

CIEMAT Cosmology Group

External Scientific Advisory Panel

CIEMAT (Madrid)

March 11-12, 2026

Eusebio Sánchez on behalf of CIEMAT Cosmology Group

Outline

- Current Personnel
- Funding
- Science Landscape

DES

DESI

Euclid

LSST-DESC

- Short, medium and long-term vision
- Responsibilities in collaborations
- Challenges and outlook

Current Personnel

Scientific Personnel

Seniors: **E. Sánchez** (PI, DES, DESI, Euclid, LSST), **I. Sevilla** (co-PI, DES, LSST), **S. Ávila** (DES, DESI, Euclid)

Senior Computing Support: **F. J. Rodríguez** ($\frac{1}{2}$ FTE)

Senior Researchers: **L. Toribio** (DES, LSST)

Ramon y Cajal (tenure track): **S. Joudaki** (DESI, LSST)

Atracción Talento CAM (tenure track): **A. Porredon** (DES, DESI, Euclid), **C. García** (starting June 2026, LSST, Euclid)

Students: **N. Deiosso** (2027, DESI, Euclid), **M. F. Ruiz** (2029, DESI), **A. Souki** (2029, Euclid, DESI)

Collaborator from PIC-CIEMAT

Senior Researchers: **J. Carretero** (Euclid, LSST, computing)

Support from other Departments (technology)

Senior Scientists: **J. de Vicente** ($\frac{1}{2}$ FTE, DES, LSST)

Funding

Spain National Plan (FPN)

Project: **Fundamental Physics and Cosmology with Extragalactic Surveys**

Funding Agency: MICINN (PID2021-123012NB-C42)

Duration, from: **2022 to: 2025** → **extended to 2026**

Funding: **237,160 €**

PI: **Eusebio Sánchez** ; co-PI: **Ignacio Sevilla**

Spain National Plan (FPN)

Project: **Fundamental Physics and Cosmology with Extragalactic Surveys**

Funding Agency: MICINN (PID2024-159420NB-C42)

Duration, from: **2025 to: 2028**

Funding: **223,125 €**

PI: **Ignacio Sevilla** ; co-PI: **Shahab Joudaki**

Funding

Spain National Plan (AyA)

Project: **Fundamental Physics and Cosmology with Extragalactic Surveys**

Funding Agency: MICINN (PID2024-156844NA-C22)

Duration, from: **2025 to: 2028**

Funding: **203,375 €**

PI: **Santiago Ávila** ; co-PI: **Anna Porredon**

CAM Networks

Project: **MAD4Space**

Funding Agency: CAM (TEC-2024/TEC-182)

Duration: form: **2025 to: 2028**

Funding: **113,501.25 €** (of 1,026,000€ total MAD4Space)

PI: **Laura Toribio**; co-PI: **Juan de Vicente**

Highlights

Stage-3 experiments are finishing: DES

Stage-4 experiments taking data: DESI, Euclid, LSST

Some hints of dynamical dark energy → We need to confirm (or not) this result and understand its physics

Some tensions in Λ CDM → Hubble tensión, σ_8 tensión...

We need to clarify if they are due to unknown systematics or new physics and understand it.

An ambitious world-wide program in cosmology for the present and the future to understand the physics of the dark energy, dark matter, early universe and to resolve tensions.

Highlights: DES



CIEMAT in DES since 2006

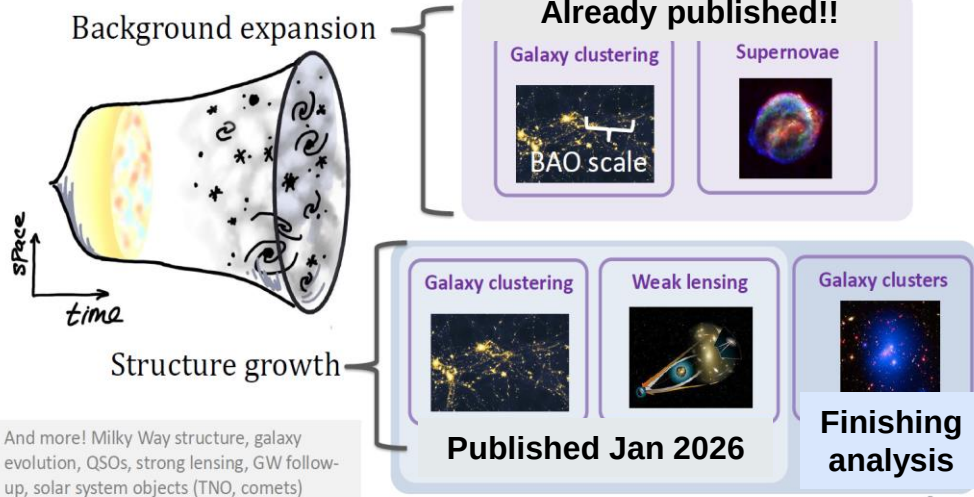
Optical/IR imaging survey
with the Blanco 4m
telescope (CTIO, Chile)

5000 sq-deg (1/8 of the
sky) in grizY bands
+ 30 sq-deg time-domain
griz (SNe)

Up to $i_{AB} \sim 24$ th
magnitude at 10σ ($z \sim 1.5$)

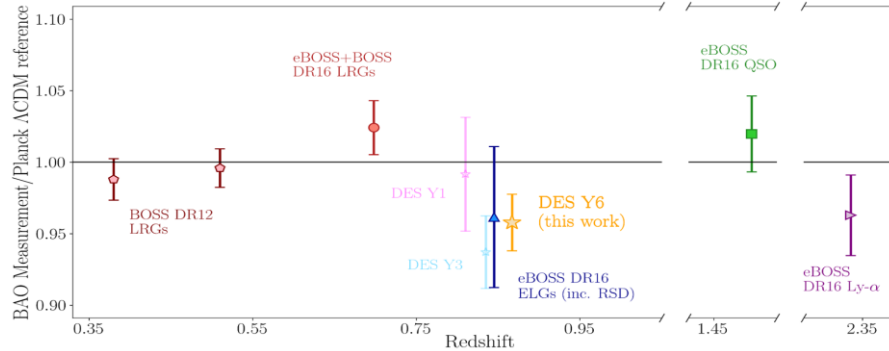
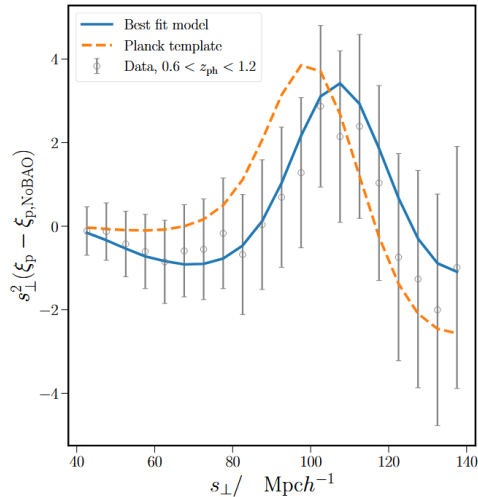
570 Mpx camera with 3
sq-deg FoV

We probe physics with the Dark Energy Survey by observing:



CIEMAT-PP ADVISORY COMMITTEE 11/02/2023-11/02/2023 _____ March 11th-12th, 2020

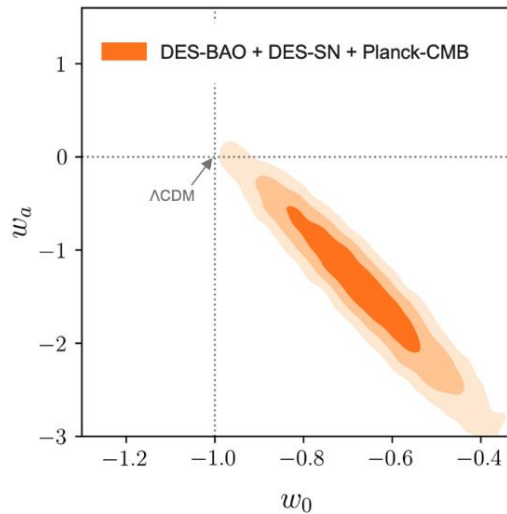
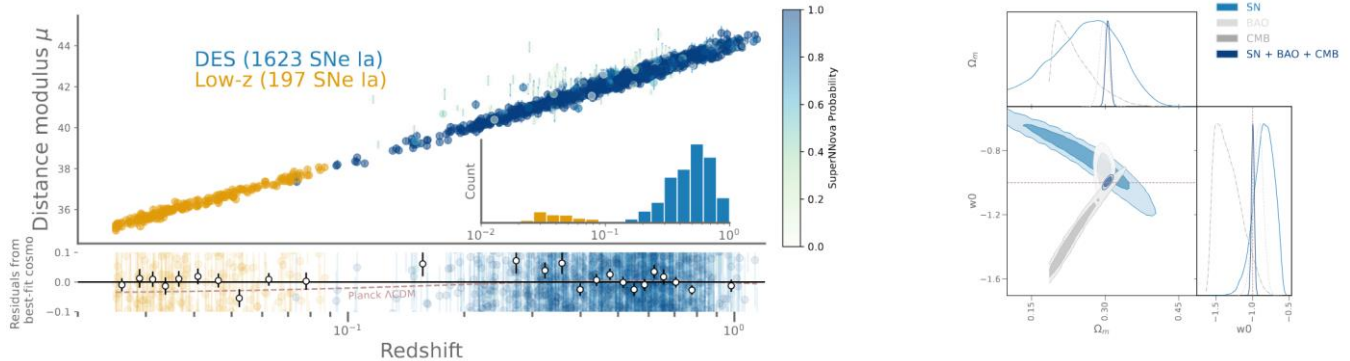
DES-Y6 Final BAO Measurement



Measurement of the Sound Horizon Scale at $z \sim 0.87$ with $\sim 2\%$ precision

CIEMAT led the whole analysis (PhD thesis of Juan Mena, 2023)

DES Final Supernovae Measurement



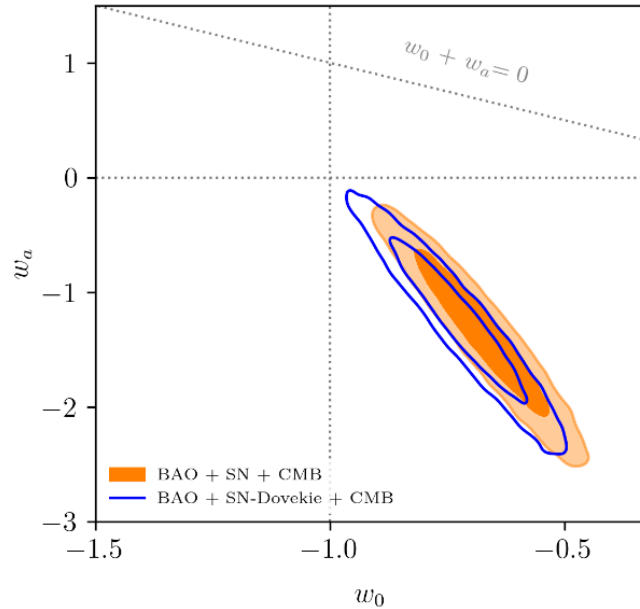
When combining DES BAO with DES SNe and the CMB, we find a parameter shift of 3.2σ away from Λ CDM

Similar but lower significance than DESI results

$$w_0 = -0.673^{+0.098}_{-0.097}$$

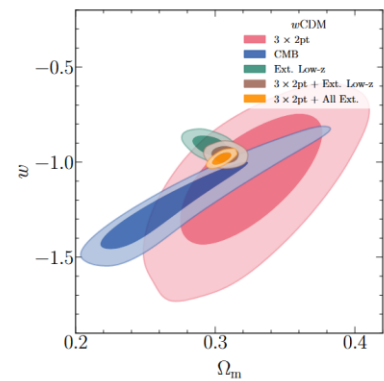
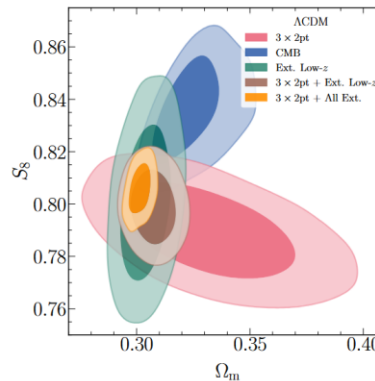
$$w_a = -1.37^{+0.51}_{-0.50}$$

DES Final BAO + Supernovae



New calibration of DES supernovae reduces the tension with Λ CDM to $\sim 2.5\sigma$

DES Multiprobe Results



DESI (Dark Energy Spectroscopic Instrument)

**Located at 4-m Mayall Telescope in
Arizona**

Upgraded telescope for wide-field
spectroscopy

Now dedicated to multi-object spectroscopy

**First Stage-IV Dark Energy Experiment
Optimized for BAO measurement**

10X improvement to $w_0 w_a$ FoM compared to
Stage-II SNe

Comprehensive Cosmology Program

Redshift Space Distortions

Cross-correlations with other surveys

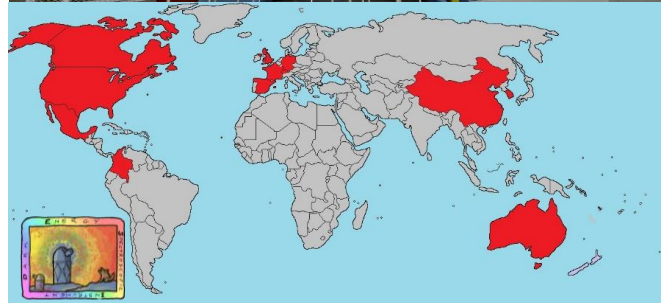
Other wider topics

CIEMAT in DESI since 2014

Large collaboration: More than 900 scientists, 17 countries, 72 institutions

Australia, Canada, China, Colombia, France, Germany, Korea, Mexico, Spain, Switzerland, U.K., and U.S.

Lead by LBNL

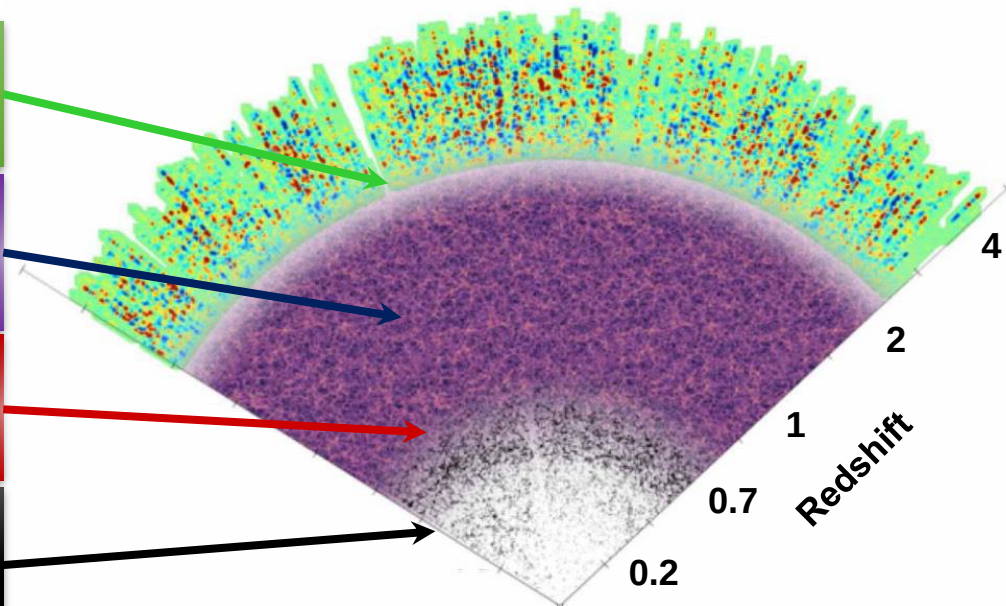


Highlights: DESI

DESI survey covers $\sim 17,000 \text{ deg}^2$ in 8 years!

Over 40M galaxy and quasar redshifts in 4 years of operation,
 $\sim 14\text{M}$ of which are used in DR2 analysis:

2 million quasars + Ly- α forest ($1 < z < 3.5$)
6.5 million Emission Line Galaxies ($0.6 < z < 1.6$)
4.5 million Luminous Red Galaxies ($0.4 < z < 1.1$)
1 million Bright Galaxies ($0.0 < z < 0.4$)



Highlights: DESI

DESI DR2 BAO

DESI DR2 gives a 40% improvement in precision with respect to DR1

$$\Omega_m = 0.2975 \pm 0.0086$$

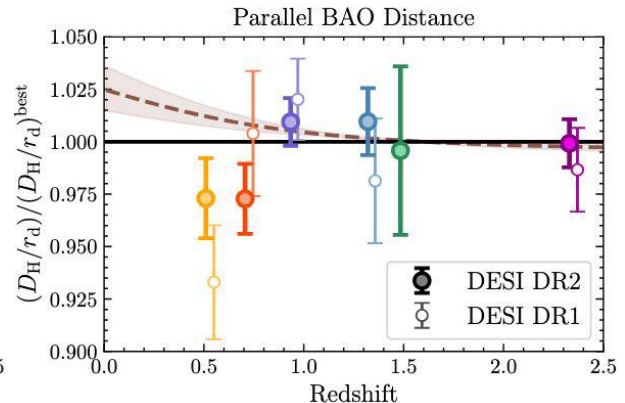
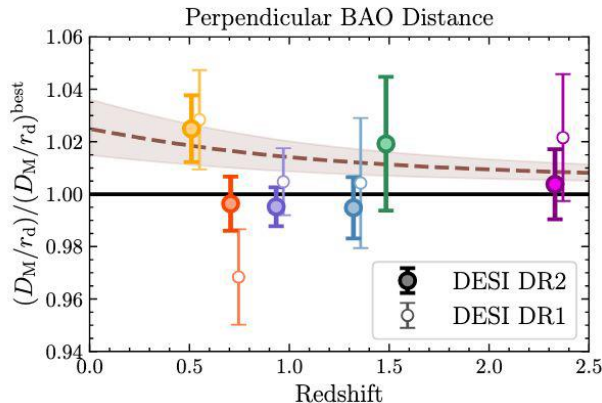
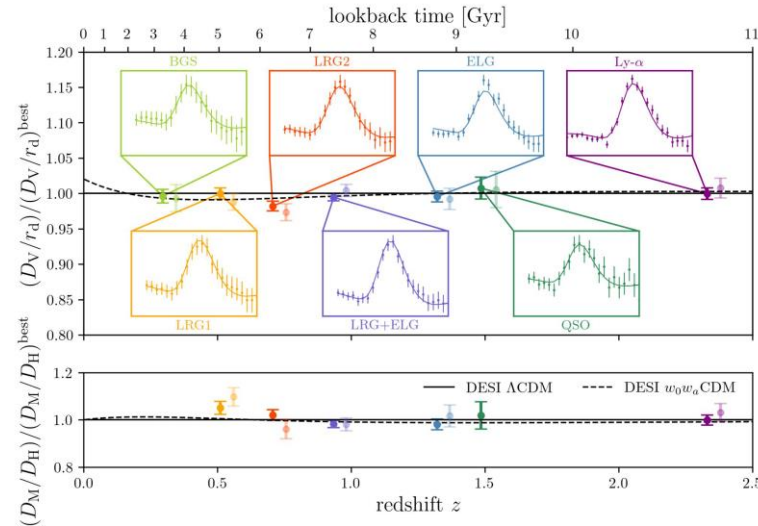
$$H_0 r_d = 101.54 \pm 0.73 [100 \text{ km s}^{-1}]$$

Use BBN to calibrate BAO and measure H_0

$$\text{DESI+BBN: } H_0 = (68.51 \pm 0.58) \text{ km s}^{-1} \text{ Mpc}^{-1}$$

$$\text{DESI+BBN}+\theta^*: H_0 = (68.45 \pm 0.47) \text{ km s}^{-1} \text{ Mpc}^{-1}$$

4.5 σ tensión with SH0ES



Highlights: DESI

**DESI+CMB by itself
is now showing a
 3.1σ tensión with
 Λ CDM, even
without supernovae**

Including latest
supernovae, the
tensión goes from 2
to 3σ depending on
the supernovae
dataset.

With Pantheon+:

$$w_0 = -0.838 \pm 0.055$$

$$w_a = -0.62^{+0.22}_{-0.19}$$

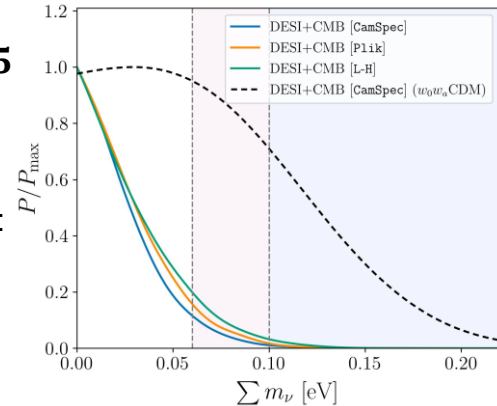
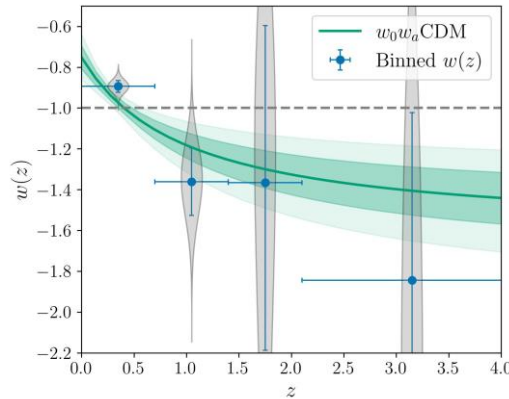
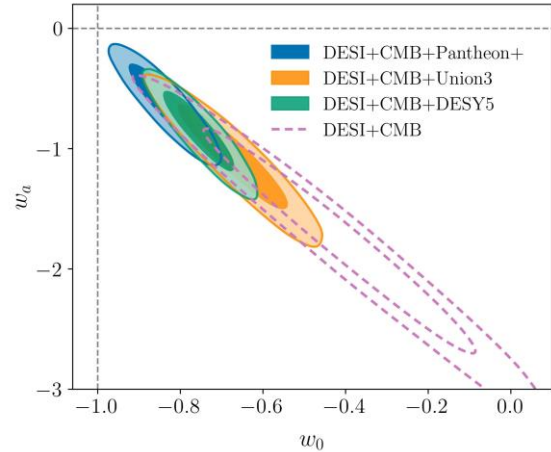
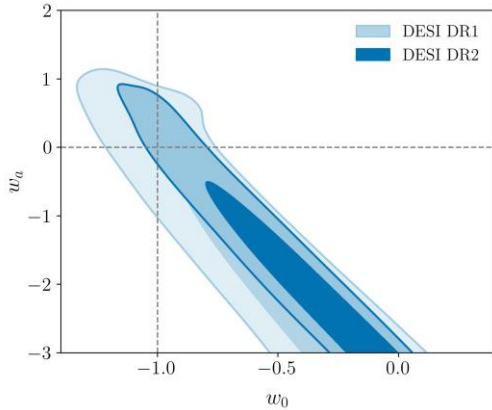
Neutrino mass DESI+CMB:

Λ CDM:

$$m_\nu < 0.0642 \text{ eV (95\%)}$$

$w_0 w_a$ CDM:

$$\Sigma m_\nu < 0.163 \text{ eV (95\%)}$$



Highlights: Euclid

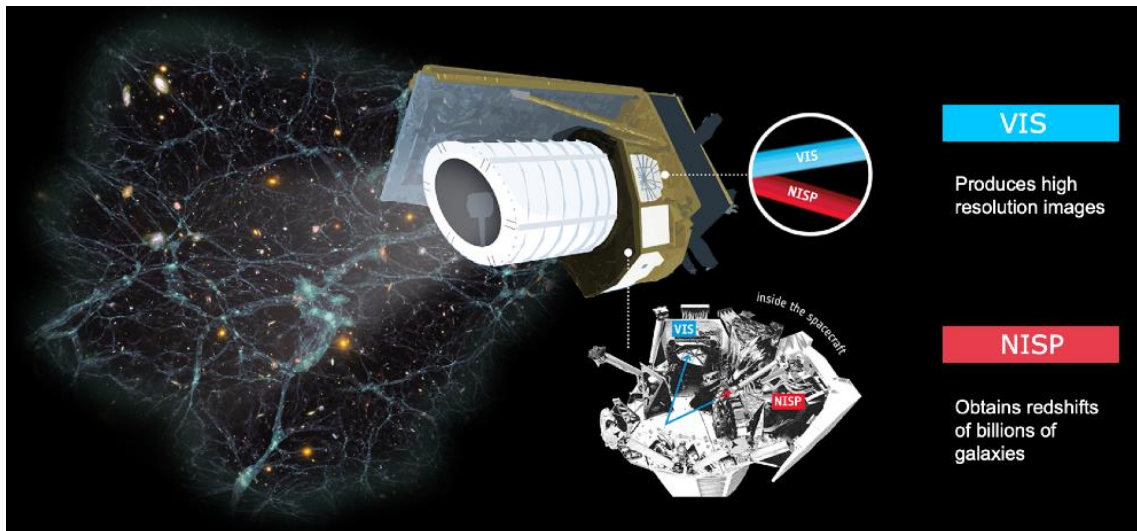
Survey started on Feb. 14th, 2024 → First stage-4 weak lensing survey in operation

Contains 2 instruments:

Visible Instrument (VIS) → Imaging

Near Infrared Spectrometer and Photometer (NISP) → Imaging and spectroscopy

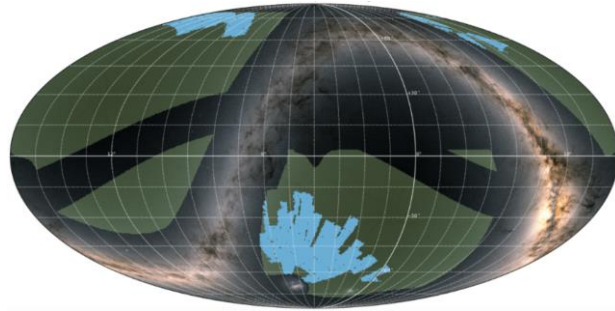
CIEMAT in Euclid since 2011



Highlights: Euclid

Quick Data Release 1 (Q1):

- **63 sq-deg** (of ~14000 sq-deg that Euclid will cover)
- **No cosmology yet** with this dataset
- Public release of the data in March 2025



DR1:

- **1900 sq-deg** (500 north, 1400 south)
- **October 2026. First cosmology results.**
- CIEMAT: 3x2pt analysis, spec clustering



Highlights: LSST-DESC

8.4m dedicated telescope on Cerro Pachón Chile at 2647m

Charles Simonyi Telescope

LSST Camera

3 lenses, 3.5 deg diameter field of view

ugrizy filters, 189 CCDs, 3.2 Gpx, ~2 seconds readout

Legacy Survey of Space and Time (LSST) – Dark Energy Science Collaboration (DESC)

10 years southern sky survey

Deep ~26.8 mag

Wide ~20000 sq-deg (1/2 of the sky)

Fast ~800 visits per field

Use experience from DES

1st images June 2025; First Light september 2025

Scientific survey starts on 2026. Alerts started 24/02/2026.

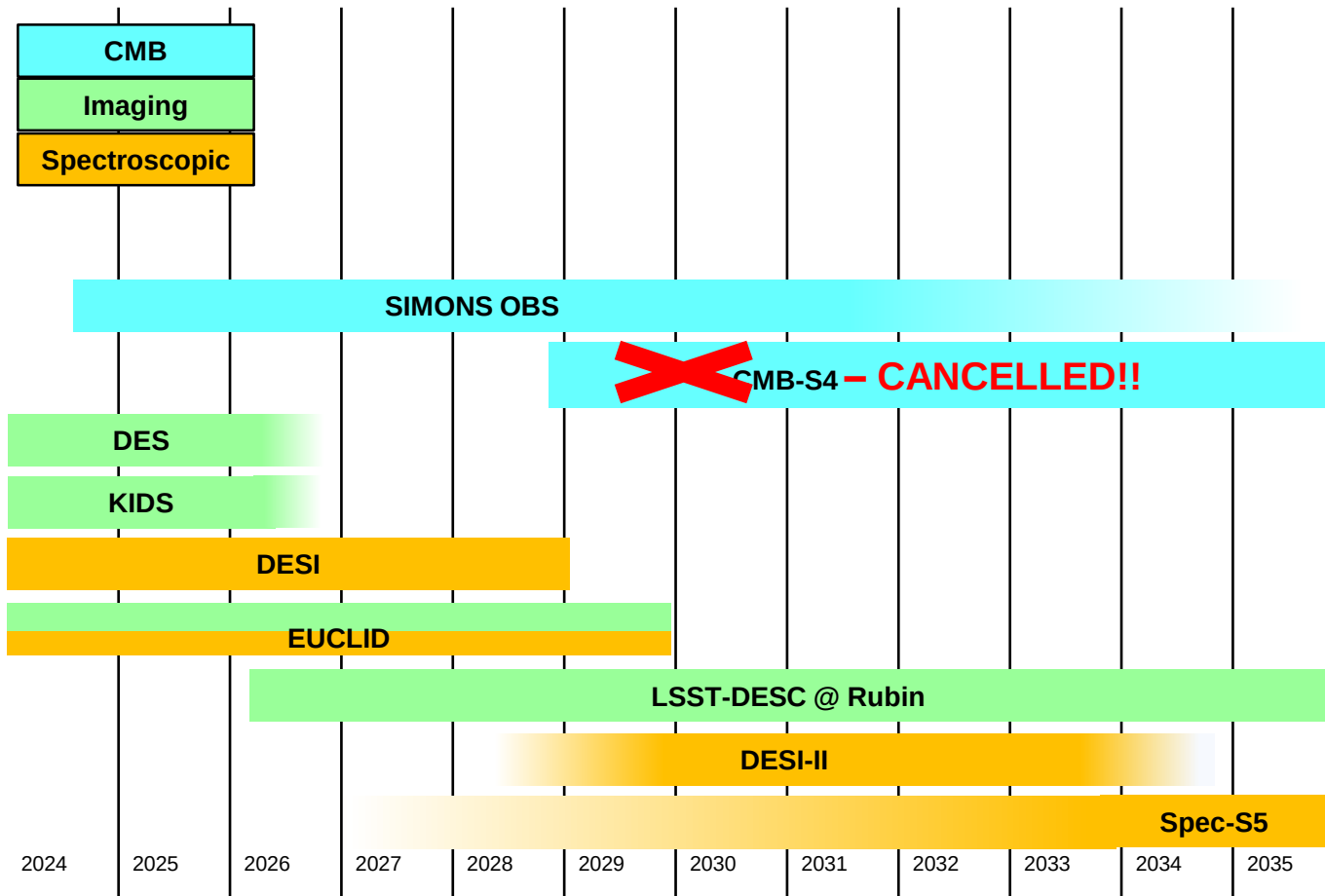
Currently in commissioning. CIEMAT contributes.

CIEMAT in LSST-DESC since 2011

Highlights: LSST-DESC



Short, Medium and Long-term vision



Current Responsibilities in Collaborations

DES:

Member of the Management Committee
Chair of the Membership Committee
Convener of the Science Release WG
Conveners of the Galaxy Clustering WG

DESI:

Member of the IB
Member of the Speakers Board
Member of the Professional
Development Committee
Member of the External Coll. Committee
Convener of the DR3 Meganalysis WG
Convener of the DR3 BGS selection
Task Force

Euclid:

Conveners of the Clustering in
Configuration Space Analysis Task
Convener of simulated data
challenges

LSST-DESC:

Co-chair of the Collaboration Council
Computing Coordinator
Convener of Science Release and
Validation
Member of Speakers Bureau

Challenges and outlook

Cosmology is an outstanding probe for new physics

CIEMAT is well positioned in world leading cosmology projects, serving in leadership positions (both science and management)

Group needs to face some challenges for the near future:

Lack of personnel → Need for more postdocs and PhD students

Need to decide for medium and long term projects after LSST-DESC → Associated technical activities and responsibilities
SO, Spec-S5

Promising Scientific future for the field in the next ~25 years