

Observational Cosmology at IFAE

BCN-MAD Cosmo Meeting (CIEMAT)

Observational Cosmology Group Members

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Observational Cosmology Group Members

- Umut and Cesar have graduated in 2024
 - Cesar is now a Postdoc in our group
- Santi has left IFAE to CIEMAT
- The foreseen 3 new postdocs have now started at IFAE

Observational Cosmology Funding

Spanish

Plan Nacional FPN (2022-2025), coordinated with CIEMAT, IFT, PIC
PIs: R. Miquel, A. Font-Ribera
Exploitation of DES and DESI, preparation for LSST

Plan Nacional ESP (2023-2026), coordinated with ICE, PIC
PIs: C. Padilla, M. Manera
Exploitation of Euclid, synergies with PAUS, DESI, LSST

Plan Nacional PCI-ESP (2024-2026)
PI: C. Padilla
Exploitation of Euclid and Hardware for IR Detectors

Consolidación Investigadora (2024-2026)
PI: M. Manera
Exploitation of Euclid

Plan Nacional AYA (2023-2026)
PI: C. Sánchez
Exploitation of DES, preparation for LSST

ATHENA (2024-2027)
PI: C. Padilla
R&D for IR detectors

European

PRODEX ARRAKIHS (2025-2026)
PI: C. Padilla
Hardware Contribution to ARRAKIHS Mission

ERC CoG: COSMO-LYA (2022-2027)
PI: A. Font-Ribera
Lyman- α forest with DESI

Observational Cosmology Surveys

Many projects, at different stages and with different emphases:

- DES: Last data taken in 2019. IFAE has had a large impact on **photo-z**, **WL** and **LSS**. **Final (Y6) analysis expected during 2025 (BFD in 2026?)**
- PAU: Last data taken in 2020 (commissioning of WEAVE). Leadership on **photo-z**. **After last thesis, group no longer particularly engaged**
- DESI: Year-3 BAO papers expected by mid March (the Ly- α BAO supporting paper is led by IFAE). Main survey 90% complete, but **extension approved until end of 2028**
- Euclid: First venture into space instrumentation. Launched in 2023. Involved in **photo-z** and **WL**. **Analysis: 2024-2029+**
- Rubin / LSST / DESC: Contributions to software and data management. Natural continuation of DES. Synergies with PAU and Euclid. Starting a push on **WL** and **photo-z**. **Analysis: 2026-2036+**

Observational Cosmology Surveys

Tradition of hardware and software contributions to these projects:

- DES: designed and produced **read-out electronics** of DECam with CIEMAT (and FNAL)
- PAU: Designed and built the **whole PAUCam** with ICE, CIEMAT, IFT
- DESI: Designed and built the **GFA cameras** with CIEMAT, ICE, IFT
- Euclid: Designed and built the **Filter Wheel Assembly** with ICE
- Rubin / LSST / DESC: Contributions to **software** (IFAE) and **data management** (PIC)
- ARRAKIHS: Responsible of the **characterization of the IR detectors**
- R&D in **IR detectors**: with newly developed European IR and VLWIR detectors

Observational Cosmology: Future

Possible options for 2030+:

- DESI-II: Continuation of DESI at $z > 2$. Not clear yet how much in-kind we should contribute, but it should not be much. It seems a no-brainer. **Supported by P5 and APPEC**
- Spec-S5: Stage-5 spectroscopic survey at Mayall and Blanco to start later than 2037. Higher redshift to look for PNG and primordial features in the power spectrum (complementary to CMB). **P5 report gave the green light to initiate studies.**
- CMB-S4: Stage-4 CMB experiment in Chile (South Pole option cancelled) to look for tensor modes of inflation plus all the other CMB science. Start around 2033. **Number one priority in P5 report. Supported on APPEC roadmap.**
- ARRAKIHS: First ESA Spanish lead mission. Expected launch in 2030. Responsible of the IR detector characterization.

Starting to study the possibility to join Spec-5 and/or CMB-S4.

Observational Cosmology: Future

Possible options for 2030+ (contributions):

- DESI-II: No large new contributions necessary. Will be there.
- Spec-S5: Too early to tell
- CMB-S4: Exploring contributions to read-out electronics or, possibly, a complete SAT , with France and Italy.
 - Studies to evaluate the scientific performance without observations in the South Pole ongoing. More news in March 2025
 - Apparently, the required precision in r can only be achieved if CMB-S4 joins Simons Observatory (SO)
 - Starting to explore the possibility to participate already in SO (Tony Mroczkowski joining ICE this summer) while the hardware contribution to CMB-S4 materializes

Summary

- The group has grown significantly in recent years.
- In **DES**, leadership in Y6 continues along the path started in SV and continued in Y1 and Y3, until 2025.
- In **DESI**, leadership in Ly- α for Y1, Y3 and beyond. With **DESI-II**, state-of-the-art spectroscopic data until 2029.
- **Euclid** scientific exploitation has started and will continue until the end of the mission.
- **LSST**, access to top-grade imaging data until 2035.
- Exploring **Spec-S5** and **CMB-S4** for future beyond 2035.
- **ARRAKIHS** contribution in characterizing IR detectors puts the group in the frontier of these technologies
- Well positioned to become experts in **IR and VLWIR** detector characterization.