THE SCHMIDT AT CALAR ALTO

Gilles BERGOND, support astronomer

Calar Alto Observatory (www.caha.es)

Northern skies cosmic flows, Marseille 2018

Outline

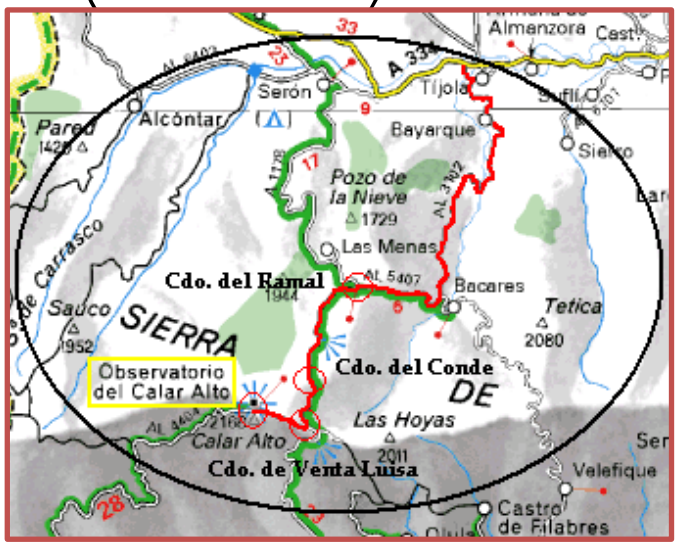
1. Calar Alto
   a. Main telescopes
   b. Seeing, extinction, h
   c. Past/current surveys

2. The Schmidt
   a. Features
   b. Recent use
   c. Virtual tour

3. MOS survey
   a. Footprint
   b. Duration
   c. Calar Alto future

1. The Calar Alto Observatory

Late 60's: German astronomers searched for best site around, Calar Alto (2168 m) chosen.



Agreement Germany / Spain signed in 1973

Centro Astronómico Hispano-Alemán ***(CAHA)***

Head MPIA Heidelberg

MAX-PLANCK-GESELLSCHAFT

+ ≥2004 at 50%

IAA Granada

CSIC

New partner(s) from 2019 on

The German will leave as expected in late 2018.
CSIC shall remain at 50%, but needs co-funding:
Junta de Andalucía is the natural new co-partner.

Soon *Centro Astronómico Hispánico en Andalucía*
(and domain name unchanged: www.caha.es)

New partner(s) from 2019 on

JUNTA DE ANDALUCIA

The German will leave as expected in late 2018.
CSIC shall remain at 50%, but needs co-funding:
Junta de Andalucía is the natural new co-partner.

Soon *Centro Astronómico Hispánico en Andalucía*
(and domain name unchanged: www.caha.es)

Universites: training, academies in and beyond

Third party partners (and funds…) welcome!

TBD later on (end of the talk and of the workshop)

1.a. The main telescopes at CAHA

1975: 1.2 m first light (largest  teles)

1977: *Spanish 1.5 m (REOSC; abandoned)*

1979: 2.2 m (twin ESO)

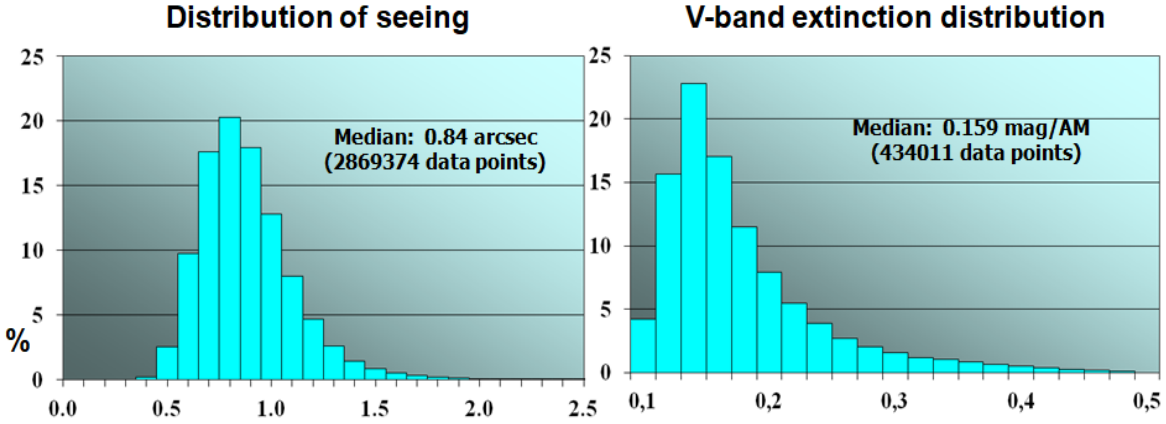
1980: 0.8–1.2 m Schmidt

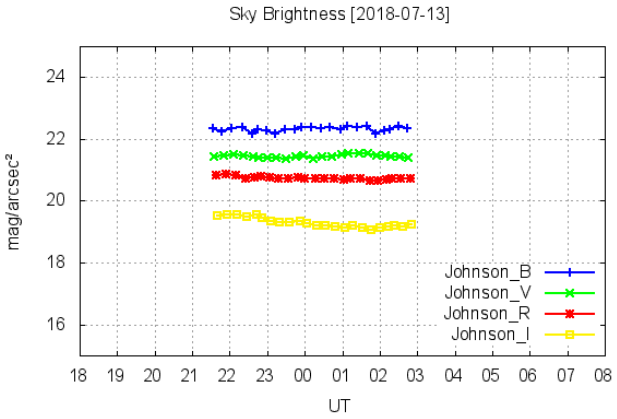
1984: 3.5 m (still largest within EU!)

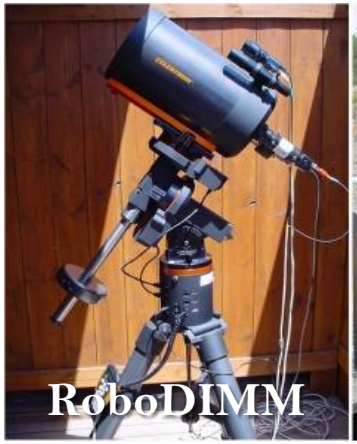
1.b. Sky quality monitoring

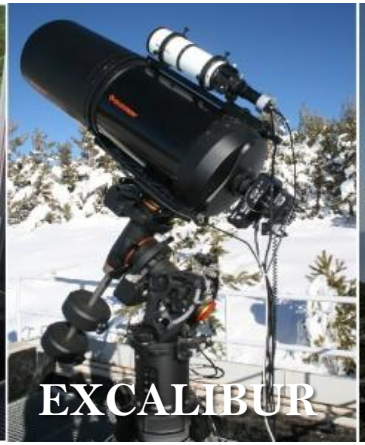
Weather Station

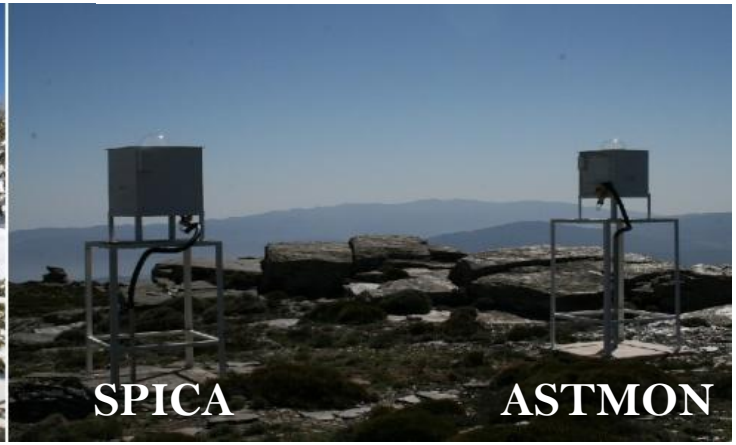
2005-2017: seeing, extinction and SB_V~21.5 mag/□″







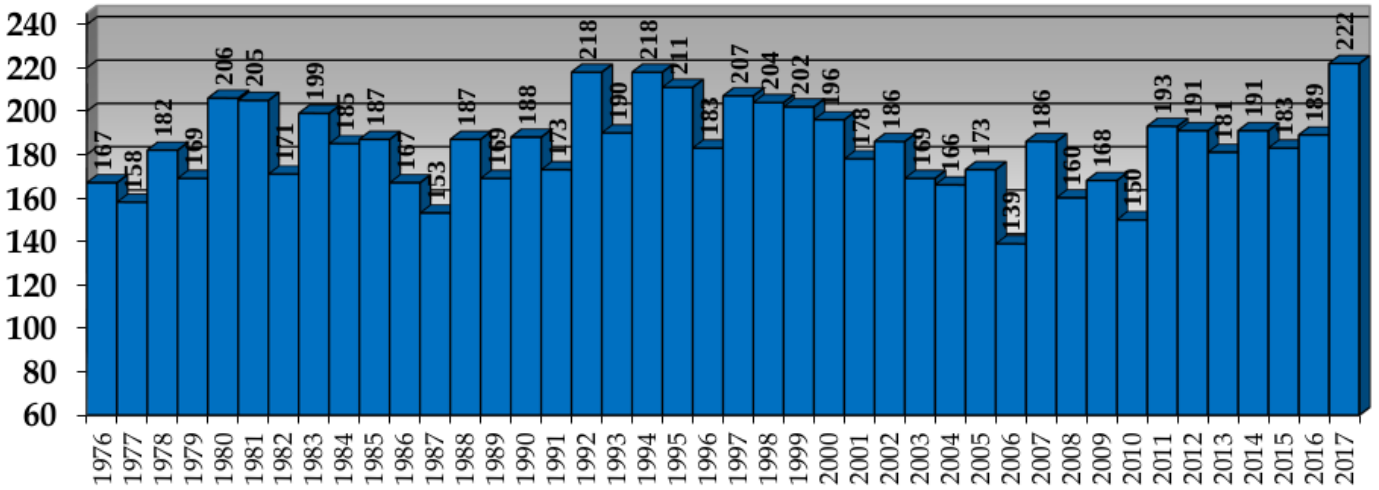




Observation statistics for 40+ years

Clear>6 hours:

184±19 nights



Useful hours:

1973±241 h

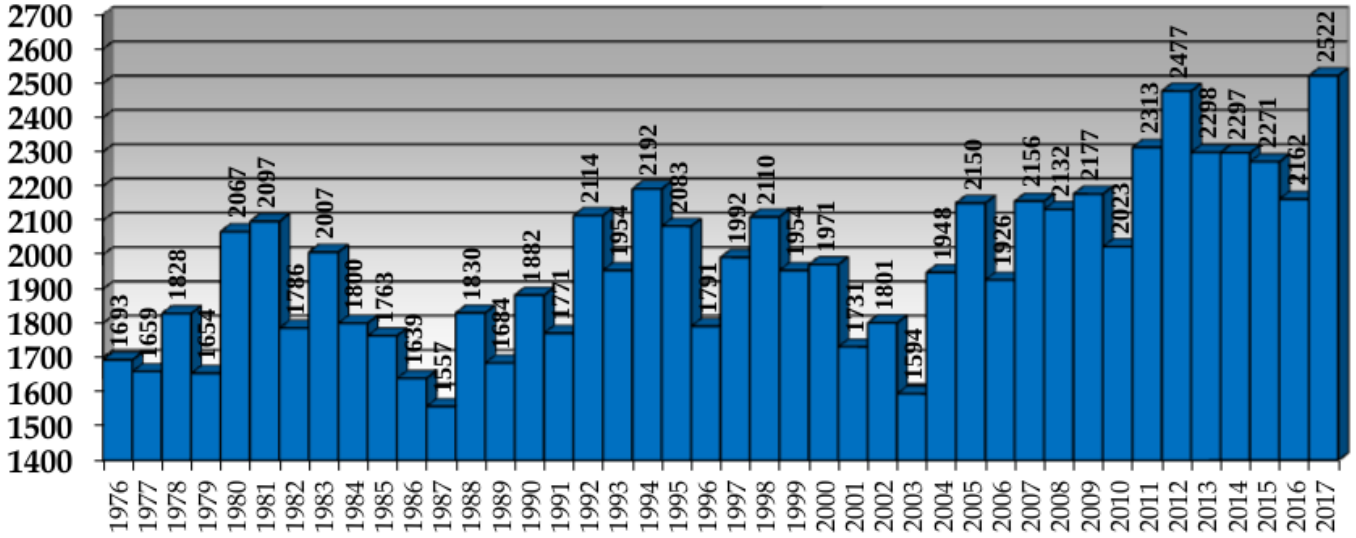
(out of 3570)

or

2295±159 h

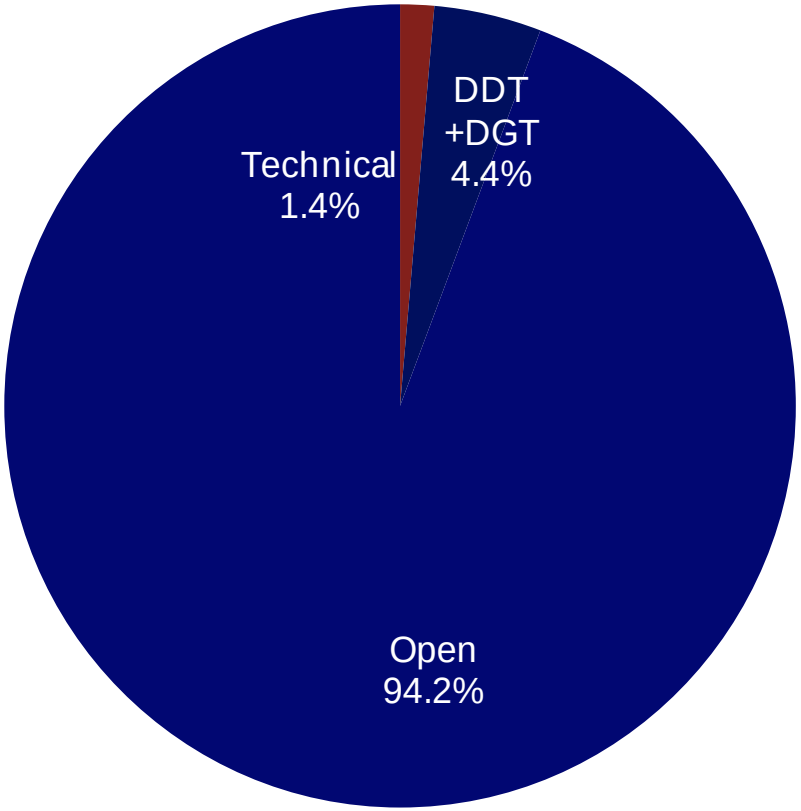
from 2010 on

(+one month)



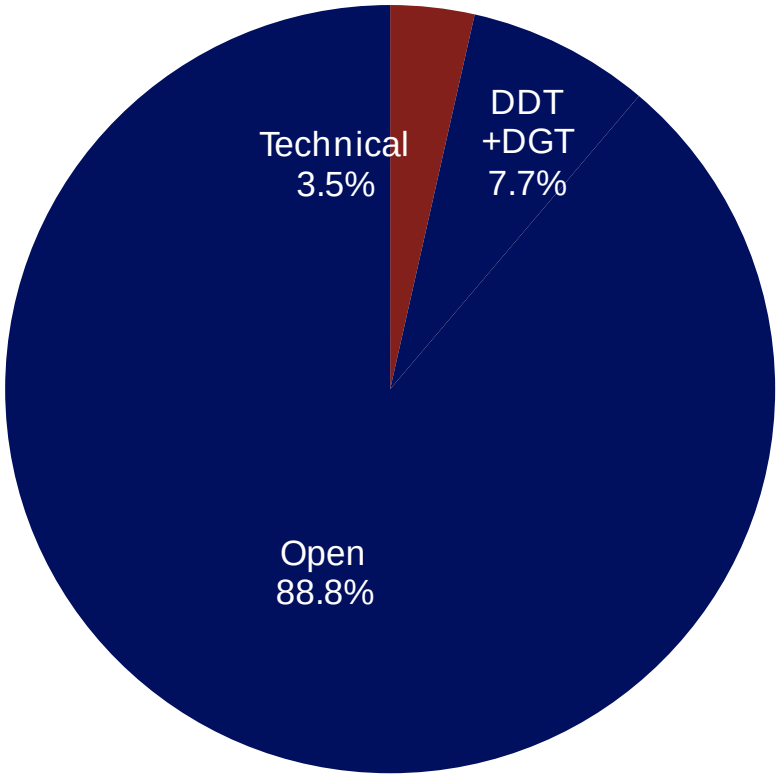
Technical time loss: 1.4–3.5% in 2017

2.2 m



Science: 98.6%

3.5 m



Science: 96.5%

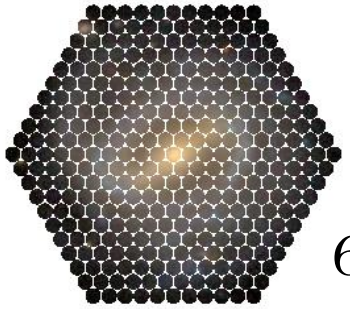
1.c. Science programs at Calar Alto

TAC for open time/EC for large programs (surveys)

3.5: Laica/Ω2000

ALHAMBRA SURVEY

7 years



PMAS

1' IFU

600 gal

CALIFA Survey 6 yrs

carmenes

2.2: CAFOS

Black hole Host Lifecycle Evolution

BHOLE

AGN reverberation mapping survey with the Calar Alto 2.2-m telescope

Since 2017

~40 AGNs

Infraestructuras Científicas y Técnicas Singulares

>20% left for open programs + DDTs – likely more in 2019! + OPTICON and pay-per-night

2. Großer Hamburger Schmidtspiegel at Calar Alto

- **First large Schmidt** (ZEISS Jena 1937–WWII–built 1951): 0.8-m UBK7 plate, 1.2-m ZK7 mirror
- **1954**: installed at Hamburg observ.
- **1976**: moved to Calar Alto (MPIA)
- **1980-2000**: operational at CAHA with a Grubb Parsons fork mount
- **2015**: refurbished for CCD, remote observations

Bernhard Schmidt

Astro-Optiker

Bergedorf, Gojenbergsweg 108

Herstellung von größeren Spiegeln und Objektiven in erstklassiger Ausführung

Nachkorrektur vorhandener Optik

Spezialausführung: Komafreie Spiegelteleskope mit großem, vollkommen scharfen Bildfeld

Komafreies Spiegelteleskop 1 : 1,75
der
Hamburger Sternwarte in Bergedorf

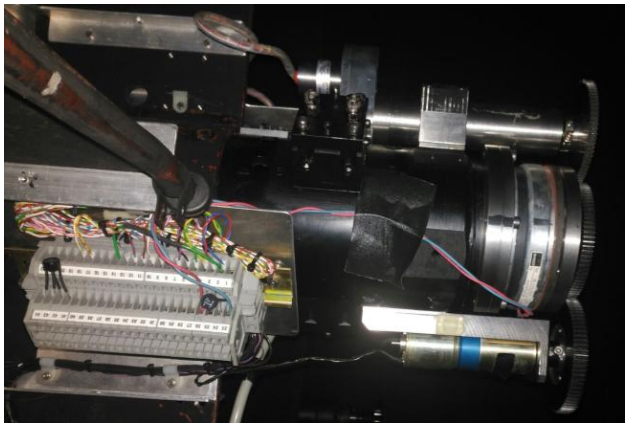
Öffnung 50 cm Brennweite 62,5 cm

Vollkommen scharfes Bildfeld von 15° Durchmesser

Preis einschließlich quadratischer Kamera, Fokussierungseinrichtung und Kassette (ohne Leitrohr und Montierung) 5500 RM.

2.a. The CA Schmidt main features

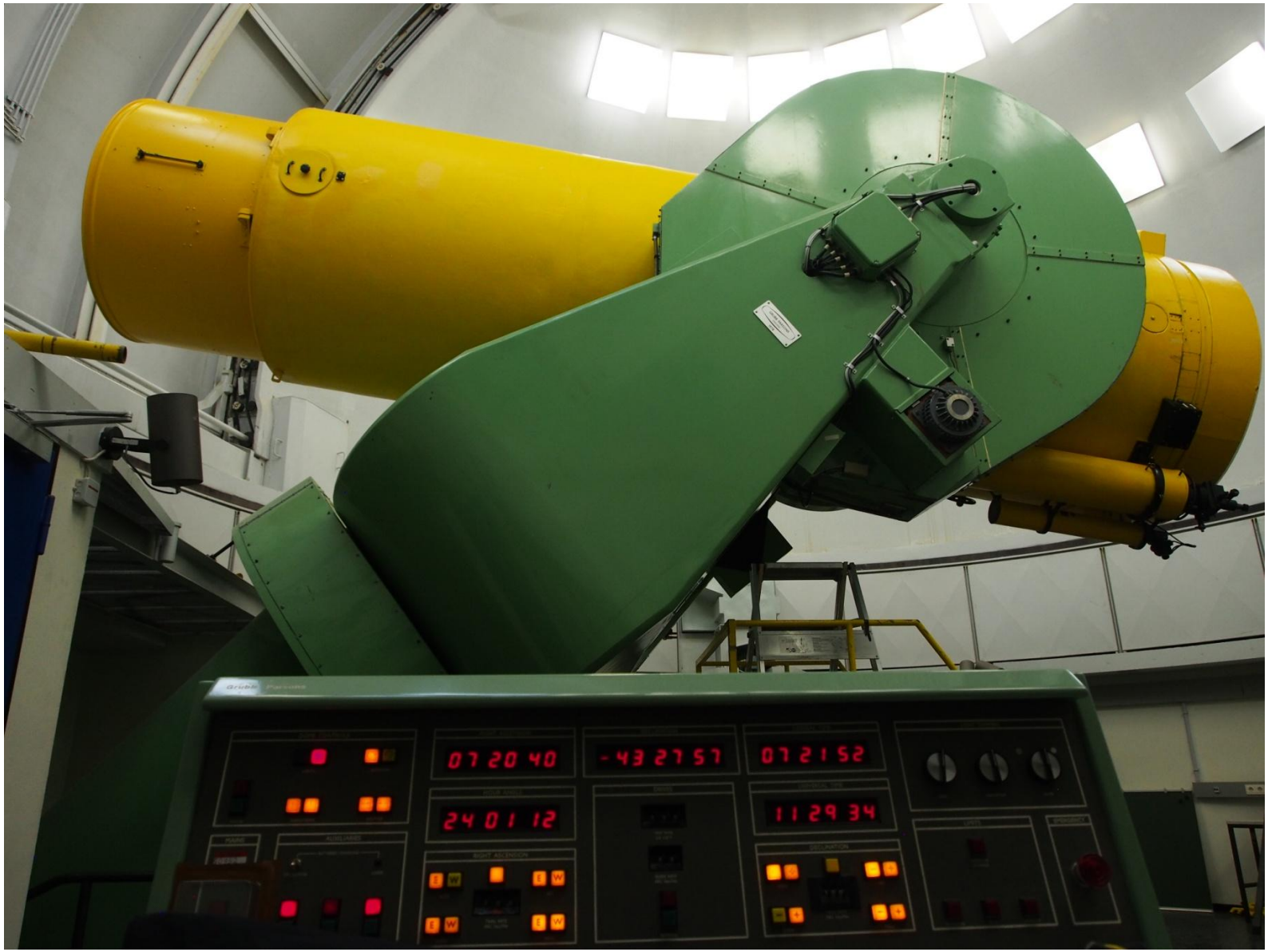
- 24×24 cm plates = 30□°, bended at R = 240 cm
  Circular plug/robotic plates up to Ø34 cm = 8°?
- 86"/mm or 6" for 70 μm fibres; AG+astrometry SDSS/2MASS + future CANIS@2.2 far North?



Refurbished w/:

- New δ motor
- Critical focus (f/3): focus motor being upgraded
- Renovated TCS: new hardware (two automates), software (Python scripting) and GUI (ScadaBR)

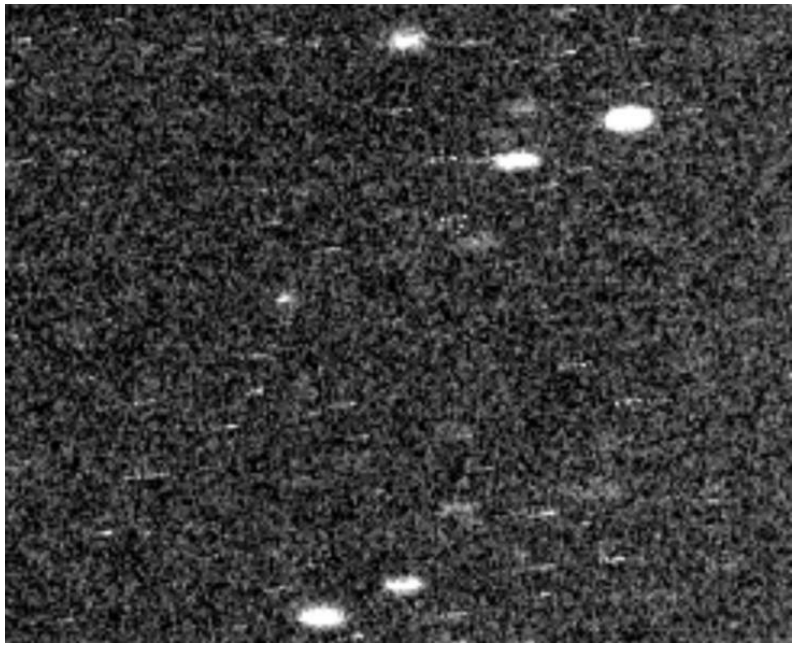
2.b. Recent use: a rejuvenated Schmidt



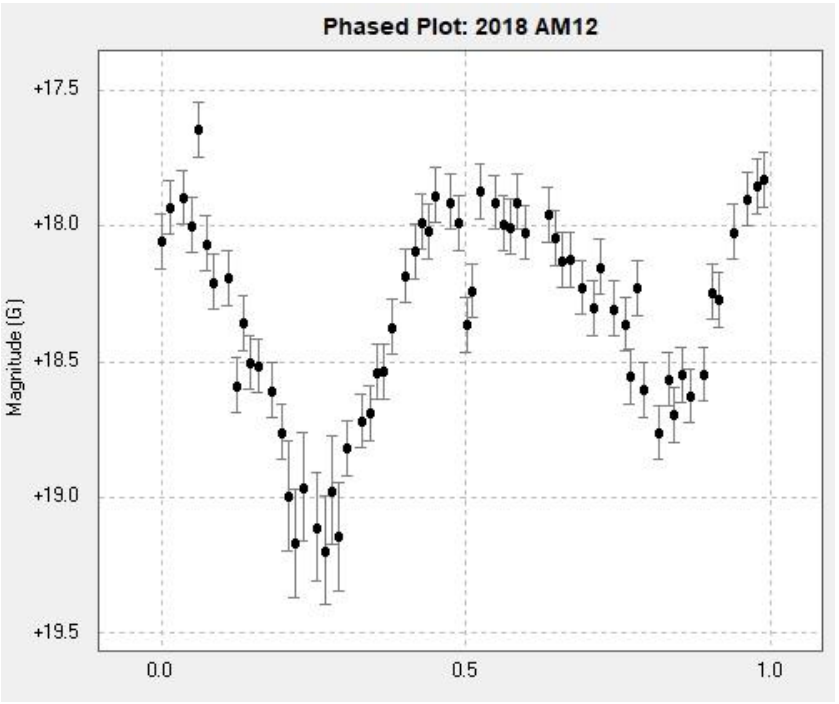
2016 – 2018: ESA at Schmidt

Operated remotely by ESA within the SSA program

- Recover potentially hazardous asteroids & comets
- 123 IAU-MPC circulars about NEOs in 17 months



P/2011 CR42 Catalina (Schwab et al. 2018)



Next? New CCD on T80

- Good feedback from ESA but contract in standby; current SBIG CCD obsolete
- ESA plans to use a commercial 4 K CCD, on the Schmidt *or on another 80 cm* to be installed soon.

Next? New CCD on T80

- Good feedback from ESA but contract in standby; current SBIG CCD obsolete
- ESA plans to use a commercial 4 K CCD, on the Schmidt *or on another 80 cm* to be installed soon.

Schmidt "rental" conditions should remain as it:

- Technical help but **NO setup-observing support**
- 60 k€/year for a remote use
- Full Moon±3 nights reserved at CAHA discretion

All TBC by CAHA director in future MoUs.

2.c. Virtual tour of the Schmidt

Access to telescope plate holder…

Space OK? for robotic positioner…

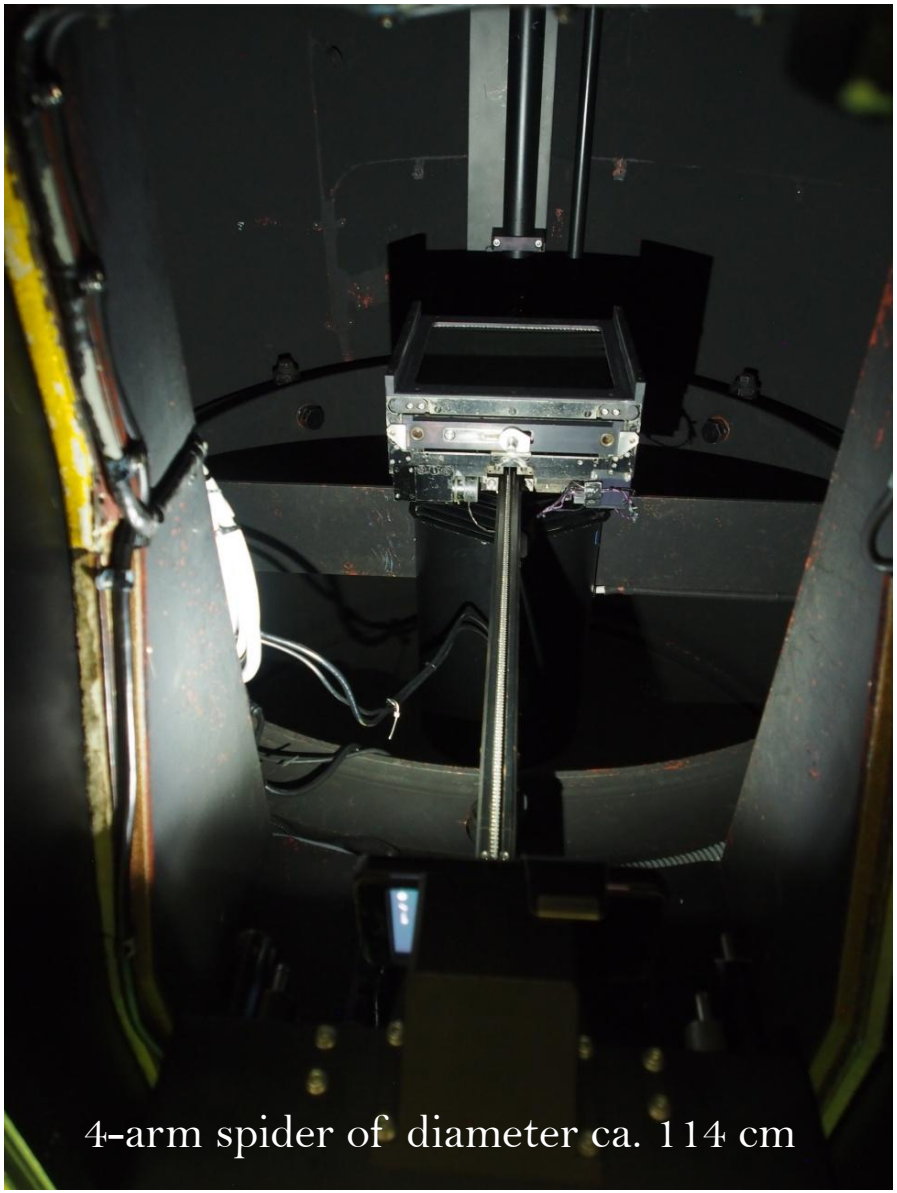
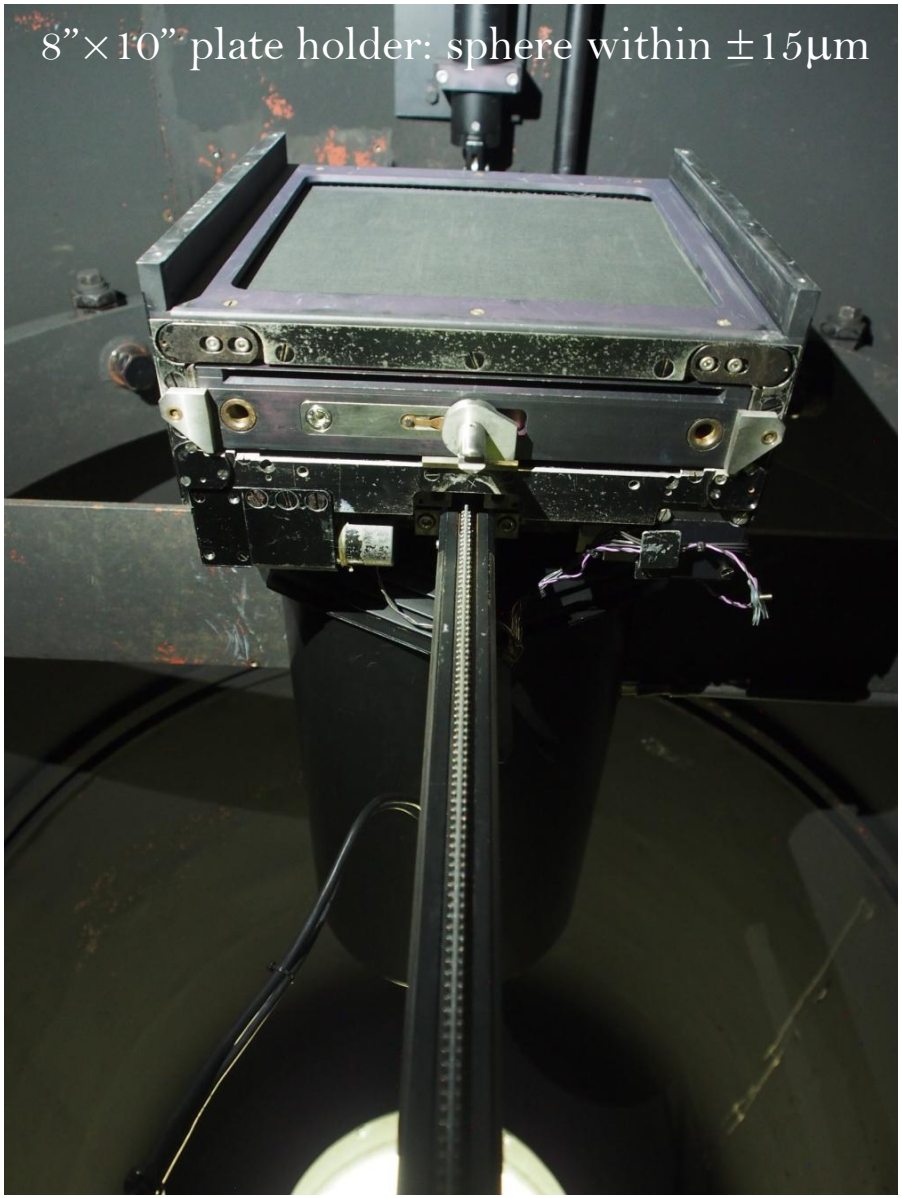
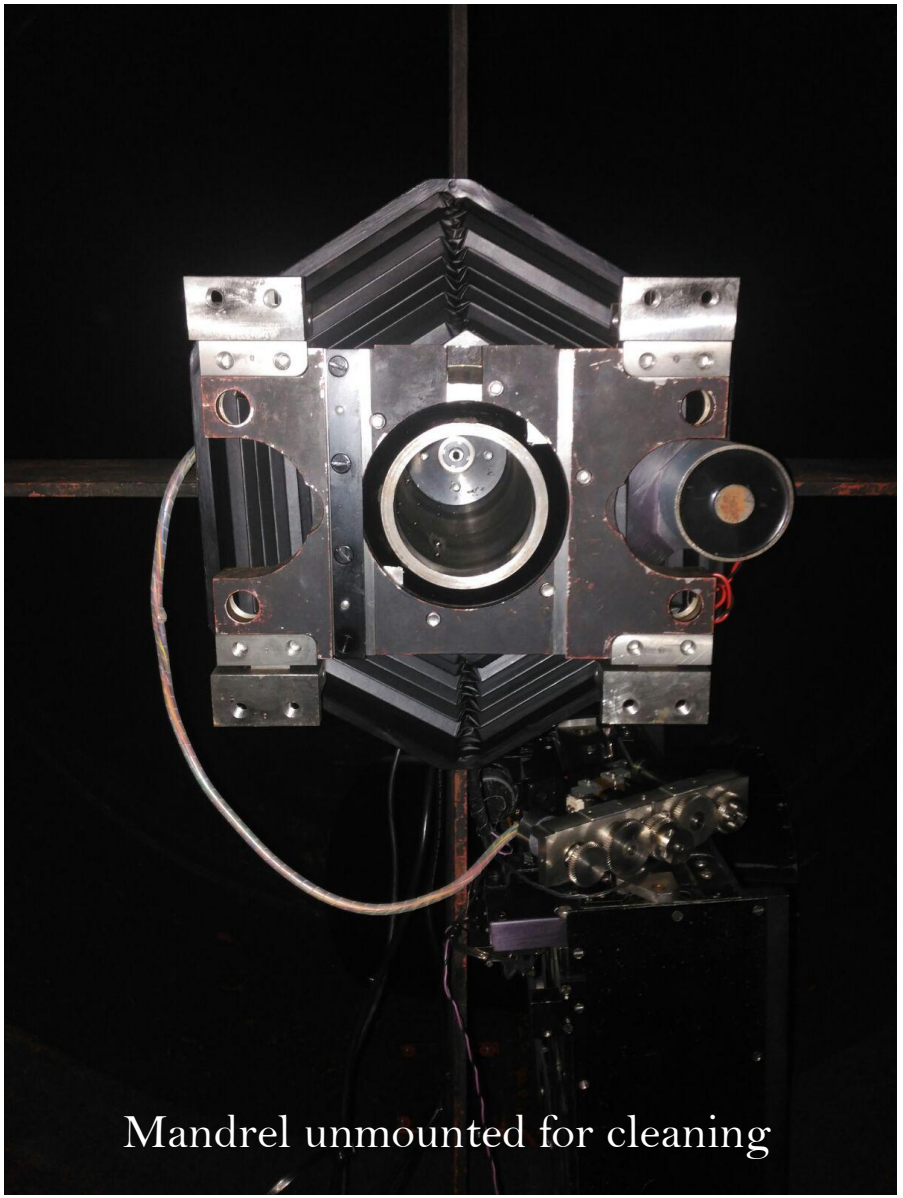


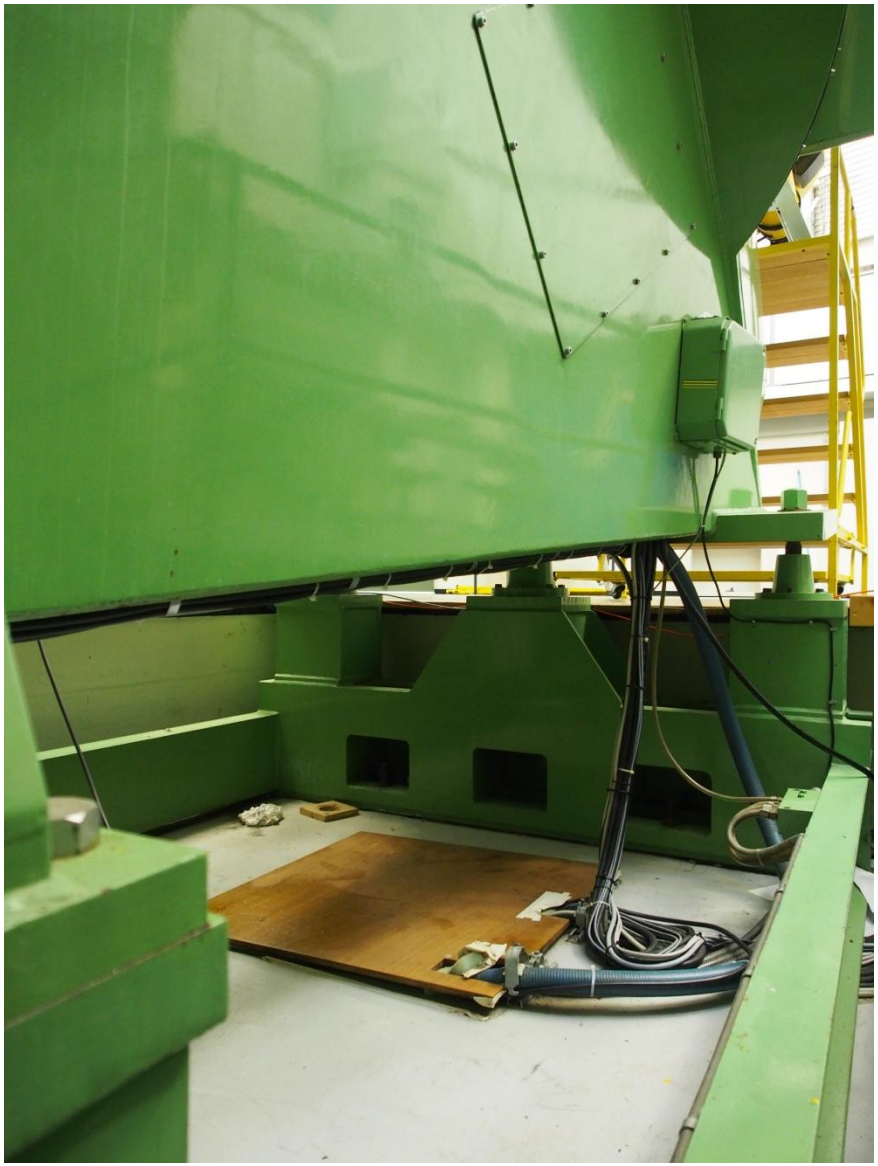
Plate holder/mandrel unmounted…



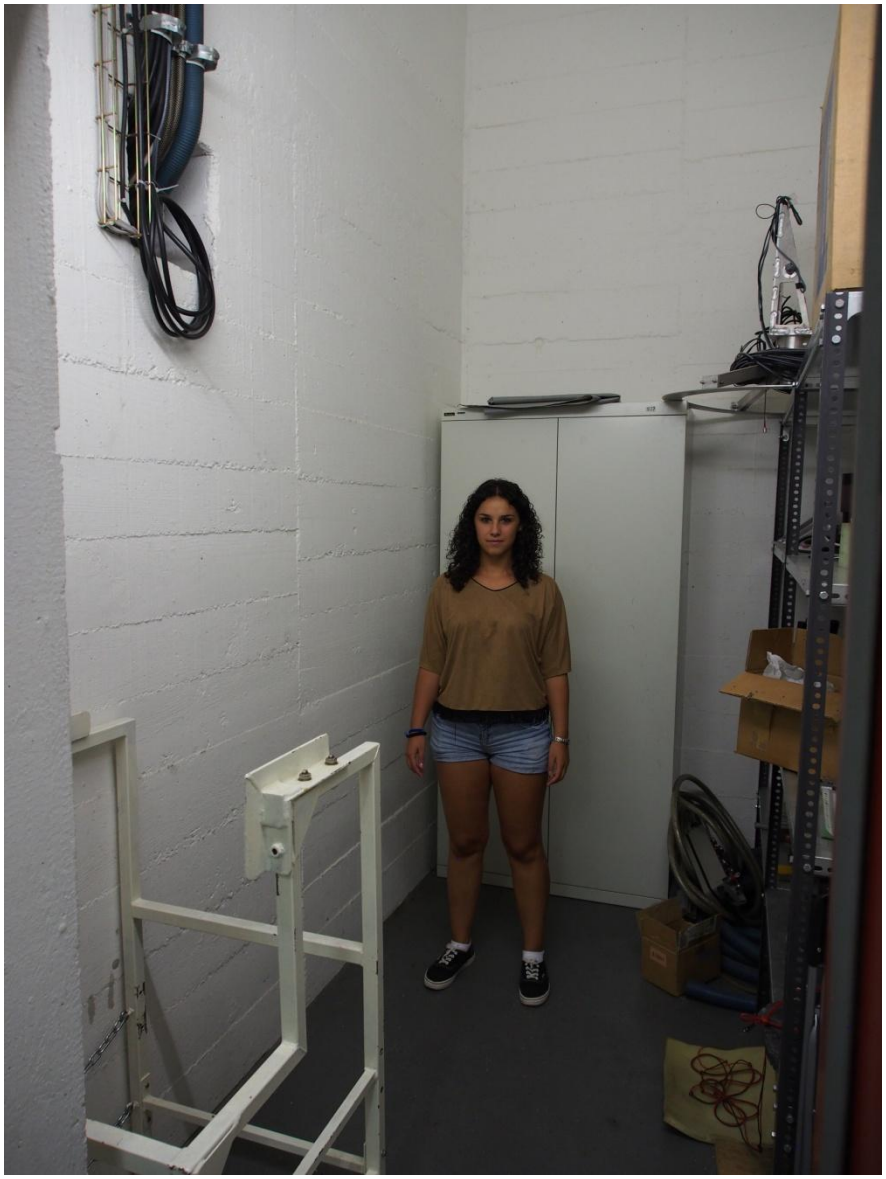


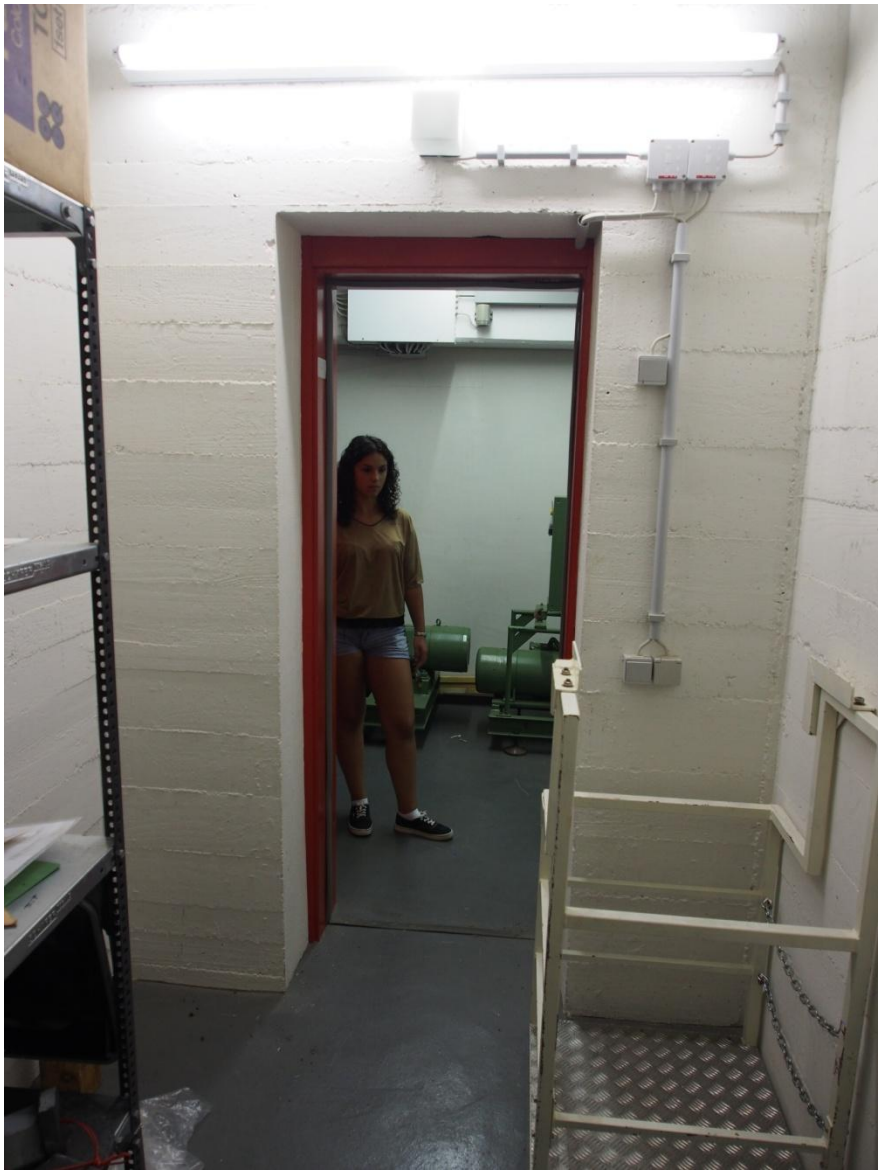
Fibres exit through α axis…

Fibres go down ca. 10 m…

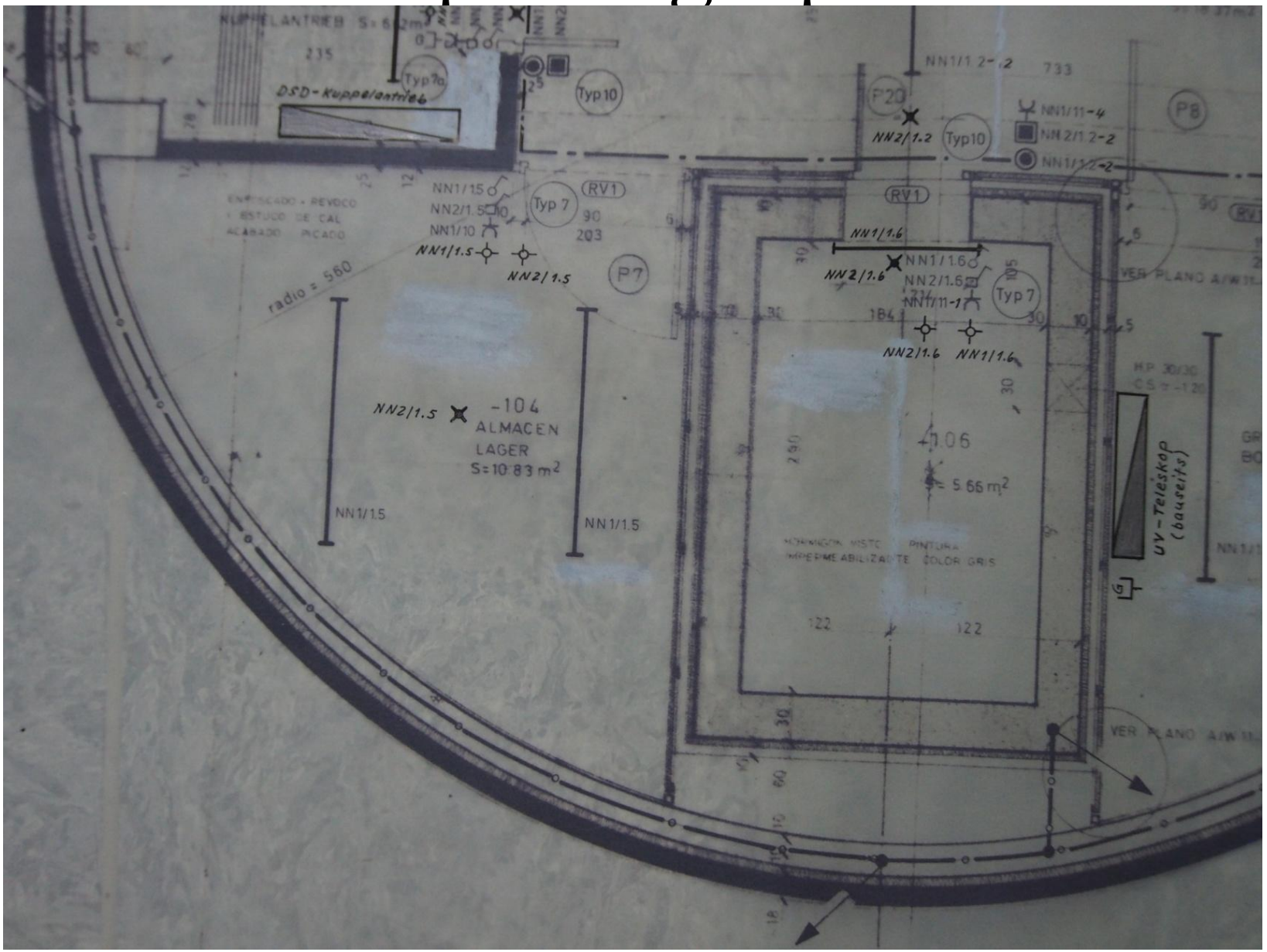


Below-the-pier (stable) room…





Room for spectrographs: small…

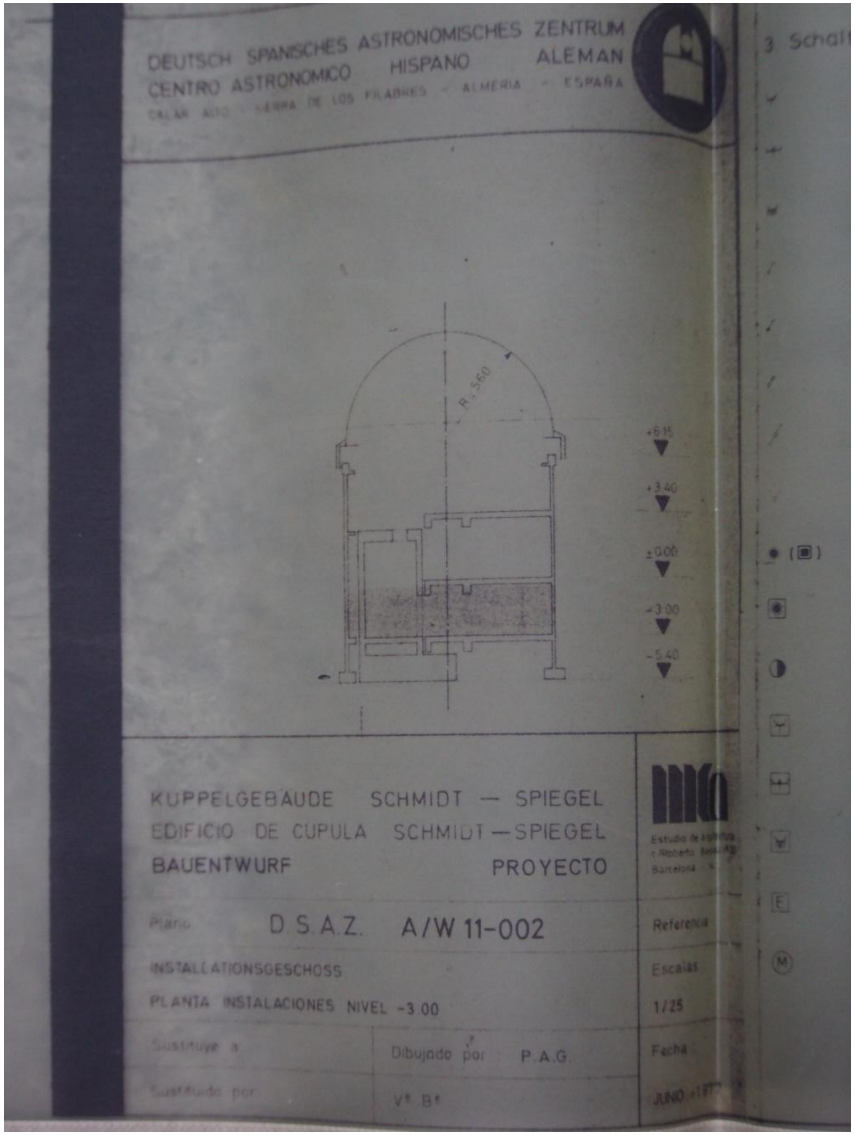


… but 4.5-m (or 3 students!) high.

One spectrograph on top of the other if blue/red arms?

Underground, 45-cm thick walls: likely stable within a few 0.1°C at night (TBC).

2-door underground level and wooden plate to dome: insulation easy to improve.

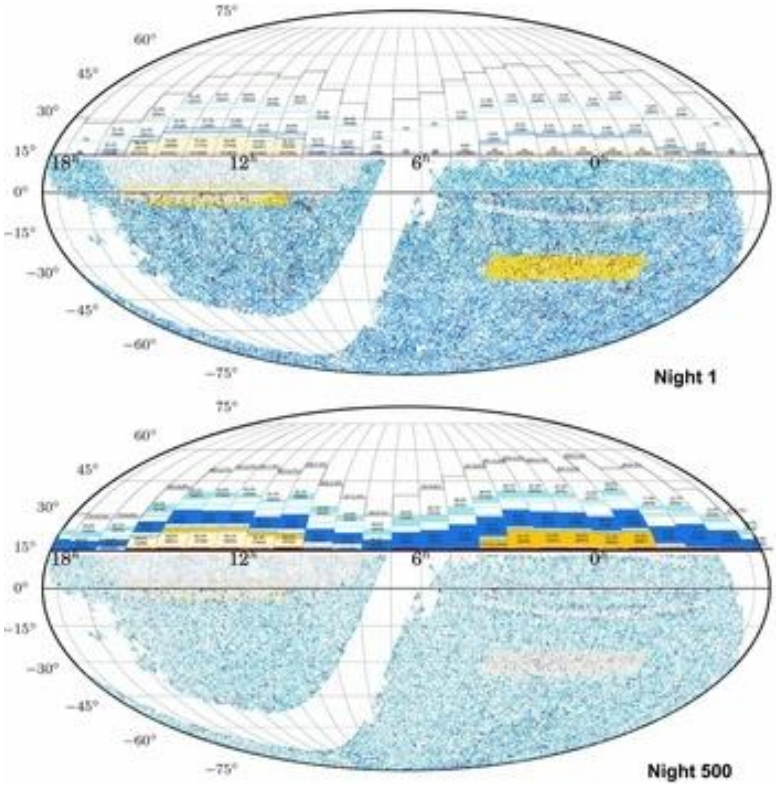


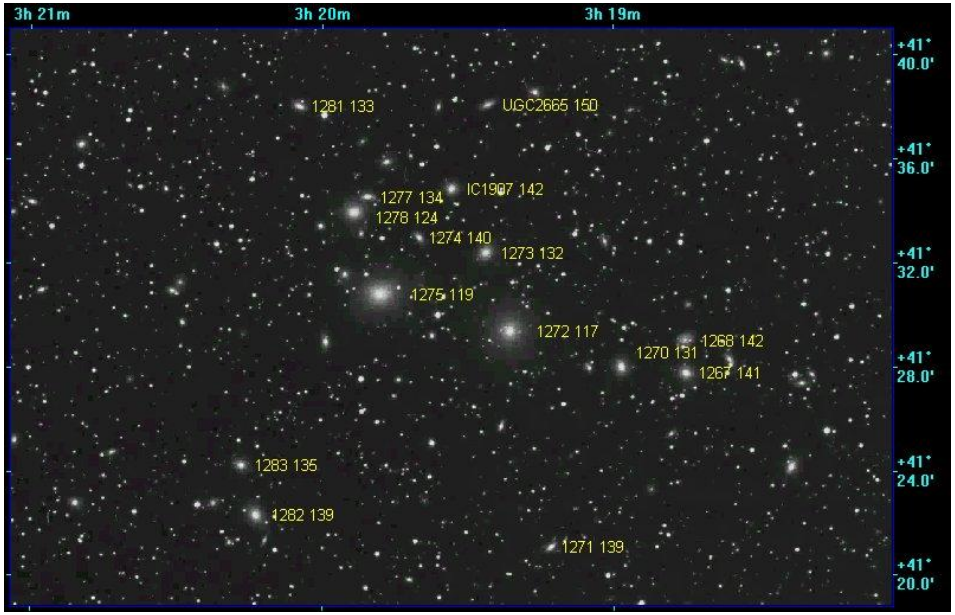
3.a. MOS survey extension in space

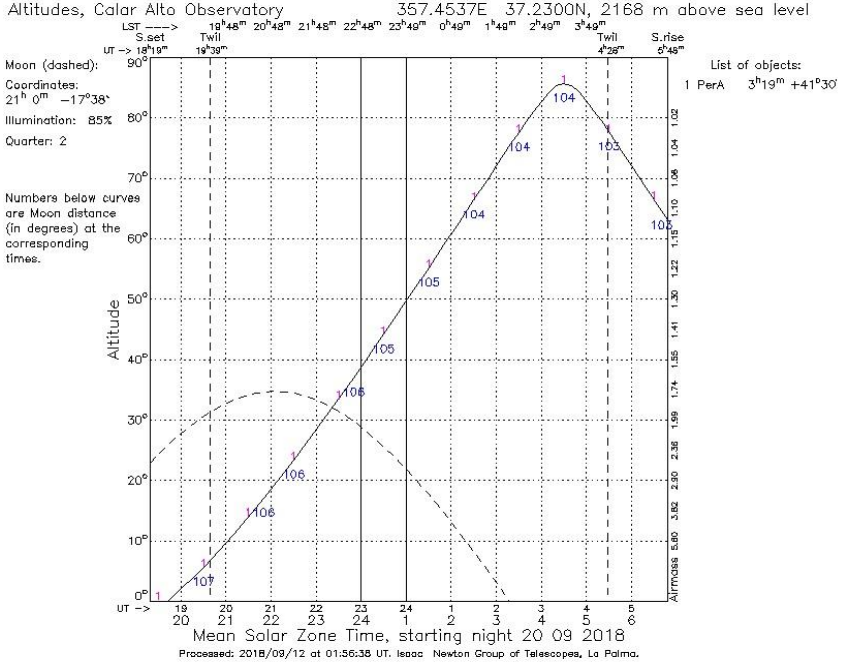
15,300□° for the Northern ($\delta > 15°$) sky – 3000□°
(removing $|b| < 10°$ / $l \approx 50°$-200° stripe)=**12,300□°**

Northern Milky Way is less extended, making low b clus. visible (NGC 1275 at $b = 13°$)

<u>About field visibility from Calar Alto (latitude = 37.2°)</u>

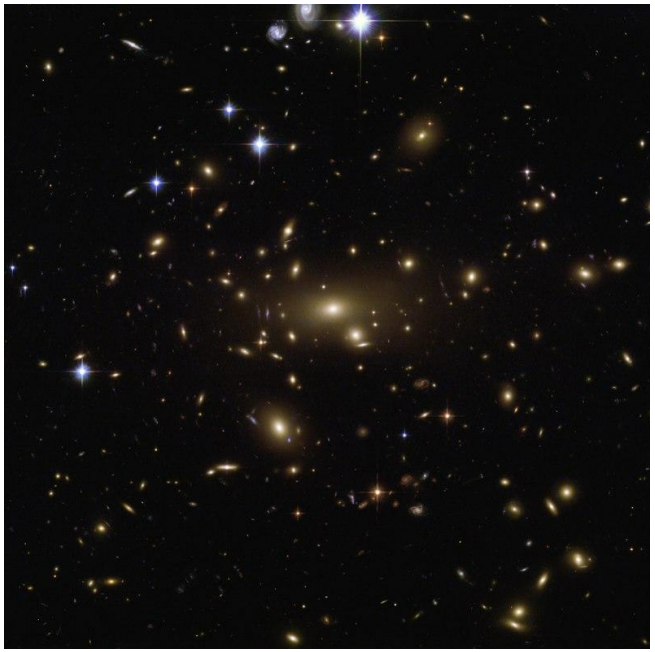


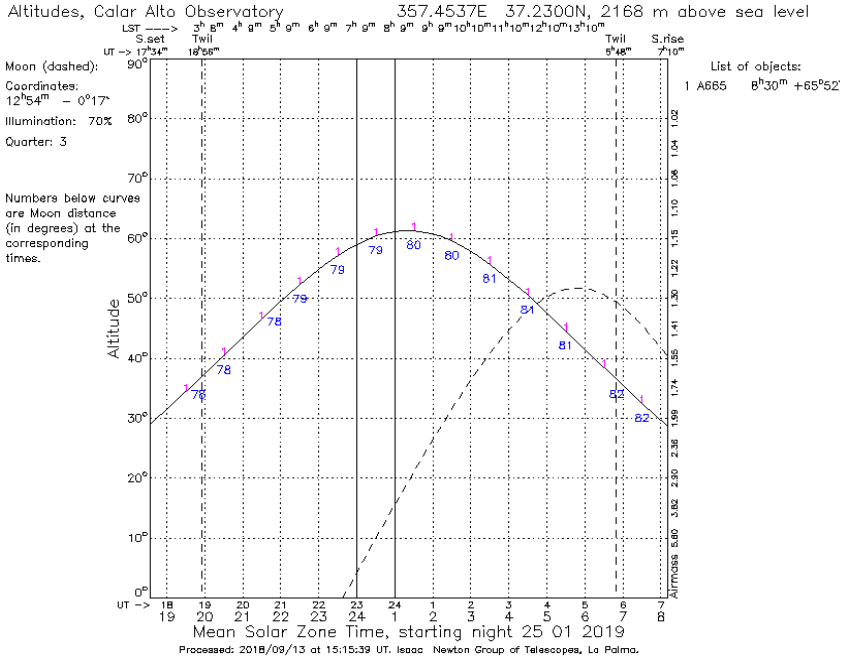




Abel 665

1 plate/n at δ>60º!





3.b. MOS survey extension in time

- 12,300□° to survey, one-pass with some overlap?
- 6°×6° unvignetted? fields: 342 pointings needed
- 1 field/night+overhead (ROs, 0-1 plate change): ca. **365 clear nights** to reach mags. ≈ TAIPAN *(UKST = 2.25 × CAST area)*
- 61% of mostly clear nights in 2017, mean ≈50%

Should be completed in **3 years in dark/grey time** (<67% Moon? Max. 2 fields half-exposed per night; at $\delta > 60°$, single field visible for 11 h at sec(z)<1.8)

3.c. Future telescopes… & partners?

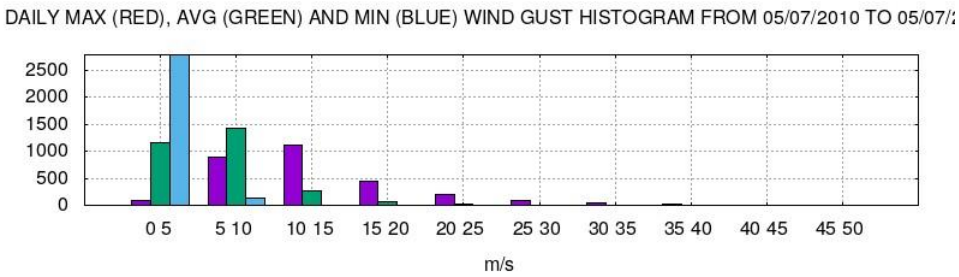
Continental site:
easy, cheap access.
Also NOT windy!
There's space left

at Calar Alto for

new telescopes,

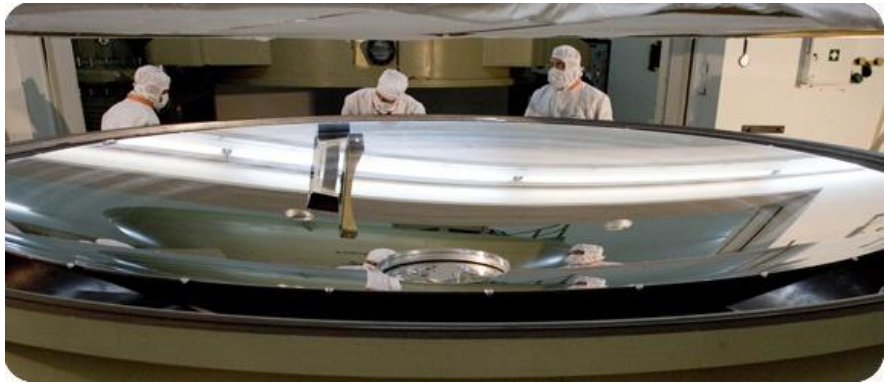
and 3rd parties:

French U.,CNRS?



Realuminizing the Schmidt

Last aluminization in 2009

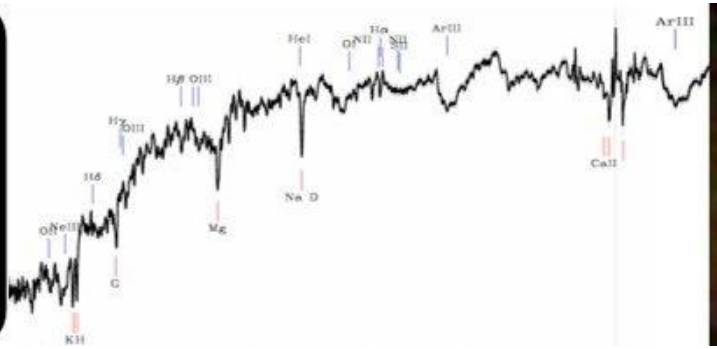


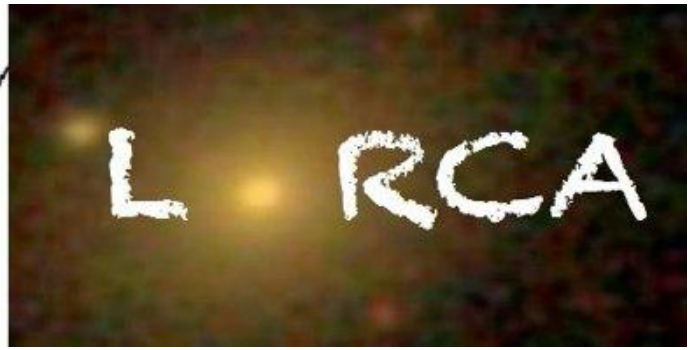
… like the 3.5-m Herschel!

Current mirror reflectivity:
77.1/78.6/78.7/79.6%

Estimated cost: 12.800€
(it may require 4-5 days)

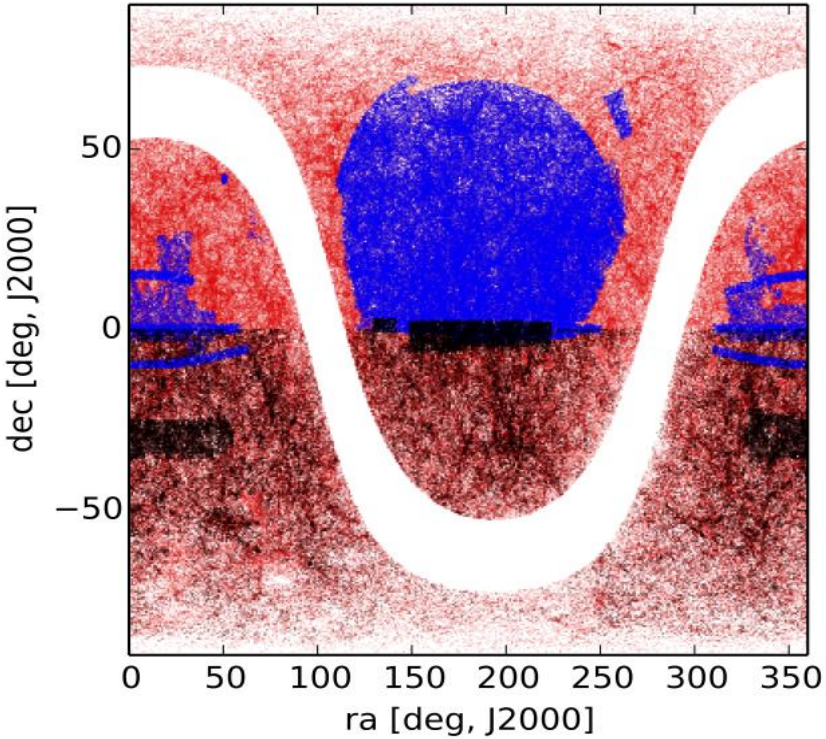
Projects for the 0.8/1.2 m Schmidt





Comparat et al. (2016)

Extended, international version TAIPAN-North



MOS/IFU on the 0.8/1.2 m Schmidt

- TAIPAN-North, around 3 years of dark/grey time
- Australian-French-Spanish project
- Big fibers >6" (+ IFUs?)
- Blue/red arms
- Cost approx. 400 k€ (cloning AAO fibre positioner)?

LUCA: 9×PMAS and survey
Local Universe from Calar Alto

IFU-based survey proposed by Prada et al. (IAA):
go **WIDE** and blue (OII@3727Å, not in MUSE)

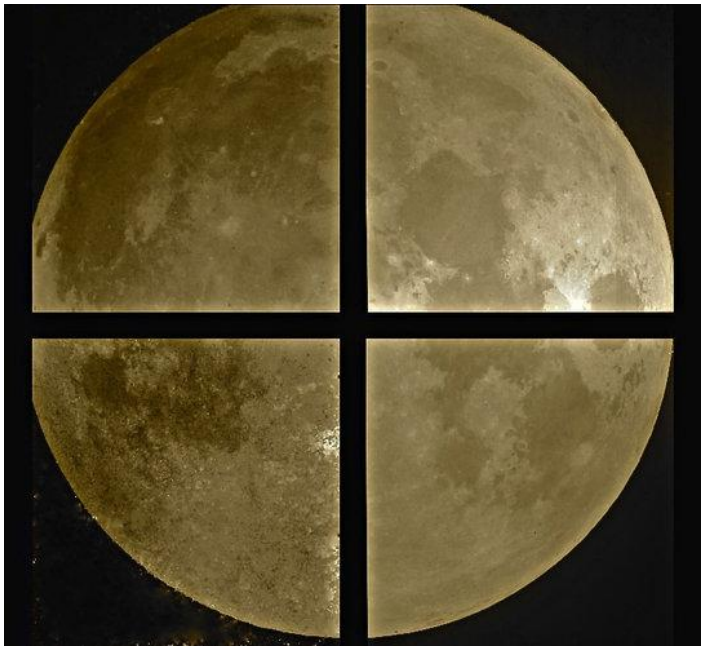
- 200 local galaxies 

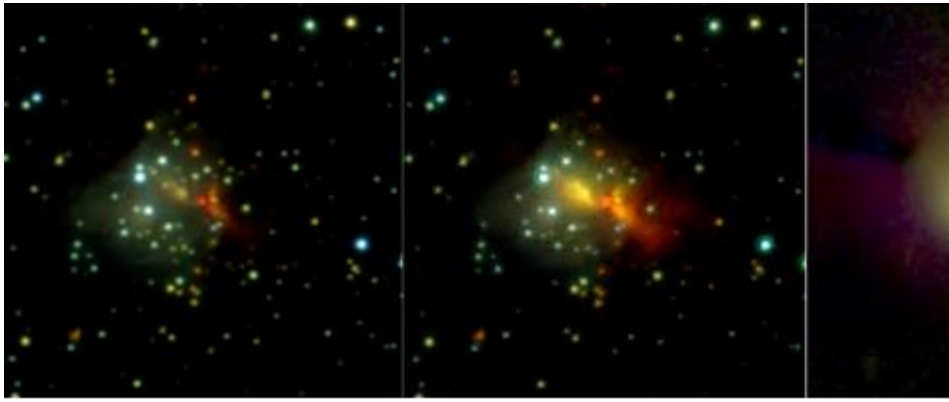
(< 11 Mpc and $M_B < -16$)
- 300 in Virgo ($M_g < -17$, $> 10^9$ $M_\odot$), scale 70 pc/″

Complete CAHA IFU+MOS extragalactic surveys

PANIC2.0: getting monolithic in 2019

- Complete UKIDSS at $\delta > 60^{o}$: useful to find (obscured) targets for Schmidt MOS survey?
- 4 HawaiiR2G detectors with many bad pixels
- New 4kx4k monolithic one with 26'x26' FoV

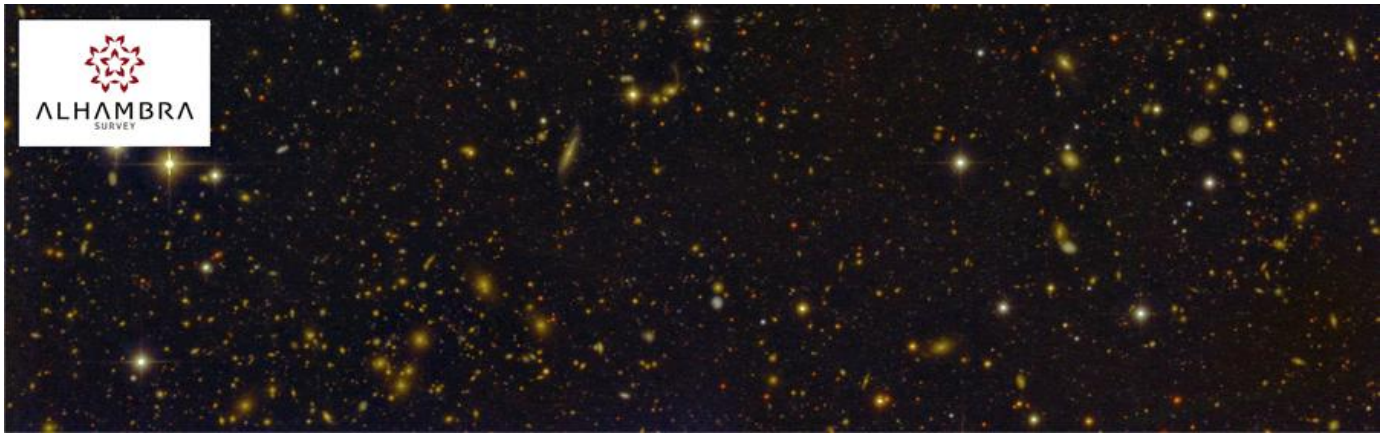




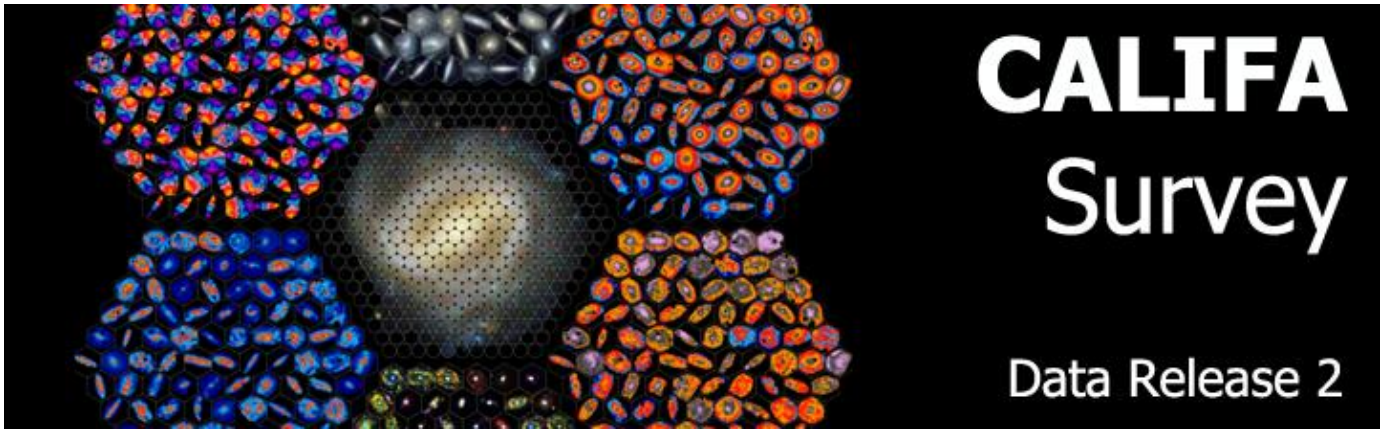
Archives at Calar Alto, IAA and SVO

General archive (SVO) and dedicated surveys:

Alhambra Gold/DR1 Nov. 2013



CALIFA DR Legacy IFU survey (**DR3** in April 2016)



Over-subscription statistics

Spring 2018

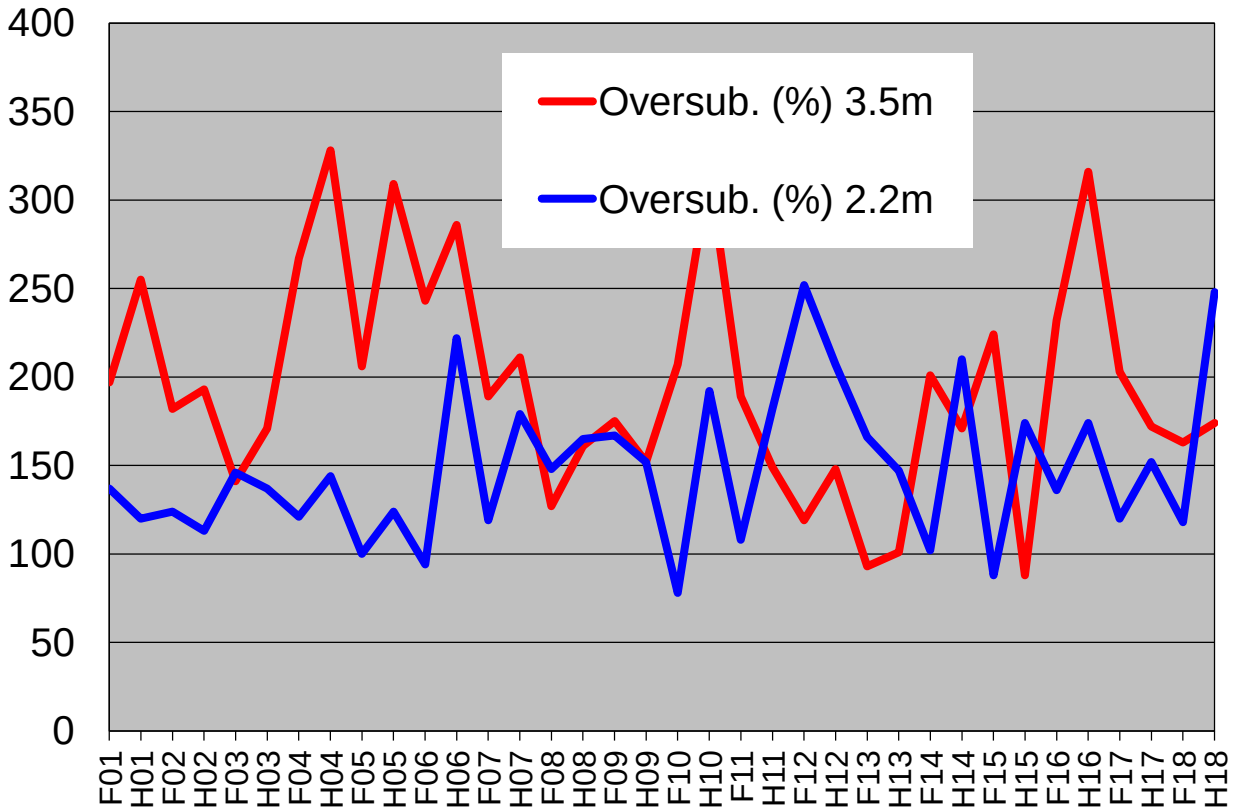
2.2m: 118%

3.5m: 163%

Fall 2018

2.2m: 248%

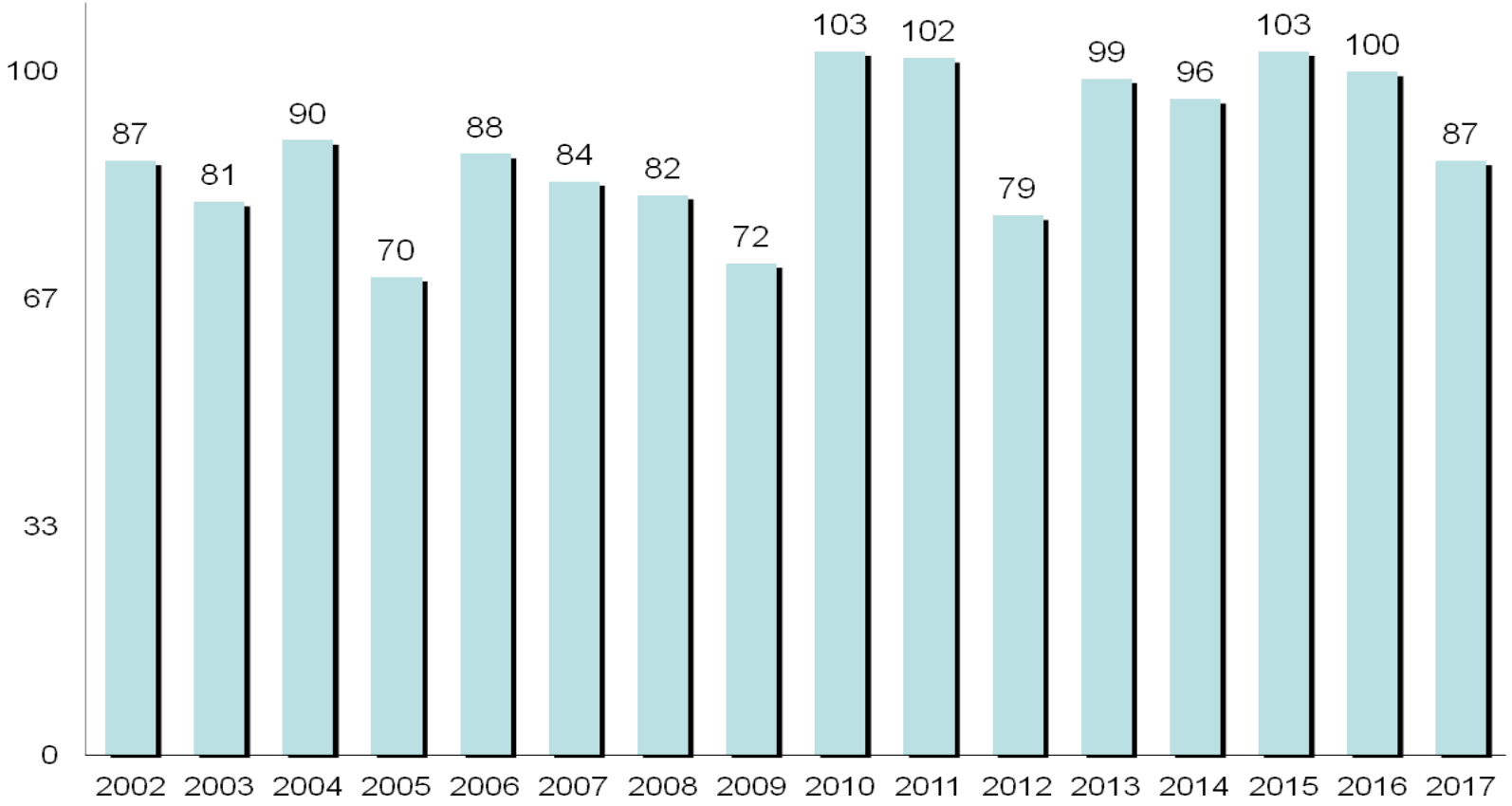
3.5m: 174%



3.5/CARMENES GTO (250 nights/year)

2.2/CAFOS RM survey (220 nights/year)

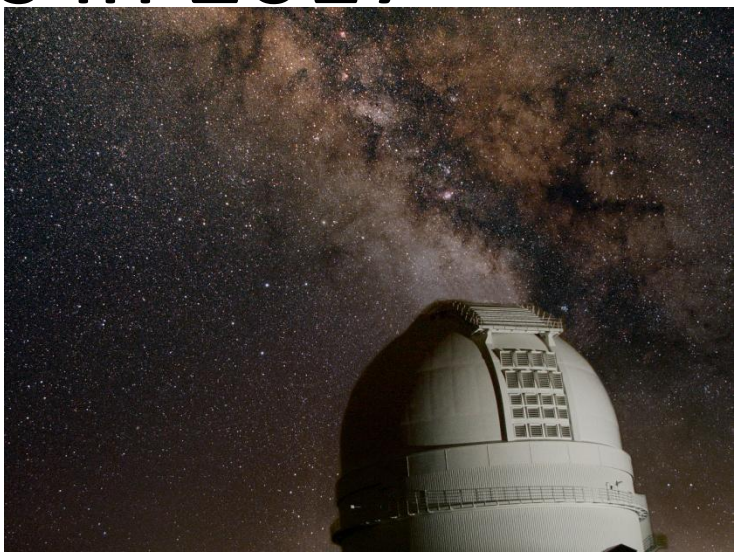
Publications



- 56 papers based on CAHA data in 2018A!
- Publication rate: 89 papers vs. 96 w/ service mode since 2010

Weather statistics in 2017

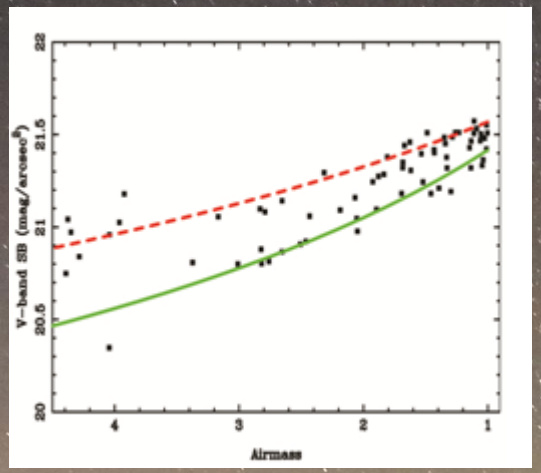
- Observing nights: **70.7%** of total nights (>6h)
- Clear nights: **60.8%** of total nights (no clouds)
- Photometric nights: **41.1%** of observing nights
- Spectroscopic nights (= observing - photometric): **58.9%** of observing nights



Christian Dahm

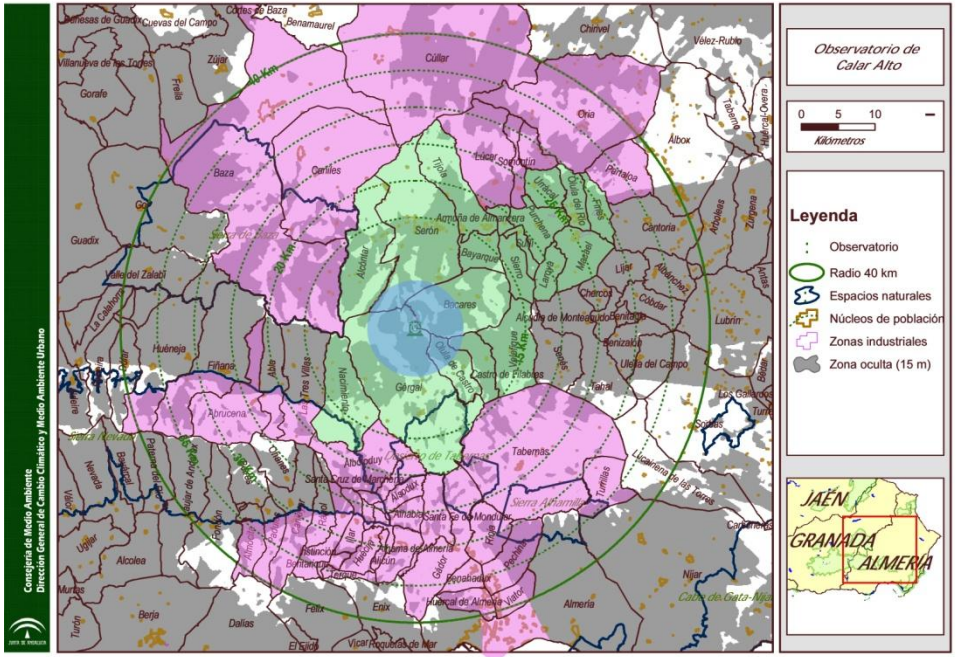
Emilio Gutierrez. Astroburgos

Still a pretty dark site but…



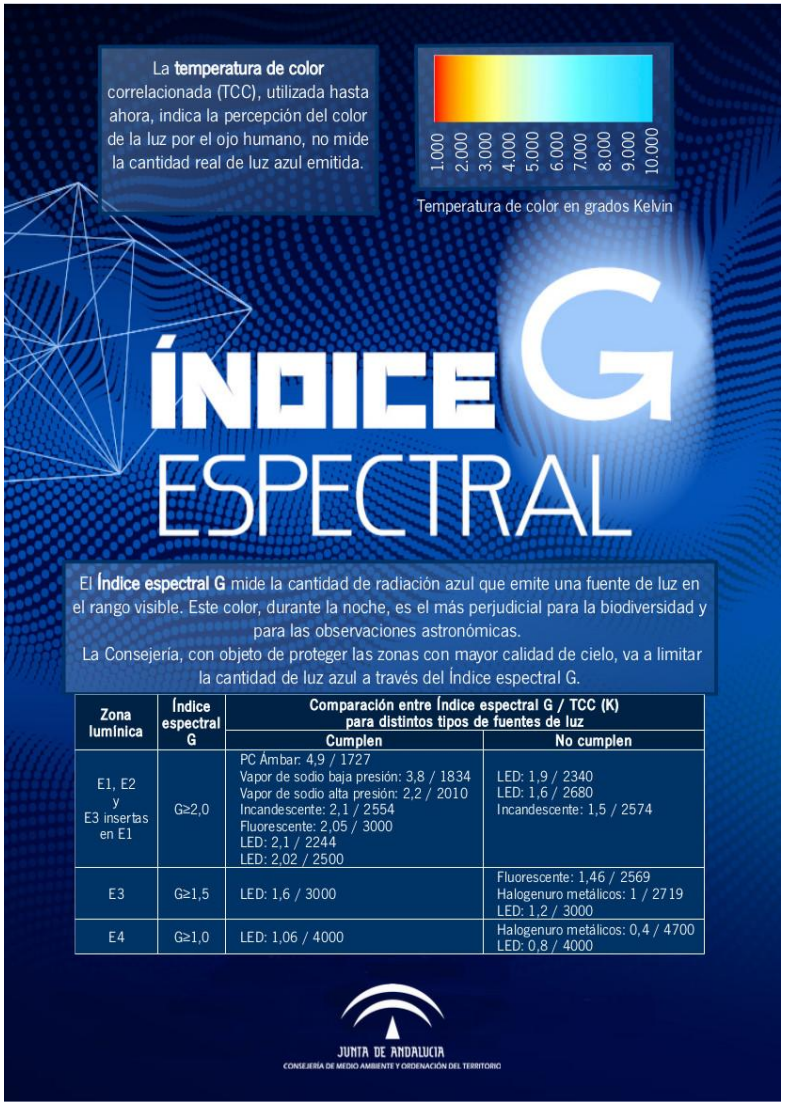
Sky protection: Andalusian laws

2010: 1st *decreto* published



2019: new law ($\subset$ LEDs)

("G index" by D. Galadí)



Zona lumínica	Índice espectral G	Comparación entre Índice espectral G / TCC (K) para distintos tipos de fuentes de luz	
		Cumplen	No cumplen
E1, E2 y E3 insertas en E1	G≥2,0	PC Ámbar: 4,9 / 1727 Vapor de sodio baja presión: 3,8 / 1834 Vapor de sodio alta presión: 2,2 / 2010 Incandescente: 2,1 / 2554 Fluorescente: 2,05 / 3000 LED: 2,1 / 2244 LED: 2,02 / 2500	LED: 1,9 / 2340 LED: 1,6 / 2680 Incandescente: 1,5 / 2574
E3	G≥1,5	LED: 1,6 / 3000	Fluorescente: 1,46 / 2569 Halogenuro metálicos: 1 / 2719 LED: 1,2 / 3000
E4	G≥1,0	LED: 1,06 / 4000	Halogenuro metálicos: 0,4 / 4700 LED: 0,8 / 4000

Renovating the TCS

Current hardware:
two automates (not communicating…)

Current software: written in python, automated scripts (ESA compliant)

Current GUI: ScadaBR basic visual interface
(OK for engineering work, not for casual user)