XIV SCSLSA

OVERVIEW OF LARGE SPECTROSCOPIC SURVEYS

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23 JUNE 2023

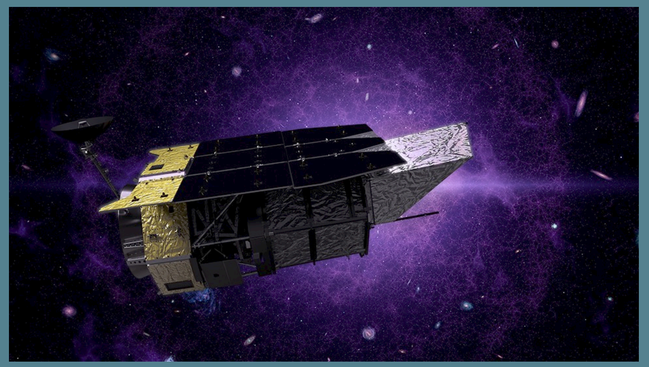
THE ERA OF LARGE SURVEYS

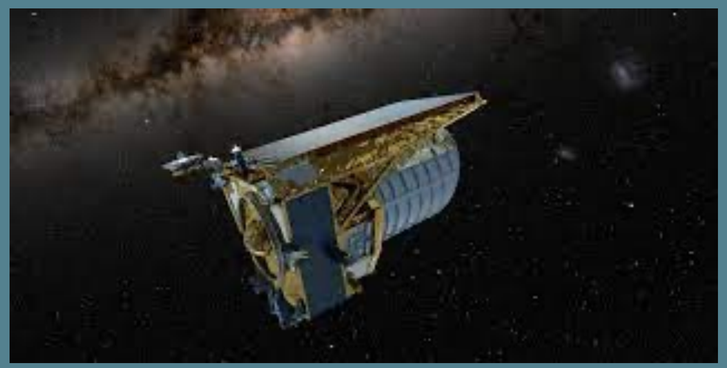
DEEP-WIDE field imaging surveys coming online in the next years

Vera Rubin LSST (NOIRLAb): 6.5m, 10 years, *ugrizy* ~ 25-27 over 18,000 deg^2
ugrizy ~ 27-29 over 38 deg^2 (deep drilling fields)

Nancy Roman Space Telescope (NASA / ex WFIRST): 2.4m, YJH ~ 26-27 over 2,000 deg^2

Euclid Space Telescope (ESA): 1.2m, 6 year mission, riz+YJH ~ 24 over 15,000 deg^2
~ 26 over 40 deg^2





THE ERA OF LARGE SURVEYS

DEEP-WIDE field imaging surveys coming online in the next years

- Cosmology – end to end tests of the standard model, dark energy/modified GR, neutrino mass/hierarchy
- Galaxy evolution – environmental studies relating to cosmic web, baryon cycle studies
- Galactic archeology – kinematics for DM probes, chemical tagging for assembly histories
- Transient universe – classifications of SN types, exploring phase-space for new classes of variables
- Solar system – trans-Neptunian studies

From Ellis 2021

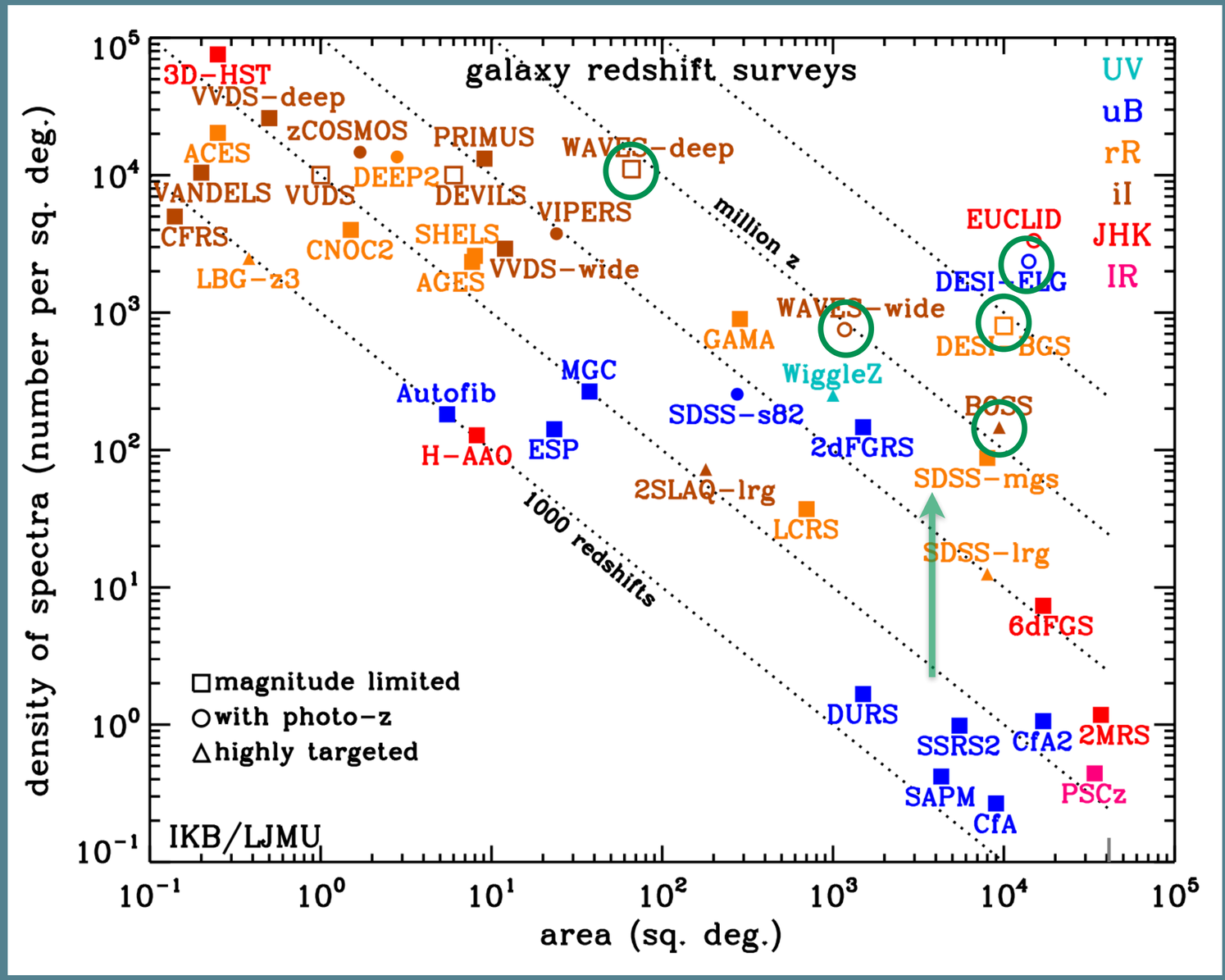
THE ERA OF LARGE SURVEYS

Ground-Based

	Instrument/Telescope	Collecting Area m^2	Field of view deg^2	Multiplex	R
4m class funded	4MOST	10.7	4.00	1400	6500–20000
	Mayall 4m / DESI ✓	11.4	7.08	5000	2000–5000
	WHT / Weave	13.0	3.14	1000	5000–20000
8-10m class funded	Subaru / PFS	52.8	1.25	2400	3000–5000
	VLT / MOONS	52.8	0.14	500	4000–6000
	Keck / DEIMOS ?	76.0	0.015	150	9000–20000
Proposed & unfunded	Megamapper @ GMT	28.0	7.06	20,000	
	Keck / FOBOS	76.0	0.087	1800	
	MSE @ CFHT	78.5	1.52	4000	
	ESO Spectel	113.1	4.90	5000	

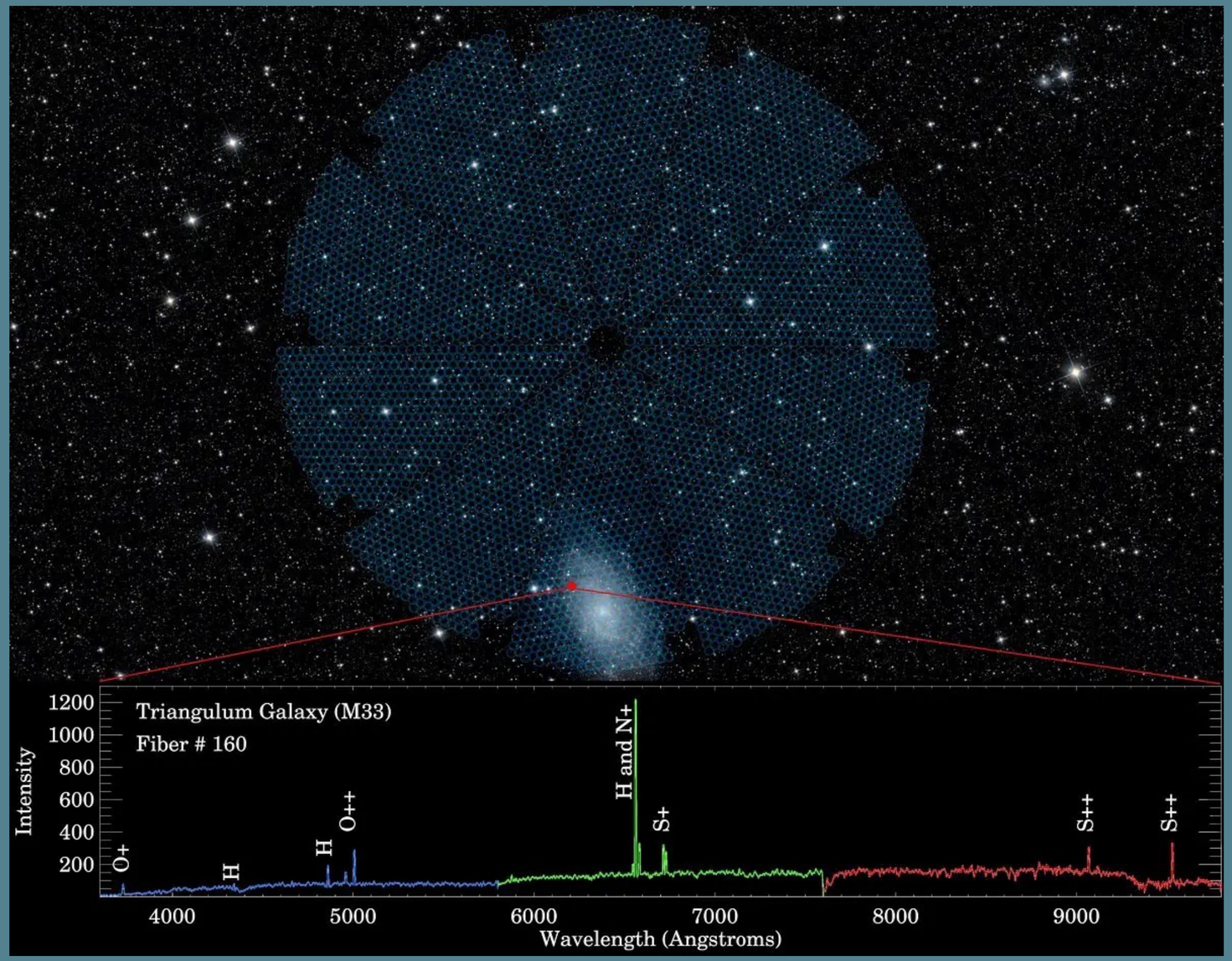
From Ellis 2021

THE ERA OF LARGE SURVEYS



I. K. Baldry

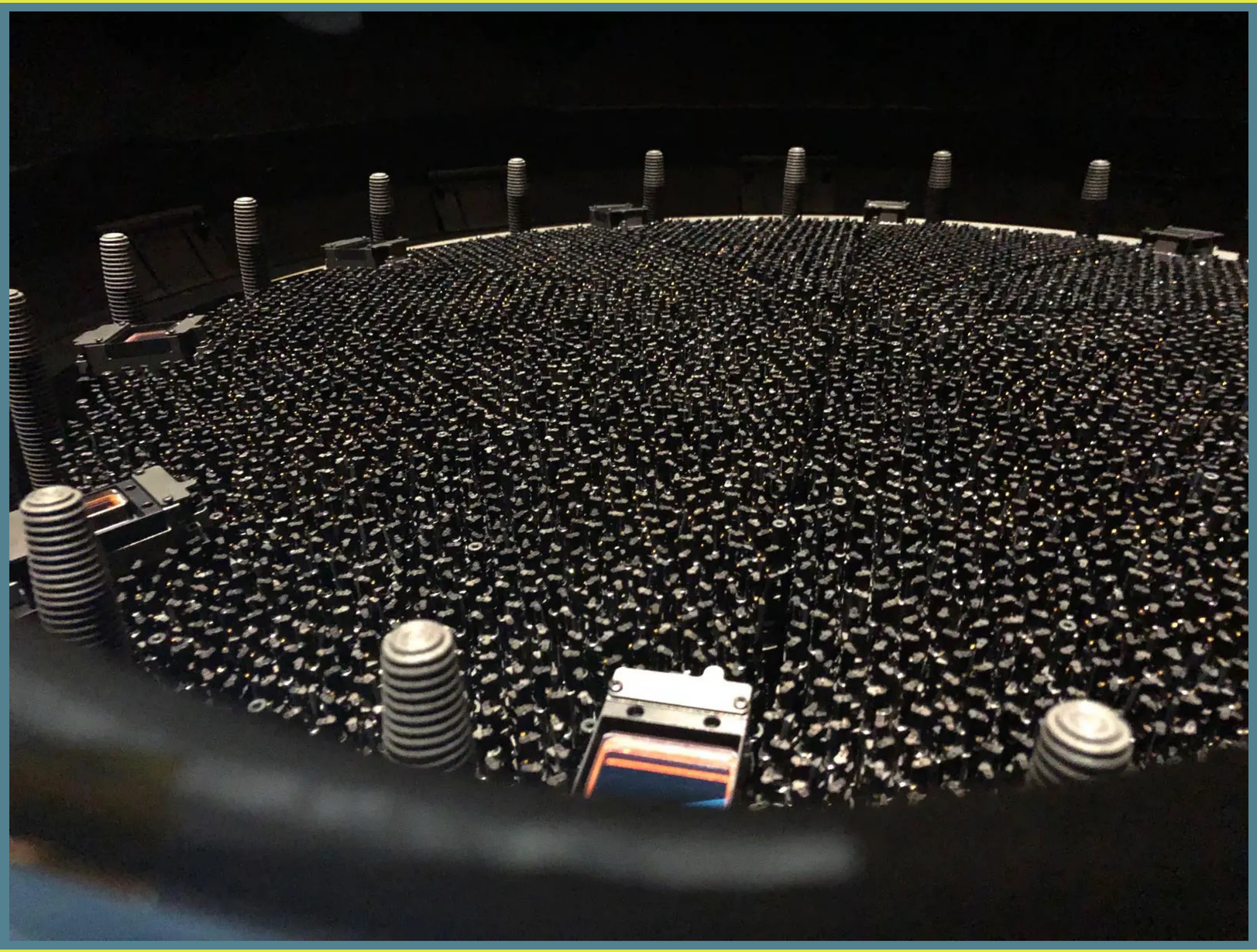
DARK ENERGY SPECTROSCOPIC INSTRUMENT (DESI)



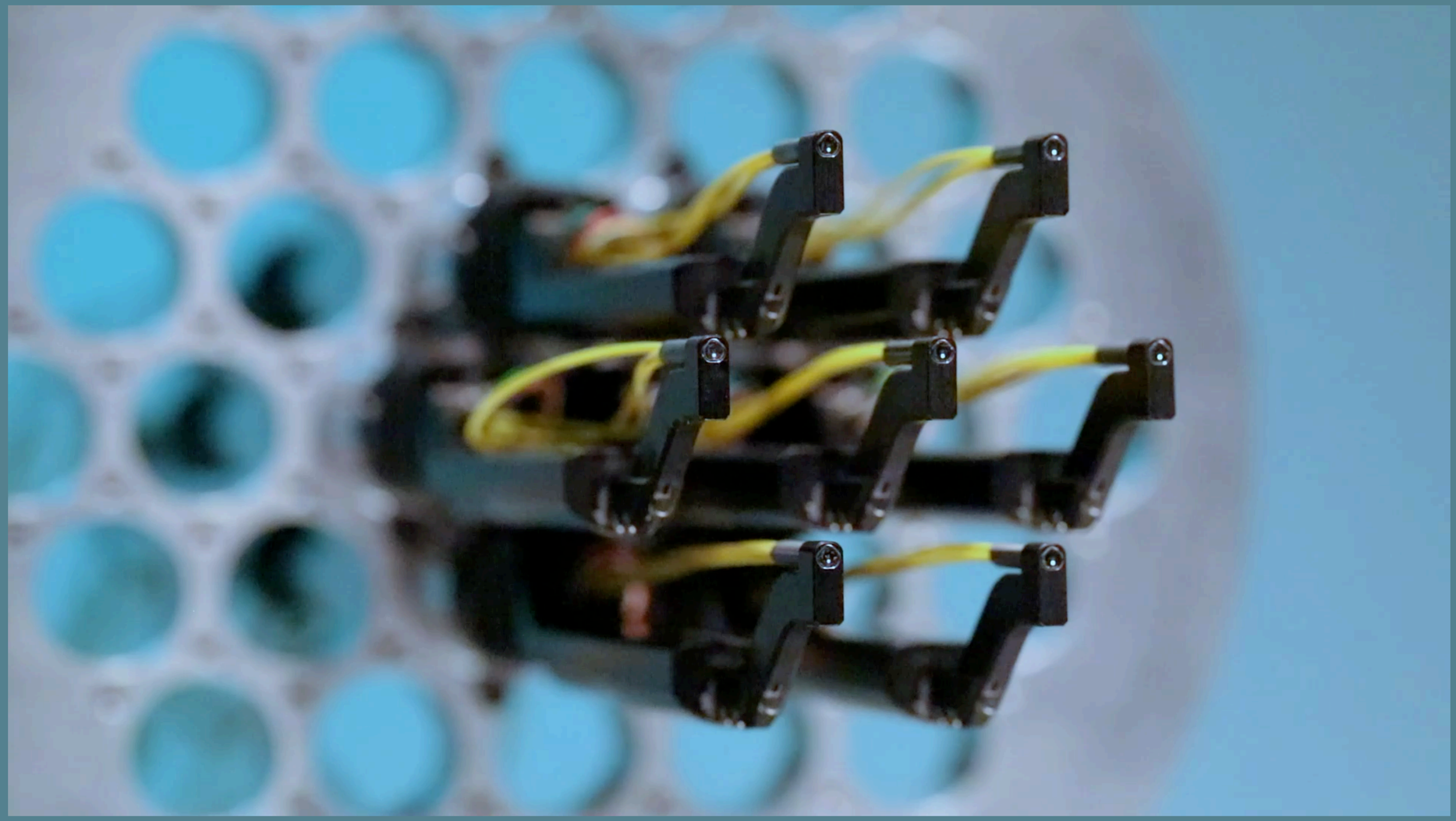
DESI Early Data Release contains 2M spectra from the Survey Validation phase of galaxies, quasars and stars

Targets have been selected from the Legacy Surveys (DECaLS, BASS and MzLS)

DARK ENERGY SPECTROSCOPIC INSTRUMENT (DESI)



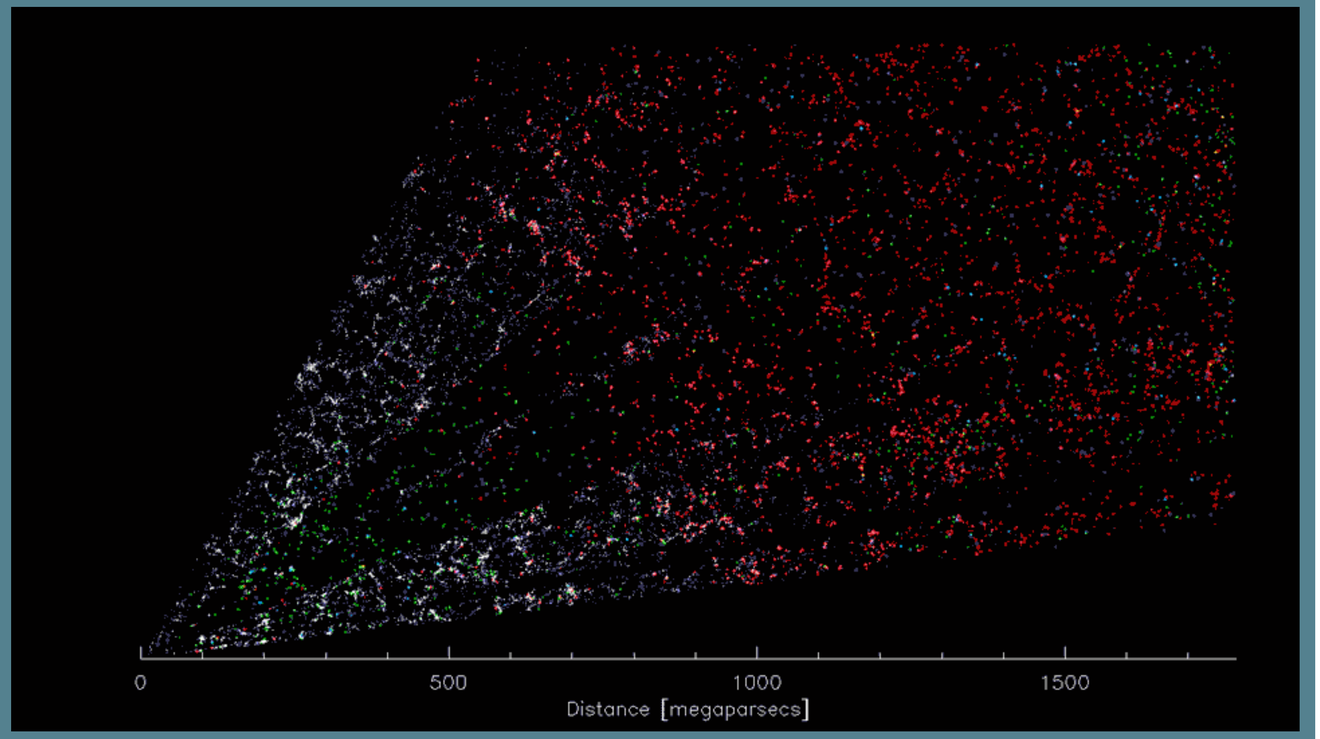
SDSS-V FIBERS FOR APOGEE-2



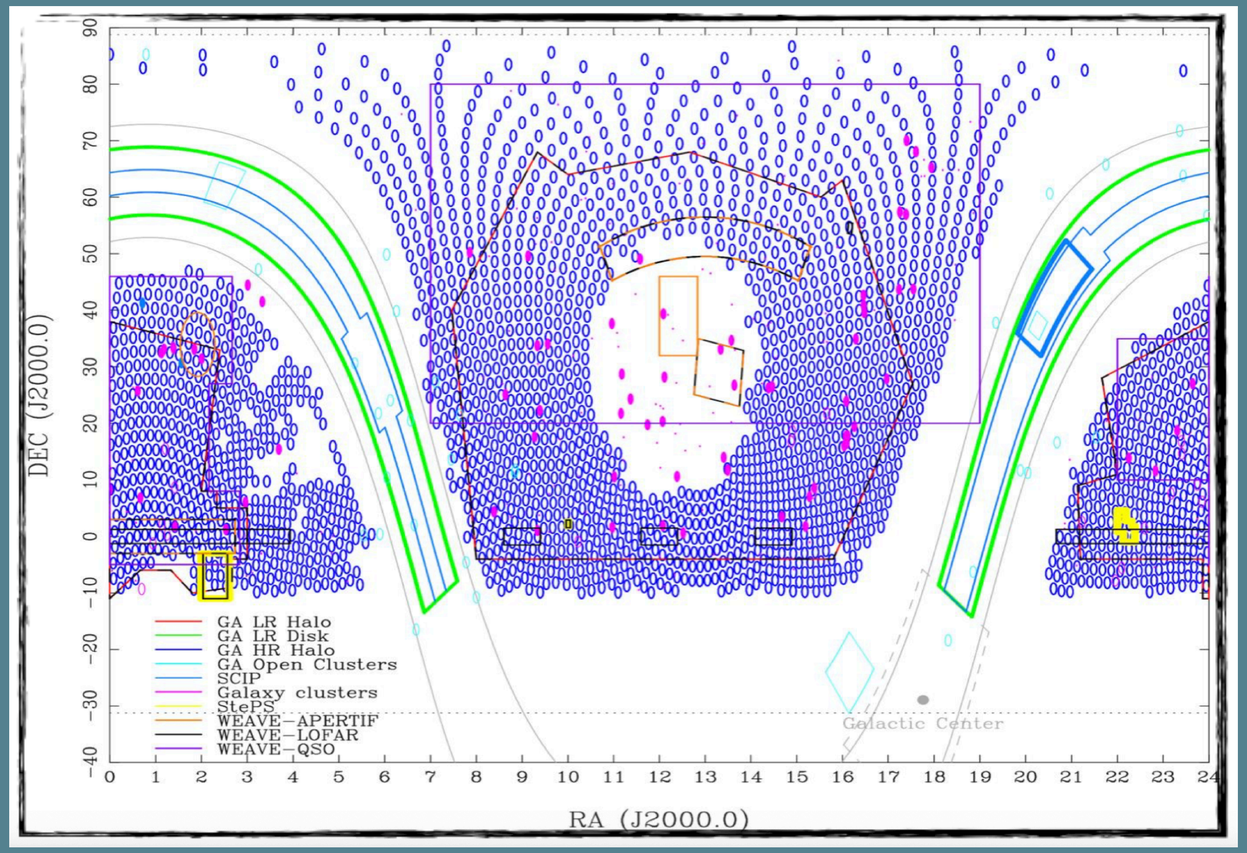
WHT ENHANCED AREA VELOCITY EXPLORER (WEAVE)

THE ERA OF LARGE SURVEYS: HIGHLIGHTS

4m-class: DESI (Mayall) / WEAVES (WHT)



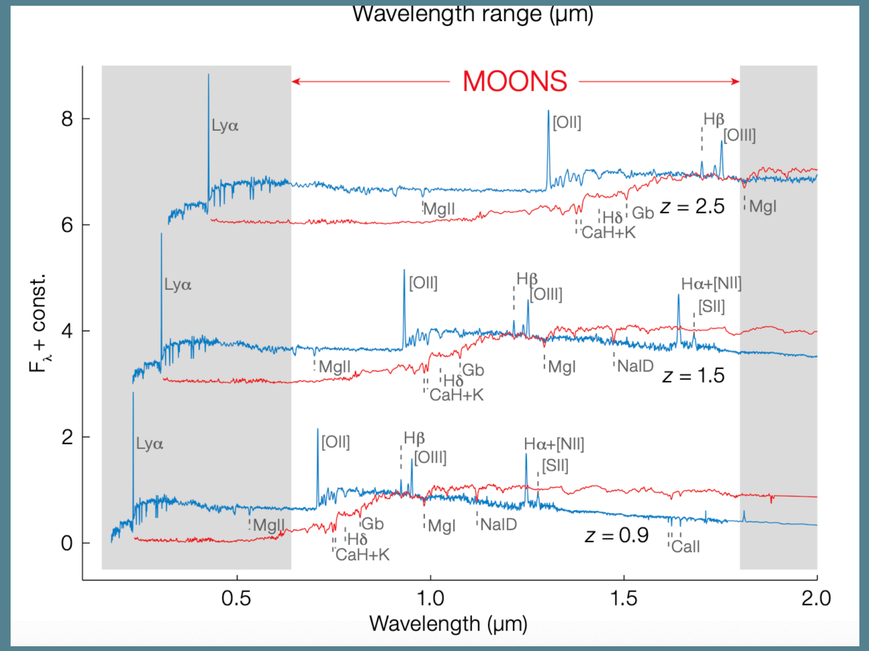
DESI Press Release 2022



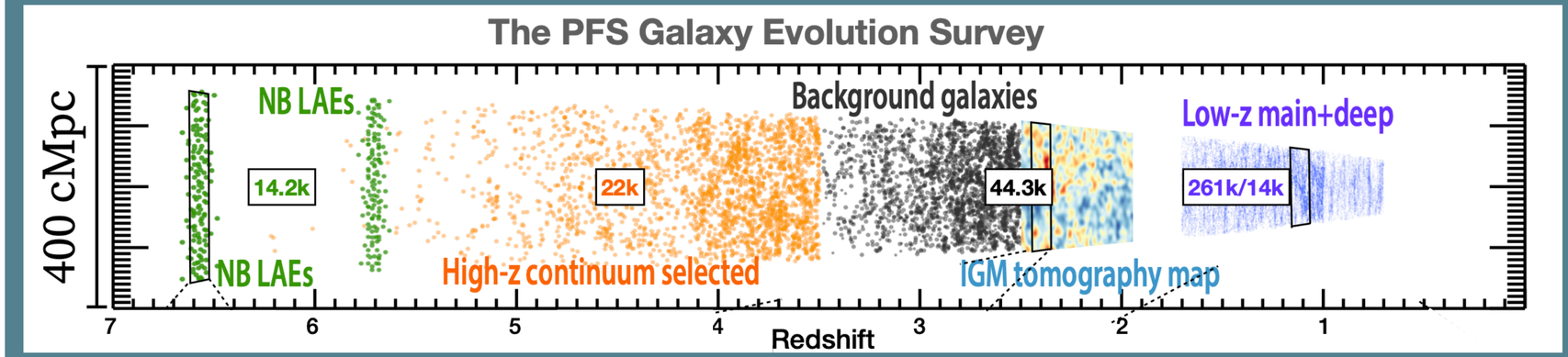
By S. Trager

THE ERA OF LARGE SURVEYS: HIGHLIGHTS

8m-class: MOONS (VLT) / PFS (Subaru)

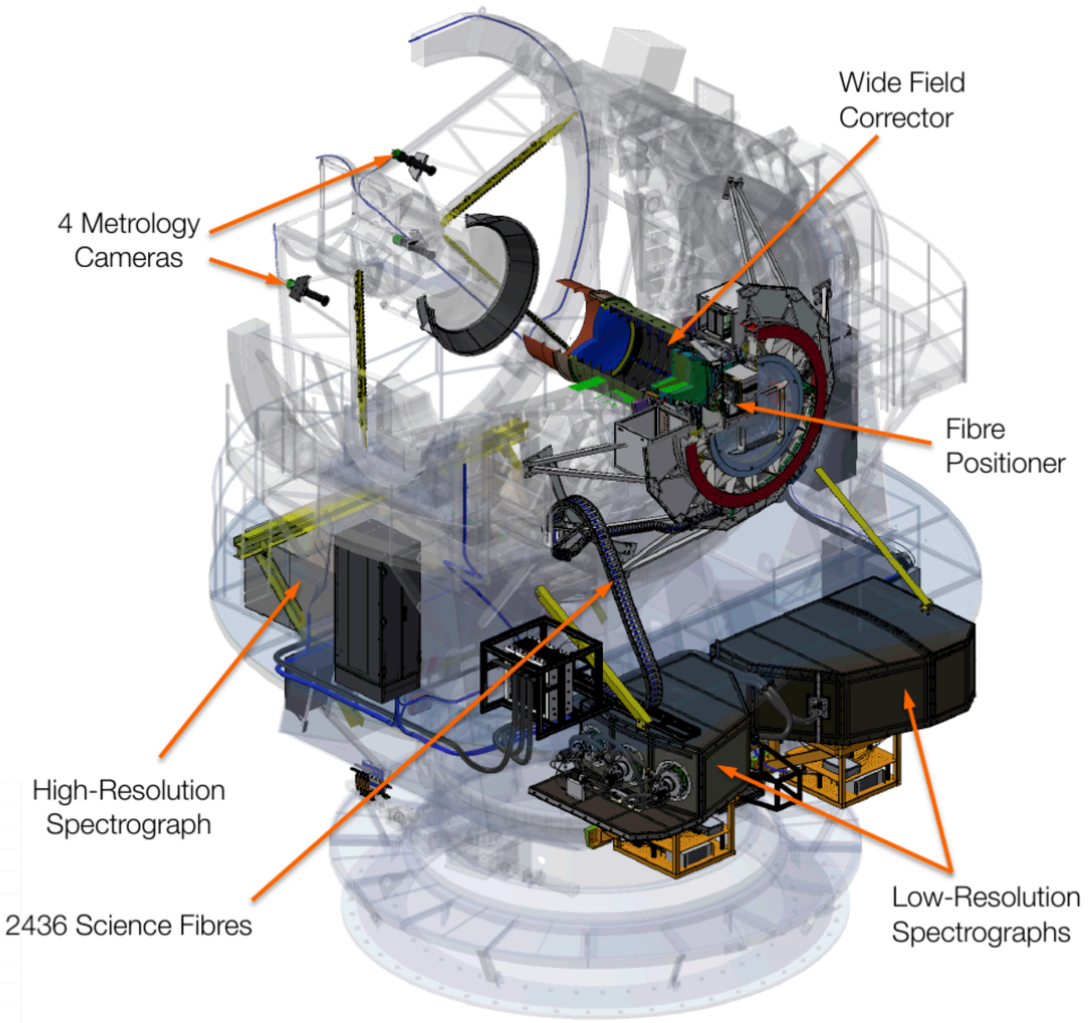


Maiolino+2020



Greene+2022

THE 4M MULTI-OBJECT-SPECTROSCOPIC-TELESCOPES (4MOST)



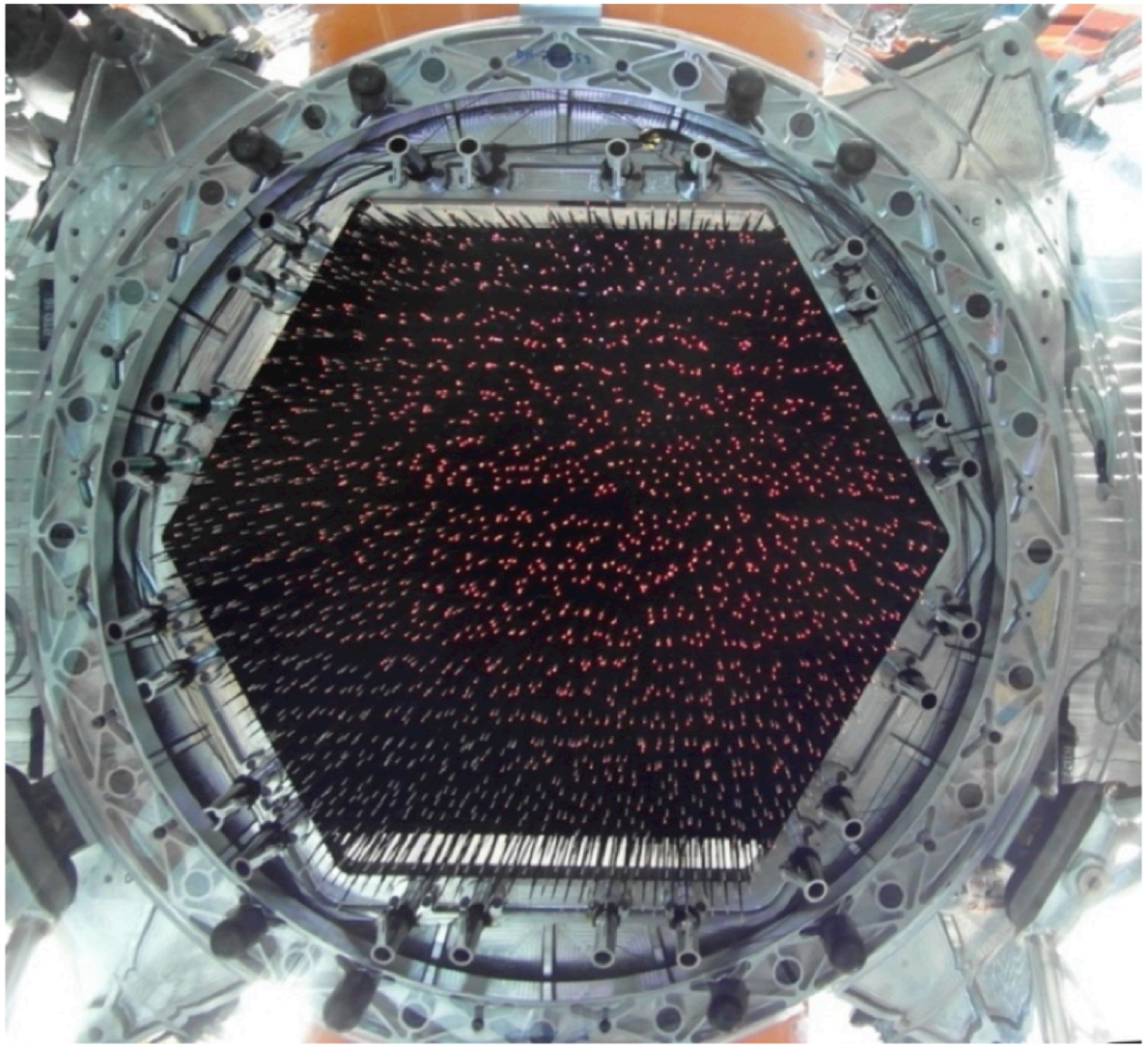
Low Resolution Spectrographs (2x)	Passband: 370-950nm $R > \lambda \times 10$ for 400nm $< 500nm$ $R > 6000$ for 500nm $< 885nm$ Velocity Accuracy <1 km/s 1624 fibres in total
High Resolution Spectrograph	Passbands: 392.6-435.5, 516-573, 610-679 nm $R > 18{,}500$ Velocity Accuracy <1km/s 812 fibres

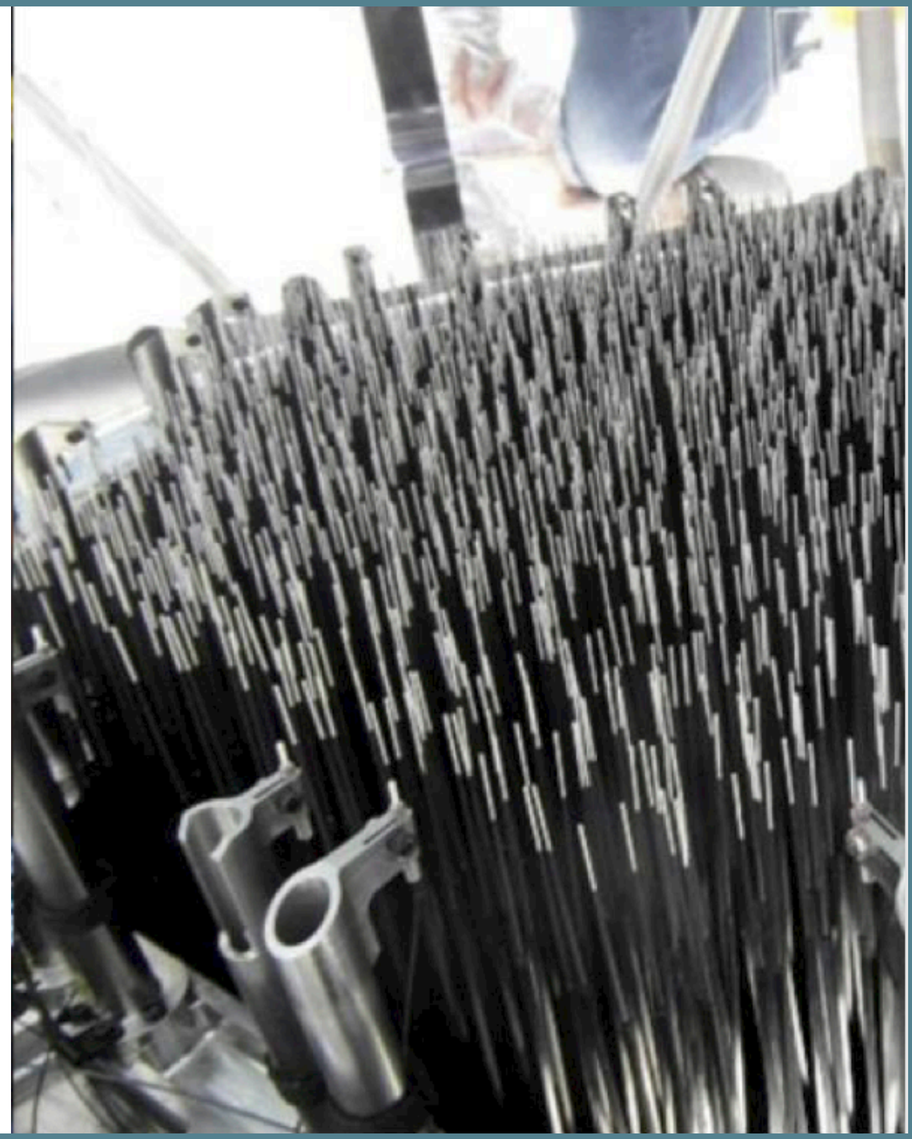
In a 5-year survey 4MOST of **survey observations**

- Cover at least twice an area of =16,000 degree^2 (goal >20,000)
- Obtain >15 million (goal >25 million) spectra at resolution R~5000
- Obtain >1 million (goal >2 million) spectra at resolution R~20,000.

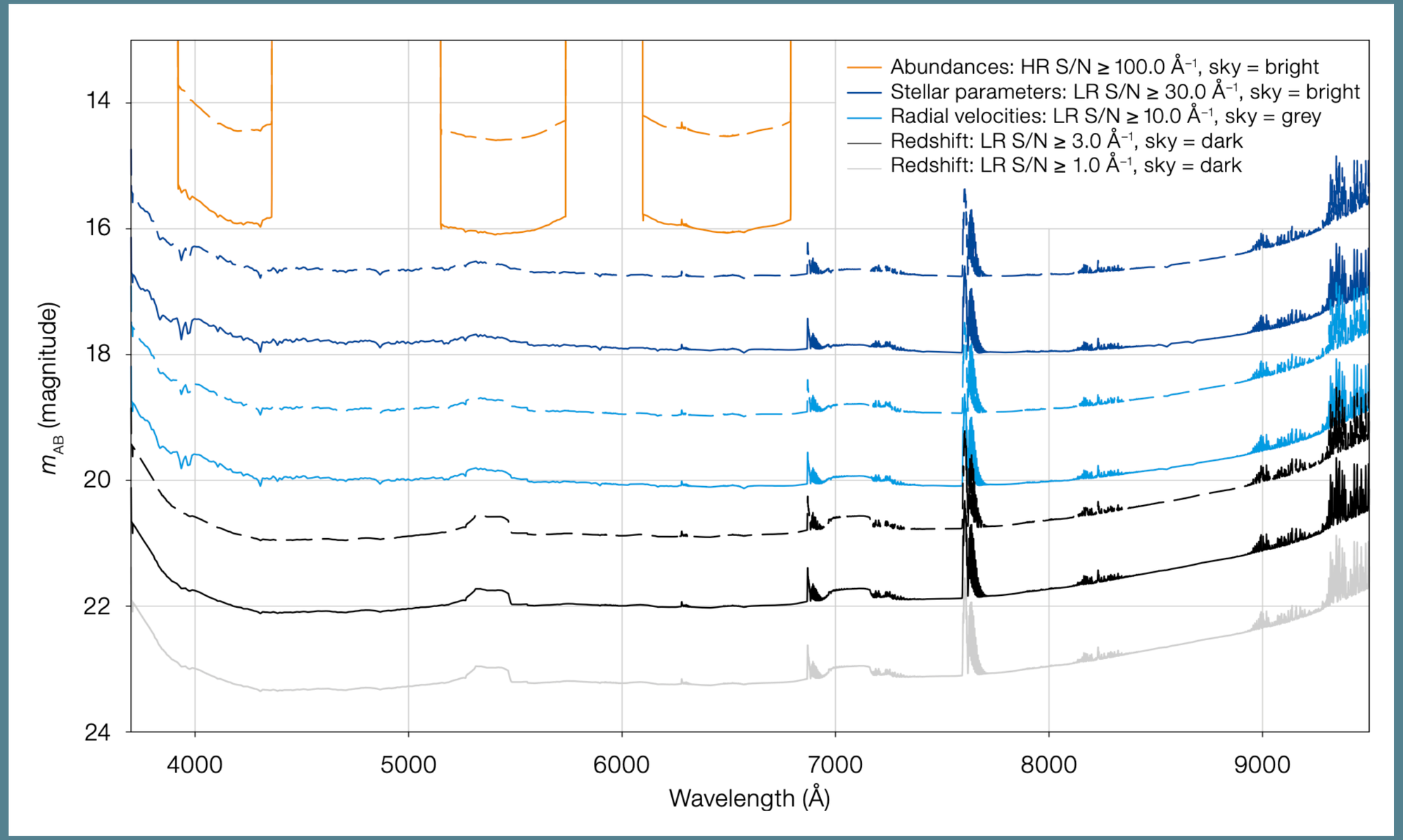
VISTA Telescope @ Paranal

4MOST





4MOST


Abundances: HR S/N ≥ 100.0 Å⁻¹, sky = bright
Stellar parameters: LR S/N ≥ 30.0 Å⁻¹, sky = bright
Radial velocities: LR S/N ≥ 10.0 Å⁻¹, sky = grey
Redshift: LR S/N ≥ 3.0 Å⁻¹, sky = dark
Redshift: LR S/N ≥ 1.0 Å⁻¹, sky = dark
m_{AB} (magnitude)
14
16
18
20
22
24
4000
5000
6000
7000
8000
9000
Wavelength (Å)

4MOST

Consortium Surveys (70%)

• Milky Way Halo LR Survey	Irwin (IoA) , Helmi (RuG)
• Milky Way Halo HR Survey	Christlieb (ZAH)
• Milky Way Disk and Bulge LR Survey	Chiappini, Minchev, Starkenburg (AIP)
• Milky Way Disk and Bulge HR Survey	Bensby (LU), Bergemann (MPIA)
• Galaxy Clusters Survey	Finoguenov (MPE)
• AGN Survey	Merloni (MPE)
• Galaxy Evolution Survey (WAVES)	Driver (UWA), Liske (UHH)
• Cosmology Redshift Survey	Kitaura (AIP), Richard (CRAL), Kneib (EPFL)
• Magellanic Clouds Survey	Cioni (AIP)
• Time-Domain Extragalactic Survey (TIDES)	Sullivan (Southampton)

4MOST

Community Surveys (30%)

Toloza, O. et al. – The White Dwarf Binary Survey (WDB)
Sacco, G. G. et al. – The 4MOST Survey of Young Stars (4SYS)
Ibata, R. et al. – 4MOST Gaia RR Lyrae Survey (4GRoundS)
Lucatello, S. et al. – Stellar Clusters in 4MOST
Pawlak, M. et al. – Spectroscopic Discovery of Binaries with Dormant Black Holes
Skúladóttir, Á. et al. – The 4MOST Survey of Dwarf Galaxies and their Stellar Streams (4DWARFS)
Iovino, A. et al. – Stellar Population Survey Using 4MOST (4MOST-StePS)
Duncan, K. et al. – Optical, Radio Continuum and HI Deep Spectroscopic Survey (ORCHIDSS)
Gruen, D. et al. – 4MOST Complete Calibration of the Colour-Redshift Relation (4C3R2)
Haines, C. et al. – CHANCES: A CHileAN Cluster galaxy Evolution Survey
Bauer, F. E. et al. – Chilean AGN/Galaxy Extragalactic Survey (ChANGES)
Krogager, J.-K. et al. – The 4MOST–Gaia Purely Astrometric Quasar Survey (4G-PAQS)
Peroux, C. et al. – Transform our Understanding of the Baryon Cycle with High-Resolution Quasar Spectroscopy (ByCycle)
Taylor, E. N. et al. – The 4MOST Hemisphere Survey of the Nearby Universe (4HS)
Collett, E. T. et al. – The 4MOST Strong Lensing Spectroscopic Legacy Survey (4SLSLS)

Messenger Nº190

CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

~ 10% of the 30% of 4MOST Comm Survey time: ~ 2 Mhrs of low-resolution spectroscopy for a representative sample of (mostly) variability and SED selected AGN

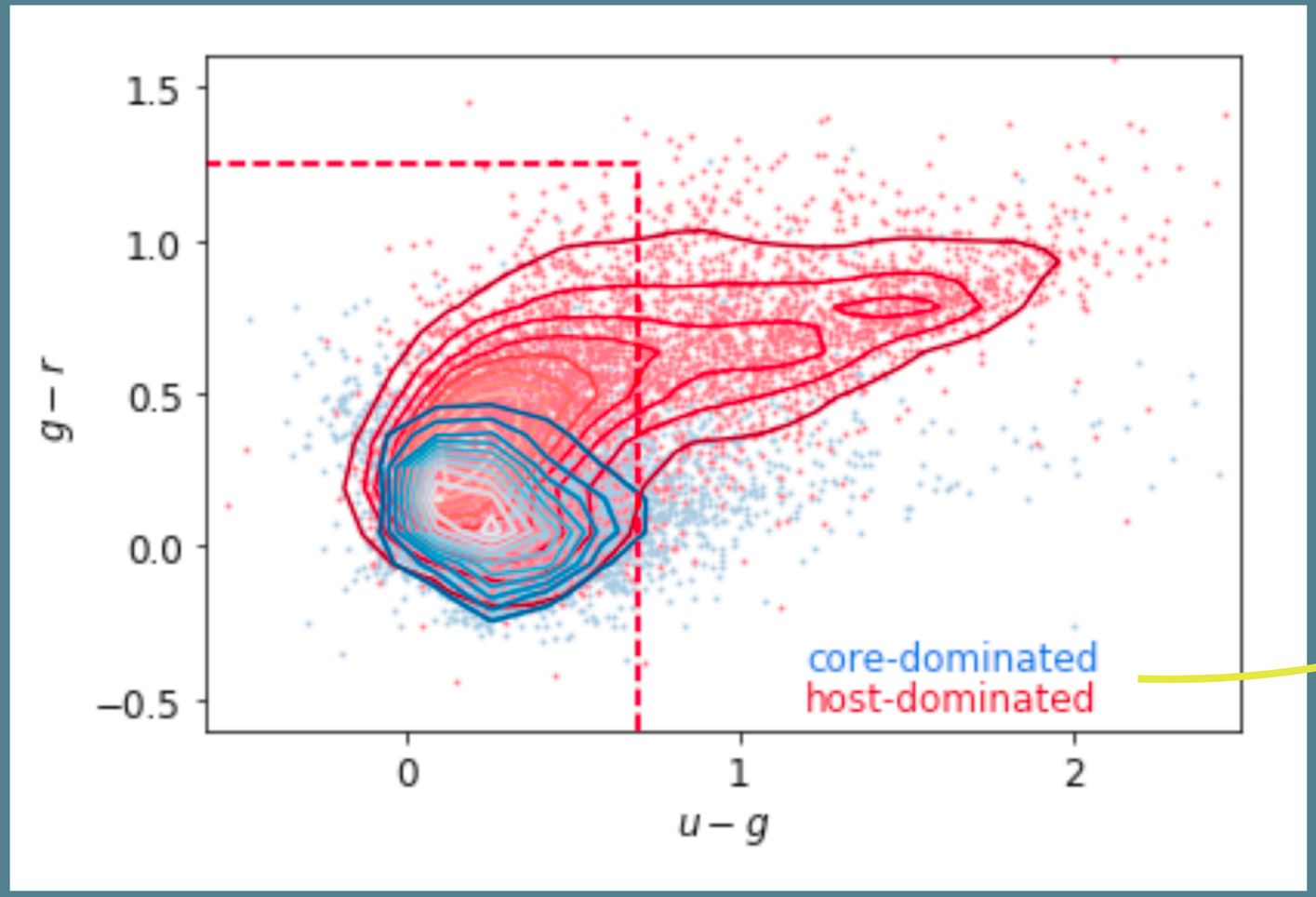
Variability selection:
Currently ZTF + CLQ
In the future: Rubin LSST survey
We are using advanced AI techniques (see the ALeRCE Explorer: https://alerce.online)

SED selection:
Optical-NIR-MIR SED modeling to look for warm dust

+ Changing Type / State AGN, TEDs, Lenses, Intervening QALs

CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

Variability selection:

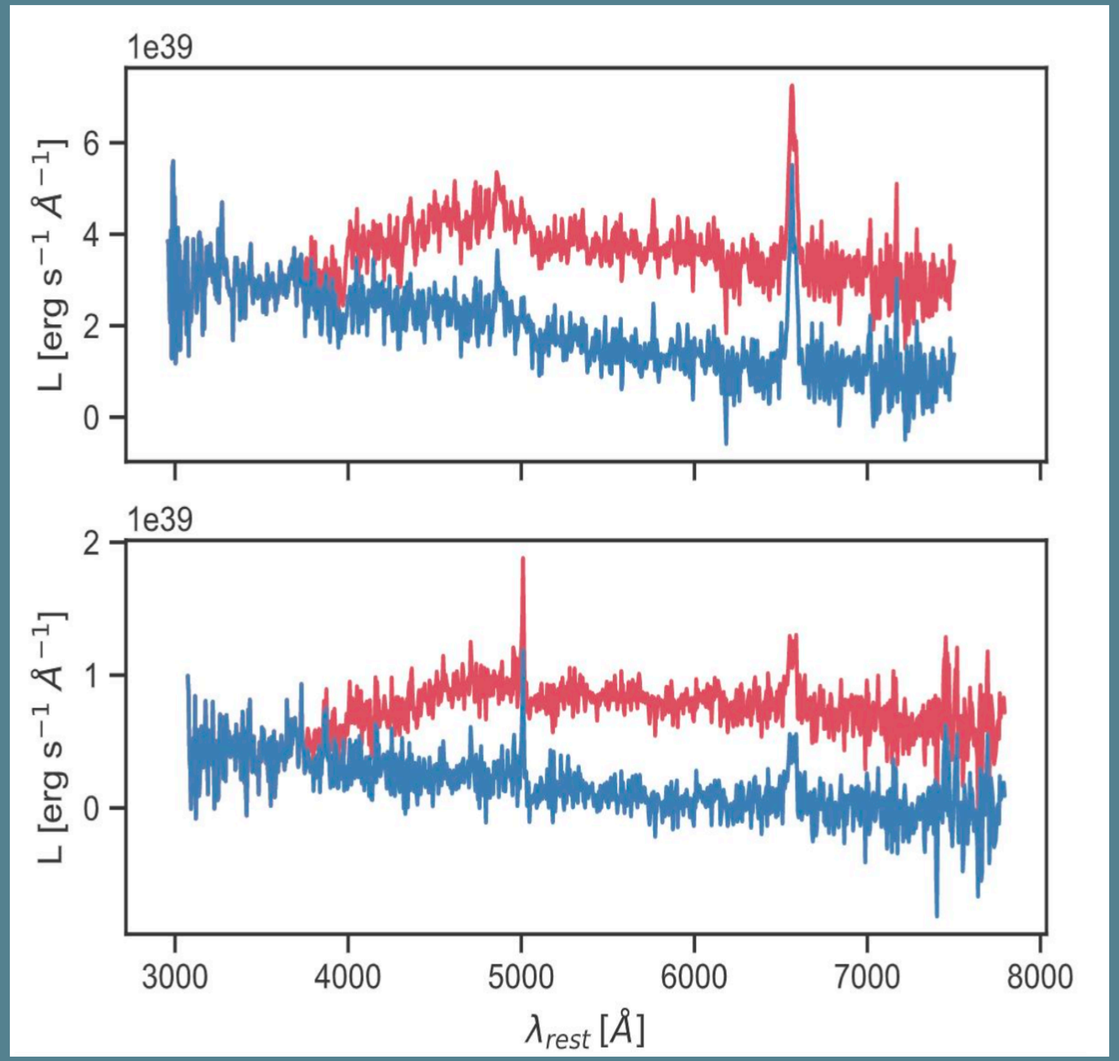


As classified by a random forest algorithm (see alerce.online)

Sánchez-Saez+2021

CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

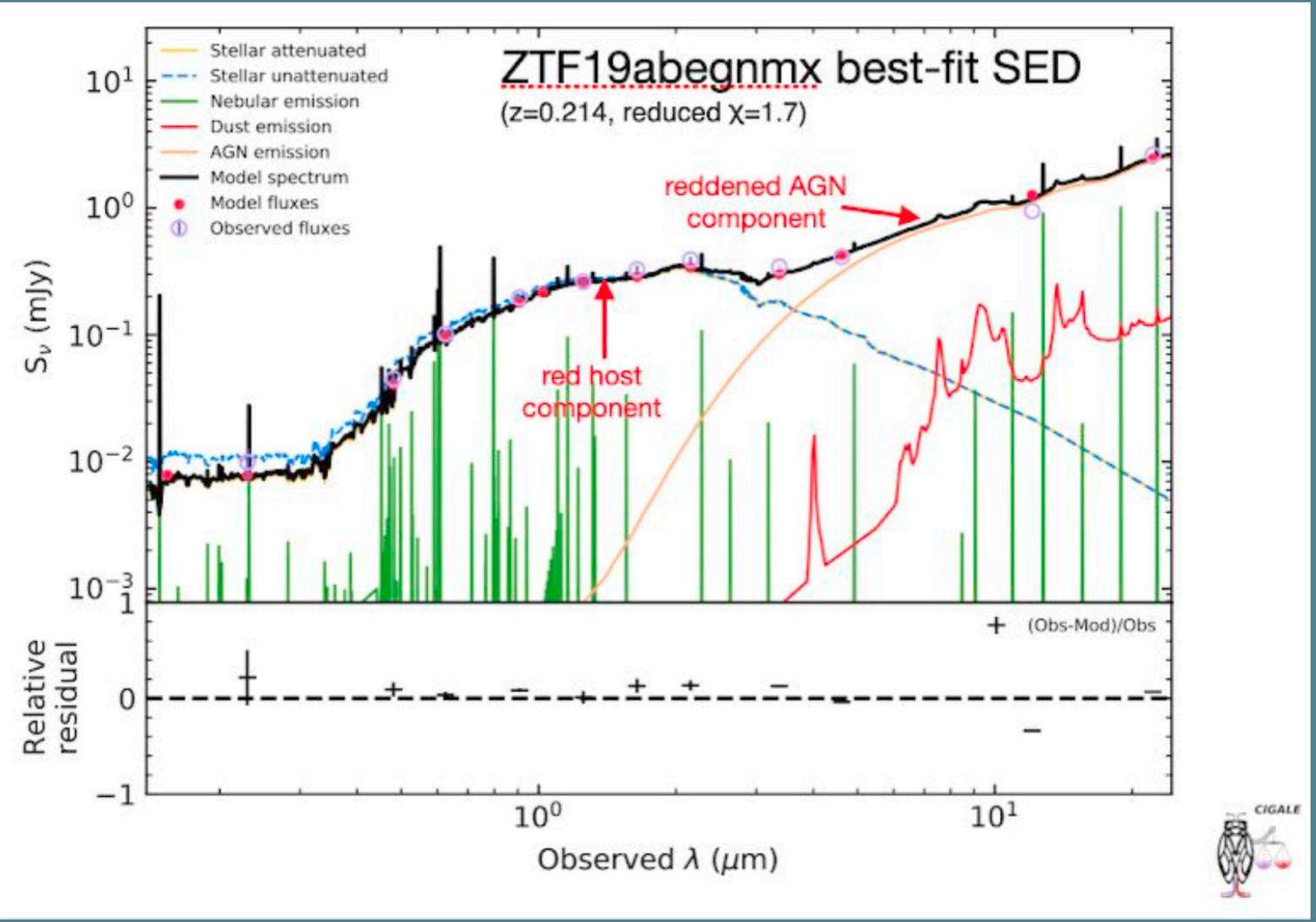
Variability selection:



Sánchez-Saez+2019

CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

SED selection:

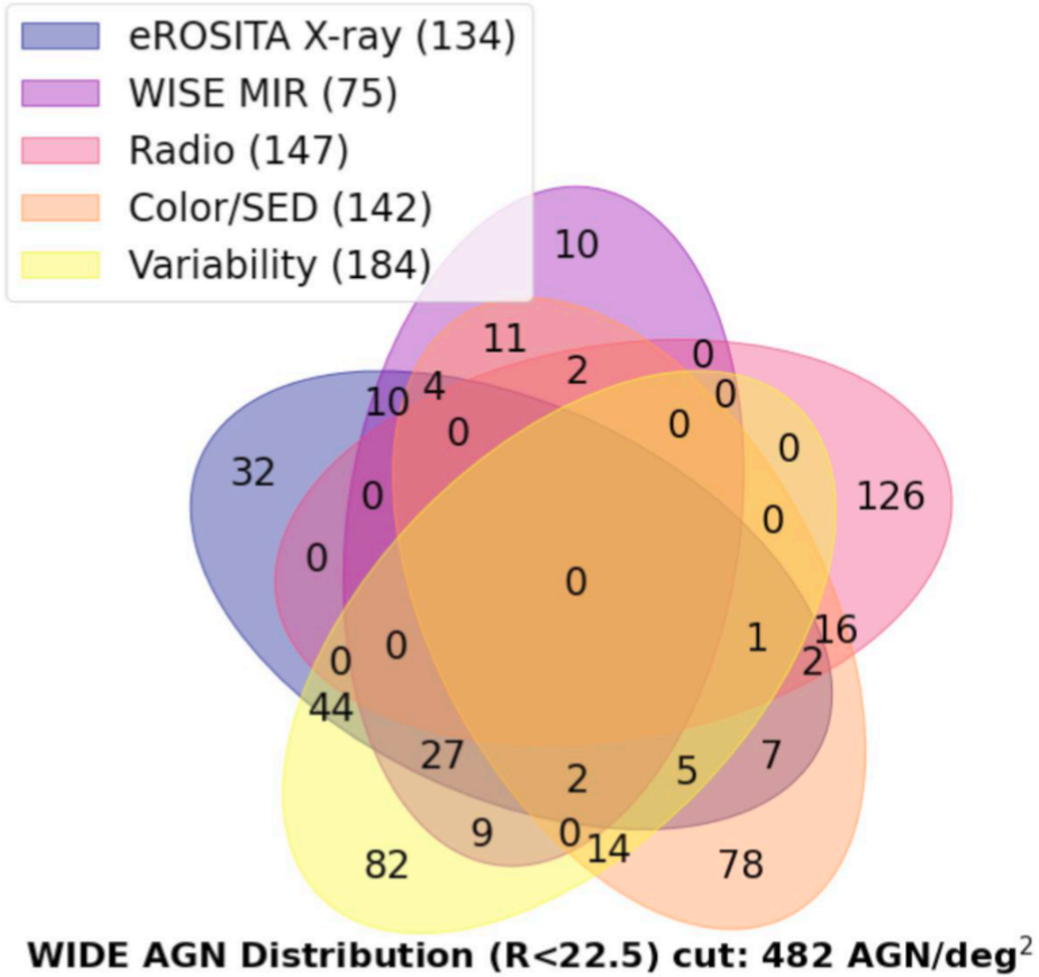


Using CIGALE

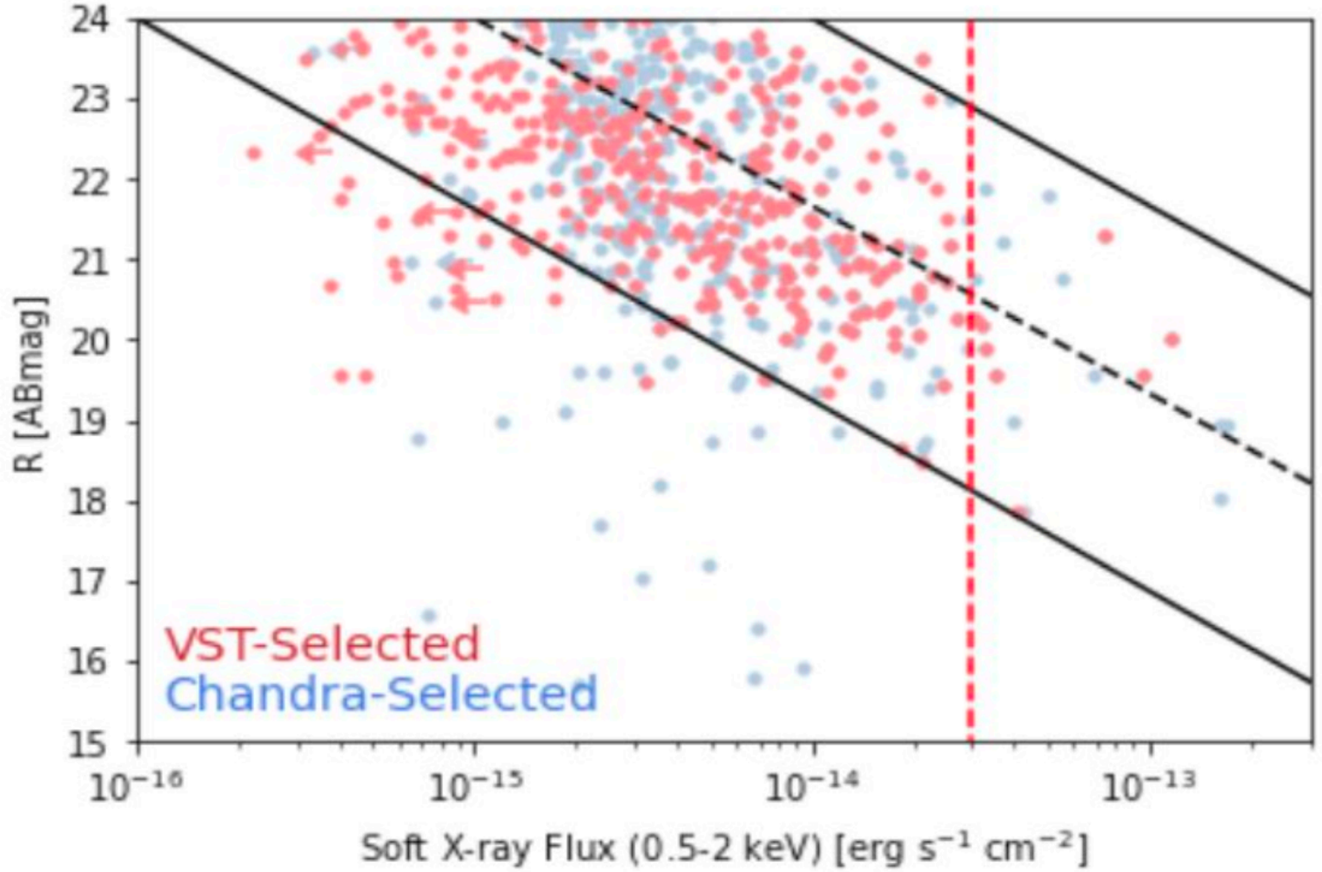
Boquien+2019

CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

Overlap with eROSITA GTO AGN Survey



WIDE AGN Distribution (R<22.5) cut: 482 AGN/deg^2



CHILEAN AGN / GALAXIES EXTRAGALACTIC SURVEY (CHANGES)

Main Measurables:

- Redshifts
- Emission line measurements
- Detection of broad components
- Host Galaxy characterization
- Variations in SED / line emission profiles

Main Deliverables:

BH accretion rate densities, evolution and host synergies for moderately accreting AGN ($10^{-4} < L/L\mathrm{Edd} < 10^{-1}$) that comprises ~ 50–80% of the estimated total mass accretion onto BHs in type 1 and mildly obscured AGN that strongly complements other 4MOST AGN samples.