Minigrant RSN1

The stellar population scaling relations from LEGA-C and their evolution with redshift

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Associated INAF project (Schede):

- LEGA-C: an ESO public spectroscopic survey with VLT/VIMOS
- Coordinator: Anna Gallazzi
- INAF Collaborators: Stefano Zibetti (INAF-OAA), Davide Bevacqua (PhD, INAF-OAB), Paolo Saracco (INAF-OAB), Giovanni Cresci (INAF-OAA), Angela Iovino (INAF-OAB)
- External Collaborators: Arjen van der Wel (Uni Ghent), Rachel Bezanson (Pittsburgh), Yasha Jaushal (PhD, Pittsburgh), Angelos Nersesian (postdoc, Uni Ghent) and the LEGA-C team

Abstract:

The Large Early Galaxy Astrophysics Census (LEGA-C) survey has gathered **deep spectra for about 3500 K-band selected galaxies at redshift 0.6<z<1**. The high quality of the data allows a robust analysis of the stellar continuum for a sample spanning all spectral and morphological types down to stellar masses of $10^{10}M_{sun}$. The survey offers the first detailed view of **stellar populations and dynamical properties** of a sizable sample of galaxies 7 Gyr back. The LEGA-C team is highly international, and only two INAF researchers are part of the LEGA-C team (Anna Gallazzi being survey scientist). This grant supports the publication and dissemination of the results with INAF PI-ship and to foster collaboration with young members of the LEGA-C team through visits.

The specific goal of the project supported by this grant is **the derivation of robust stellar populations physical parameters, the quantitative characterization of the stellar populations scaling relations at the mean redshift of LEGA-C z=0.7 and their evolution with redshift**.

Accomplishments and Deliverables:

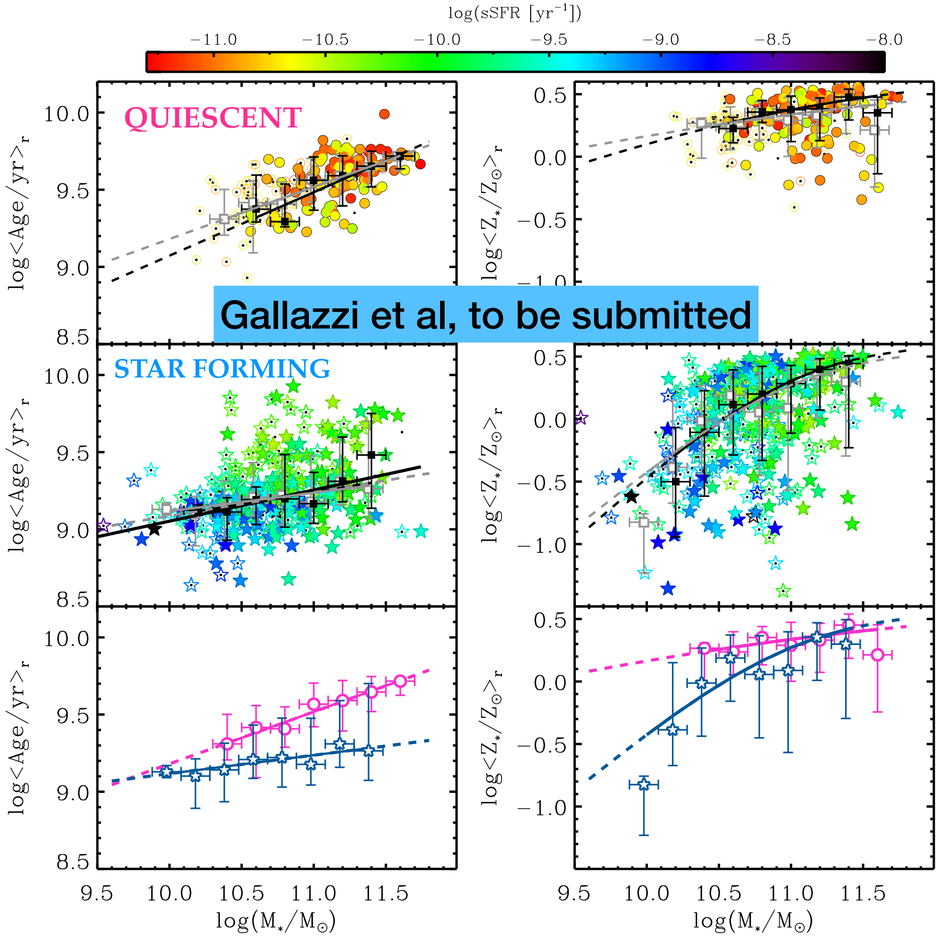
I have re-analysed the LEGA-C DR3 spectra to provide **revised stellar absorption index measurements**. I have derived estimates of stellar population physical parameters for LEGA-C galaxies using our **Bayesian Spectral Fitting code BaStA** (see Scheda GAUSP). A key aspect was the assessment of systematics within our method and in comparison to other methods adopted within the collaboration.

We have established the **age-mass and stellar metallicity-mass relations for both quiescent and star-forming galaxies at z=0.7 from LEGA-C**. We have applied a consistent analysis to SDSS z=0.1 galaxies, including corrections for aperture effects. This analysis provides a **robust assessment of the evolution of the population scaling relations over 6 Gyr of cosmic time**. It is the core of a paper in preparation which we expect to submit by the end of 2023 (Gallazzi et al, in prep). Alongside, the **catalog of stellar absorption indices and stellar population parameters** will be published.

The revised analysis of SDSS galaxies has been part of a Master thesis (under the supervision of S. Zibetti and A. Gallazzi), and the associated publication is in preparation (Mattolini, Zibetti, Gallazzi, in prep.).

Our team has performed independent analysis, led by PhD student Yasha Kaushal and postdoc Angelos Nersesian, using other spectral fitting methods, specifically Bagpipes and Prospector, focusing on the star formation histories of passive and star-forming galaxies.

In collaboration with the ETG12 team (see Schede ETG12) the elements abundance ratios and metallicities of passive galaxies in LEGA-C have been analysed by PhD student Davide Bevacqua.



The dependence of light-weighted age and stellar metallicity on stellar mass for a ‘golden’ sample of LEGA-C galaxies at z~0.7. The scatter in the relations depends on the galaxy star formation activity, and quiescent and star-forming galaxies follow different relations (Gallazzi et al, to be submitted)

Publications related to the mini grant project:

- The evolution of the stellar populations scaling relations since z~0.7 from LEGA-C, Gallazzi et al, to be submitted
- A census of star formation history of massive galaxies at 0.6<z<1 from spectrophotometric modeling using Bagpipes and Prospector, Kaushal et al, ApJ accepted
- Less is less: photometry alone cannot predict the observed spectral indices of z~1 galaxies from the LEGA-C spectroscopic survey, Nersesian et al, A&A in press
- The elemental abundances of quiescent galaxies in the LEGA-C survey: the (non)evolution of [α/Fe] from z=0.75 to z=0, Bevacqua et al, 2023, MNRAS, 525, 4219
- The gas-phase mass metallicity relation of massive galaxies at z~0.7 with the LEGA-C survey, Lewis et al, 2023, ApJ submitted

Expenses:

- participation to international conferences to disseminate the results
- collaboration visits to make progress on the work and possible focused mini-workshop in 2024
- hardware (laptop)
- publication expenses

Further developments and broader context:

Further analysis will include: i) study the correlation between metal abundances and structural properties to investigate the dichotomy of quiescent and star-forming galaxies; ii) compare with predictions from theoretical models and constraints from cosmic SFH

This work ties with the broader goals of the GAUSP (PI: Zibetti) and MetEvol (PI: Mannucci) Schede and represents a pivotal point for the stellar population analysis from upcoming surveys at intermediate and higher redshifts.