TNG & Macroarea 1

Micol Bolzonella on behalf of MA1
with the kind help of MA1 past and present TAC members
(De Lucia, Gilli, Napolitano, Pentericci, Zucca)
and Emilio Molinari

MA1 science

MA1: optical/NIR observations in 2020 perspective

Science of MA1:

- ❑ Galaxies, AGN and their evolution
- ❑ Clusters, LSS and IGM
- ❑ Theoretical and observational cosmology

Current and future main projects for MA1 need:

- Large area photometry (multi-band for SED-fitting and photometric redshifts)
- “High” resolution spectroscopy (detailed physical properties, dynamics)
- High multiplexing spectroscopy (cosmological surveys, clusters of galaxies)
- IFS (spatial description of physical properties)
- Morphology (structural evolution, assembly history)

Is TNG what MA1 needs?

TNG instrumentation

	commissioning	type	characteristics
NICS	September 2000	Imager/spectrograph	FOV=4.2′x4.2′ R=50-2500 λ=[0.9,2.5]µm
DOLORES+MOS	December 2000	Imager/spectrograph	FOV=8.6′x8.6′ R=500-6000 MOS: 30-40
HARPS-N	April 2012	Echelle spectrograph	FOV=1" R=115 000 λ=[3830,6930]Å
GIANO	October 2013	Spectrograph	R=50 000 λ=[0.95,2.45]µm

Is TNG what MA1 needs? Old instrumentation, small area, old-style spectroscopy…

➜ not ideal for major science, but still interesting for many medium-small projects

Proposal categories

A - Cosmology

Surveys of AGNs and high-z galaxies; Identification studies of extragalactic surveys; Large scale structure and evolution; Distance scale; Groups and clusters of galaxies; Gravitational lensing; Intervening absorption line systems;High redshift galaxies (star formation and ISM)

B - Galaxies and galactic nuclei

Morphology and galactic structure; Stellar populations; Chemical evolution; Galaxy dynamics; Peculiar/interacting galaxies; Non-thermal processes in galactic nuclei (incl. QSRs, QSOs, blazars, Seyfert galaxies, BALs, radio galaxies, and LINERS); Thermal processes in galactic nuclei and starburst galaxies (incl. ultraluminous IR galaxies, outflows, emission lines, and spectral energy distributions); Central supermassive objects

C - Interstellar medium, star formation and planetary systems

Gas and dust, giant molecular clouds, cool and hot gas, diffuse and translucent clouds; Chemical processes in the interstellar medium; Star forming regions, globules, protostars, HII regions; Pre-main-sequence stars (massive PMS stars, Herbig Ae/Be stars and T Tauri stars); Outflows, stellar jets, HH objects; Main-sequence stars with circumstellar matter, early evolution; Young binaries, brown dwarfs, exosolar planet searches; Solar system (planets, comets, small bodies)

D – Stellar evolution

Main-sequence stars; Post-main-sequence stars, giants, supergiants, AGB stars, post-AGB stars; Pulsating stars and stellar activity; Mass loss and winds; Supernovae, pulsars; Planetary nebulae, nova remnants and supernova remnants; Pre-white dwarfs and white dwarfs, neutron stars; Evolved binaries, black-hole candidates, novae, X-ray binaries, CVs; Gamma-ray and X-ray bursters; OB associations, open and globular clusters, extragalactic star clusters; Individual stars in external galaxies

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MA1

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HARPS-N

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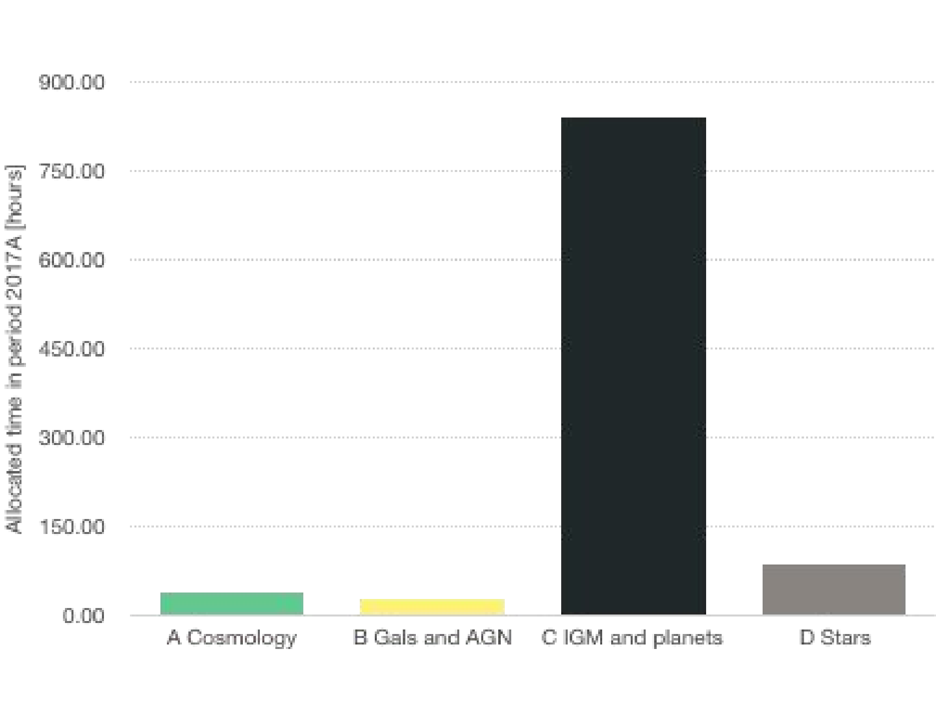
Allocated time in period 2017A per categories

A very small amount of time is dedicated to programmes of interest of MA1.
Is HARPS-N the only reason?

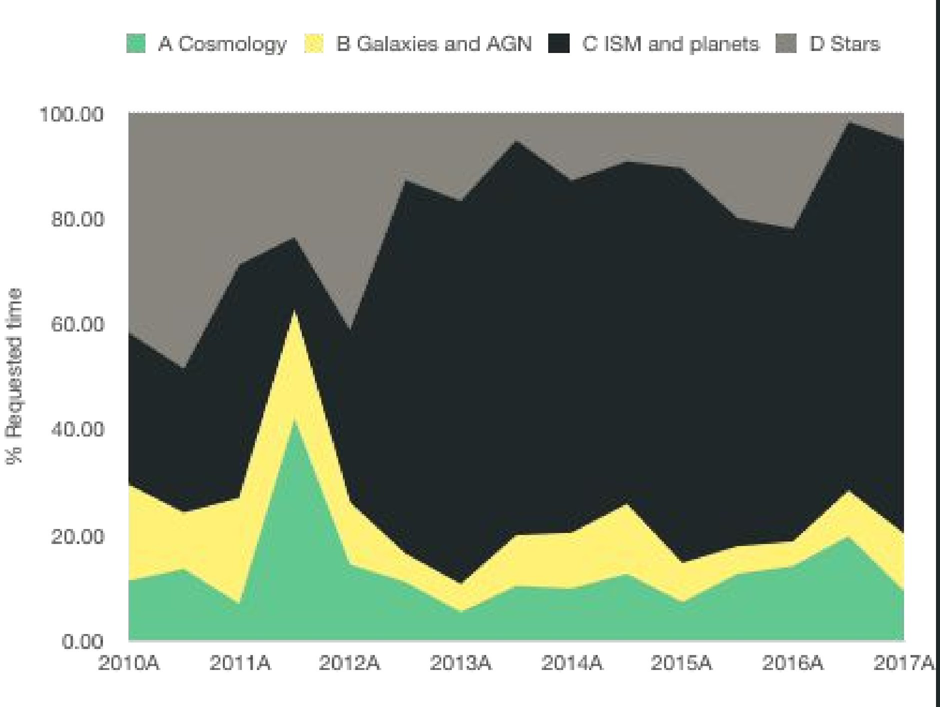


Data from Emilio Molinari

TNG and MA1: a historical view (since 2010) of disaffection

Requested time

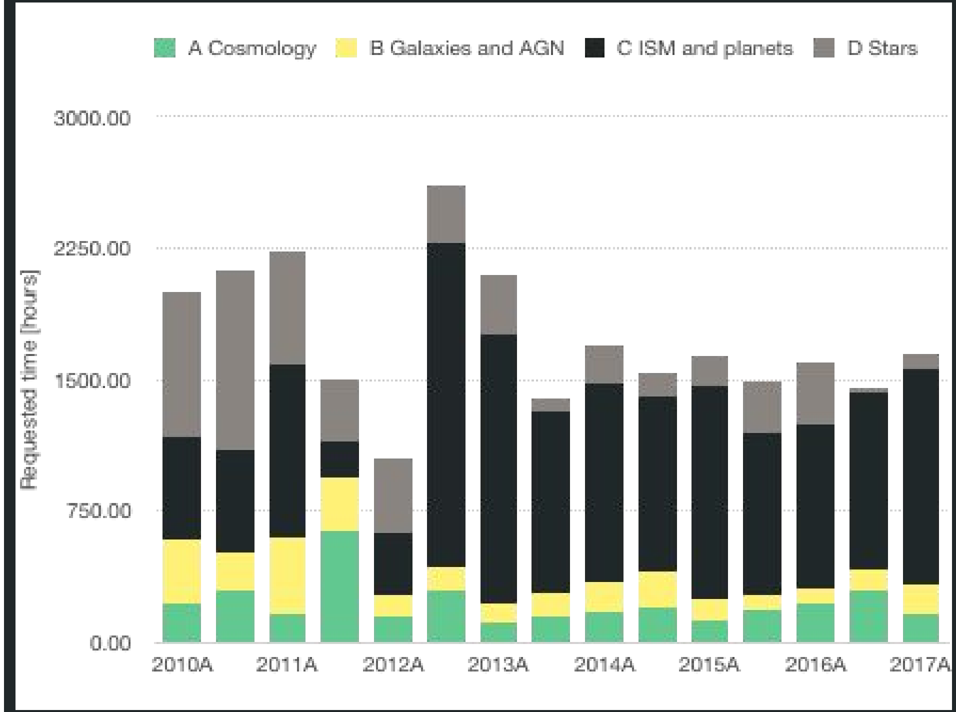
Looking at the percentage of the requested time since 2010, the trend of categories A+B is flat and only slightly decreasing



Data from Emilio Molinari

Requested time

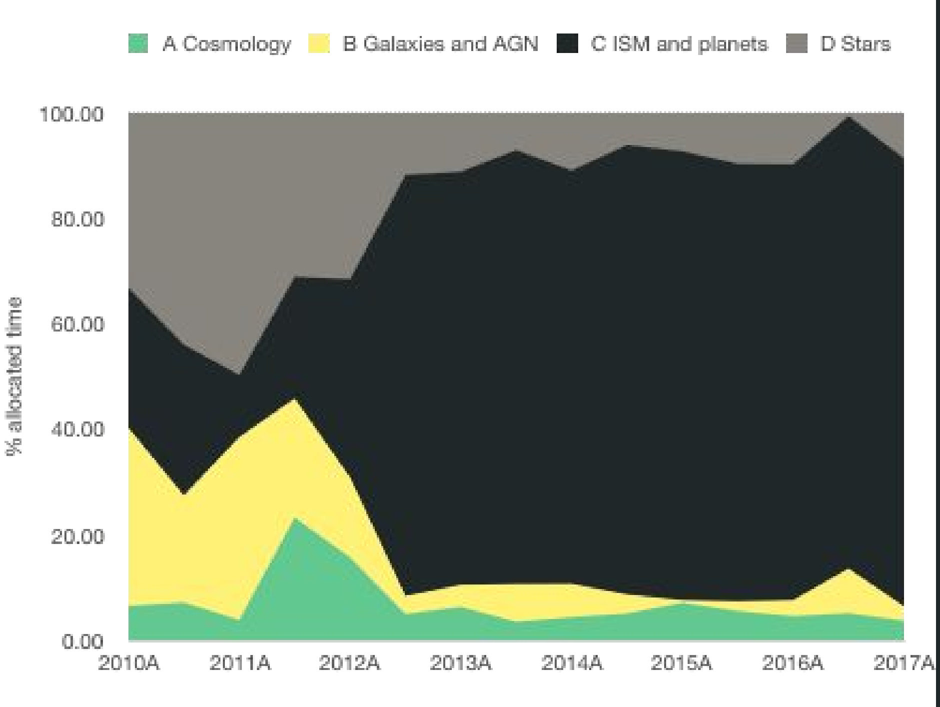
Looking at the absolute value of the requested time since 2010, the trend of categories A+B (and also D) is clearly decreasing after 2012



Data from Emilio Molinari

Allocated time

The percentage of allocated time (including GTO, decision by DS, all TACs) decreased a lot for categories A+B (and D) since the advent of HARPS-N in 2012

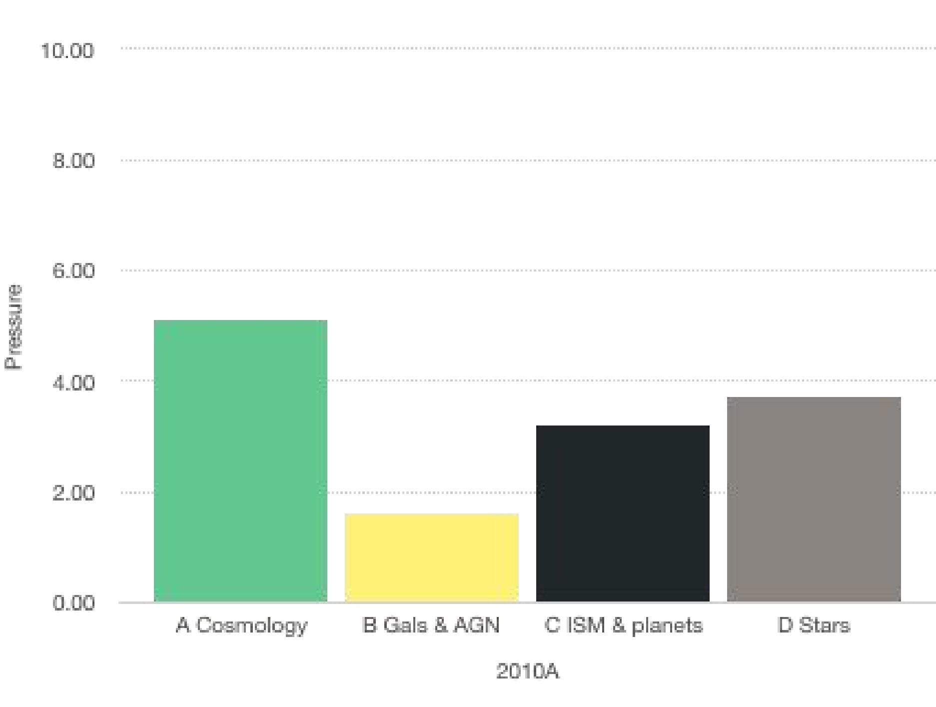


Data from Emilio Molinari

Pressure

The ratio between requested and allocated time gives the pressure for the 4 categories since 2010.

2010A



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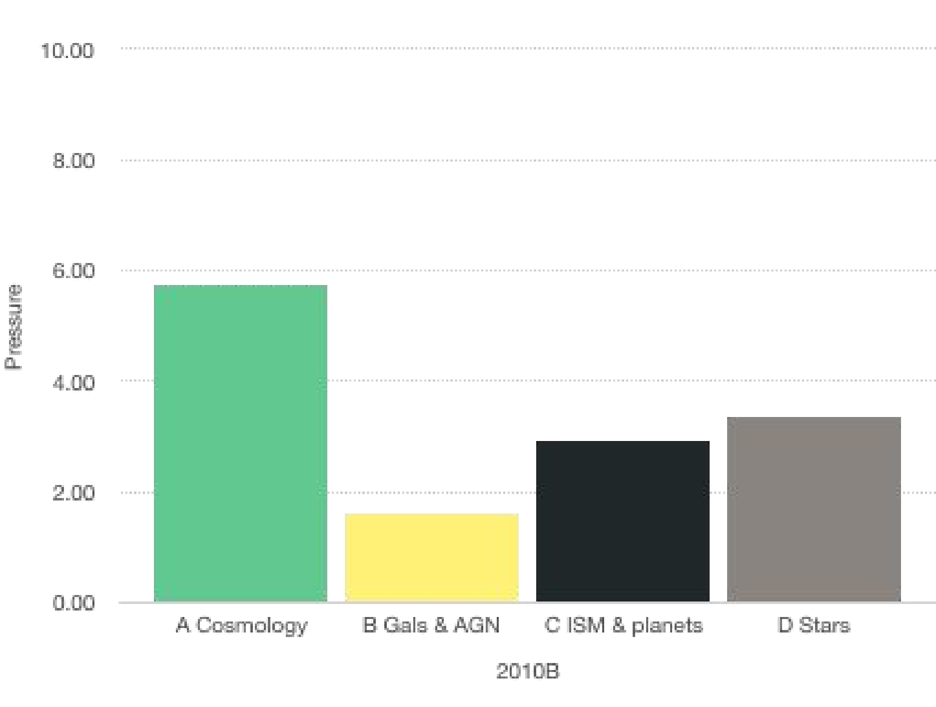
2010B



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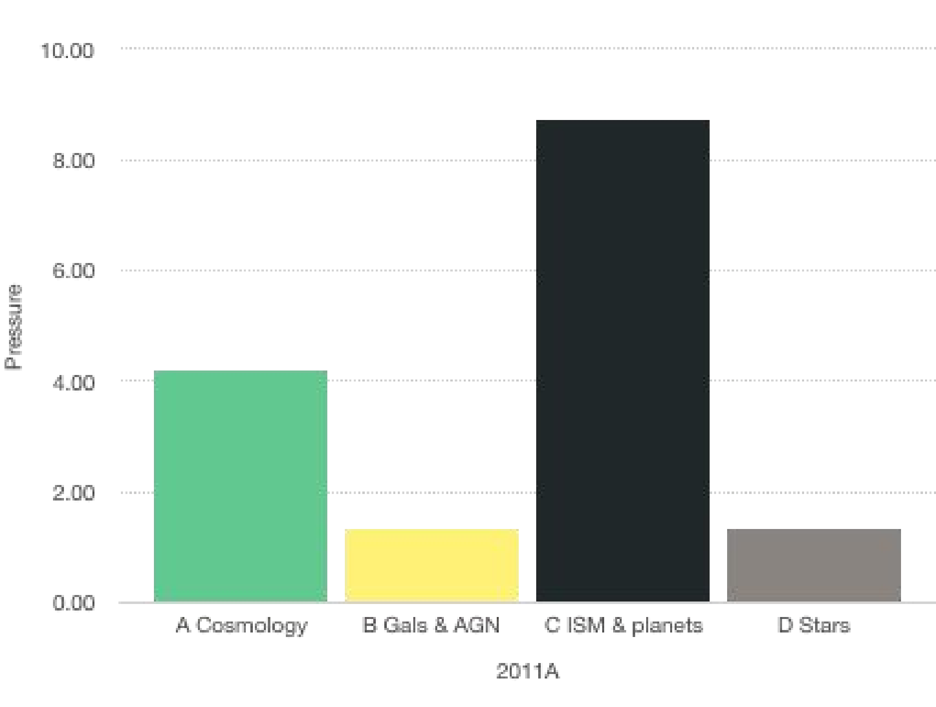

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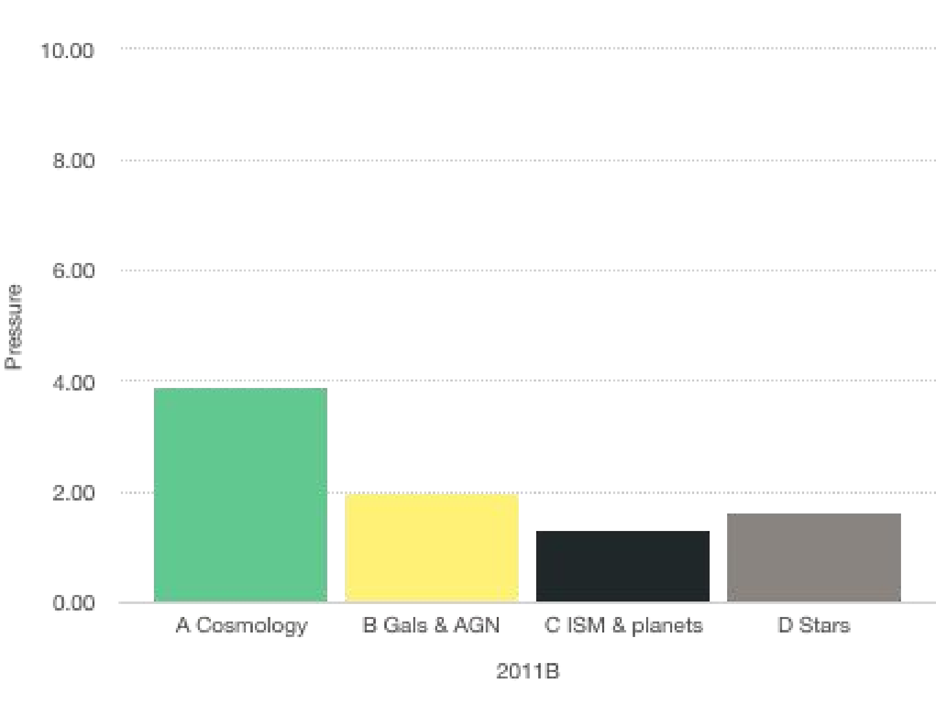
2011B



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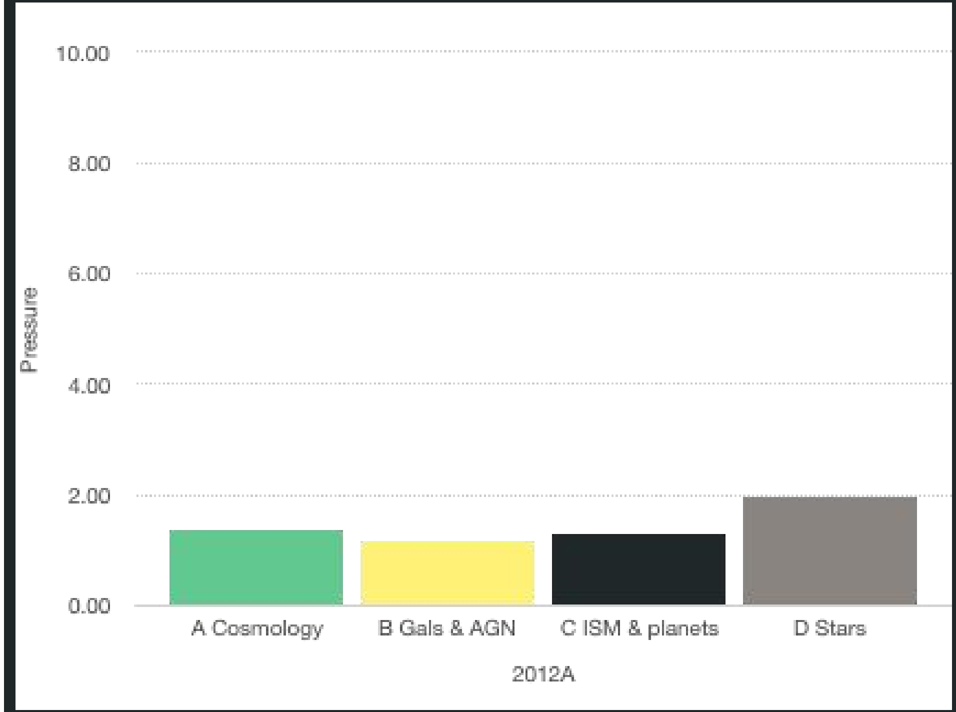

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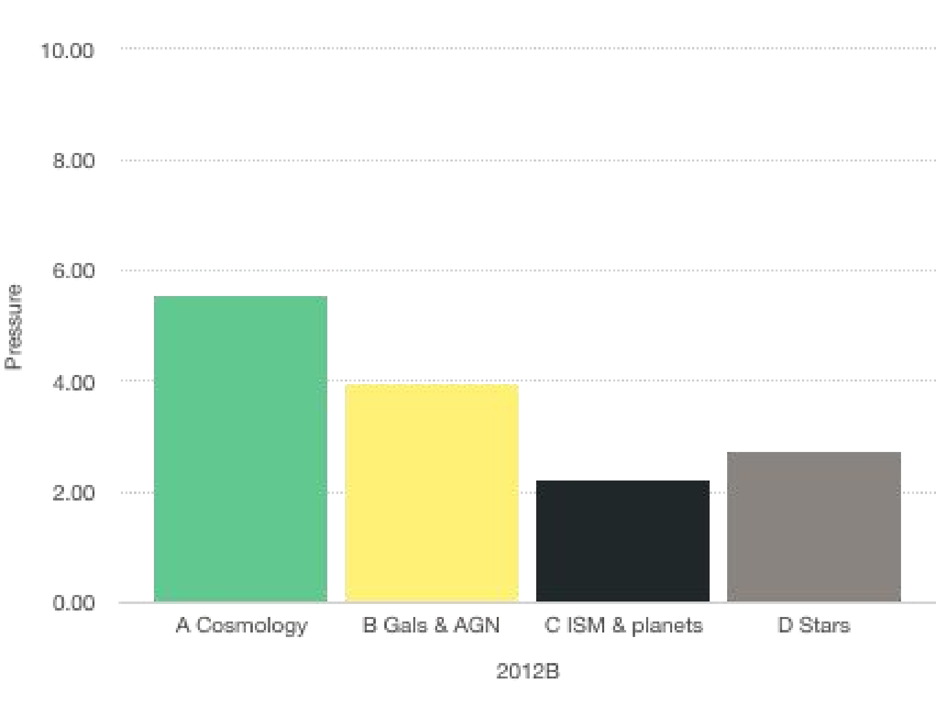
2012B



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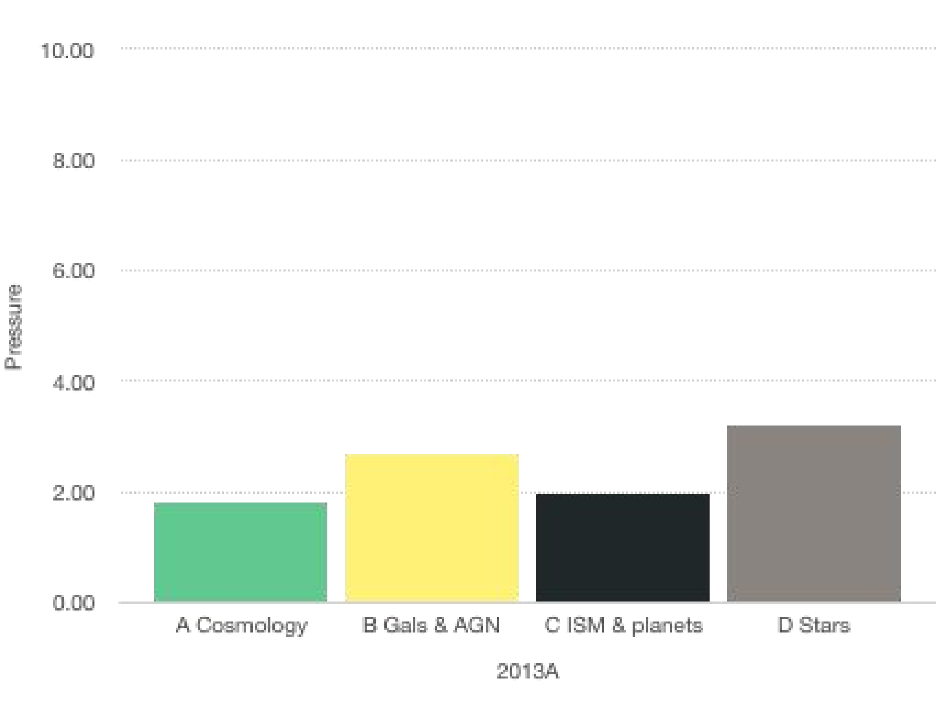
2013A



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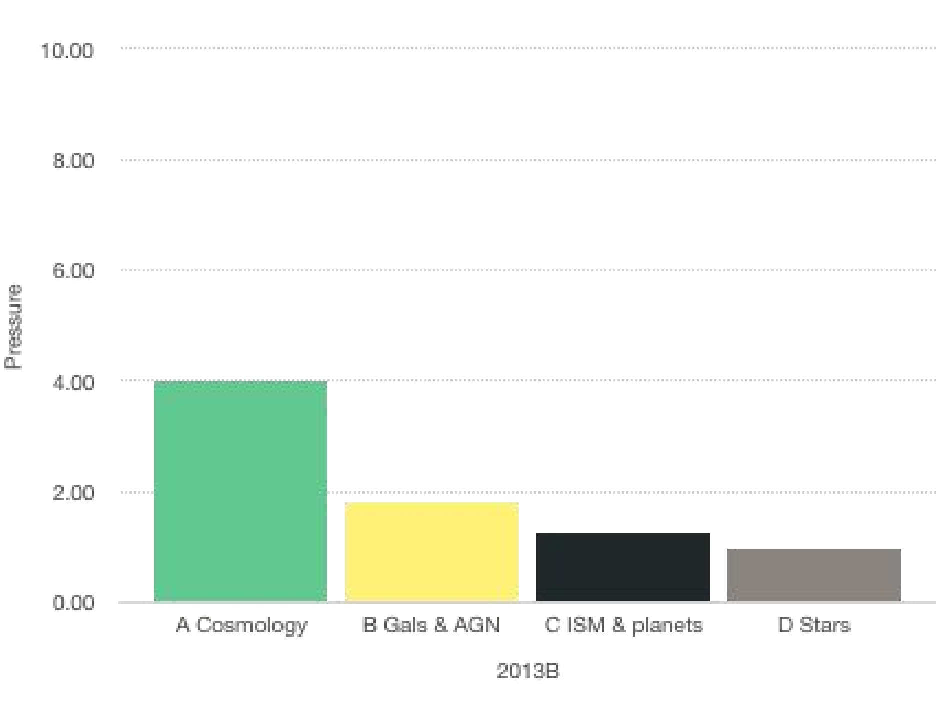
2013B



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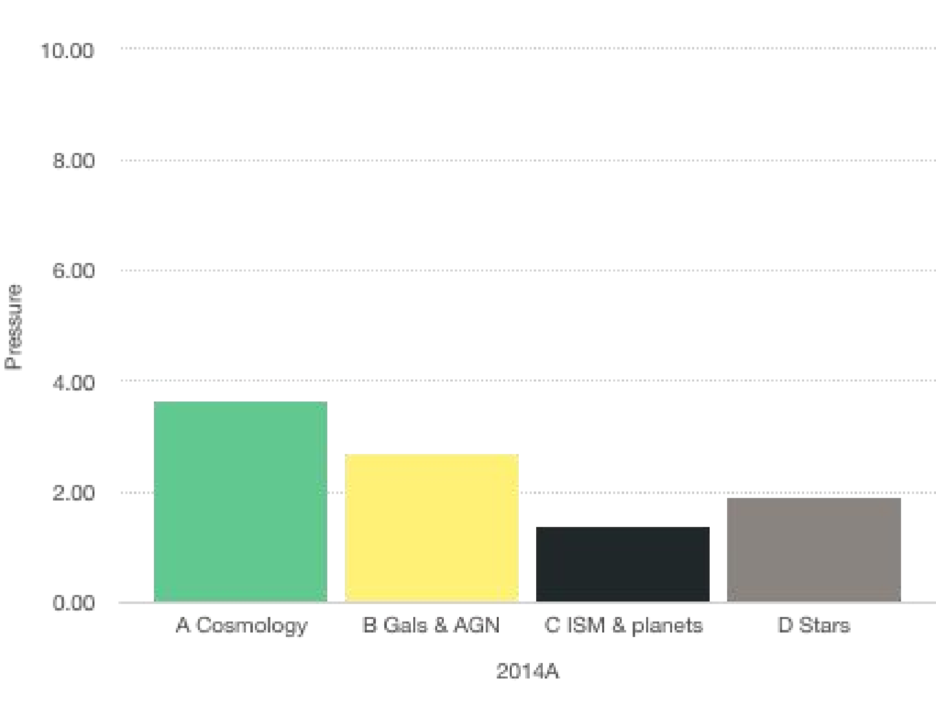

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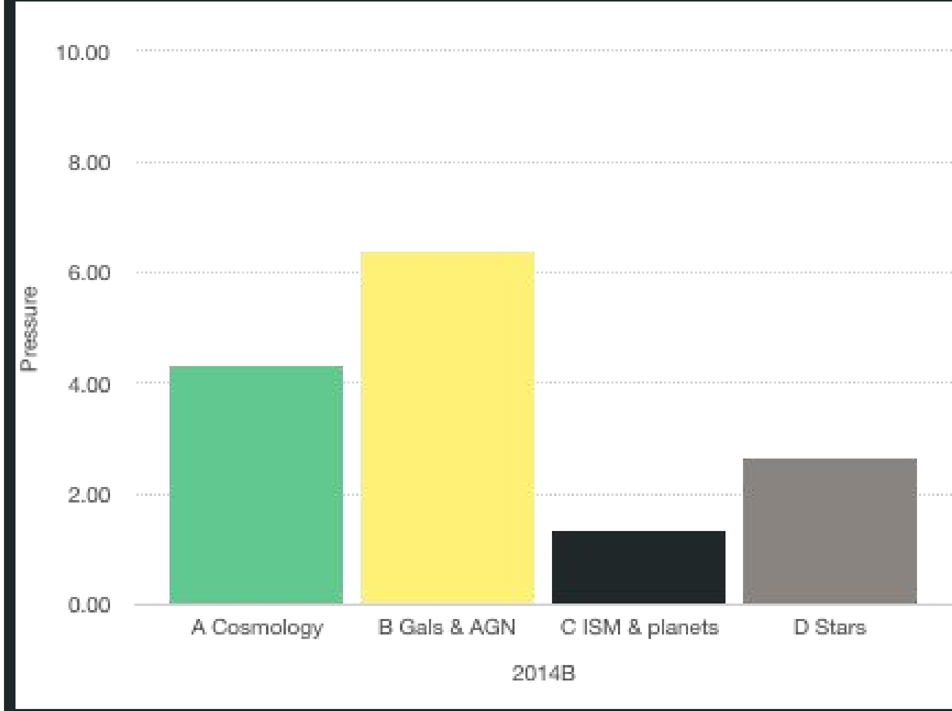

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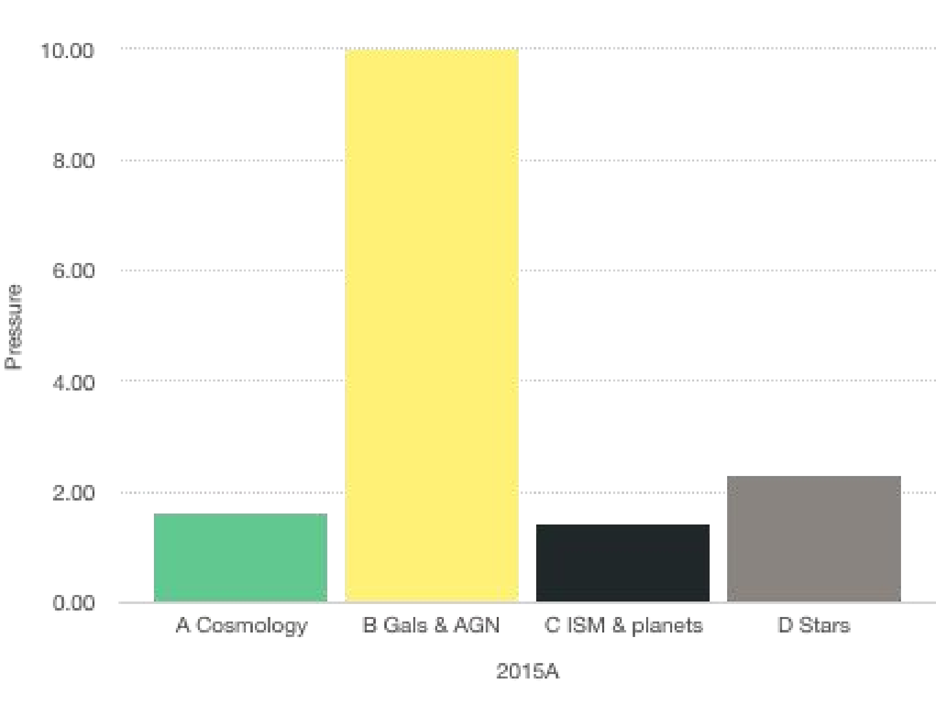
2015A



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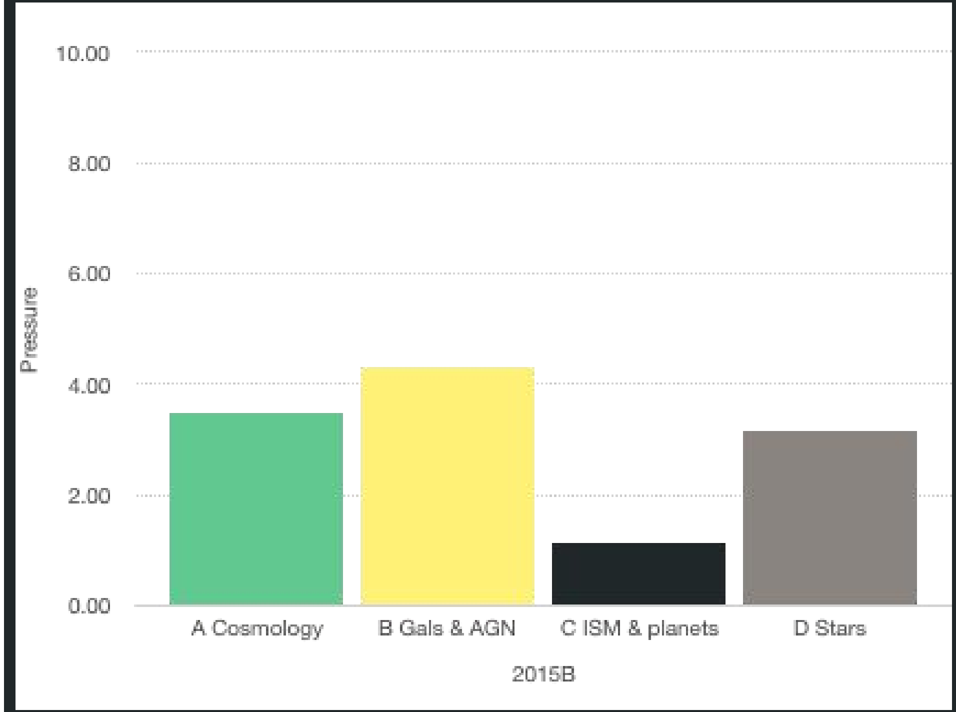
2015B



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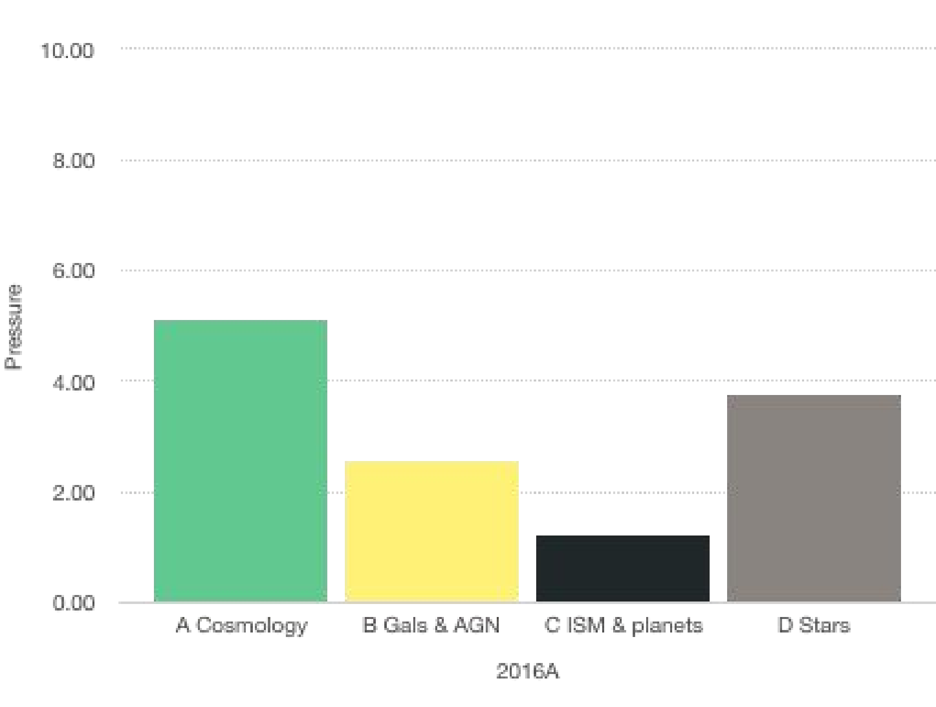
2016A



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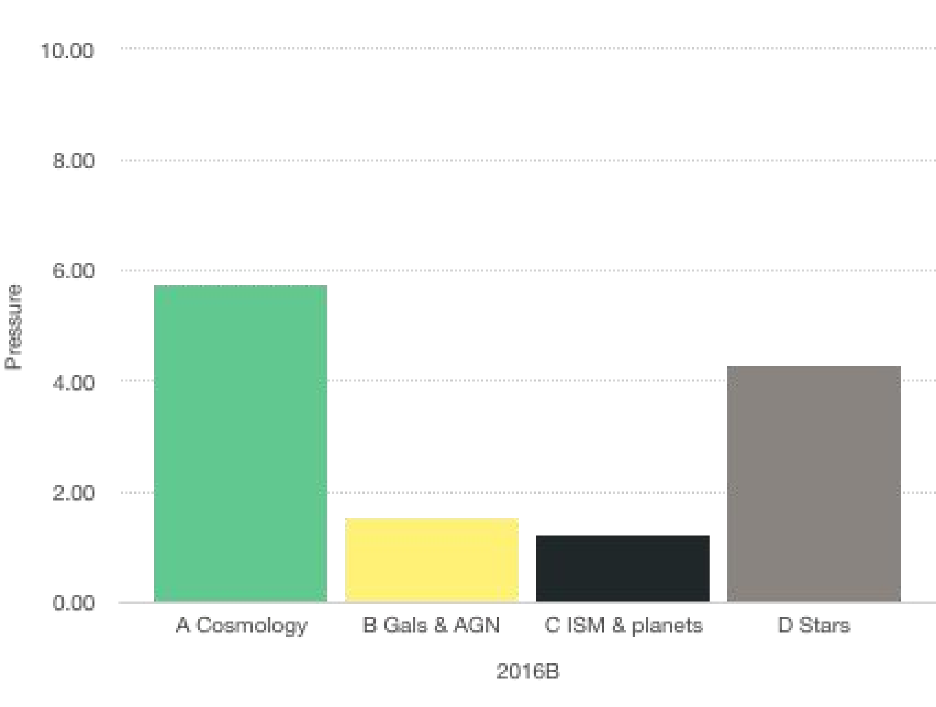
2016B



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Pressure

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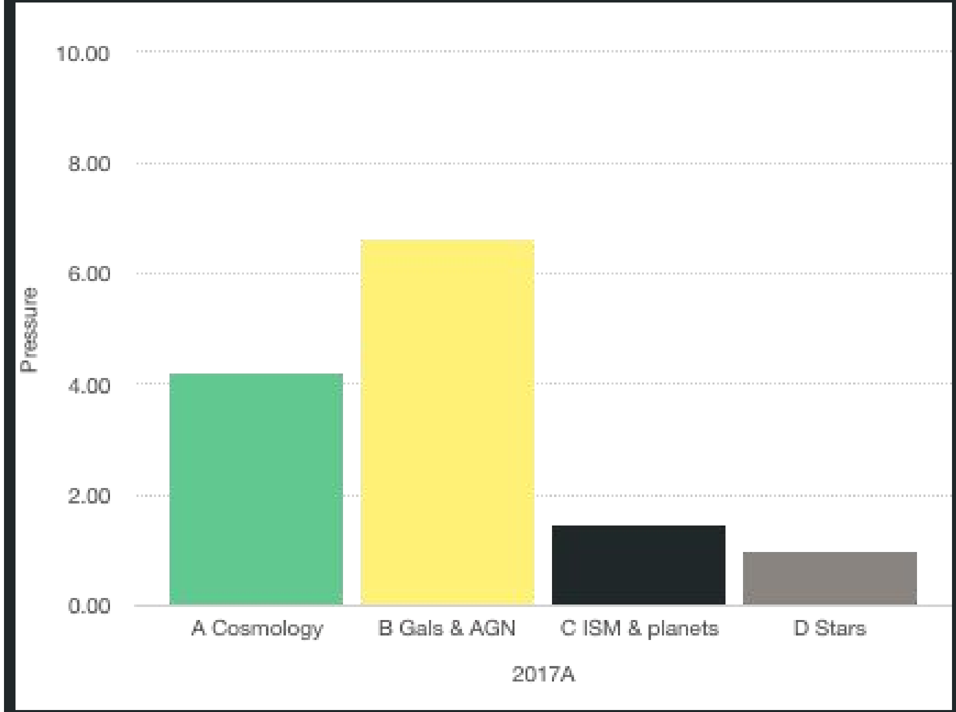
2017A

The requested time in categories A+B decreased since 2012, but the pressure is still high: is it due to low quality of proposed programmes?



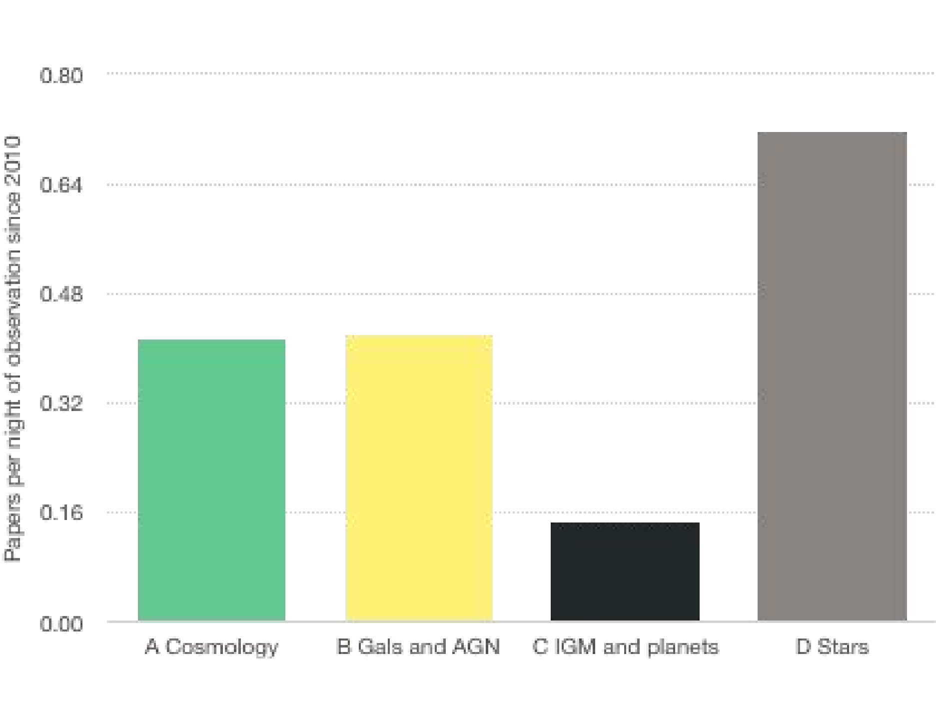
Data from Emilio Molinari

Productivity of TNG observing time

Productivity

The ratio between the number of papers in each category derived from http://www.tng.iac.es/publications/ and the allocated time [in nights, considered as 9h] considering the total between 2010 and 2016

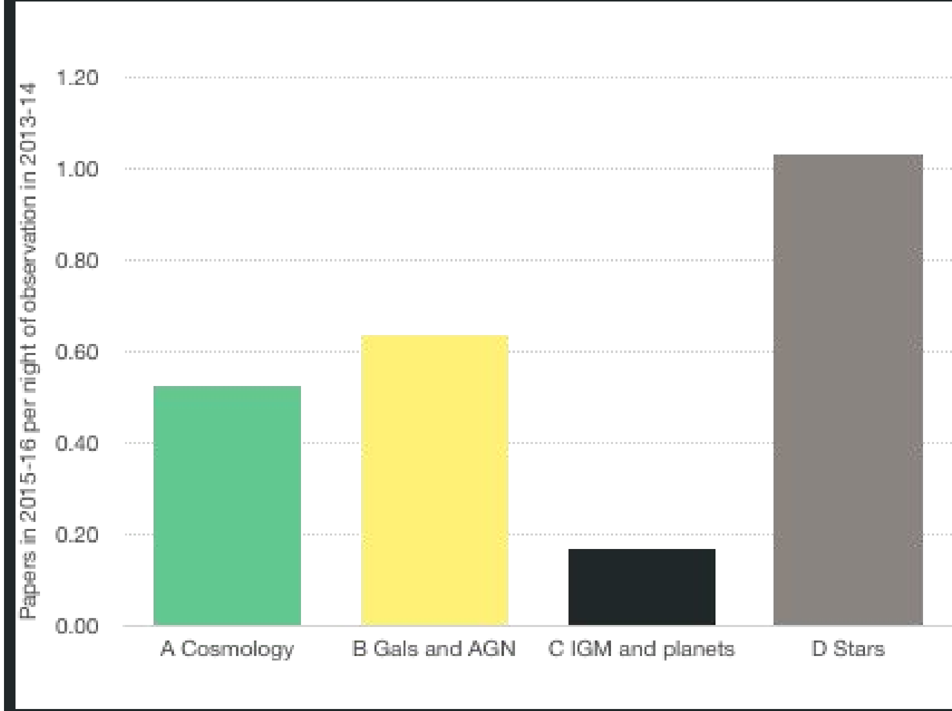
The productivity of programmes in categories A, B and D is significantly higher than the one in C



Total published papers/Total allocated time in period 2010-2016

Productivity

The ratio between the number of papers in each category derived from http://www.tng.iac.es/publications/ and the allocated time [in nights] considering papers published in 2015-16 and observations in 2013-14 (as Rafael Barrena presentation) The productivity of programmes in categories A, B and D is significantly higher than the one in C



Published papers in 2015-16/Allocated nights in 2013-14

The reasons of disaffection (and a possible solution)

In spite of:

- old instrumentation (not suitable for competitive projects)
- frustration because of high pressure and small amount of time available (that lead to the decrease of requests, but still with a good quality and productivity)
- HARPS-N is taking it all...

TNG can still attain high visibility and provide high legacy value in programmes of MA1 when used in conjunction to big projects, i.e. for follow-up observations, as demonstrated by the high productivity rate.

To this aim a reasonable amount of nights should be available in open time

To be considered renegotiating HARPS-N

HARPS-N at TNG in 2010: CS opinion in 2010

3. L'accordo per essere accettabile deve avere un alto profilo scientifico, e rappresentare per INAF una concreta opportunita' di diventare uno dei protagonisti mondiali nello studio dei pianeti extrasolari.

Did become INAF a protagonist?

Are HARPS-N results comparable to the ones obtained with HARPS-ESO?

HARPS-N at TNG in 2010: Science document

(Gratton et al. 2010)

The search for low mass planets is an optimal program for the first years of HARPS-N at TNG (2012-2014), completing the Kepler follow-up and other less demanding programs. A smaller amount of time (e.g. follow-up of multi-planet systems) can be devoted after 2015 when additional programs like GAIA and then PLATO follow-up will start.

Plato launch now foreseen for 2024

In this scenario ETSRC proposed that TNG should concentrate mainly on low-res optical-NIR spectroscopy and imaging. In the 2012-2015 period, TNG was suggested to operate Dolores+NICS, implementing some form of Rapid-Response mode, in addition to an improved-efficiency ToO mode. SARG also should continue to be offered along with Giano, the NIR (R~30000) spectrograph in construction at Arcetri. In the longer term (2015+) was proposed that the aging Dolores and NICS be replaced with a new instrument able to perform optical and NIR low-res spectroscopy in a single shot (a "Son-of-X-Shooter").

Ageing of DOLORES and NICS… Did we give up? What happened to SOXS?

its construction and operation. The simultaneous presence of Harps-N and Giano might configure TNG as almost entirely dedicated to high-resolution spectroscopy. In any case, the number of nights available for Dolores and NICS, currently the most productive TNG instruments, will be drastically reduced, leaving the Italian community orphan of the access to low/intermediate-resolution spectroscopy and imaging in the northern hemisphere (in perspective, only with the share of LBT). This clearly is a major drawback to the Harps-N affair.

Italian community left orphan of the access to productive instruments…

Realistic wishes from MA1

Optimising MA1 science return of TNG

We understand that we have to consider the total Roque offer (e.g. WEAVE on WHT), and also LBT, but NICS and DOLORES can still be used:

- Large programmes available in next periods open to all categories
- But still keeping space for small/medium projects
- Any investment on new instrumentation?

In any case we need a clear statement on the possibilities for next years, i.e. the number of nights in open time should be adequate and stable on a reasonable timescale to allow planning of projects.

Optimising MA1 science return (even without TNG)

Since TNG is, and probably will be (unless GTO time will drastically decrease), mostly dedicated to exoplanets projects, MA1 science needs a compensation!

Considering the cost per night of TNG = 7-8k€ and the number of nights devoted to HARPS-N observations (80 nights per year for GTO, 70-80 nights per year for GAPS), INAF investment on exoplanets has been (and will be, as Adriano Fontana already said):

150 nights x 7.5k€ = 1.1 M€/year

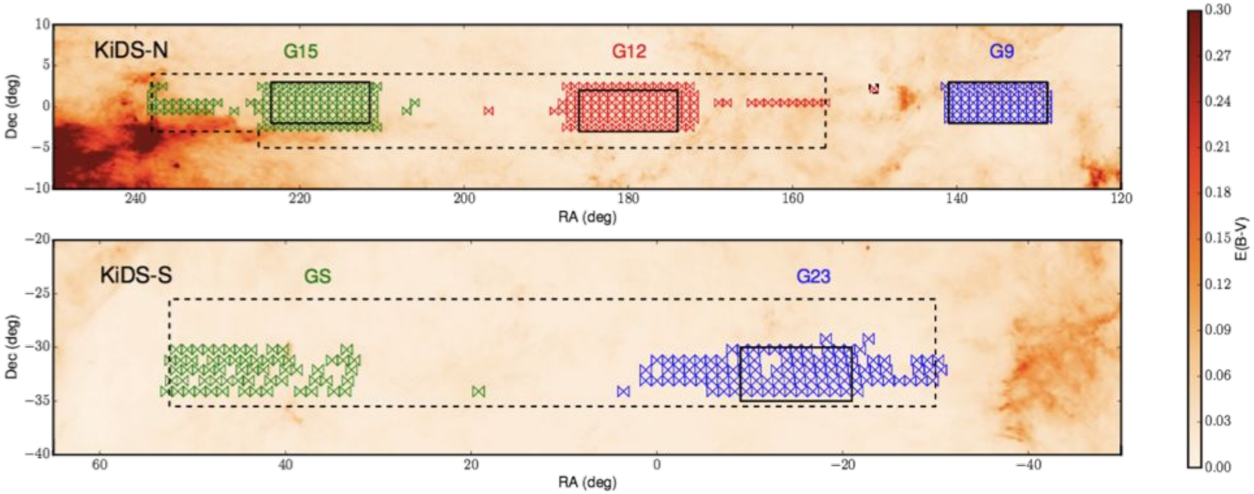
A fair compensation would be to allocate similar resources (e.g. by means of PRIN) for other science projects). In addition, other improvements for observations can be foreseen, e.g. finding an agreement to have time also on GTC.

Examples of possible MA1 large programmes

MA1 science with TNG - Galaxy evolution with KiDS

Nicola Napolitano: on-going (in 2016B period) project with DOLORES-MOS on massive ultra-compact galaxies in KiDS. The programme can be extended to 4-6 semesters to *spectroscopically confirm different subsamples*, for instance gravitational lenses candidates. Faint targets will be observed with Grantecan.

KIDS survey progress
KIDS-450 released Nov 17
KiDS-900 expected Nov18



MA1 science with TNG - Galaxy evolution with KiDS

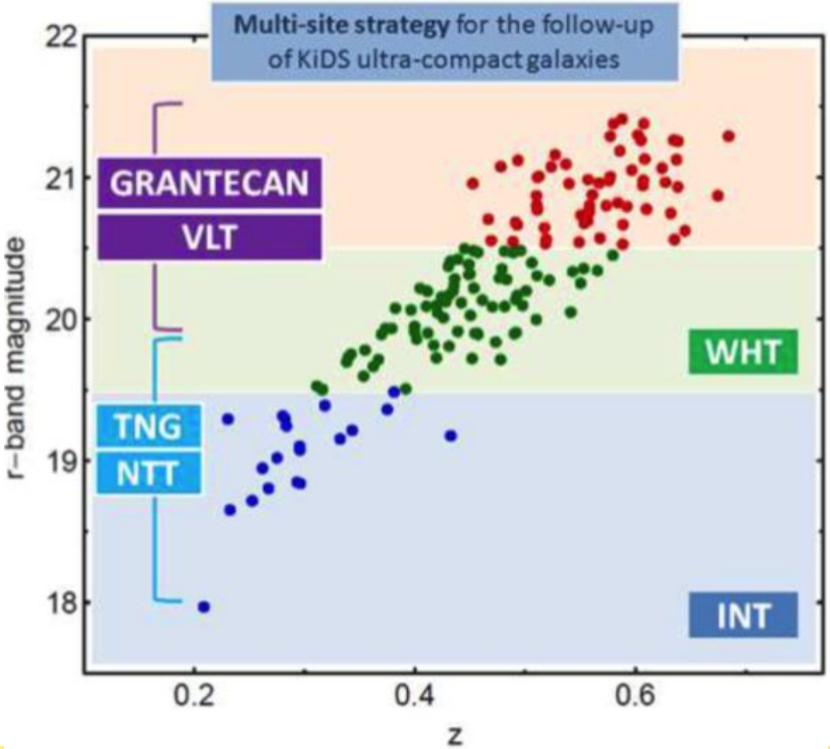
Ultra-Compact Massive Galaxies (UCMG)

$$R_e < 1.5\,\mathrm{kpc}$$

$$M_\star > 8 \times 10^{10}\, M_\odot$$

Relics of high-z red nuggets?

- role of environment
- test-bench of galaxy formation theories
- DM and IMF in these rare systems



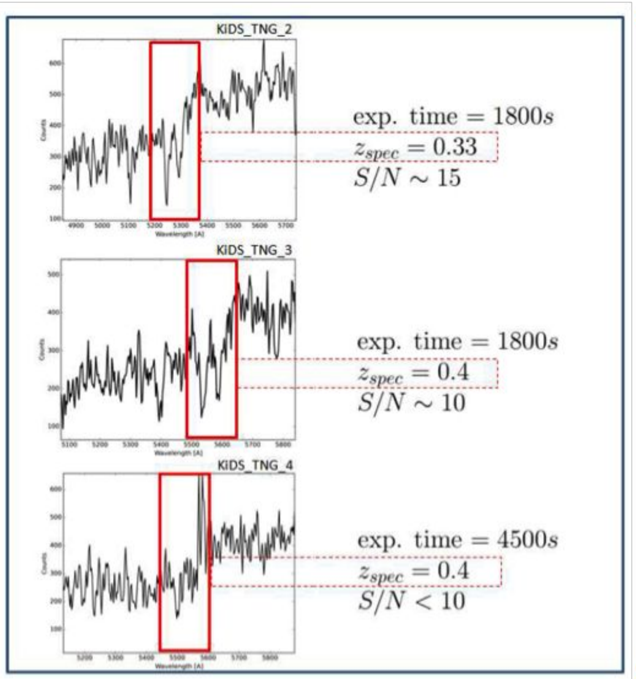
Multi-site/facility strategy

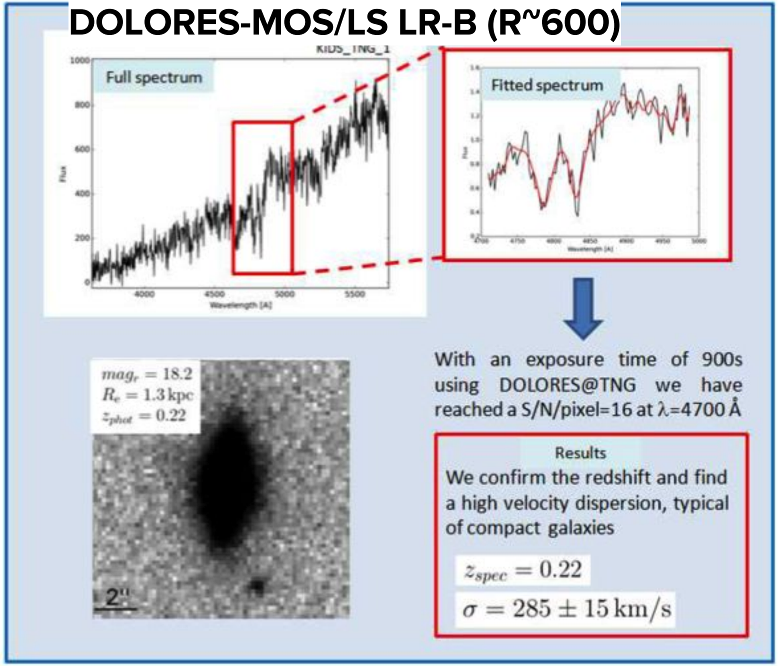
TNG 2015B OBSERVED
(2 nights, 20 candidates)

TNG 2016B
(3 nights, 30 candidates)
NTT 2016B GRANTED
(3 nights, 25 candidates)
GTC 2016B
(28 hours, 25 candidates)
INT 2017°
(6 nights, 25 candidates)

MA1 science with TNG - Galaxy evolution with KiDS

Ultra-Compact Massive Galaxies (UCMG)





Multi-site/facility strategy

TNG 2015B
(2 nights, 20 candidates)

16 observed/12 confirmed
>80% successful rate

100h in AOT36/39 for
60 confirmed UCMG
~200 from all facilities

MA1 science with TNG - Galaxy evolution with KiDS

Strong lensing follow-up

VIMOS-IFU@VLT pilot

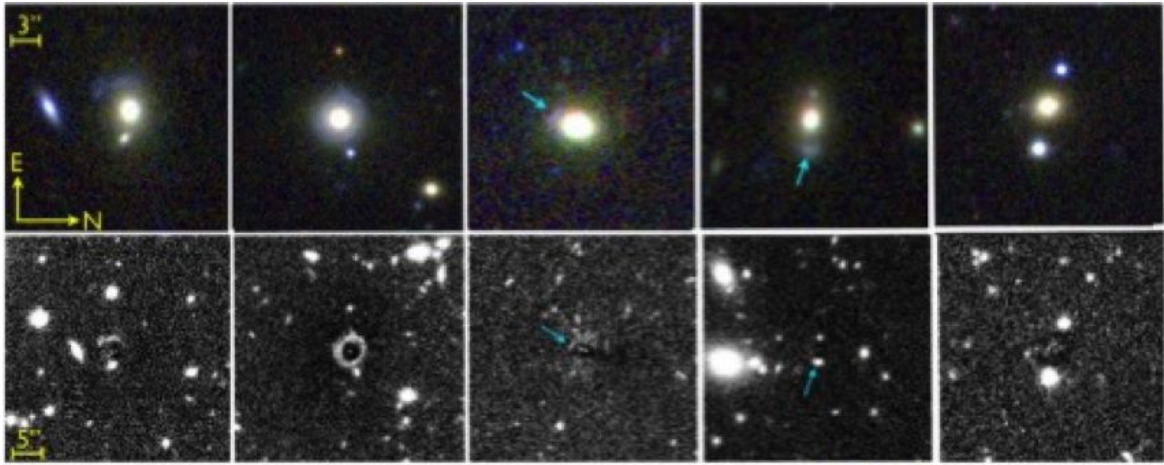
(11h 11 candidates – incl. overheads)

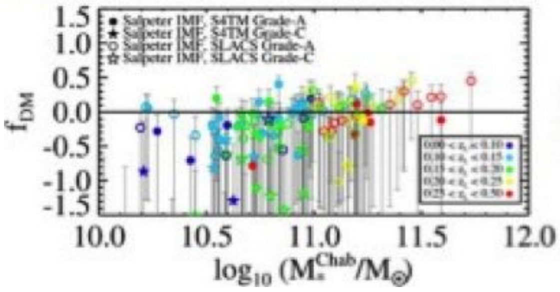
- medium resolution (R=720)
- 0.67” fibre
- wavelength range: 490 to 1015nm

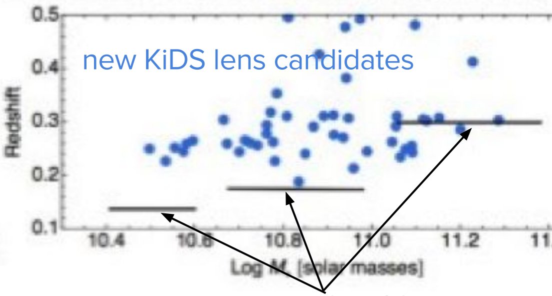
Feasibility and optimization of future programs (TNG, WHT, NTT, VLT)

TNG needs ~2x VIMOS on target exptime: **up to 150h (AOT36-39)** for 75 candidates

50 new lenses from TNG only



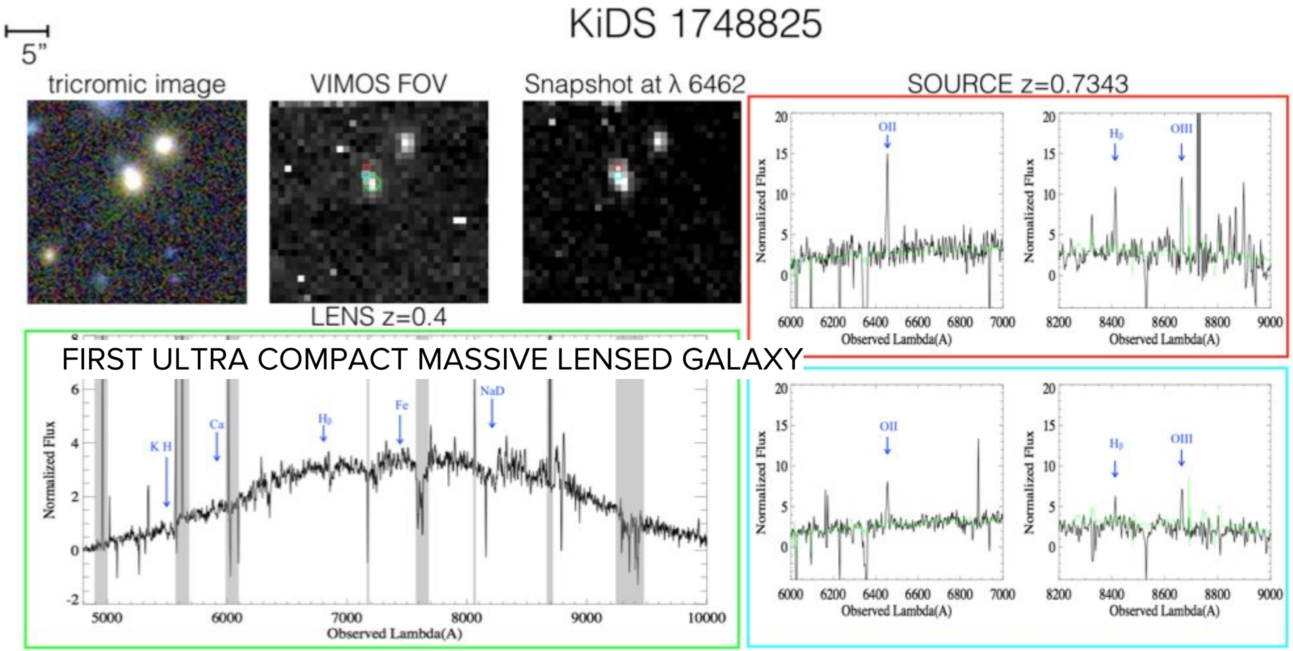


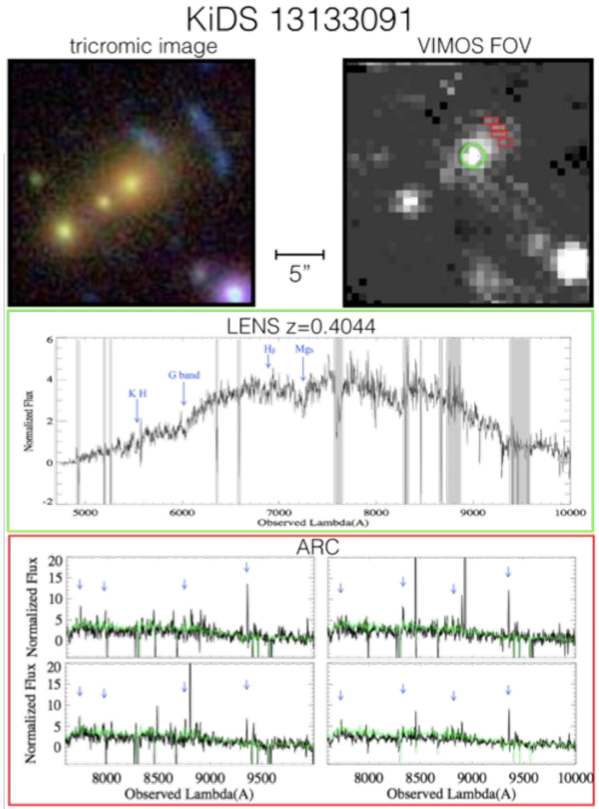


MA1 science with TNG - Galaxy evolution with KiDS

Strong lensing follow-up (first results)

VIMOS-IFU@VLT pilot





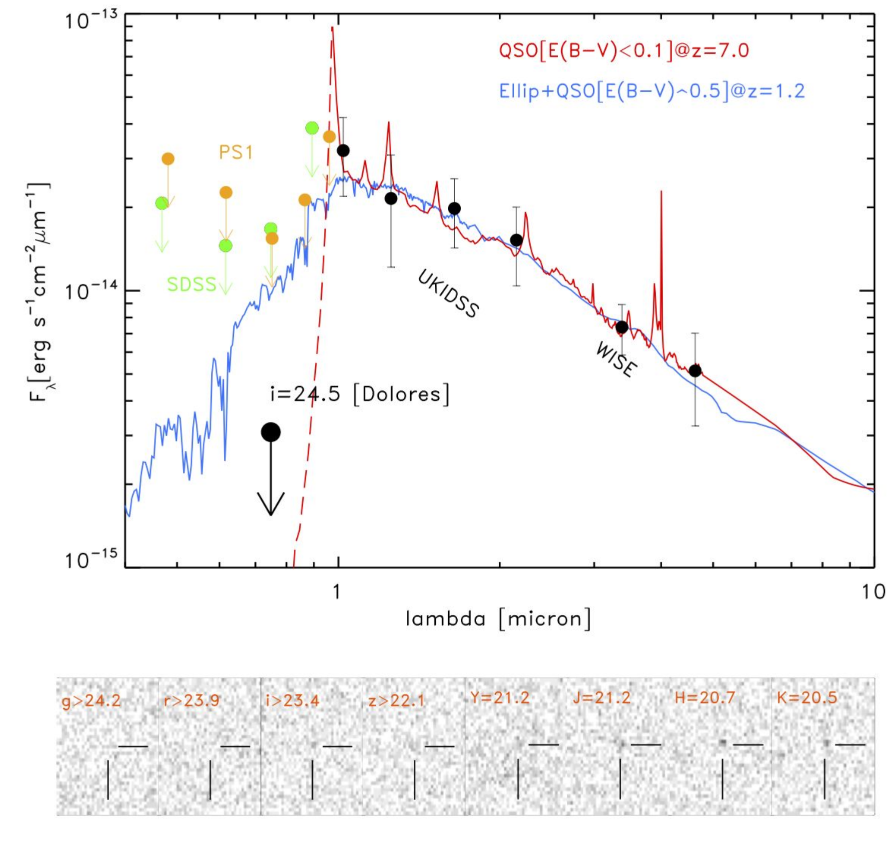
MA1 science with TNG: looking for high-z QSOs

Alberto Moretti: *Looking for quasars in the first Gyr after the Big Bang*

The aim is to select high-z quasars candidates from large photometric surveys (e.g. UKIDSS-WISE). The available photometry doesn't allow to discriminate between galaxies at z≈1.5 and QSOs at z≈7. Deep I-band photometry (30 minutes to I≈24.5) is efficiently used to reject contaminant objects at lower redshifts: if DOLORES data don't reveal any counterpart, the object can be considered as reliable high-z candidate.

21.5h DOLORES allocated in period 2016B

Large programme: expanding search area + spectro confirmation with 8m class telescope



Radio source (from FIRST) with IR from LAS-UKIDSS but no counterpart in SDSS neither in PanStarrs1

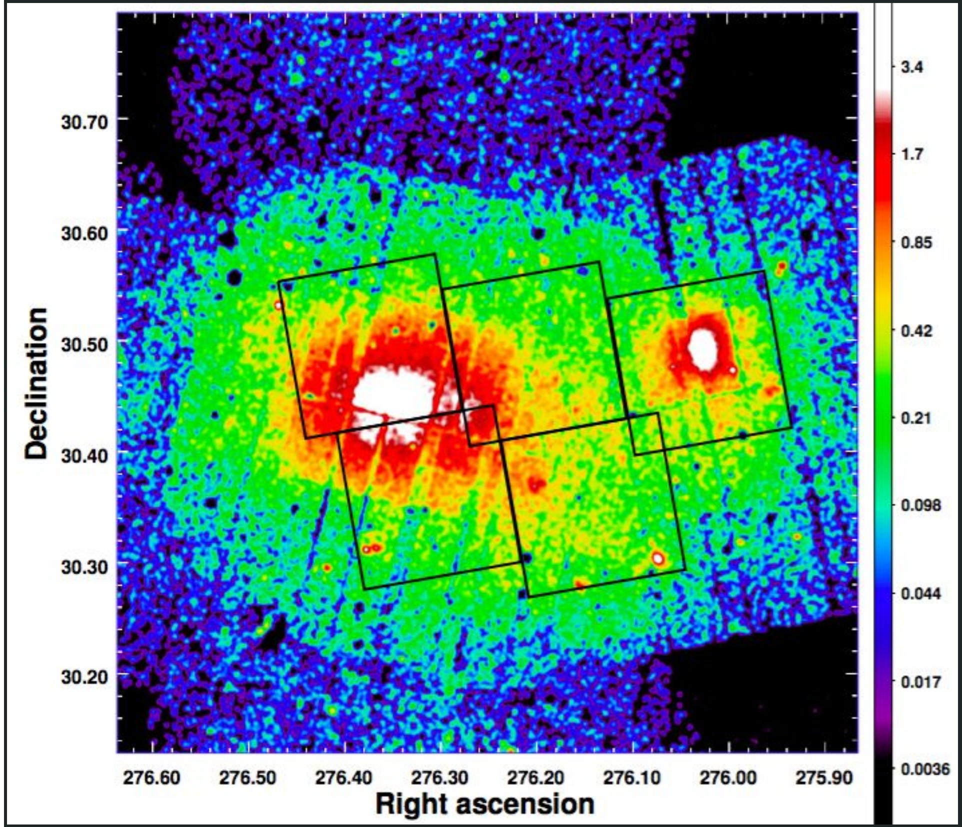
MA1 science with TNG: the accretion of clusters

M. Longhetti & S. De Grandi: *The Galaxy Cluster RXC J1825.3+3026: a case study for the accretion mechanisms of the cosmic structures*

BVri photometry of an X-ray (ROSAT) discovered galaxy cluster (also detected as SZ source with Planck, but missing any optical information) at z=0.065 showing signatures of pre- and post-merger phase. The aim is to identify cluster members computing zphot, derive 2D distribution to be compared with X-ray substructures.

20h in 2017A with DOLORES

Large programme: Other clusters in different evolutionary phases, spectro follow-up of the selected members to study their physical properties as a function of environment



X-ray mosaic image of the RXC J1825 cluster

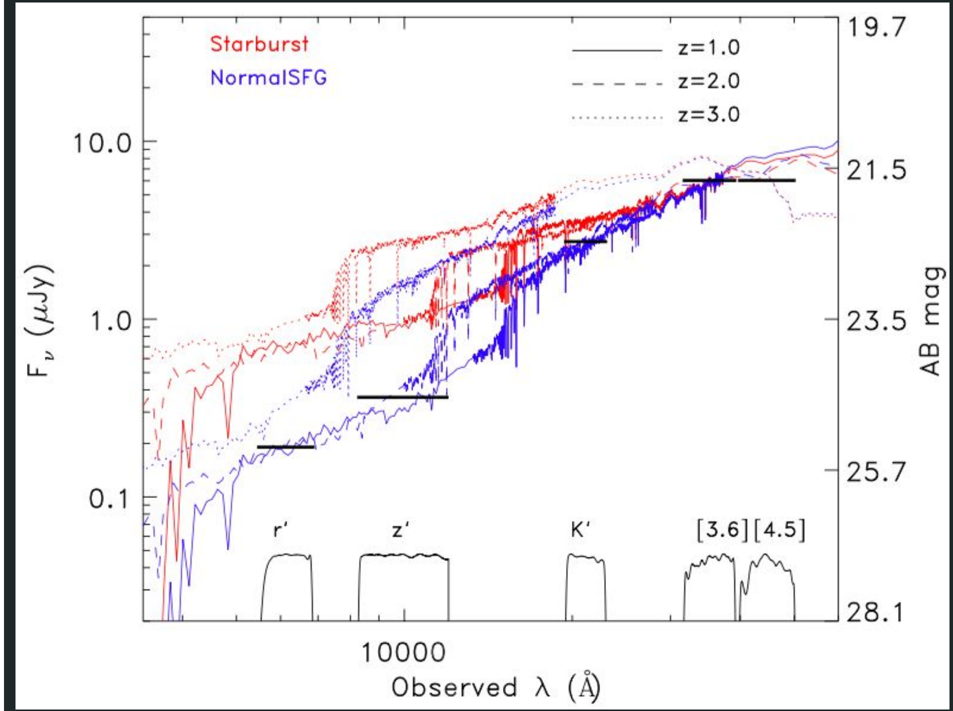
MA1 science with TNG: Planck proto-clusters

Mari Polletta: *Galaxy physical properties in high-z (2< z < 4) nascent clusters revealed by Planck*

Proto-clusters at 2<z<4 are selected as red sub-mm sources from Planck all-sky observations. Optical and NIR photometry is used together with the already available IR data from Herschel/SPIRE and Spitzer/IRAC to identify galaxy members of proto-clusters and derive their photometric redshifts. Their physical properties are then compared to those of field galaxies at the same redshifts to study the environmental effects at these early epochs of structures formation.

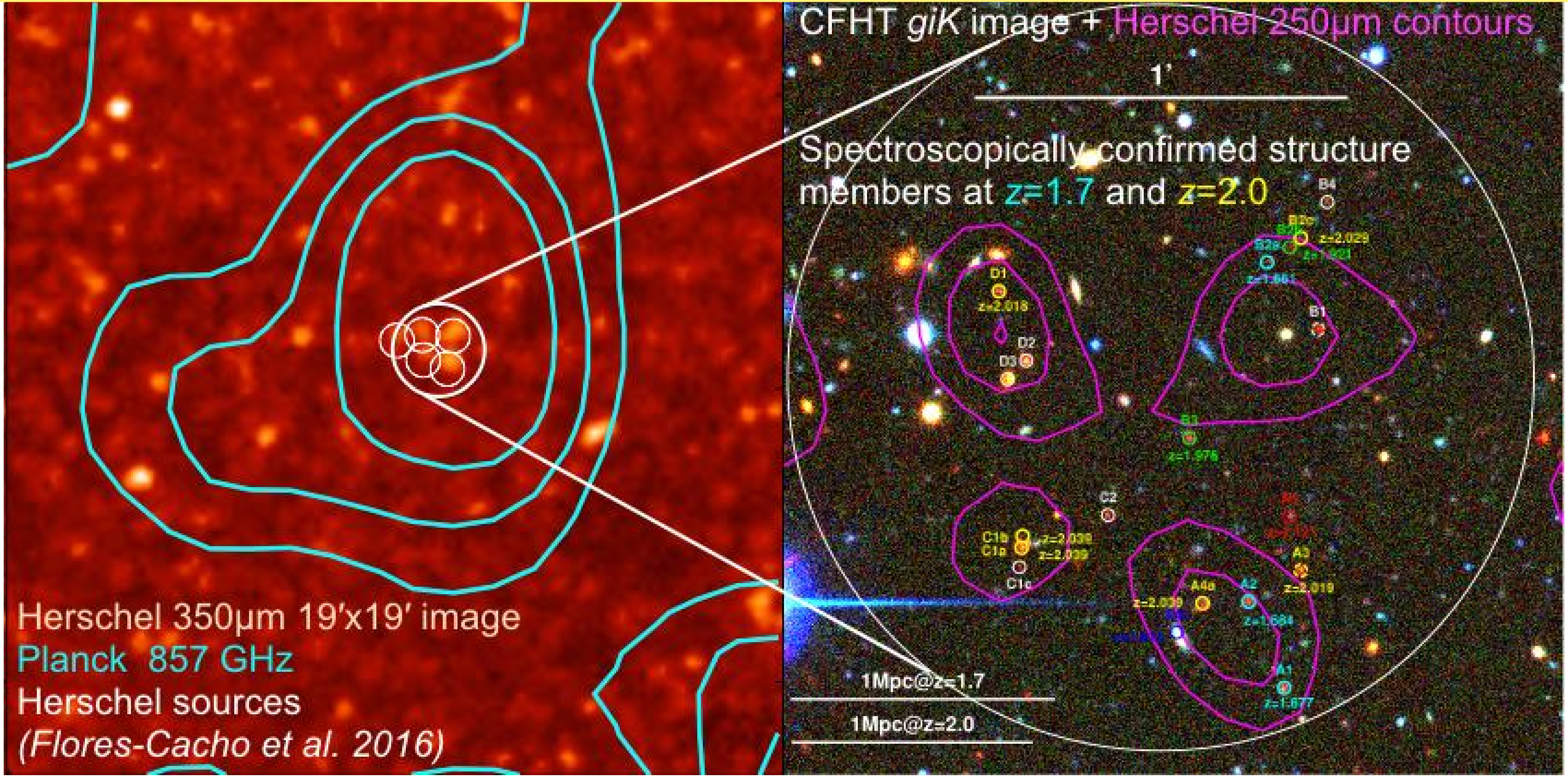
27h DOLORES+NICS allocated in period 2017A

Large programme: increase number of targets and wavelength coverage + LBT spectro follow-up



Expected magnitudes at z=3 in r', z' and K' for IRAC sources with mag(AB)=22

MA1 science with TNG: Planck proto-clusters



MA1 is ready!