

Science with multi-object spectrographs: perspectives and opportunities for the Italian community

Milano, 12-13 December 2018

MOONS: Galactic survey

Emanuele Dalessandro (INAF-OAS Bologna)
on behalf of the MOONS *Galactic Survey Science Team*

Galactic Survey Science Team

Core Team: L Origlia (I), O González (UK), A Mucciarelli (I), M Schultheis (F), E Caffau (F), E Dalessandro (I), P DiMatteo (F), E Pancino (I), S Randich (I), A Recio Blanco (F), R Schiavon (UK), W Taylor (UK), M Zoccali (CL)

Co-Is: M Bellazzini (I), K Biazzo (I), P Bonifacio (F) G Clementini (I), R Contreras (CL), P DeLaverny (F), H Drass (CL), P Francois (F), M Haywood (F), V Hill (F), R Ibata (F), S Lucatello (I), L Magrini (I), N Martin (F), B Nisini (I), G Sacco (I), N Sanna (I), E Valenti (ESO)

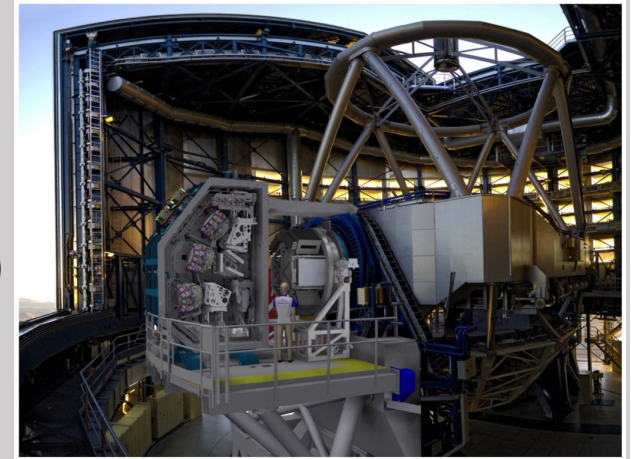
Members at large: C Babusiaux (F), A Bragaglia (I), B Burningham (UK), M Catelan (CL), MR Cioni (D), C Evans (UK), A Ferguson (UK), M Gieles (UK), G Gilmore (UK), F Hammer (F), T Puzia (CL), F Royer (F), M Tosi (I)

MOONS in a nutshell

FoV: 500 sq. arcmin at the Nasmyth focus of the 8.2m VLT

multiplex: 1000 fibers, possible deployment in pairs (target+sky)

fiber positioning time: <1 min only!



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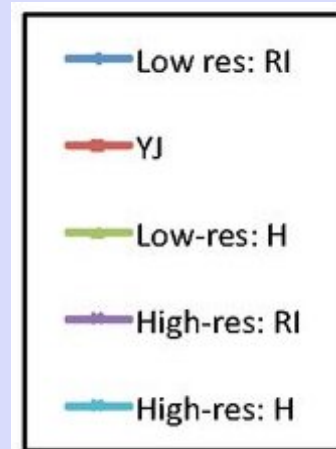
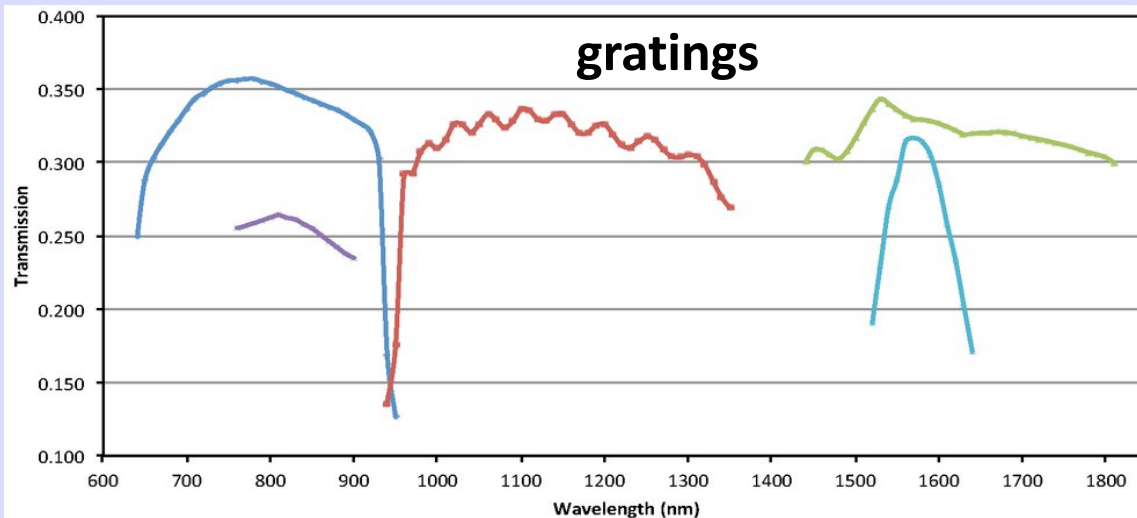
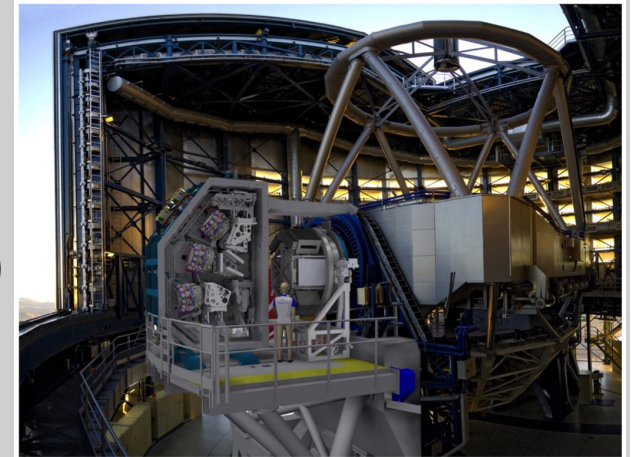
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two observing modes:

LR: simultaneously 0.7-1.8 μ m at R~4–6,000

HR: 3 bands, 0.75-0.90 μ m at R~9,000; YJ at R~4,000; 1.52-1.63 μ m at R~19,000



R~4,100

R~4,300

R~6,600

R~9,200

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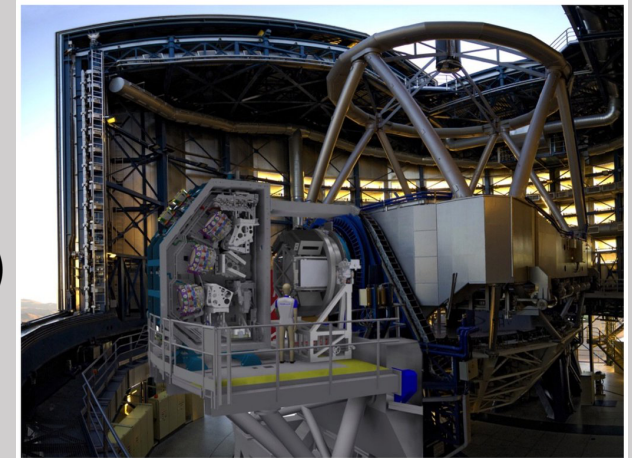
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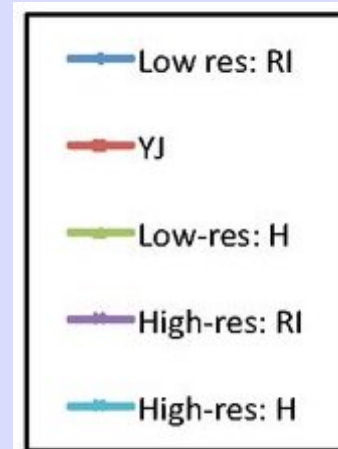
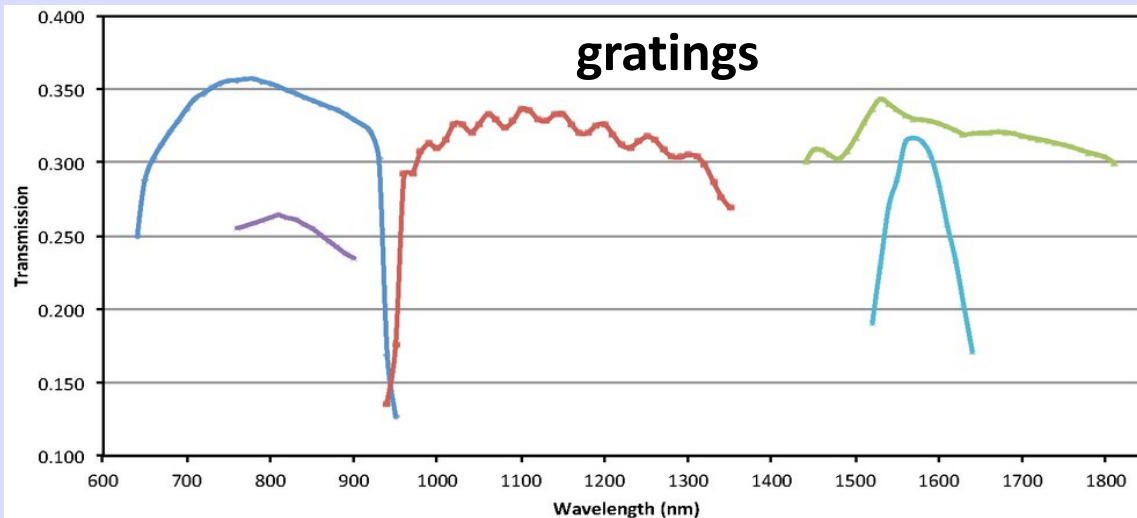
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First light foreseen on 2021+



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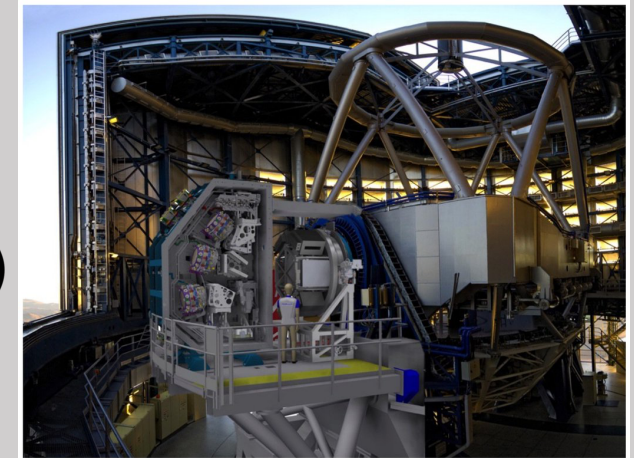
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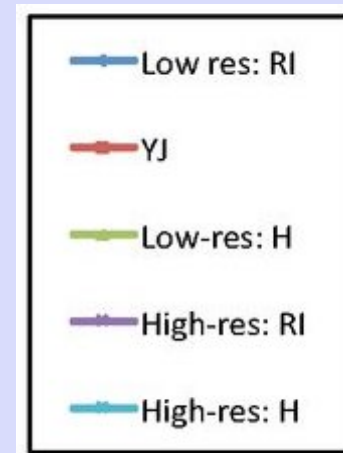
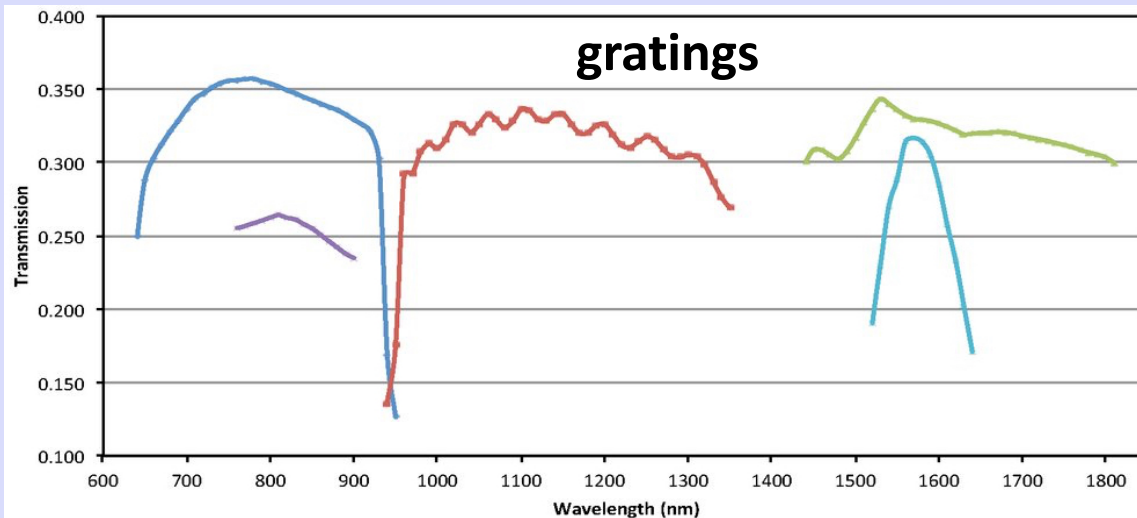
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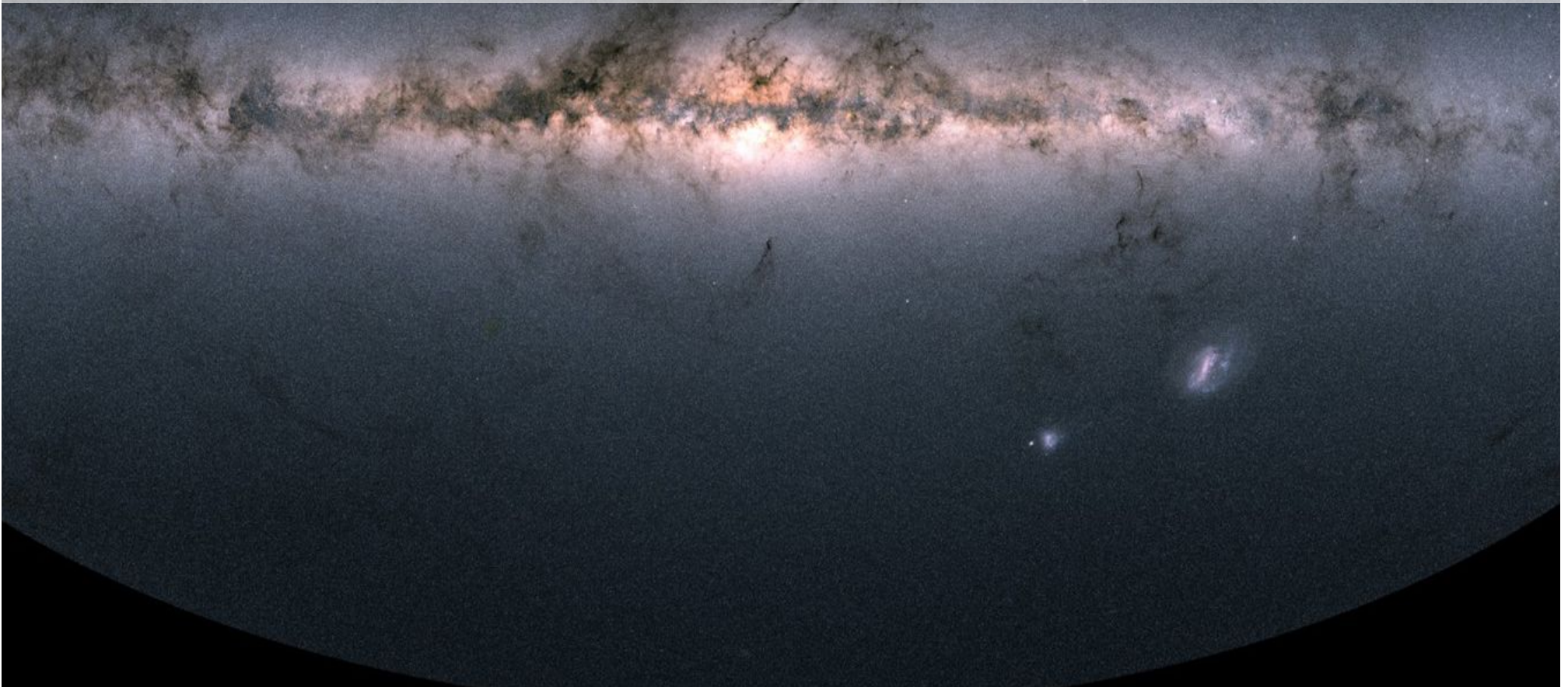
300 GTO nights split in two main surveys:

- extra-galactic survey (200 nights, see F. Mannucci's talk)
- Galactic survey (100 nights)

MOONS GTO Galactic Survey: scientific survey

Principles

- GTO science globally intended for Consortium, NO individual assignment to the partners
- GTO NOT for SV, pilot, calibration or other small projects



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Projects

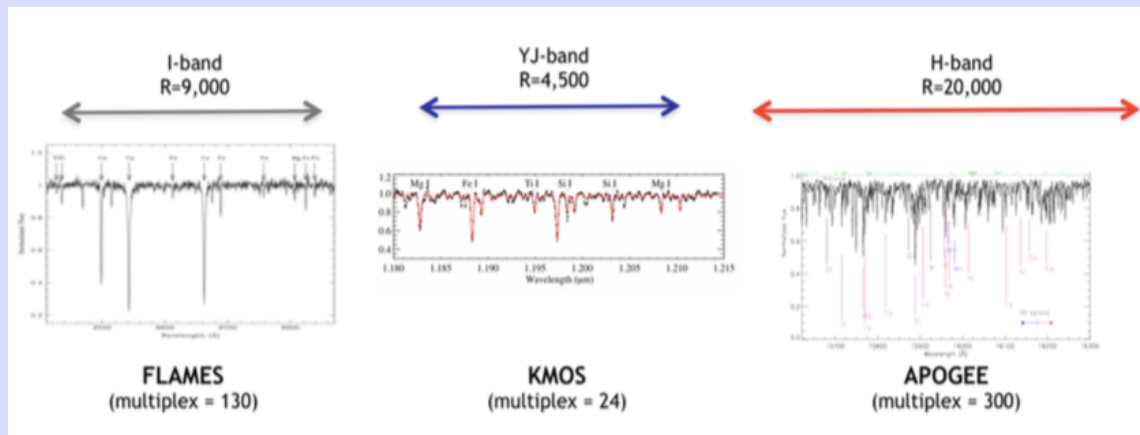
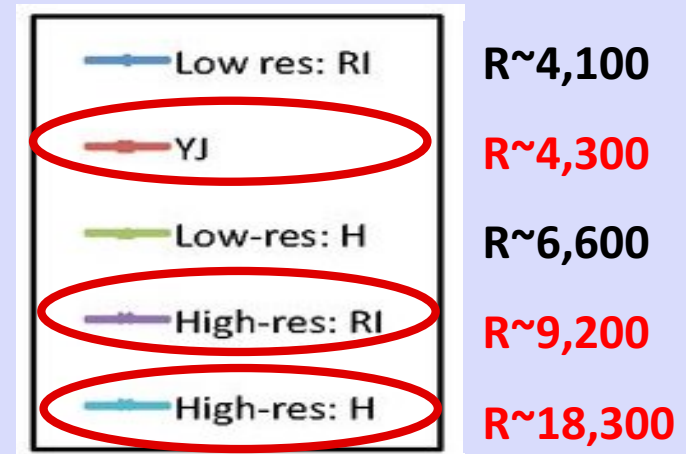
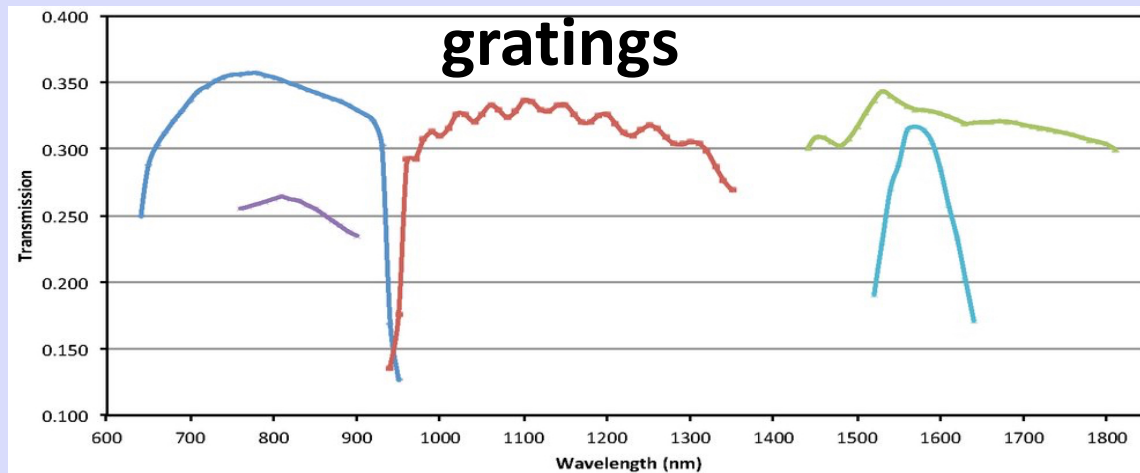
GS1: red/reddened Milky Way (~70 nights)

GS2: Milky Way satellites: MCs and Sagittarius (~30 nights)

MOONS GTO Galactic Survey: scientific strategy

- selecting environments and/or stellar populations poorly (if any) sampled by previous/ongoing/future spectroscopic surveys (*e.g.* GES, GIBS, WEAVE, APOGEE, 4MOST)
- self-consistent surveys within the available GTO time allocation
- maximizing the scientific information from kinematics + detailed chemistry by using the high resolution gratings in the I and H bands
- select fields dense enough at the desired magnitudes to maximize fiber allocation
- performing a science-driven trade-off analysis between depth/SNR (i.e. exp time) and survey size (i.e. # of fields) to fulfill the science goals and maximize the legacy value of the surveys

MOONS GTO Galactic Survey: observational strategy

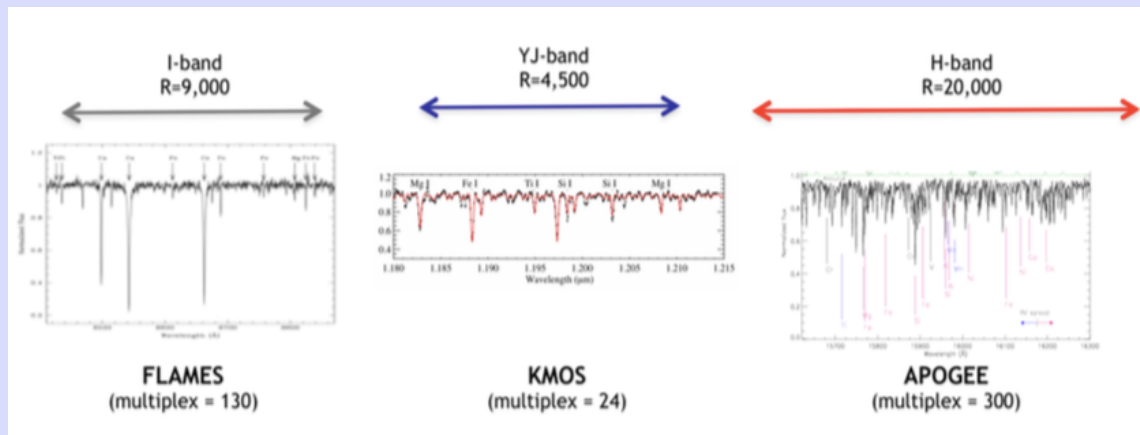
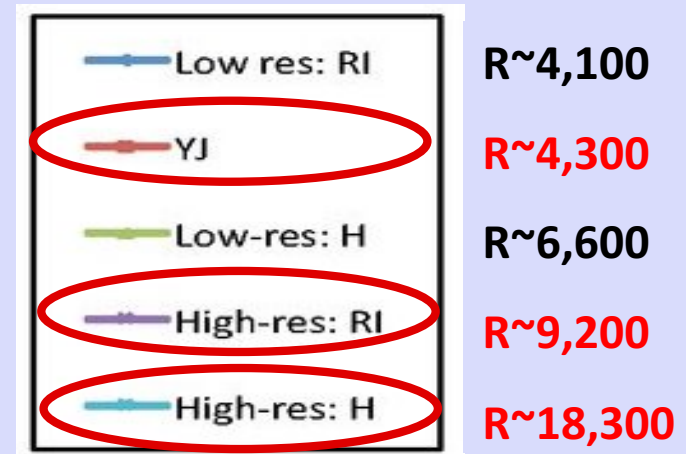
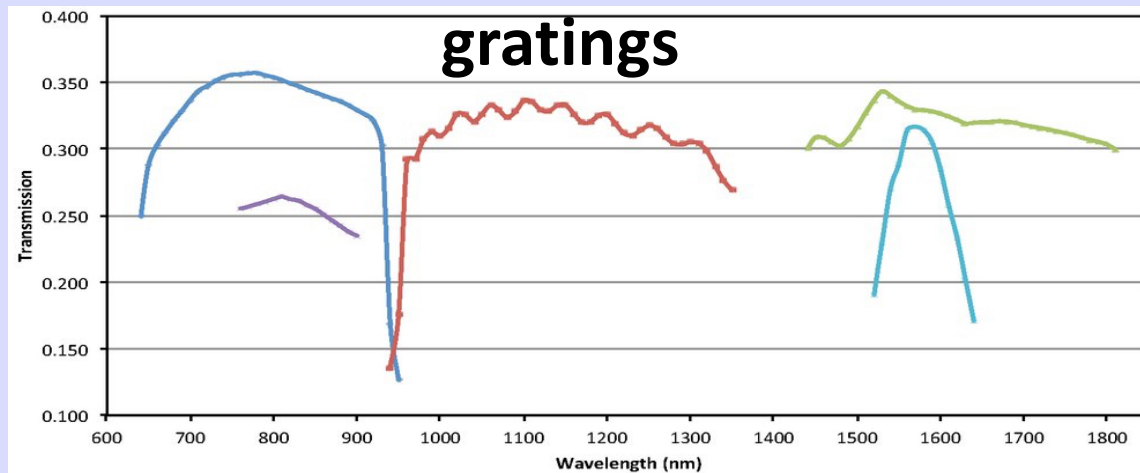


spectroscopic diagnostics
proven effective from previous
experience with FLAMES,
KMOS and APOGEE

exposure times: 1-4 OBs of 1hr, including overheads

sky subtraction: mostly *a la* FLAMES, i.e. stare mode with a few tens fibers on sky and the other 900+ to target stars; for star-forming regions target+sky pairs

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funny fibers: occasionally 1-2 fibers on faint BD or EMP stars in extragalactic fields

GS1: Red/reddened Galaxy survey

Galactic Bulge and South hemisphere disk



GS1: Red/reddened Galaxy survey

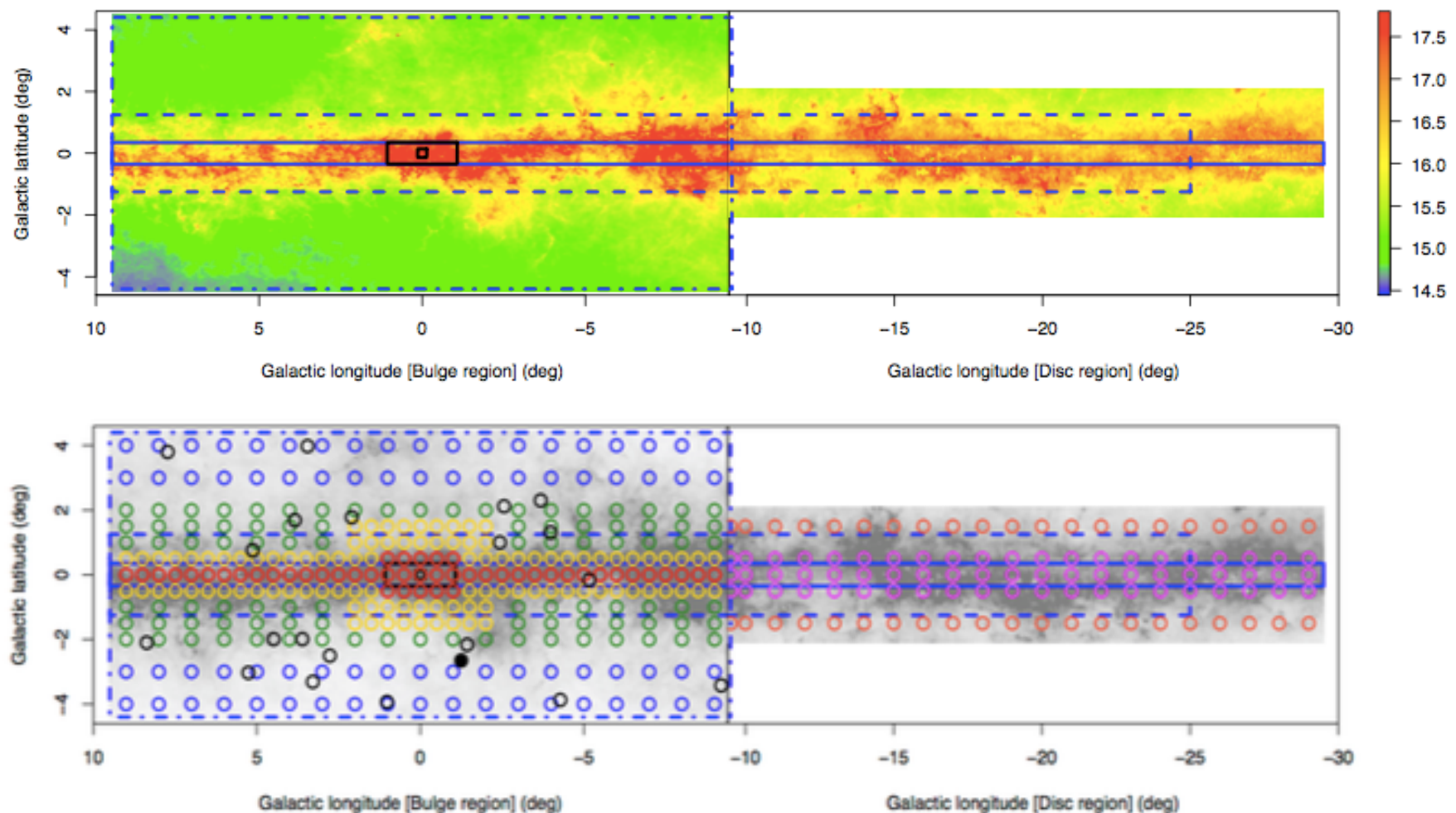
chemo-dynamical characterization of the inner bulge and disc

impact on our understanding of extra-galactic bulges and nuclear regions of disc galaxies

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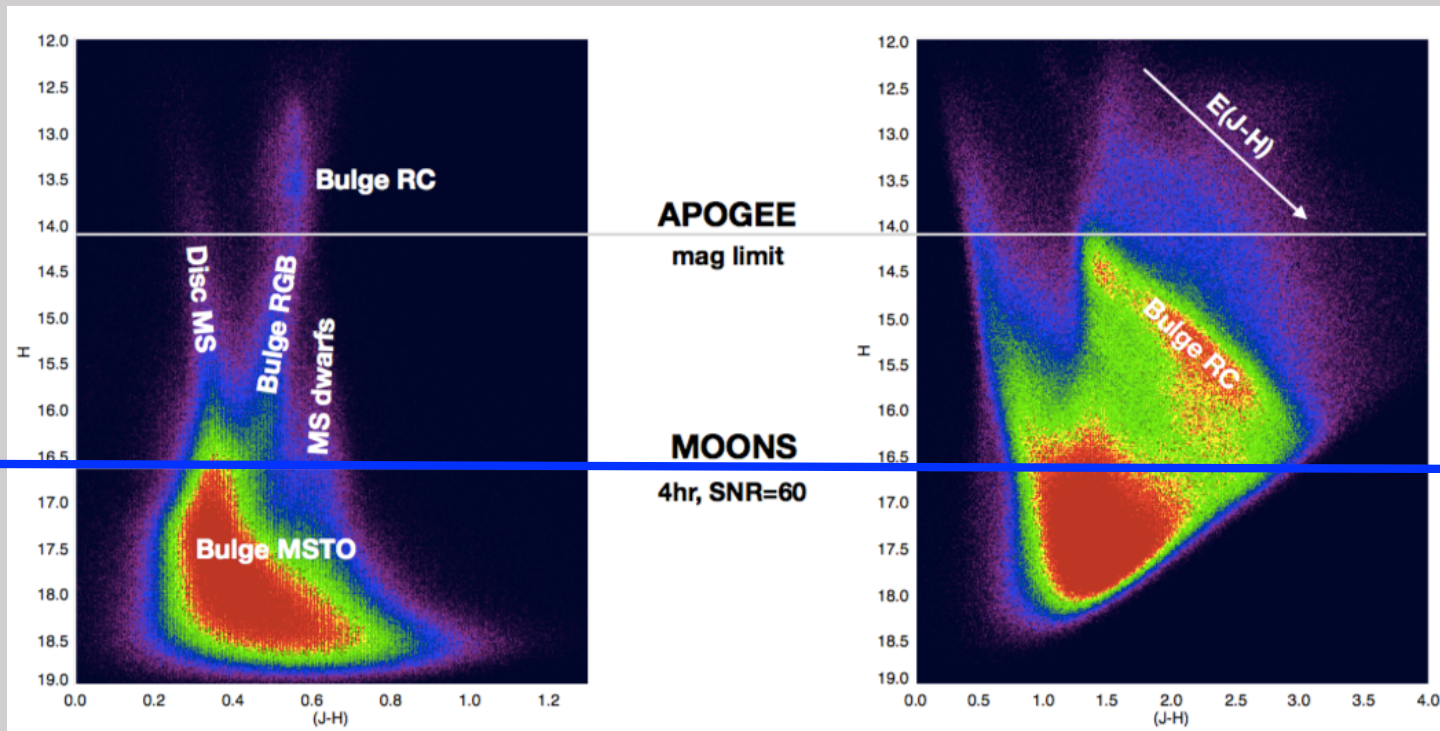


Red/reddened Galaxy survey: main objectives

analysis of the inner Galaxy at the same detailed level as for the other components of the MW

stellar tracers: giant stars down to the Red-Clump →
sample unbiased to distance/depth effects due to reddening

MOONS will be the only MOS observing giants down to the Red Clump
and some SF regions in the innermost and highly reddened Galaxy



GS2: The Milky Way Satellite survey

Sagittarius dwarf
Spheroidal galaxy



Magellanic Clouds



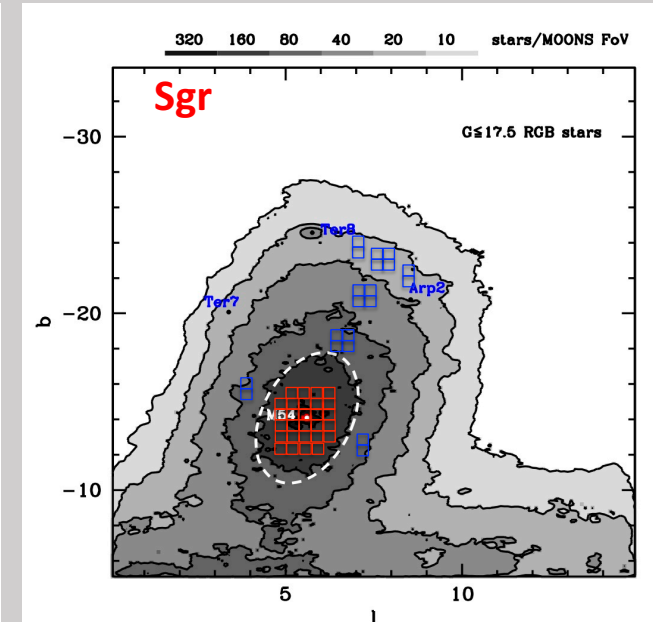
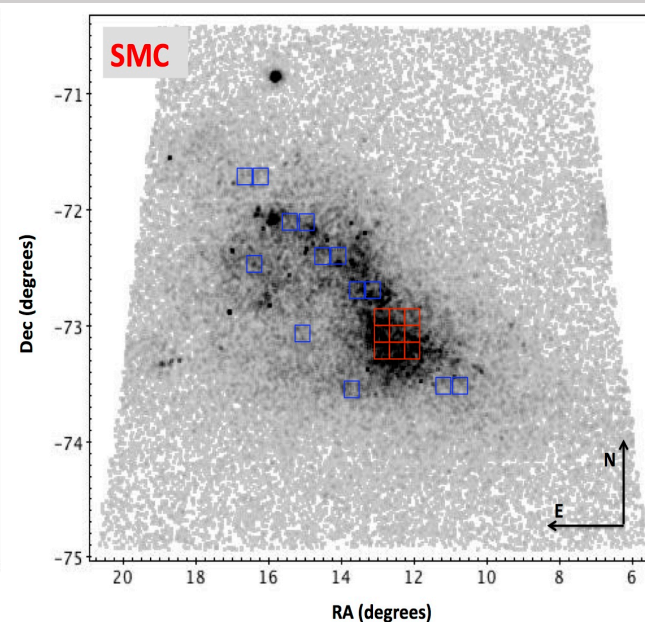
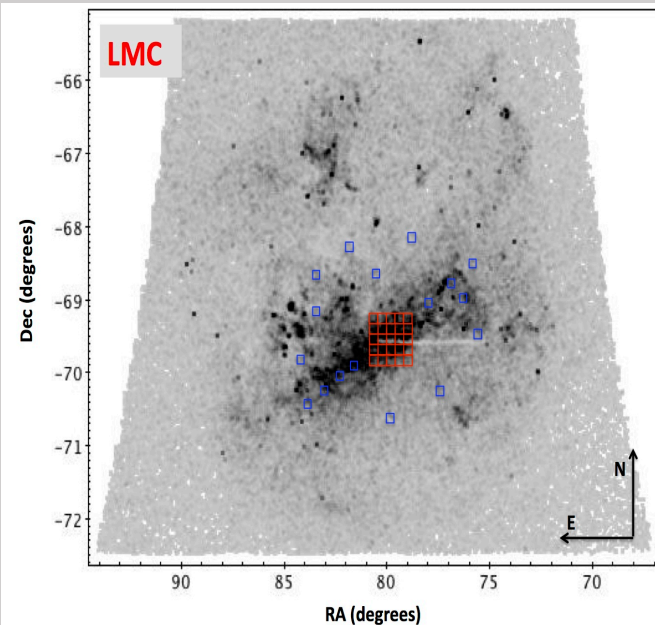
GS2: The Milky Way Satellite survey

mosaic of fields in central regions of the MC and Sgr galaxies

- comprehensive chemical maps for the MCs and Sgr to investigate the timescale of their enrichment histories and the role played by dynamical evolution
- compare the abundance ratios of Sgr and LMC that are both dominated by stellar-populations of similar ages and metallicities ($[Fe/H] \sim -0.5$ dex) but characterized by different star formation histories

fields along the major and minor axis of the MC and Sgr galaxies

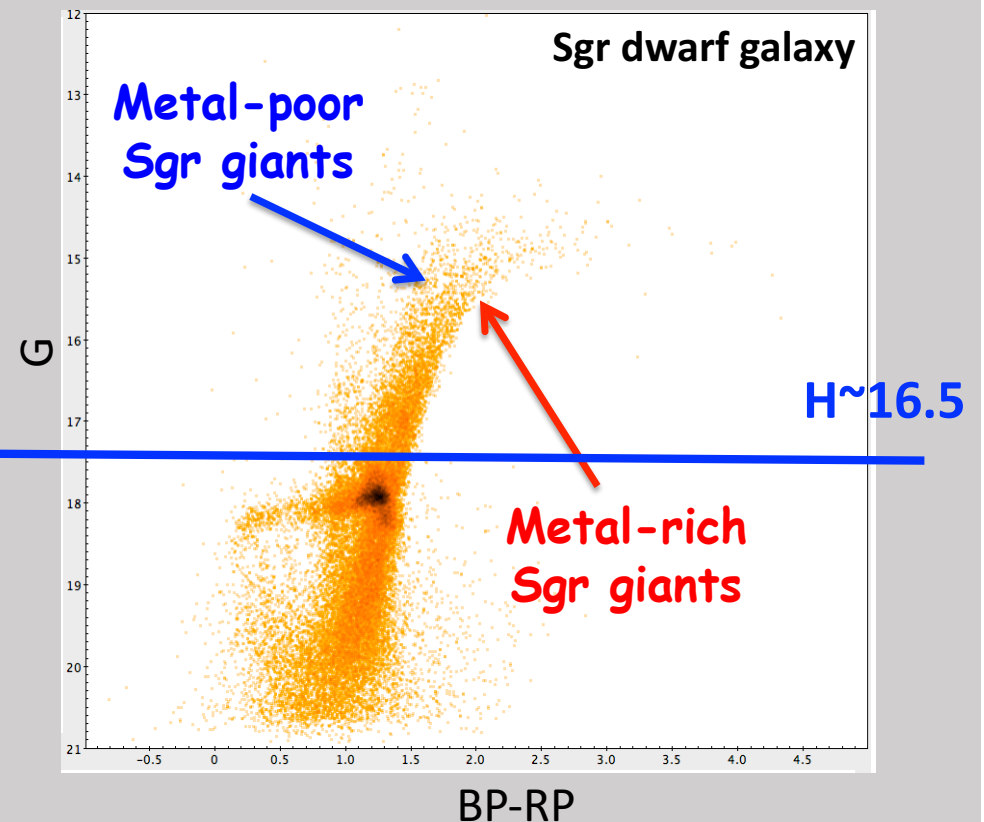
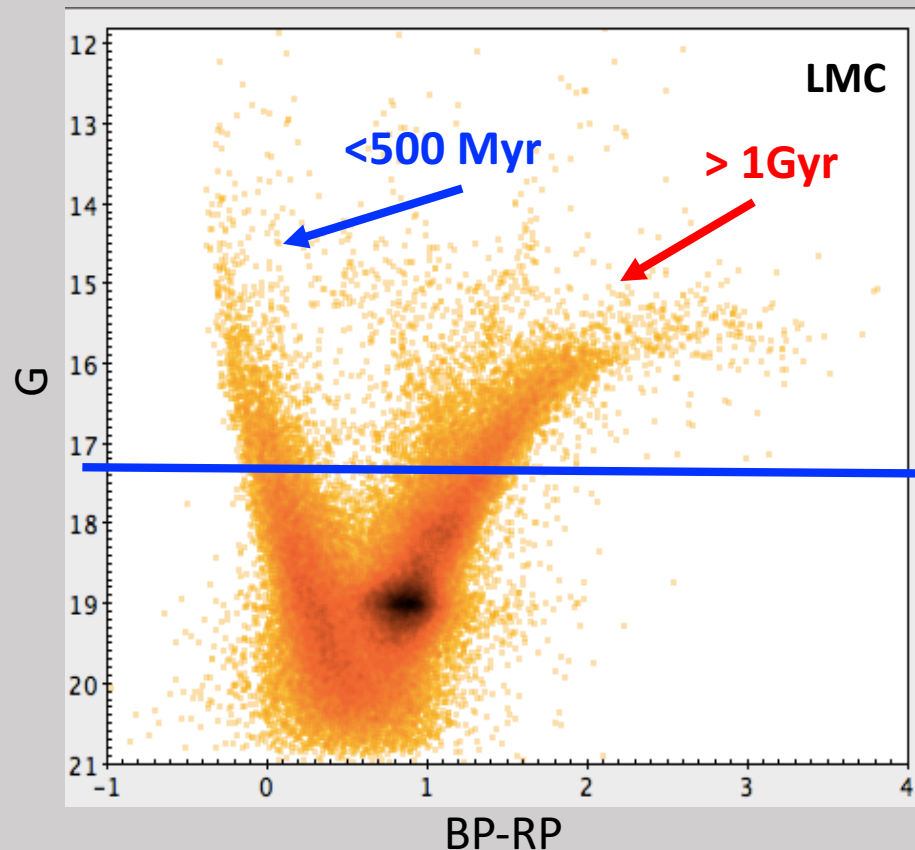
- identify possible kinematically and chemically distinct sub-structures in the MCs (bar, halo), likely connected to the complex star formation and dynamical history of the parent galaxies
- chemical and kinematical properties of star clusters



MW satellite survey: main objectives

the first, systematic characterization of the chemistry and kinematics of the stellar pops in the central regions of the Magellanic Clouds and Sagittarius dwarf galaxy

stellar tracers: red giant branch stars



Galactic Survey: final remarks

unprecedented, detailed chemistry and kinematics for
0.5M stars in the red/reddened Galaxy
0.1M stars in the MCs and Sgr MW satellites

Italian representatives in the Science Team

project coordinator: *L. Origlia*

work package responsables:

- the nuclear region: *L. Origlia*
- young star clusters: *S. Randich*
- Magellanic Clouds chemistry & kinematics: *A. Mucciarelli*
- Magellanic Clouds stellar clusters: *E. Dalessandro*
- calibrations: *E. Pancino*
- photometric surveys: *E. Dalessandro*
- **+ 8 co-Is and 2 members at large**

MOONS GTO Galactic Survey

Science Team

Scientists with proved expertise in resolved SPs, Galactic archaeology, optical and IR photometric and spectroscopic surveys, stellar chemistry and kinematics

Core Team: 13 people (5 I)

survey coordinators and working group responsables

L Origlia (I), O González (UK), A Mucciarelli (I), M Schultheis (F), E Caffau (F), E Dalessandro (I), P DiMatteo (F), E Pancino (I), S Randich (I), A Recio Blanco (F), R Schiavon (UK), W Taylor (UK), M Zoccali (CL)

Co-Is: 18 people (8 I)

key people to coordinate and execute the activities within the scientific and technical working groups, with the ultimate goal of optimizing the performances of the survey and maximizing its astrophysical output

M Bellazzini (I), K Biazzo (I), P Bonifacio (F), G Clementini (I), R Contreras (CL), P DeLaverny (F), H Drass (CL), P Francois (F), M Haywood (F), V Hill (F), R Ibata (F), S Lucatello (I), L Magrini (I), N Martin (F), B Nisini (I), G Sacco (I), N Sanna (I), E Valenti (ESO)

Members at large: 13 people (2 I)

high profile scientists who contributed to the *launch* of the MOONS Galactic Survey and will continue to share interest and expertise with the Core Team and Co-Is

C Babusiaux (F), A Bragaglia (I), B Burningham (UK), M Catelan (CL), MR Cioni (D), C Evans (UK), A Ferguson (UK), M Gieles (UK), G Gilmore (UK), F Hammer (F), T Puzia (CL), F Royer (F), M Tosi (I)