An Overview of the Gaia-ESO Survey

C. Allende Prieto

Instituto de Astrofísica de Canarias

The Gaia-ESO Survey

- Homogeneous spectroscopic survey of 10^5 stars in the Galaxy
- FLAMES@VLT: simultaneous GIRAFFE + UVES observations
- 2 GIRAFFE spectral settings for 10^5 stars
- Unbiased sample of 10^4 G-type stars within 2 kpc
- Target selection based on VISTA (JHK) photometry
- Stars in the field and in ~ 100 clusters

Science

- Galactic phase-space substructure
- Chemical evolution
- Star migration
- Disk gradients and their time evolution
- Cluster evolution (formation, dissolution, self-polution)

The field stars

- Mid-resolution GIRAFFE spectra (R~12,000) for 10^5 stars to V < 20 (mostly in the Gaia RVS *gap*)
- GIRAFFE HR21 (Ca II IR triplet) + HR10 (~540 nm) with 10<S/N<30 to yield atmospheric param., radial velocities, limited chemistry
- UVES spectra for 10^4 G-type stars to V<15 with S/N>50 to yield detailed atmospheric parameters , high-precision radial velocities and 11+ elemental abundances

Breakdown by population

- Bulge: bright (I~15) K-giants with 2 GIRAFFE settings at 50<S/N<100
- Halo/Thick disk: F-type turn-off stars (SDSS 17<r<19)
- Outer thick disk: F-type turnoff (75%) and K-type giants at intermediate galactic latitude
- Thin disk (I~19) from 6 fields in the plane with HR21-only data (+ UVES sample)

The cluster stars

- Cluster selection from Dias et al. (2002), Kharchenko et al. (2005), WEBDA catalogues, supplemented by exploratory program at Geneva
- Only clusters with membership information considered
- Nearby (<1.5 kpc; down to M-dwarfs) and distant clusters (giants only) will be observed, sampling a wide range in age, [Fe/H], galactocentric distance and mass
- 6 GIRAFFE settings (HR03/05A/06/14A/15N/21) down to V~19
- + UVES sample down to V~16

Observations and Calibration

- Visitor mode observations -- start December 2011
- 300 nights over 5 years (~1500 pointings)
- Target selection will be largely based on VISTA VHS photometry + additional information for clusters
- ESO Archive (on-going analysis)
- Calibration fields to control/match parameter/abundance scale across surveys

Data reduction/analysis

- Data reduction performed at Cambridge (GIRAFFE) and Arcetri (UVES) likely based on ESO pipeline
- Radial velocity derivation
- Object classification
- Spectral analysis: atmospheric parameters and abundances
- Gaia-ESO archive

Spectral analysis

- UVES spectra of *normal* FGK stars
- GIRAFFE spectra of *normal* FGK stars
- Pre-MS and cool stars
- Hot (OBA-type) stars
- Funny things
- Survey parameter homogenization

Consortium

- Over 300 people involved (90+ centers)
- 2 co-Pis (G. Gilmore and S. Randich)
- A steering committee
- 17 working groups

Steering Committee

Name	Function	Affiliation	Country
Gerry Gilmore	Co-PI	Institute of Astronomy	UK
Sofia Randich	Co-PI	INAF Obs Arcetri	I
M. Asplund	Steering Group	MPA	D
J. Binney	Steering Group	Oxford	UK
P. Bonifacio	Steering Group	Paris	Fr
J. Drew	Steering Group	Herts	UK
S. Feltzing	Steering Group	Lund	Se
A. Ferguson	Steering Group	Edinburgh	UK
R. Jeffries	Steering Group	Keele	UK
G. Micela	Steering Group	Palermo	I
I. Negueruela	Steering Group	Alicante	Sp
T. Prusti	Steering Group	ESA	ESA
H-W. Rix	Steering Group	MPIA	D
A. Vallenari	Steering Group	Padova	I

Working groups

Function	Contributing Groups	FTE/yr	Coordinators
Survey Overview	Co-PIs	2x0.4	Gilmore, Randich
Management Overview	Steering Group	12x0.05	12 members
Target selection, Calibrators, FPOSS & OBs			
Open Clusters: membership analysis auxiliary data target selection	Alicante, Armagh, Torino, ETH, MSSL Vienna, MPIA, Palermo, Barcelona, Granada Bologna, Madrid (CAB), ESO, ESA, Geneva, AIP Herts, Arcetri, Uppsala, ROBelg, ESO, ESA Leicester, Indiana, ETH, Lisbon, Grenoble Keele, IAC, Athens Padova, Catania, Porto, Nice, ZAH	6	E. Alfaro (Sp) E. Paunzen (At) A. Bragaglia (I)
Galactic Plane Field Selection	Paris, RUG, AIP, MSSL, Strasbourg, Oxford	4.5	C. Babusiaux (Fr)
Calibrators & Standards	AAO, AIP, Uppsala, Camb, Bordeaux Antwerp, Bologna, Madrid, Paris, MPA,	1.5	E. Pancino (I)
OB/fposs generation: Field Survey Cluster Survey	Paris, ESO, Camb, Lund, AIP, ZAH Arcetri, Bologna, Catania, Padova, Palermo, IAC Exeter, Alicante, CAUP, ESO	2 2.5	T. Bensby (Se) E. Flaccomio (I)
Spectrum Extraction Pipelines			
Pipeline Raw Data: GIRAFFE Reduction UVES Reduction	CASU, Keele Arcetri	1 2	M. Irwin (UK) L. Morbidelli (I)
Radial Velocities	Camb, Keele, Arcetri, Antwerp, ZAH	2	Camb/Keele/Arcetri
Discrete Classification	Camb, MPIA, IAC, Madrid, MSSL, Porto, ZAH	2.5	S. Koposov (UK)
Spectrum analyses			
FGK Stars: GIRAFFE	Paris, MPA, Lund, Uppsala, Nice, IAC, Bordeaux Arcetri, Bologna, Liège, Geneva, Alicante Nice, ESO, Porto, ZAH, Arcetri, Naples Catania, Padova, Kaypten,	17	A. Recio-Blanco (Fr) & C. Allende Prieto (Sp)
FGK Stars: UVES	Paris, MPA, Lund, Uppsala, Nice, IAC, Vilnius, Herts Arcetri, Bologna, AIP, Indiana, Madrid (UCM) Groningen, ESO, Naples, Porto, ZAH, Catania, Alicante Catania, Padova, Liège, Bordeaux	14	A. Korn (Se) & R. Smiljanic (ESO)
Pre-Main-Sequence stars	Arcetri, Catania, IAA Naples, Palermo, ETH, CAUP Keele, Exeter, Madrid (UCM, CAB)	8	A. Lanzafame (I)
OBA Stars	Liege, RO Belg, AIP, OMA, Madrid, Paris, Armagh Alicante, Uppsala, MPIA, ZAH, Leuven, Herts Calar Alto, Nice, IAA	2	R. Blomme (Be)
Unusual Objects	SRON, Nijmegen, Warwick, MPIA, Herts, ZAH, Leuven	1	tbc
Survey monitoring, database, archive			
Survey Parameter Homogenisation	all spectrum analysis groups	4	P. Francois (Fr)
Survey Progress	CASU	0.5	Co-PIs
Operational database	CASU/Cambridge	1	CASU
Survey Archive	AIP, RUG, Madrid, Vienna, ZAH, Edin	1	N. Hambly (UK)
Outreach	Cambridge	0.1	N. Walton (UK)

Data Release

- All raw data immediately public
- 3-level data products with different time scales
- Level-1: 1D spectra, associated photometry, object classification and RVs (release every 6 months)
- Level-2: RV variability info, atmospheric parameters and abundances (yearly releases)
- Level-3: all of the above for final co-added data and mean cluster metallicities (end of survey)

Competition

- SDSS, SEGUE1/2
- BOSS
- SDSS-III APOGEE
- HERMES
- HETDEX
- After Sloan 3 (STREAMS, APOGEE-II/S)
- BigBOSS, 4MOST, MOONS, WEAVE

Spanish involvement

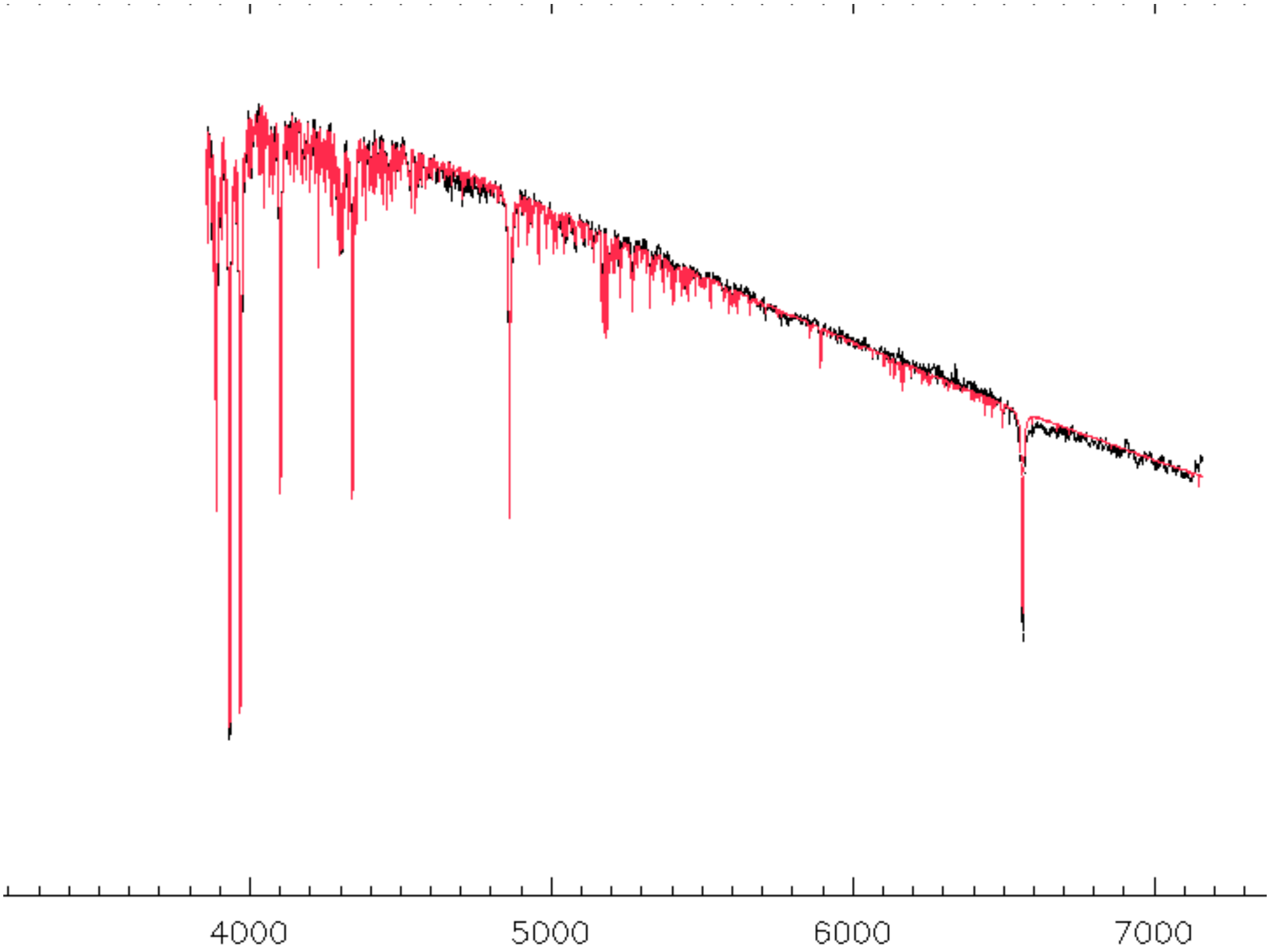
- Groups at Alicante, Barcelona, CAB, Calar Alto, IAA, IAC, UCM
- I. Negueruela on the Steering Committee
- E. Alfaro & C. Allende Prieto as WG coordinators; also A. Recio-Blanco (OCA)
- IAC/Alicante/AIP group on spectral analysis

IAC - UA - AIP

- Analysis of GIRAFFE spectra with automated methods: ANN, Bayesian (Bikini), optimization/interpolation (FERRE) w/o PCA
- Close collaboration with OCA (Nice)
- Analysis of UVES spectra with FERRE

Data Analysis

- FERRE optimization with interpolation on a pre-computed grid
- N-dimensional f90 code
- Various algorithms: Nelder-Mead (Nelder & Mead 1965), uobyqa (Powell 2002), Boender-Rinnooy Kan-Strougie-Timmer algorithm (1982)
- Linear, quadratic, cubic spline interpolation
- Spectral library on memory or disk
- PCA compression
- Handling of complex PSF w/o compression
- Flexible: SDSS/SEGUE/BOSS, WD surveys, APOGEE, STELLA, Gaia-ESO…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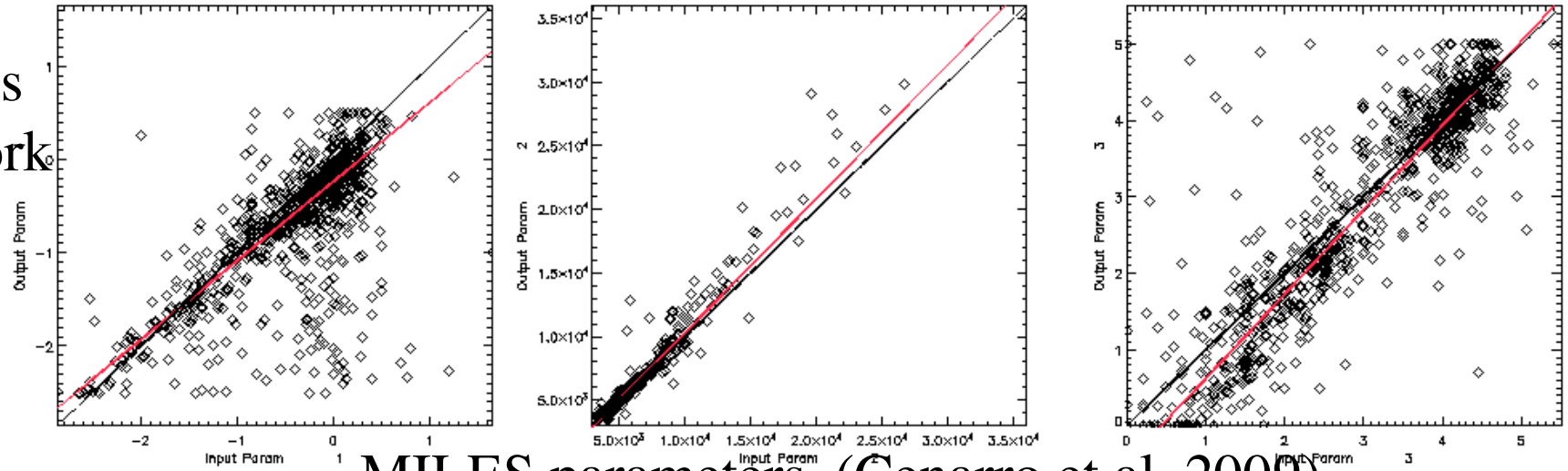
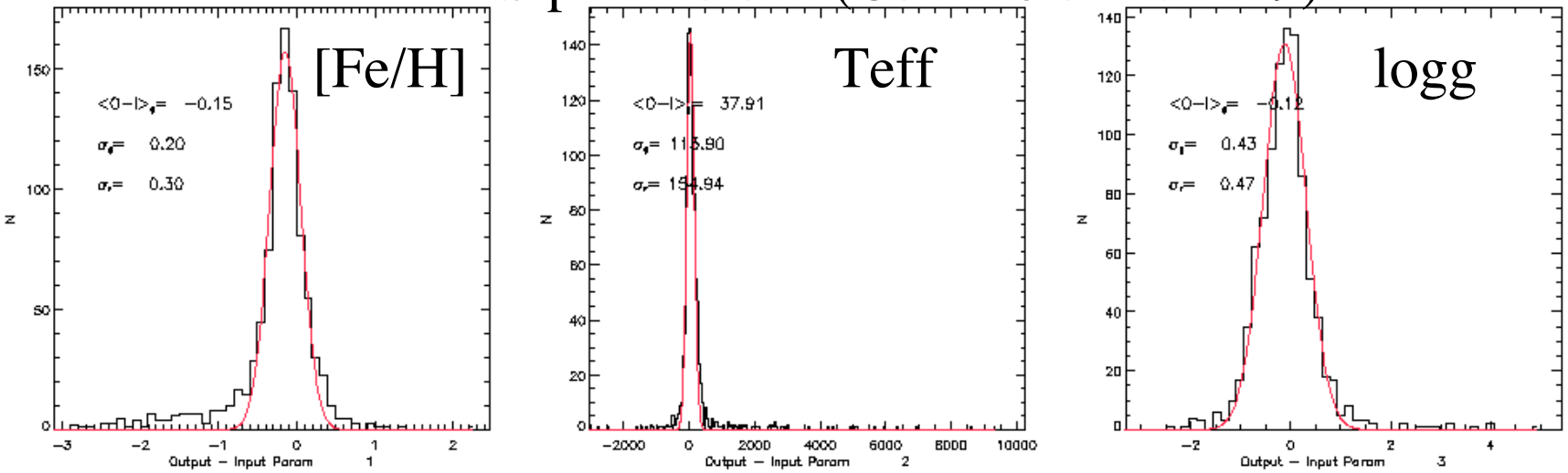
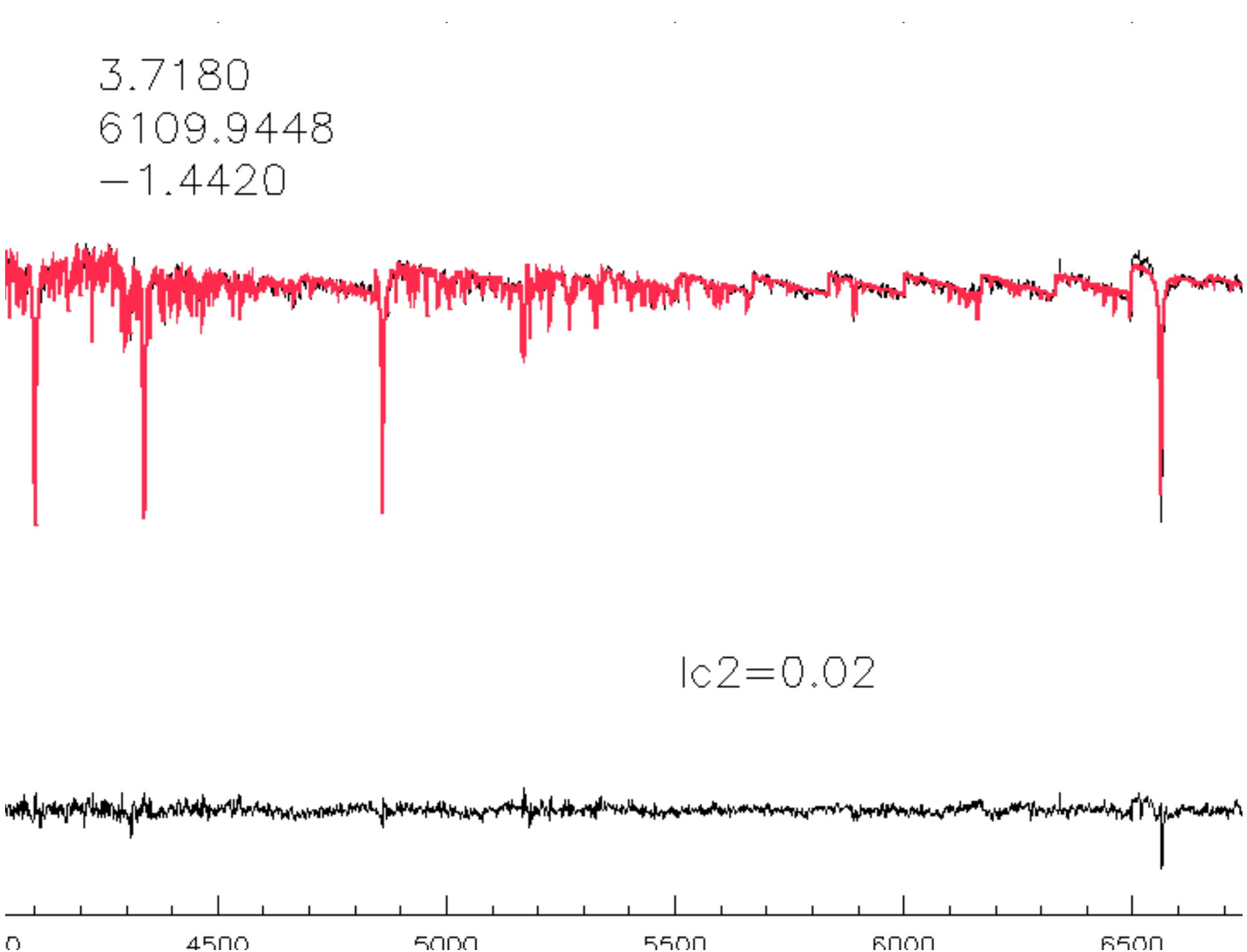


MILES parameters (Cenarro et al. 2009)



Distributions of residuals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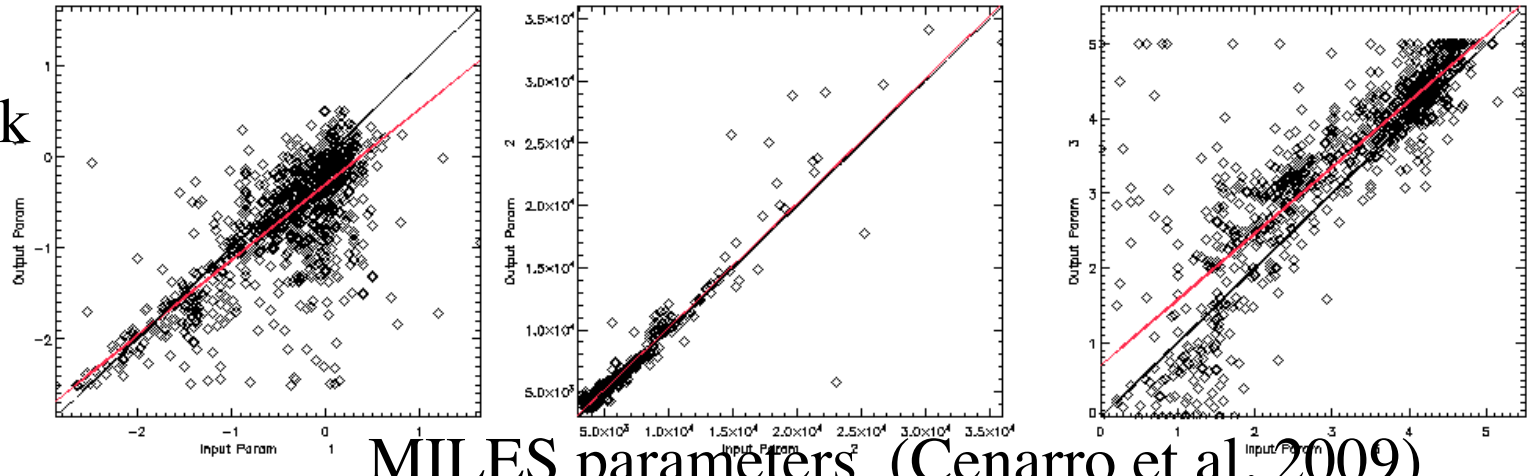
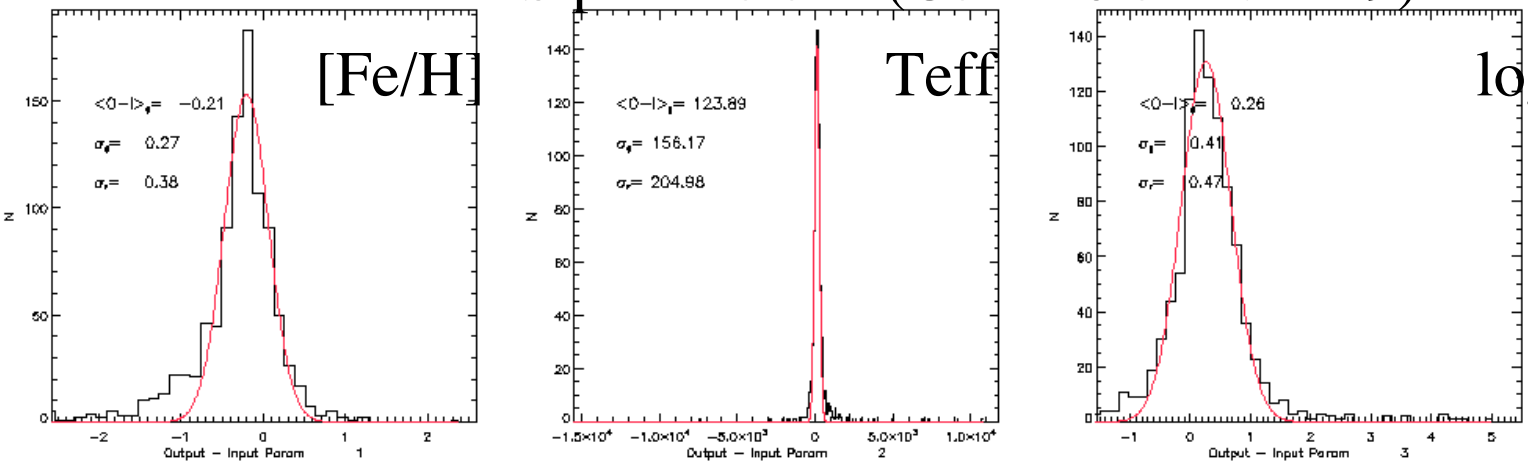


MILES parameters (Cenarro et al. 2009)

[Fe/H] Teff logg



Distributions of residuals

Gaia-ESO Summary

- 100,000 stars at mid-resolution (x2 GIRAFFE settings) and 10,000 stars at high-resolution: 300 VLT nights over 5 yr
- Field stars and open clusters
- Uniform composition and radial velocity information across the Galaxy complementing Gaia's data
- Large european consortium
- Swift schedule for data reduction/processing/analysis/delivery
- But serious competition!