CoRoT Red Giants in GES

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Solar like oscillating RG

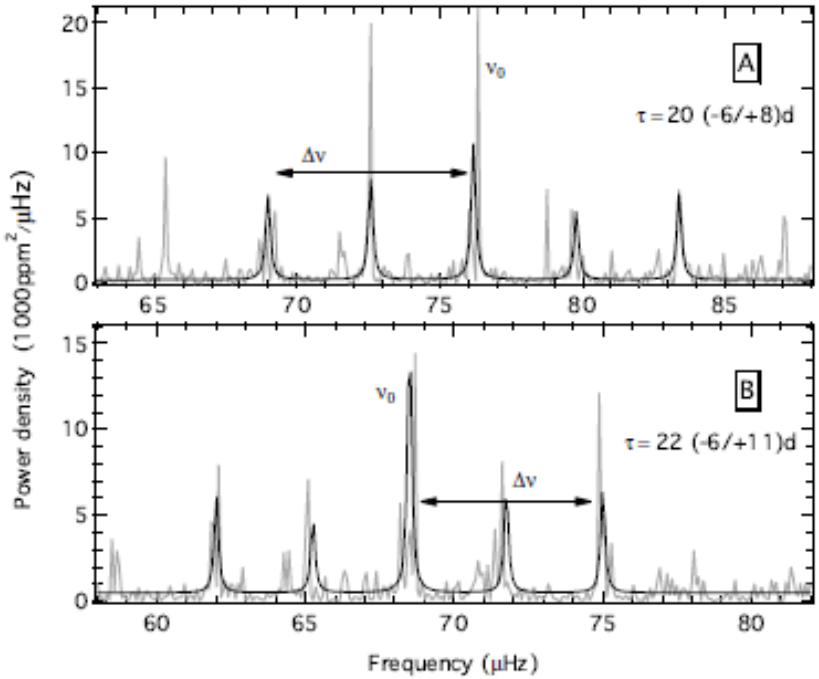
CoRoT solar like oscillating giants are a unique sample:

- well populated class of objects
- good distance indicators
- large age range
- large distance range
- evolutionary stage
- calibration fields for surveys

Large Frequency spacing

Proportional to the mean density (Vandakrov, 1967):

$$\Delta\nu \simeq \sqrt{\frac{M/M_\odot}{(R/R_\odot)^3}}\Delta\nu_\odot, \quad (1)$$

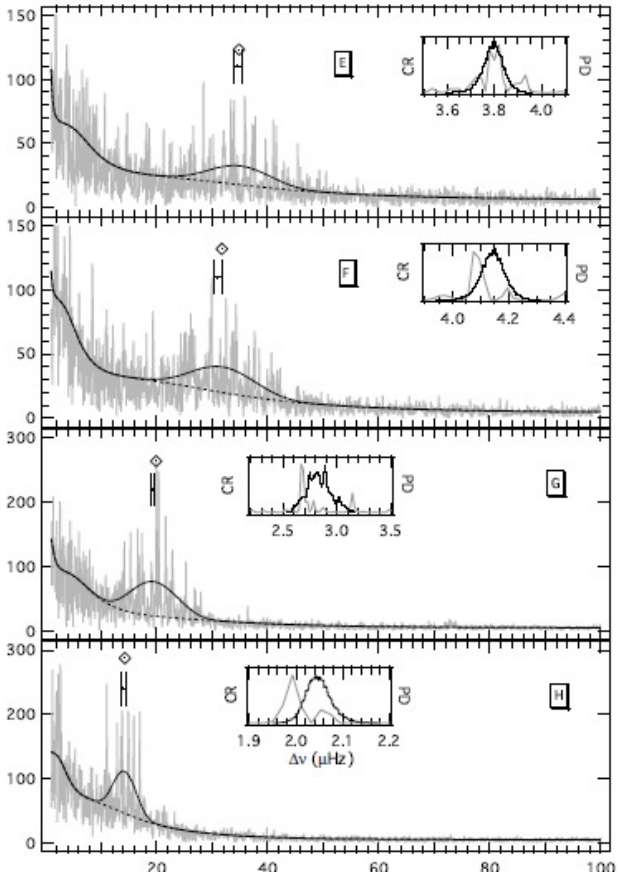


Kallinger et al.2010

Frequency of Maximum power

Proportional to the acoustic cutoff frequency (Brown et al., 1991)

$$\nu_{\max} \simeq \frac{M/M_\odot}{(R/R_\odot)^2\sqrt{T_{\rm eff}/T_{\rm eff,\odot}}}\nu_{\max,\odot}\,, \quad (2)$$



Kallinger et al.2010

Scaling relations

$$\frac{M}{M_\odot} \simeq \left(\frac{\nu_{\rm max}}{\nu_{\rm max,\odot}}\right)^3 \left(\frac{\Delta\nu}{\Delta\nu_\odot}\right)^{-4} \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{3/2} \quad (3)$$

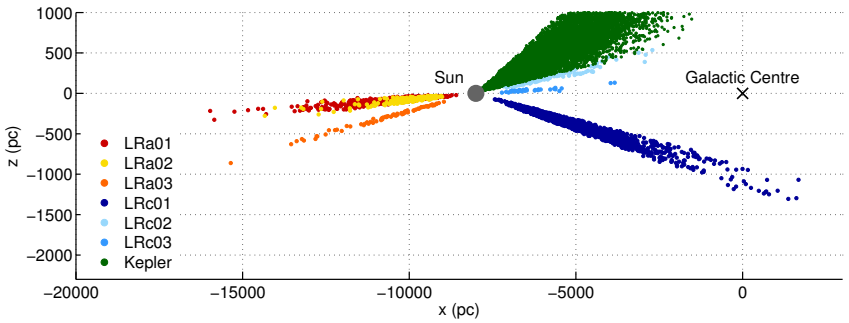
$$\frac{R}{R_\odot} \simeq \left(\frac{\nu_{\rm max}}{\nu_{\rm max,\odot}}\right) \left(\frac{\Delta\nu}{\Delta\nu_\odot}\right)^{-2} \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{1/2}. \quad (4)$$

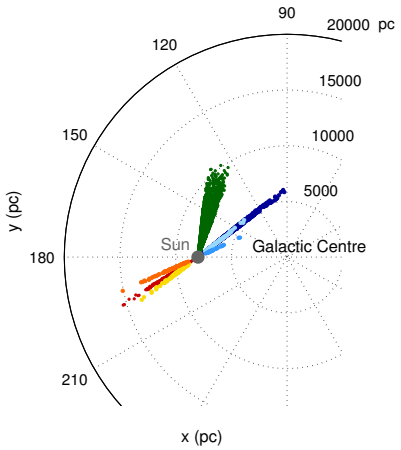
- Uncertainty on M $\sim$ 10%
- Uncertainty on R $\sim$ 3%
- Tests ongoing: interferometry (Huber et al. 2012); Hipparcos parallaxes (Silva Aguirre et al. 2012); OC NGC6791 (i.e. Miglio et al. 2012 and Sandquist et al.2013), eclipsing binaries, etc

Distances

From the radius determination it is possible to derive distance (i.e. Miglio et al. 2013):

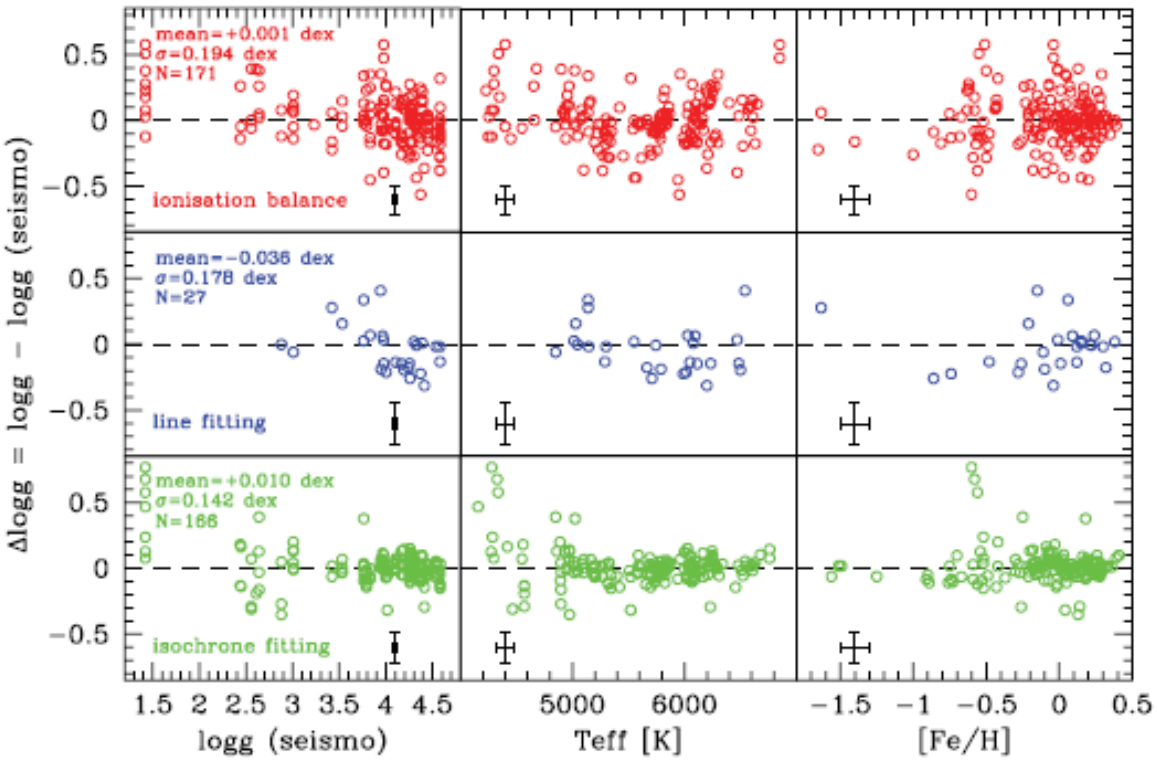
- R from asteroseismology + Teff → L
- Apparent magnitude + Bol. Corrections + Extinction → l
- $d^2 \ \alpha \ \frac{L}{l}$
- uncertainty 10-15%





log(g)

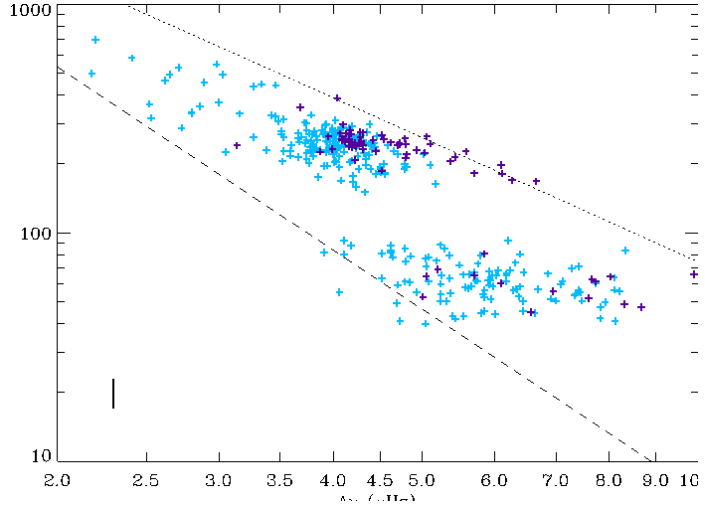
From the scaling relations it is possible to derive log(g) (Morel& Miglio 2012). Uncertainty of $\sim$ 0.03 dex.



Evolutionary status

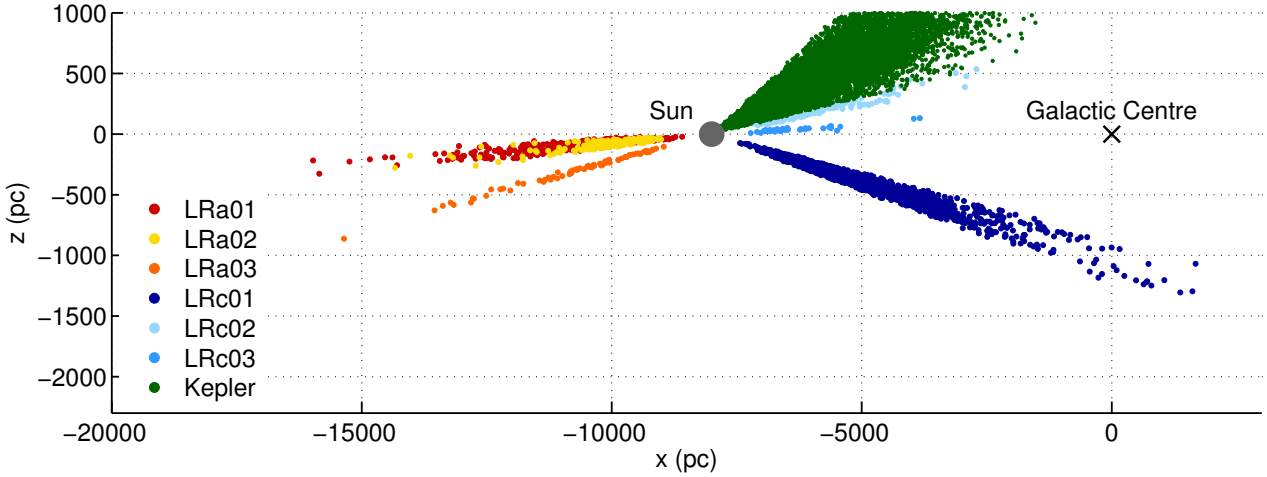
Thanks to asteroseismology it is now possible to distinguish H-shell burning stars from those that are also burning He in the core. (see J. Montlban talk)
Mosser et al 2011: CoRoT data (period separation of mixed modes vs $\Delta\nu$).

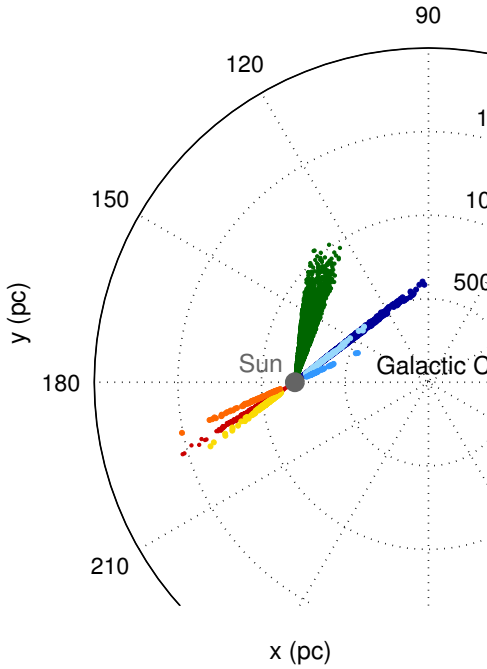
Unknown details of stellar evolution and structure!



The CoRoT and Kepler sample

The sample of solar like oscillating giants provided by CoRoT and Kepler satellites provide a unique sample for mapping and dating stellar populations in our Galaxy





GES

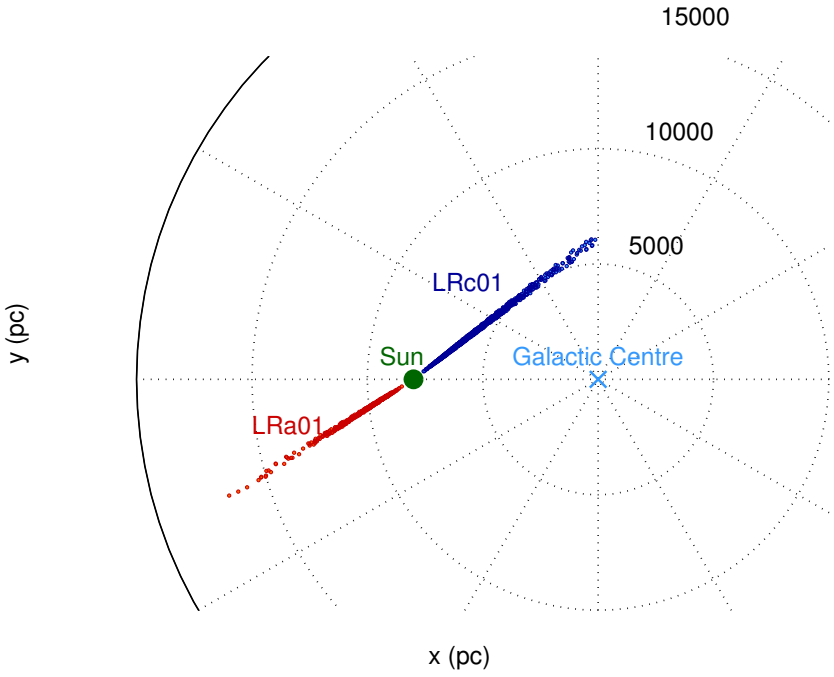
CoRoT-GES: the sinergy between spectroscopy and asteroseismology.

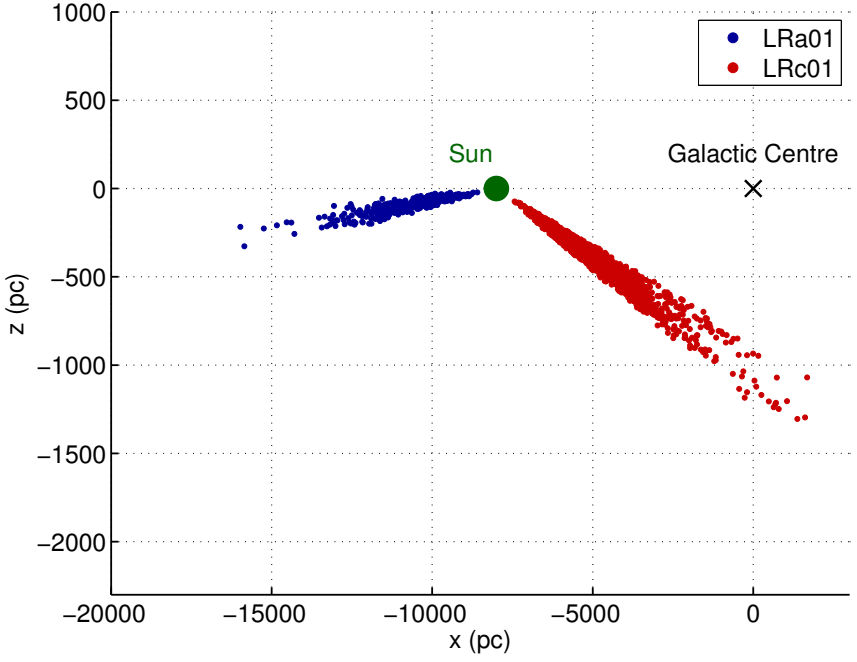
- Ges is an ambitious survey:more than 350 people involved from ∼95 institutes. PI: G. Gilmore and S. Randich.
- Objective: to investigate the formation and evolution of the MW and its components, providing radial velocities, atmospheric parameters and abundances.
- GIRAFFE: intermediate-low R∼18,000
- UVES: high resolution spectra R∼48,000

LRa01 and LRc01

CoRoT solar-like oscillation RG group provided to GES a target list of more than 6,000 red giants, located in the LRa01 and LRc01 fields.Target V magnitudes: 12 - 16.

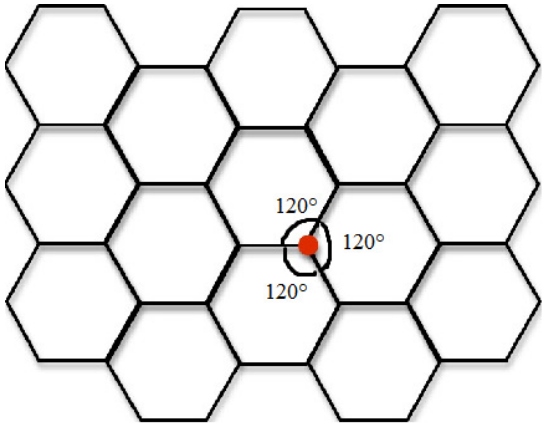
- Calibration
- Mapping and dating stellar populations

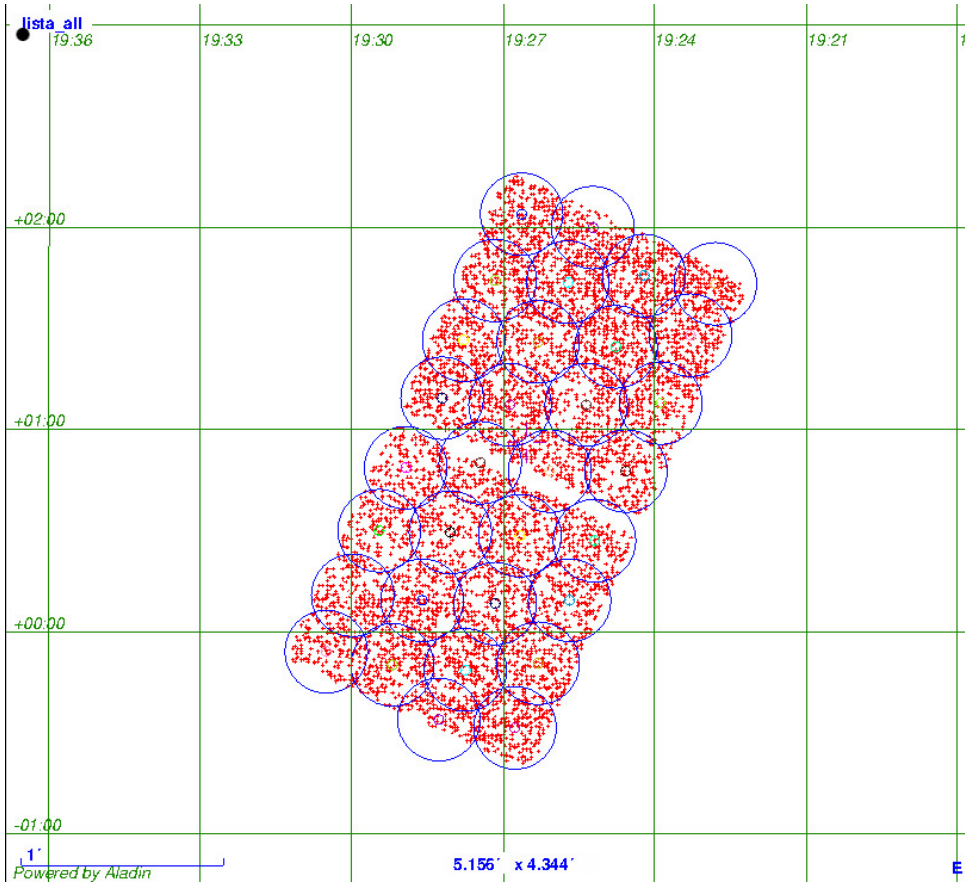




The LRc01 field

LRc01 field is 1 x 2.5 deg, FLAMES instrumental FOV is 25 arcmin. For covering the biggest number of targets we adopted a exagonal tessellation.

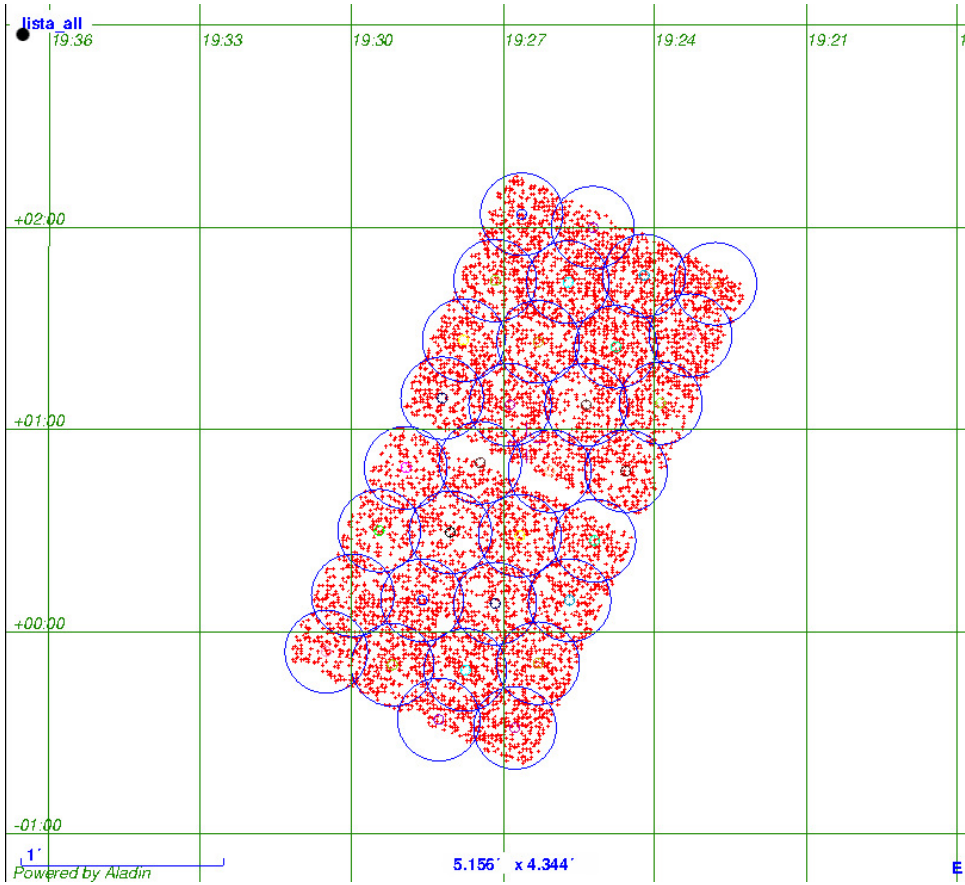




Status of observations

So far GES observed 10 field.

- UVES 112 targets with a SNR $\sim$ 100
- GIRAFFE: 1133 targets with SNR $\sim$ 90 (HR21, HR15N, HR10)

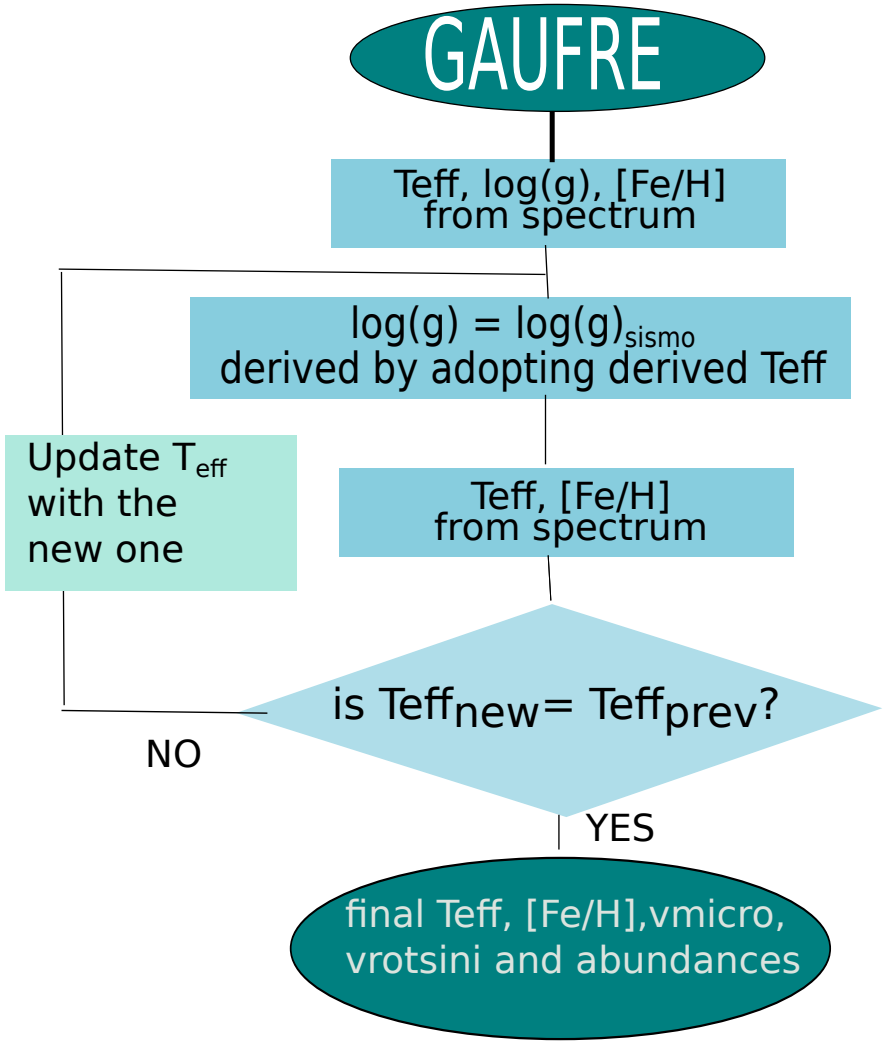


Status of seismic log(g) determination

- CoRoT RG team at the moment is analyzing the new reduction of CoRoT light curves in order to derive more precise and accurate $\Delta\nu$ and νmax.
- Planning the iteration process!!
- GIRAFFE : Fe, Ti, Ca, Si, Mg, Mn, Co, Cr, Ni, V, Y, Zr, Li.
- UVES: alpha elements (O, Mg, Si, Ca, Ti), s-elements (Ba and Y), iron peak elements (Fe, Ni, Mn, Cr), and also Na, Al and Li. C CH C2 Swan (0,1) band head (very high SNR). 5635,5 Angstroms.

The Liege node

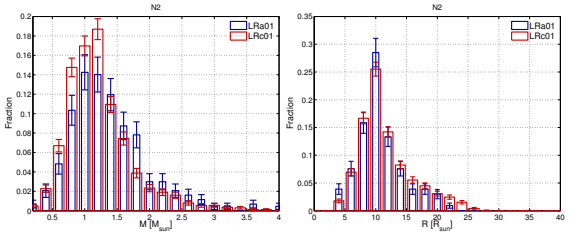
Liege node developed a code for the automated analysis of GES spectra (Valentini et al. 2013). By fixing the surface gravity to the seismic value we increased the precision of the atmospheric parameters and abundances.
UVES-GES: σ Teff $= 40$ K
σ[Fe/H] $= 0.05$ dex



Conclusions

Asteroseismology provides a unique and promising tool for GES:

- log(g) → calibration of pipelines
- distances, AGES, precise atmospheric parameters and abundances → galactic archaeology



Miglio et al. 2013