# MAAT@GTC

## A new Integral-Field Spectroscopy mode for OSIRIS on the GTC

*Francisco Prada on behalf of the MAAT Collaboration*


MAAT[1] is proposed as a visitor mirror-slicer optical system that will allow the OSIRIS spectrograph on the 10.4-m Gran telescopio CANARIAS (GTC) the capability to perform Integral Field Spectroscopy (IFS) over a seeing-limited FoV 14.20'' x 10'' with a slice width of 0.303''. MAAT@GTC will enhance the resolution power of OSIRIS by 1.6 times as compared to its 0.6'' wide long-slit. All the eleven OSIRIS grisms and volume-phase holographic gratings will be available to provide broad spectral coverage with moderate resolution (R=600 up to 4100) in the 360-1000 nm wavelength range. MAAT unique observing capabilities will broaden its use to the needs of the GTC community to unveil the nature of most striking phenomena in the universe well beyond time-domain astronomy. The GTC equipped with OSIRIS+MAAT will also play a fundamental role in synergy with other facilities, some of them operating on the northern ORM at La Palma. This White Paper presents the different aspects of MAAT@GTC - including scientific and technical specifications, outstanding science cases, and an outline of the instrument concept.

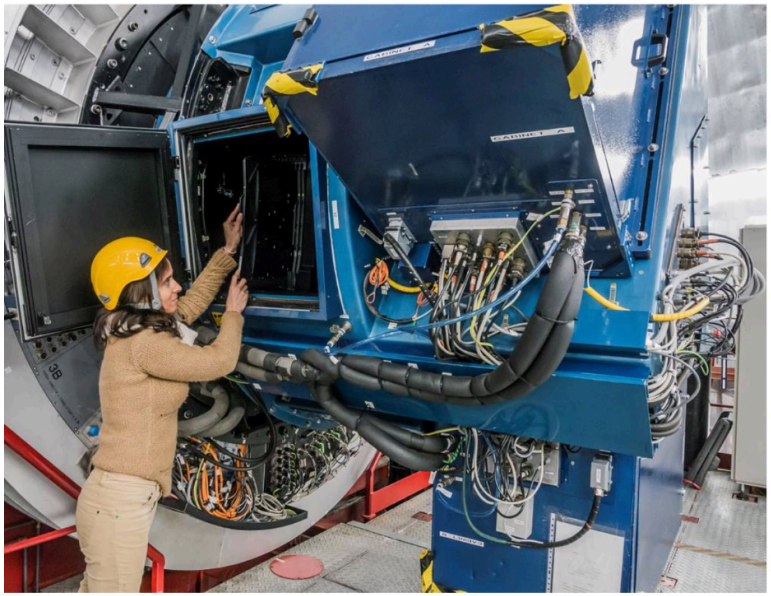
[1] MAAT *refers to the ancient Egyptian concepts of truth, balance, order, harmony, law, morality, justice, and cosmic order*.

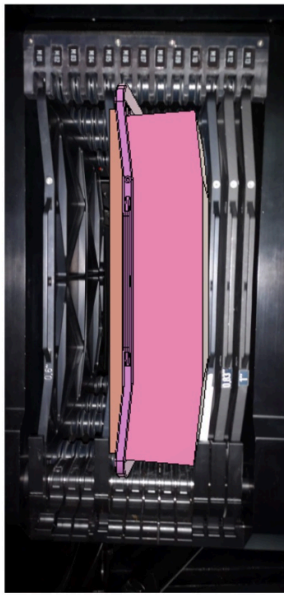
# The MAAT basic parameters

| Parameter | Value | Notes |
|---|---|---|
| Spectrograph | OSIRIS | Install at GTC Cassegrain focus |
| Module | Integral Field Unit | |
| Field-of-View | $14.20'' \times 10.00''$ | IFU sky area is 142 arcsec$^2$ (141 arcsec$^2$ without vignetting) |
| Field aspect ratio | 1.42 | The footprint can be rotated to match the target shape or multiple objects |
| Slicer width | $0.303''$ | |
| Spatial sampling | $0.303'' \times 0.127''$ | $0.303'' \times 0.254''$ with $1 \times 2$ CCD binning |
| Wavelength range | 360 to 1000 nm | |
| Spectral resolution | 600 to 4100 | Enhanced 1.6 times resolution power w.r.t. a $0.6''$ long-slit |
| Detector | $4k \times 4k$ (15 $\mu$m pixel) | New Teledyne-e2v CCD231-84 deep-depleted astro multi-2 |
| CCD plate scale | $0.127''$ per pixel | |

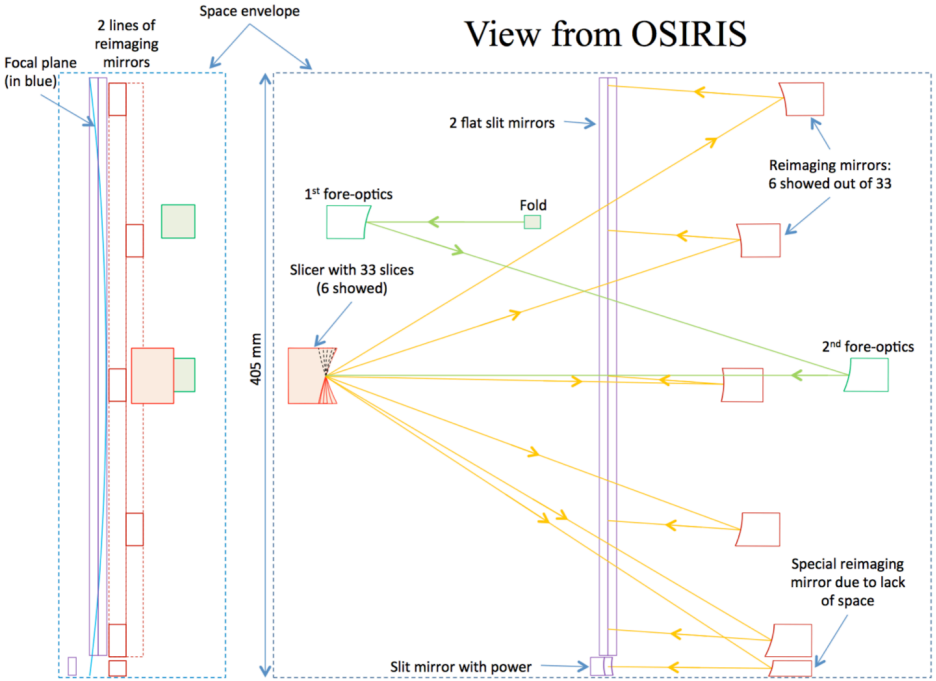
| Sky | Telescope | Instrument | Spectral range | Resolution | Field of View | Spatial sampling | IFU |
|---|---|---|---|---|---|---|---|
| Southern | VLT | MUSE | 480–930 nm | 1770–3590 | $59.9'' \times 60.0''$ | $0.2'' \times 0.2''$ | mirror slicer |
| Northern | Keck | KCWI | 350–560 nm | 3000–4000 | $8.25'' \times 20.0''$ | $0.34'' \times 0.147''$ | mirror slicer |
| N & S | Gemini | GMOS-IFU | 360–940 nm | 600–4400 | $5.0'' \times 7.0''$ | $0.2''$ | lenslet/fibers |
| Northern | GTC | MAAT | 360–1000 nm | 600–4100 | $10.0'' \times 14.20''$ | $0.303'' \times 0.127''$ | mirror slicer |

# The MAAT instrument





Left: OSRIS mask exchanged operation as being done by a GTC staff member. Right: Mock-up image of the MAAT module inserted in the OSIRIS Cassette structure (Credit: GTC).




Optics lay-out of the proposed IFU concept (only 6 out of 33 slices are shown)

# Why MAAT on the GTC?

MAAT@GTC will provide to the GTC community with highly competitive unique observing capabilities, i.e.,

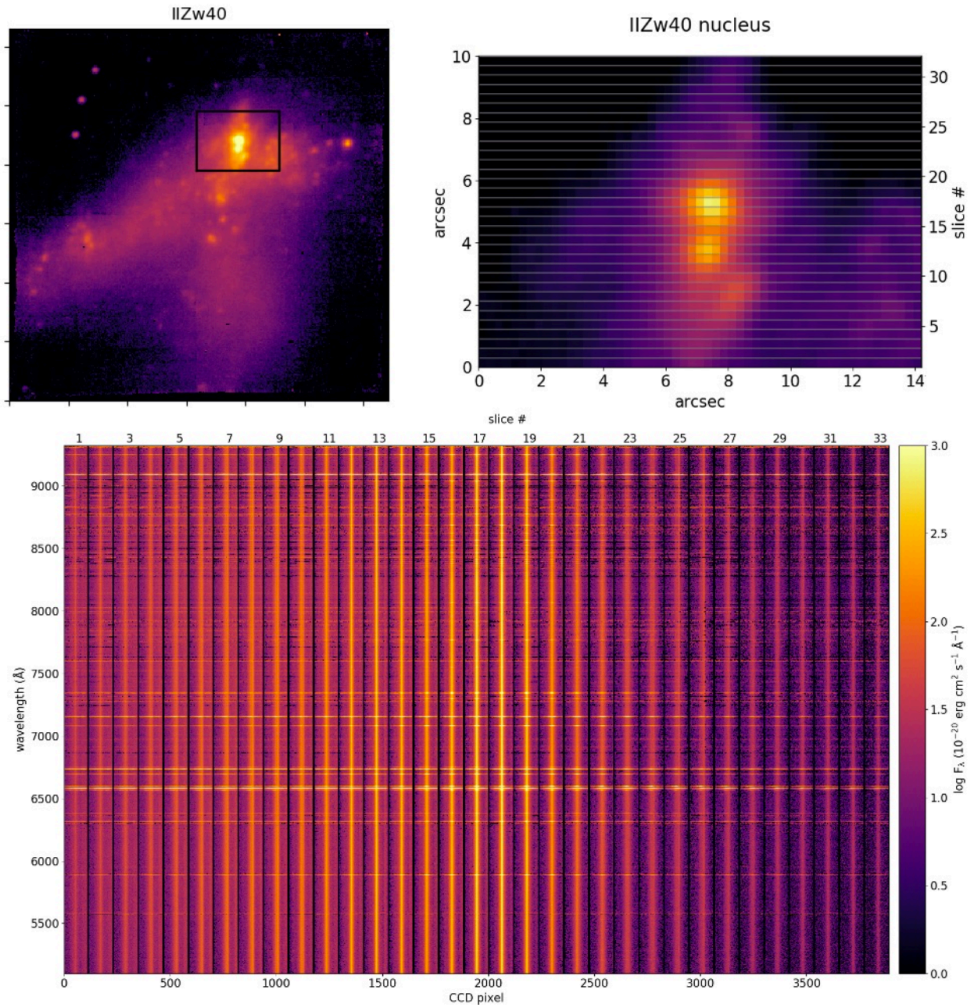
1. Seeing-limited and wide-band IFS at moderate (600-4100) spectral resolution,

2. All photons are collected, and a larger efficiency is obtained,

3. MAAT can perform spectro-photometry and spectro-astrometry,

4. Advantage on bad (any) seeing conditions. MAAT keeps its nominal spectral resolution regardless the seeing,

5. Target acquisition with no overheads. An entire FoV image could be generated from the 3D data cube.




MAAT simulation of the circumnuclear region in the low metallicity dwarf galaxy IIZw40. The simulations are based on a MUSE archival spectral cube of IIZw40.

# The MAAT science

While the science potential of MAAT@GTC is essentially unlimited, this presentation highlights the focus on a selected set of outstanding science topics enabled by the proposed instrument in different areas of expertise. These include:

- The nature of the diffuse universe: the intergalactic and circumgalactic mediums,
- Strong galaxy lensing studies,
- Time-domain cosmography with strongly lensed quasars and supernovae,
- Identification and characterisation of EM-GW counterparts,
- Exploration of the host galaxy environment of supernovae,
- Binary masses and nebulae abundances,
- Brown dwarfs and planetary mass objects,
- Synergies with worldwide telescopes, and other facilities on La Palma.

More details can be found in the White Paper on MAAT@GTC posted in the *arXiv*

***Muchas gracias!***

## Synergy Chart of MAAT@GTC