub-structure search, we will target Sgr dSph tidal tail red clump giants (V$\sim$ 19), to map the dark matter halo potential shape.

◇ *fields with $b \geq 20°$ to quantify the halo and distant thick disk kinematic and abundance distribution functions, and their gradients; Goal 2.10^5 stars, 10^4 UVES parallels. Estimate 2000H*

◇ *fields with $5° \leq b \leq 20°, -50° \leq l \leq +50°$ to determine the kinematic and elemental abundance distribution functions of the bulge and inner thick disk; Goal: 3.10^4 stars, 2500 UVES parallels. Estimate 500H*

◇ *fields with $5° \leq b \leq 20°, 220° \leq l \leq 270°$ to determine the kinematic and elemental abundance distribution functions of the outer thick disk and warp, complementing the inner results; Goal: 10^4 stars, 1500 UVES parallels. Estimate 300H*

◇ *10 fields with $b \leq 2°$, through known low-extinction windows, HR21 only, to determine the effects of the Galactic Bar and spiral arms on the kinematic DF. Each line of sight to have ~ 10 setups, providing 1000RVs, plus UVES parallels. Estimate 100H.*

◇ *30 star clusters (plus ESO archive), for abundance, temperature, metallicity, age calibration of the CaT spectral region, to match to APOGEE and HERMES calibrations, and tidal tail science; two settings. Estimate 100H*

For all fields we will use FLAMES/GIRAFFE in HR21 setup (CaT; R=16000) with UVES parallels(R=47000), and reobserve the brighter stars with HR12(R=18000)+UVES to allow elemental abundance determinations (UVES: SNR=70 at V=14; FLAMES S/N=50 at V=16). HR21 and HR12 have the highest available efficiency. HR12 observations will be taken some time after HR21 to optimise variability detection. The FLAMES field of view is excellently matched to relevant target surface densities. There is considerable community experience, and optimised and operational software, to deliver advanced data products, including accurate radial velocities, and stellar [Fe/H] abundances. FLAMES delivers radial velocities to an accuracy of better than 3 km/s at $r = 19.5$ in 45min integration (60min OB, incl full overheads). The proven performance is below 1km/s at $r = 18$ (see Fig 2 below).

The input catalogue will be based primarily on VISTA imaging, supplemented by (public, DR8) SDSS imaging and some OGLE and EROS bulge fields. As VST data come available (& DES, SkyMapper, Gaia) we will use them to enhance our data products and analyses. The VISTA data are from the VHS, VVV, and Viking surveys, which have data processed and released at IoA Cambridge. VISTA astrometry and photometry are good. VISTA has already imaged a large area in stripes well-suited for FLAMES followup, and will have more than 3000sq deg of archive data before Gaia-ESO starts. We have analysed extant photometry to ensure suitable target identification and source densities are available - they are. In the Plane, extinction fortuitously makes identification of red clump giants easy and reliable, while more generally they occupy a narrow colour range in the CMD, and dominate dwarf stars at our magnitudes. At low latitudes extinction and crowding are issues: we have analysed extant photometry, using isochrones to isolate relevant CMD cuts, and measure an observable source density delivering the science goals well matched to a few FLAMES setups per pointing. Even the lowest density (Galactic Pole) star counts from VISTA & SDSS show the surface density of stars in the blue part of the CMD (the F/G stars targeted here) is well matched to FLAMES; (actual is 117/sq deg, $17 \leq r \leq 19$, 40/sq deg $r \leq 16; g - r \leq 0.5$). Candidate WD/BHB stars will also be observed. We will use GALEX, XMM-Newton and other catalogues to ensure interesting rare sources are observed wherever feasible, and reobserve suitable field stars with well-observed abundances, to enhance legacy value.

4 Estimated observing time:

The performance outlined in the strategy section shows the optimum exposure for the primary targets involves a single 60-minute OB, providing 45min integration, in 2 sub-integrations for cosmic ray removal. UVES parallels with brighter targets will be acquired. In this mode, experience shows 15-20 sky fibres are needed, so 110 targets per pointing are observed. With ambitious science goals we aspire to $\geq 10^5$ stars. Using star clusters as standards and a small set of repeat fields, to define errors and variability statistics, this implies 3000 hours. Target fields are somewhat biased to the inner Galaxy (RA=18H), and the SGP. We show in the figure below the CMD selection we adopt, that sufficient VISTA input data are available, that FLAMES does indeed deliver excellent velocity precision in a single OB at the magnitudes of interest here, and our simulations of minimum delivered stellar parameter accuracy.

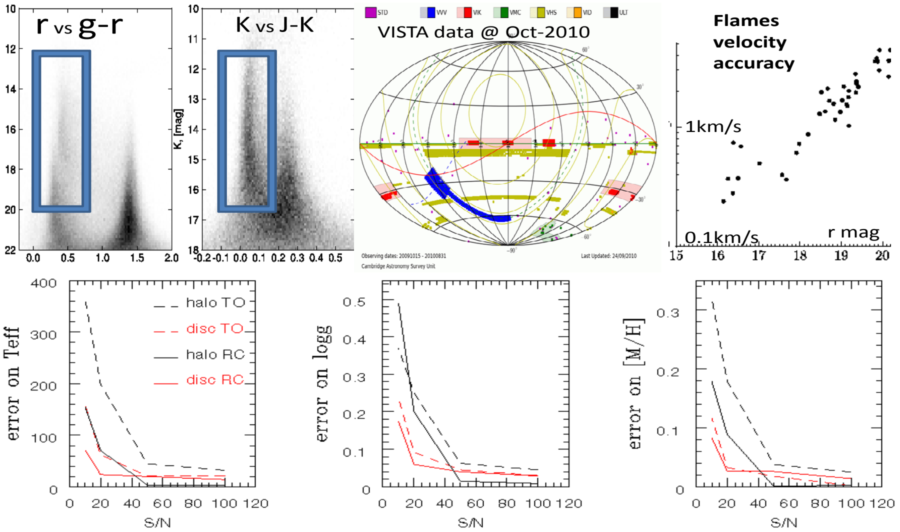

Figure 2: Top panel: a) optical & near-IR CMDs, showing our F/G star selection; b) current reduced VISTA data, showing extensive input target data exist; c) Flames data showing velocity accuracy < 2km/s from a single OB. Lower panels: Expected internal performances for stellar parameters (Teff, logg, [M/H]) from GIRAFFE-HR21 spectra alone of red clump (RC) and FGK turnoff stars (TO) of typical disc and halo metallicities, from an automatic procedure trained on a grid of synthetic spectra (MATISSE and related methods). The expected performances for the Gaia-ESO sample will be enhanced by the addition of HR12 and multi-band photometry.

Our use of HR21 (CaT) for all fields, with supplementary HR12, means the majority of the survey is unaffected by moon phase. The source surface density is such that we will be able to prepare two sets of OBs - one set for brighter stars, which can efficiently use poor seeing and transparency, one for fainter targets which will use mean and better conditions. We will observe with HR12 some non-critical time after HR21, for variability detection. We restrict targets to $+2^\circ \geq \delta \geq -60^\circ$. That is, the survey is robust with respect to observing conditions, has only the RA-imposed scheduling restrictions, and will be able to use all available time effectively. We plan to ramp up scheduled observing rapidly, allowing us to optimise our reduction system, and then assume uniform allocations: but the actual distribution is very flexible, and will be agreed with ESO.

Period	Instrument	Time (h)	Mean RA	Moon	Seeing	Transparency
P88	FLAMES/GIRAFFE/UVES	250	18h	any	any	any
P89	FLAMES/GIRAFFE/UVES	550	6h	any	any	any
P90	FLAMES/GIRAFFE/UVES	550	18h	any	any	any
P91	FLAMES/GIRAFFE/UVES	550	6h	any	any	any
P92	FLAMES/GIRAFFE/UVES	550	18h	any	any	any
P93	FLAMES/GIRAFFE/UVES	550	6h	any	any	any

5 Data management plan: responsibilities within the team. (1 page)

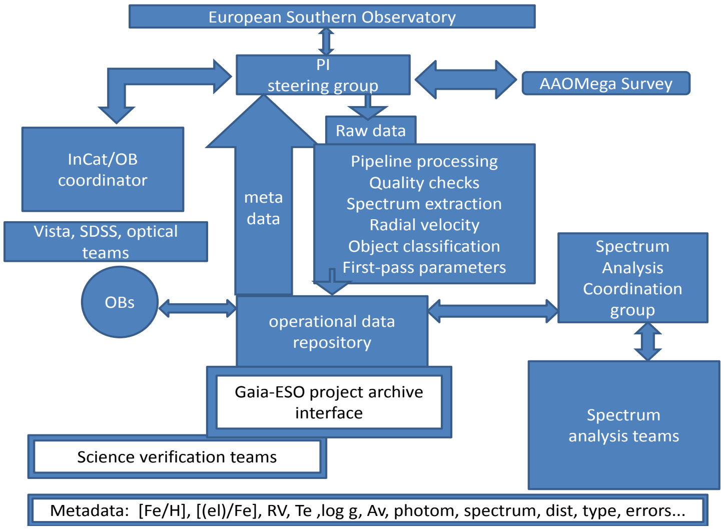

Figure 3: Block diagram illustrating the Gaia-ESO project dataflow. The management structure to deliver this dataflow is described below.

The Gaia-ESO project will follow standard proven large-project management methods, with responsibilities and communications linked to work effort requirements and deliveries. The PI is the point of contact to ESO, and is assisted by a steering group. Resources are being identified in each active participant group listed as Co-Is. All groups involved are active participants - the work will be distributed, with clearly defined and agreed local responsibilities under negotiation. Project coordination will involve kick-offs, regular telecons at Work Package (WP) level, and PI-WP lead level, with regular WP working meetings, and annual consortium meetings.

In order of the data/communications flow: coordination is provided by the IoA Cambridge team, who link up to ESO (& the AAOMega survey,§6) and internally to the activity groups. Target and field selection, and detailed OB preparation, involves groups at CASU/IoA (Vista), MPIA (SDSS), and Paris (OGLE, EROS), coordinated from Paris. Firstpass data pipeline processing and quality assurance, spectrum extraction, combination, and radial velocity determination is coordinated from IoA, involving groups across the partnership. The MPIA Gaia group lead several activities in initial source classification, which will identify types of unusual sources, and deliver first-pass stellar parameters for normal stars. All raw and reduced data, and all metadata products, will be stored in a repository, with access via an archive interface, coordinated by WFAU Edinburgh. The survey workload is of course dominated by extraction of stellar parameters and abundances from the spectra. The exceptional strength of our collaboration is that all the major European groups with proven expertise in reduction and analysis of stellar spectra to deliver stellar parameters and elemental abundances are included. The groups will use a single set of 1-D model atmospheres (MARCS), and a master set of LTE synthetic spectra. These groups will focus on the following workpackages: **Atomic Data** Paris, Heidelberg, Lund, Uppsala, Nice, Vienna; **NLTE for selected elements** Uppsala, MPA, Heidelberg, IAC; Na, Ca, Si; **1D model atmospheres** updated MARCS models; **Synthetic spectra** OCA Nice to compute grids of LTE synthetic spectra; **3D corrections, add-on to abundances:** Heidelberg, Paris, IAC (CO5BOLD, ASSET); MPA Stagger code; **Analysis, incl extinction:** Paris/Heidelberg (MyGisFoS, ALDAP, SPADES); Nice (Matisse); IAC/MPIA (Bayesian); Uppsala/Lund/Porto (SME automated); MPA/Bologna. The results of the different Teams/Methods will be collated by the spectrum analysis coordination unit, which will provide, for each star, a "best" set of atmospheric parameters and abundances, as well as the ranges associated with random errors and with systematics/model assumptions. The methodology will be clearly defined, documented and traceable. The results of each separate analysis will be archived, to allow users to make different choices and combinations.

5.1 Description of data products and justification of their legacy value: (1 page)

The primary (meta)products will be reduced and calibrated spectra, associated radial velocity and abundance information, stellar parameters, extinction, and all public photometry, supplemented by identification flags for the anticipated many rare objects. This will be provided to ESO through its archive, as required. Additionally, we anticipate dedicated archive access sites provided by the collaboration, with enhanced VO facilities, and complementary data products. Archive access activities will be coordinated by WFAU Edinburgh, with several partner contributions. Our collaboration includes several organisations which led development of the VO, includes the host organisation for the RAVE survey, and its data system, and for the UKIDSS/WFCAM and VISTA Science Archives (WSA, VSA). These prototype the VO-compliant analysis tools which will be most useful here, leading into archive matching to the Gaia data.

The accurate kinematics and abundances will become the basis for developing and implementing the analyses which the community is building for full Gaia dataset analysis. Useful proper motions exist for the subsample overlapping SDSS, to facilitate this. One of the Gaia approaches, which will be implemented for this sample, is spectral classification and parameter estimation. This means discrete classification (star/quasar/galaxy, plus binary detection) and first-guess stellar parameter estimation (T_{eff}, log g, [Fe/H], [α/Fe]), which will be starting points for full spectrum analysis. We will implement several methods for both classification and more detailed abundance estimation, as for Gaia. The range of techniques being developed, and the critical need for early tests with real data, are reviewed in Proceedings of Joint Discussion 5 at IAU XXVII, Rio, 2009. The conclusion is that models must be 'observable' with the same errors and biases as occur in real observing programs. This Gaia-ESO survey will be the first survey with high statistical weight, probing velocity-chemistry-position space, and with a consistent, well-defined selection function. This will allow analysis at many different levels by many communities. Many rare objects of special interest are anticipated. There is considerable community experience, and optimised and operational software, to deliver advanced data products, including accurate radial velocities, and elemental abundances. Much of our experience has been derived from study of faint stellar populations, from field thick disk stars to the systematic properties of halo stars, kinematic and abundance gradients from the Bulge to the field halo, finding the most metal-poor old stars in dSph galaxies, field halo streams, and the Sgr dSph galaxy. For example, the science driver of precision kinematics and abundances in dSph galaxies has led to bug-correction and enhancements to the data reduction pipelines, together with local value-added pipelines for improved wavelength recalibration (using sky lines) and spectral fitting to determine accurate radial velocities and stellar parameters.

A primary use of this dataset includes determination for the first time of the metallicity-kinematics distribution functions for definable sub-populations. To date only heavily pre-selected biased studies have been possible, eg for metal-poor stars. In addition to unbiased extremes, a key goal here is to define the typical. Rare stars will of course be found, including UMPs, BHBs, WDs, CVs, dCs, emission-line stars, high-velocity stars, even compact galaxies, some QSOs, and perhaps very rare objects. Large numbers of spectroscopic binaries will be found. With Gaia distances a 3-D map of the ISM can be derived. The stars studied here are mostly near the MS turnoff: many will be subgiants. Thus, while Gaia data are not needed for our target selection, reprocessing our spectra with Gaia's astrometric distances/gravity measures will improve the abundance precision, and will increase the phase-space dimensionality. Since this will be the only clean sample of Bulge, thin disk, thick disk and halo turnoff stars, a unique product, combining Gaia astrometry with the abundances and element ratios derived here, will be the age distribution function(s) for the Milky Way, delivering the first robust contribution to the relative importances of assembly and accretion, and star formation histories. Our analysis techniques include those currently used in the AMBRE project to re-reduce the ESO archive: thus the entire ESO spectral archive will be re-reduced and calibrated consistently with this large survey, substantially enhancing its value.

This project is developed in the GREAT collaboration, which provides some funding support, and involves the whole European Gaia community, ensuring this survey meets a wide range of astronomical interests, and the community is ready to exploit these archive data. We also include our own AAOmega survey of the Sgr dSph: these science results will also be archived, while the project will help integrate Australian and European science activities.

6 Other remarks, if any: (1 page max)

This Gaia-ESO consortium. Our consortium is large and widespread, illustrating the very broad community interest. We include groups expert in deriving abundances from spectra. We include Galactic dynamics groups, and chemical evolution modellers. Together we are ensuring survey design is optimum for the large community involved in modelling galaxy formation and evolution, and preparing for Gaia science analysis.

AAOmega: South. Of particular science interest is the very wide area, roughly 100° x 30°, around the South Polar Cap, where the Sgr dSph tail crosses, and where the body of the Sgr dwarf itself and the local tail is close enough that the member RGB stars are bright. The surface density of the brighter M giants is however low, and the area very large. In order to optimise study here, our consortium is proposing a complementary survey to use AAT/2dF+AAOmega to study brighter Sgr stars over a wide area. The Australian consortium are part of this Gaia-ESO consortium.

Related GREAT activity. A subset of this Gaia community is responding to the ESO CfP for next generation spectroscopy instruments - we are in close contact. This survey is developed in the GREAT consortium, a subset of which is also proposing a survey, focussed on star clusters. These proposals are deliberately complementary.

Other relevant spectroscopic projects.
Gaia: all-sky. This survey is complementary to, but is not dependent upon, Gaia. The Gaia RVS instrument will obtain spectra with useful (end of mission) velocity accuracy for all stars with $V \leq 16.5$. Gaia astrometry (first data release planned for late 2015), when combined with our spectra, will determine more accurate abundances, and, uniquely, ages: the combination will be the first ever age-abundance-kinematics distribution function for old stars. www.rssd.esa.int/index.php?project=GAIA&page=index

SDSS I, II, & III: 2.5m, North. SDSS has published some 250K spectra providing velocities to $\sim 10-20$km/s, and [Fe/H] abundances to ~ 0.25dex for stars with $14 \leq r \leq 19$. These studies complement the SDSS photometric analyses, which identified very considerable rich structure in the outer Galactic halo. SDSS spectra have provided only very limited information on the substructures prominent in the SDSS photometry: this is a consequence of SDSS's very sparse spatial sampling, and the low precision radial velocities and abundances from their spectra. SDSS3 stellar spectroscopy continues, at ~ 5 stars/sq deg. We learn from SDSS that higher precision data with a well-defined but not too narrow selection function is needed for progress. SDSS misses the Galactic thin disk and Bulge, because of its observing limits. www.sdss3.org/

SDSS-APOGEE: 2.5m, North, IR. APOGEE is a survey of Galactic stellar populations, to begin in 2011, aimed at obtaining high resolution (R = 30,000), high S/N (≥ 100) spectra in the H band (1.5-1.7 microns) for 10^5 stars, primarily G-M giants, with $11 \leq H \leq 14$. APOGEE will study 50 high latitude Galactic halo fields, 65 bulge fields, and 110 low latitude disk fields, including 30 'key calibrator' and some 200 other star clusters. We will observe several clusters in common with APOGEE, for calibration. www.sdss3.org/apogee.php

LAMOST: 4m, North. LAMOST is in transition from commissioning to full operations. It operates at SDSS resolution (R$\sim$ 1700), and will be able to observe very large numbers of northern targets at intermediate magnitudes. We are in discussion with the LAMOST project, concerning possible complementary targeting.

AAT-HERMES: 4m, South. HERMES, to begin observations in 2013, aims to obtain precision multi-element abundances for 10^6 stars with $V \leq 14$, from high S/N, R=30000 spectra, in 10^3 AAT nights. Our teams are coordinated, and surveys complementary, with HERMES restricted to brighter targets.
www.aao.gov.au/AAO/HERMES/

AAOmega: 4m, South. AAOmega is completing a CaT survey of 30000 bulge and inner disk clump giants, $13 \leq I \leq 16$. Like HERMES, this brighter target survey is complementary to, and will provide some interesting UVES targets for, our Gaia-ESO survey.

UKST-RAVE: 1.2m, South. RAVE is obtaining accurate radial velocities ($\leq$5km/s) and useful abundances for $\sim 5.10^5$ stars with $I \leq 13$. RAVE uses the Gaia CaT window, and will provide interesting UVES targets for this survey. www.rave-survey.aip.de/rave/