Citius, Altius, Fortius: the Olympic Games of Telescopes

GranTeCan and OSIRIS, a new Opportunity for European Astronomy

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ESO/GTC

In the ESO Call for Proposal for Period82 we found out that people from ESO member countries can apply for GTC time.

Only "large programs" are allowed: 20nights minimum.

The grand-total of "ESO–available" time is 135nights.

Do we want to give it all to people hunting for GRBs, supernovae, extrasolar planets, and galaxies $z = 10$?

Proposal deadline is: 21 April 2008, 12:00 noon Central European Summer Time.

The era of big telescopes

The biggest telescopes available now are:

- 10m ($\times$2) Keck (Hawaii, USA, operating since 1993 and 1996)
- 11.1m $\times$ 9.8m (eff.ap. 9.2m) Hobby Eberly Telescope (Mt.Fowlkes, Texas, USA, operating since 1999)
- 11m SALT (Sutherland, South Africa, operating since 2006)

Big telescopes "under consideration":

- 24.5m Giant Magellan Telescope (Las Campanas, Chile), scheduled 2017
- 24m Thirty Meters Telescope (*location still unknown / Cerro Armazones, Chile*), scheduled 2016
- 42m E–ELT (*location still unknown*), scheduled 2017

Gran Telescopio Canarias

The biggest telescope ever built in Europe (*for the next decade*).
Funded by:

- 90% by the Central Government of ESpain and the Regional Government of the Islas Canarias.
- 5% by Mexico (through the IA–UNAM and INAOE)
- 5% University of Florida

Diameter: 10.4m

First light expected mid-2003.
"Official" first light on 13-Jul-2007.

Informations about telescope/instruments are not easily accessible *(yet)*.

Figure: aerial view of the GCT enclosure.

GCT optical design

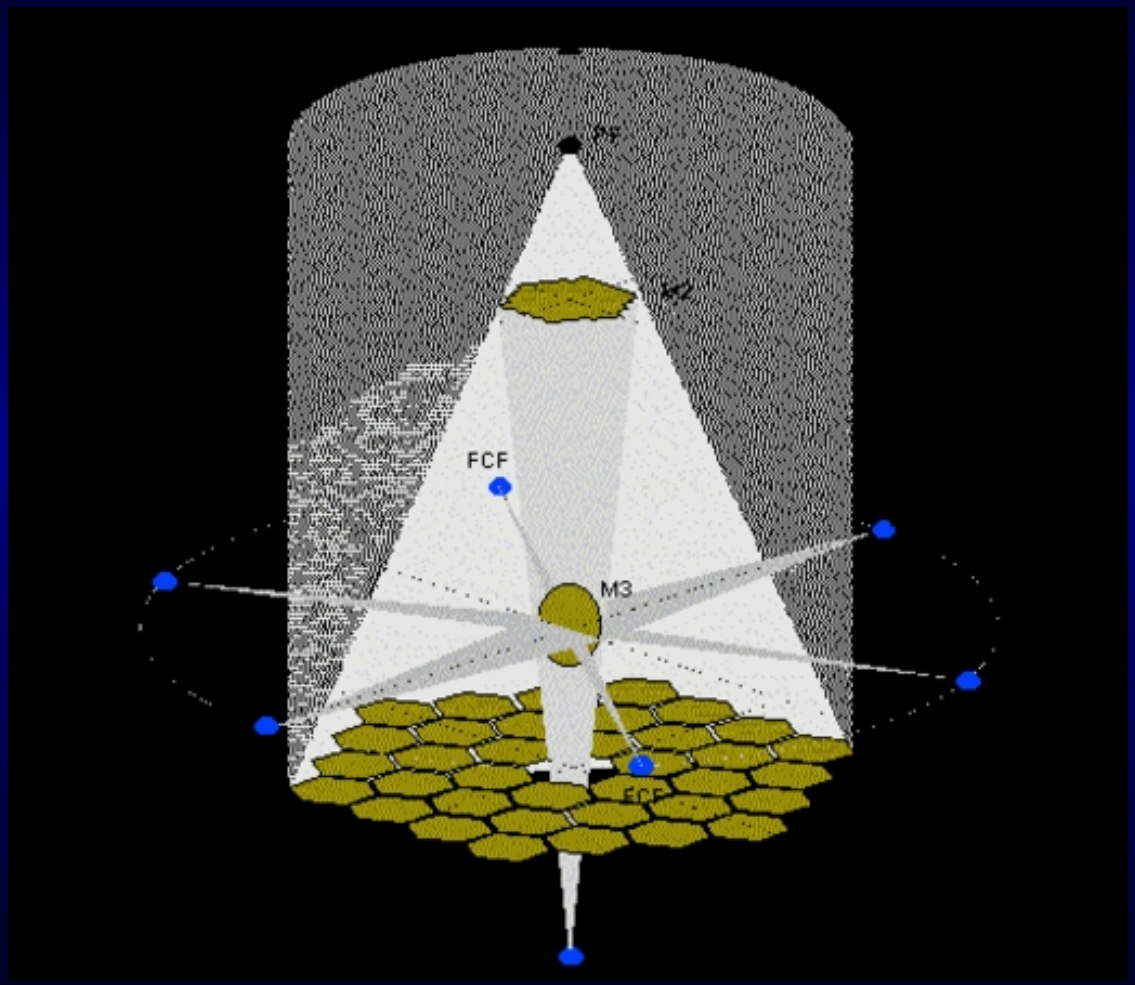


Figure: the Gran Telescopio Canarias has 7 foci.

GTC's instruments

- OSIRIS: the GTC tunable imager & spectrograph
- CanariCam: the GTC Multi-Mode Mid-IR Camera
- *EMIR: the GTC NIR multiobject imager-spectrograph* [1]

[1] although in an advanced state, this is not a day-one instrument

OSIRIS – Optical System for Imaging and low-Intermediate-Resolution Integrated Spectroscopy

Common name for an instrument: there are OSIRISes on Rosetta, Odin, Keck, SOAR

Consortium: IAC and Universidad Nacional Autonoma de Mexico (IA–UNAM)

OSIRIS reminds of EMMI (or EFOSC, FORS*x*, . . .).

Table: OSIRIS modes

Imaging	Broad and Narrow band using Tunable Filters
Spectroscopy	Long slit and MOS using masks
Fast Modes	Photometry and spectroscopy

OSIRIS Scientific Drivers

While some instruments for the 8-10m class of telescopes are conceived as Redshift Machines, the main scientific motivation for OSIRIS is to be a Star Formation Machine, unique to provide an homogeneous and consistent mapping of star formation indicators in nearby and back to the furthest observable galaxies with GTC. (from the OSIRIS website[2])

Main original scientific drivers:

- The evolution of the star formation of the Universe
- The star formation in nearby galaxies
- The stellar population in nearby galaxies

[2] http://www.iac.es/project/OSIRIS/OSISCI/Science.html

OSIRIS characteristics

Field of view	8.53' × 8.53'
Plate scale	0.125"
Wavelength Range	365 – 1000nm
Detector	2×(2k×4k), 15μm
	E2V44-82 BI
Filter wheel	18 positions
Tunable filters	365 – 670nm and 620 – 1000nm
Spectroscopic resolution	250 – 2500
Slit masks loader	13masks
MOS targets	40 – 60
	$\sim$1000 [3]

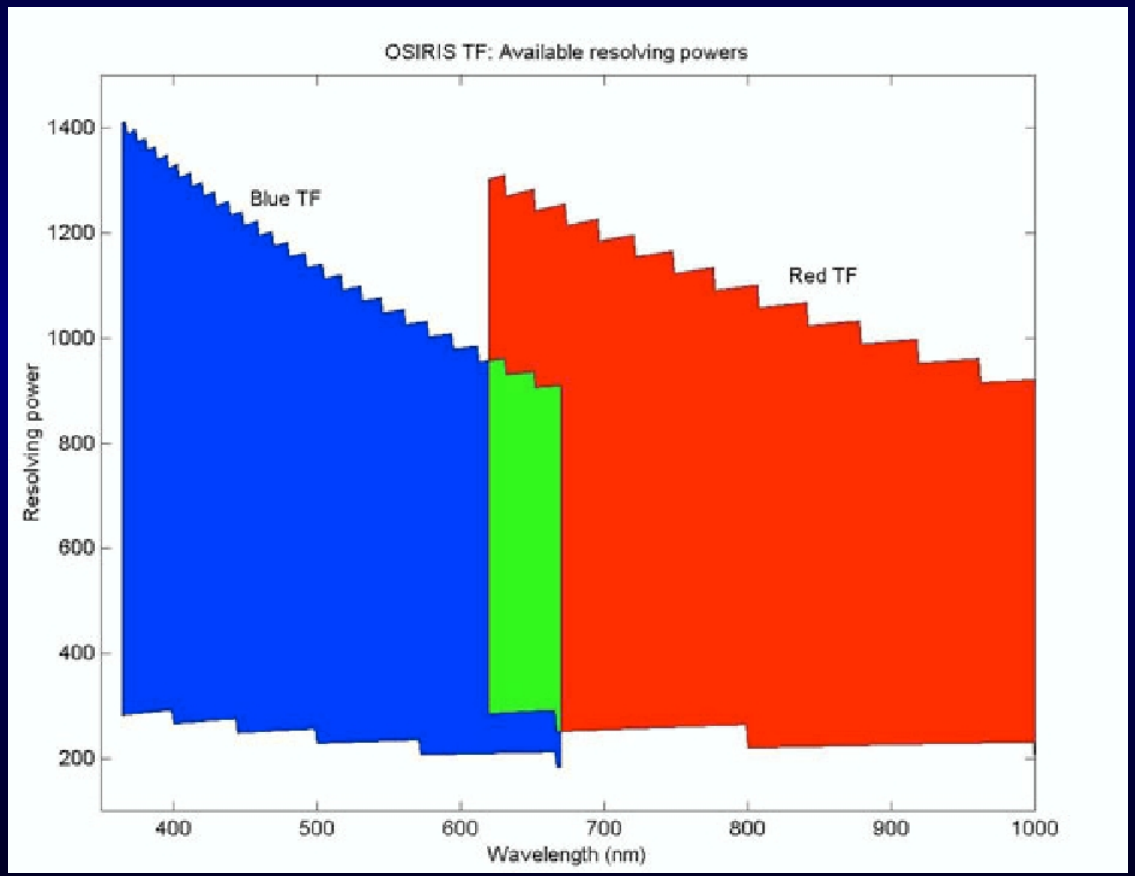
An IFU (higher resolution 20,000) is under development

[3] with microslit MOS sorting spectra

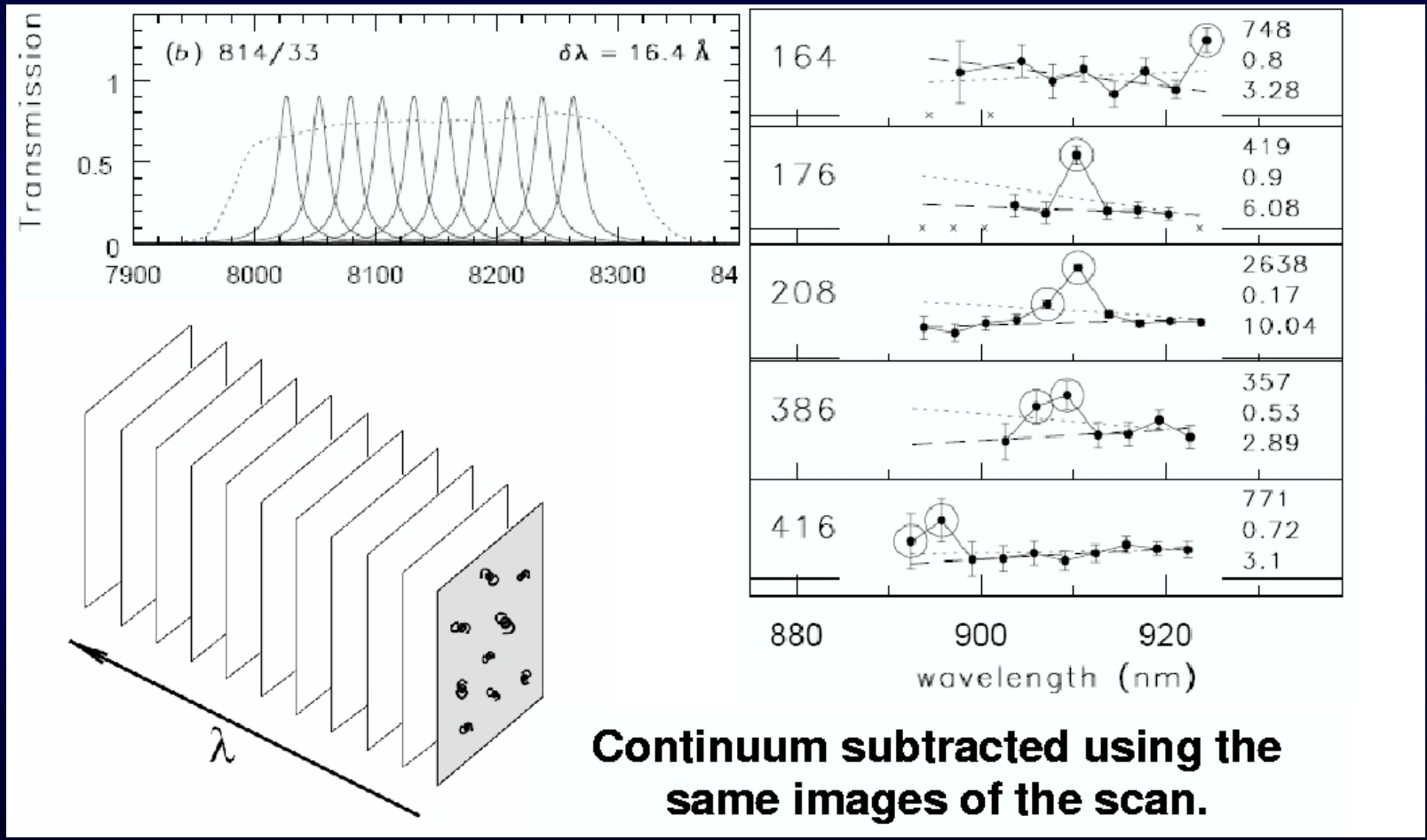
OSIRIS filters

- Broad band filters
  - Sloan
- Order sorter filters
- Tunable filters

OSIRIS TF Resolving Power



OSIRIS TF Usage



Continuum subtracted using the same images of the scan.

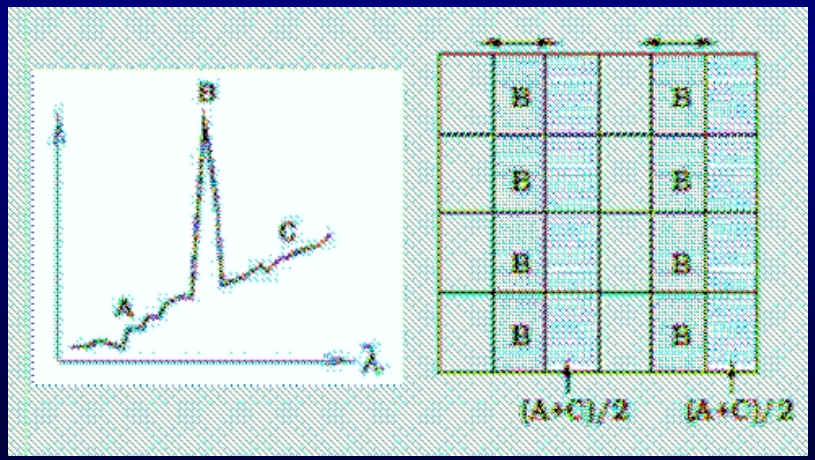
OSIRIS grisms

Table:

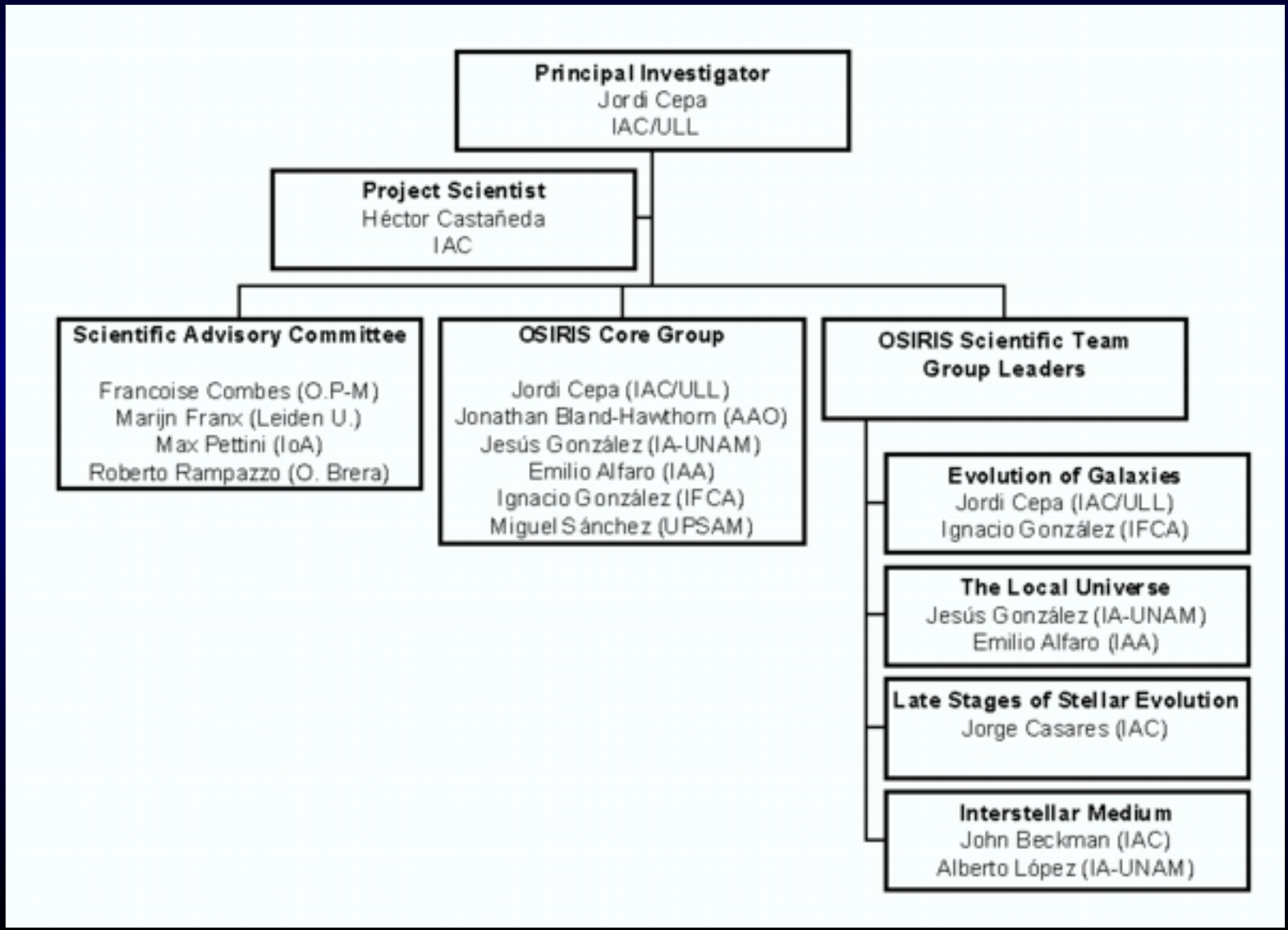
Grism	λ_c	Spectral Range	Resolution
	Å	Å	
MBR-G1	4420	3500 - 7000	325
MBR-G2	6650	5000 - 10000	327
BR-G1	4730	3500 - 7000	501
BR-G2	7170	5000 - 10000	582
IR-G1	4830	3500 - 6900	1343
IR-G2	5450	3700 - 7580	1375
IR-G3	7470	5300 - 10000	1278
R2500-G1	3990	3500 - 4560	2585
R2500-G2	5180	4480 - 5960	2516
R2500-G3	6560	5640 - 7550	2516
R2500-G4	8650	7420 - 9980	2571

The Fast Modes of OSIRIS

- Frame–transfer
- Charge-shuffle



Science with OSIRIS: the group



Scicence with OSIRIS: OTELO and His Brothers

- OTELO
- Asteroids and Comets
- Variable stars
- Stellar activity cycles in open cluster stars
- Stellar populations in remote parts of the galaxy
- Brown dwarfs
- White dwarfs in star clusters
- HII Regions in Galaxies
- Black Hole Hunting
- Surveys of galaxies
- AGN-Normal galaxies link
- AGN Unification Models
- AGN components
- Optical counterparts of radiojets
- Optical counterparts of GRBs
- The Origin of the X-ray Background
- QSOs
- The Environments of QSO at z¿1
- Clustering around radio sources
- Evolution of low-redshift galaxies
- Determination of redshifts of faint objects
- Probing Dark Matter
- Microlensing

OTELO – OSIRIS Tunable Emission Line Object Survey

OTELO is the key OSIRIS science project.

Deep emission line object survey to be performed with the OSIRIS TF in selected atmospheric windows relatively free of sky emission lines.

The total survey sky area is about 1 square degree distributed in different high latitude anda low extinction fields.

A 5σ depth of 1×10^{-18}erg cm^{-2}s^{-1} will make OTELO the deepest emission line survey to date.

OTELO will be complemented with NIR photometry/spectroscopy of the high redshift targets. The FIR data will be obtained via HERSCHEL extragalactic survey.

Science with OSIRIS – Planets and Stars

- Discovery of massive proto-Jupiters (1–10M_{Jup} with deep imaging (I=27mag)
- Time-resolved (10sec time resolution) spectrophotometry of low-mass X-ray binaries
- Individual stellar spectra in nearby galaxies as M31 and M33

Science with OSIRIS – Normal Galaxies

- TF and 10m-class telescope: study of ionized gas
- TFs are ideally suited for the study of HII region populations, examining their physical conditions, electron densities and chemical abondances
- Diffuse Ionized Gas: understanding the ionization mechanism (Lyman continuum radiation emitted by the OB associations or shocks?)
- Metallicity gradients in elliptical galaxies to disentangle between monolithic collapse and hierarchical merging
- Blue compact dwarf galaxies: young or old? Need to observe at very low surface brightness

Science with OSIRIS – Active Galaxies

- Using the TFs to study the extended emission of ionized gas
- stellar populations of AGN host galaxies, examining the link between starburst and stellar population

Science with OSIRIS – Distant Galaxies and Quasars

- Link between Lyα absorbers and galaxies using the TF tuned to the [OII] emission at the appropiate redshift.
- The environments of radio loud and radio quet quasars: are they different?
- Is the level of quasar activity related with the host galaxy environment?

Science with OSIRIS – Clusters of Galaxies

- Star forming galaxies in Galaxy Clusters

Science with OSIRIS – Targets of Opportunity

- Supernovae
- Gamma–Ray Bursts
- *Classical Novae!!*

ToO rules not clear yet.
RRM not advertized.

Conclusions

- For the first time in history, Europe has access to a 10m-class telescope (in the northern hemisphere)
- 135 nights spread over 2 years are "ESO–time"

- OSIRIS will be one of the two "day one" instruments
- "Wide" field of view
- Low and medium dispersion spectroscopy
- Tunable filters

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