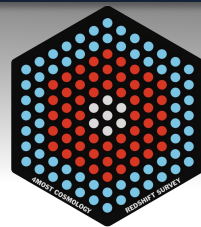




4MOST – 4m Multi-Object Spectroscopic Telescope



4MOST-CRS: BG and LRG Target Selection

WG Dark Energy 9th Edition, University of Montpellier

Aurélien Verdier, Antoine Rocher & Behnood Bandi - EPFL - LASTRO

ArXiv: 2508.07311 & 2510.02449

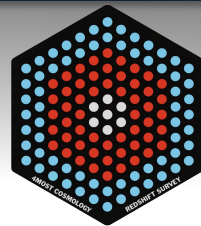
07.11.2025

www.4MOST.eu





4MOST – 4m Multi-Object Spectroscopic Telescope



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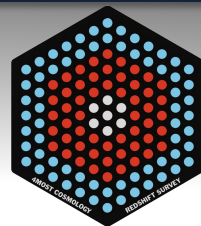
07.11.2025

www.4MOST.eu





4MOST – 4m Multi-Object Spectroscopic Telescope



4MOST-Cosmology Redshift Survey: Overview

WG Dark Energy 9th Edition, University of Montpellier

Aurélien Verdier, Antoine Rocher & Behnood Bandi - EPFL - LASTRO

ArXiv: 2508.07311 & 2510.02449

07.11.2025

www.4MOST.eu



4MOST

4MOST Site

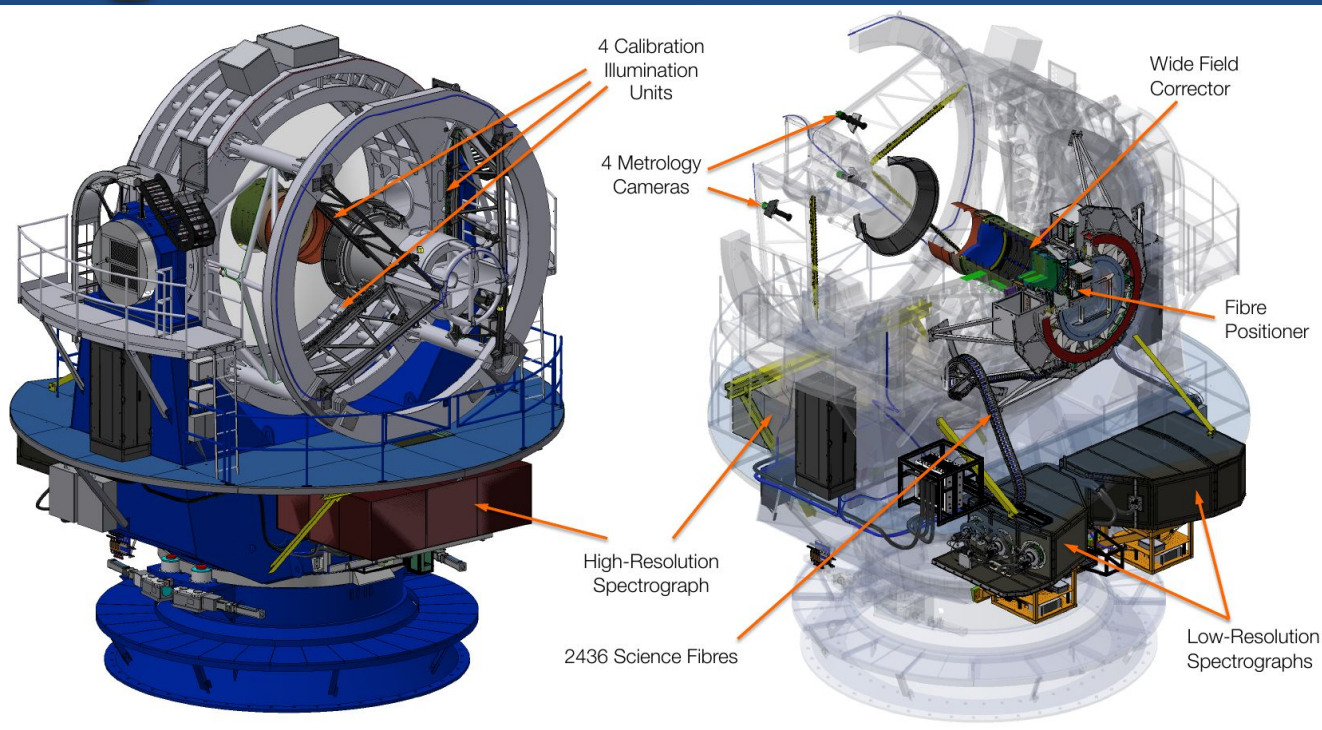
Visible and Infrared Survey
Telescope for Astronomy (VISTA)



Picture from P. Horálek/ESO



4MOST Facility



5-years
Starts in
2026

Fibers
2436

FoV
4.2 deg²
Hexagonal

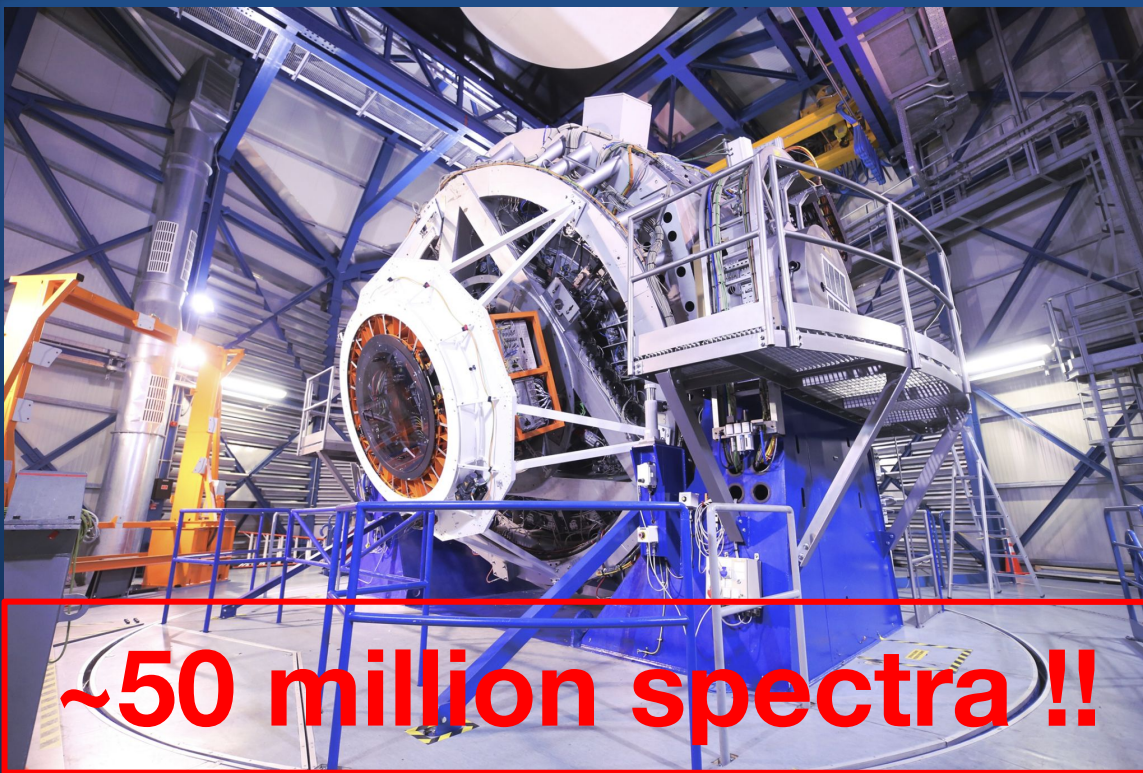
Mirror
4m
(VISTA)

Spectro
Low-res &
High-res

Channels
Blue,
Green and
Red



4MOST Facility



~50 million spectra !!

5-years
Starts in
2026

Fibers
2436

FoV
4.2 deg²
Hexagonal

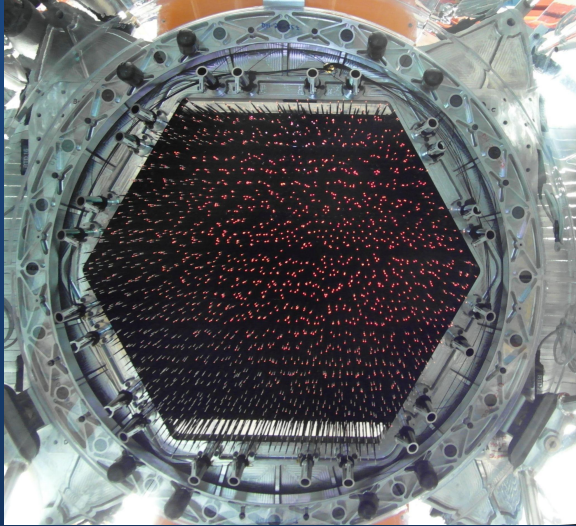
Mirror
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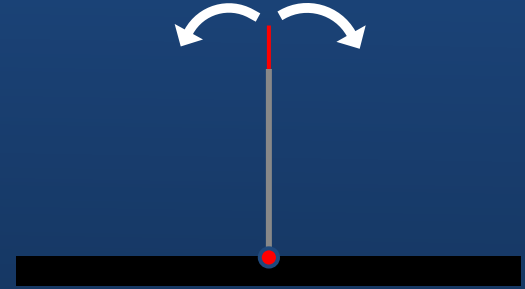


4MOST Fibre System



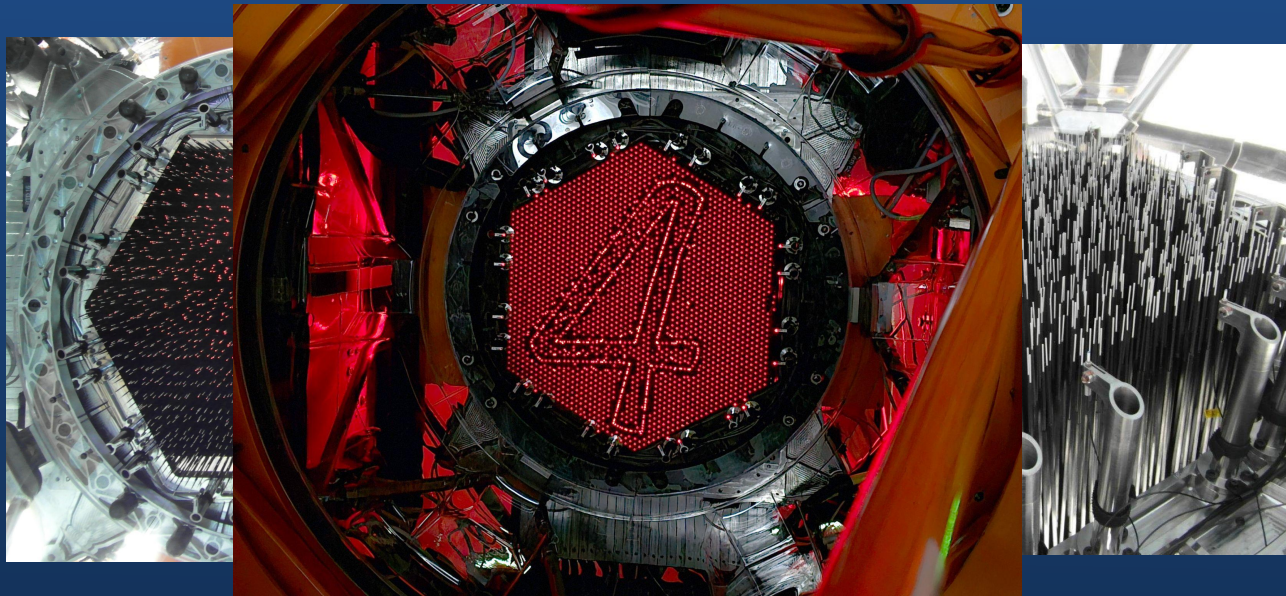
Reconfiguration time

$< 2\text{min}$

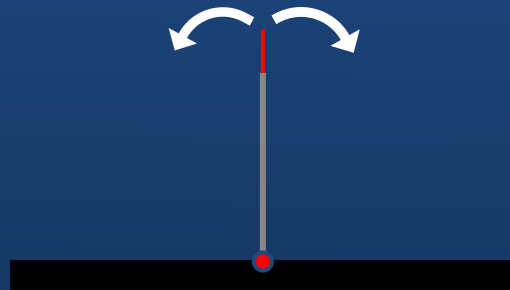




4MOST Fibre System

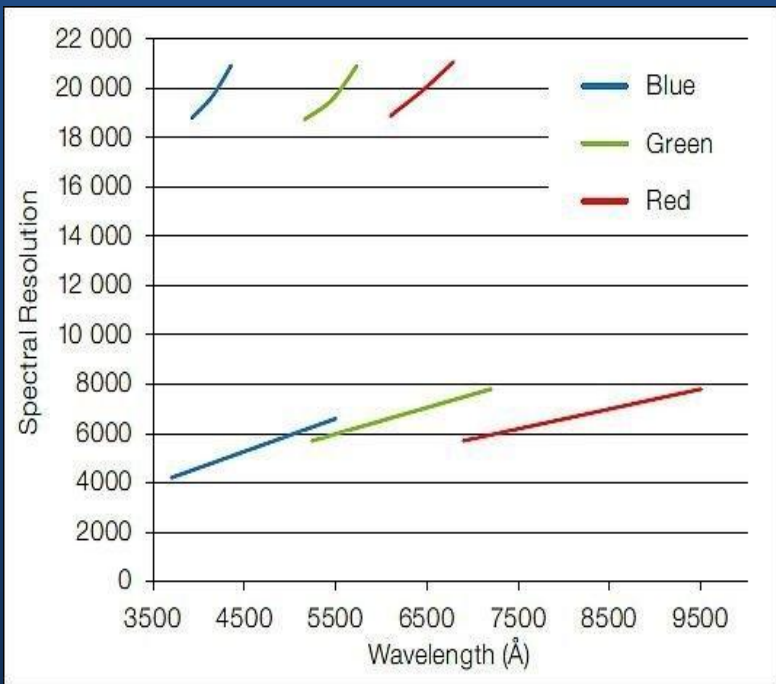


Reconfiguration time
 $< 2\text{min}$





4MOST Spectros



Reconfiguration time

< 2min

1624 Low-Res. Spectro.

R ~ 4'000 - 8'000

Wavelength Coverage

370-950 nm

812 High-Res. Spectro.

R ~ 18'500 - 21'000

Blue

393-436
nm

Green

516-573
nm

Red

610-679
nm

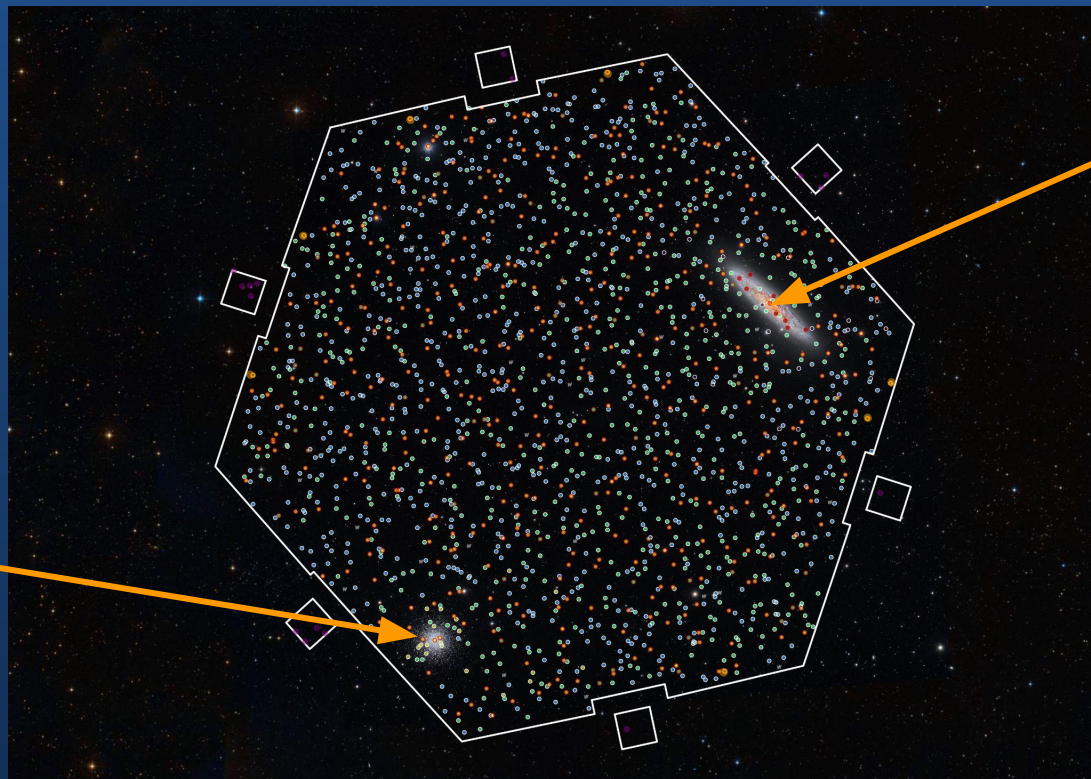


4MOST First Light !

18 Oct. 2025

NGC 288

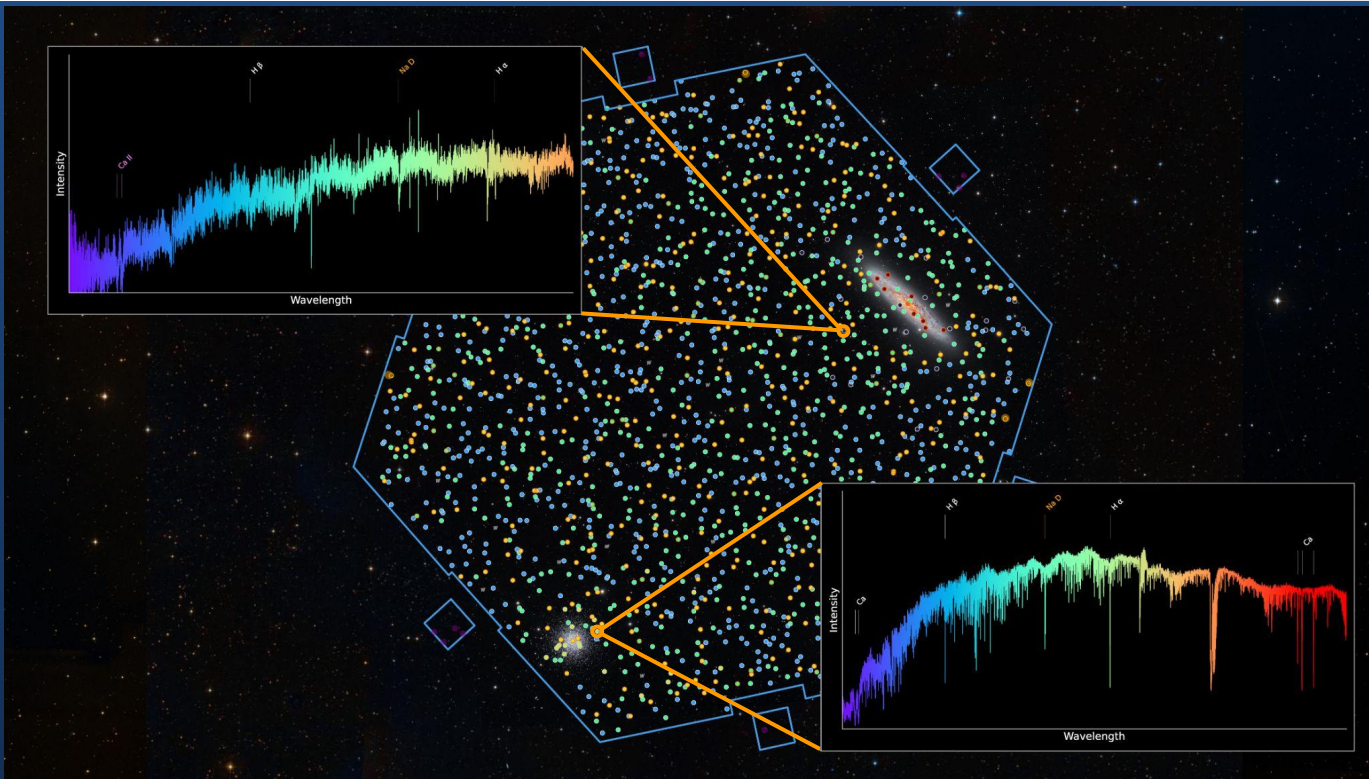
Sculptor Galaxy



4MOST

4MOST First Light !

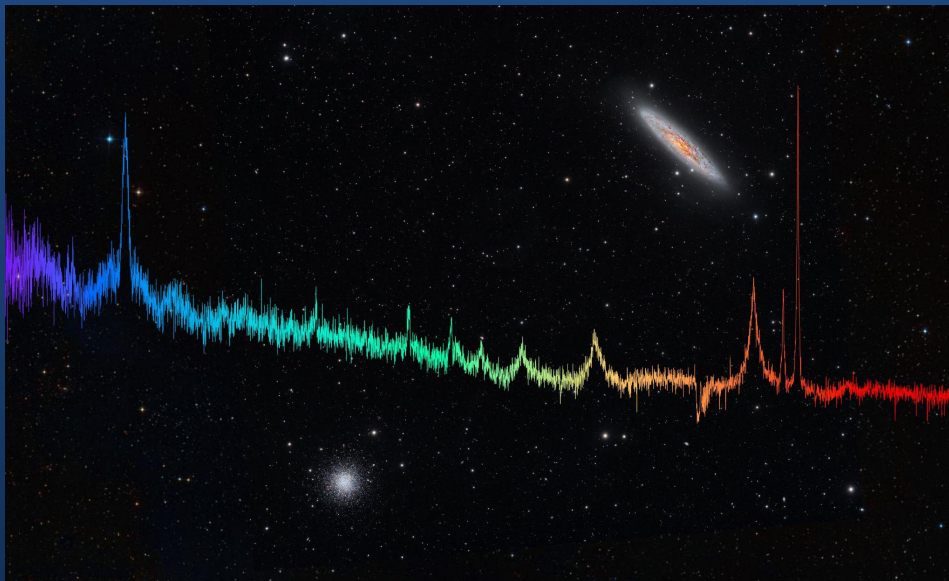
Stellar Clusters





4MOST First Light !

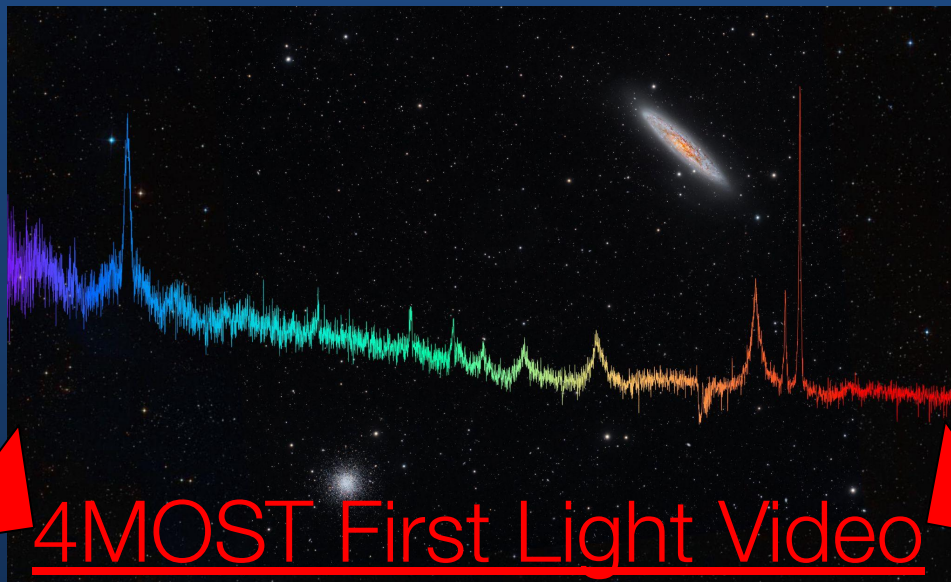
AGN Spectrum





4MOST First Light !

AGN
Spectrum



[4MOST First Light Video](#)

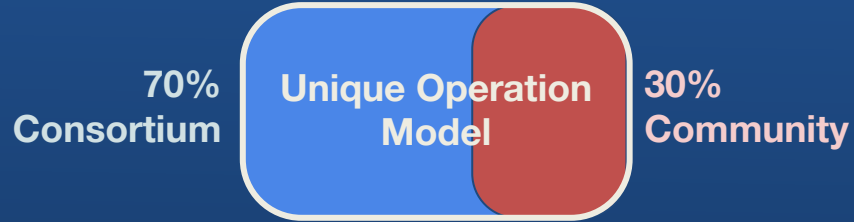


4MOST Surveys

**Unique Operation
Model**

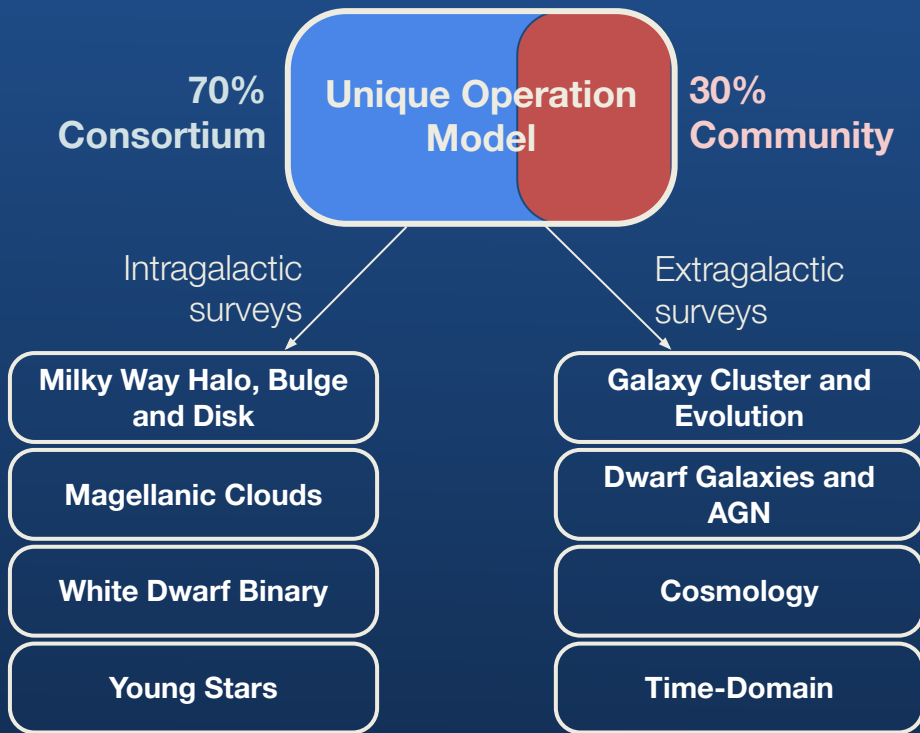


4MOST Surveys





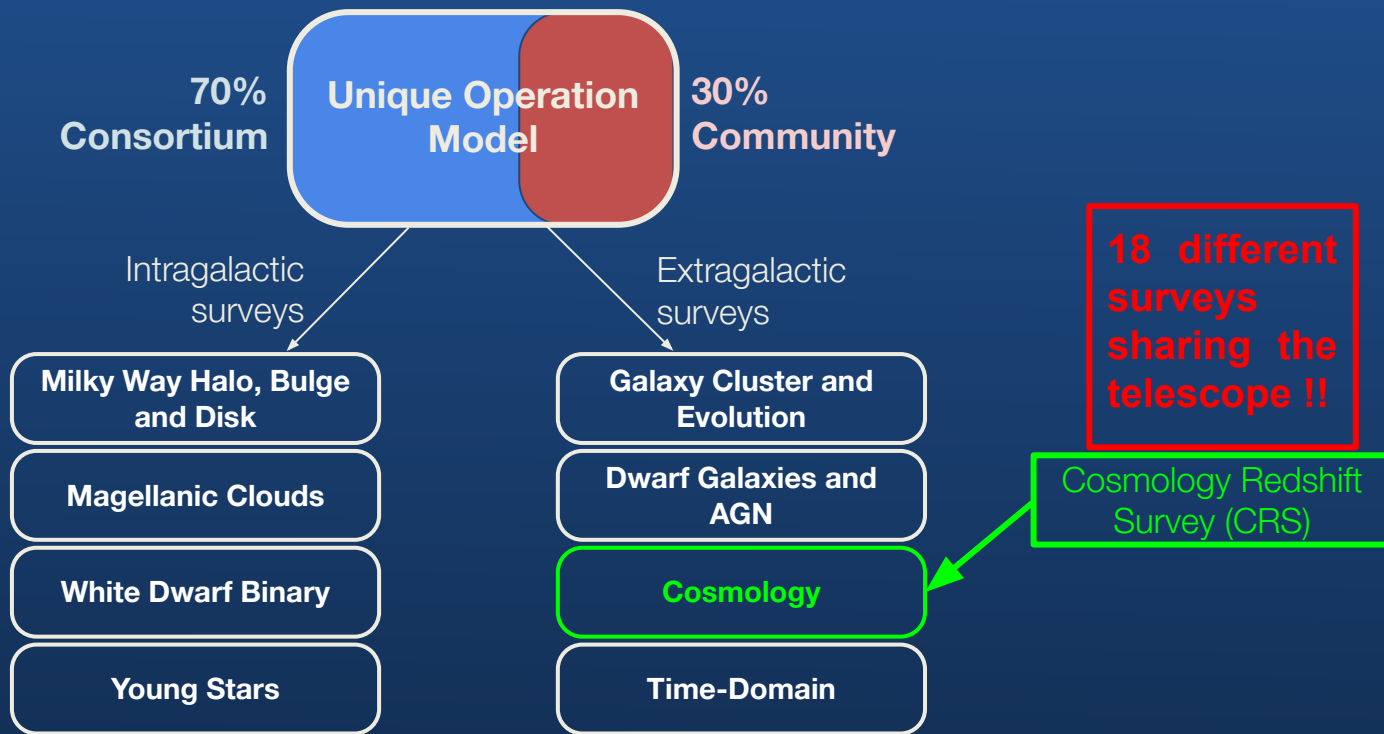
4MOST Surveys



18 different surveys sharing the telescope !!

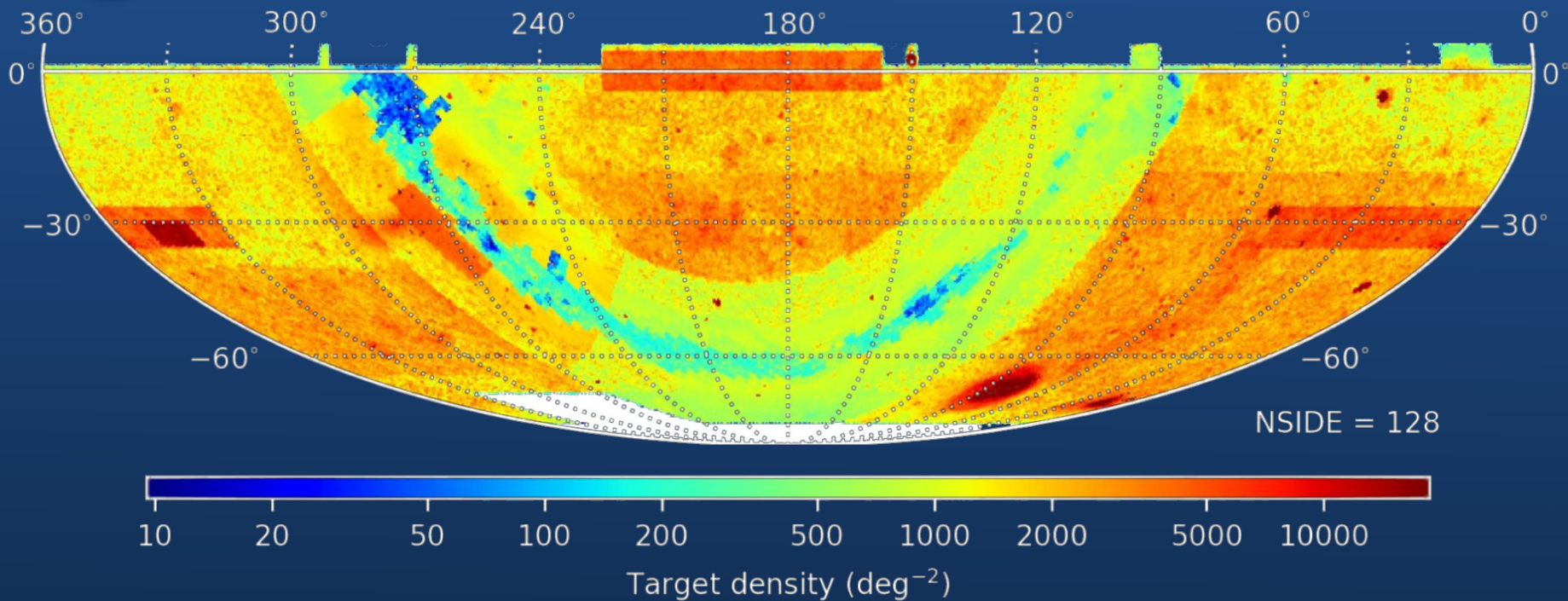


4MOST Surveys





4MOST Footprint





4MOST Synergies

Main Science Purposes

Weak Lensing

Galaxy Clusters

SNe Ia

Large Scale Structures

Synergies

LSST / Euclid
Weak Lensing

SKA / HIRAX
Radio Surveys

SPT / ACT
CMB Surveys

eROSITA
Clusters



Questions about 4MOST ?





CRS

COSMOLOGY REDSHIFT SURVEY

Overview

Goal: Constrain Dark Energy and General Relativity by measuring cosmic expansion history and growth of structure

Bright Galaxies

~1.5 million targets

Luminous Red Galaxies

~2.8 million targets

Quasars + QSO Lyman α

~1.5 million targets





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CRS is one of the 18 surveys in 4MOST
Fiber time is shared with other experiments

Hard to be competitive
with DESI !

Synergy with South Hemisphere facilities



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Quasars + QSO Lyman α

~1.5 million targets

0.15

0.4

1.0

2.1

3.5

Redshift

This Talk

CRS is one of the 18 surveys in 4MOST
Fiber time is shared with other experiments

Hard to be competitive with DESI !

Synergy with South Hemisphere facilities



CRS BG & LRG Footprint

COSMOLOGY REDSHIFT SURVEY

CRS Sky Area

$\sim 5'800 \text{ deg}^2$

BG Density

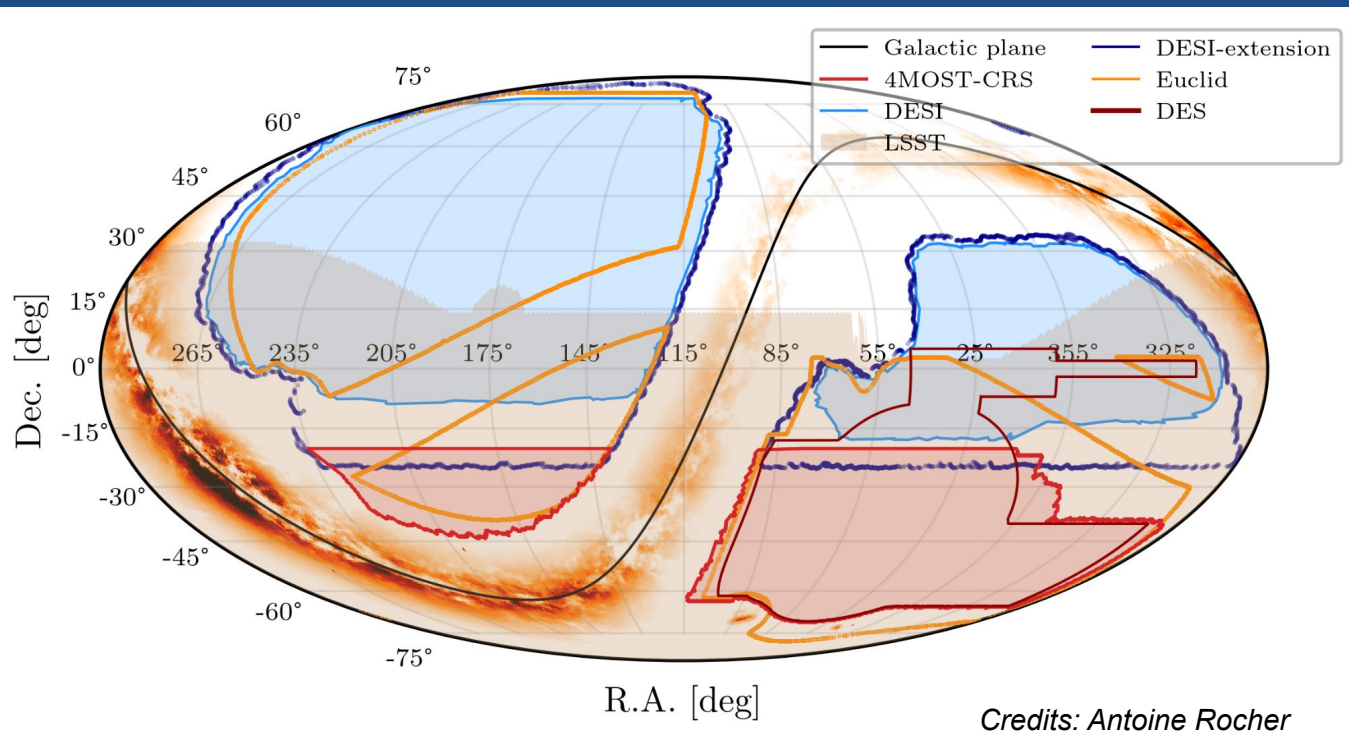
$\sim 250 \text{ deg}^{-2}$

LRG Density

$\sim 400 \text{ deg}^{-2}$

**DESI-ext + CRS
Sky Area**

$\sim 24'000 \text{ deg}^2$



Credits: Antoine Rocher



CRS BG & LRG Photometry

COSMOLOGY REDSHIFT SURVEY

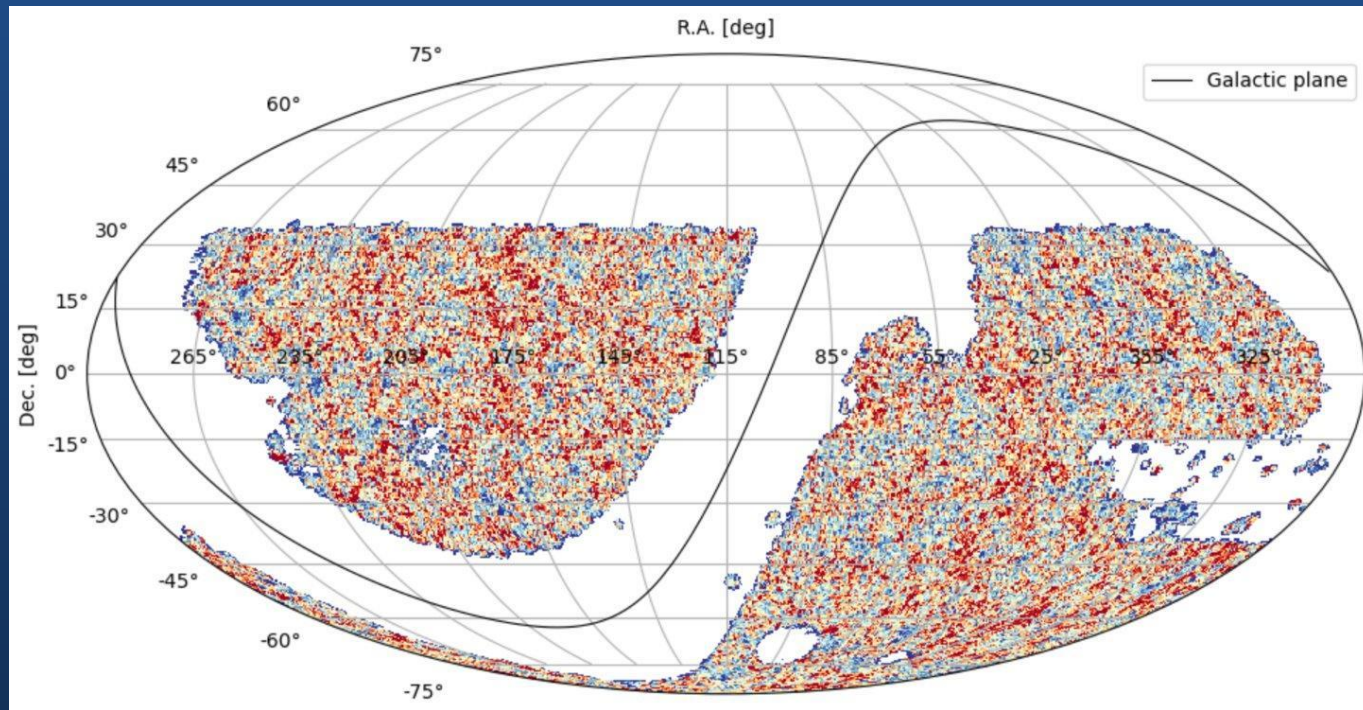
DESI Legacy Survey
DR10.1

DECaLS

DES

Target Selection adapted
from DESI for BG & LRG

Create complementary
samples with DESI





CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

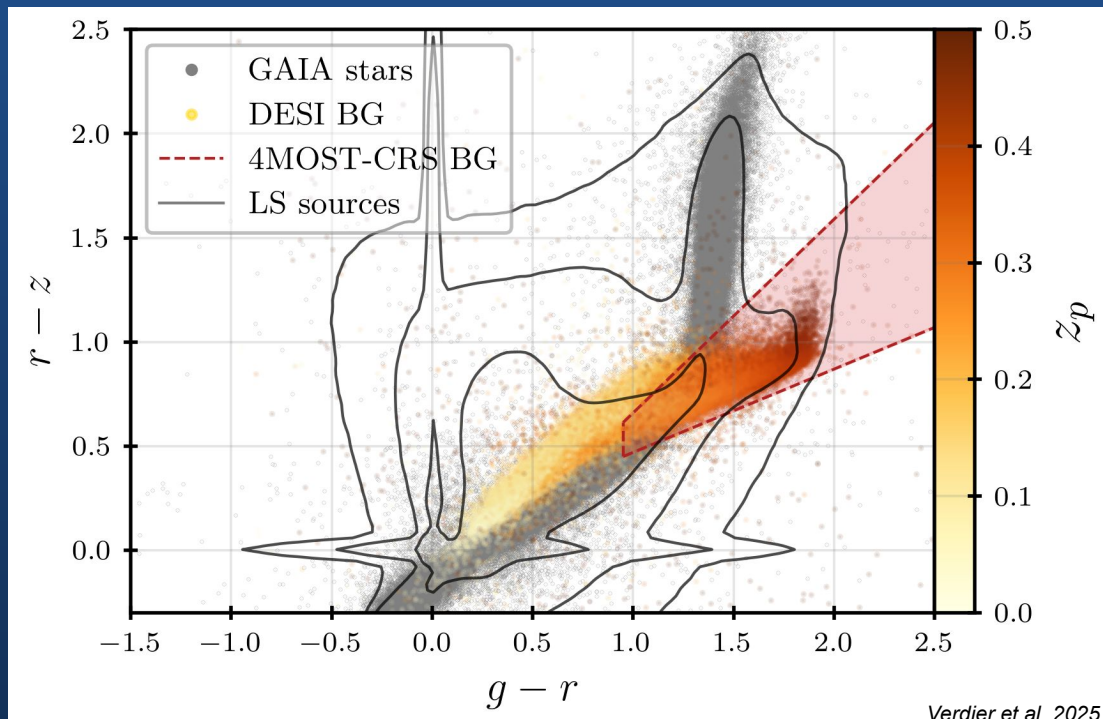
Target Selection (BG)

Bright Galaxies

R magnitude cut > 19.25
(19.5 in DESI)

+

Color cut to select
Photo $z > 0.15$



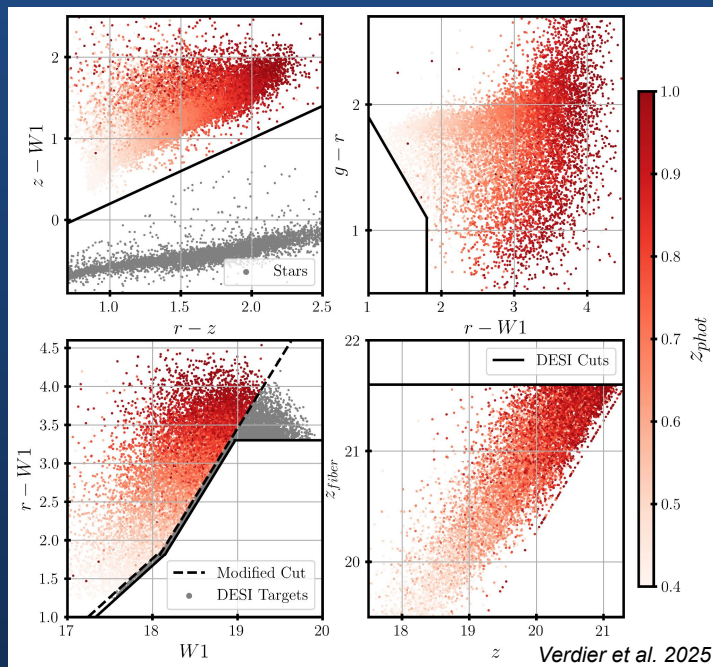
Verdier et al. 2025



CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

Target Selection

Luminous Red Galaxies

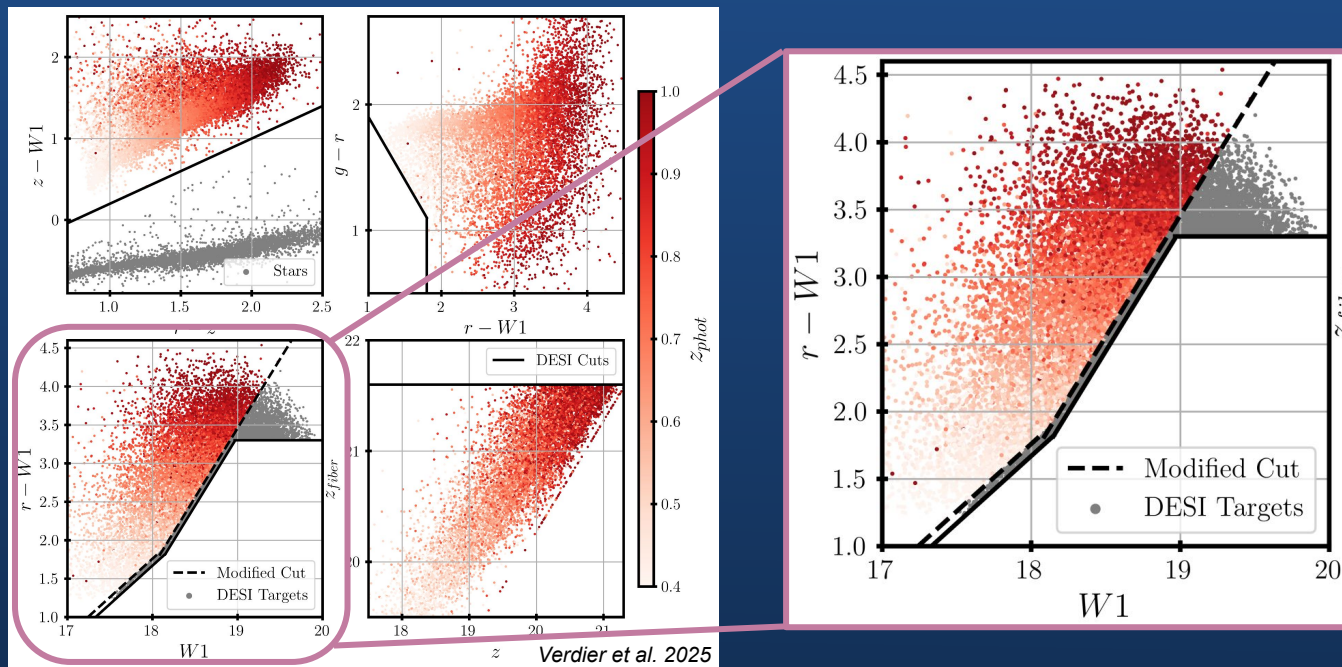




CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

Target Selection (LRG)

Luminous Red Galaxies

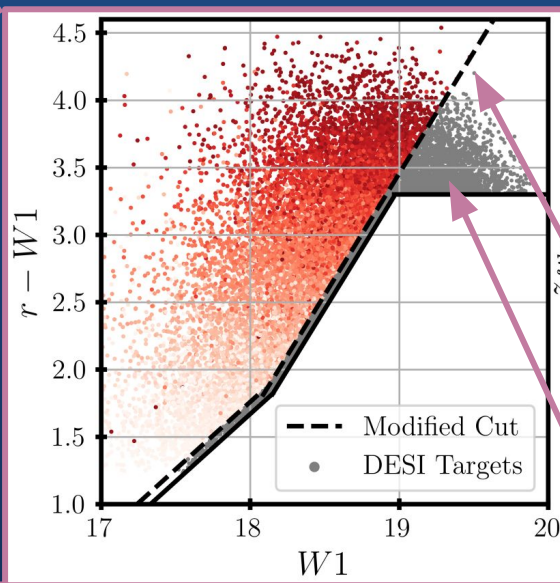
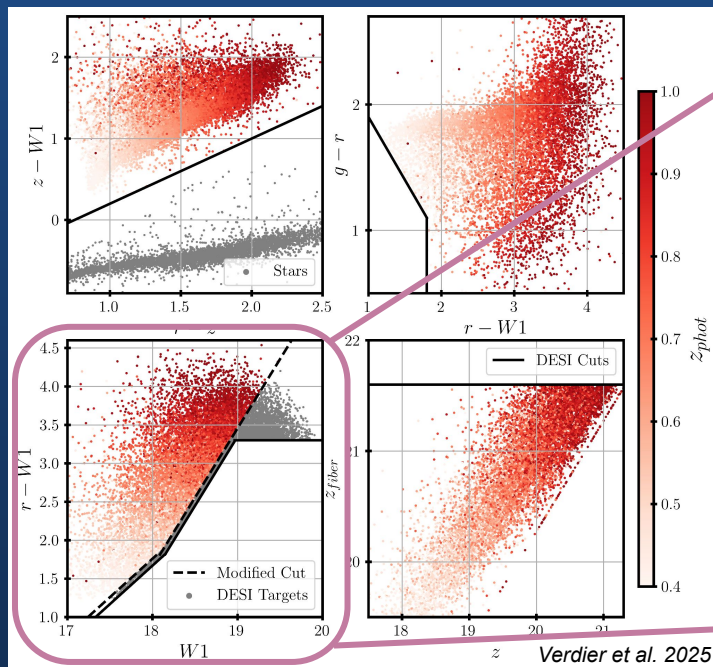




CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

Target Selection (LRG)

Luminous Red Galaxies



DESI Like Cuts

+

Shift

+

Not adding
“high-z”



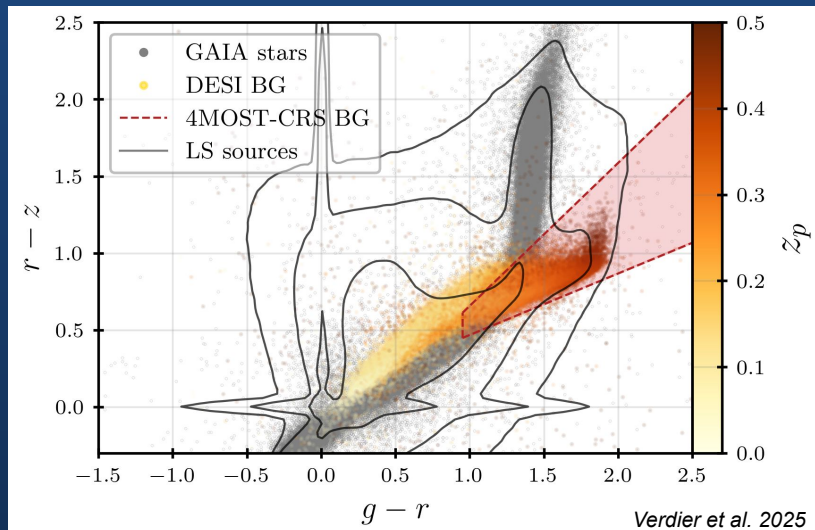
CRS BG & LRG

COSMOLOGY REDSHIFT SURVEY

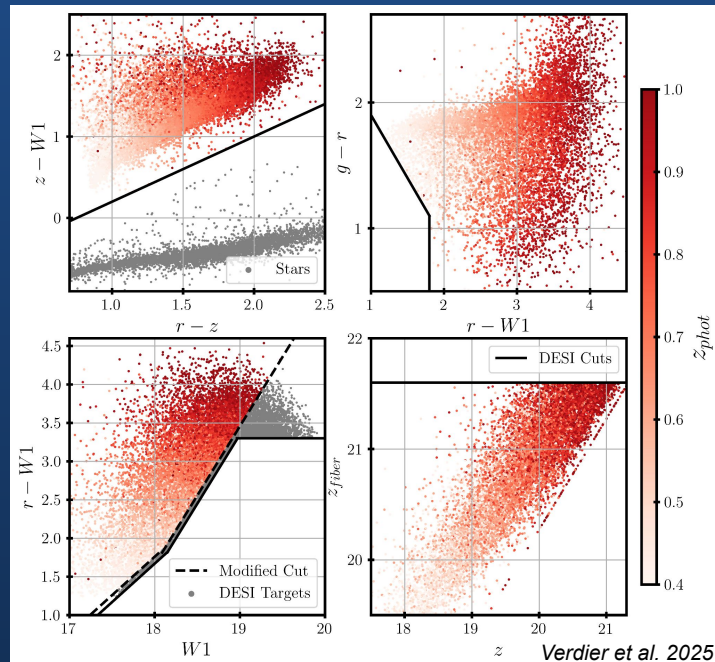
Target Selection

Bright Galaxies

R magnitude cut > 19.25 (19.5 in DESI)



Luminous Red Galaxies





CRS BG & LRG

COSMOLOGY REDSHIFT SURVEY

Redshift Density

DESI Densities

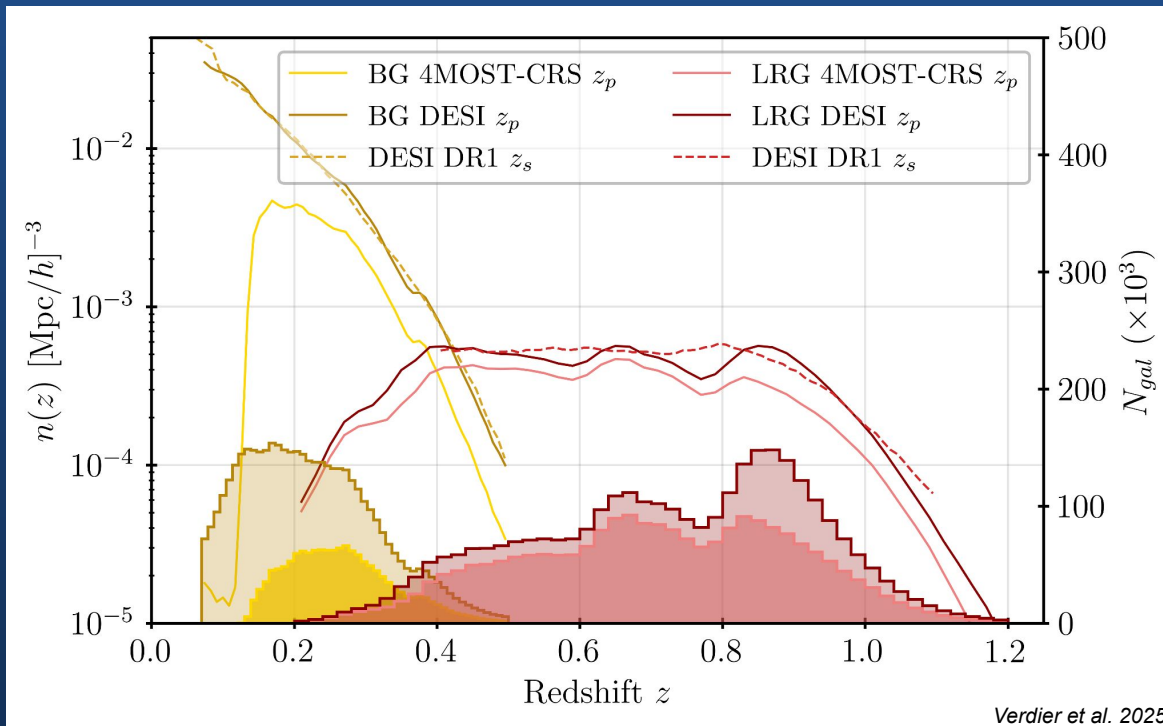
BG Density
~860 deg⁻²

LRG Density
~600 deg⁻²

4MOST-CRS Densities

BG Density
~250 deg⁻²

LRG Density
~400 deg⁻²

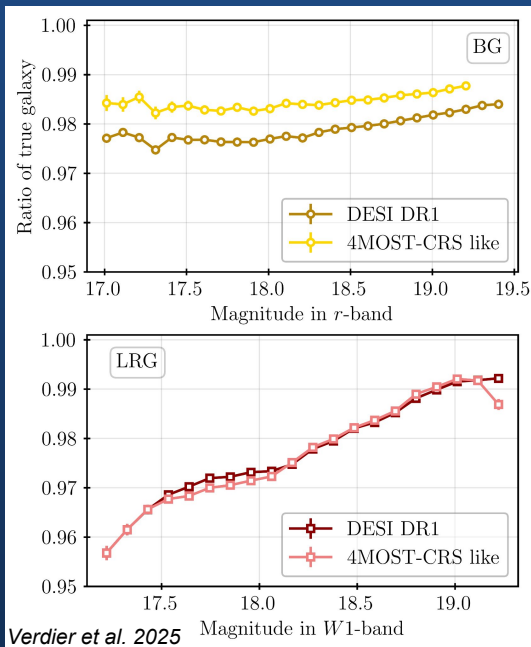


Verdier et al. 2025



Purity

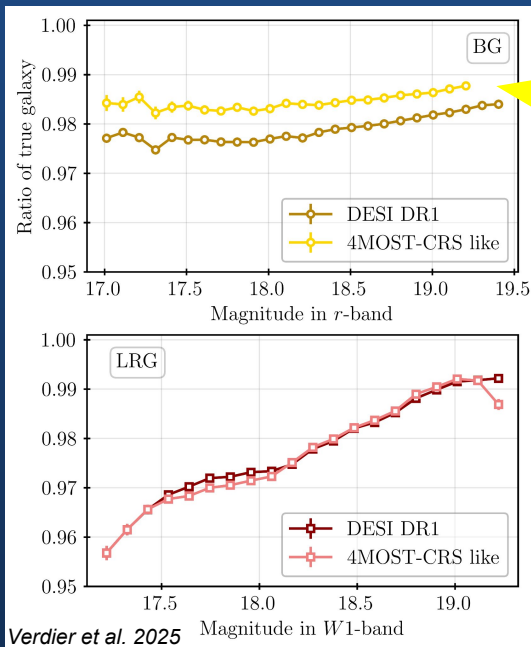
Using DESI DR1





Purity

Using DESI DR1



4MOST better than DESI !



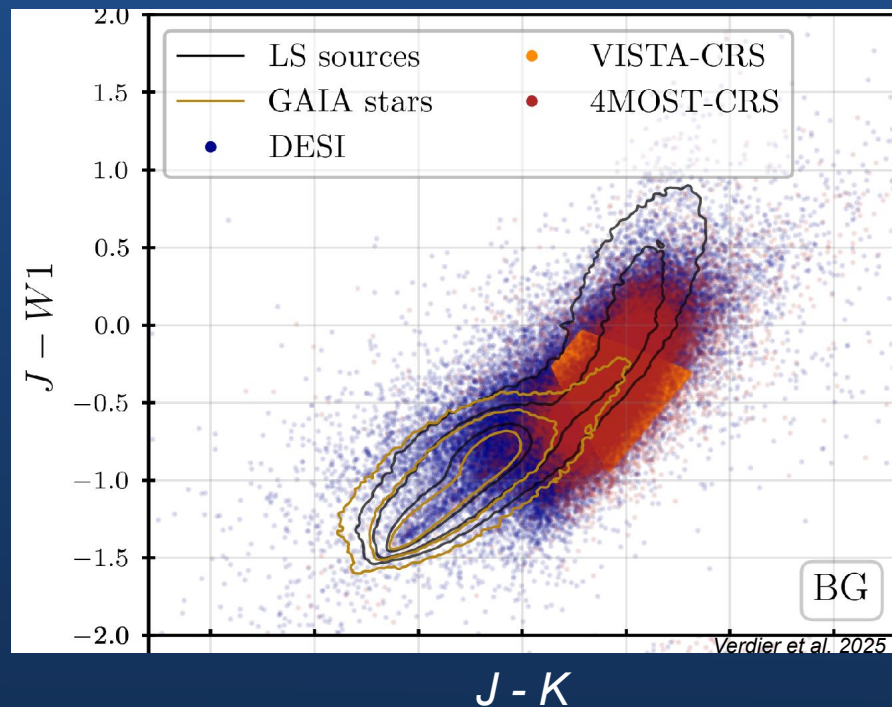
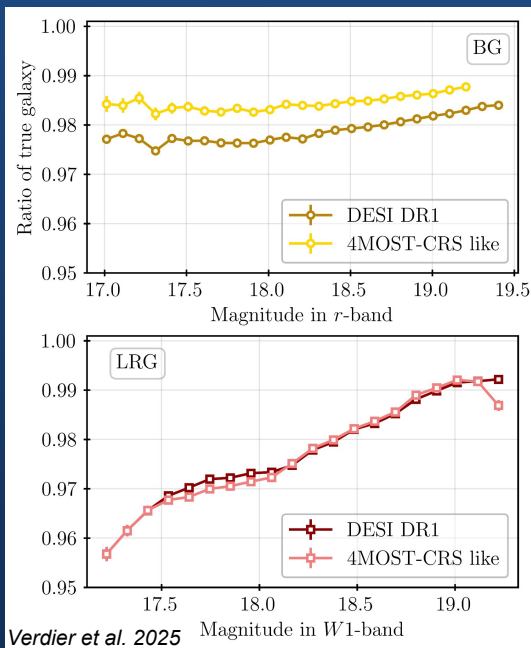
CRS BG & LRG

COSMOLOGY REDSHIFT SURVEY

Quality Check

Purity

Using DESI DR1





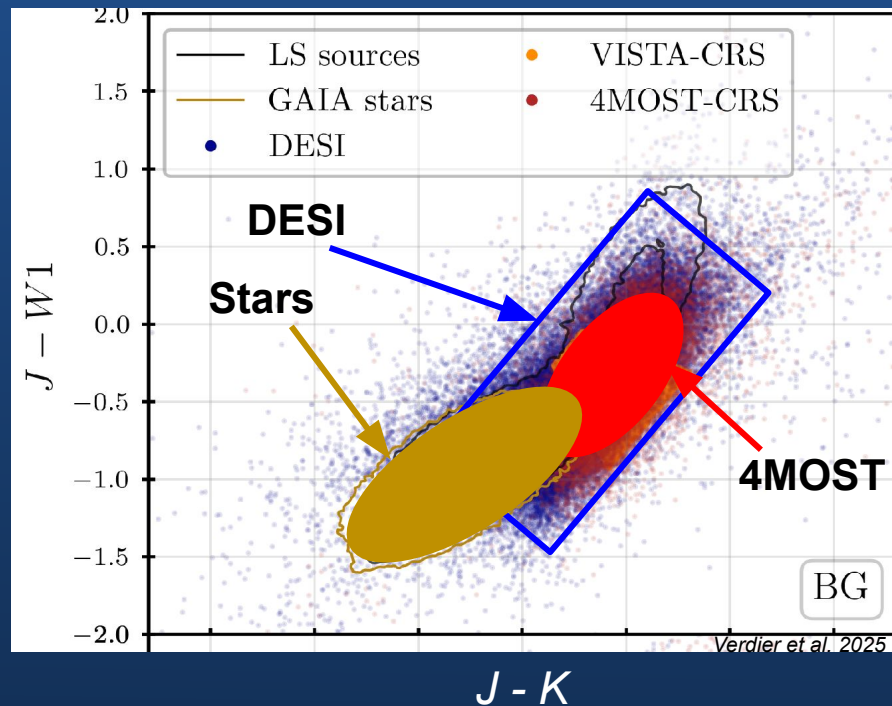
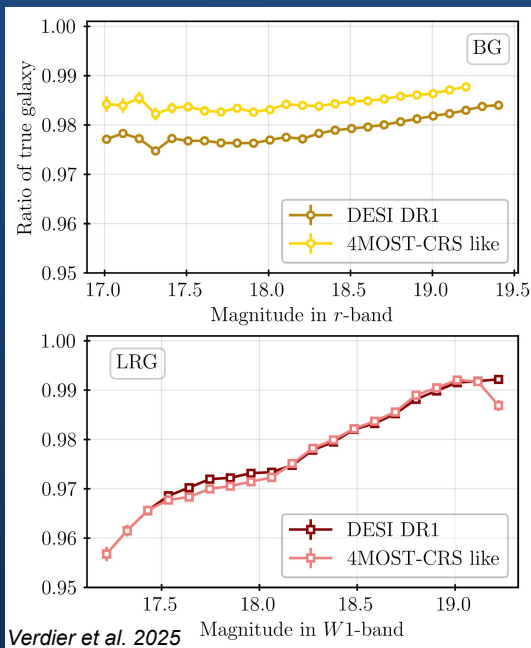
CRS BG & LRG

COSMOLOGY REDSHIFT SURVEY

Quality Check

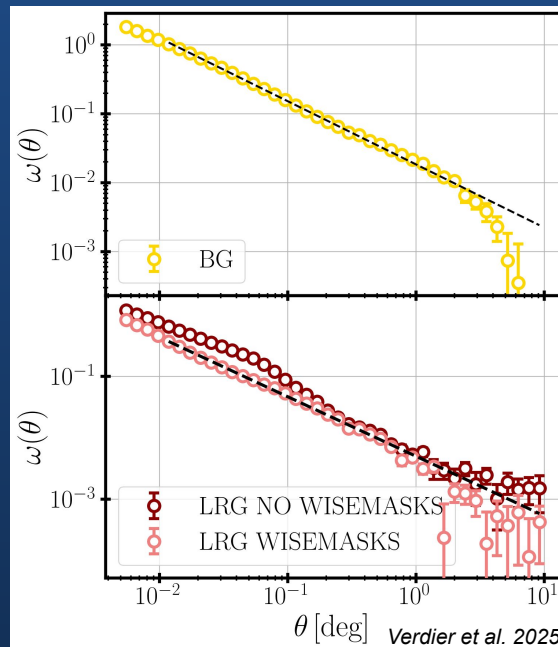
Purity

Using DESI DR1





Angular Clustering



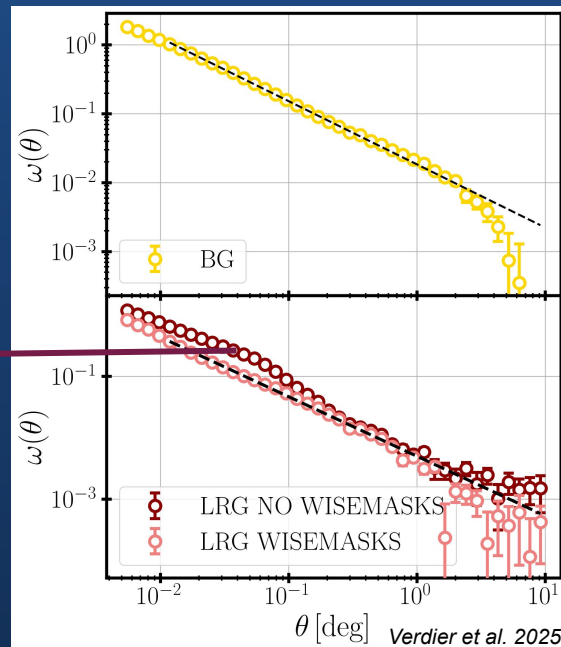
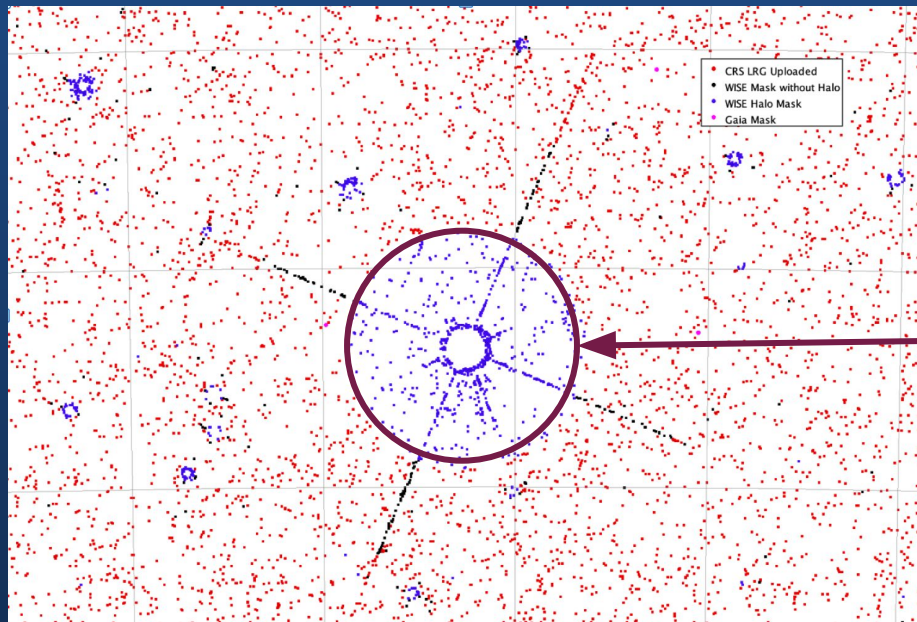
Angular
Clustering tests
in Bandi et al.
2025

Verdier et al. 2025

Verdier et al. 2025



Angular Clustering



Angular
Clustering tests
in Bandi et al.
2025



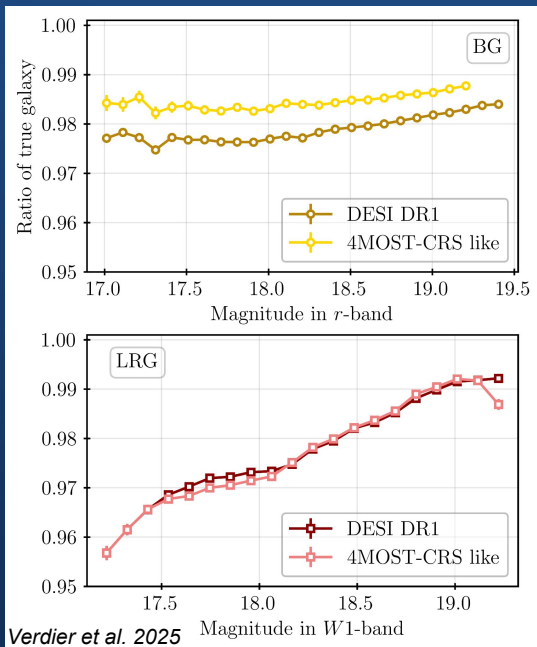
CRS BG & LRG

COSMOLOGY REDSHIFT SURVEY

Quality Check

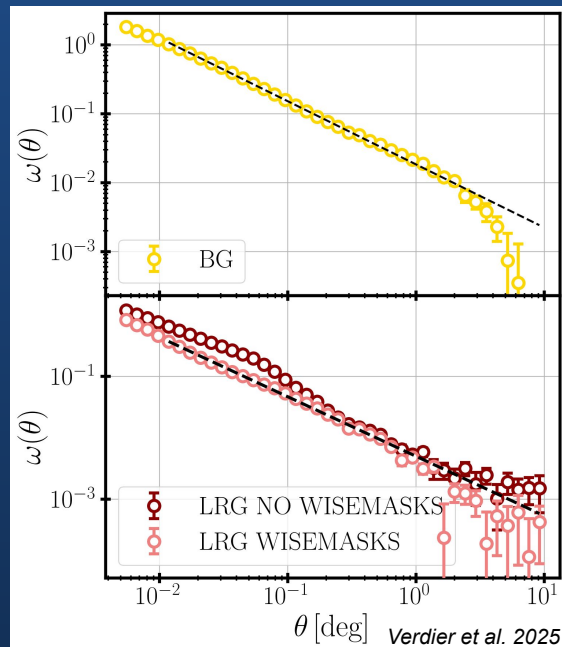
Purity

Using DESI DR1



Angular Clustering

Angular Clustering tests in Bandi et al. 2025





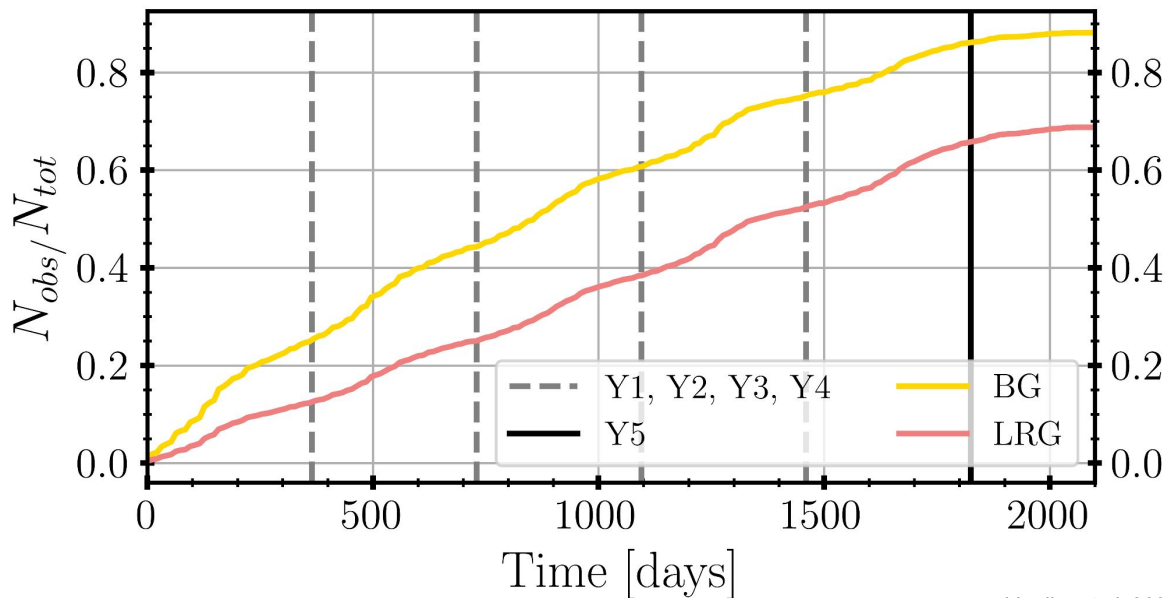
CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

Survey Progress

5-years 4MOST
completeness simulation

BG ~87%

LRG ~67%



Verdier et al. 2025



CRS BG & LRG Forecasts

COSMOLOGY REDSHIFT SURVEY

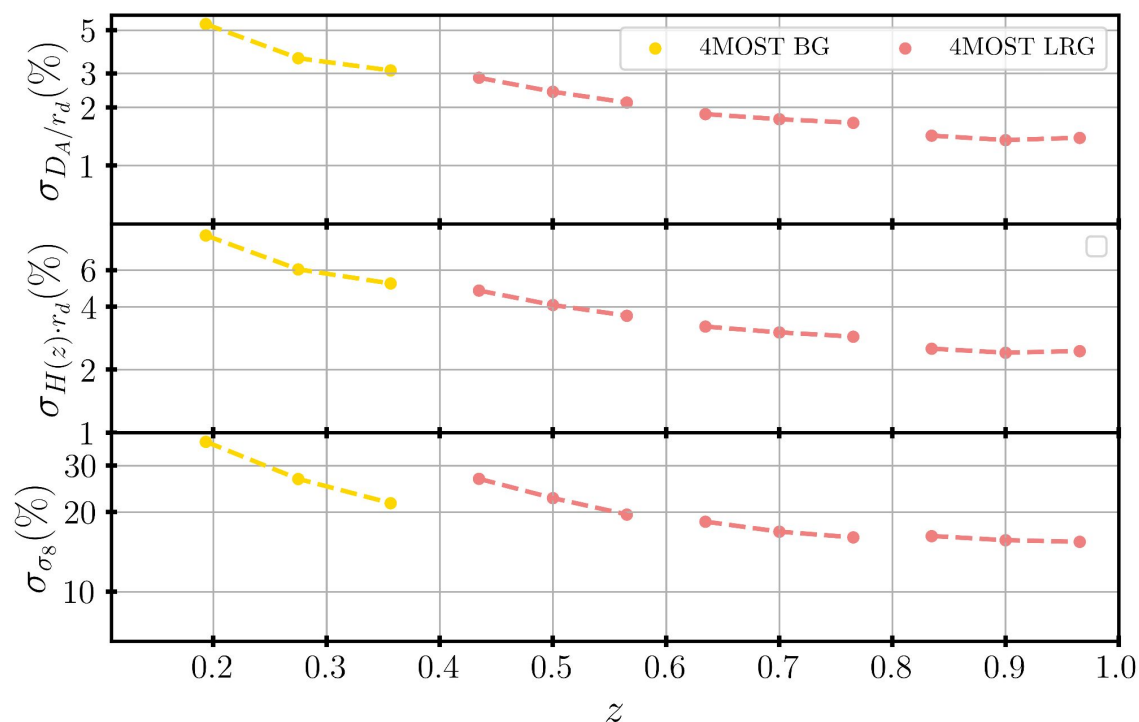
Fisher Forecasts taking into account:

5-years 4MOST completeness simulation

BG ~87%

LRG ~67%

4MOST Alone



Verdier et al. 2025



CRS BG & LRG Forecasts

COSMOLOGY REDSHIFT SURVEY

Fisher Forecasts taking into account:

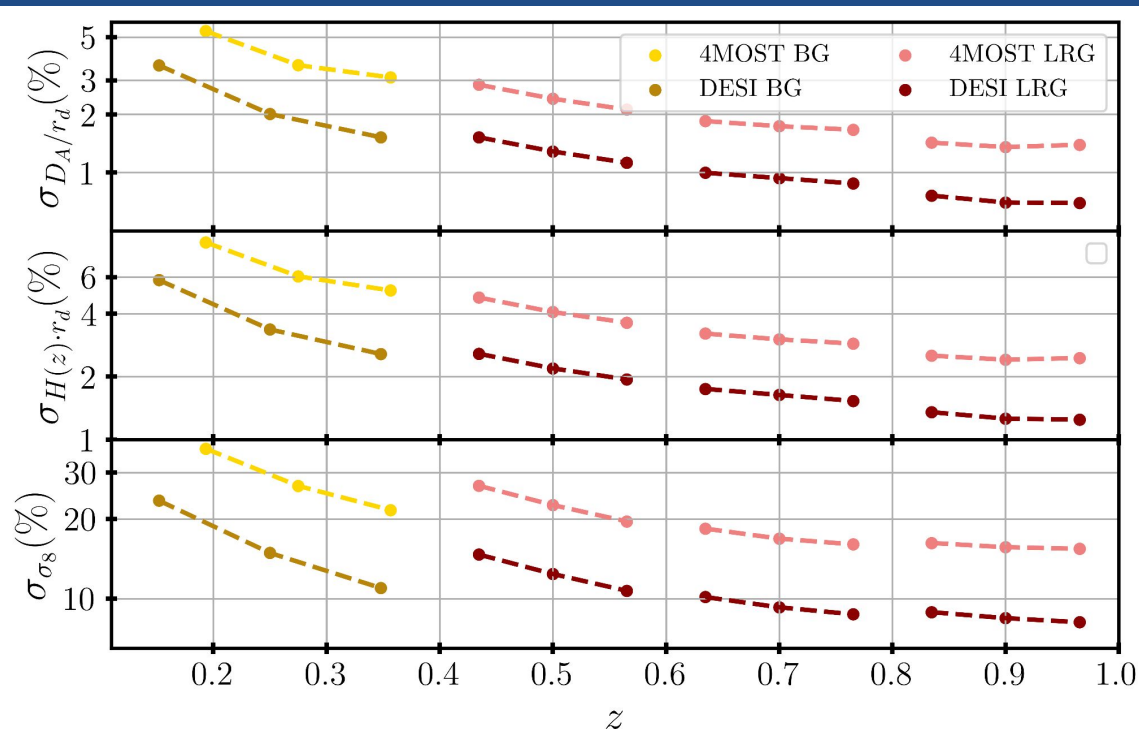
5-years 4MOST completeness simulation

BG ~87%

LRG ~67%

4MOST Alone

Comparison with DESI 100% completeness





CRS BG & LRG Forecasts

COSMOLOGY REDSHIFT SURVEY

Fisher Forecasts taking into account:

5-years 4MOST completeness simulation

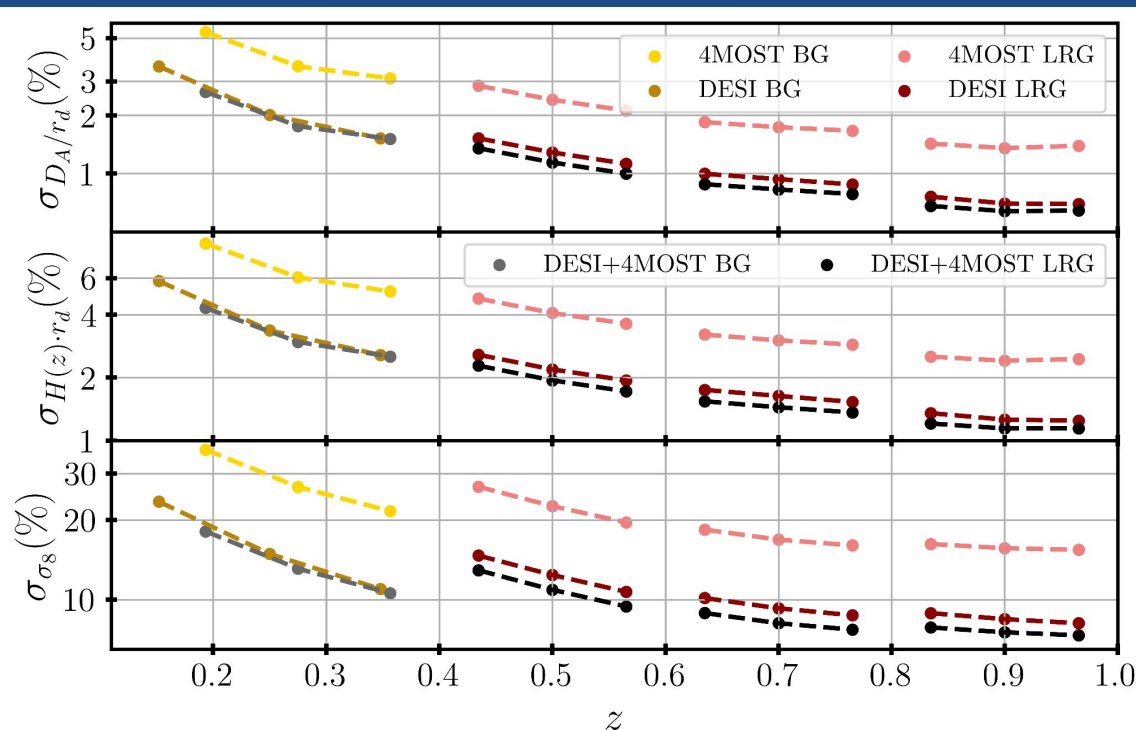
BG ~87%

LRG ~67%

DESI downsampled to CRS densities

+

Merge 4MOST and DESI Targets as one sample



Verdier et al. 2025



CRS BG & LRG Forecasts

COSMOLOGY REDSHIFT SURVEY

Fisher Forecasts taking into account:

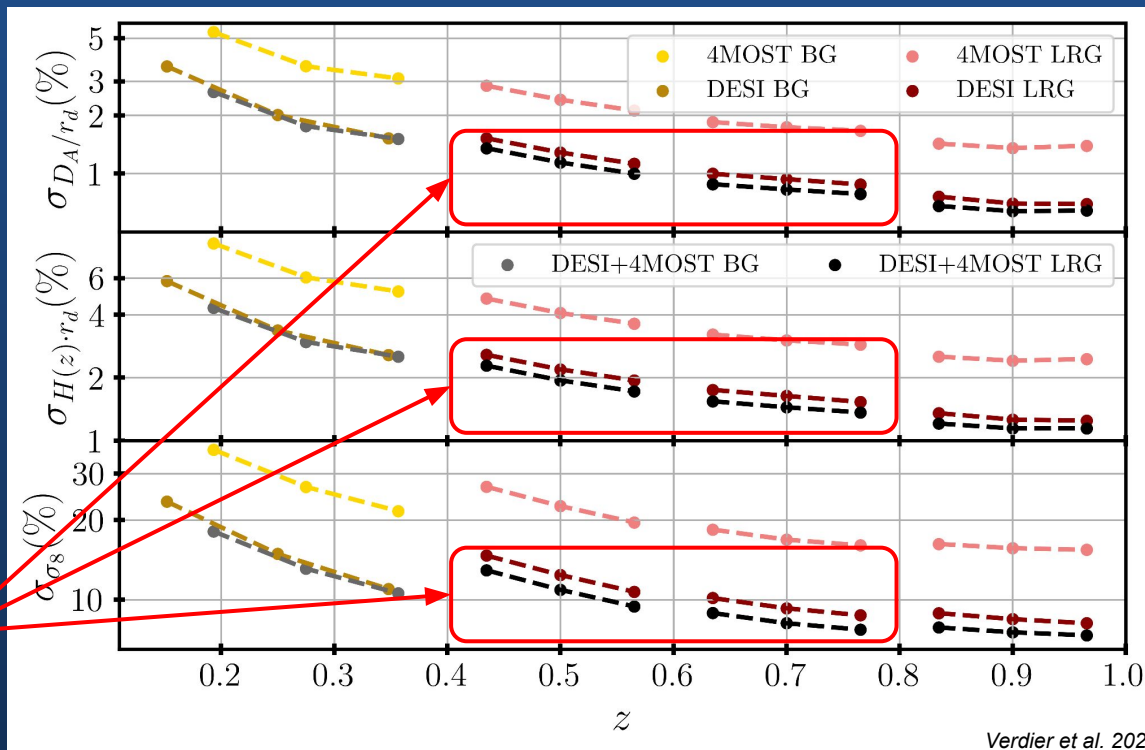
5-years 4MOST completeness simulation

BG ~87%

LRG ~67%

4MOST-CRS + DESI

4MOST+DESI will improve constraints in redshift bins $0.4 < z < 0.8$ by at least 15%



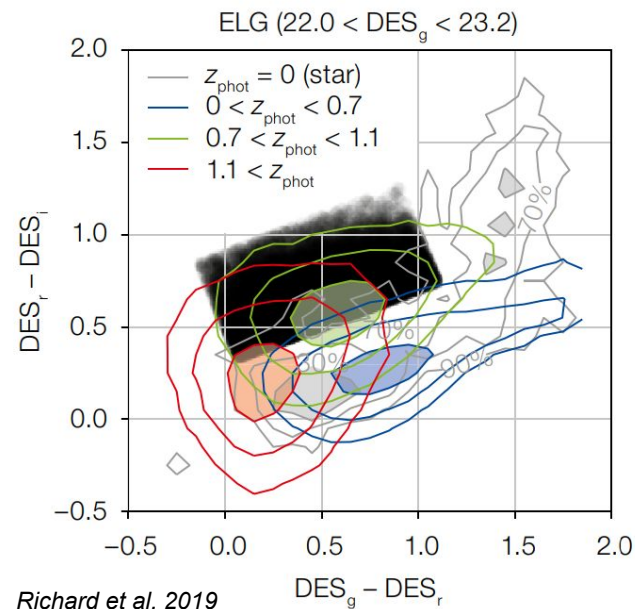
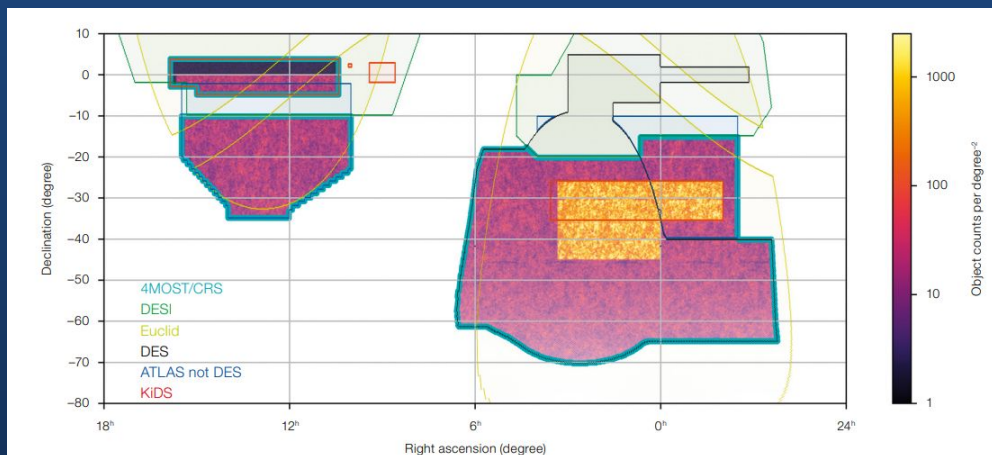


CRS
COSMOLOGY REDSHIFT SURVEY

What about ELG ?

Was dropped from
CRS

Euclid will observe
them

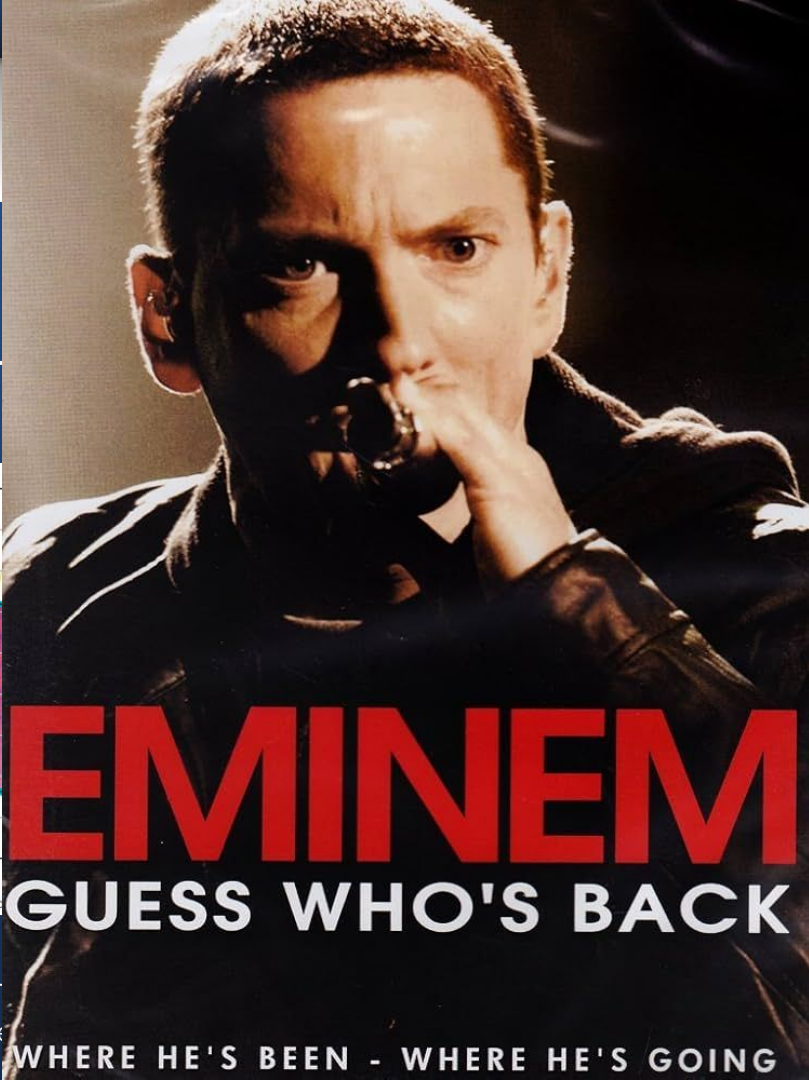
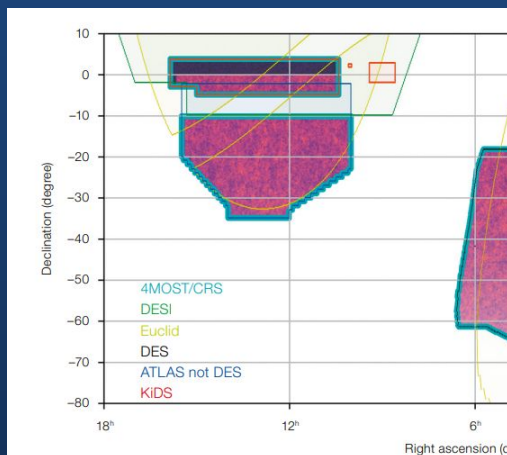


Richard et al. 2019



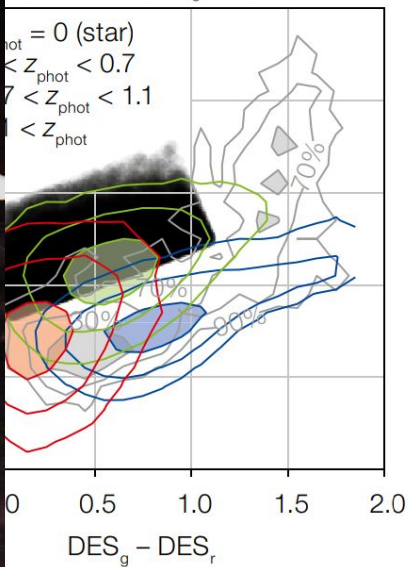
CRS
COSMOLOGY REDSH

Was dropped from
CRS



LG ?

LG (22.0 < DES_g < 23.2)





CRS

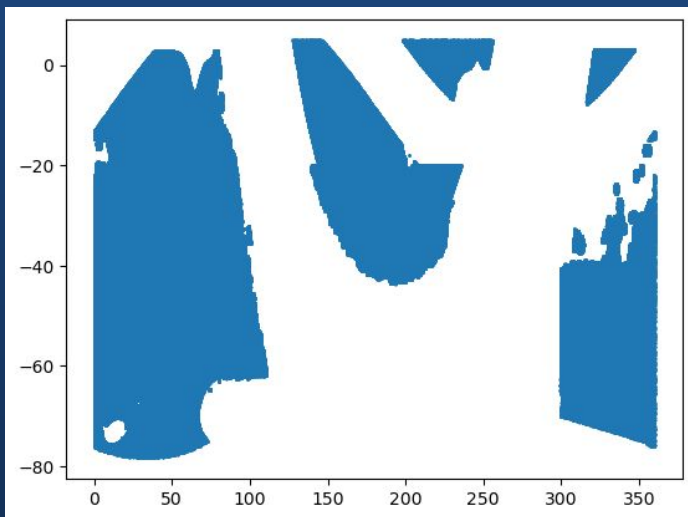
COSMOLOGY REDSHIFT SURVEY

New ELG Sample !

There will be unused fibers

Call for
“Supplementary Targets”

ELG Proposal



4MOST-CRS +
Euclid Footprint

DESI cuts +
 $g < 23.4$

~3 million ELG

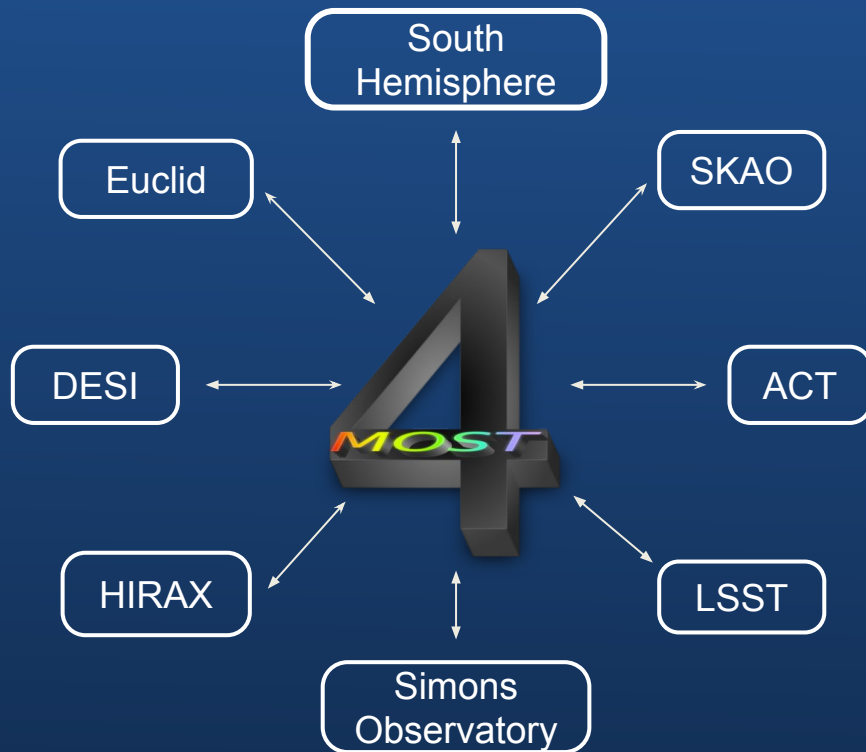
$0.6 < z < 1.6$

No use for Clustering
Good for Photo/Spectro- z Calibration



CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

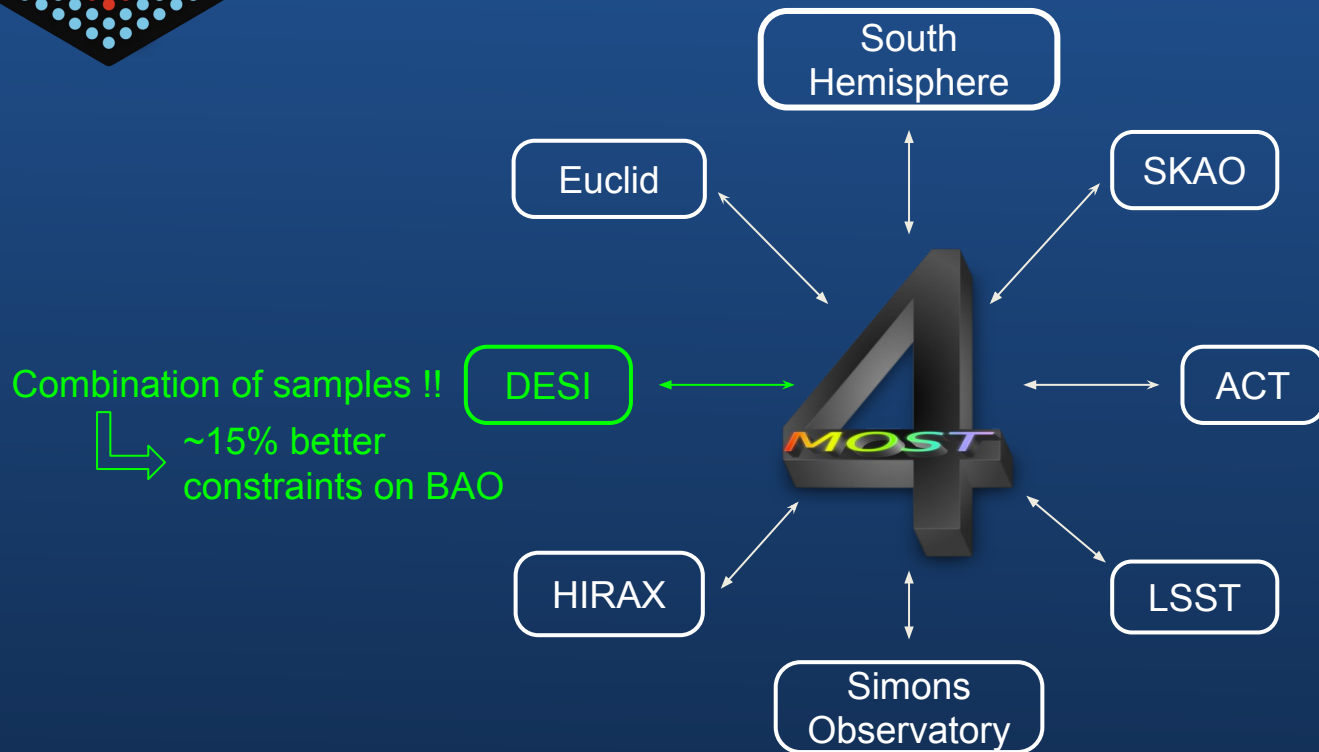
Conclusion





CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

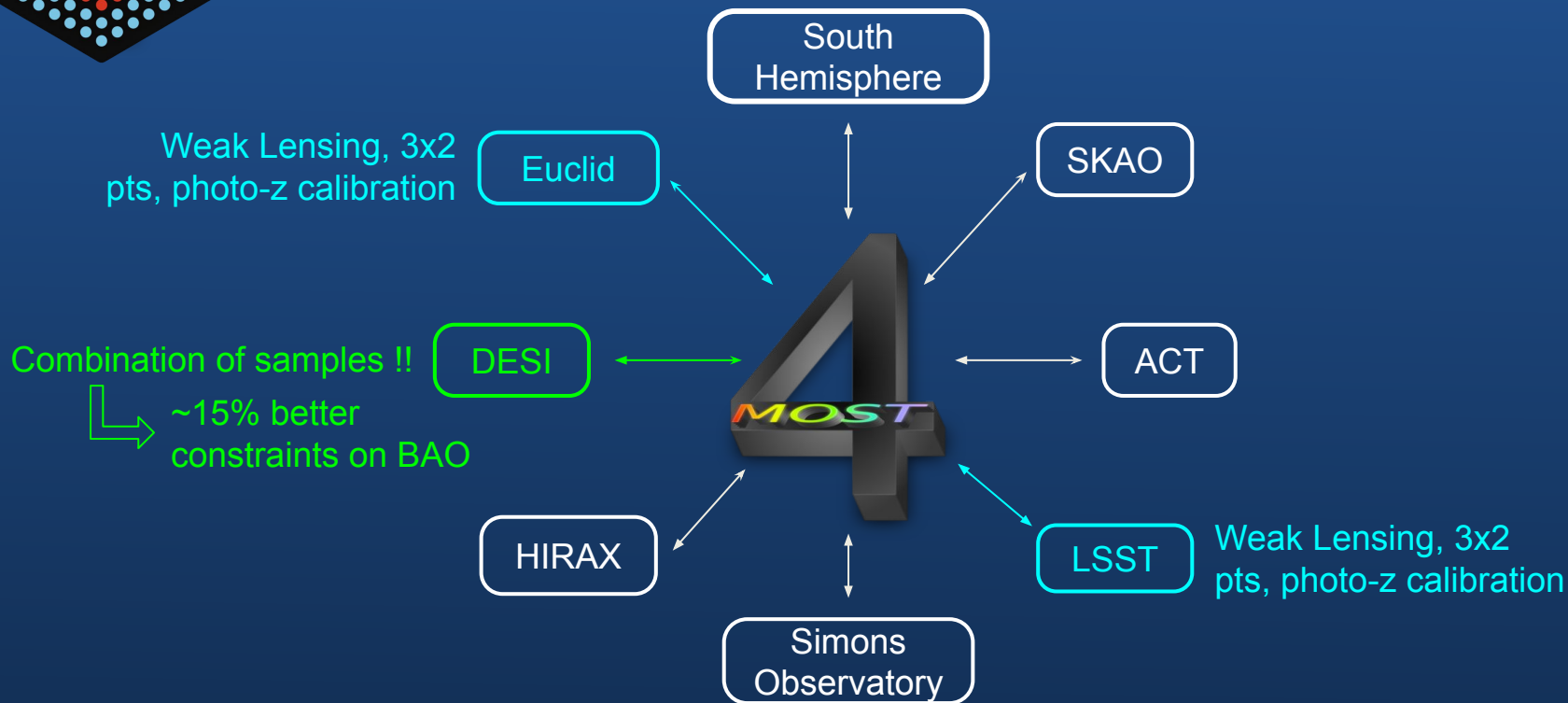
Conclusion

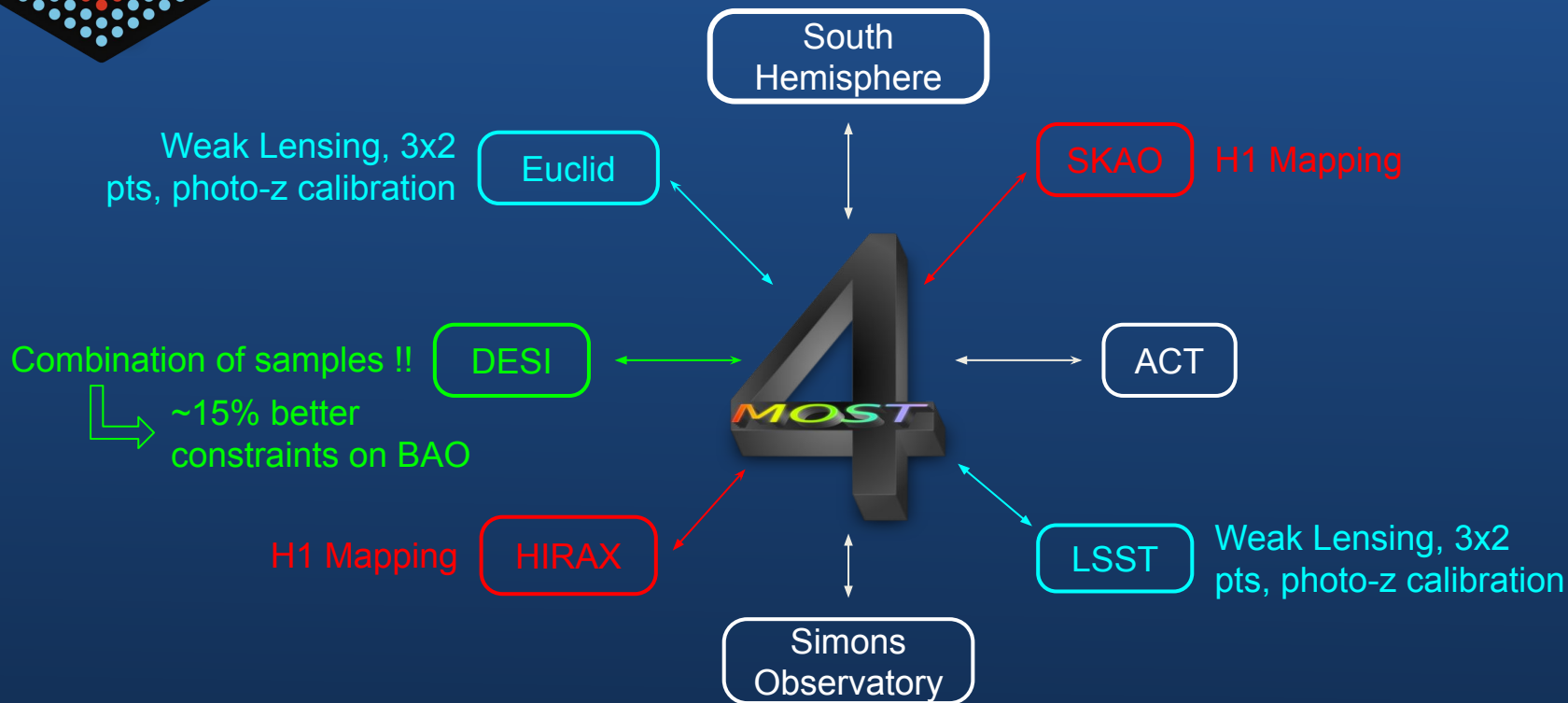


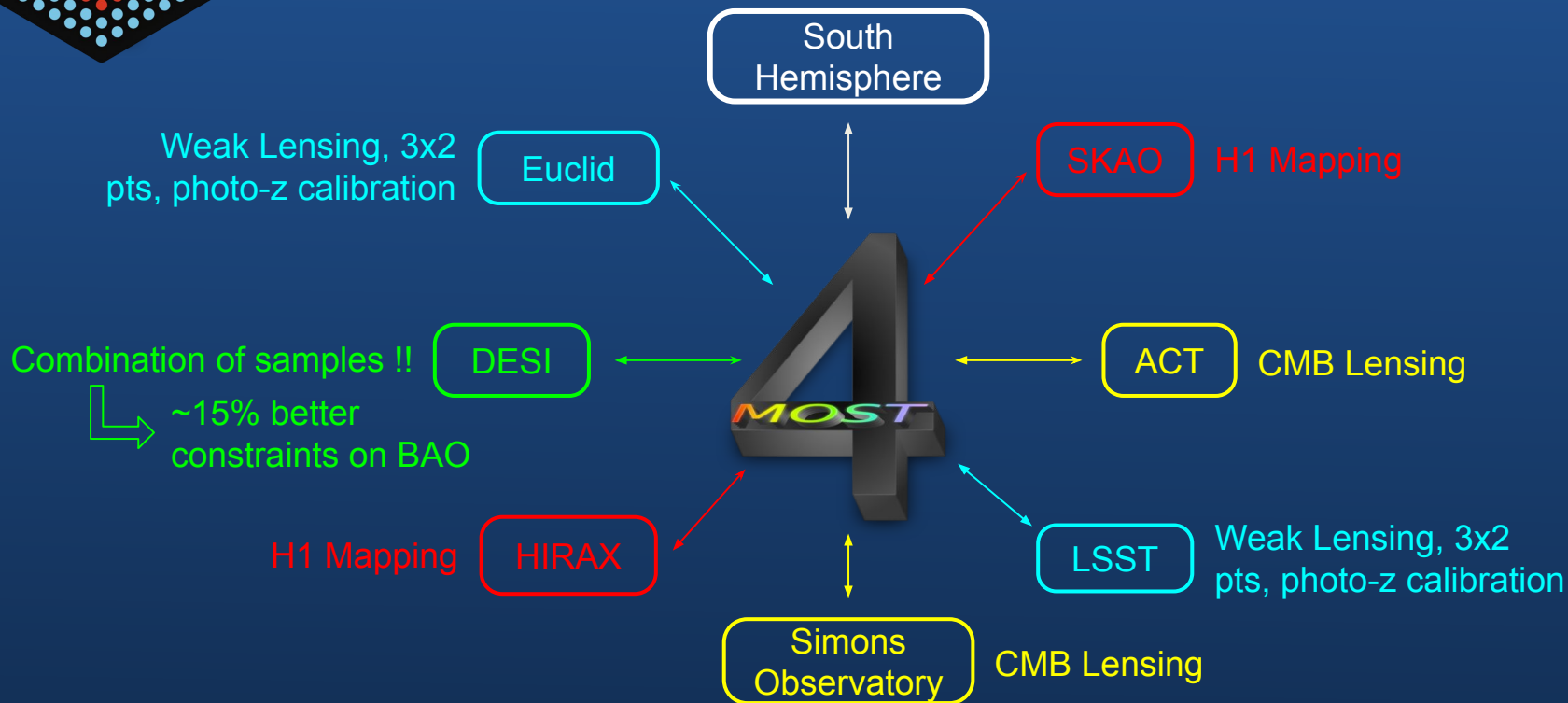


CRS BG & LRG
COSMOLOGY REDSHIFT SURVEY

Conclusion









Thank you for your Attention !

