



4MOST – 4m Multi-Object Spectroscopic Telescope

4MOST: ESO's wide-field, high-multiplex optical spectroscopic survey facility

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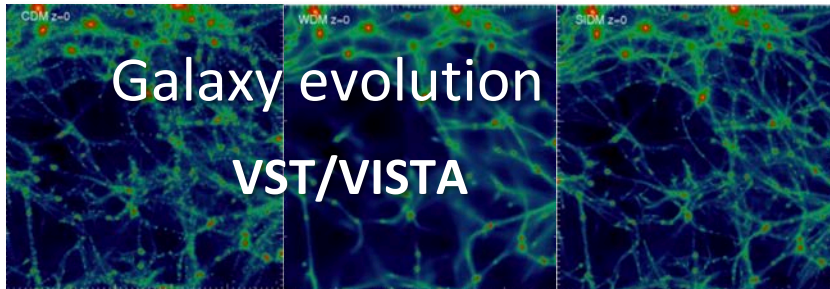
12 April 2019

www.4MOST.eu



Science Themes

4
MOST



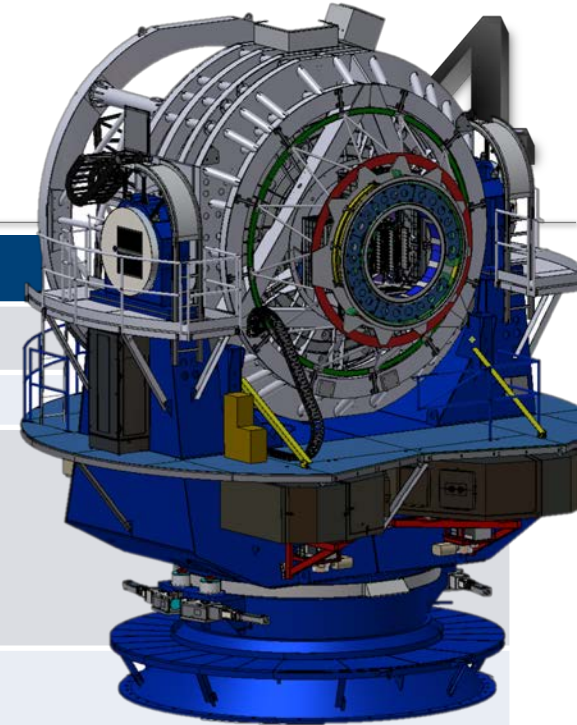
Ten Consortium Surveys



No	Survey Name	Survey (Co-)PI
S1	Milky Way Halo LR Survey	Irwin (IoA) , Helmi (RuG)
S2	Milky Way Halo HR Survey	Christlieb (ZAH)
S3	Milky Way Disk and Bulge LR Survey	Chiappini, Minchev, Starkenburg (AIP)
S4	Milky Way Disk and Bulge HR Survey	Bensby (LU), Bergemann (MPIA)
S5	Galaxy Clusters Survey	Finoguenov (MPE)
S6	AGN Survey	Merloni (MPE)
S7	Galaxy Evolution Survey (WAVES)	Driver (USW), Liske (HHU)
S8	Cosmology Redshift Survey	Richard (CRAL), Kneib (EPFL)
S9	Magellanic Clouds Survey	Cioni (AIP)
S10	Time-Domain Extragalactic Survey (TiDES)	Sullivan (Southampton)

Instrument Specification

Specification	Design value
Field-of-View (hexagon)	$\sim 4.2 \text{ degree}^2 (\varnothing > 2.6^\circ)$
Multiplex fiber positioner	2436
Medium Resolution Spectrographs (2x)	R $\sim 4000\text{--}7500$
# Fibres	812 fibres (2x)
Passband	370-950 nm
Velocity accuracy	$< 1 \text{ km/s}$
High Resolution Spectrograph (1x)	R $\sim 20,000$
# Fibres	812 fibres
Passband	392.6–435.5 nm, 516–573 nm, 610–679 nm
Velocity accuracy	$< 1 \text{ km/s}$
# of fibers in $\varnothing=2'$ circle	> 3
Fibre diameter	$\varnothing=1.45 \text{ arcsec}$
Area (first 5 year survey)	$> 2\text{h} \times 18,000 \text{ deg}^2$
Number of science spectra (5 year)	$\sim 75 \text{ million of } 20 \text{ min}$



VISTA at Paranal Observatory, Chile



Wide Field Corrector and Atmospheric Dispersion Compensator (WFC/ADC)



ADC

4 Lenses Groups with 2 counter-rotating prisms

Field $\varnothing = 2.6$ degree

535 mm Focal Diameter
Largest lens ~ 950 mm

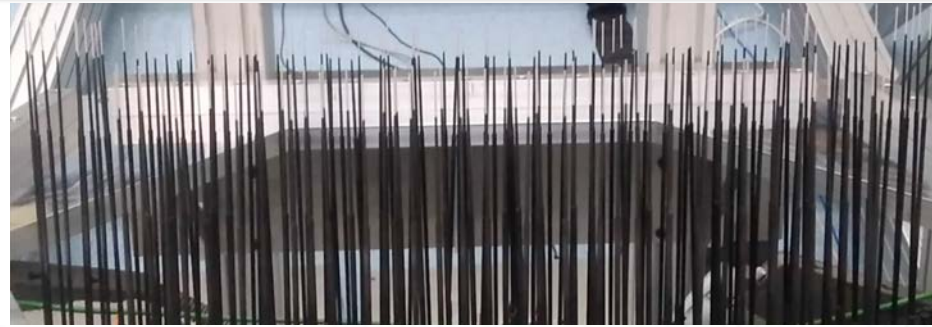
ADC functions to
 $ZD=55^\circ$

Design AIP
Assembly and alignment
UCL

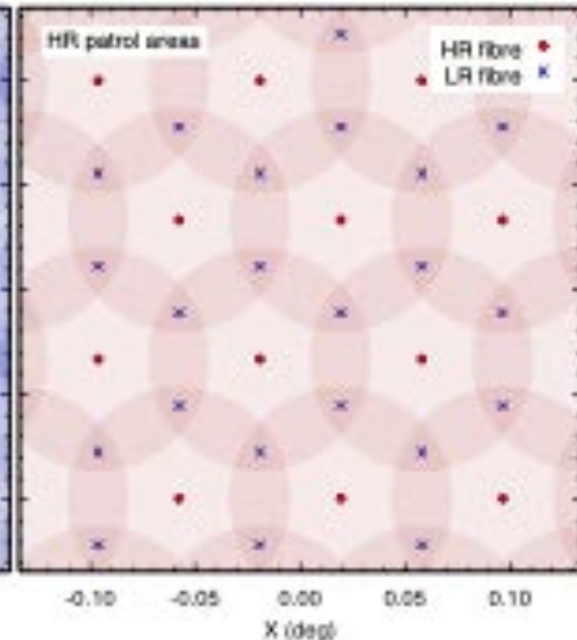
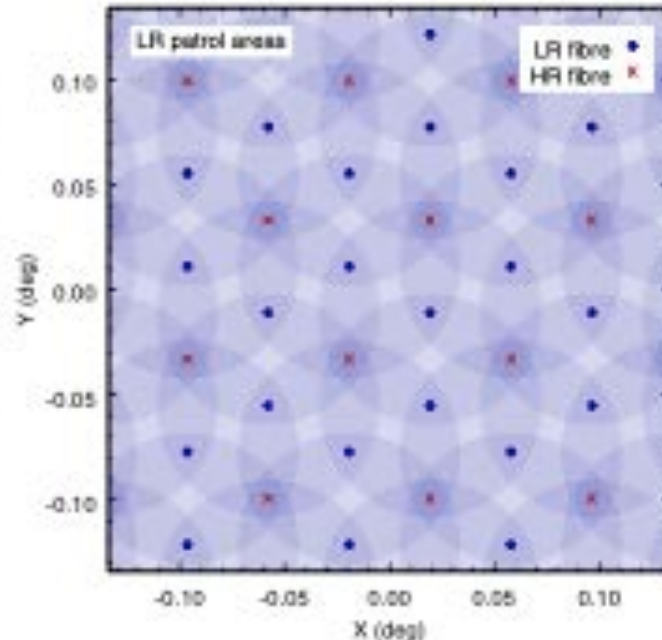
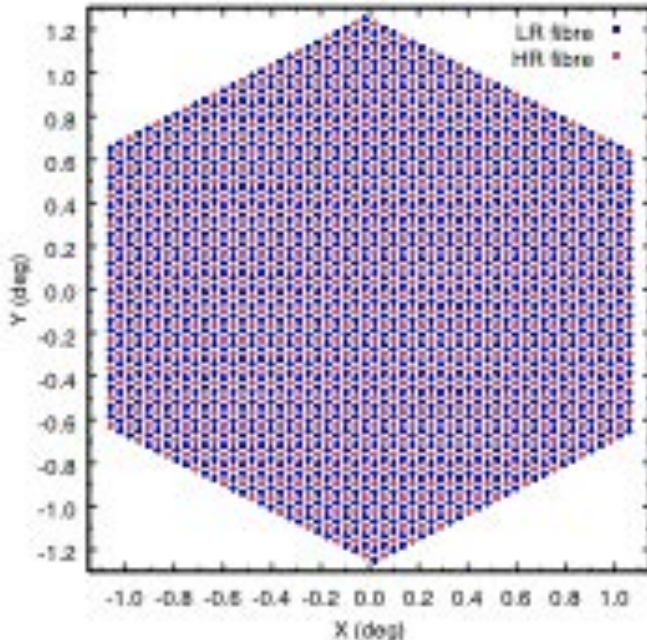


AESOP Fiber Positioner

2436 Fiber Probes
-pitch diameter 2.4x pitch
-minimum separation $\sim 20''$
-reconfiguration time < 2
min during CCD readout



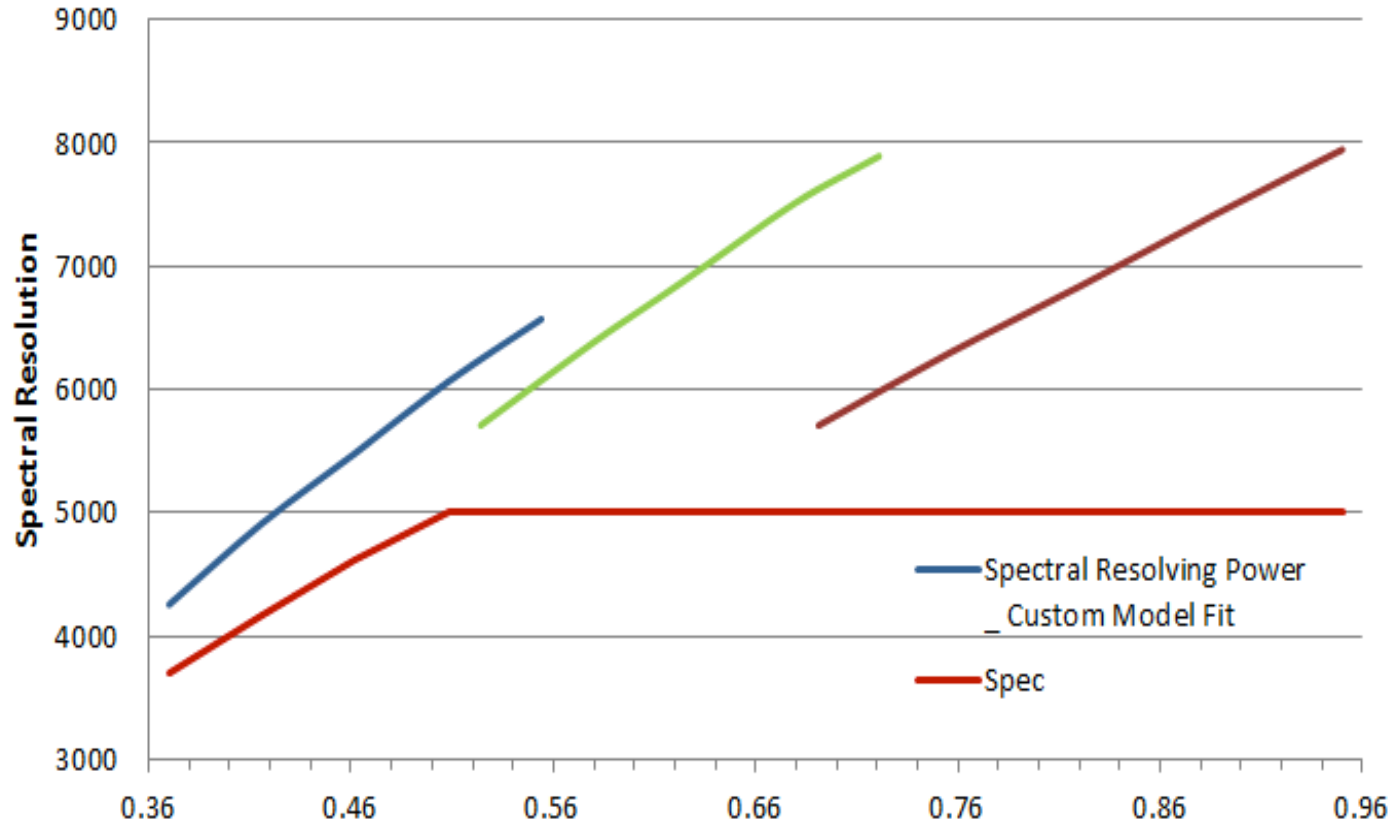
N_{fib}	LR fibres %	HR fibres %
1	–	39.8
2	7.2	46.1
3	50.9	14.1
4	33.0	–
5	3.6	–
6	5.3	–



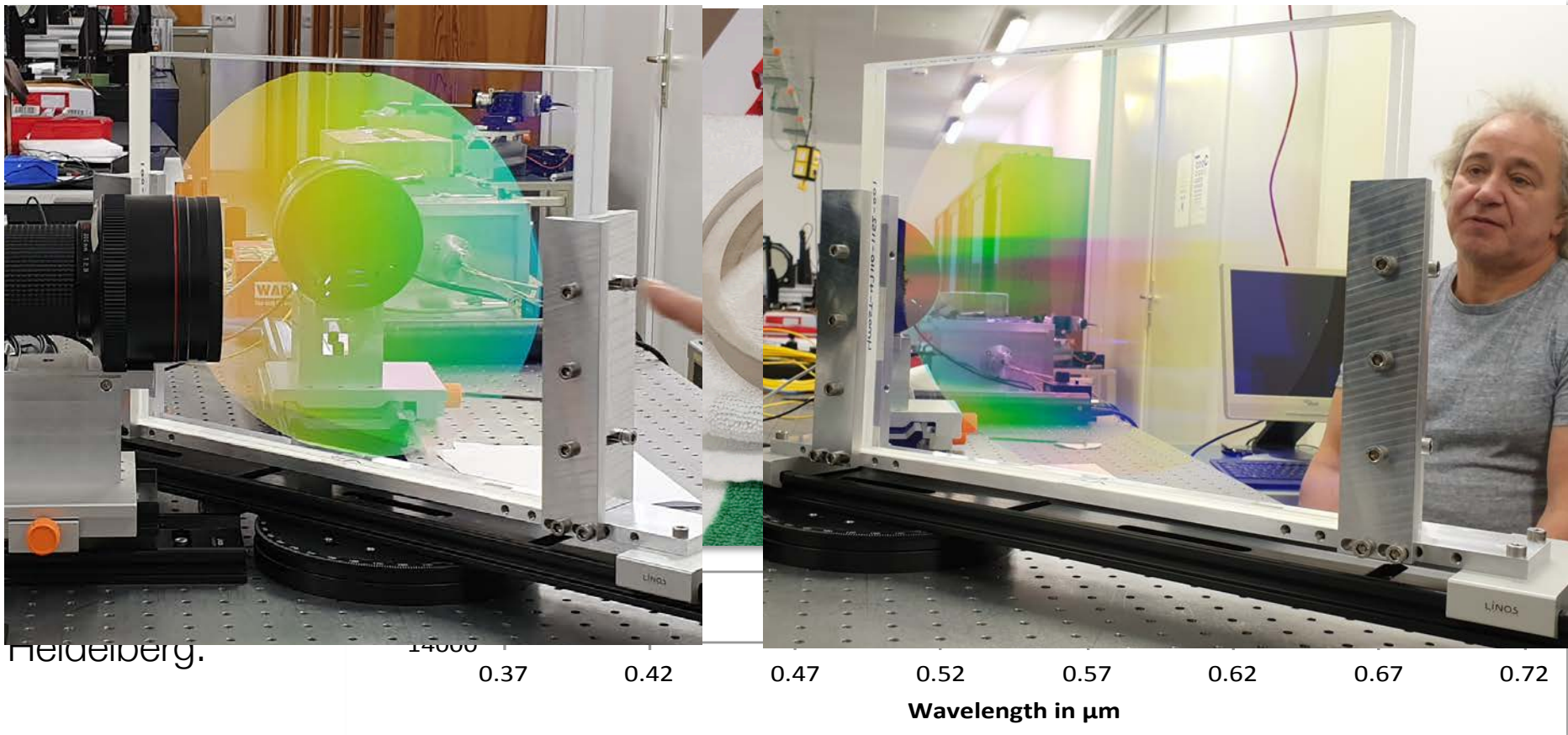
Low Resolution Spectrograph (LRS)



3 arms
spectrograph
3 CCDs 6k x 6k
200 mm beam size
812 science fibers
per spectrograph
2 mirrored
spectrographs
Thermally stabilized
Design and build at
CRAL in Lyon.



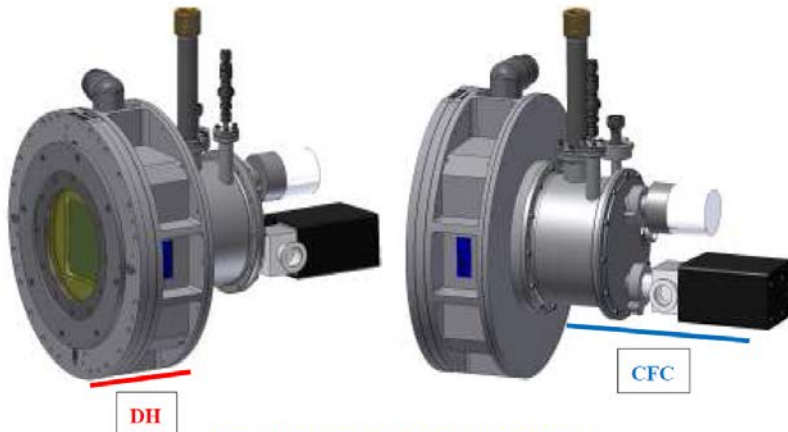
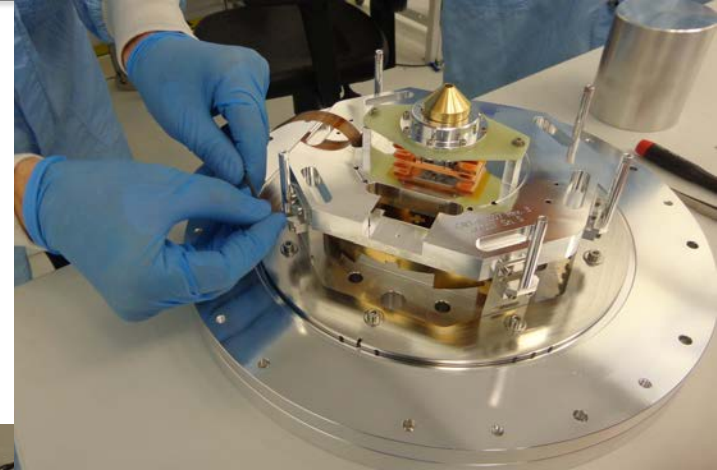
High Resolution Spectrograph (HRS)



4MOST Detectors

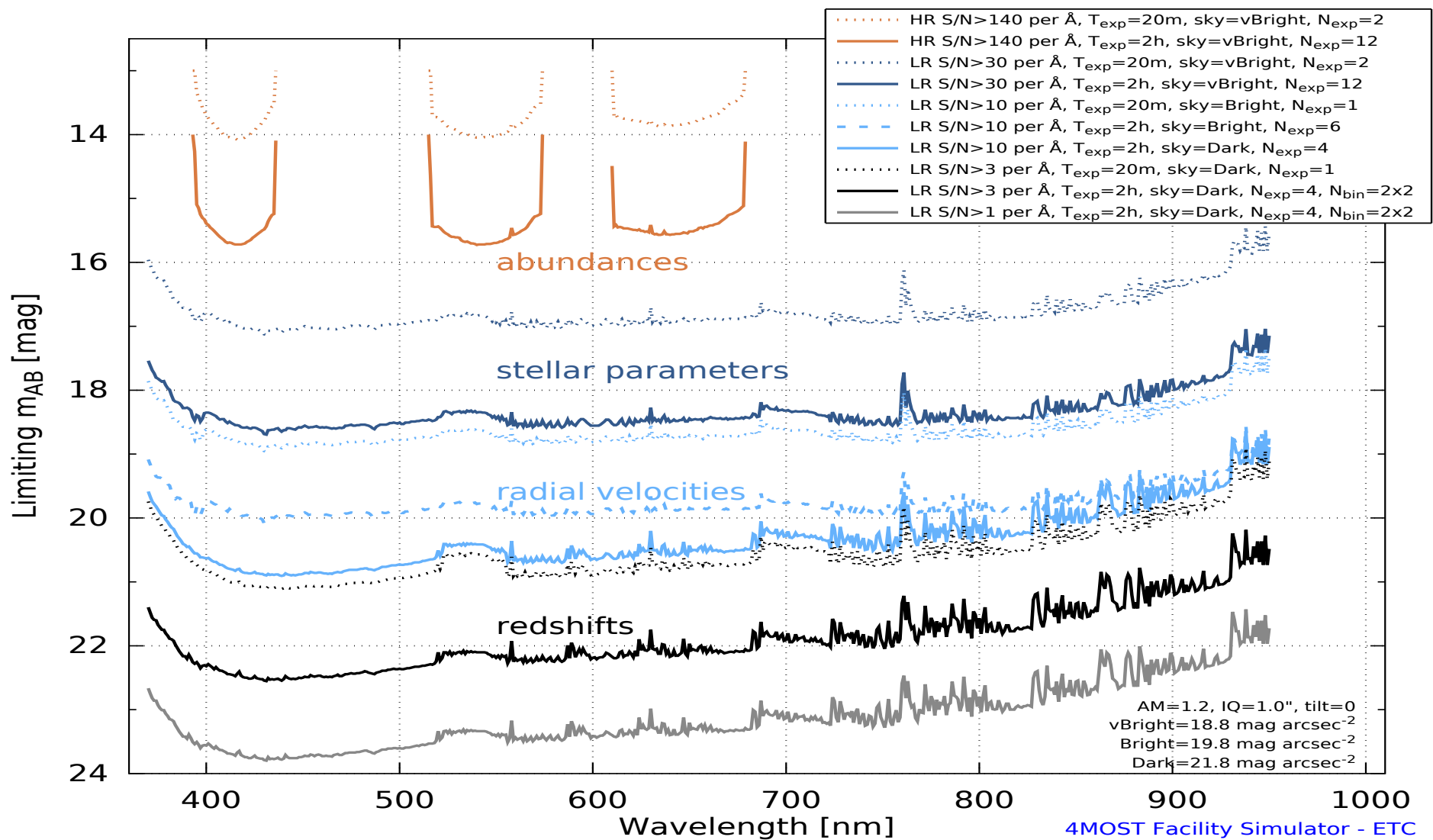


- 9 identical detectors
(plus spares and engineering devices)
- E2V 6kx6k – Deep Depletion – Broad Band Coating
- Detector head based on ESPRESSO design
- Cooling and controls identical to MUSE design
- All to ESO standards



Design and build at ESO in Garching.

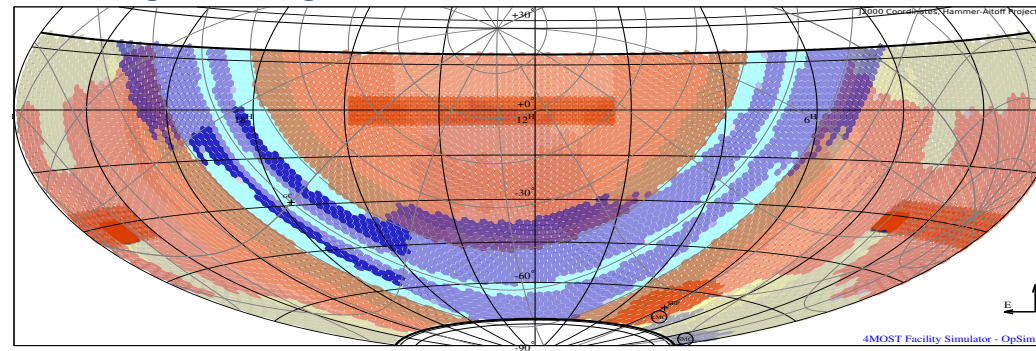




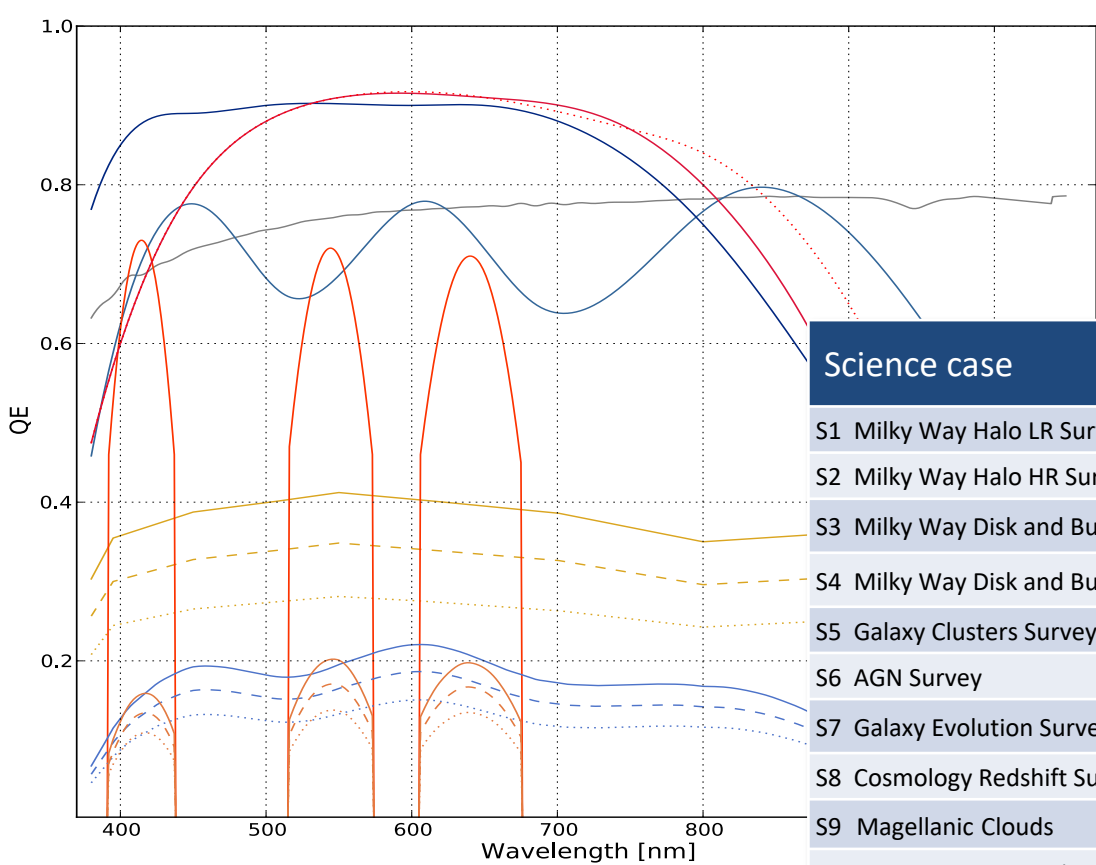
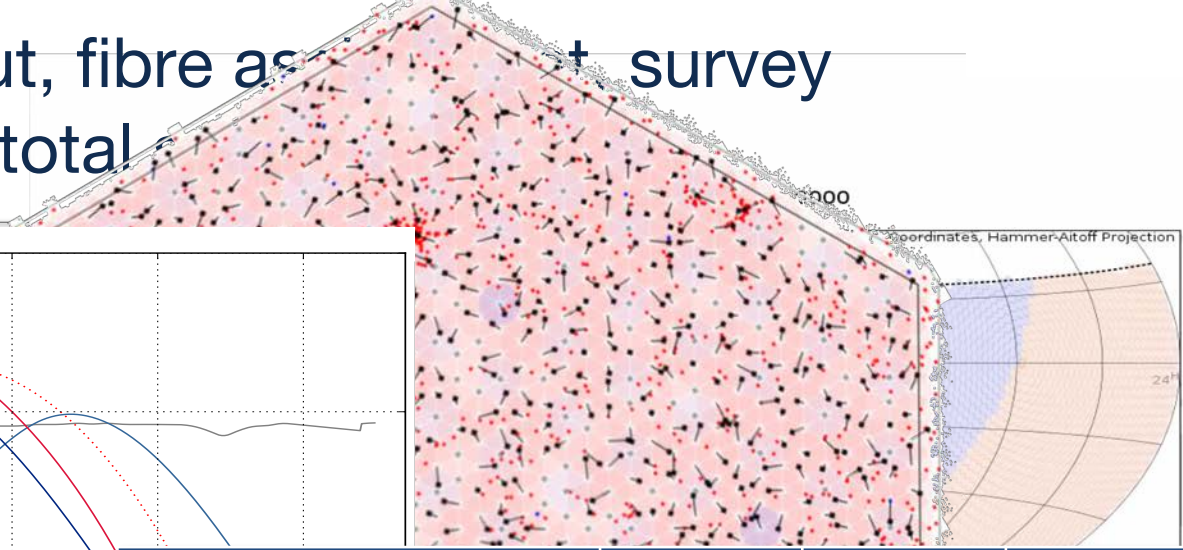
4MOST Operations



- Unique operations model for MOS instruments suitable *for most* science cases
- 4MOST program defined by *Public Surveys* of 5 years
- Surveys will be defined by *Consortium* and *Community*
- All Surveys will run *in parallel*
 - Surveys share fibres per exposure for increased efficiency
- *Consortium Key Surveys* will define observing strategy
 - Millions of targets all sky
 - Fill all fibres
- *Add-on Surveys* for smaller surveys
 - Small fraction fibers all sky or
 - dedicated small areas
 - 10^3 to 10^6 targets
- Several passes of sky with 2, 10, 20, 30 mins
- Wedding-cake distribution for total time 1h to 10h

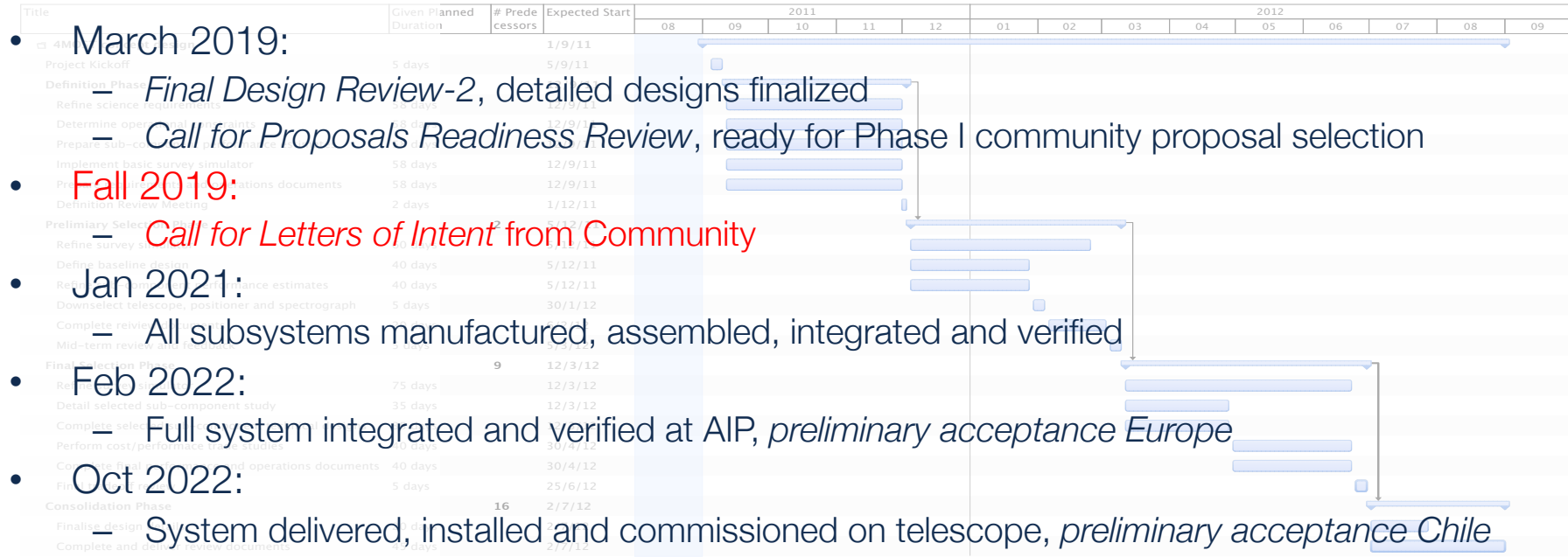


Simulate throughput, fibre assignment strategy and verify total survey



Science case	S/N / Å	r_{AB} -mags	Targets (Millions)
S1 Milky Way Halo LR Survey	10	16–20.0	1.4
S2 Milky Way Halo HR Survey	140	12–15.5	0.6
S3 Milky Way Disk and Bulge LR Survey	10–30	14–18.5	10.7
S4 Milky Way Disk and Bulge HR Survey	140	14–15.5	2.0
S5 Galaxy Clusters Survey	4	18–22.0	0.8
S6 AGN Survey	4	18–22.0	0.5
S7 Galaxy Evolution Survey (WAVES)	4	18–22.5	1.4
S8 Cosmology Redshift Survey	1	20–22.5	10.4
S9 Magellanic Clouds	10–30	16–20.0	0.3
S10 Transients Survey (TiDES)	4	18–22.5	0.3
Total			>27

Schedule and Milestones



- **March 2019:**
 - Final Design Review-2, detailed designs finalized
 - Call for Proposals Readiness Review, ready for Phase I community proposal selection
- **Fall 2019:**
 - Call for Letters of Intent from Community
- **Jan 2021:**
 - All subsystems manufactured, assembled, integrated and verified
- **Feb 2022:**
 - Full system integrated and verified at AIP, preliminary acceptance Europe
- **Oct 2022:**
 - System delivered, installed and commissioned on telescope, preliminary acceptance Chile
- **Nov 2022 – Oct 2027:**
 - First science survey of 4MOST, 30% of targets available for Community Surveys

A spectroscopic LSST



- 4MOST parallel survey model
 - Picky back many low target density surveys
- Simultaneously serving several types of spectrographs
 - HiRes large spectral coverage MOS
 - Fibre bundles – deployable IFUs
 - Partial reconfiguration of fields
- New fibre concepts (e.g. OH suppression)
- Different fibres?

