

MEGARA Science and instrument performance

Multi Espectrógrafo en GTC de Alta Resolución para Astronomía

Gil de Paz, A.¹, Gallego, J.¹, Carrasco E.², Sánchez, F.M.³, Vilchez, J.⁴, Iglesias, J.⁴, García-Vargas, M.L.⁵, MEGARA Science and Instrument Teams
¹UCM (Madrid, Spain), ²INAOE (Puebla, Mexico), ³UPM (Madrid, Spain), ⁴IAA-CSIC (Granada, Spain), ⁵FRACTAL-SLNE (Madrid, Spain)

Introduction

MEGARA (*Multi-Espectrógrafo en GTC de Alta Resolución para Astronomía*) is an optical fiber-fed spectrograph with two Integral-Field Units (IFU) and a set of robotic positioners for Multi-Object Spectroscopy (MOS) that will be installed at one of the Folded-Cassegrain foci of the GTC 10.4m telescope in La Palma.

MEGARA is being developed by a Consortium lead by Universidad Complutense de Madrid (UCM; Madrid, Spain). The co-partners are the Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE; Puebla, Mexico), Instituto de Astrofísica de Andalucía (IAA-CSIC; Granada, Spain) and Universidad Politécnica de Madrid (UPM; Madrid, Spain). The instrument is in the Detailed Design Phase, with a CDR planned for late 2013 and first light at GTC in 2016.

The use of state-of-the-art optical-fiber and VPH technology yields a total throughput unsurpassed by instruments working at these spectral resolutions.

The combination of this superb efficiency with its versatility (IFU and MOS capabilities in a wide range of spectral resolutions between R=6,000-21,500) along with the collecting area of GTC will make of MEGARA+GTC a unique facility for years to come.

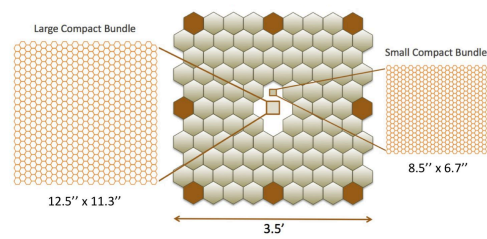
MEGARA will provide an unprecedented scientific return for astronomers within the GTC community. MEGARA data cubes shall have more than 600 spectra taken simultaneously from a given region of the sky. One of the main scientific goals of MEGARA is the study of the age, chemical abundances and kinematics of stellar populations in nearby galaxies. Other topics that drive the design of the MEGARA instrument include the study of low-mass stars and pre-Planetary Nebulae in the Milky Way, massive blue stars in the Local Group, high-redshift dwarf galaxies and proto-galaxy clusters, and the Cosmic Web from the analysis of redshifted UV line-emission from the Intergalactic Medium (IGM).

IFU bundles	12.5x11.3 arcsec ² (LCB), 8.5x6.7 arcsec ² (SCB)
MOS	92 objects in 3.5x3.5 arcmin ² (+8 for sky subtraction)
Spaxel (fiber) size	0.62 arcsec (LCB & MOS), 0.42 (SCB)
Wavelength range	3650-10000 Å
Spectral resolution	LCB/MOS: R=6000-18700 SCB: R=7000-21500
# of spectrographs	1 (IFU or MOS) (650 simultaneous spectra)
GTC station	Folded-Cass [spectrograph @ Nasmyth]

MEGARA factsheet

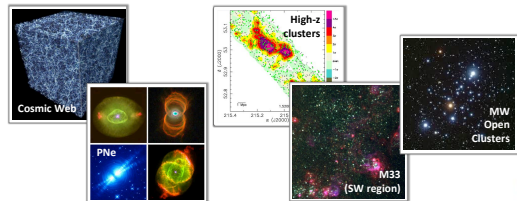
MEGARA Main characteristics

The instrument has two components, the **focal-plane unit** placed at one of the Folded-Cass foci that includes the two IFU bundles and the system of robotic positioners (see figure on the right) and the MEGARA **spectrograph**, which is located at one of the Nasmyth platforms of GTC (see below). The main characteristics of MEGARA in terms of FoV, spatial and spectral resolutions and wavelength range of operation are shown on the left.



Science

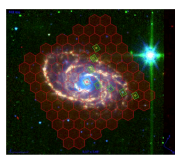
The characteristics of the MEGARA instrument are driven by a number of scientific projects designed by the MEGARA Science Team, which is composed by 54 researchers from 12 different institutions from the GTC partners' countries. These projects can be grouped in either those that need of a **contiguous field in spectroscopy** (by means of an IFU) or **high-density** (several objects per square arcmin) **multi-object spectroscopy** (MOS) both with intermediate-high resolutions.



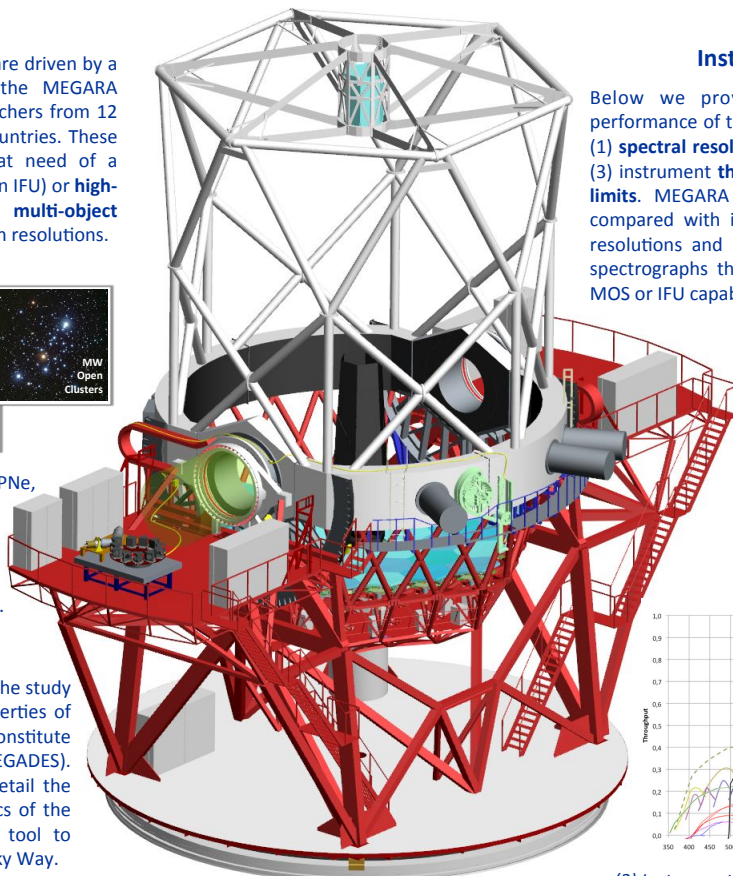
The former group includes the study of Galactic PNe, nearby galaxies (see below) and spectroscopy of the high-z IGM in UV resonant lines. As part of the latter we aim at analyzing the properties of low-mass stars in Galactic open clusters, stars in Local Group galaxies and high-z proto-clusters.

MEGADES

One of the main interests of our team focus on the study of the stellar populations and ionized-gas properties of nearby disk galaxies. Our efforts in this field constitute the *MEGARA Galaxy Disks Evolution Survey* (MEGADES). This survey will explore with unprecedented detail the distribution of ages, abundances and kinematics of the stars in external galaxies, being the perfect tool to extend ESA Gaia's future results beyond the Milky Way.



One of the MEGADES proposed observations



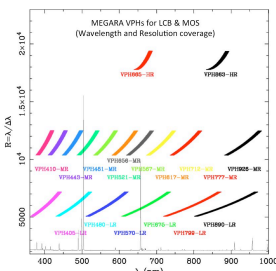
Summary

MEGARA is an intermediate-resolution optical IFU & MOS for GTC that will be available to the community in 2016 thanks to combined efforts of the MEGARA Consortium and GRANTECAN. The unprecedented efficiency of MEGARA at these spectral resolutions

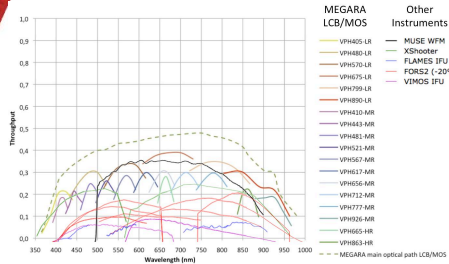
combined with the collecting area of GTC will allow pursuing research goals that were inaccessible to date, such as the detailed (spectrophotometric and chemical) analysis of stellar populations in nearby galaxies and the study of the high-redshift IGM.

Instrument performance

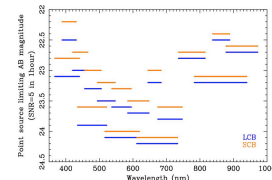
Below we provide a graphical summary of the performance of the MEGARA instrument with regards to (1) **spectral resolution** ($\lambda/\Delta\lambda$), (2) **wavelength coverage**, (3) instrument **throughput** & (4) **point source detection limits**. MEGARA provides a 3x increase in efficiency compared with instruments working a similar spectral resolutions and matches that of other state-of-the-art spectrographs that work at lower-R and lack of either MOS or IFU capabilities.



(1) Spectral resolution & (2) λ-coverage



(3) Instrument throughput & (4) PS detection limits



All the MEGARA posters presented at this meeting available at ...

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