Mapping stellar populations and star formation in nearby galaxies from MEGADES: An AC3 project application

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1 MEGADES

MEGADES is a high-spatial and high-spectral resolution IFU survey of nearby disc galaxies to unveil how they formed and evolved.

SCIENTIFIC GOAL

How do galaxy discs grow?

We test wether gas accretion drives the inside-out formation of galaxy discs and quantify the role of secular and external processes.

THE SAMPLE

- 39 galaxies
- d < 40 Mpc
- $2.5' < D_{25} < 4'$
- i < 70º

MEGARA@GTC

- 567 fibres
- 12.5'' x 11.3'' FoV
- 0.62'' spaxels
- 4350 – 7288 Å spectral coverage
- R ~ 6000

SCIENCE PRODUCTS

Stellar age maps · Metallicity maps · Kinematic maps · Ionised gas maps · Reduced datacubes

PUBLIC DATA RELEASE

All the MEGADES DR1 products are publicly available through the MEGADES archive.

www.megades.es

User: **public**

Password: **6BRLukU55E**

Scan to access the MEGADES archive

PUBLISHED RESULTS

MEGADES Data release I
Chamorro-Cazorla et al. 2023 · A&A ·

Ionised gas diagnostics
Chamorro-Cazorla et al. 2026 · A&A ·

Ionised outflows
Bellocchi et al. 2026 · A&A in press

Acknowledgements

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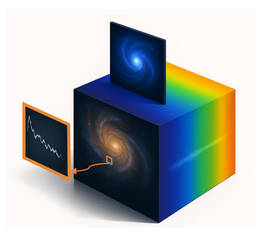
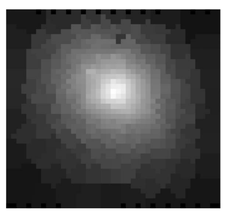
2 SCIENTIFIC PIPELINE

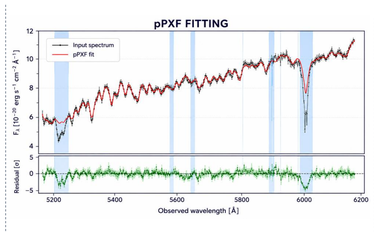
1 REDUCED MEGARA DATACUBE → 2 VORONOI BINNING → 3 pPXF → 4 STARLIGHT → 5 SCIENCE-READY PRODUCTS



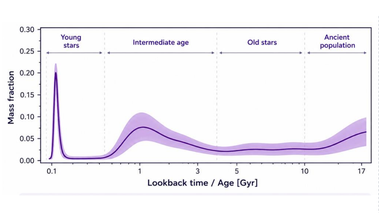
Bias, flats, wavelength and flux calibrated
IFU observations corrected and combined to produce science-ready datacubes.



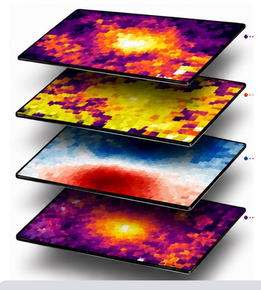
Adaptive spatial binning
Voronoi tessellation to reach the target S/N in each bin while preserving spatial information.



Stellar kinematics
pPXF fits the integrated spectrum in each bin to extract stellar velocity and velocity dispersion.



Stellar popullations & SFH
STARLIGHT derives the star formation history and stellar population properties for each spatial bin.



Maps & datacubes
Science-ready products for analysis and interpretation: stellar populations, gas tracers, kinematics and more.

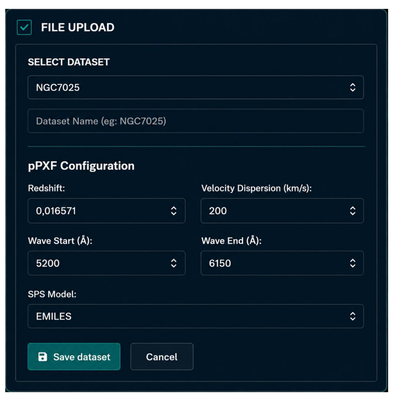
3 RUNNING THE SCIENTIFIC PIPELINE WITH AC3

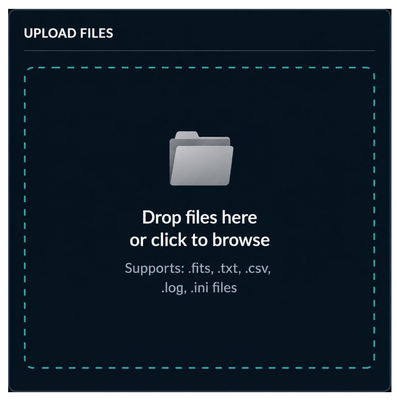
Why AC3?

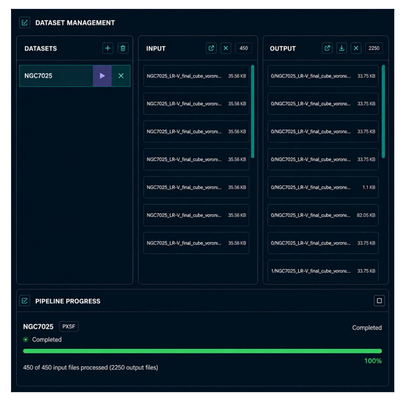
Modern IFU analysis relies on complex workflows involving multiple software packages, large datasets and computational resources.

AC3 provides a cloud-based environment to execute these workflows through an intuitive web interface.

1 CONFIGURE DATASET — Define the dataset and analysis setup
2 UPLOAD FILES — Upload the reduced IFU datacubes and related files
3 RUN ANALYSIS — Launch the analysis workflow and monitor progress



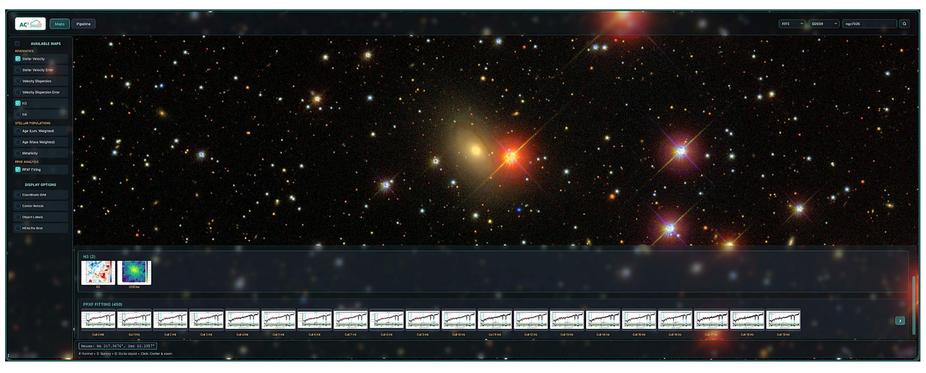




4 EXPLORE RESULTS

Visualise interactive maps and diagnostics:

- ★ Stellar velocity
- ★ Stellar velocity dispersion
- ★ h3
- ★ h4
- ★ Age
- ★ Metallicity
- ★ Spectral fittings



5 DOWNLOAD PRODUCTS

Retrieve science-ready products for your analysis

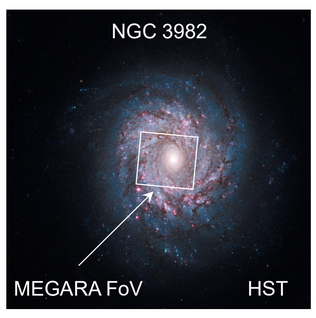
- **FITS** Best-fit model
- **FITS** Galaxy spectrum
- **TXT** Kinematics + stellar populations
- **PDF** pPXF diagnostic
- **FITS** Residuals
- **MAP** Property maps
- **CUBE** Property datacubes

4 SCIENTIFIC RESULTS: NGC 3982 (case study)

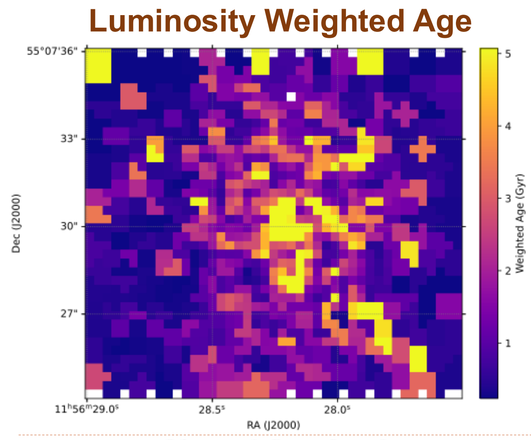
NGC 3982

SAB(r)b • H II / Sy2
Distance **15.9 Mpc**
Stellar mass **3.5 × 10¹⁰ M⊙**
Redshift **0.00371**
Effective radius **2.5 kpc**
Maximum rotation **≈200 km s⁻¹**

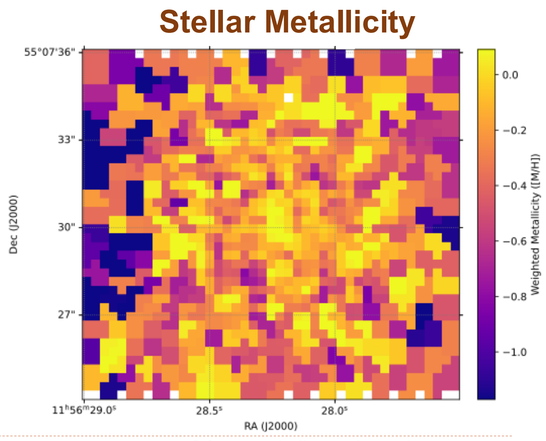
MEGARA LR-V (R ~ 6000)
Spectral coverage **5165 – 6176 Å**
Field of view **12.5" x 11.3"**

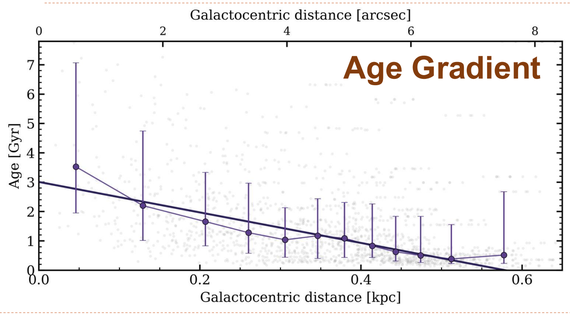


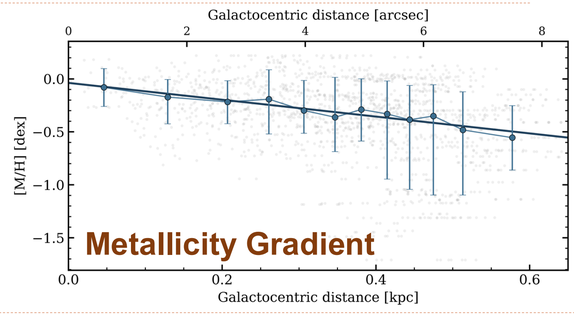
Luminosity Weighted Age



Stellar Metallicity







A negative stellar age gradient is observed across the disc
Stellar populations become progressively younger from the centre towards the outer regions.

From solar to subsolar metallicities
The central regions exhibit nearly solar metallicities, progressively decreasing to subsolar values towards the outer disc.

Consistent with inside-out disc growth
The combined age and metallicity gradients support a scenario where the stellar disc formed progressively from the centre outwards.

5 FUTURE WORK

Future developments combining AC3 capabilities with the scientific goals of **MEGADES**.

ADVANCED STELLAR POPULATION ANALYSIS

- ★ Spatially resolved star formation histories
- ★ Comparison of different SSP models and libraries
- ★ New stellar population diagnostics (e.g. dust attenuation, a-enhancement)

EXTENDED SPATIAL COVERAGE

- New MEGARA pointings to build galaxy mosaics.
- Extend the FoV to the optical outskirts
- Improve constraints on outer-disc stellar populations and radial gradients

STELLAR POPULATIONS AND GALAXY STRUCTURE

- Relate gradients to bars, rings and spiral structure
- Compare AGN and non-AGN star-forming and quiescent discs
- Constrain secular evolution in nearby disc galaxies
- Perform statistical studies across the MEGADES sample

UNIFIED MULTI-INSTRUMENT ANALYSIS WITH AC3

- Unified workflow for MEGARA, MUSE and MaNGA datasets
- Extend compatibility to additional IFU instruments
- Integrate new analysis tools within the AC3 platform
- Standardize science-ready products across surveys

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