Équipe DARK

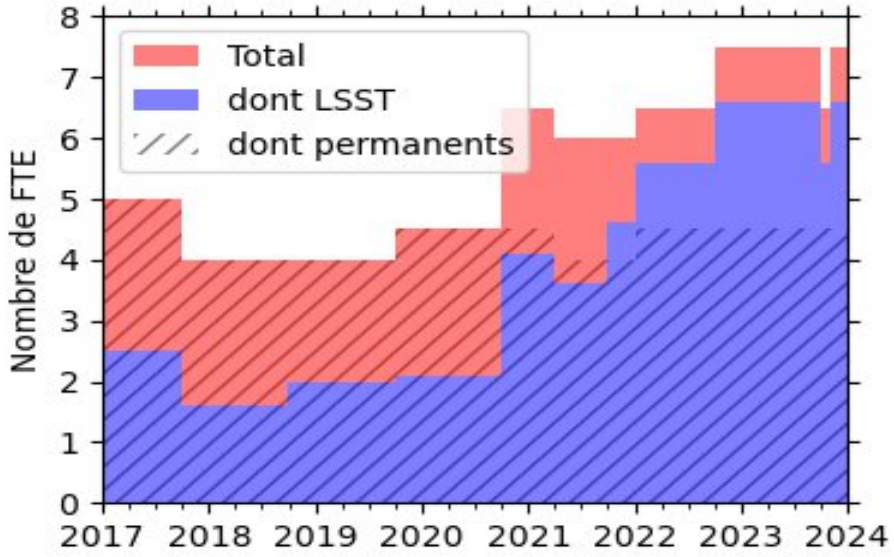
Conseil scientifique du LPSC - 01/12/2023

1. **Composition et évolution de l’équipe**
2. **Projet Rubin**
3. **Thématiques scientifiques**
4. **Conclusions et perspectives**

Composition et évolution de l'équipe

J. Bregeon, CR (HDR)
C. Combet, DR (HDR)
C. Doux, CR
M. Kuna, MCF (HDR)
D. Maurin, CR (HDR)

2020-2022 : C. Murray (post-doc ENIGMASS)
2020-2023 : C. Payerne (thèse ED)
2022-2025 : M. Masson (thèse IRGA)
2022-2025 : M. Ramel (thèse ED)
2023-2025 : J. Mena Fernández (post-doc IN2P3)



Forte évolution des membres de l'équipe

- Nombre FTE dans l'équipe (hachuré) stable
- 3 membres sur 5 arrivés après 2017

Forte évolution des thématiques dans l'équipe

- « LSST » maintenant majoritaire (en bleu)
- Rayonnement cosmique marginal (en rouge)

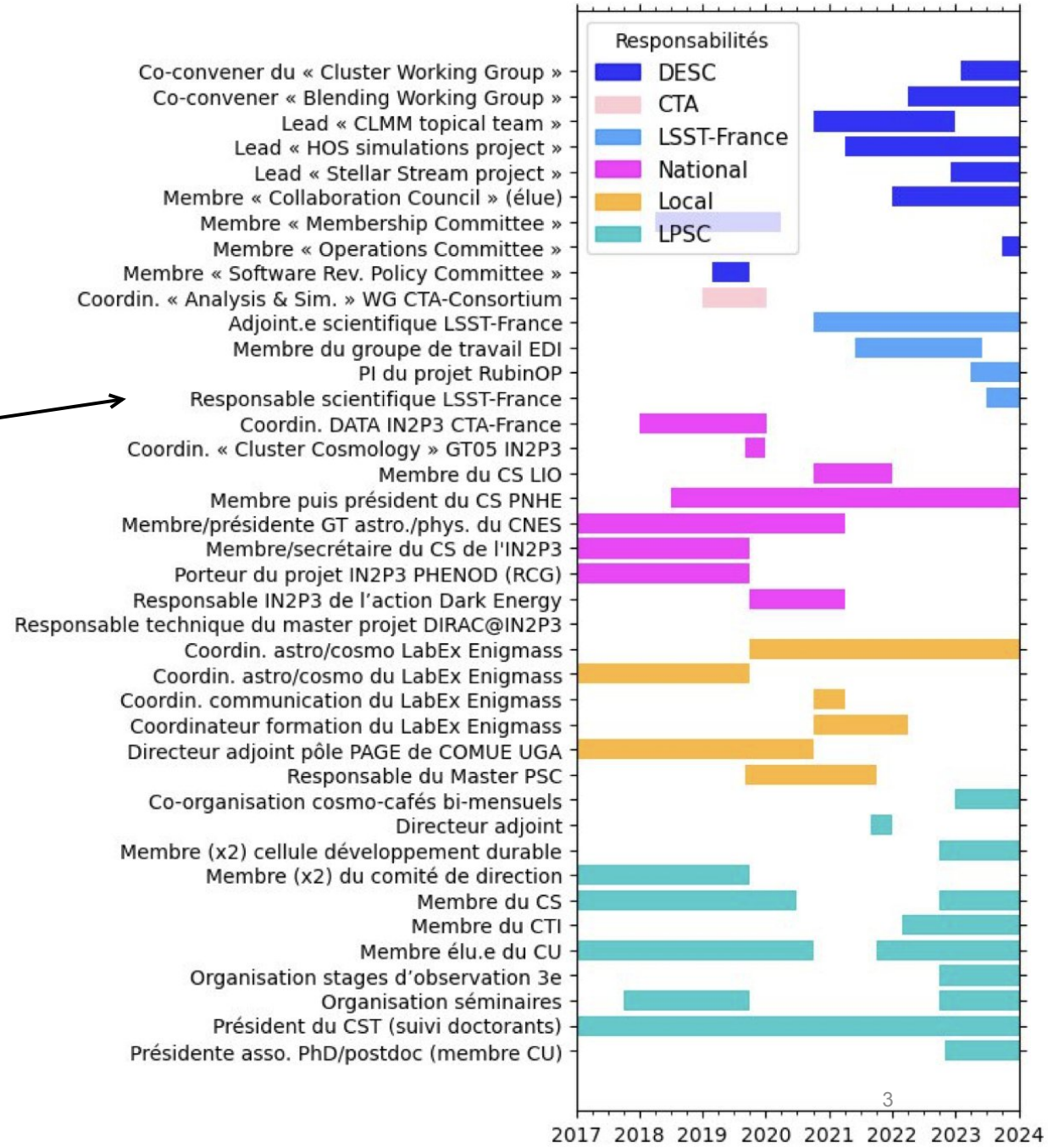
→ *voir document fourni au CS*

Services à la communauté, expertises et formation

Responsabilités

- Local : LPSC, Université, LabEx
- National : IN2P3, INSU, CNES
- International : DESC

+ expertise reconnue (comités, referees, etc.)



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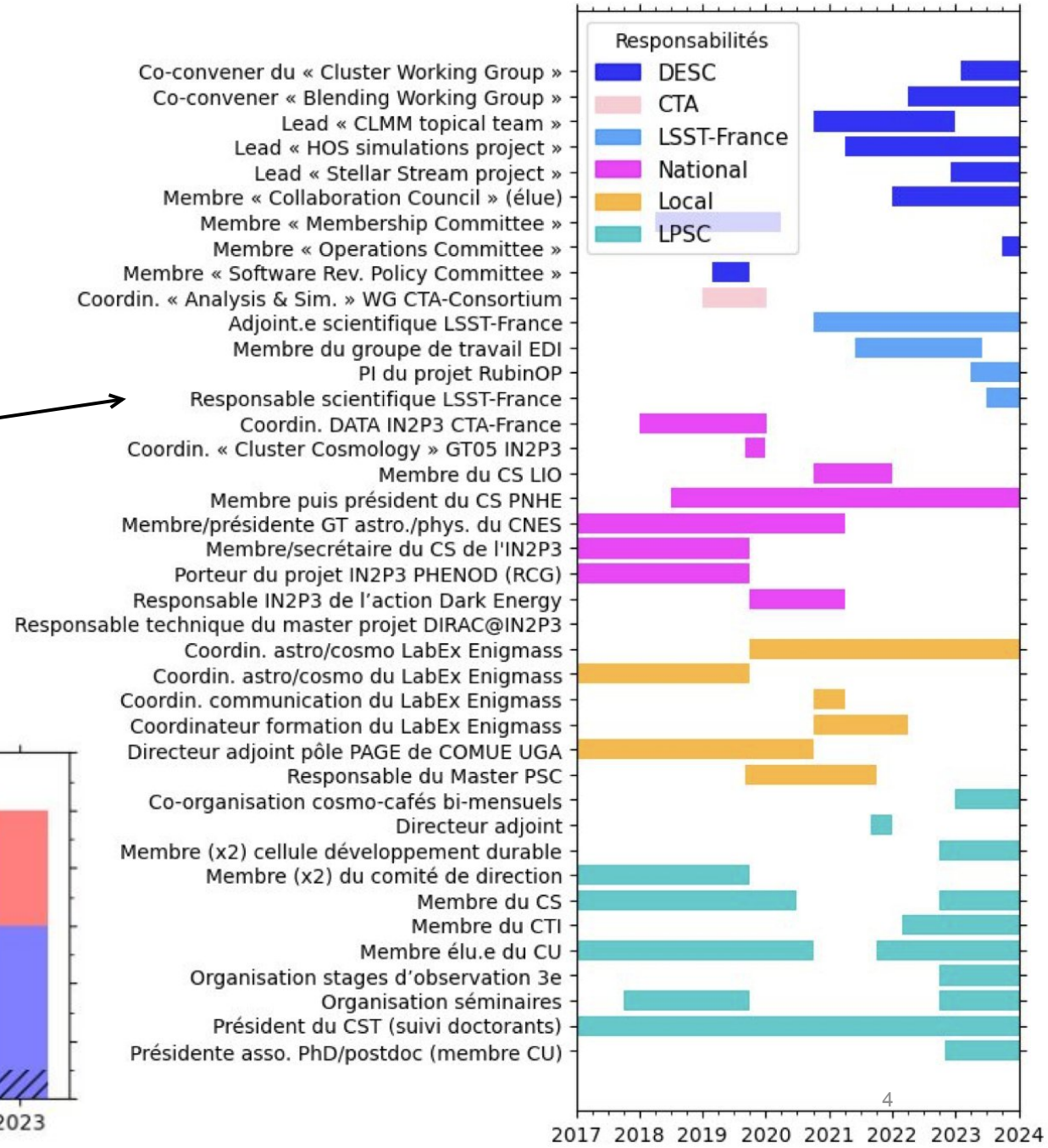
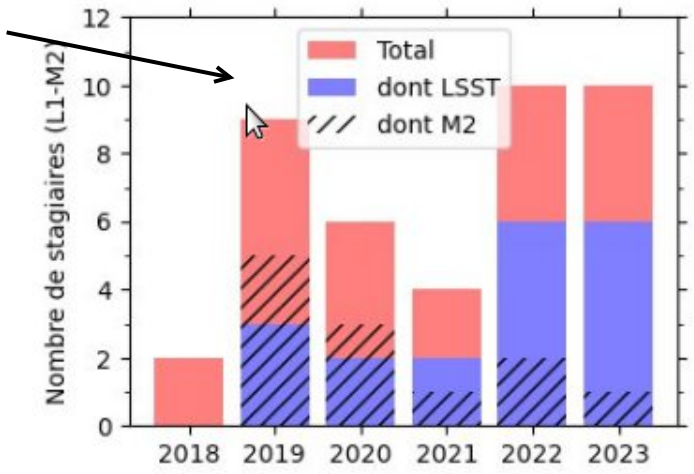


Formation et médiation scientifique

- Encadrement de nombreux stages L1-M2 (illustre aussi transition vers LSST)
- Cours/organisations d'écoles
- Nombreuses actions de médiation



1. **Composition et évolution de l’équipe**

2. **Projet Rubin**
    1. Observatoire Rubin et survey LSST
    2. Chargeur de filtre et CCOB
    3. Commissioning/computing

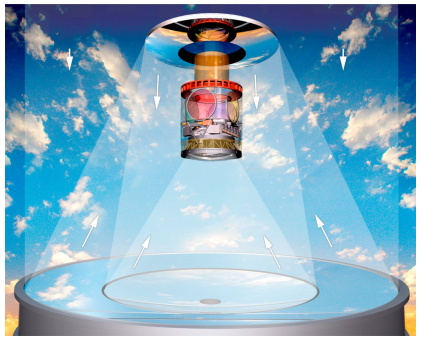
3. **Thématiques scientifiques**
    1. Collaboration DESC et science
    2. Cosmologie avec le cisaillement gravitationnel
    3. Cosmologie avec les amas de galaxies
    4. Matière noire avec les courants d’étoiles
    5. Ciel transitoire et « broker » d’alertes FINK

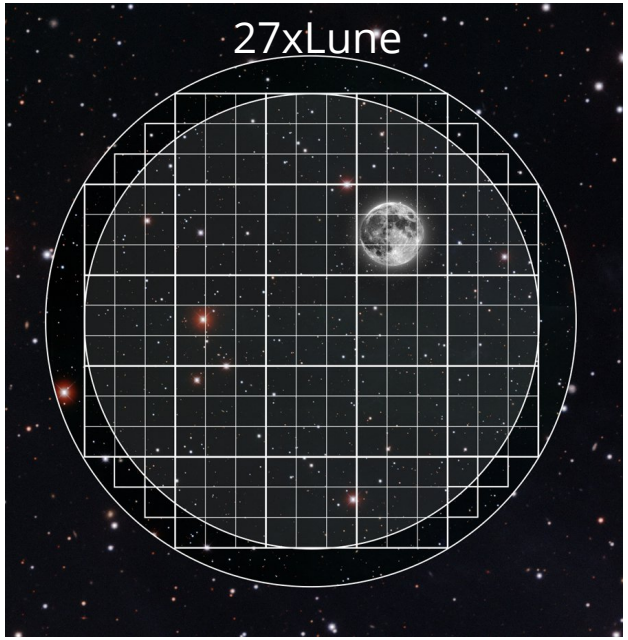
4. **Conclusions et perspectives**

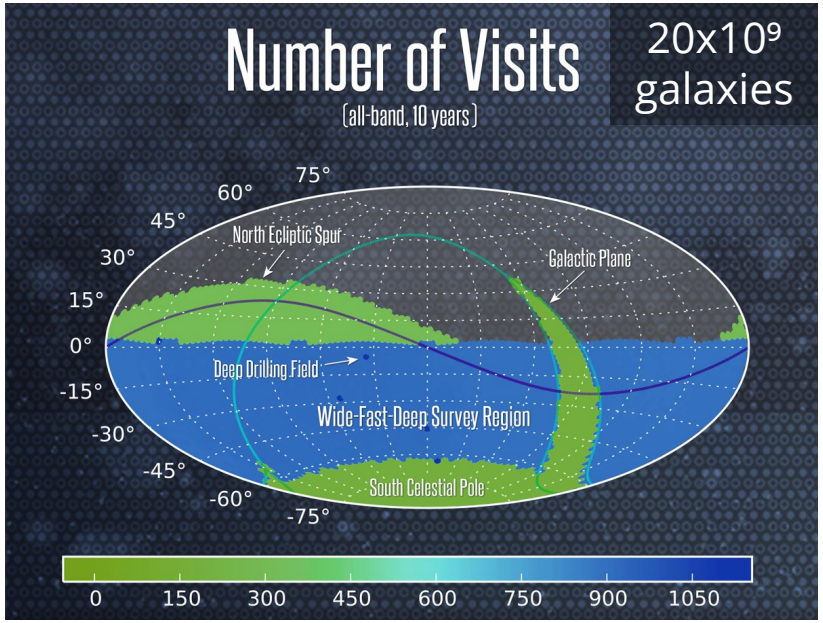
Observatoire Vera C. Rubin, grand relevé LSST

Vera C. Rubin !

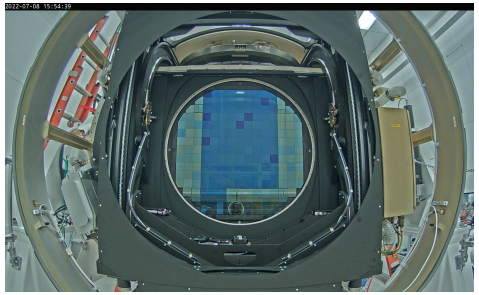
3 mirroirs
3 lentilles
6 filtres



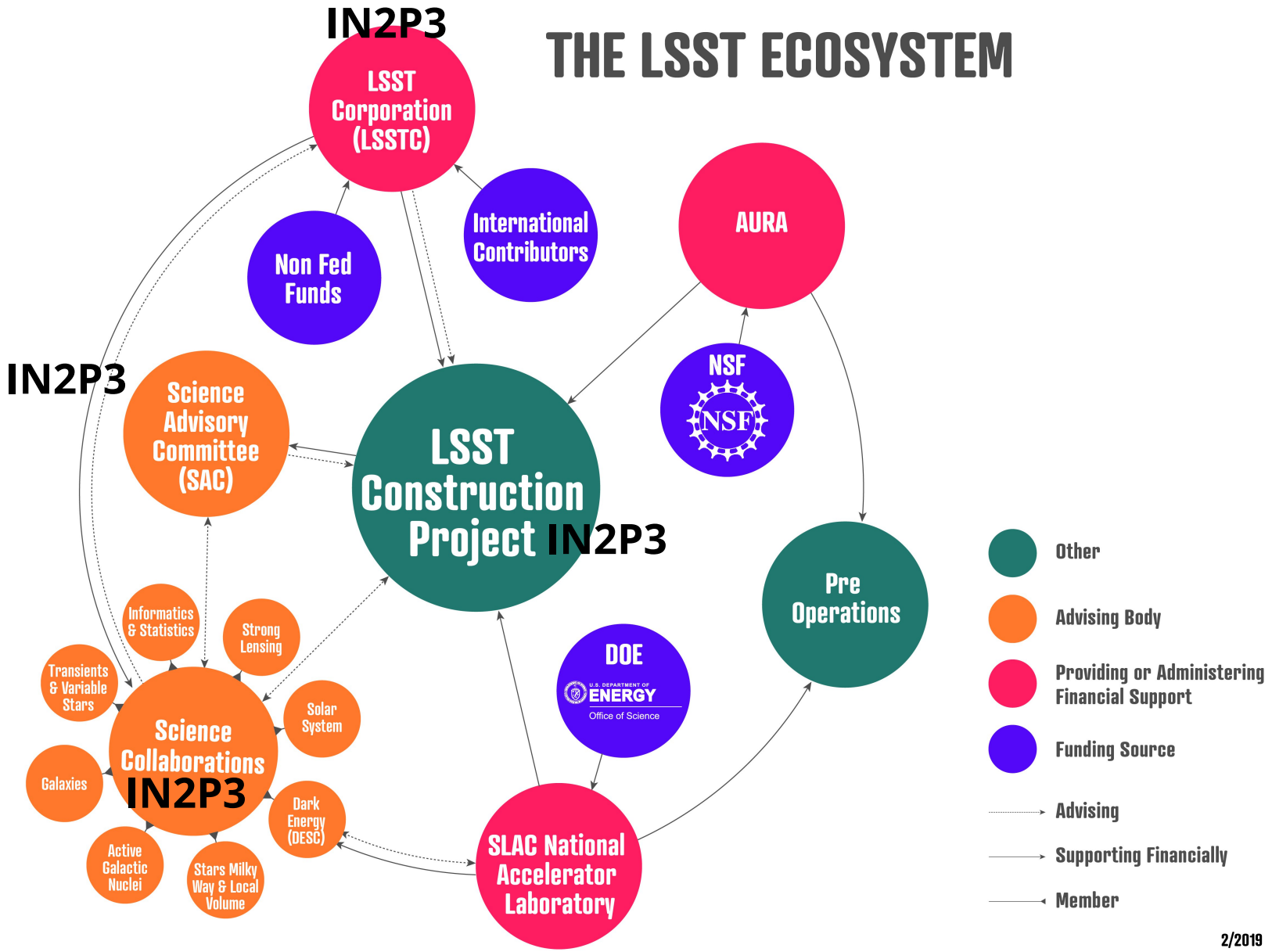




3,2 Giga
pixels
60 cm ⌀



Rubin LSST


IN2P3
THE LSST ECOSYSTEM
LSST Corporation (LSSTC)
International Contributors
AURA
Non Fed Funds
IN2P3
Science Advisory Committee (SAC)
NSF
NSF
LSST Construction Project IN2P3
Pre Operations
Informatics & Statistics
Strong Lensing
Transients & Variable Stars
Solar System
Science Collaborations IN2P3
Galaxies
Dark Energy (DESC)
Active Galactic Nuclei
Stars Milky Way & Local Volume
DOE
U.S. DEPARTMENT OF ENERGY
Office of Science
SLAC National Accelerator Laboratory
Other
Advising Body
Providing or Administering Financial Support
Funding Source
Advising
Supporting Financially
Member
2/2019

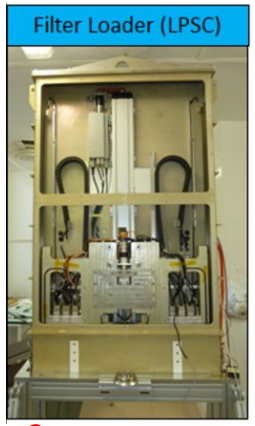
LSST@IN2P3

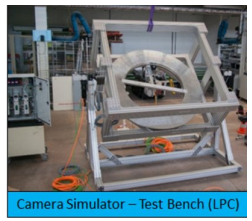
Dans les labos IN2P3
- 137 personnes
- 72 ETPs
- 800 k€/an

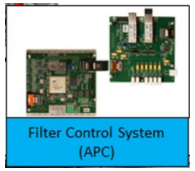
>15 années d'investissement

Construction

Changeur de filtre

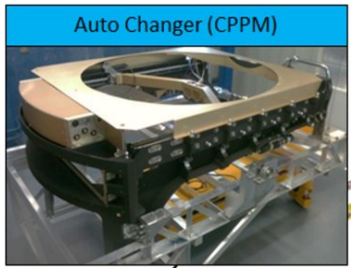


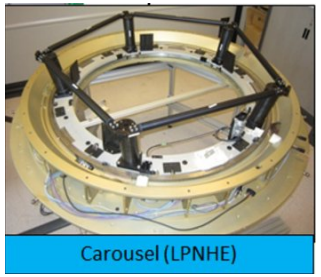




LPSC

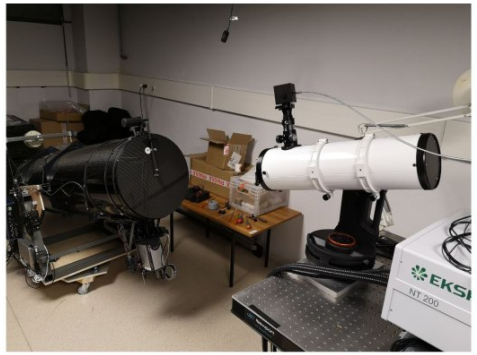
Raft electronics board





Calibration

CBPs

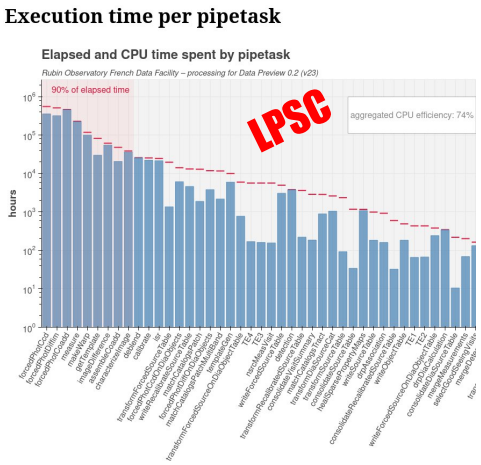


CCOBs

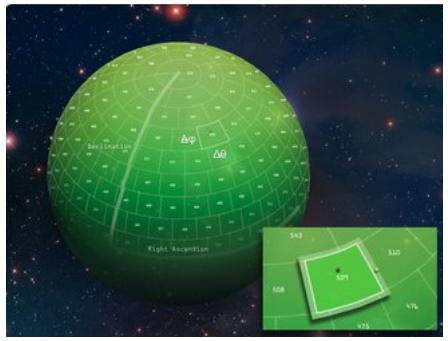
LPSC

Computing

Data processing

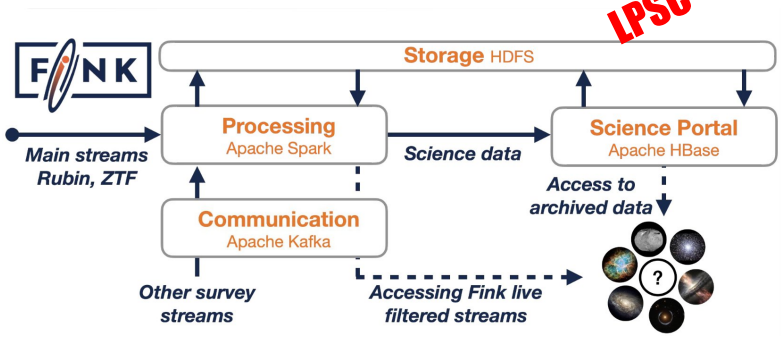


Qserv database

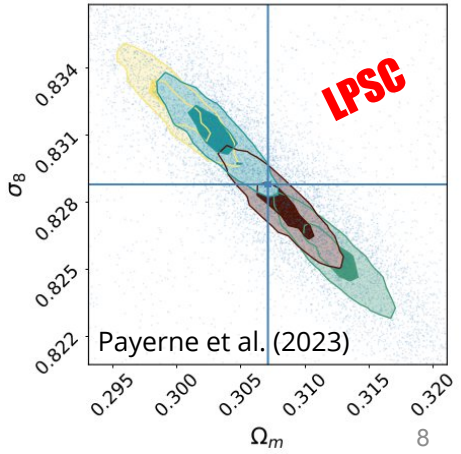


Exploitation

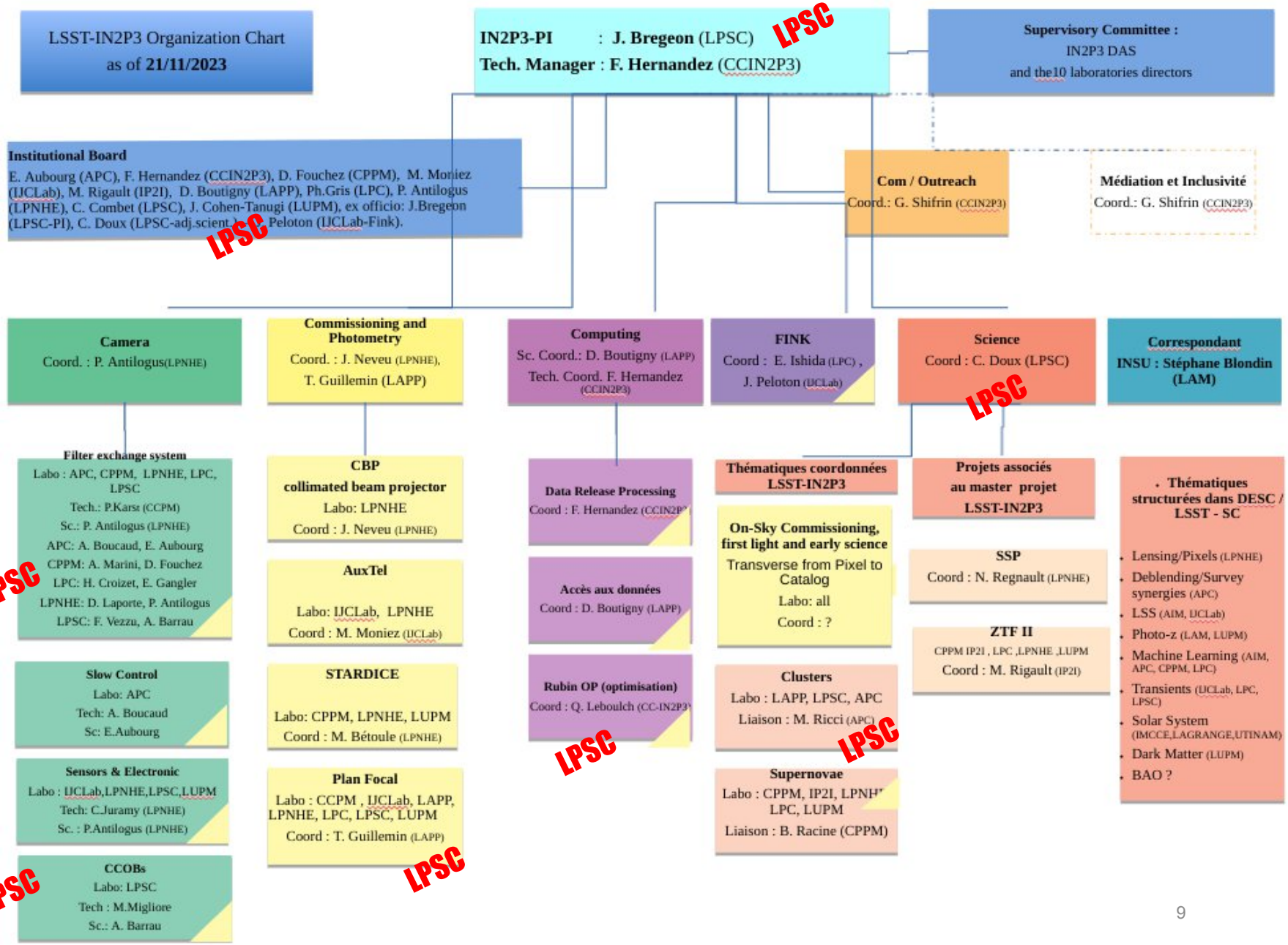
"Broker" d'alertes



Cosmologie



LSST-France


LSST-IN2P3 Organization Chart
as of 21/11/2023
IN2P3-PI : J. Bregeon (LPSC)
Tech. Manager : F. Hernandez (CCIN2P3)
LPSC
Supervisory Committee :
IN2P3 DAS
and the10 laboratories directors
Institutional Board
E. Aubourg (APC), F. Hernandez (CCIN2P3), D. Fouchez (CPPM), M. Moniez (IJCLab), M. Rigault (IP2I), D. Boutigny (LAPP), Ph.Gris (LPC), P. Antilogus (LPNHE), C. Combet (LPSC), J. Cohen-Tanugi (LUPM), ex officio: J.Bregeon (LPSC-PI), C. Doux (LPSC-adj.scient.), J. Peloton (IJCLab-Fink).
LPSC
Com / Outreach
Coord.: G. Shifrin (CCIN2P3)
Médiation et Inclusivité
Coord.: G. Shifrin (CCIN2P3)
Camera
Coord. : P. Antilogus(LPNHE)
Commissioning and Photometry
Coord. : J. Neveu (LPNHE), T. Guillemin (LAPP)
Computing
Sc. Coord.: D. Boutigny (LAPP)
Tech. Coord. F. Hernandez (CCIN2P3)
FINK
Coord : E. Ishida (LPC) , J. Peloton (IJCLab)
Science
Coord : C. Doux (LPSC)
LPSC
Correspondant
INSU : Stéphane Blondin (LAM)
Filter exchange system
Labo : APC, CPPM, LPNHE, LPC, LPSC
Tech.: P.Karst (CCPM)
Sc.: P. Antilogus (LPNHE)
APC: A. Boucaud, E. Aubourg
CPPM: A. Marini, D. Fouchez
LPC: H. Croizet, E. Gangler
LPNHE: D. Laporte, P. Antilogus
LPSC: F. Vezzu, A. Barrau
LPSC
CBP
collimated beam projector
Labo: LPNHE
Coord : J. Neveu (LPNHE)
AuxTel
Labo: IJCLab, LPNHE
Coord : M. Moniez (IJCLab)
Data Release Processing
Coord : F. Hernandez (CCIN2P3)
Accès aux données
Coord : D. Boutigny (LAPP)
Rubin OP (optimisation)
Coord : Q. Leboulch (CC-IN2P3)
LPSC
Thématiques coordonnées LSST-IN2P3
On-Sky Commissioning, first light and early science
Transverse from Pixel to Catalog
Labo: all
Coord : ?
Clusters
Labo : LAPP, LPSC, APC
Liaison : M. Ricci (APC)
LPSC
Supernovae
Labo : CPPM, IP2I, LPNHE, LPC, LUPM
Liaison : B. Racine (CPPM)
Projets associés au master projet LSST-IN2P3
SSP
Coord : N. Regnault (LPNHE)
ZTF II
CPPM IP2I , LPC ,LPNHE ,LUPM
Coord : M. Rigault (IP2I)
Thématiques structurées dans DESC / LSST - SC
Lensing/Pixels (LPNHE)
Deblending/Survey synergies (APC)
LSS (AIM, IJCLab)
Photo-z (LAM, LUPM)
Machine Learning (AIM, APC, CPPM, LPC)
Transients (IJCLab, LPC, LPSC)
Solar System (IMCCE,LAGRANGE,UTINAM)
Dark Matter (LUPM)
BAO ?
Slow Control
Labo: APC
Tech: A. Boucaud
Sc: E.Aubourg
Sensors & Electronic
Labo : IJCLab,LPNHE,LPSC,LUPM
Tech: C.Juramy (LPNHE)
Sc. : P.Antilogus (LPNHE)
CCOBs
Labo: LPSC
Tech : M.Migliore
Sc.: A. Barrau
LPSC
STARDICE
Labo: CPPM, LPNHE, LUPM
Coord : M. Bétoule (LPNHE)
Plan Focal
Labo : CCPM , IJCLab, LAPP, LPNHE, LPC, LPSC, LUPM
Coord : T. Guillemin (LAPP)
LPSC

LSST@LPSC : construction de la caméra

https://youtu.be/DJk0JibRB3A

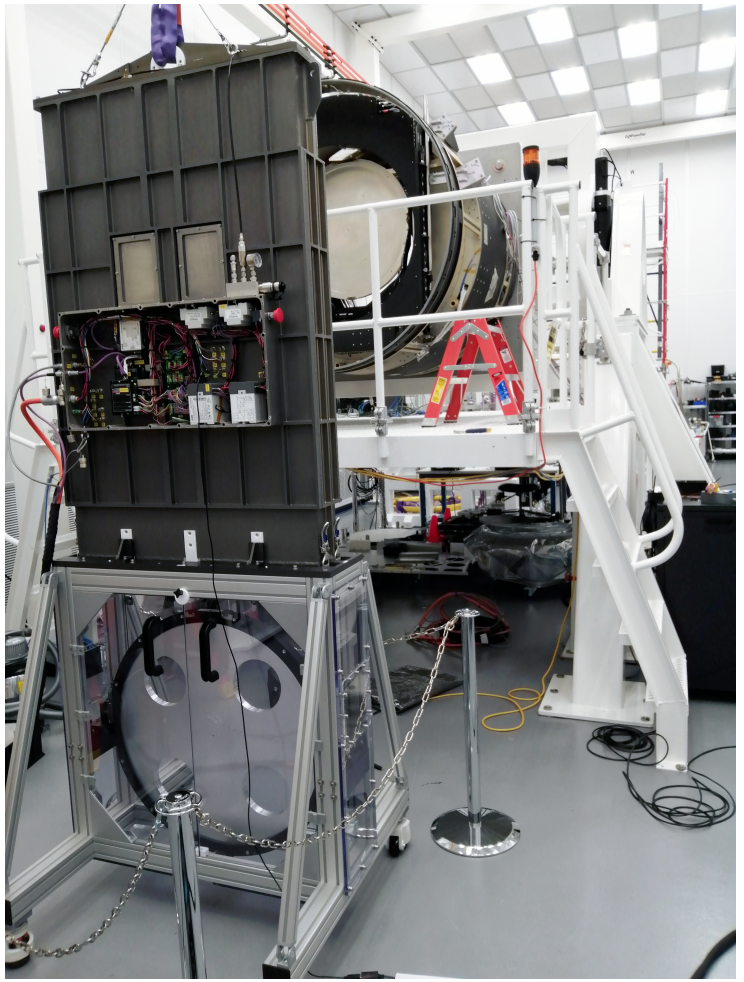
Système chargeur de filtre
(resp. technique F. Vezzu)

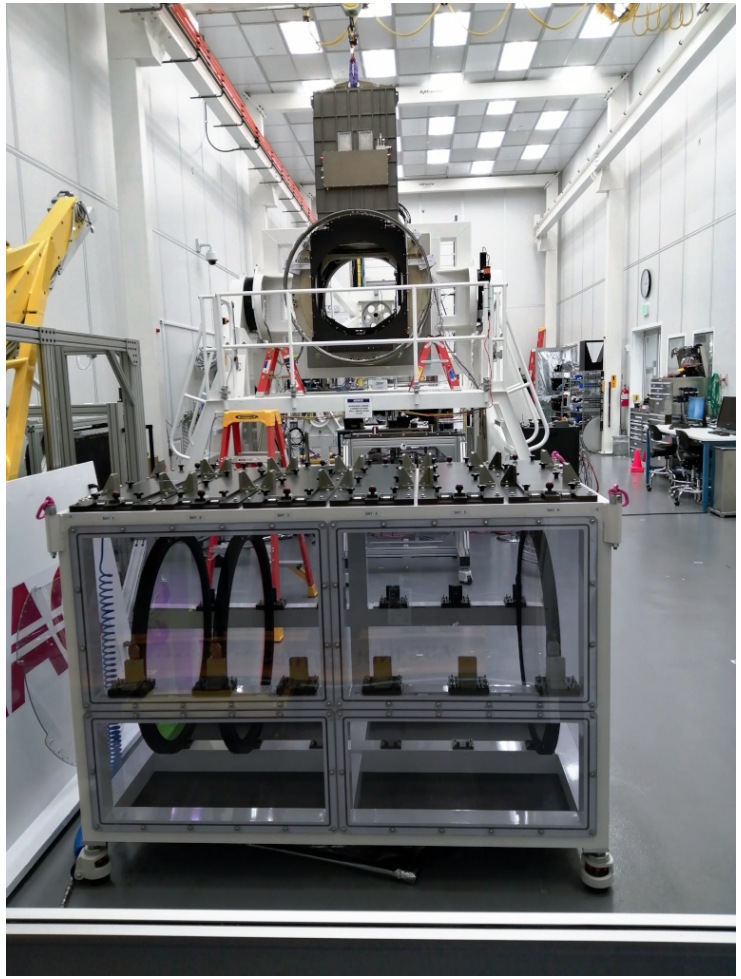
- ~25 ETP.ans ITA (mécanique, électronique, informatique, admin)
- Design, conception, construction, tests et commissioning

Objectif : transférer des filtres depuis leur boîte de stockage vers la caméra

Statut : tout le matériel est au SLAC depuis 10/2023, missions prévues au SLAC et au Chili en 2024 (F. Vezzu, M. Kusulja)

Futur : maintenance en “best effort” sur la durée du relevé





LSST@LPSC : calibration

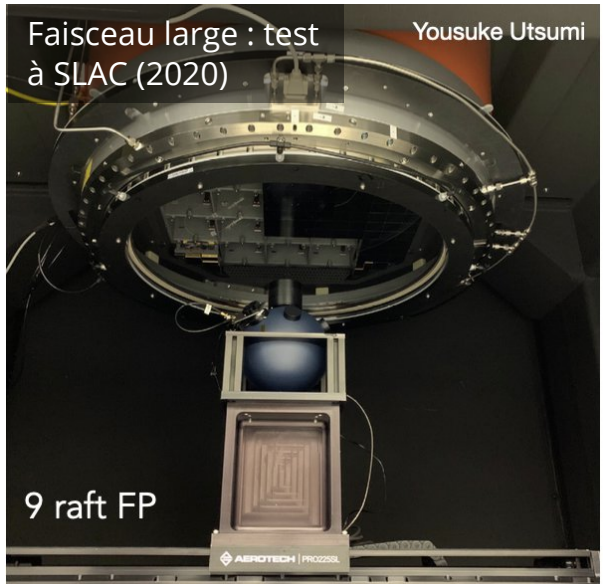
CCOBs Camera Calibration Optical Bench
(resp. technique M. Migliore, resp. scientifique A. Barrau)

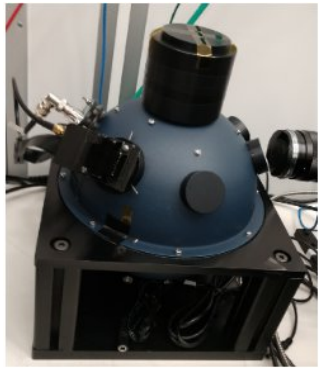
Faisceau large (C. Combet)

- *Objectif* : réponse relative du plan focal à 1 pour mille
- *Méthode* : illumination uniforme
- *Statut* : livré à SLAC fin 2017, abandonné en 2022 (pb. cryo. de la caméra), hardware partiellement réutilisé en 2023

Faisceau fin (J. Bregeon)

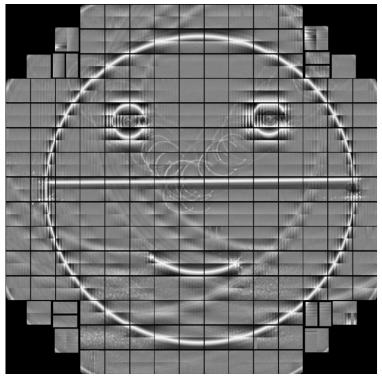
- *Objectif* : mesure de transmission de la caméra intégrée, alignement des optiques
- *Méthode* : lumière monochromatique, faisceau 2.5 mm ∅
- *Statut* : livré à SLAC en 2020, utilisé lors des prises de données du Run 6 (2023 - 2024)
- *Futur* : utilisation possible (mais à ce jour peu probable) au Chili

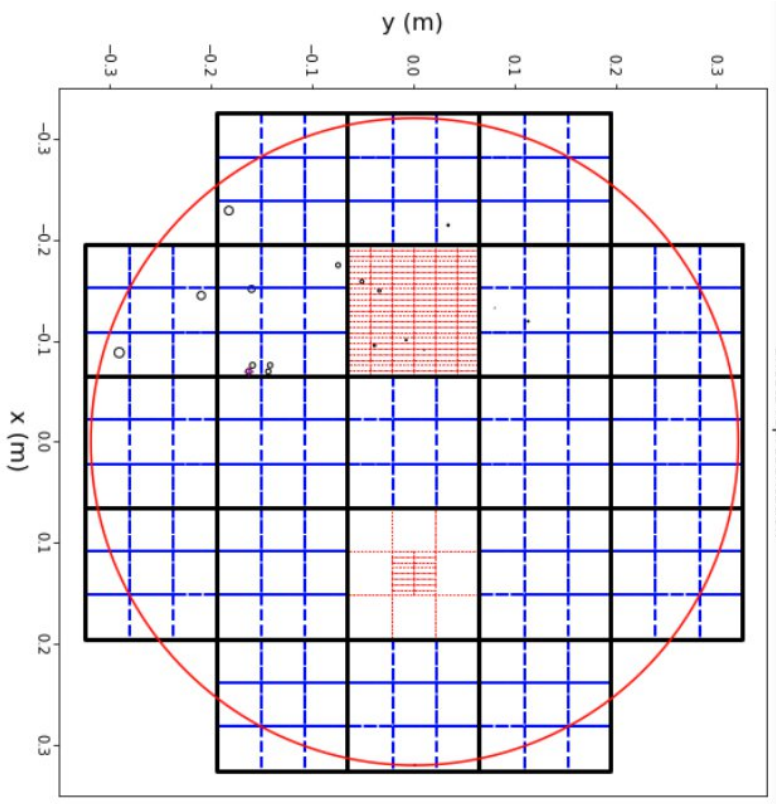




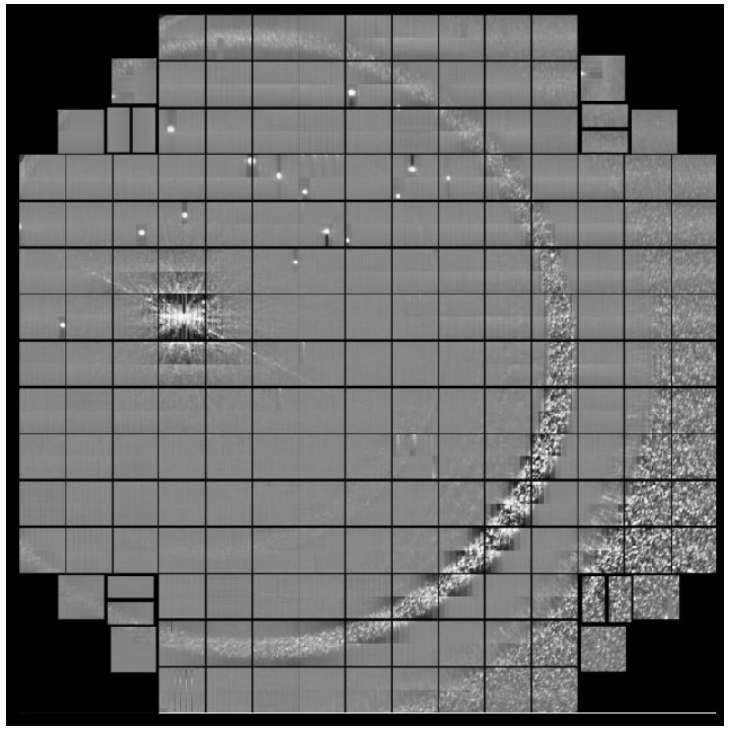
LSST@LPSC : CCOB (faisceau fin)

Données de commisionning de la caméra intégrée prises à SLAC en juin 2023

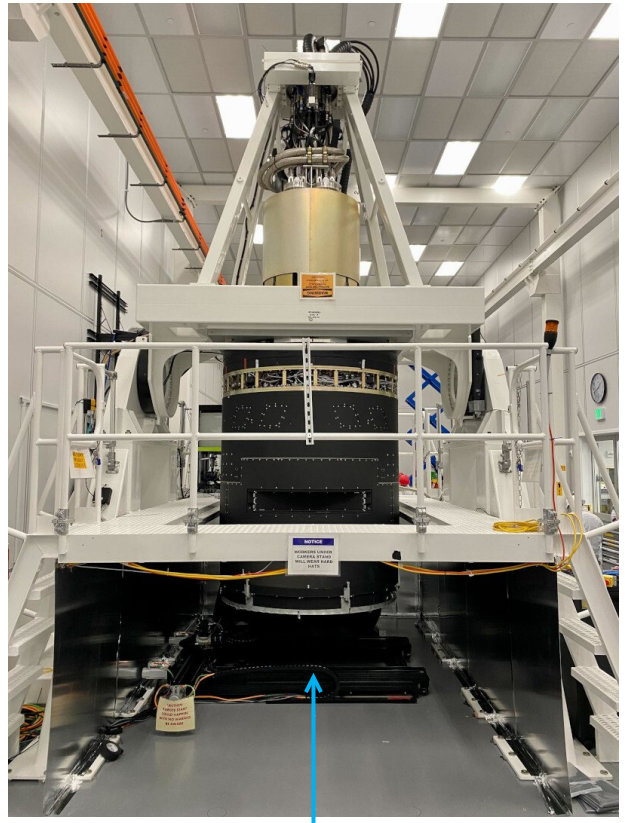




Simulation



Données



CCOB

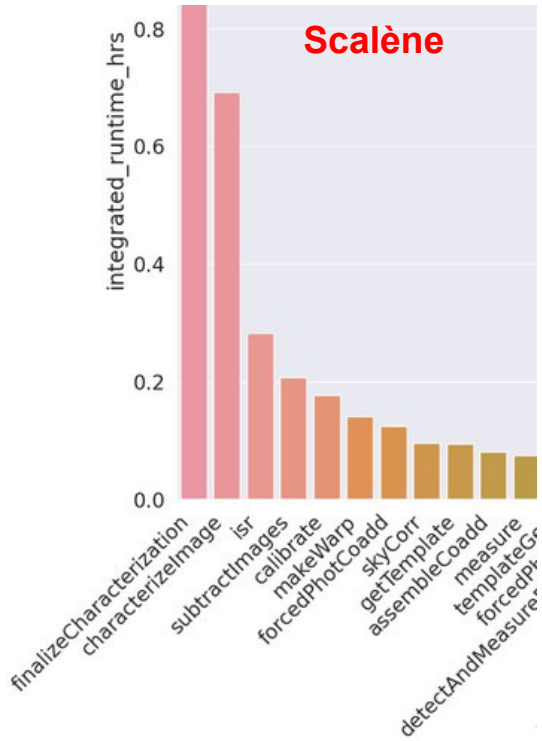
LSST@LPSC : computing (RubinOP)

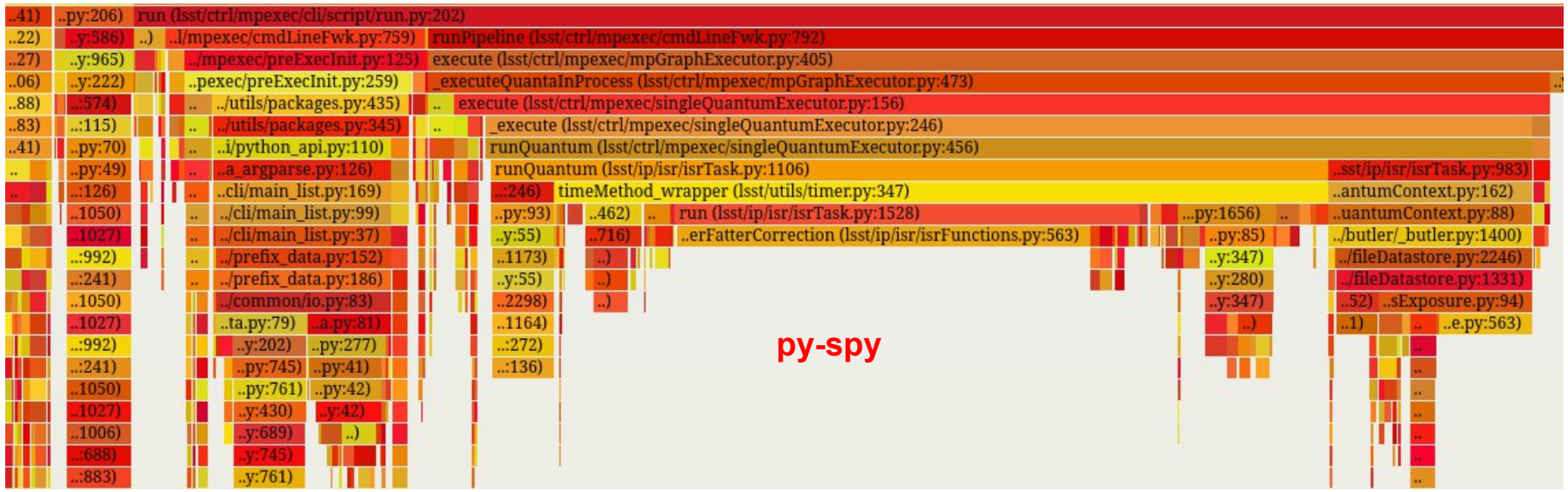
Optimisation du pipeline de traitement des données Rubin (DRP)
→ *Financement CNRS/MITI* "blanc" 2023

- PI J. Bregeon (coordinateur effectif Q. Le Boulc'h, CC-IN2P3)
- LPSC, CC-IN2P3, LAPP, APC, LIRMM (INS2I)

+ *demande renforcement CDD IR* au LPSC (?)

MoU IN2P3 - DOE
40% des données du LSST traitées au CC-IN2P3
→ 800 k€/an pendant 10 ans





Profilage CPU, mémoire, I/O : préliminaires à l'optimisation

Rubin LSST – Data Release Planning

Première *data release* (preview) attendue mi-2026…

- le travail actuel se fait sur des simulations

Implication continue dans le “commissioning”

- caméra à SLAC, puis caméra sur le ciel
- des pixels aux premiers catalogues !

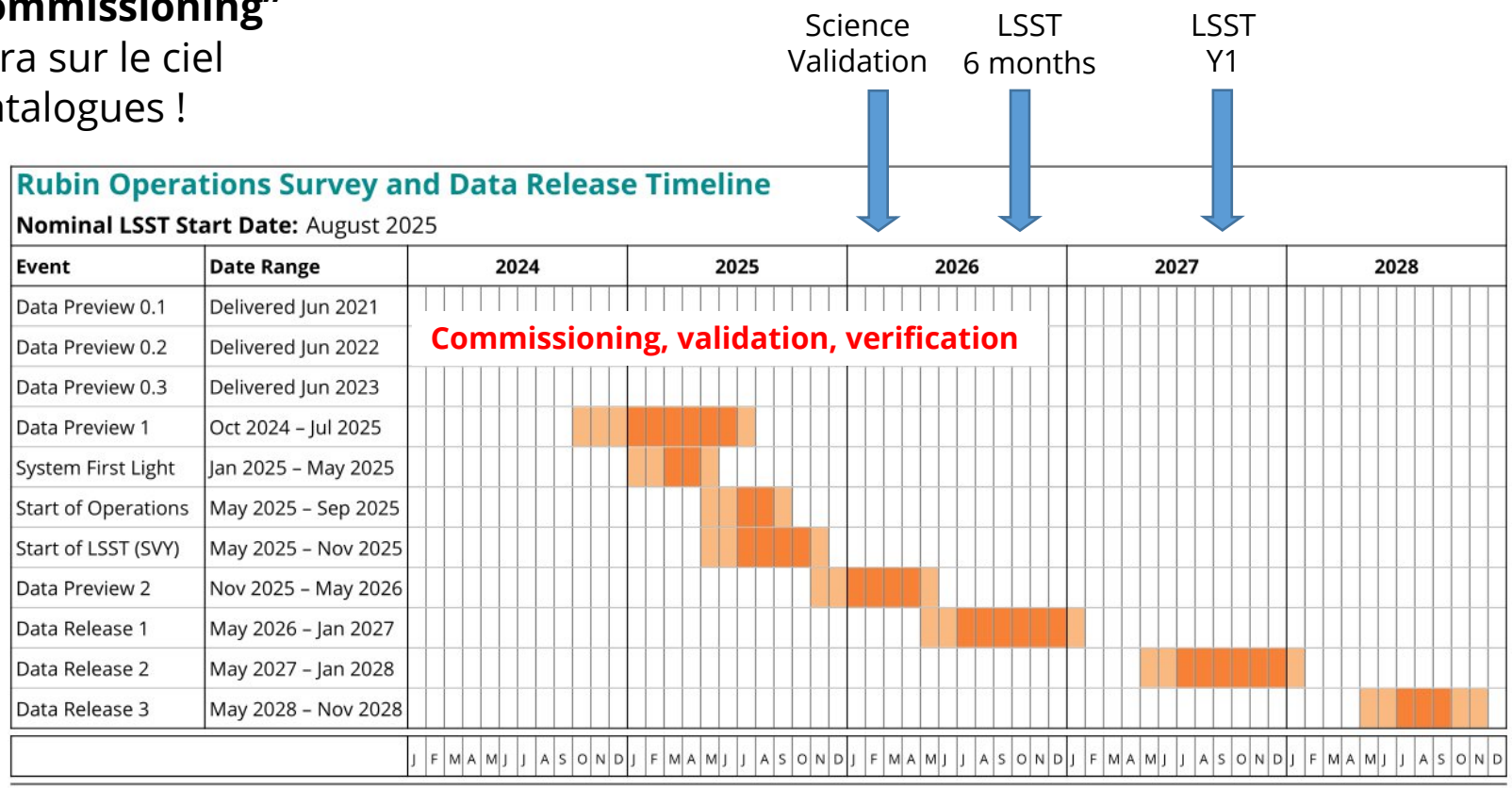


TABLE 3: Rubin Operations Key Milestones for Early Science

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    2. Chargeur de filtre et CCOB
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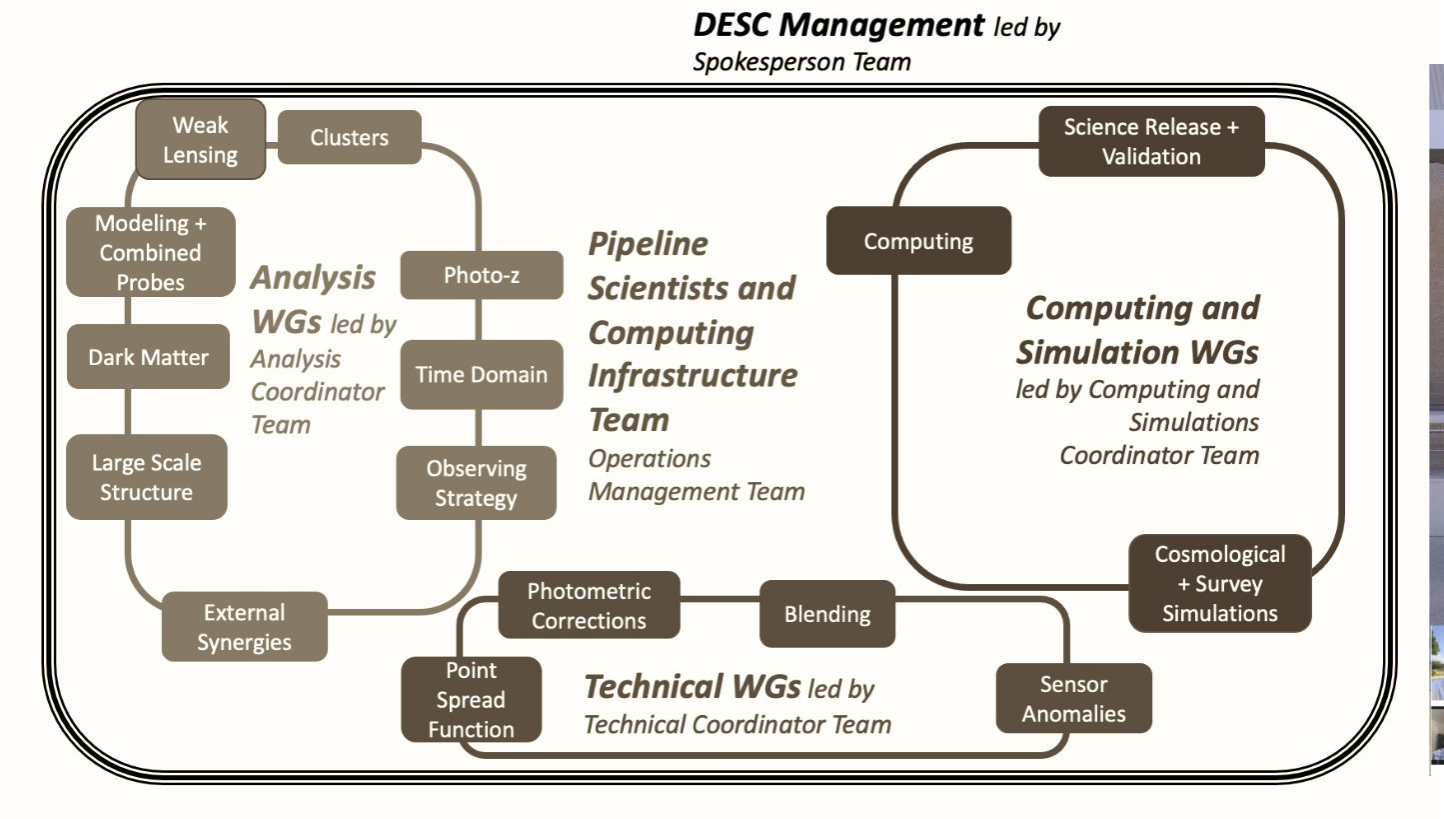
3. **Thématiques scientifiques**
    1. Collaboration DESC et science
    2. Cosmologie avec le cisaillement gravitationnel (Cyrille)
    3. Cosmologie avec les amas de galaxies (Céline)
    4. Matière noire avec les courants d’étoiles (Marine)
    5. Ciel transitoire et « broker » d’alertes FINK (Johan)

4. **Conclusions et perspectives**

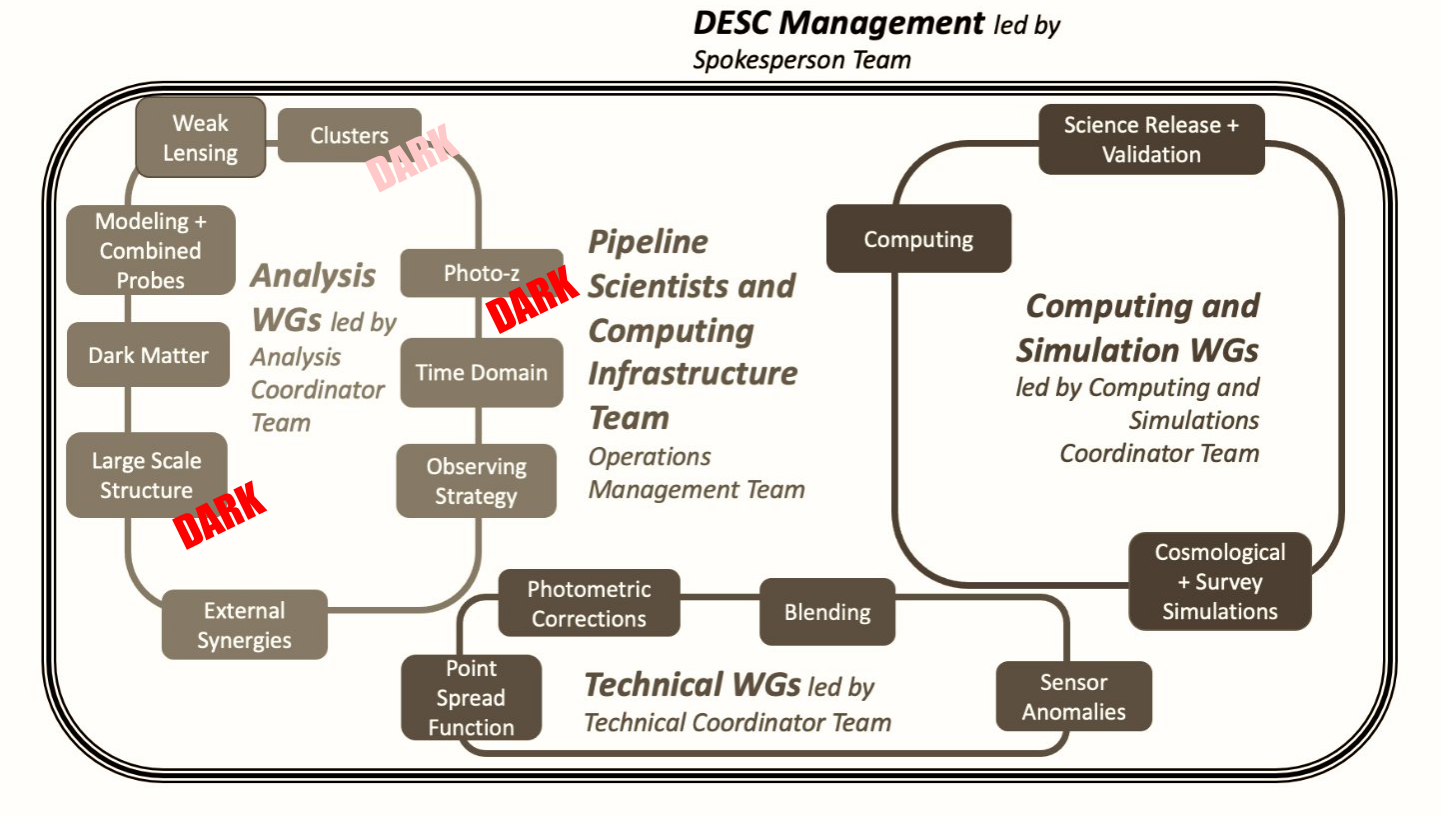
Dark Energy Science Collaboration (DESC)



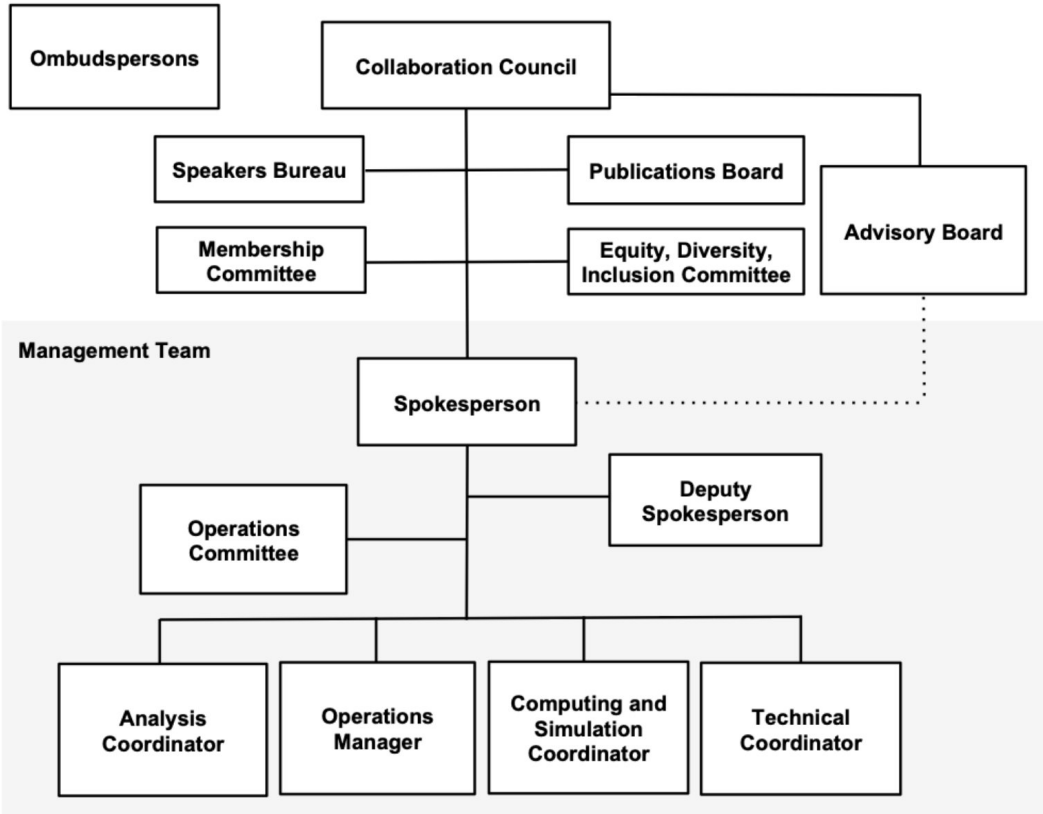
Groupes de travail

Collaboration meeting, SLAC, July 2023

DARK dans DESC au dernier CS (2018)

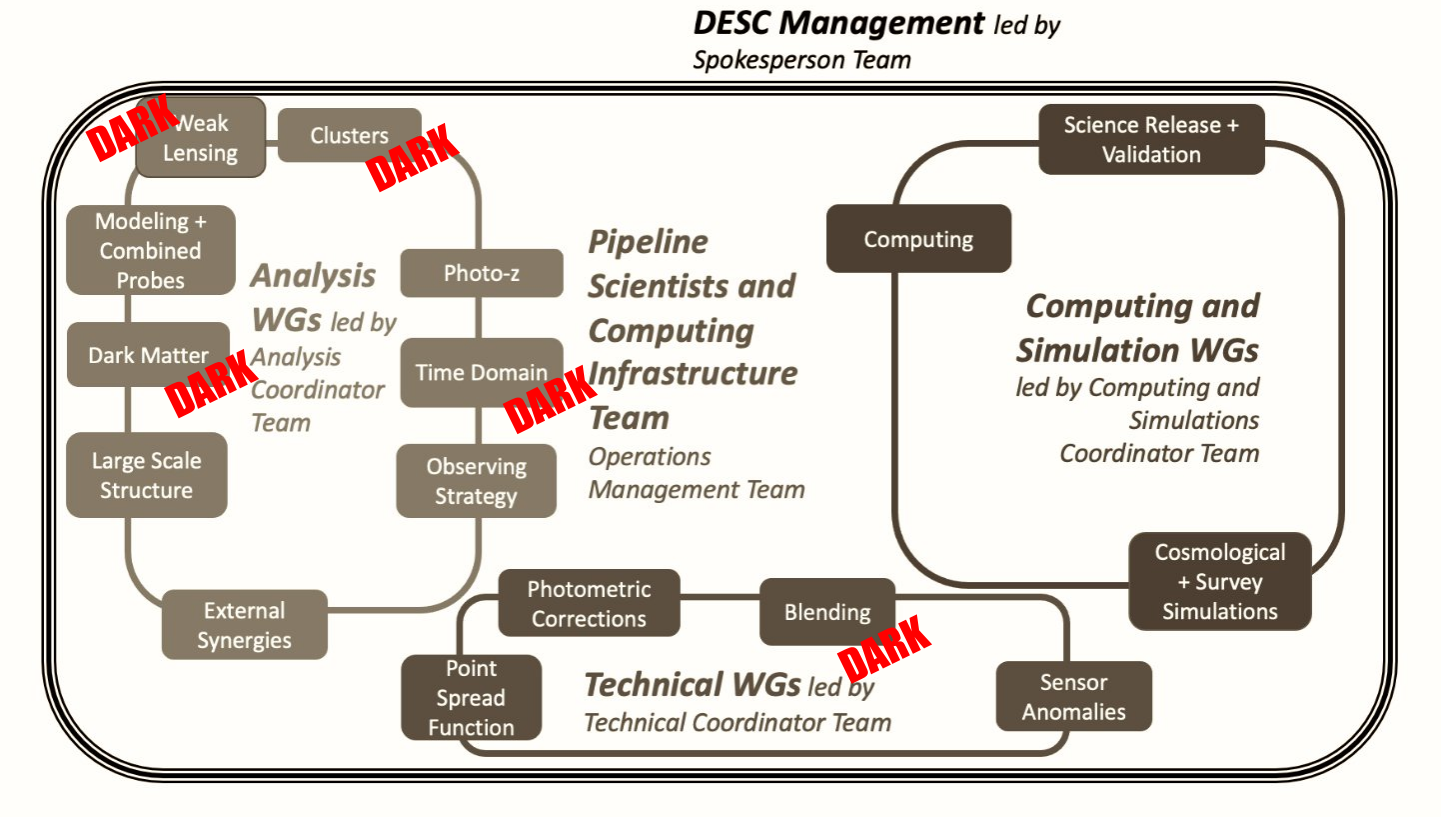


Groupes de travail

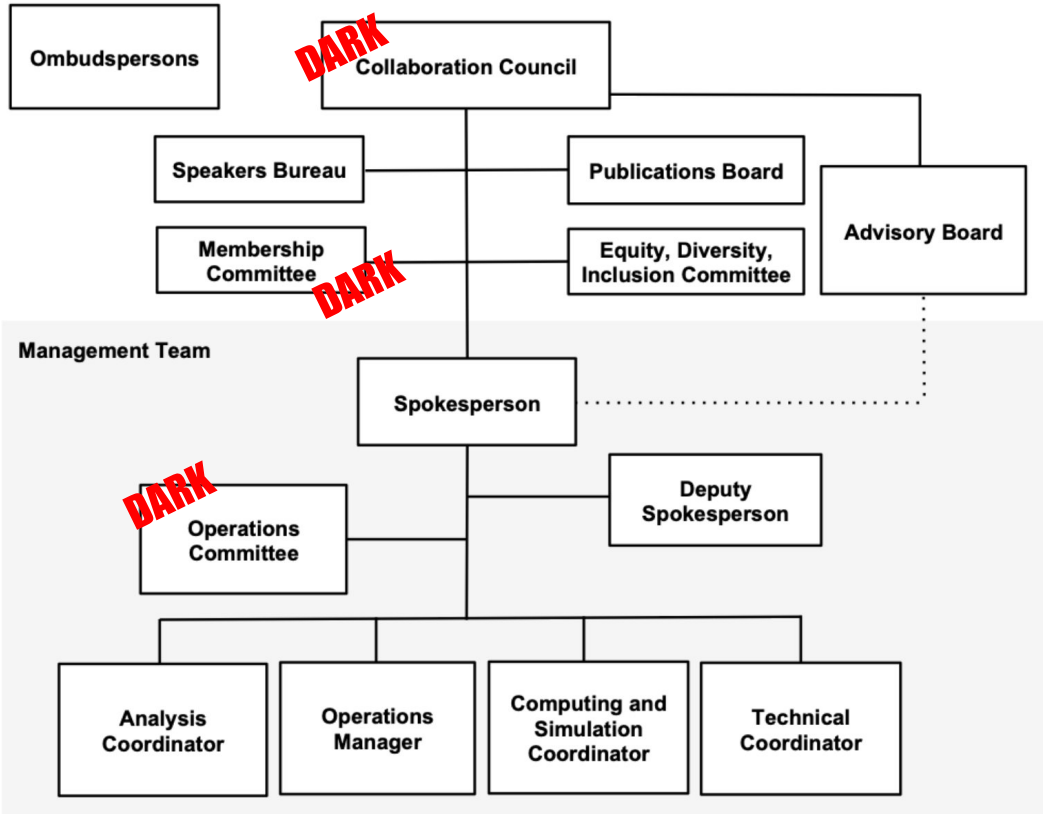


Gouvernance

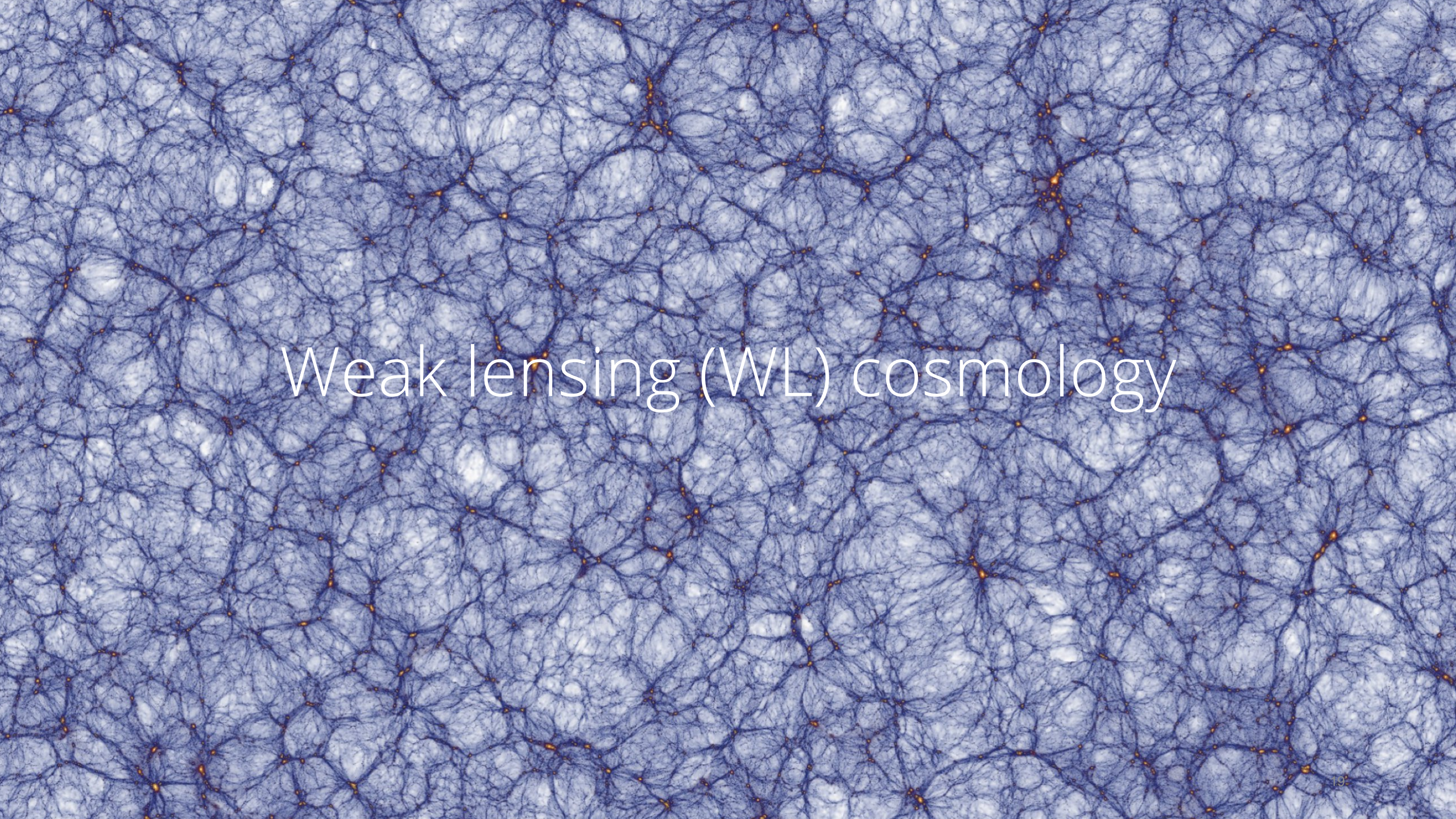
DARK dans DESC aujourd'hui



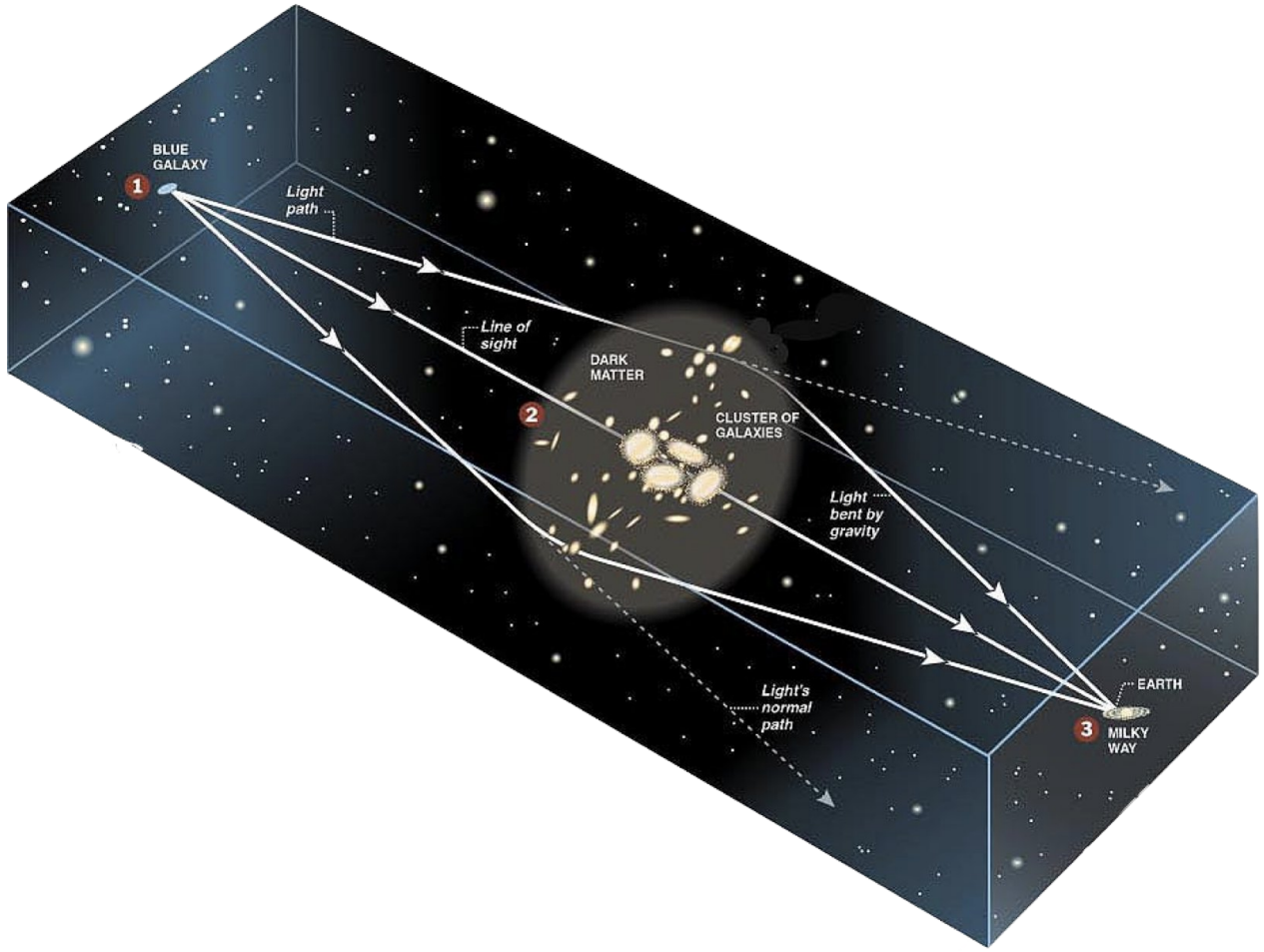
Groupes de travail

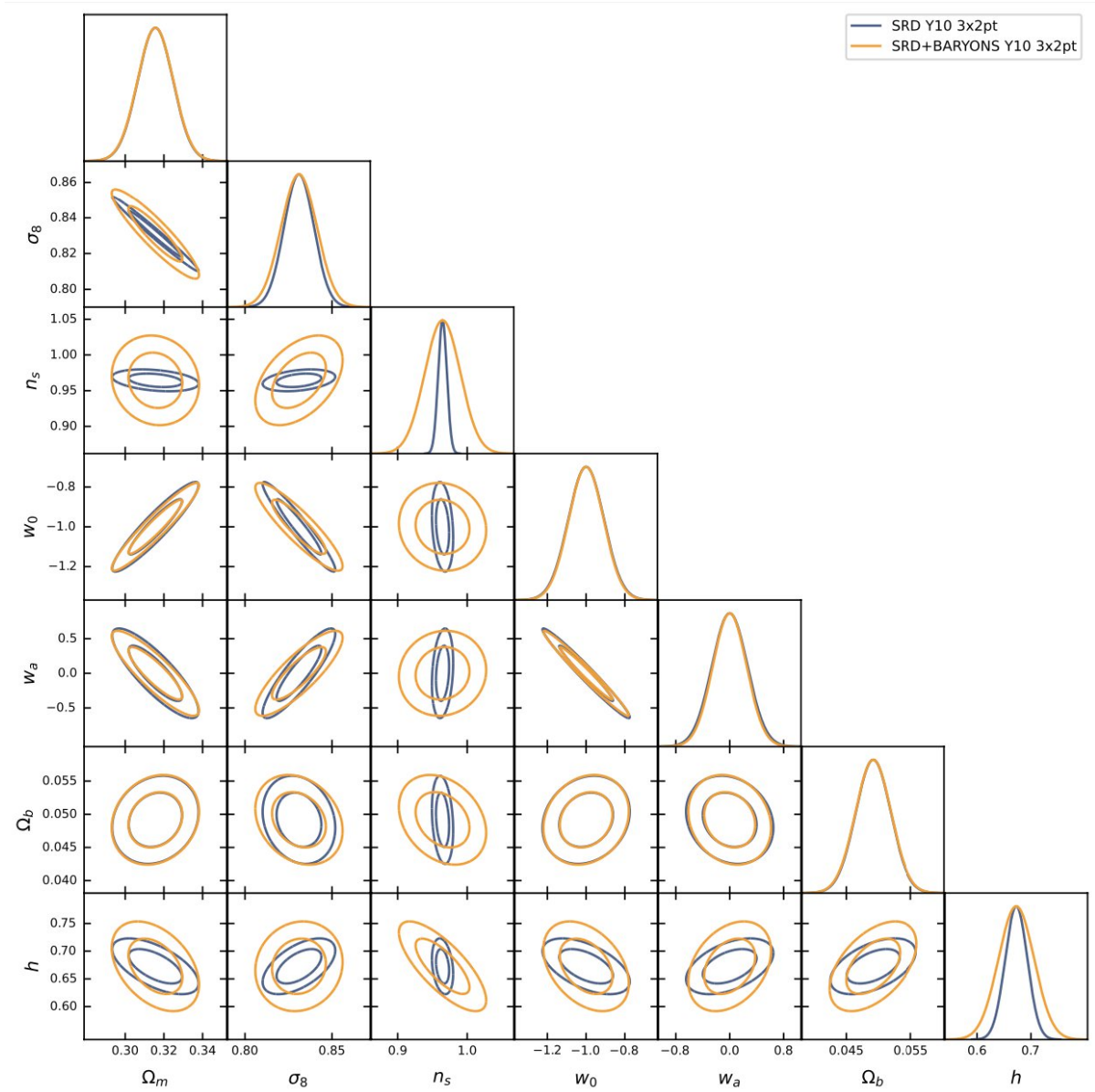


Gouvernance

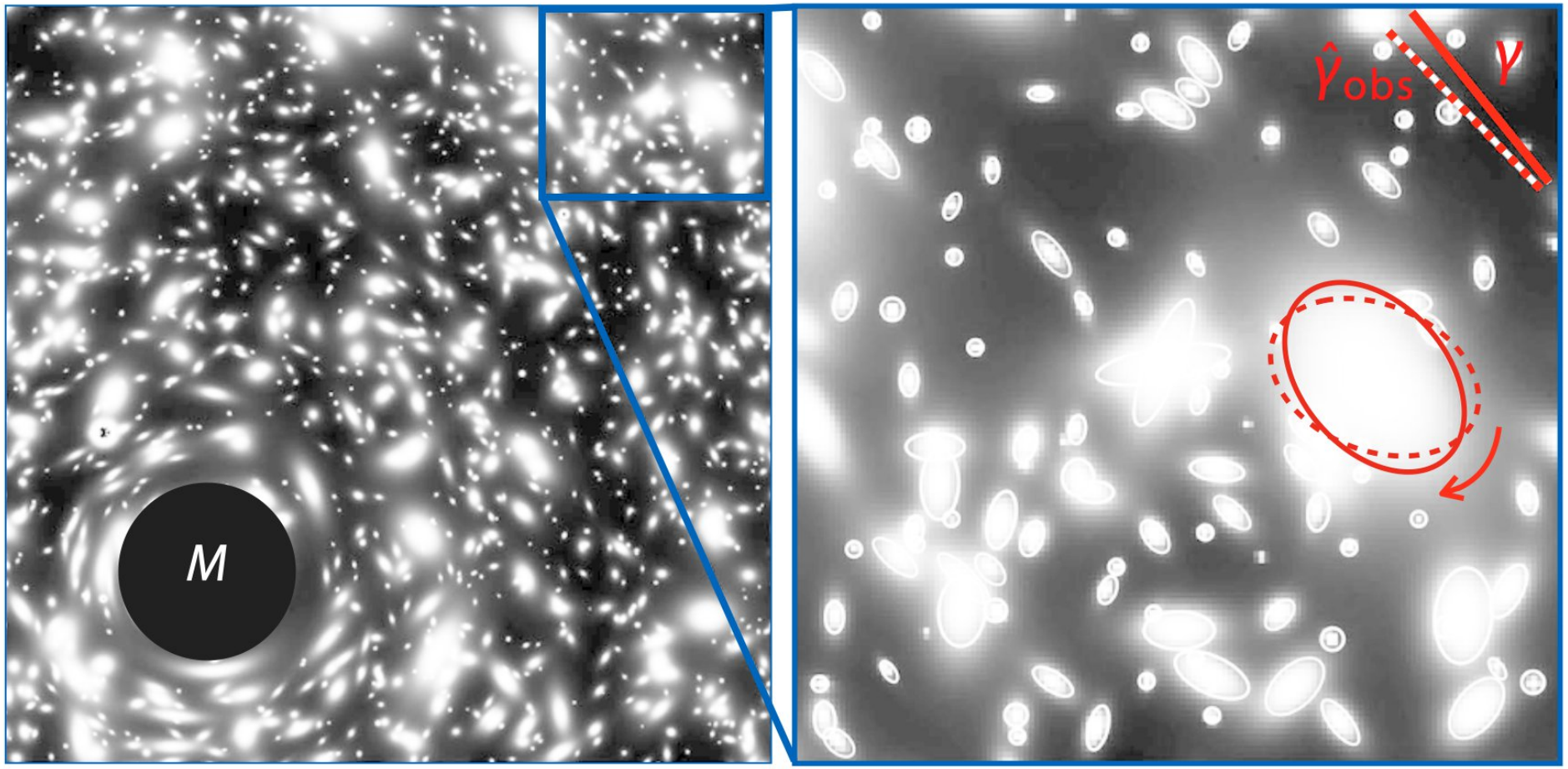

Weak lensing (WL) cosmology

Weak gravitational lensing





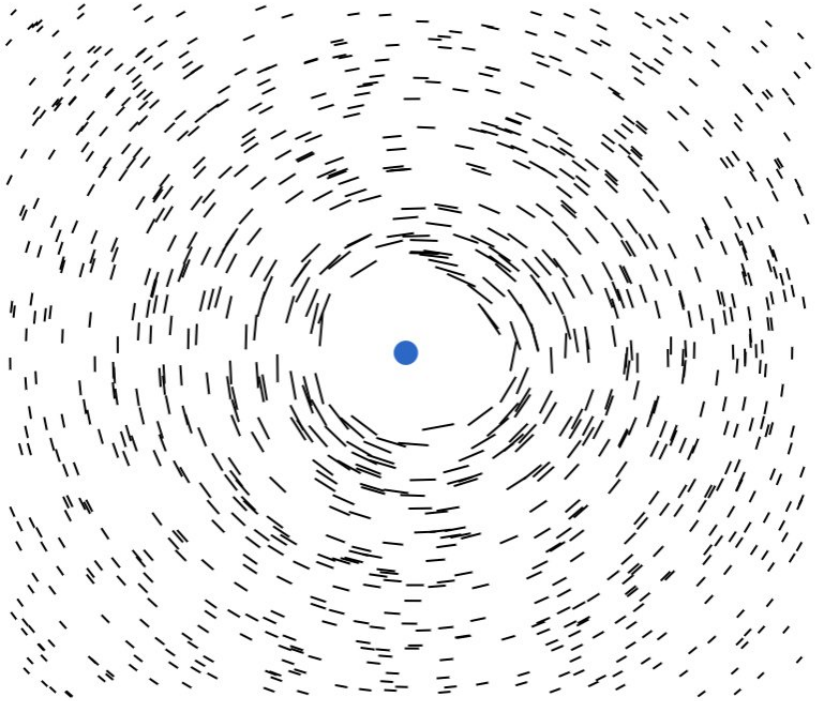
Weak gravitational lensing: cosmic shear



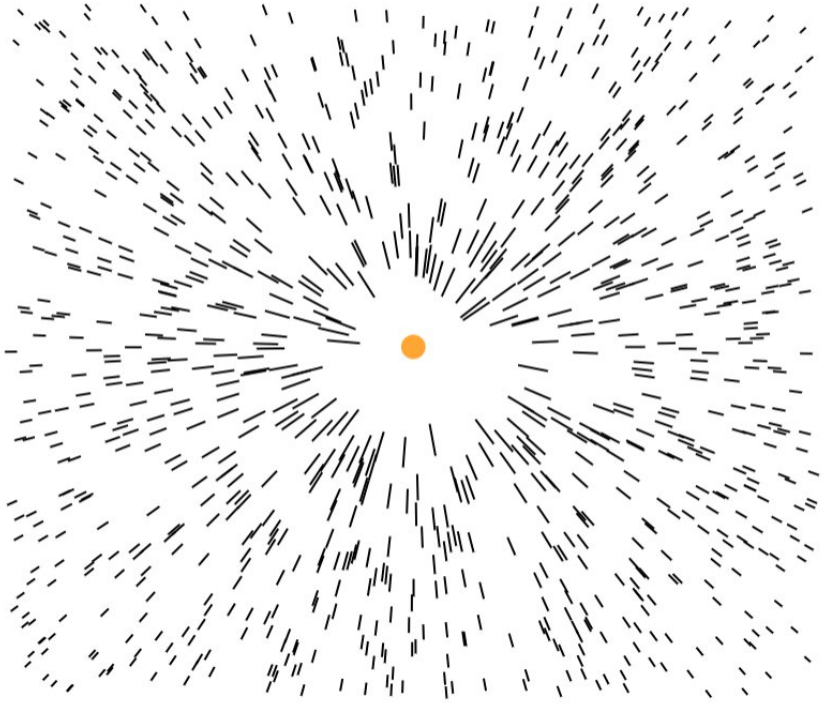
In practice, $|\gamma| \sim 0.01$ (in the field) to 0.1 (in clusters)

Weak gravitational lensing: cosmic shear

Over-density

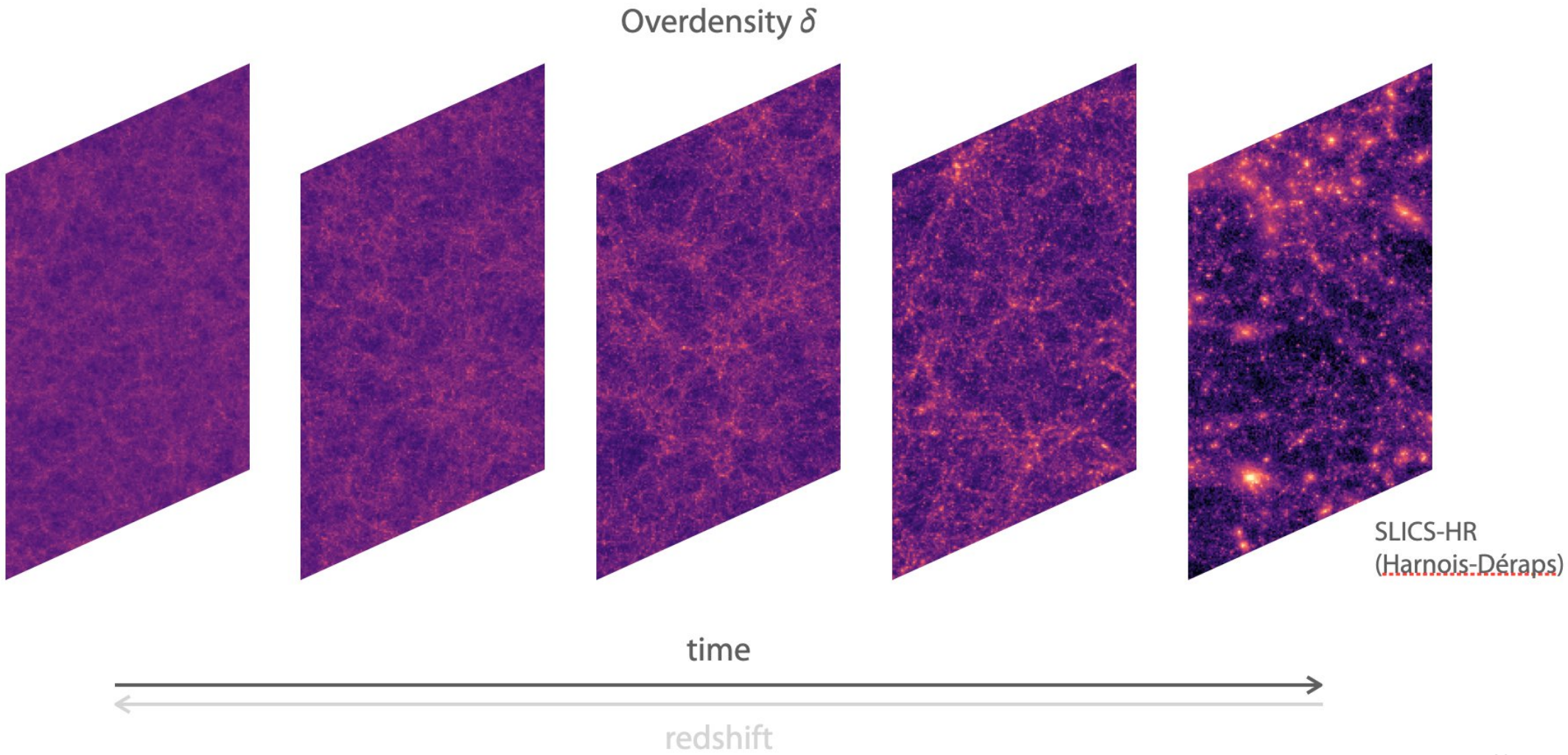


Under-density



* Lengths do not scale

Cosmic shear: lensing from the large-scale structure



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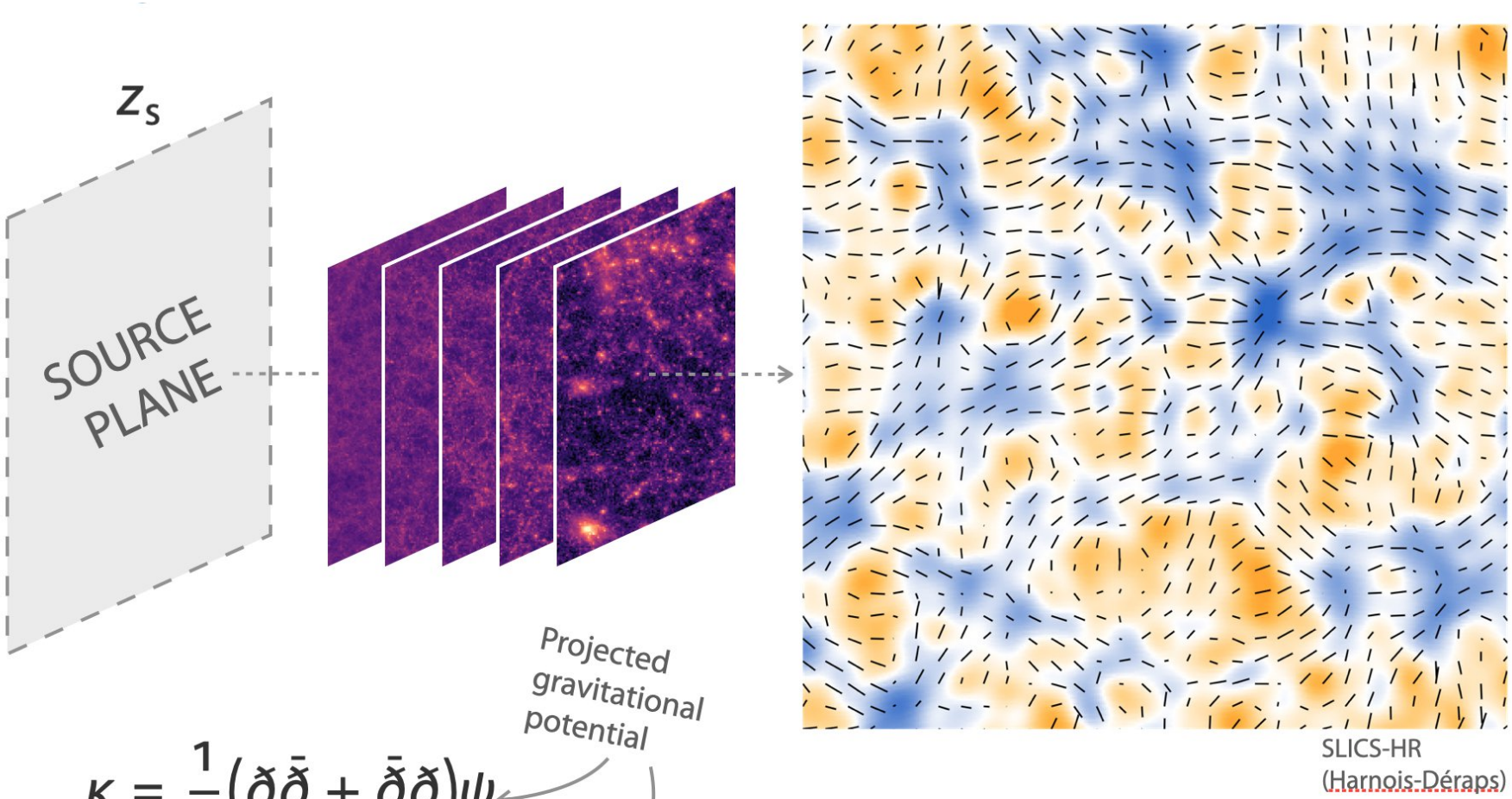
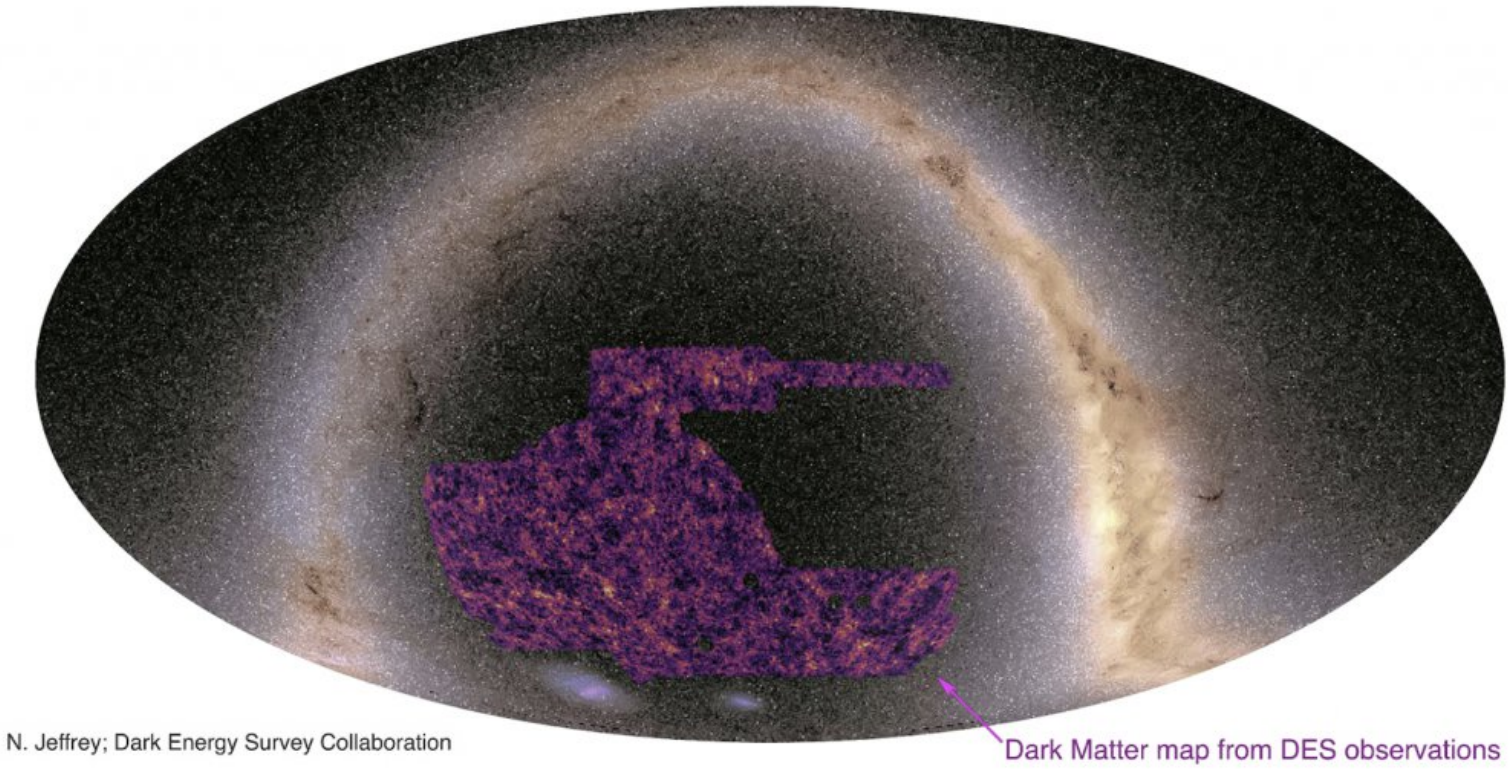


$$\kappa = \frac{1}{4}\left(\eth\bar{\eth} + \bar{\eth}\eth\right)\psi$$

$$\gamma = \gamma_1 + i\gamma_2 = \frac{1}{2}\eth\eth\psi$$

$$\kappa(\theta) = \int \mathrm{d}z\, W^{\kappa}(z, z_s)\delta(\theta, z)$$

Cosmic shear: state of the art



	Dark Energy Survey
Dates	2013-2019
Footprint	5000 deg^2
Galaxies for WL	100 millions
Density for WL	5 $gal/arcmin^2$

Jeffrey et al. (incl. Doux) (2023); Doux et al. (2022)

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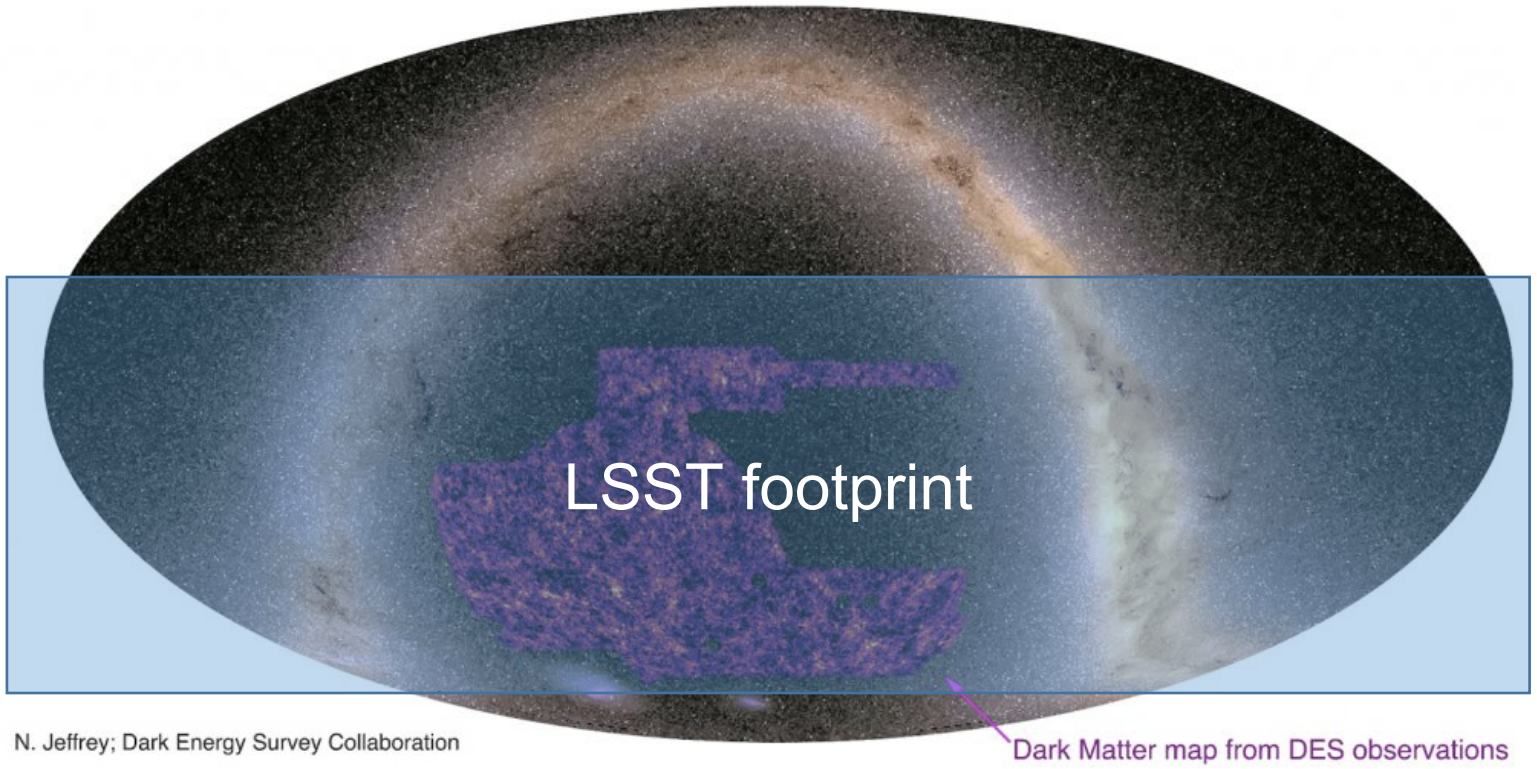

	Dark Energy Survey	LSST
Dates	2013-2019	2025-2035
Footprint	5000 deg^2	18000 deg^2
Galaxies for WL	100 millions	Few billions
Density for WL	5 gal/arcmin^2	30 gal/arcmin^2

Jeffrey et al. (incl. Doux) (2023); Doux et al. (2022)

DARK and the Rubin/DESC WL effort

DESC preparation of WL analysis

- *Systematics* = impact of blending on shear measurements

  → Simulation work (PhD M. Ramel) with a focus on cluster mass estimates and cosmology (Ramel et al., in prep.)

- *Pipeline* = lensing+clustering (2-point statistics)

  → Development of statistical tests and blinding

Rubin commissioning: shear and blending

→ Focus on validating shear measurements and deblending

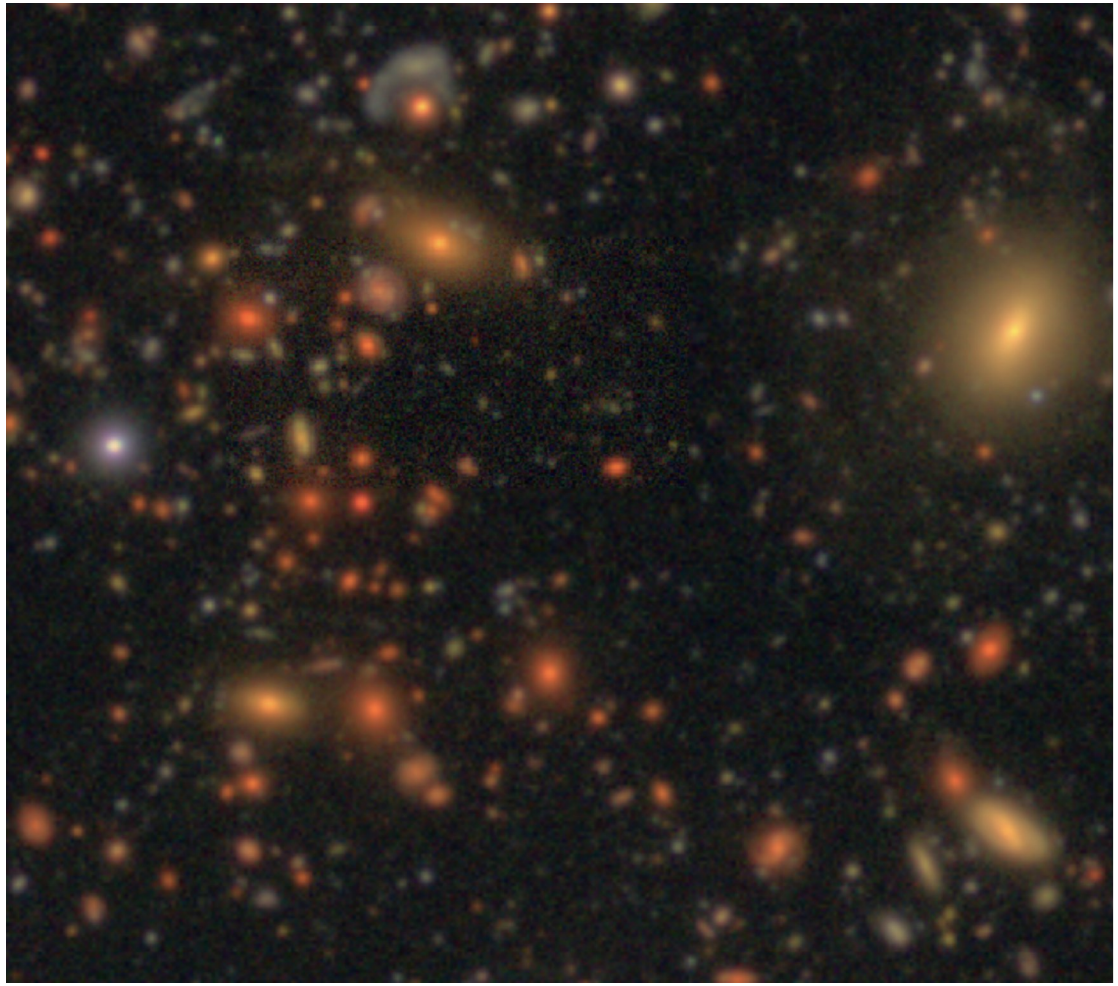

Image from HSC survey on Subaru telescope

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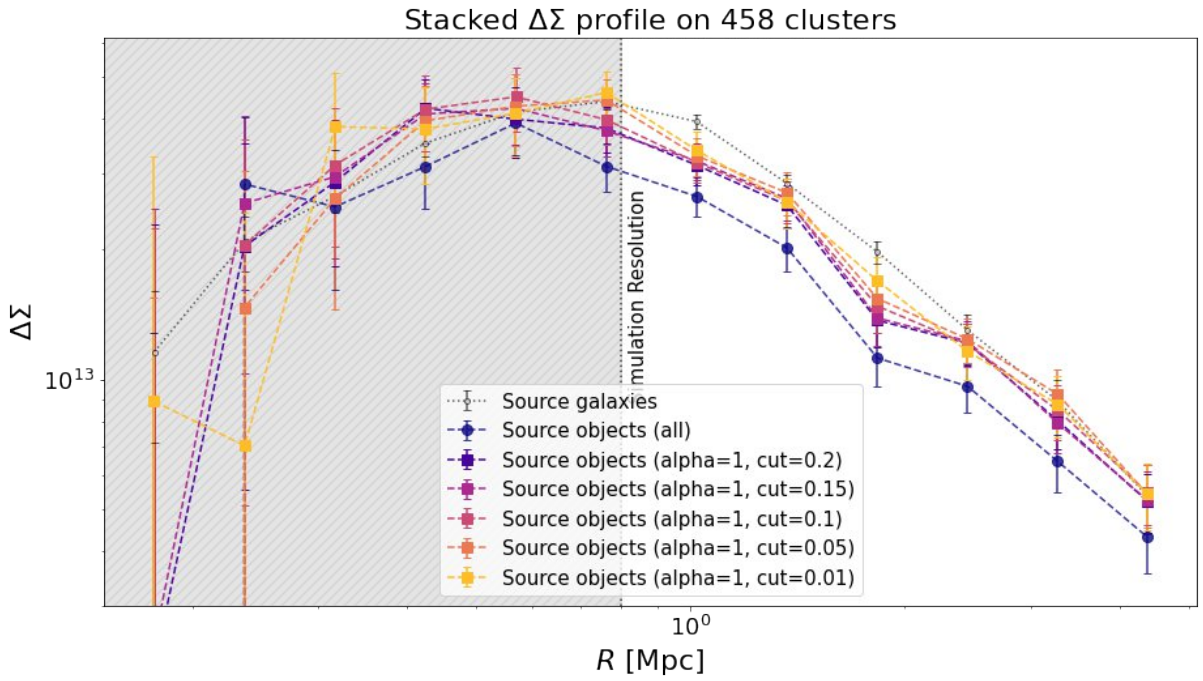
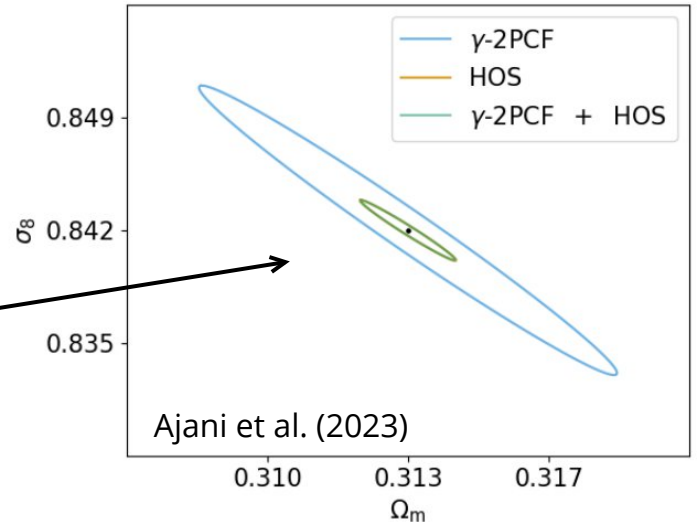


DARK and the DESC WL effort

Higher-order statistics (HOS) analysis of lensing

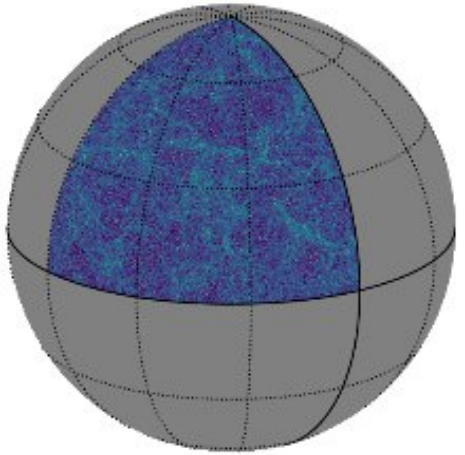
- Non-Gaussian information (peaks, filaments, etc.) at small scales thanks to higher density → cosmological constraints x4 better



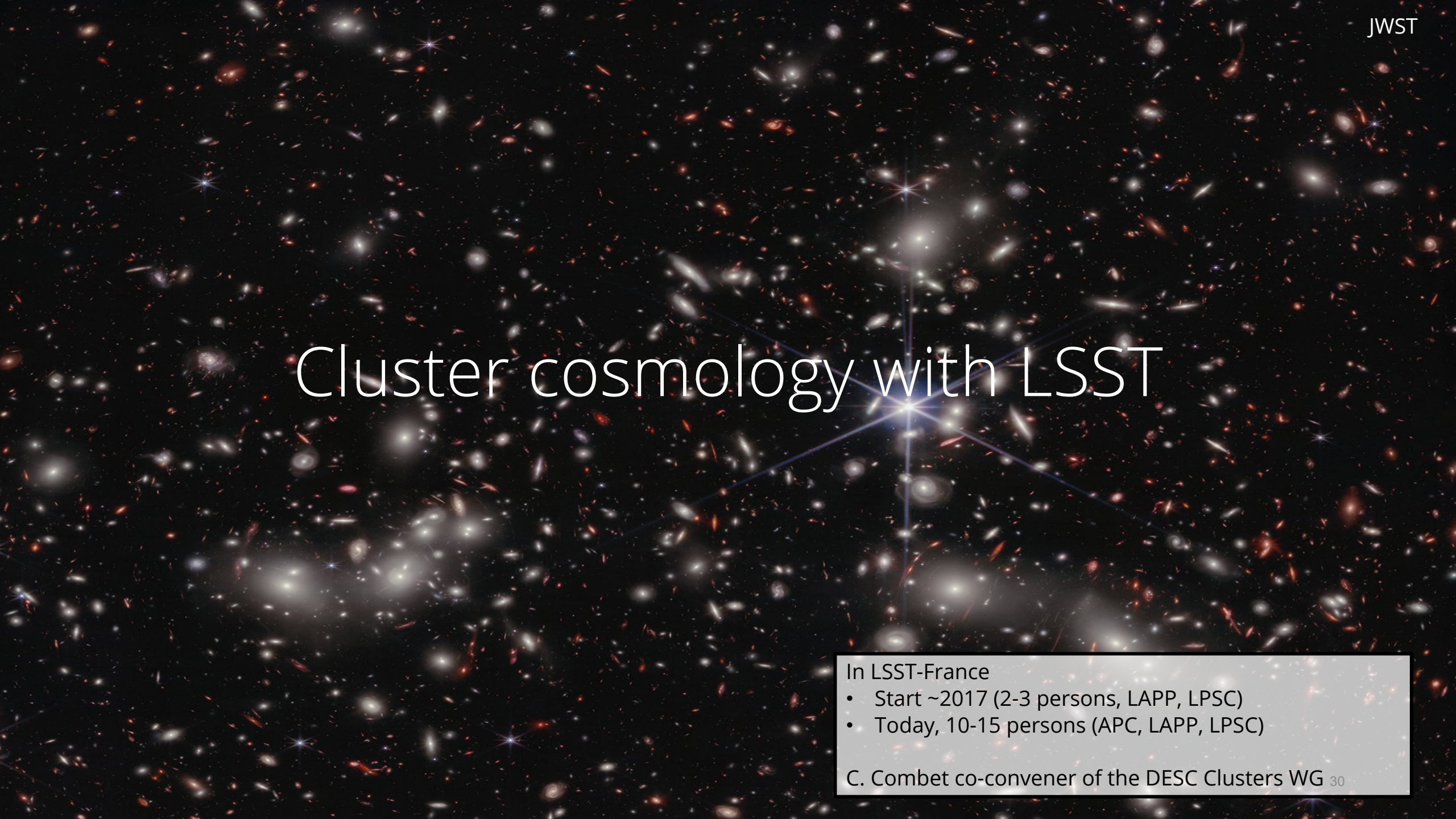
Ajani et al. (2023)

Preparation of LSST HOS analysis (ANR JCJC 2024, PI C. Doux)

- Generation of cosmological simulations for LSST Y1
  - Project lead on new light-cone simulations (C. Doux, J. Mena)
  - Systematics: intrinsic alignments, galaxy-halo connection, baryons
- Testing new HOS with DES latest data
  - New topological data analysis (C. Doux, M. Ramel) transferable to LSST/DESC



Post LSST Y1: combination with CMB data (SO/S4)!



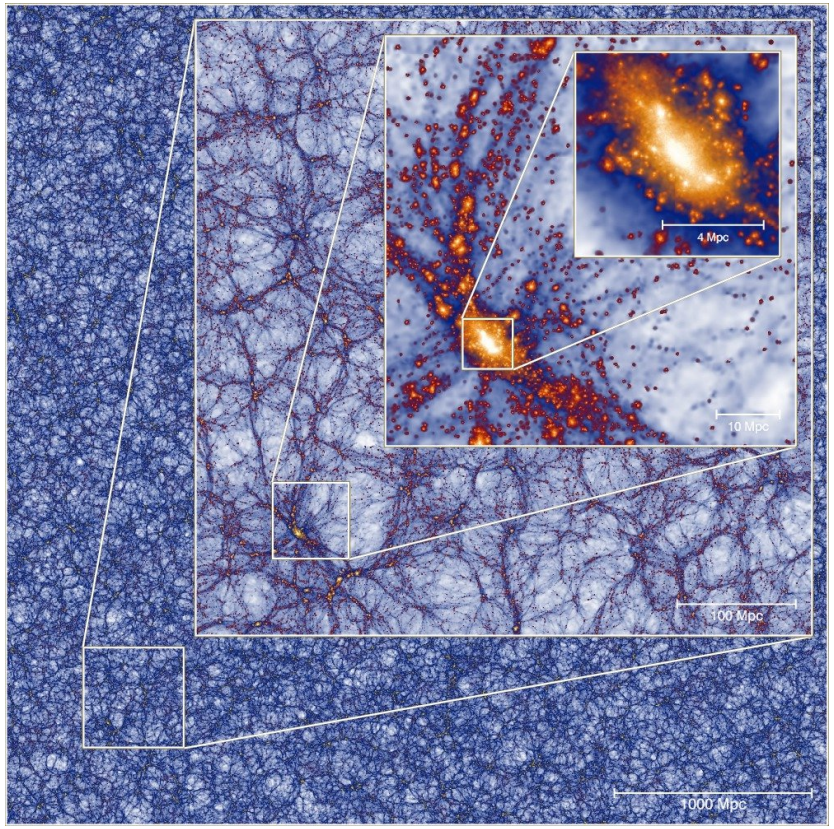
Cluster cosmology with LSST

In LSST-France
- Start ~2017 (2-3 persons, LAPP, LPSC)
- Today, 10-15 persons (APC, LAPP, LPSC)

C. Combet co-convener of the DESC Clusters WG

Cluster count cosmology in a nutshell

- last stage of structure formation
- peaks of the matter density field
- 80% DM, 20% gas and stars



Millennium-XXLsimulation

N(M,z) depends on the underlying cosmology!

Cluster count is a cosmological probe if we can measure redshift and mass…

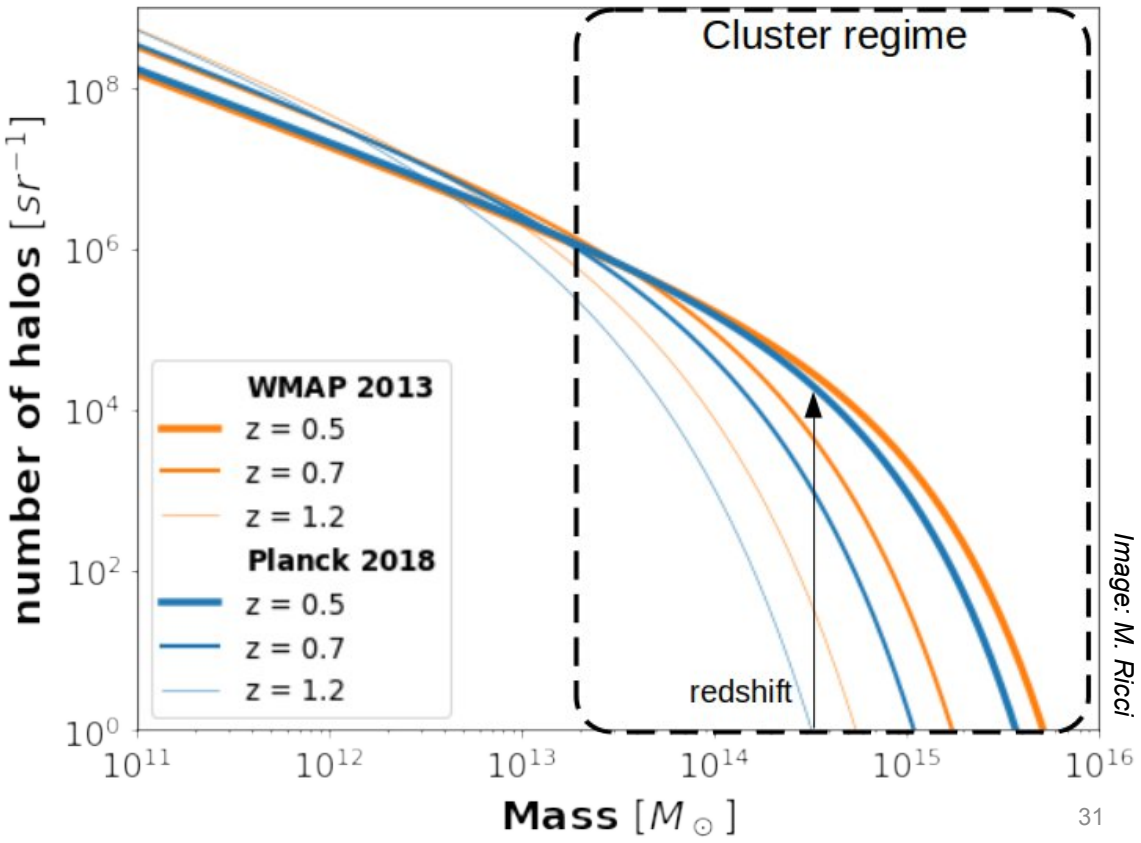


Image: M. Ricci

Cluster count cosmology today and tomorrow

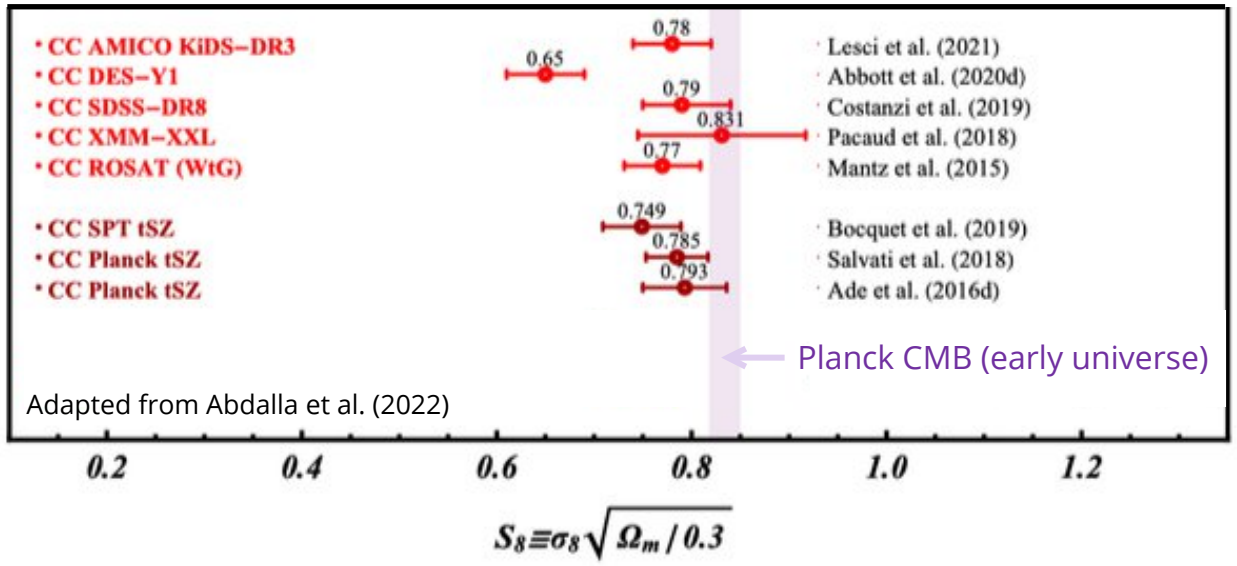
Completed surveys/data (~100-1000s clusters)

- Optical/IR: SDSS, DES, KiDs, HSC
- mm: Planck, SPT, ACT
- X-rays: ROSAT, XMM

Ongoing/future surveys/data (>10^5 clusters)

- Optical/IR: Euclid, LSST, Roman
- mm: SO, CMB-S4
- X-rays: eROSITA

The "S8 tension" as seen by Cluster Counts



Increased statistics → more challenging control of systematics
especially for mass calibration

Optical cluster count cosmology in a nutshell

… but we can't observe the mass → use the richness observable

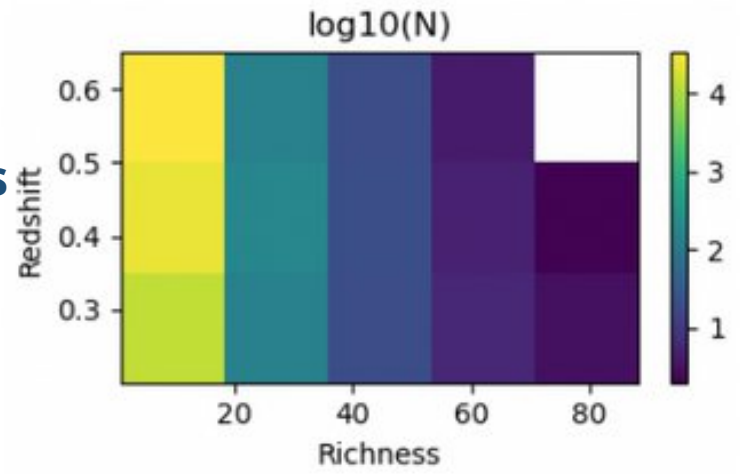
catalogs

LSST galaxies
positions
shears
redshifts

→

LSST clusters
positions
redshifts
richness

counts →



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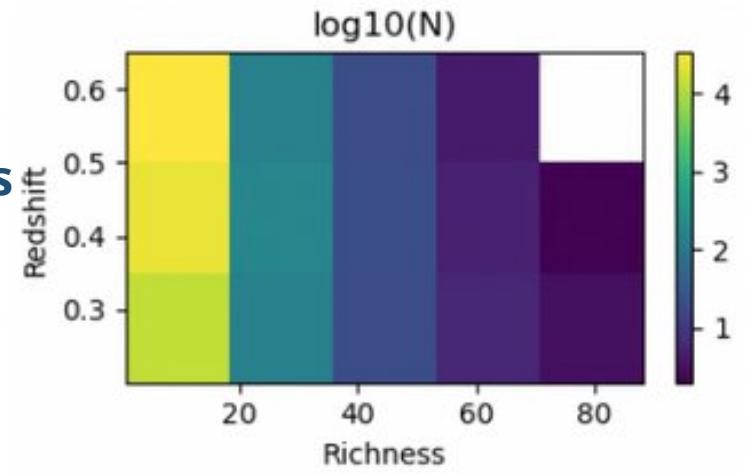
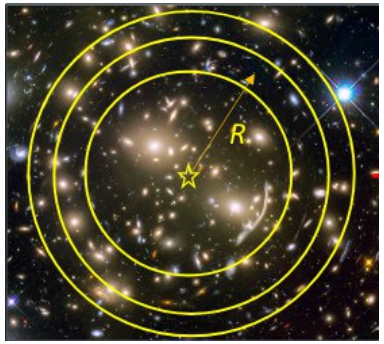
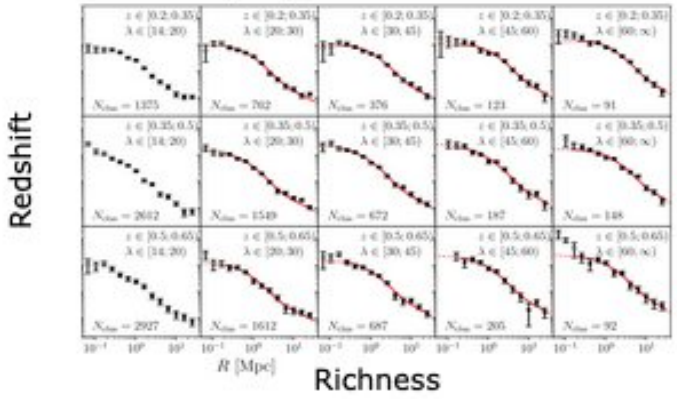




WL

⟨ΔΣ⟩ from WL **= f (mass)**



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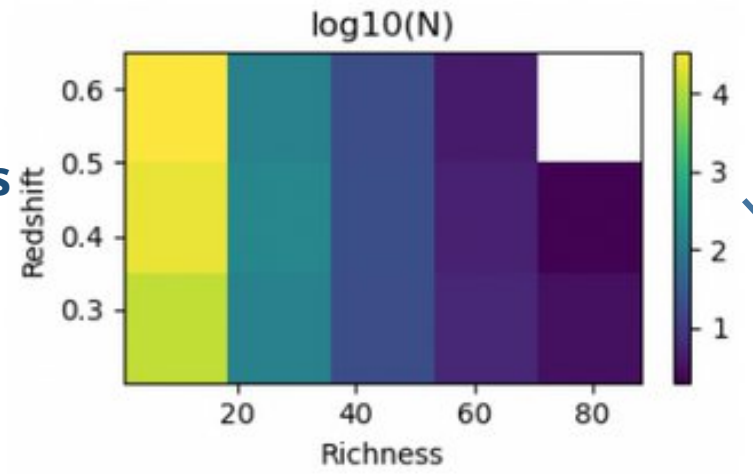

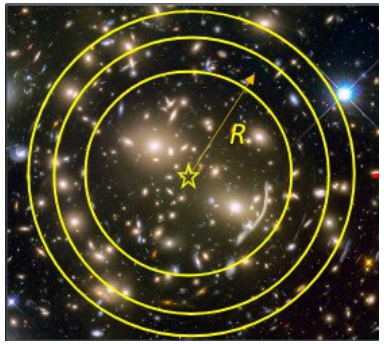

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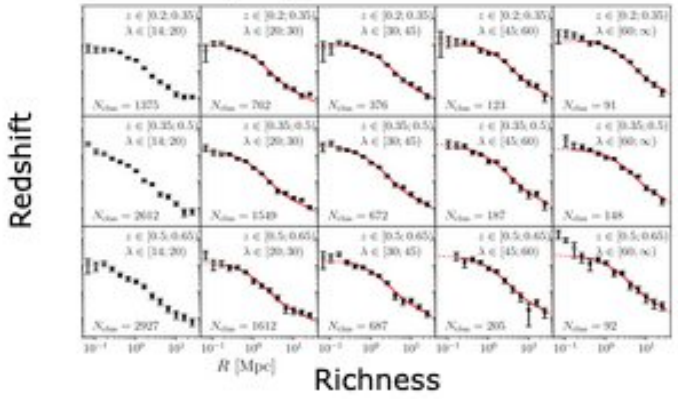

Likelihood

$$\mathcal{L}_{\text{tot}} = \mathcal{L}_{\text{counts}} \times \mathcal{L}_{\text{mass}}$$

Predictions = f(cosmo)

Cosmological parameters

Cluster cosmology in DARK: analyses [figures from Constantin's thesis]

Preparation using DESC simulations

- Sim validation from CL WL mass perspective
  - *Kovacs, …, Payerne, …, Combet et al. (2022)*
- Impact of modeling choices and measurement systematics on the on WL mass-richness relation
  - *2 Payerne et al. DESC refereed notes*
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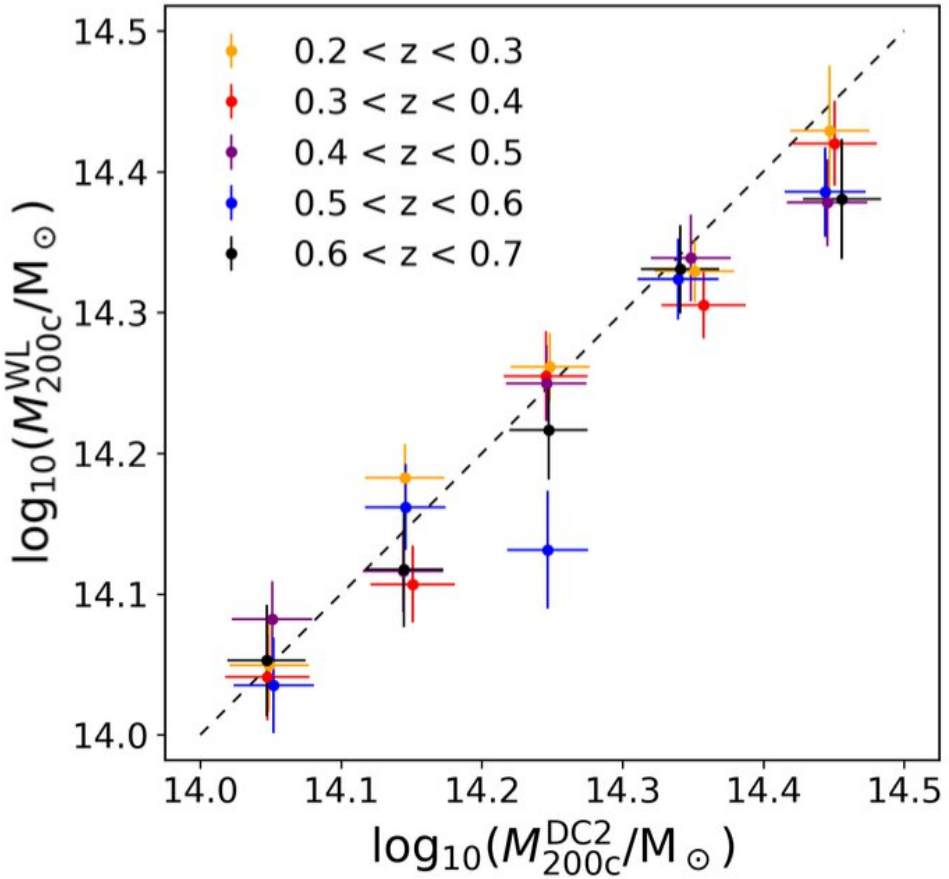
- First end-to-end cluster count+WL analysis

Fitted WL masses



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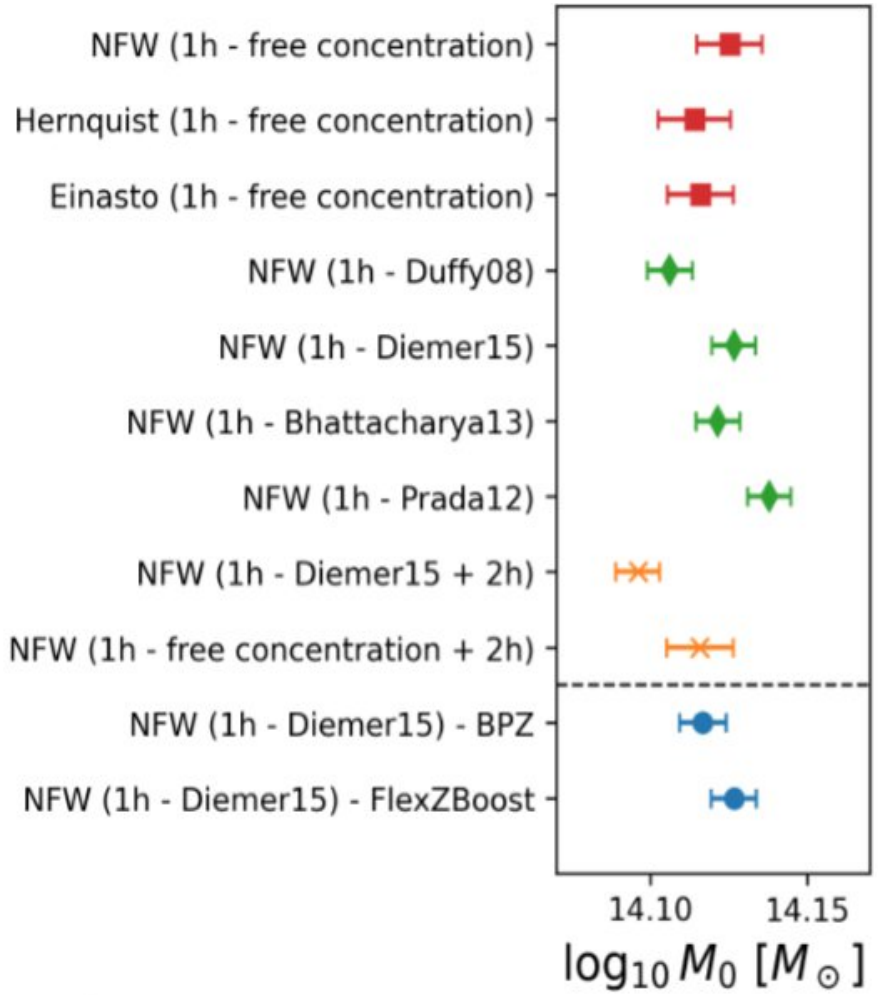

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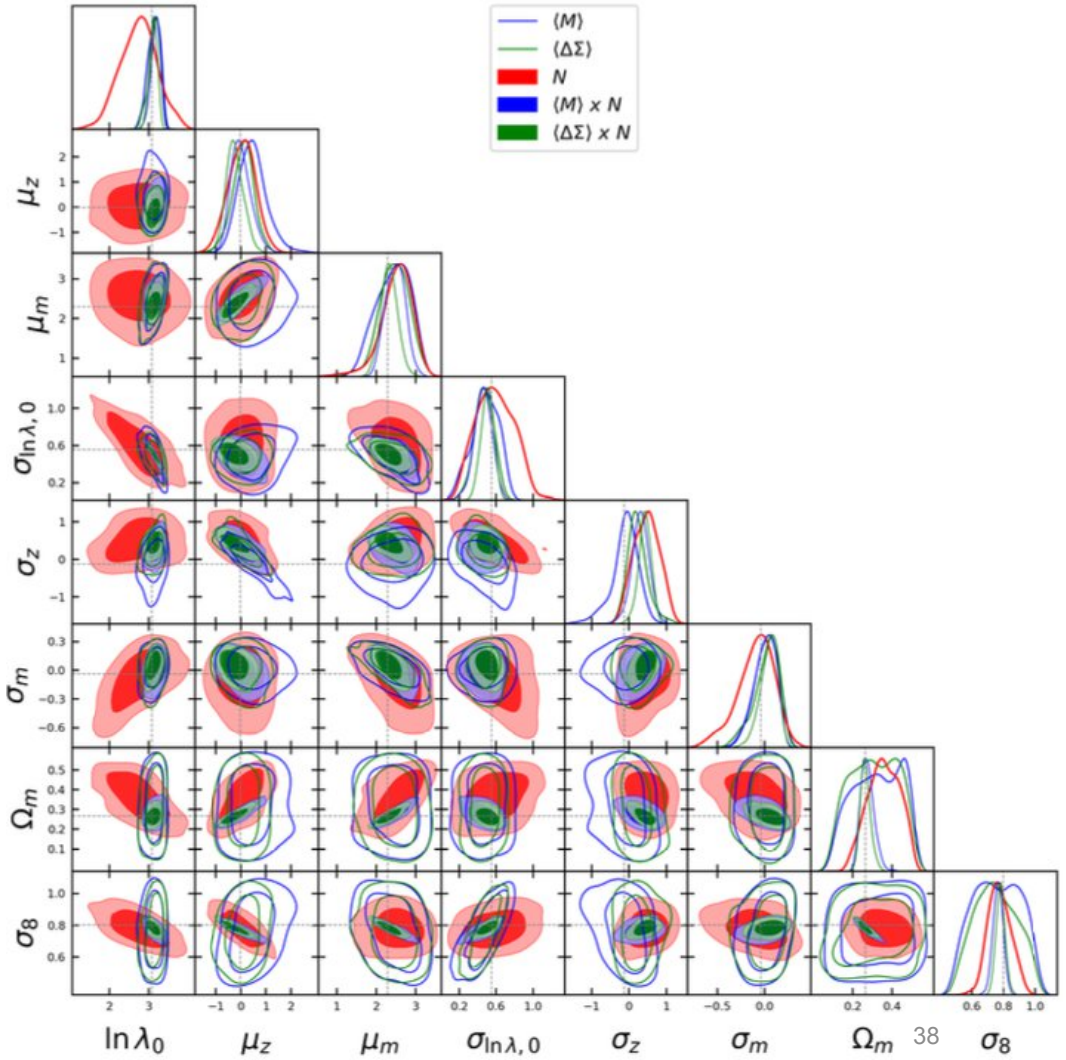

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Cluster count likelihoods

- Binned likelihoods - robustness and validity
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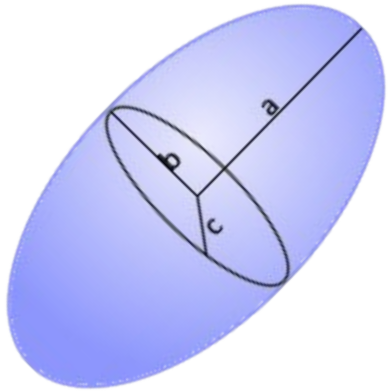
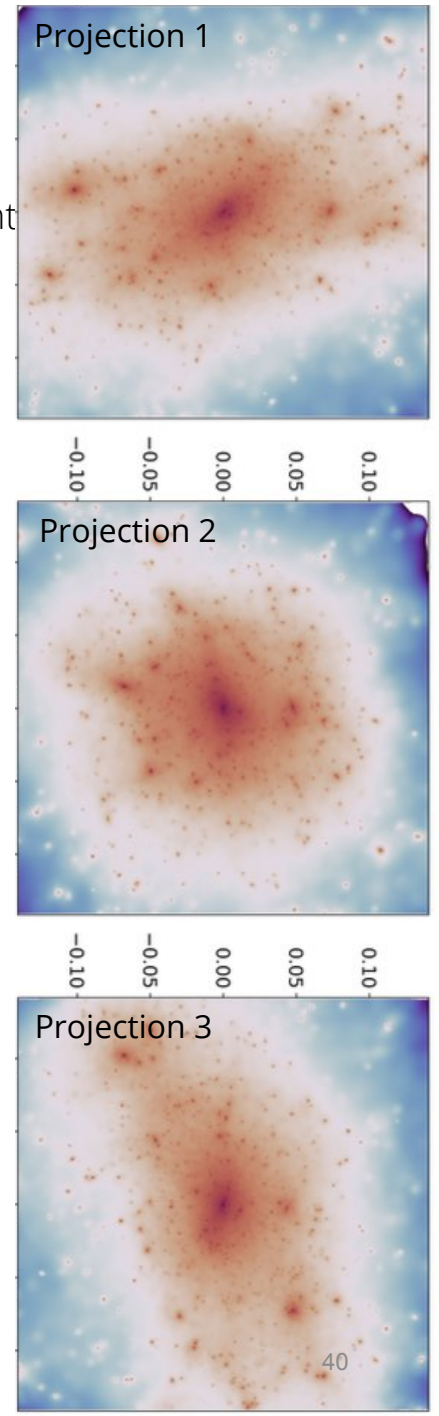
Impact/mitigation of cluster triaxiality on WL mass estimates

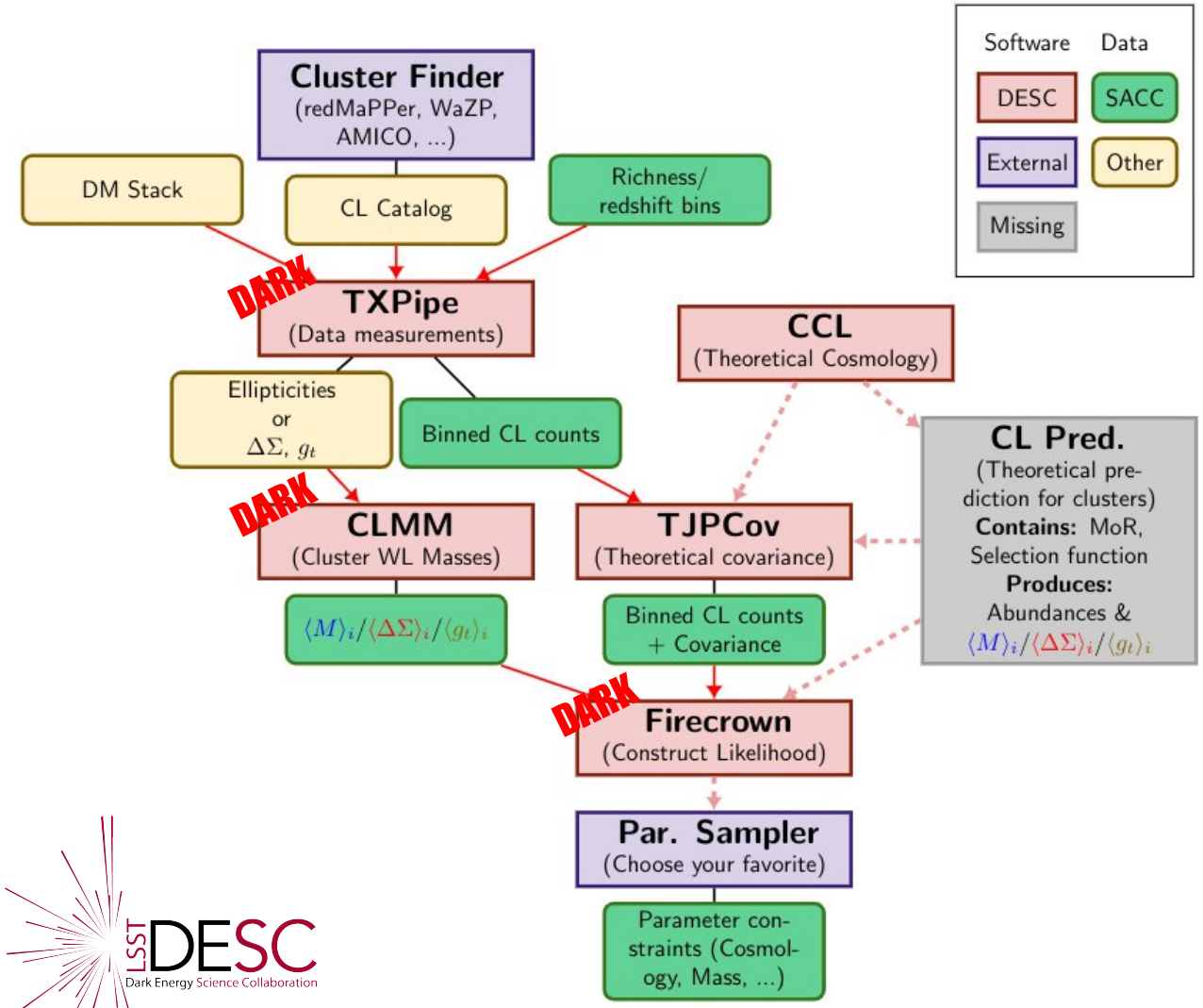
- *Payerne et al. (in prep.)*





The300 simulated cluster

Cluster cosmology in DARK: DESC CLcosmo pipeline



DESC codes/tools are
- validated
- unit-tested
- documented
- public

- CLcosmo prediction and likelihood (FireCrown) → Eduardo Barroso (10 month visit at LPSC from Brazil)
- CLcosmo data vector using TXPipe
- Development of the CLMM library - *Aguena, Avestruz, Combet et al. (2021)*

Cluster cosmology in DARK: what's next?

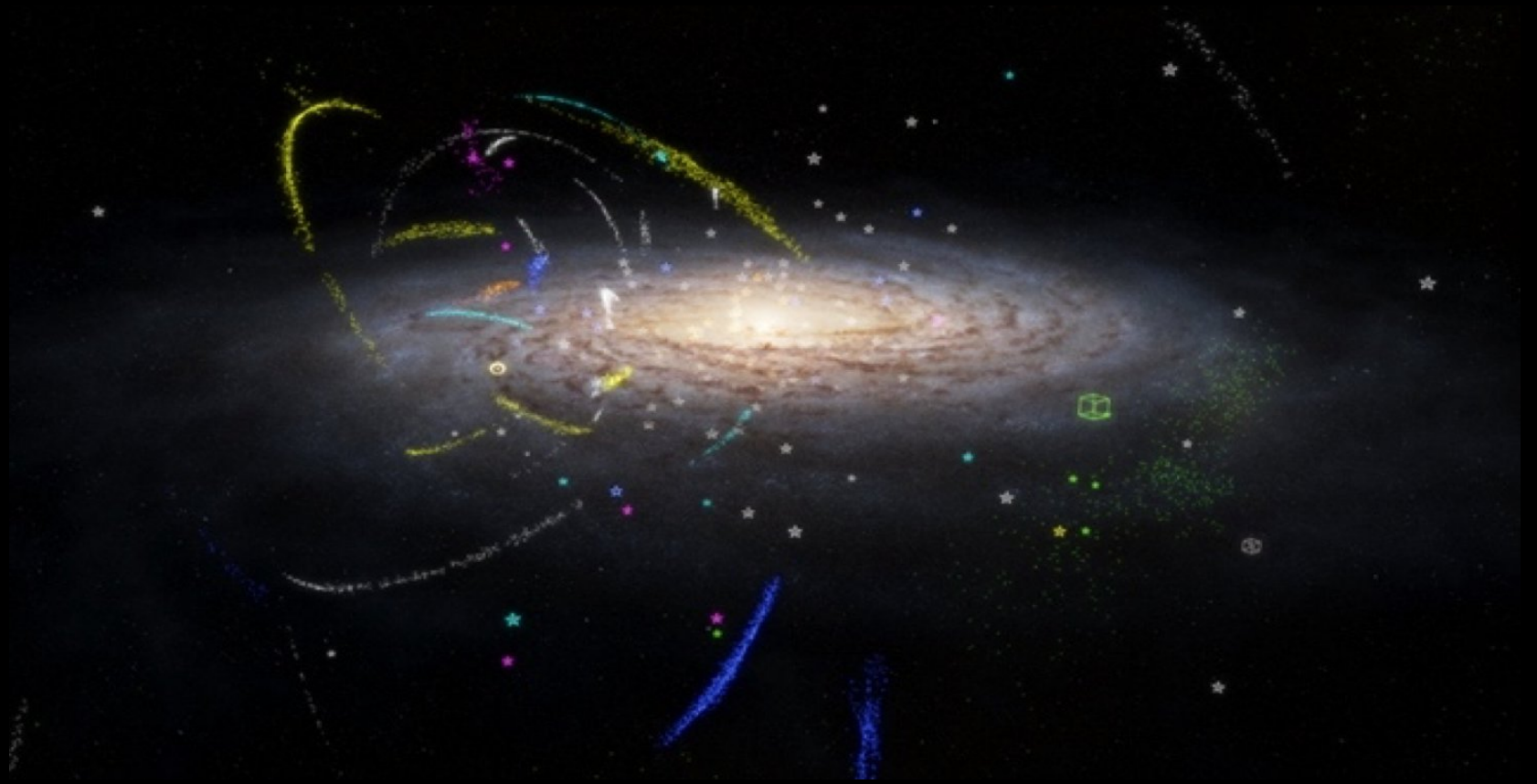
Priority: DESC cluster analyses

- Development of the DESC CLcosmo pipeline → need to be ready for the first data release!
- Re-analysis of existing datasets with those new tools
- DESC cluster commissioning project: blending in cluster fields
  - Nothing much so far, but first data in 2024…
  - Strong link to Manon's PhD work
- Full involvement in the first analyses

Beyond LSST/DESC

- CC starting to get involved in Euclid → contribute to LPSC Euclid's effort; start looking at real data before the start of LSST.
- More synergies possible on the longer term, multi-λ analyses!

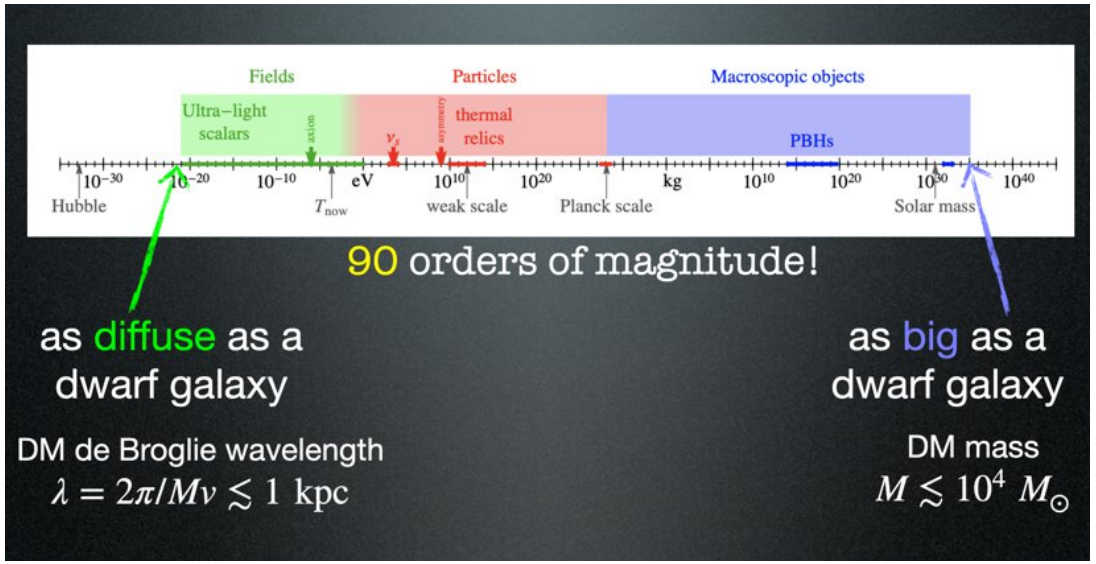
Constraints on Dark Matter from Stellar Streams



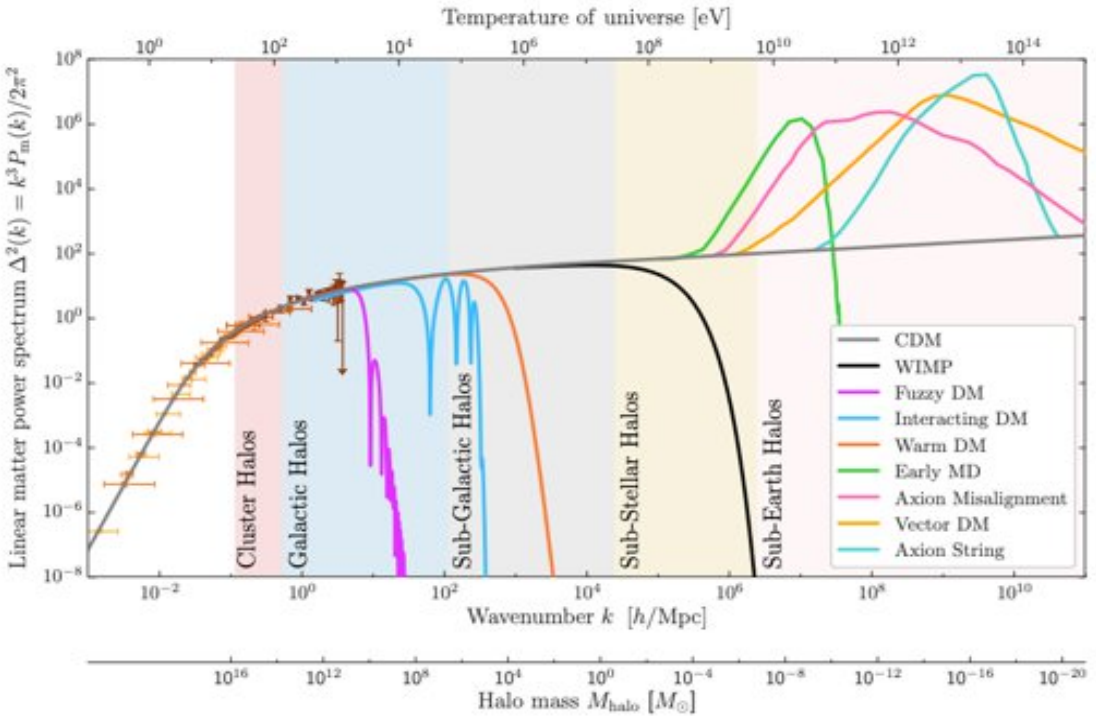
Objective

Numerous dark matter particle candidates

→ *Constrain its nature using its only known interaction to date: gravitation*



Minimum halo mass discriminant for many models



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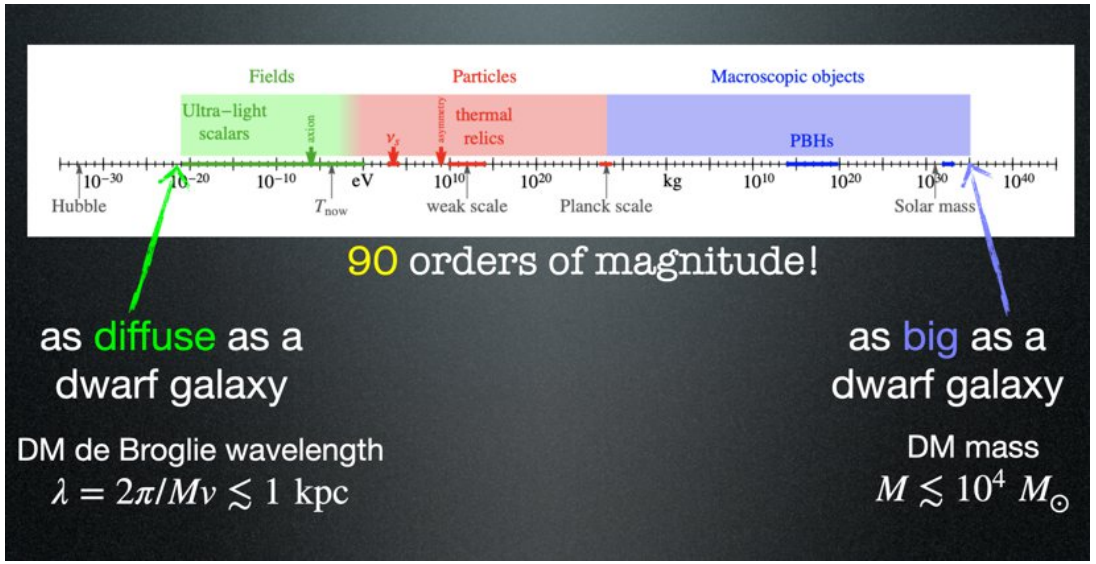
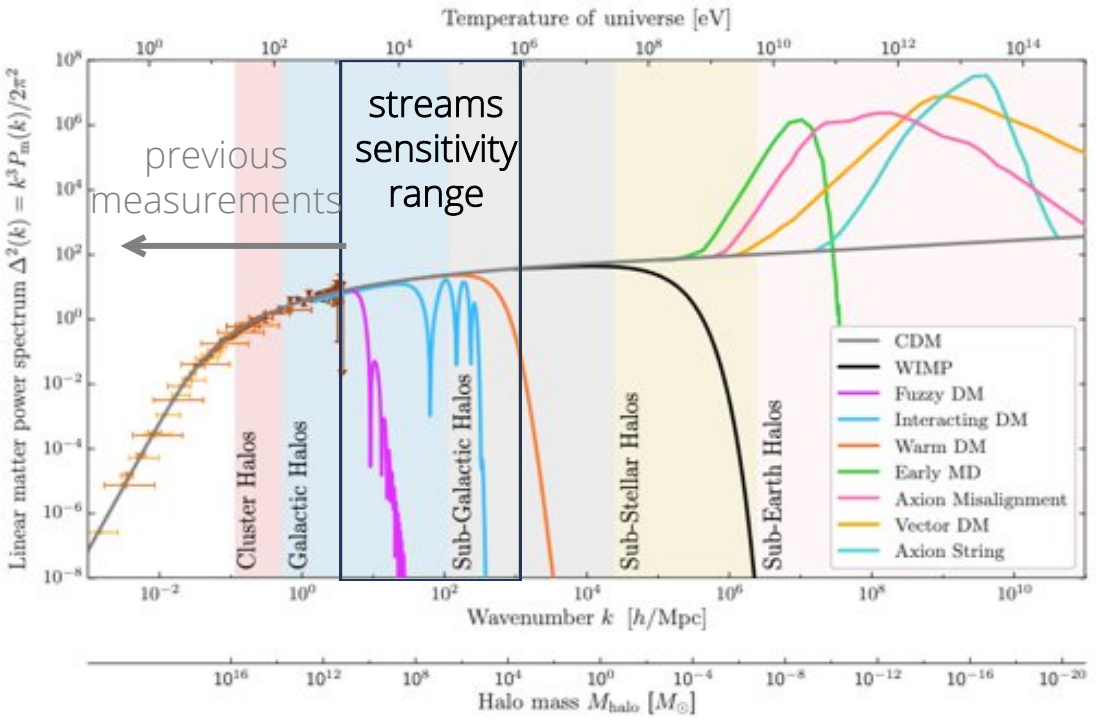
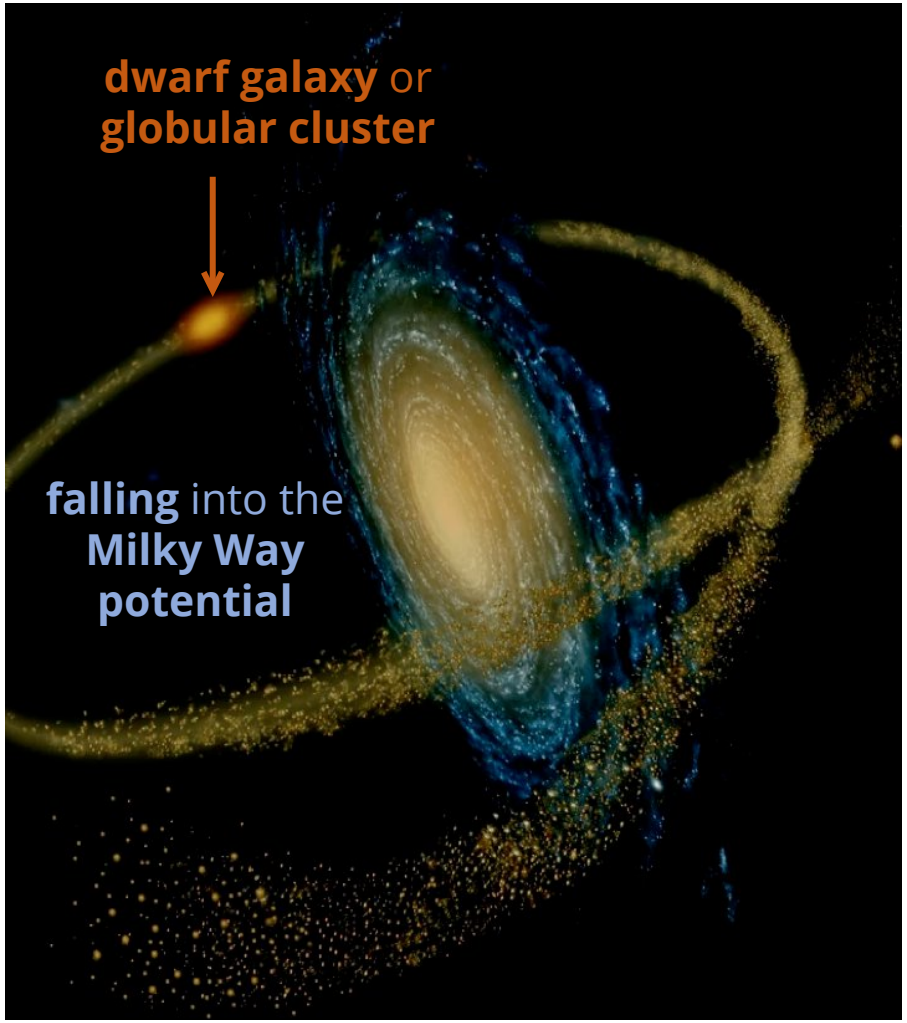


Minimum halo mass discriminant for many models

→ *Explore a never-observed-before regime (small dark matter halos)*



What are stellar streams?



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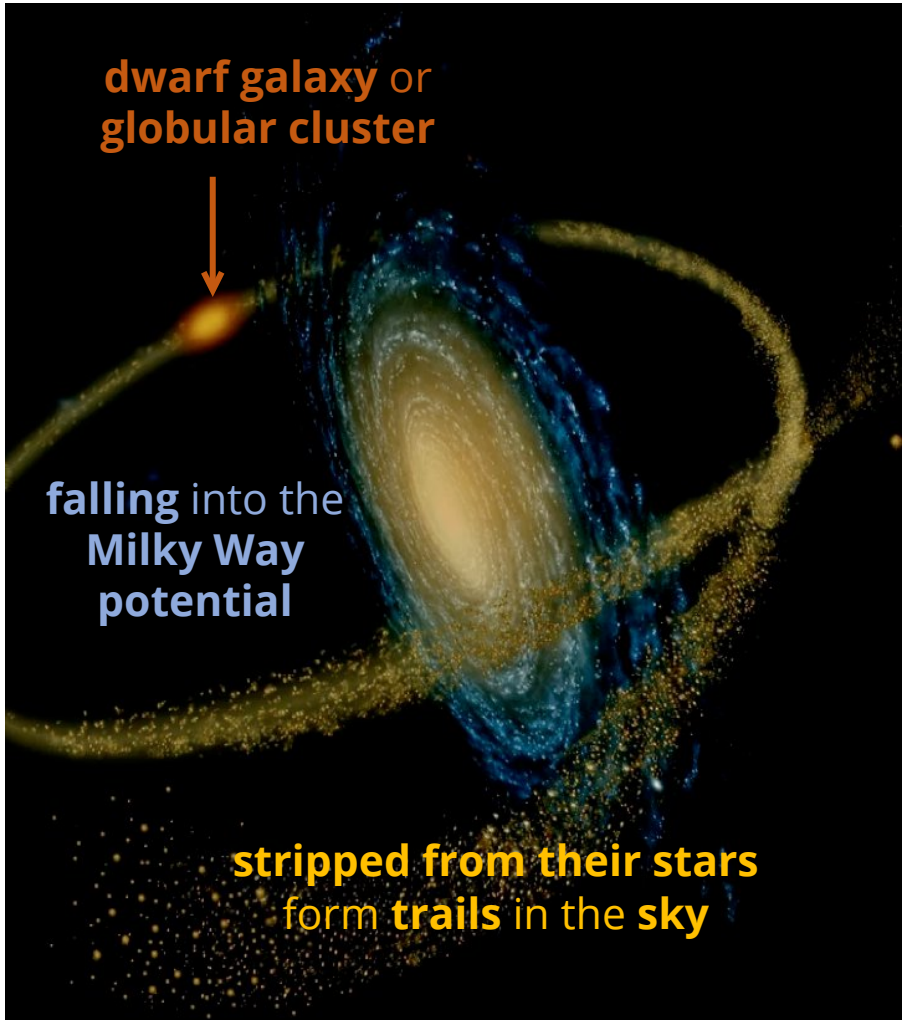

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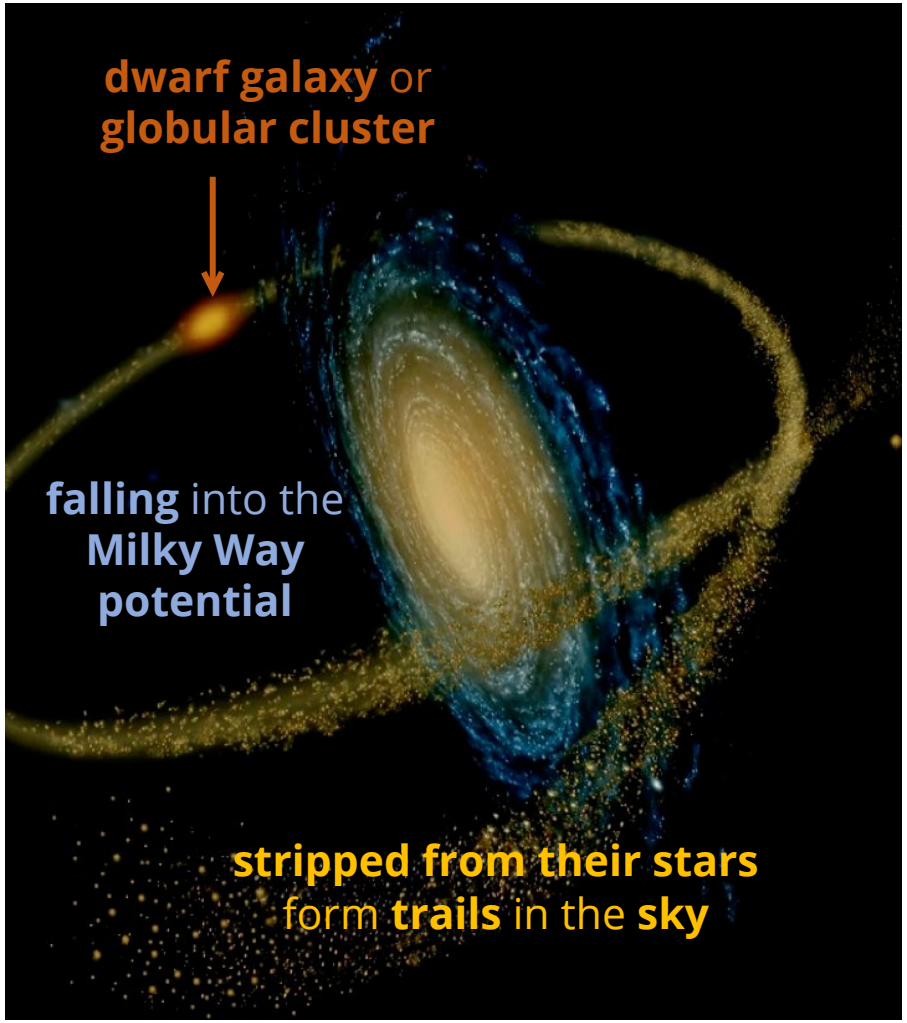

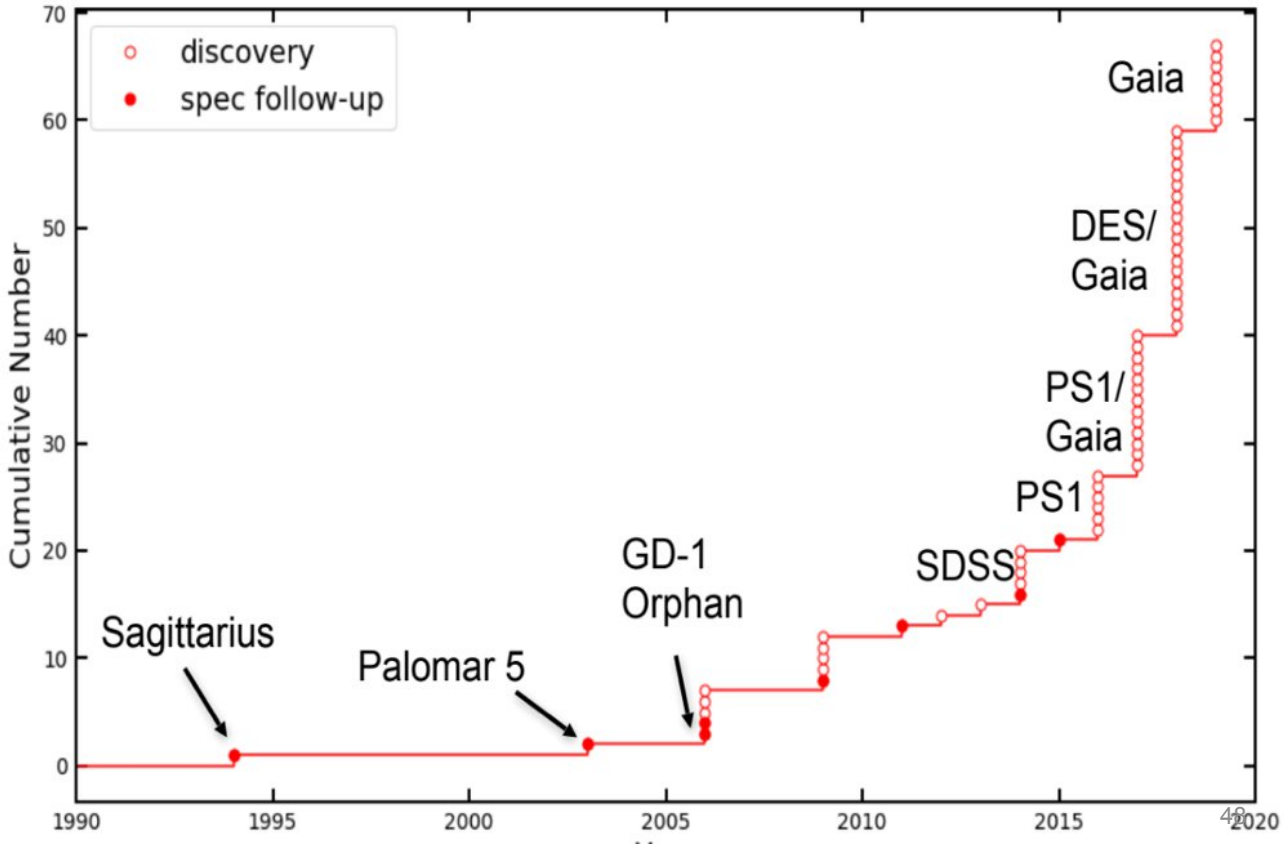

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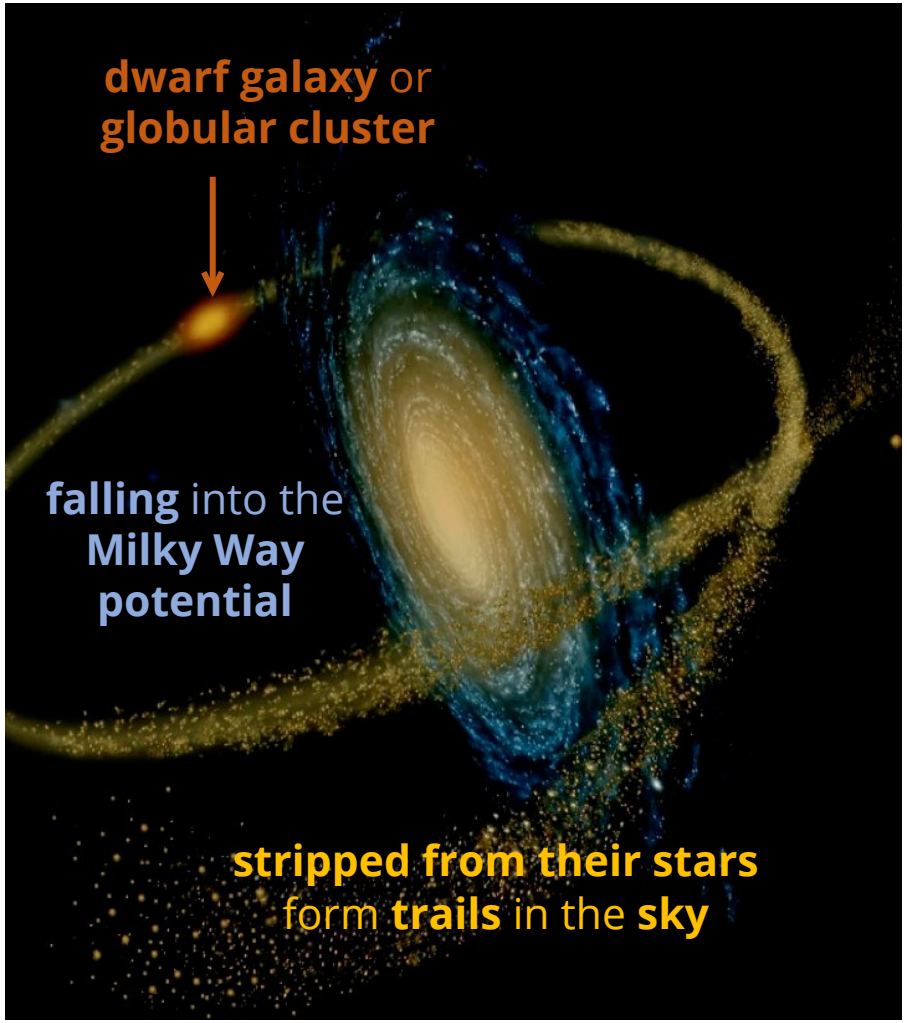

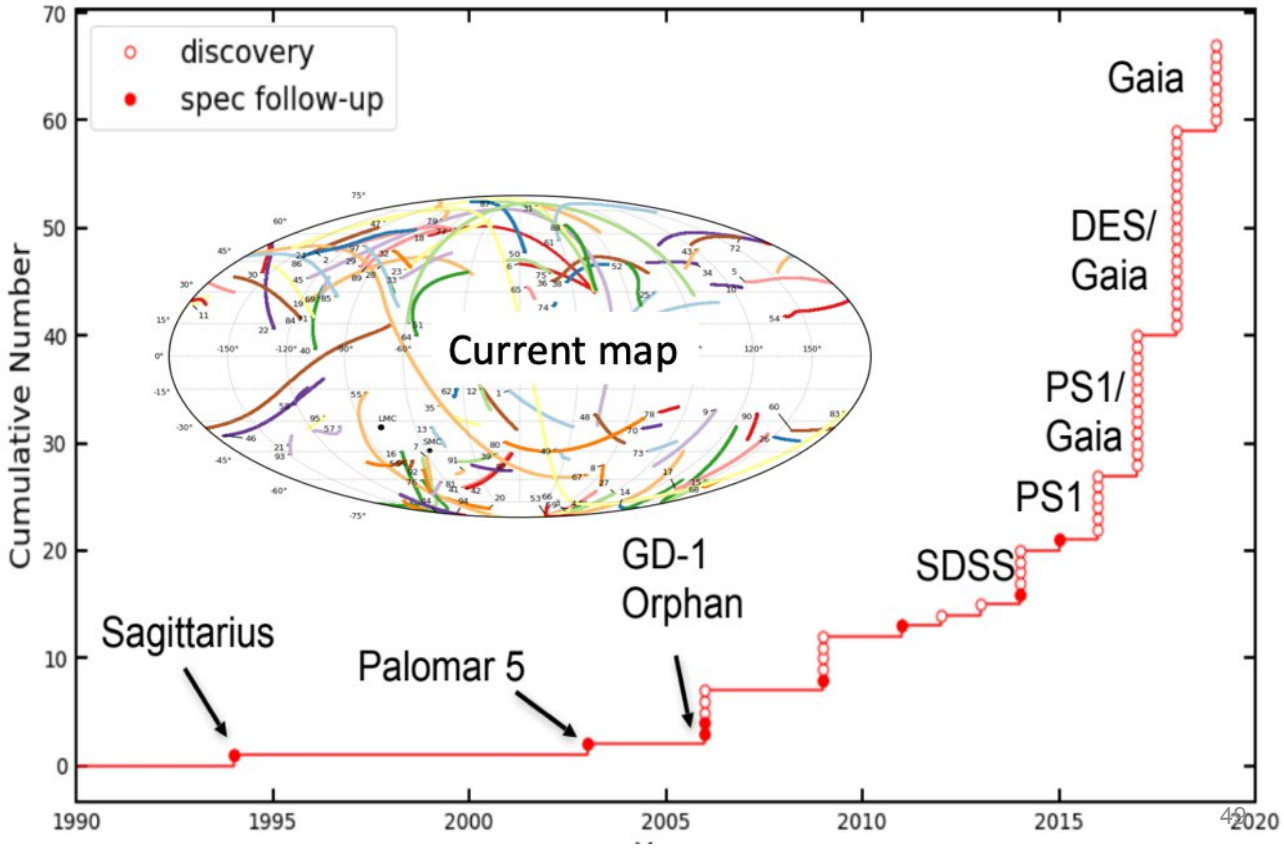

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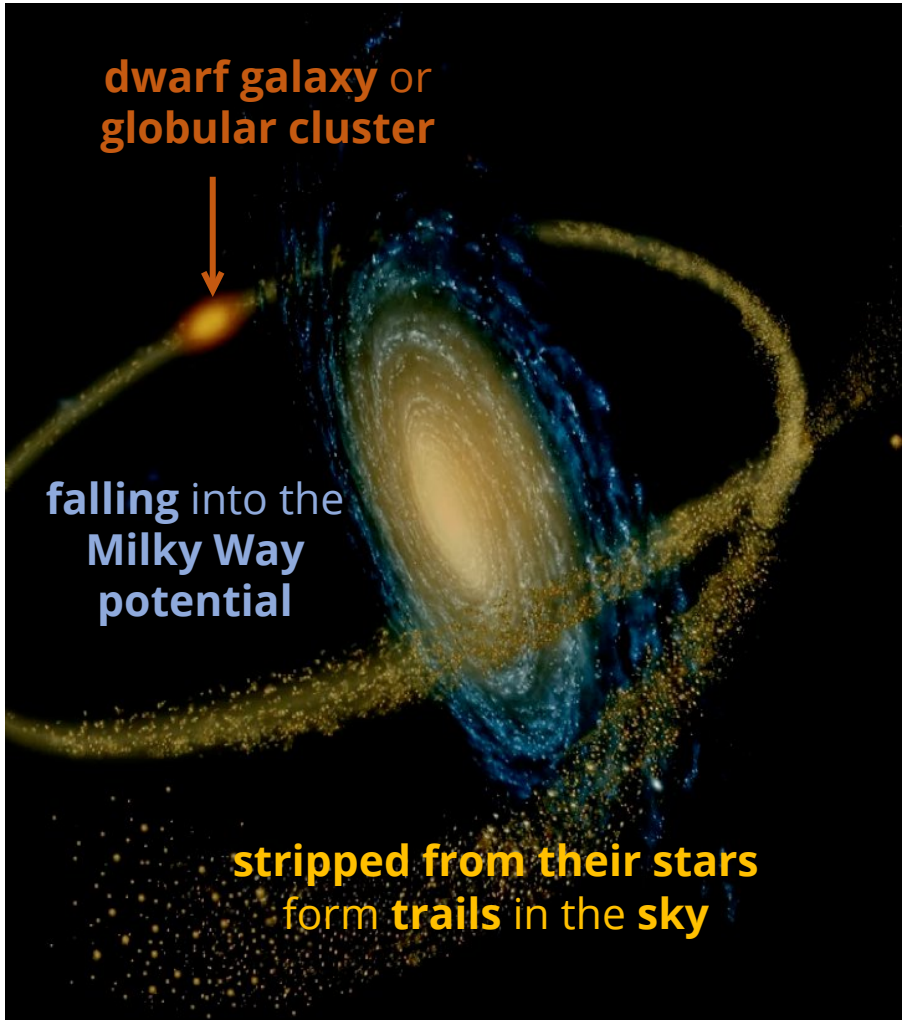
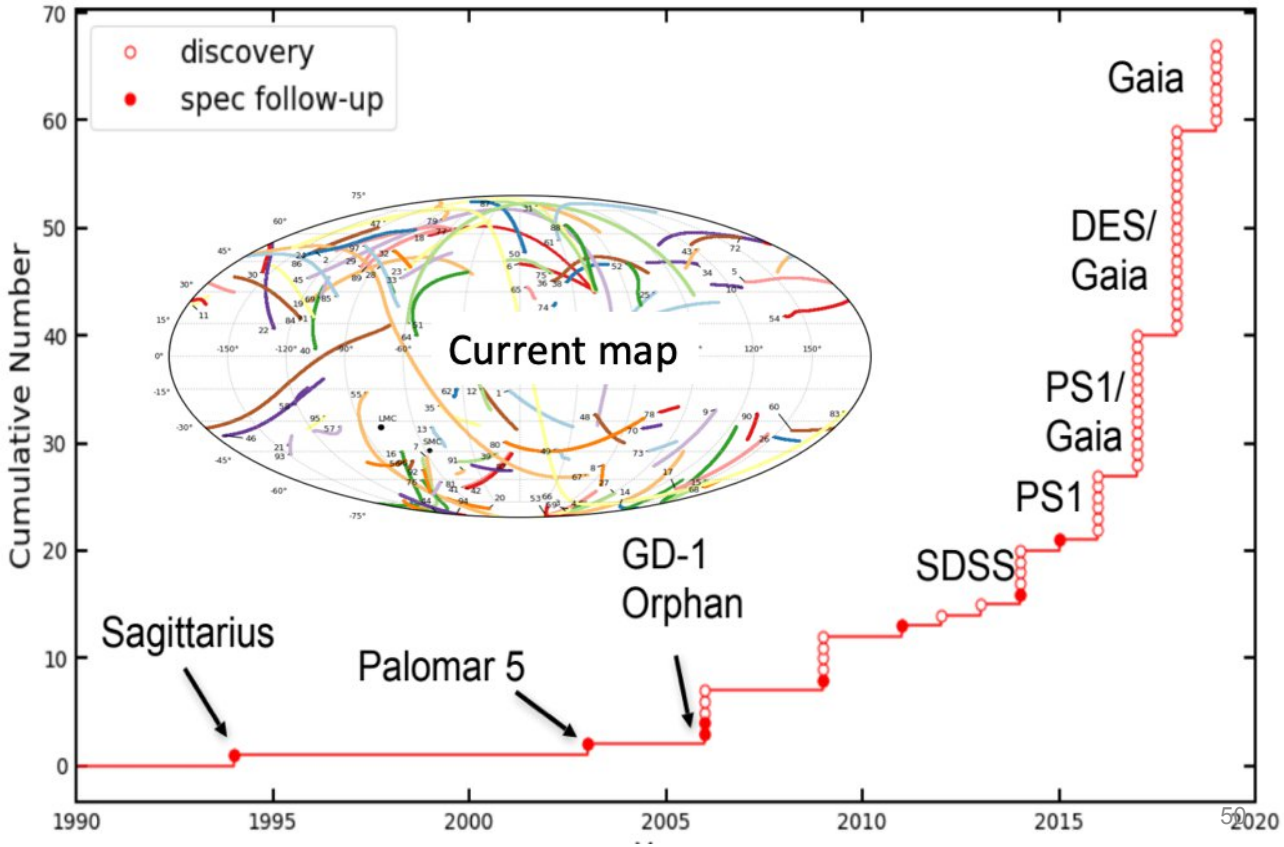
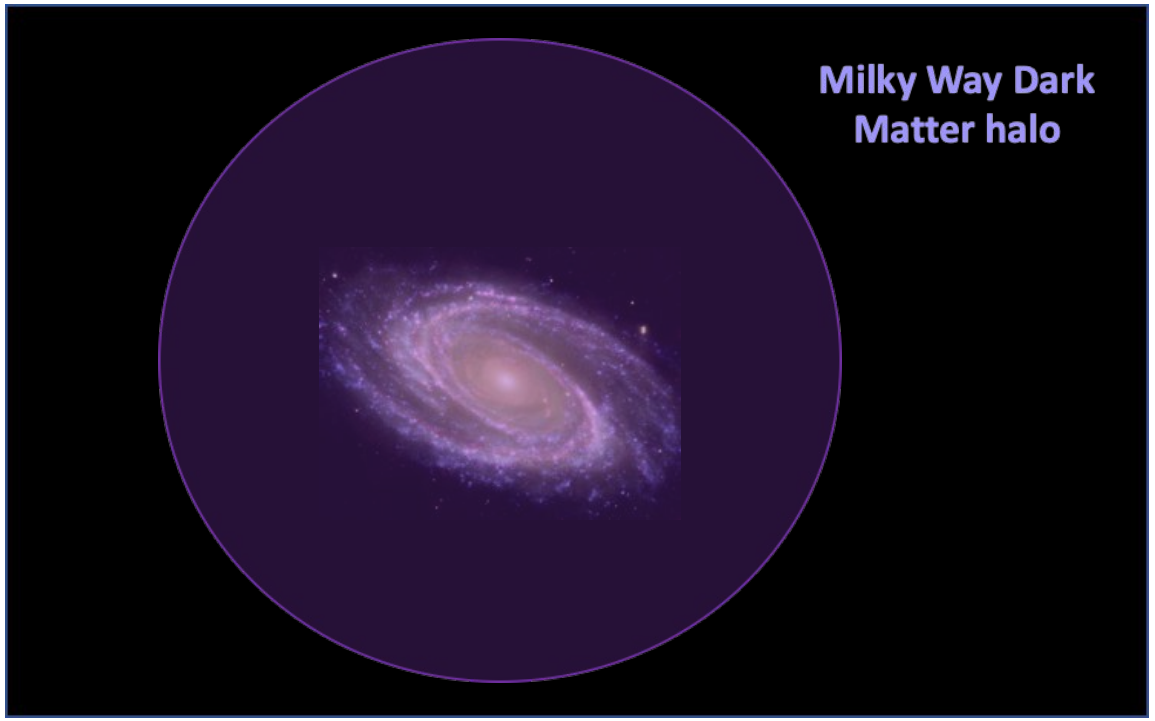




How are streams relevant to dark matter constraints?



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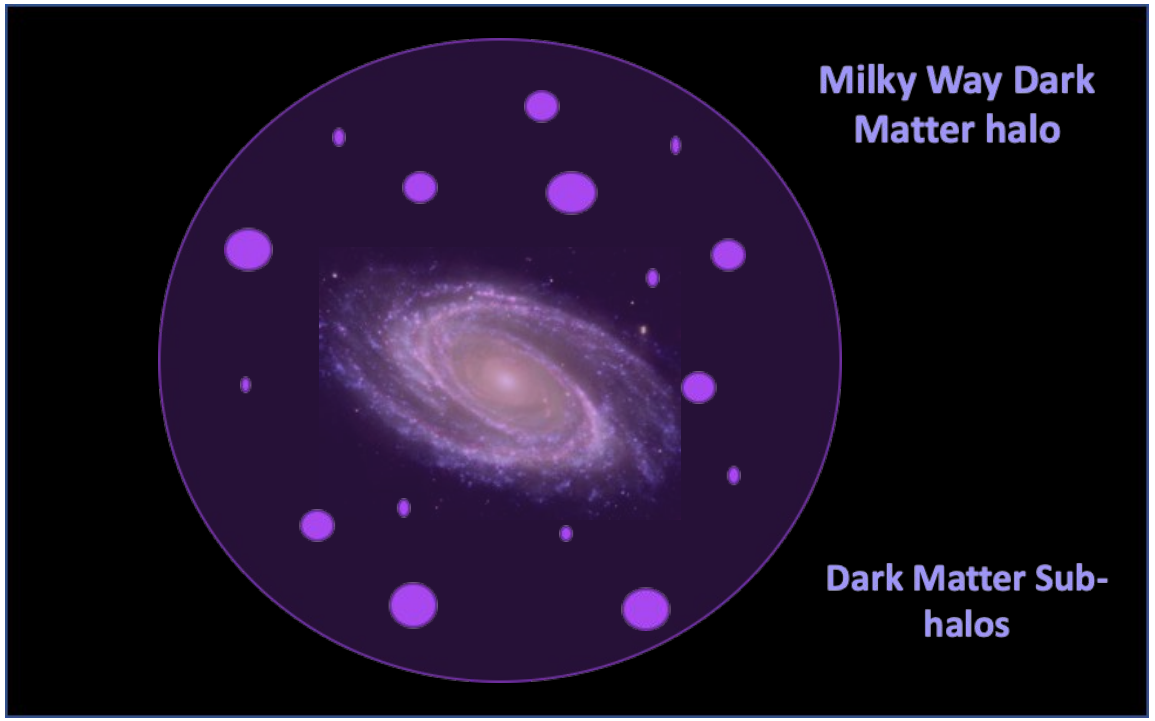
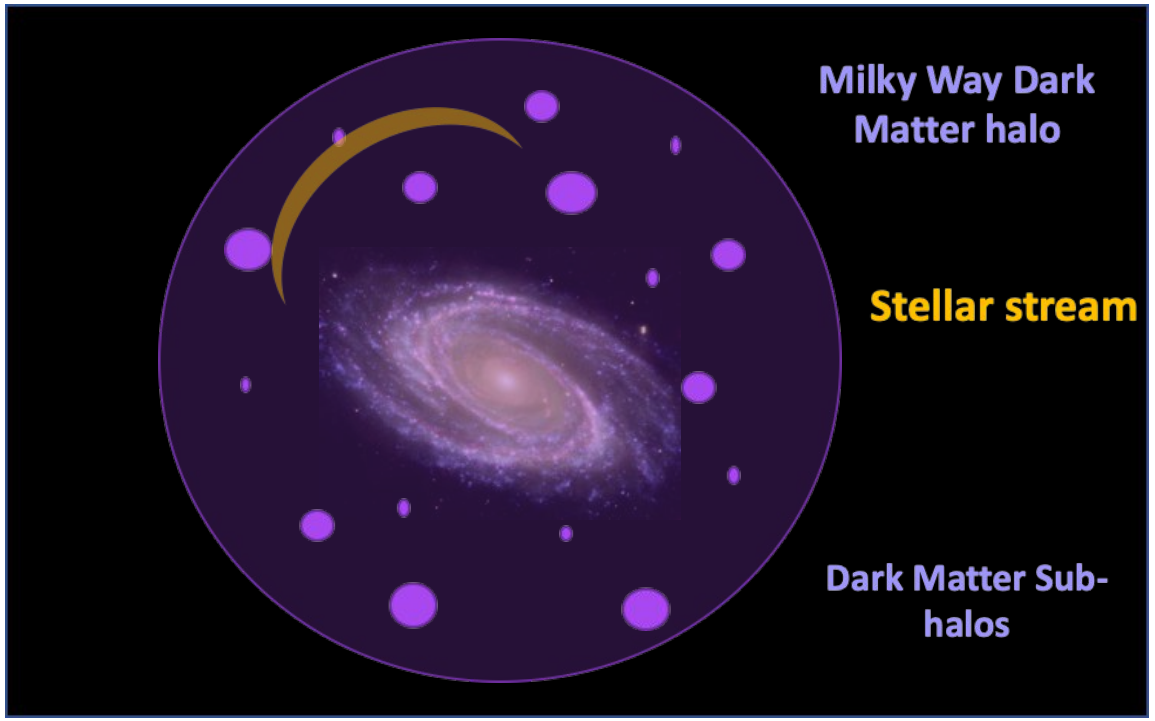
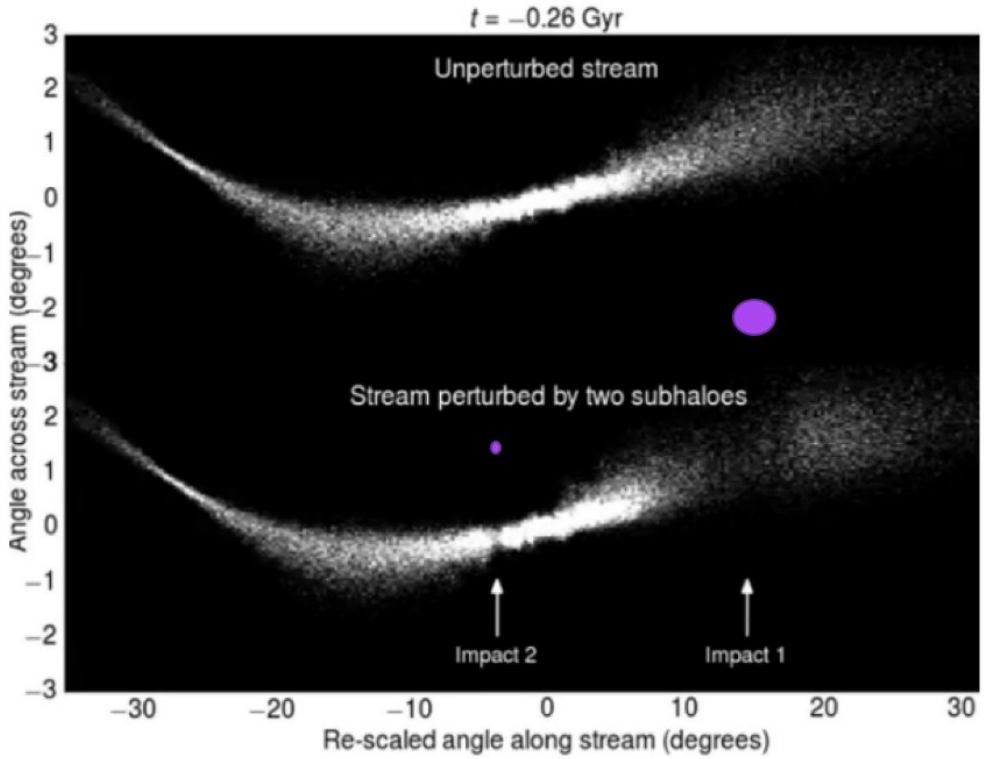


How are streams relevant to dark matter constraints?

During their revolution around Milky Way,
stellar streams and dark matter halos collide

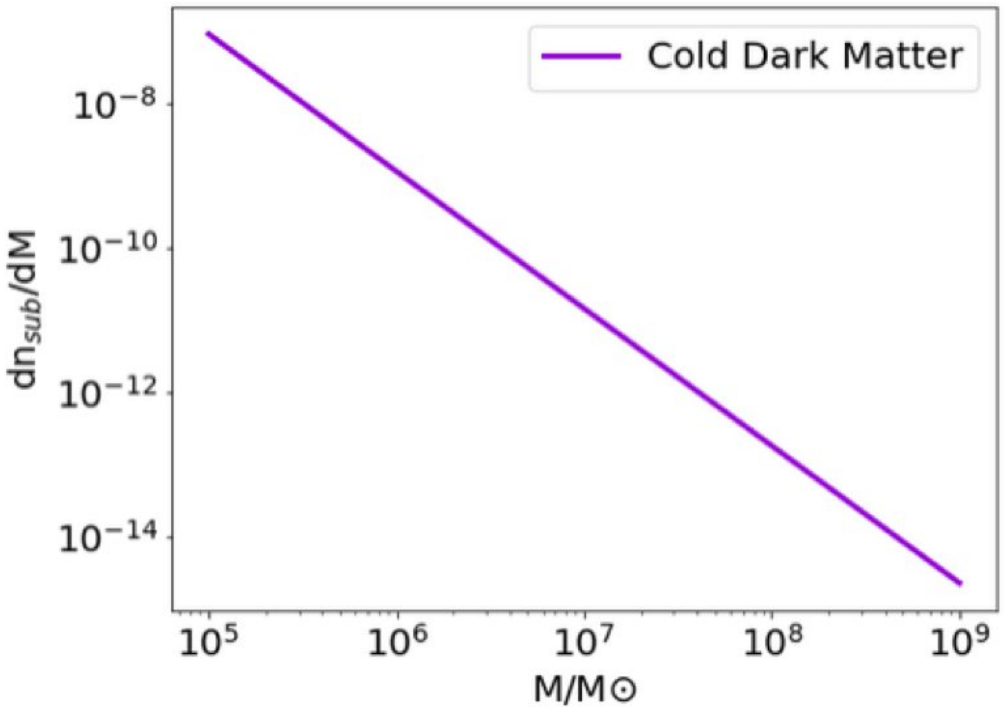
→ *Their encounter create gaps in streams*

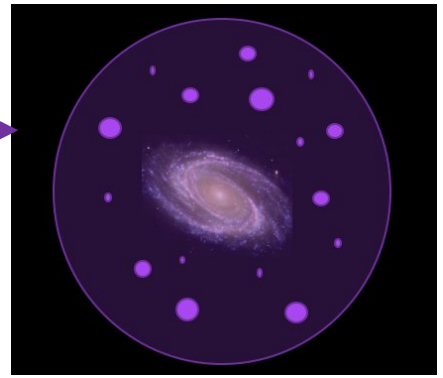


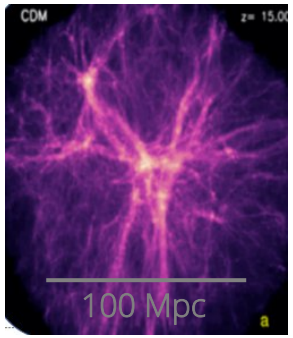


How are streams relevant to dark matter constraints?

- Cold Dark Matter candidates (WIMPS, axions…) **clump down to** very low mass

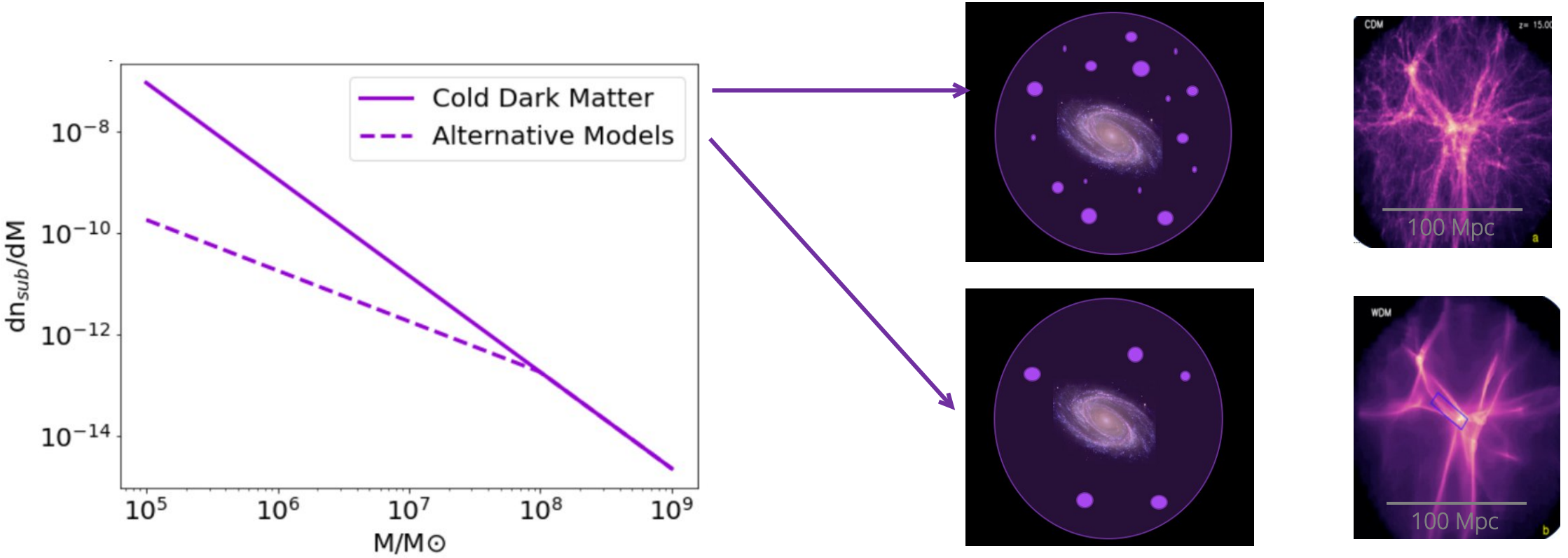






How are streams relevant to dark matter constraints?

- Cold Dark Matter candidates (WIMPS, axions…) **clump down to** very low masses
- Alternative models such as Warm, Self-Interacting or Fuzzy Dark Matter **dissolve** low mass halos



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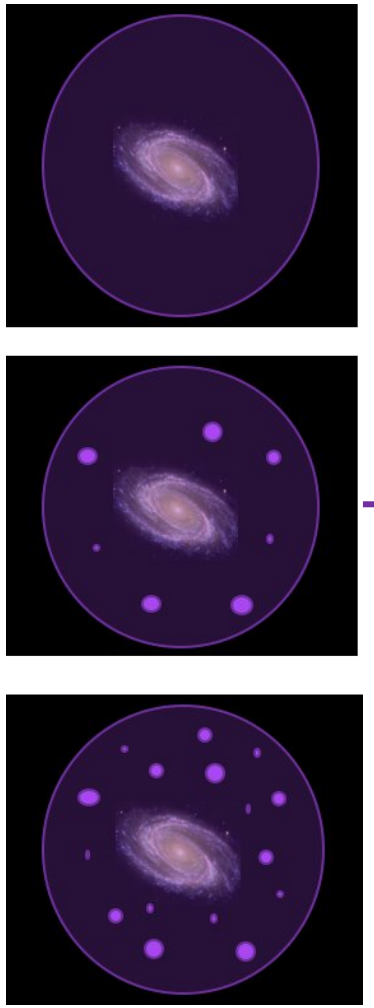
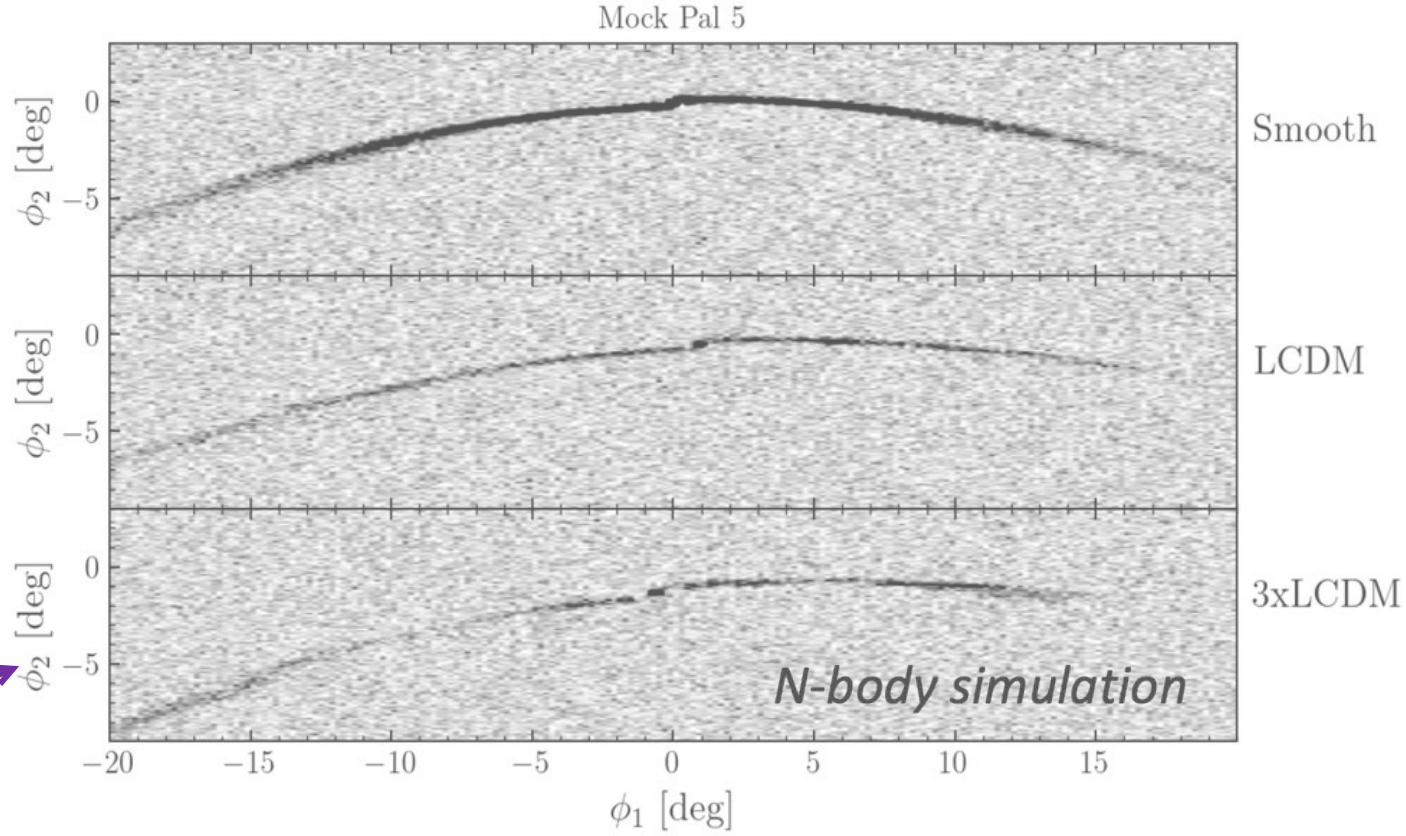


Star distribution of streams is sensitive to overall halos populations and therefore to dark matter models



→ *Build sensitive observable such as power spectrum of linear star density*

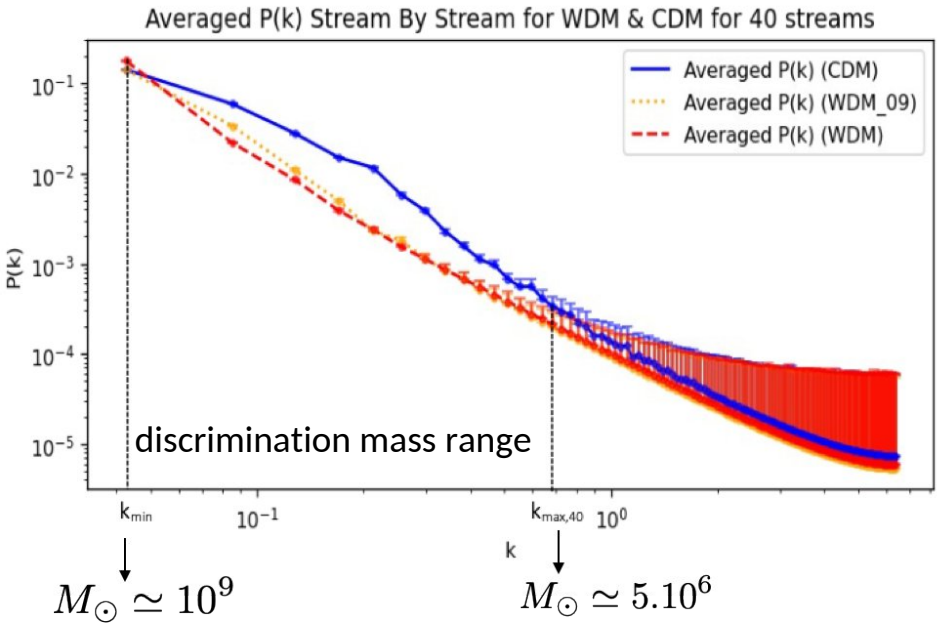
What are we doing at LPSC about Stellar Streams?

Proof of concept with toy simulation

Stellar Stream Project Lead in DESC (Marine Kuna)

- Team of world experts in streams detection and simulation
- 5 undergrad students

→ 1 M2 (spring 2024) + IRGA PhD grant request (exploratory and emerging topics)



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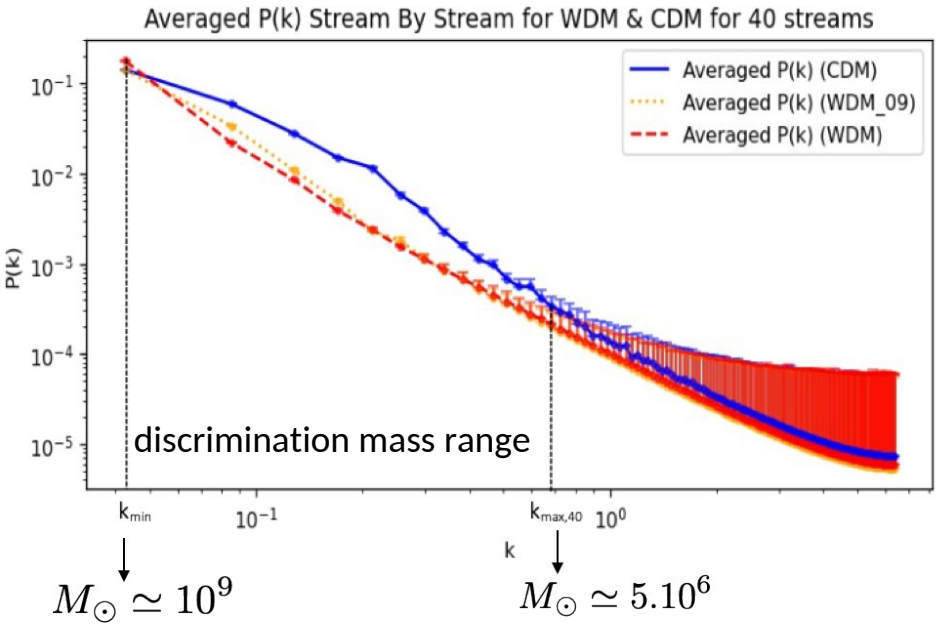

Stellar Stream Project Lead in DESC (Marine Kuna)

- Team of world experts in streams detection and simulation
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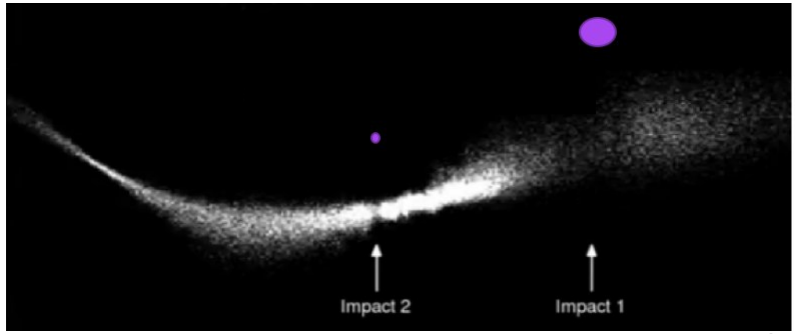
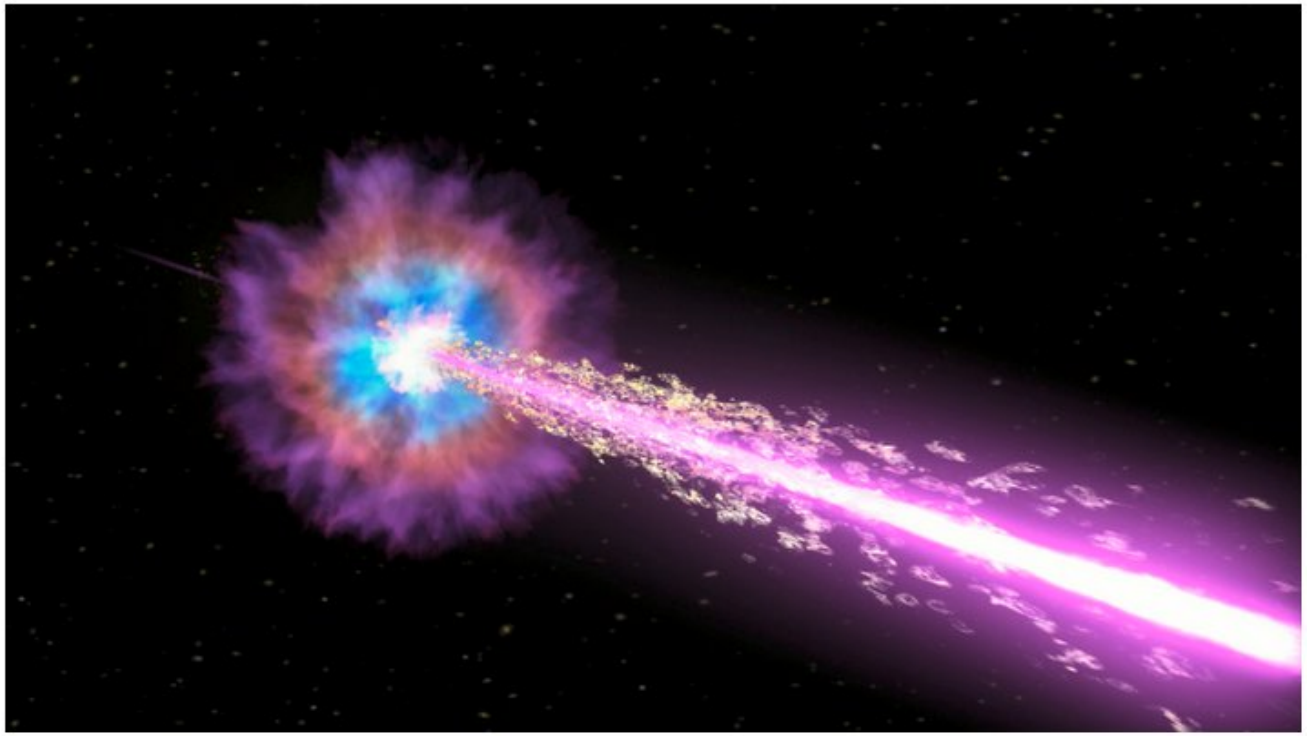
Scientific program

- Analysis optimization: sensitivity to various DKM models
  - Traditional observables (power spectra, 2-pt corr function…) + machine learning simulation-based inference
- Simulations improvement for comparison to theory
  - n-body + fast simulations
- First limits with observed streams in very first LSST data
  - Survey systematics evaluation
  - First images early 2025!



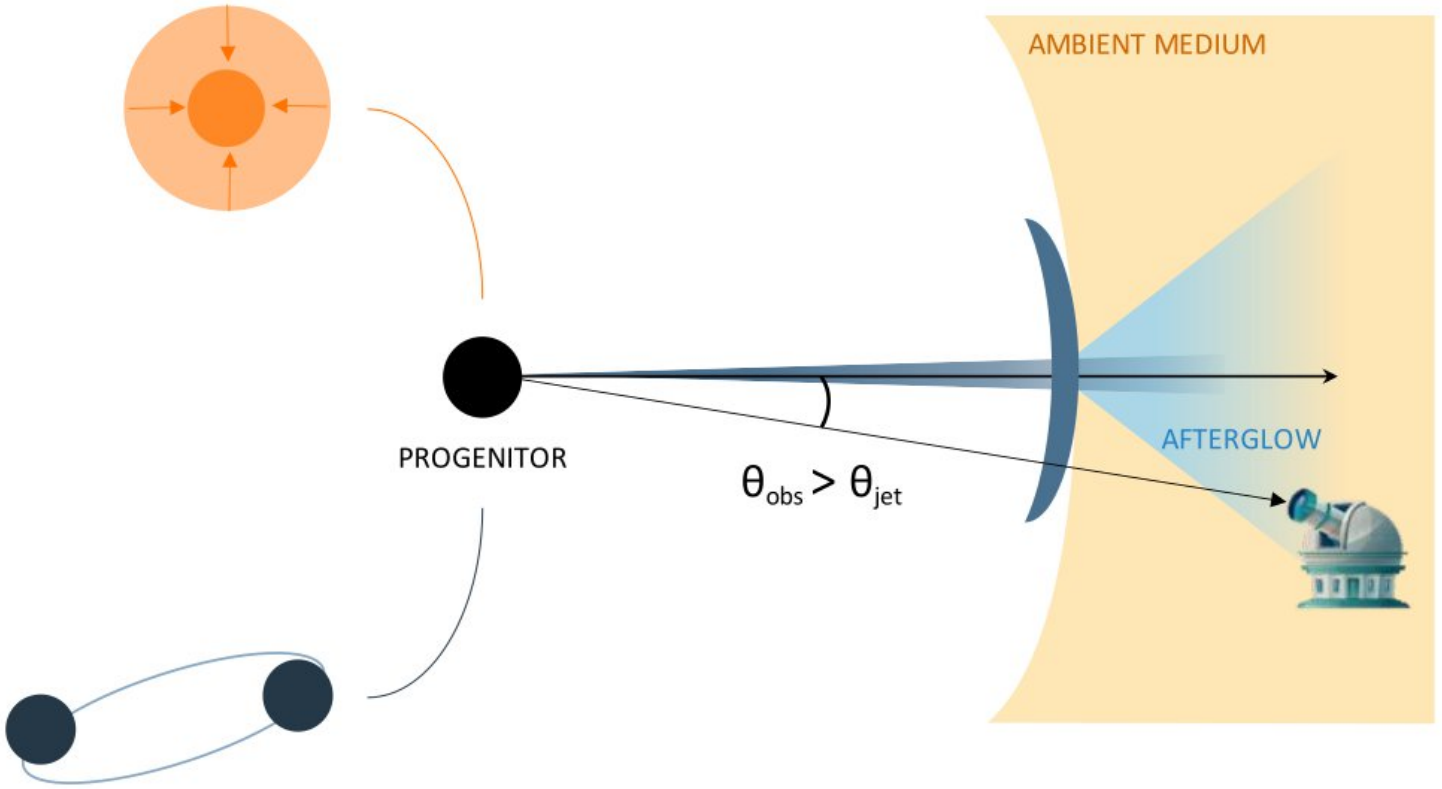
Orphan gamma-ray bursts and FINK



Astronomers think GRB 221009A represents the birth of a new black hole formed within the heart of a collapsing star. In this illustration, the black hole drives powerful jets of particles traveling near the speed of light. The jets pierce through the star, emitting X-rays and gamma rays as they stream into space.
Credit: NASA/Swift/Cruz deWilde

Orphan gamma-ray bursts

Thèse de Marina Masson 2022-2025



Afterglow = long-lasting and fading emission following the gamma prompt emission

Orphan afterglow = afterglow observed off-axis (without gamma-ray emission)
⟹ **No orphan afterglow detected so far!** (Some candidates but none confirmed)

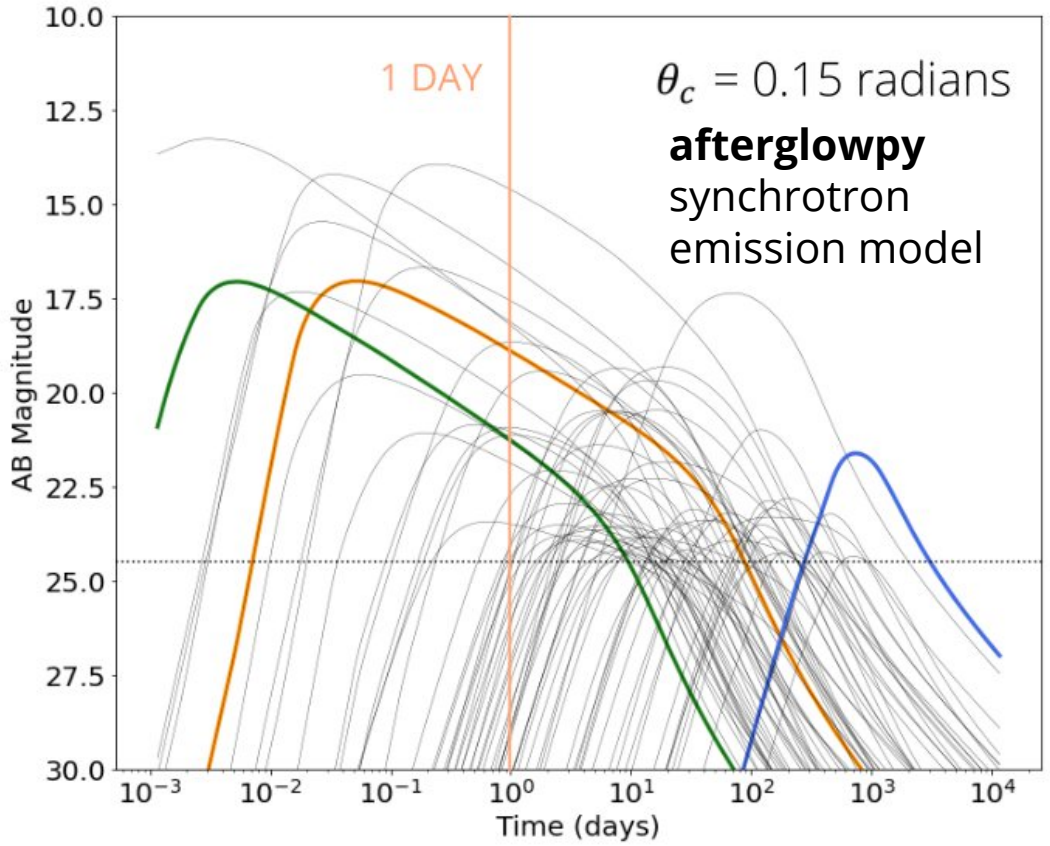
Why study orphan afterglows?

- More information on the GRB physics and their progenitors
- Multi-messenger analysis with gravitational waves

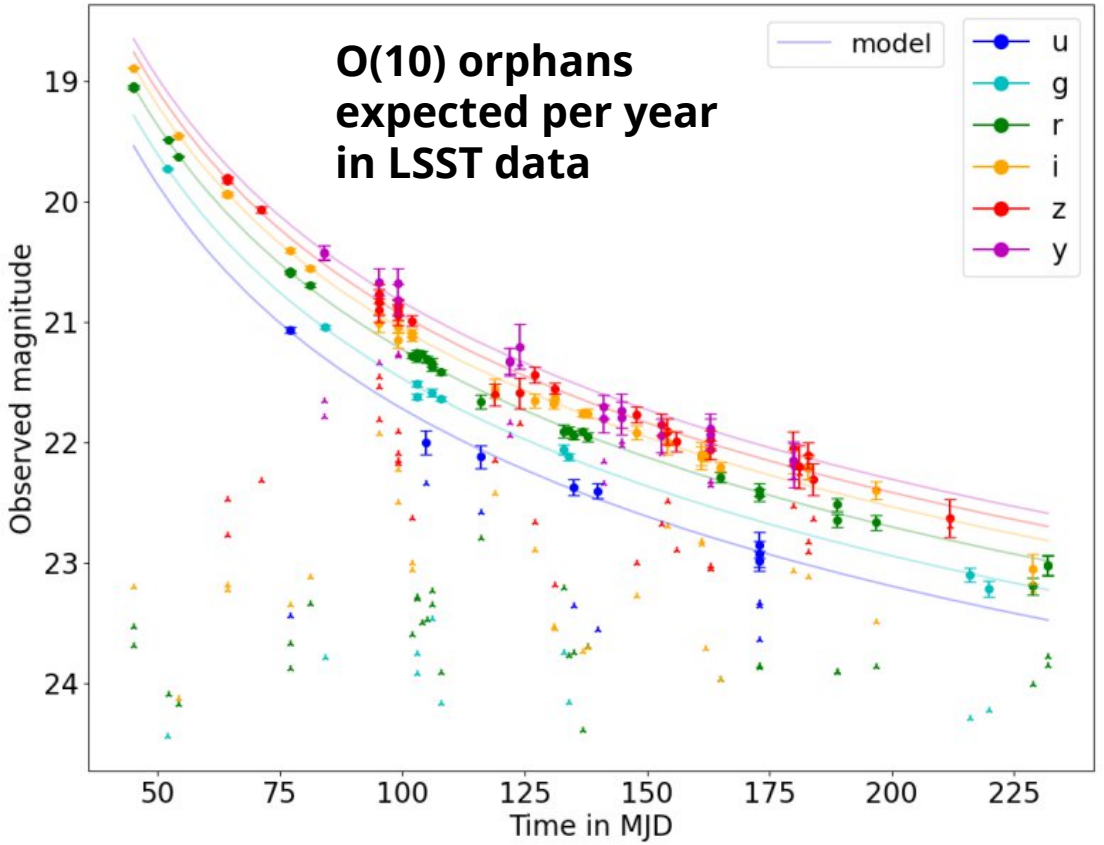
H_0 !

Orphan gamma-ray bursts: detectability with Rubin

Simulation of a population of 2e6 bursts

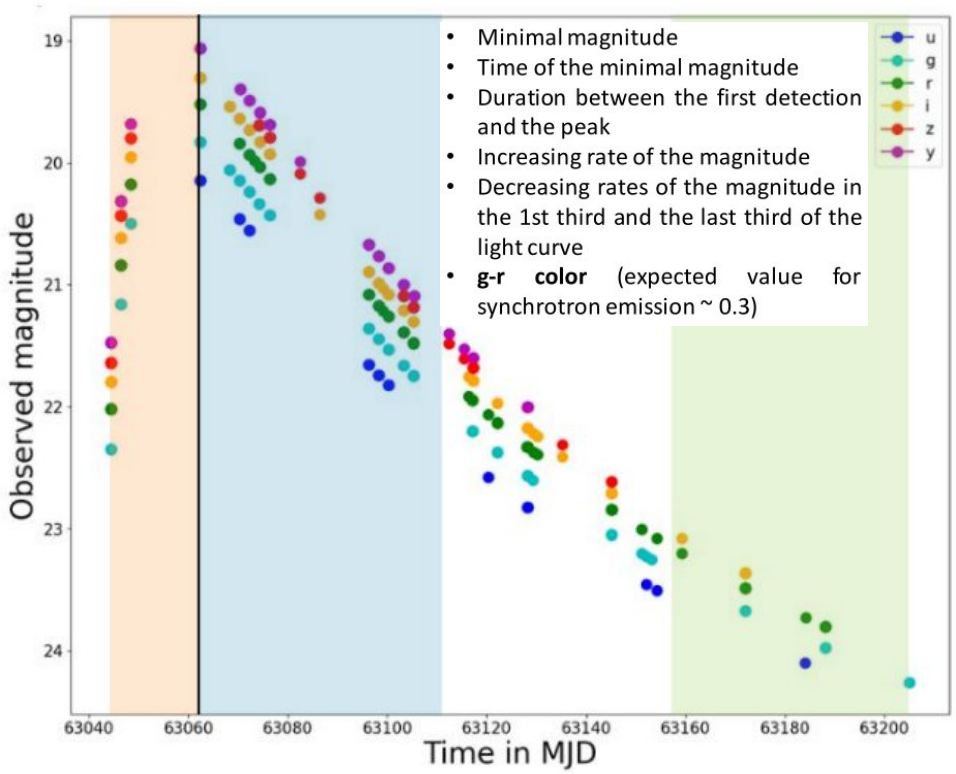


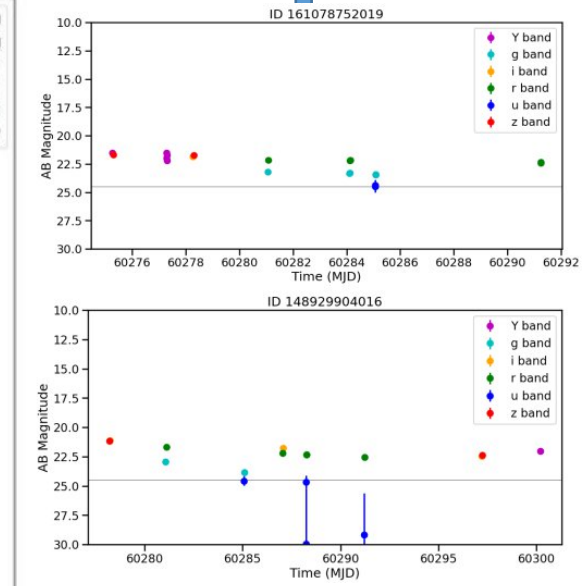
Pseudo-observations with the Rubin scheduler simulator



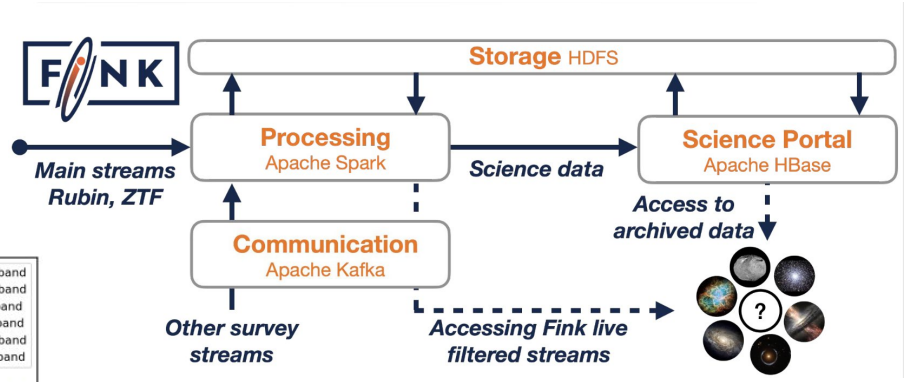
Orphan gamma-ray bursts: implementation in FINK

Light curve analysis: defining features to characterise orphans





ELAsTiCC
Alert stream simulation of all Rubin transients



Finding orphans

- Define orphan filter and integrate into FINK
- Add orphans to ELAsTiCC
- ZTF data?

New projects with Obs. Merate

- Improved populations based on SWIFT GRB catalogues
- Assess contamination of kilonova and supernova on afterglow

Orphan gamma-ray bursts: contexte collaboratif

Bourse de thèse IRGA (ADR + 5k Euros)

Projet intégré à FINK

- Participations aux workshops et présentations aux réunions générales
- Discussions avec la communauté GRB : F. Daigne, D. Turpin, S. Vergani…
- Présentations aux réunions LSST France

Projet identifié dans le DESC Time Domain working group

- Présentations au groupe en 2022 et 2023

Autres collaborations

- Prise de contact avec Transient and Variable Stars Science Collaboration
- Séjour de Marina à l'Osservatorio di Merate (Sept.-Nov. 2023, financement UGA)
  - Experts internationaux modélisation et observation MWL des sursauts gamma
- Discussions informelles avec équipe GW du LAPP (L. Rolland, cadre ENIGMASS)
- Stage M1 prévu au printemps, co-encadrement de J. Macias (CosmoML) pour l'observation des sursauts orphelins en radio

Futur ?

1. **Composition et évolution de l’équipe**

2. **Projet Rubin**
    1. Observatoire Rubin et survey LSST
    2. Chargeur de filtre et CCOB
    3. Commissioning/computing

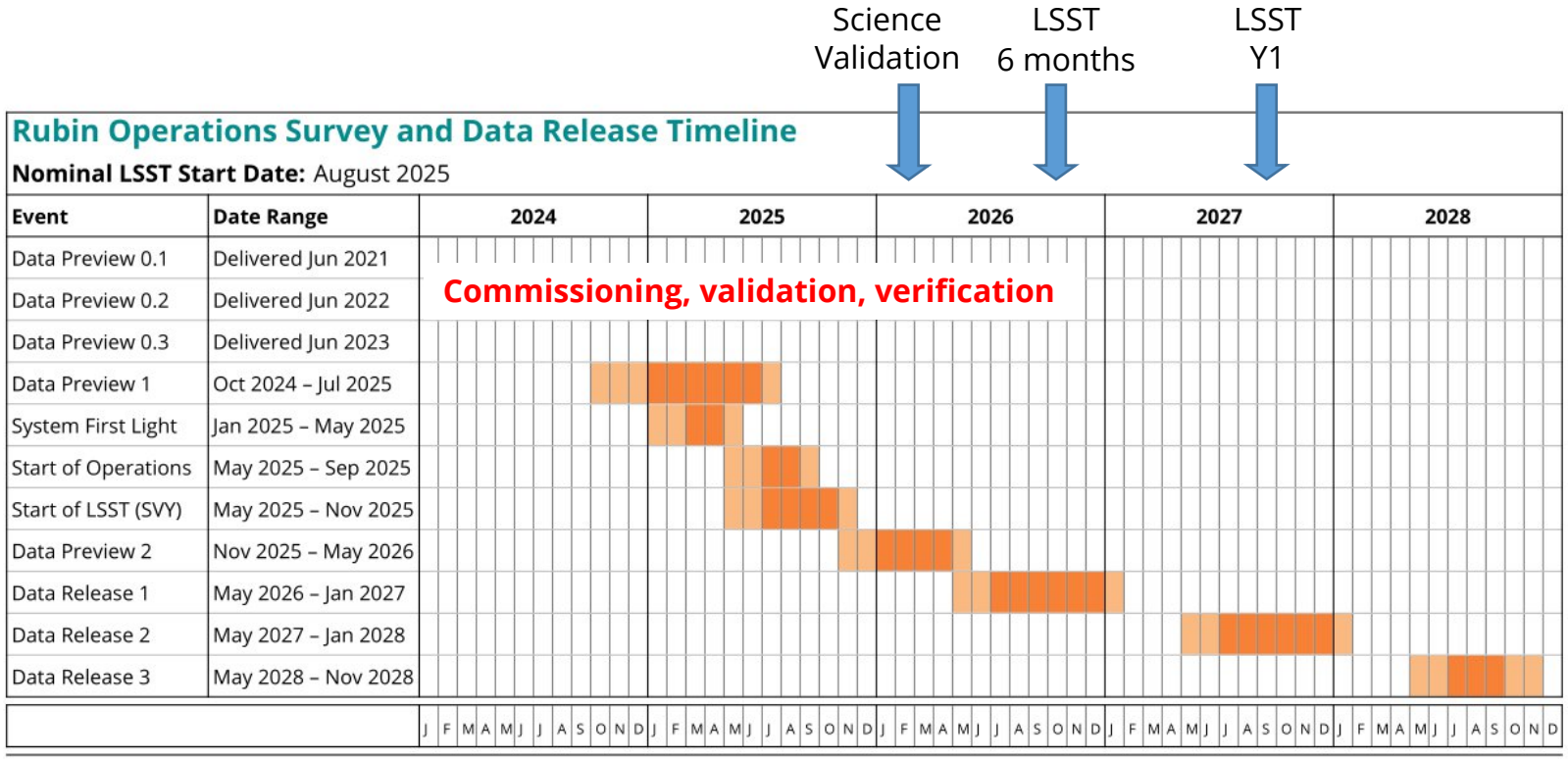
3. **Thématiques scientifiques**
    1. Collaboration DESC et science
    2. Cosmologie avec le cisaillement gravitationnel
    3. Cosmologie avec les amas de galaxies
    4. Matière noire avec les courants d’étoiles
    5. Ciel transitoire et « broker » d’alertes FINK

4. Conclusions et perspectives

Conclusions et perspectives

Forte implication dans LSST (hardware, management, computing, science)

- Fin de la construction (2024)
- Assurer la maintenance (2024-2036?)



Event	Date Range
Data Preview 0.1	Delivered Jun 2021
Data Preview 0.2	Delivered Jun 2022
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Start of LSST (SVY)	May 2025 – Nov 2025
Data Preview 2	Nov 2025 – May 2026
Data Release 1	May 2026 – Jan 2027
Data Release 2	May 2027 – Jan 2028
Data Release 3	May 2028 – Nov 2028

TABLE 3: Rubin Operations Key Milestones for Early Science

Conclusions et perspectives

Forte implication dans LSST (hardware, management, computing, science)

- Fin de la construction (2024)
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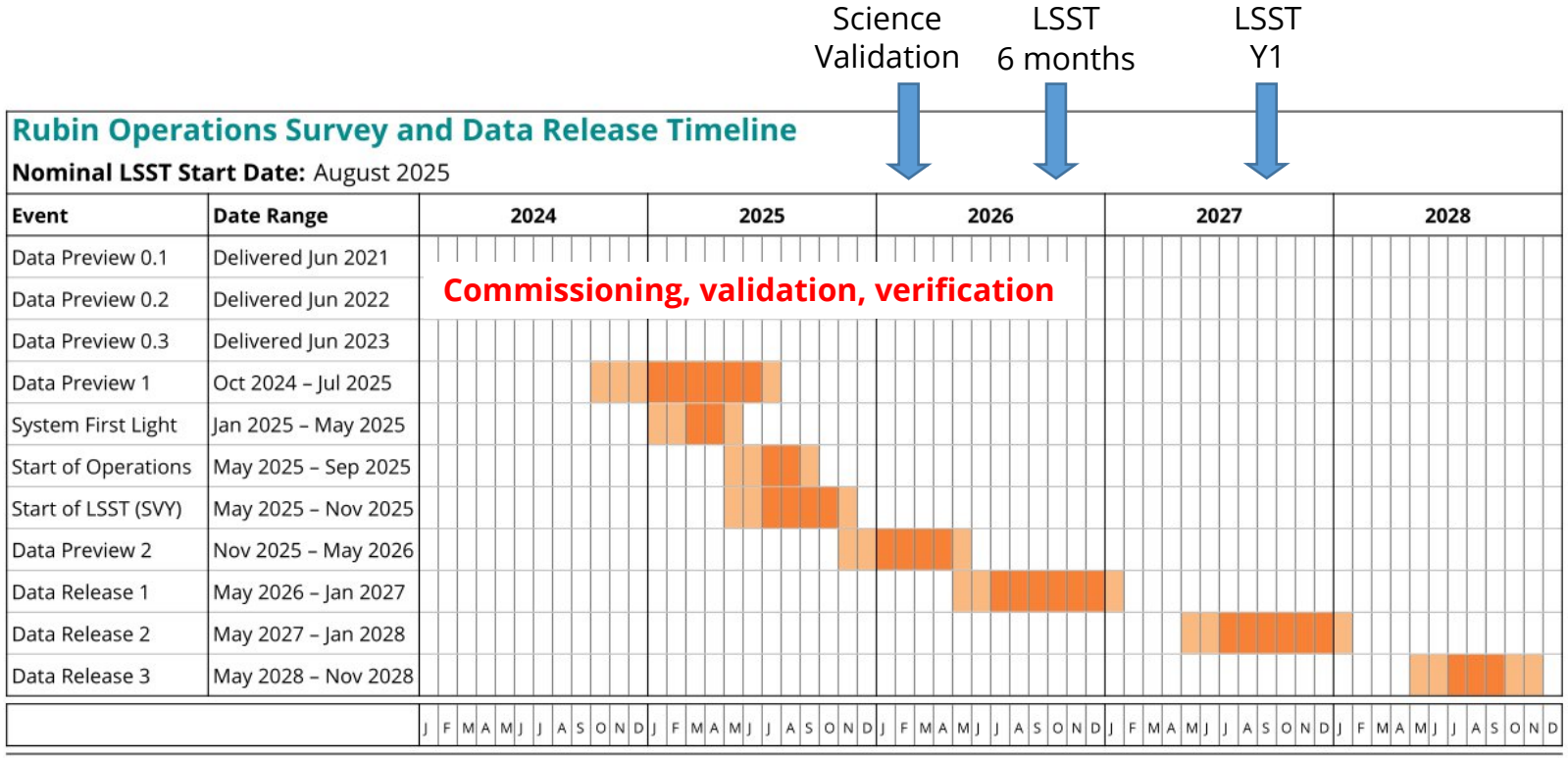
Priorité (5 prochaines années) : assurer retour scientifique LSST

- Cosmologie : weak lensing et amas
- Matière noire : “stellar streams”
- Ciel transitoire : GRB orphelins, cosmologie H_0



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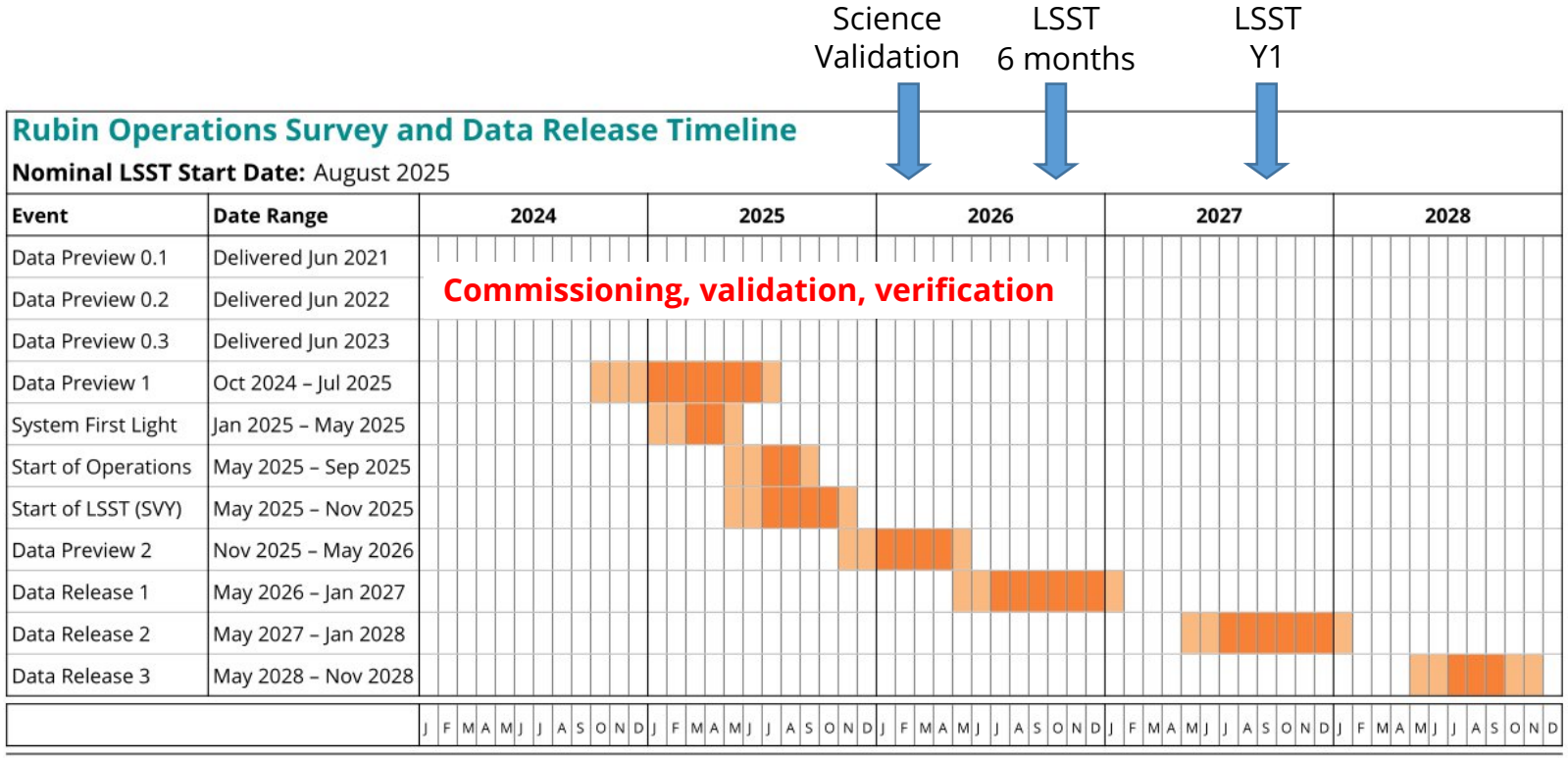

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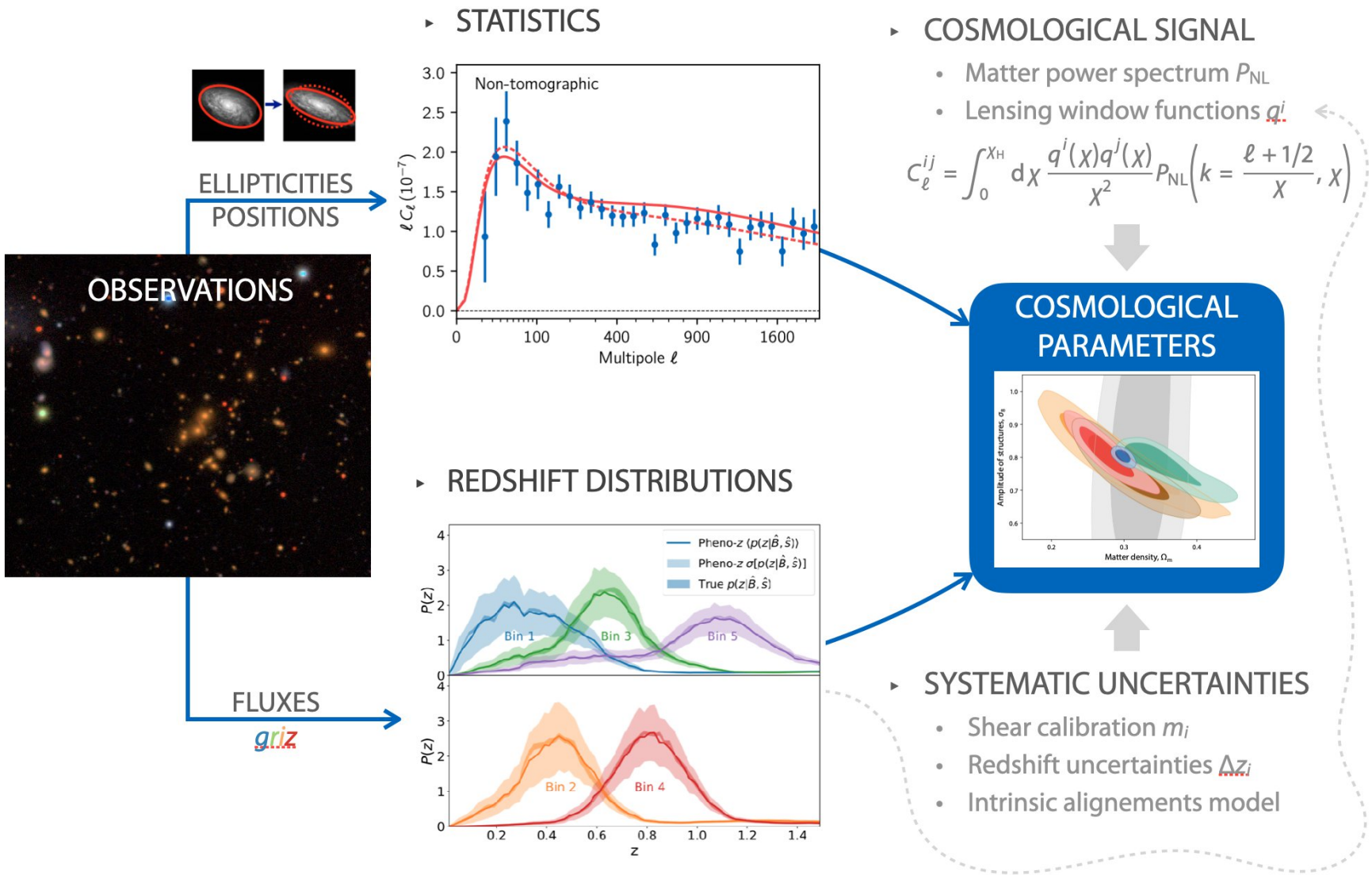
TABLE 3: Rubin Operations Key Milestones for Early Science

Autres objectifs (limités par FTE) :
ouverture multi-relevés et multi-longueurs d'onde

- Synergies avec Euclid et Roman
- Corrélations croisées avec CMB-S4 et SO

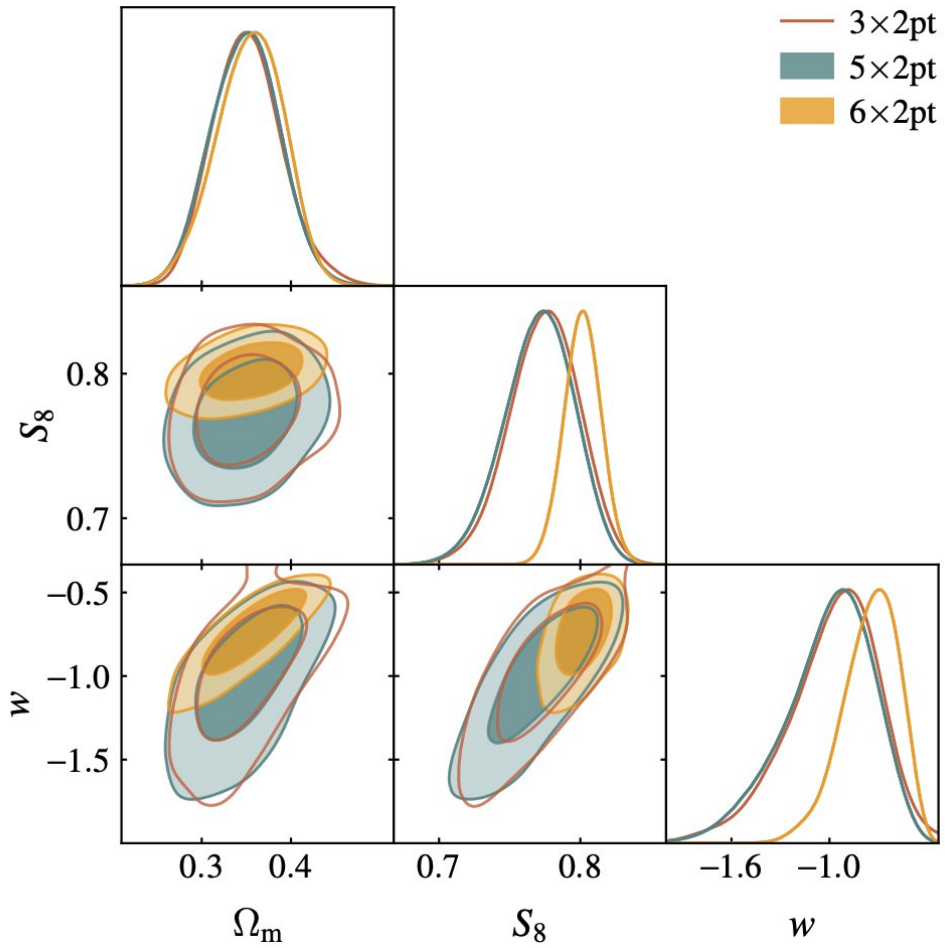
Back-up

Cosmic shear: pipeline to cosmology



Combinations of probes and surveys

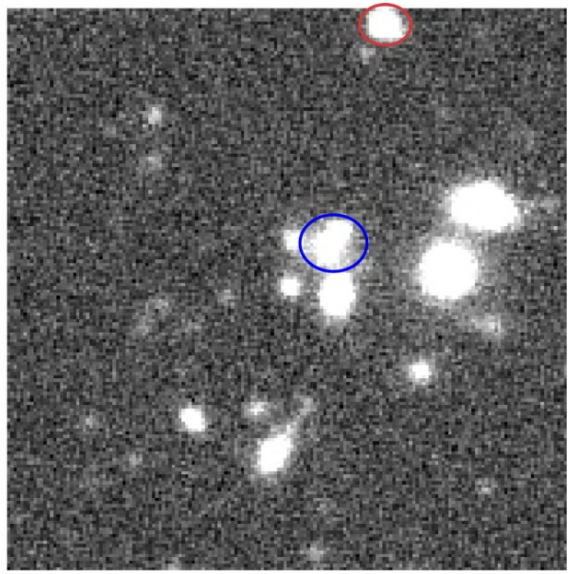
Combining galaxies (3x2) with CMB (6x2)



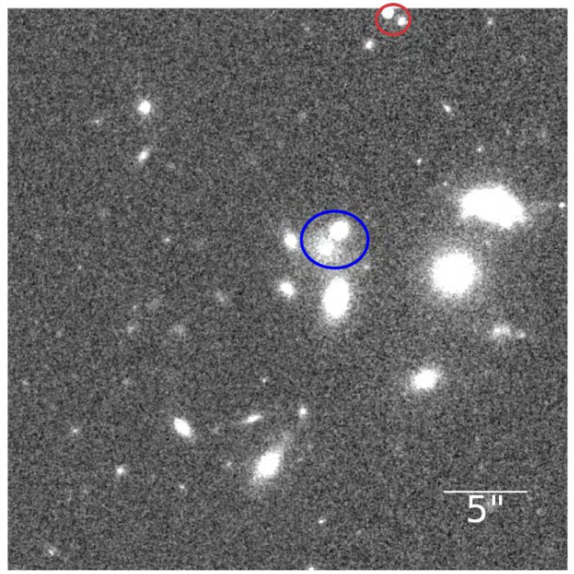
DES (incl. Doux) (2023)

Joint pixel-level analysis : detection and deblending

Rubin



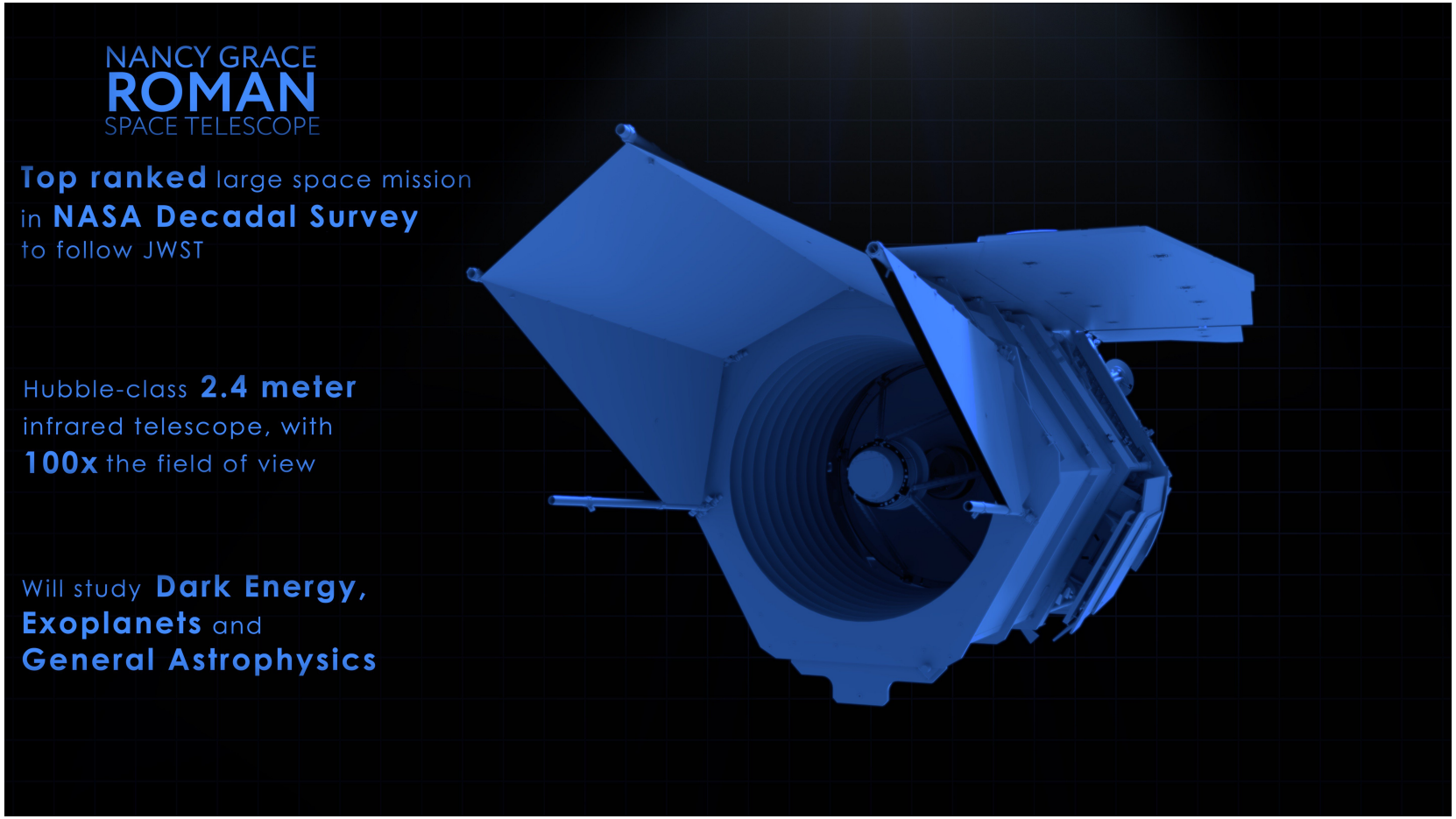
Roman



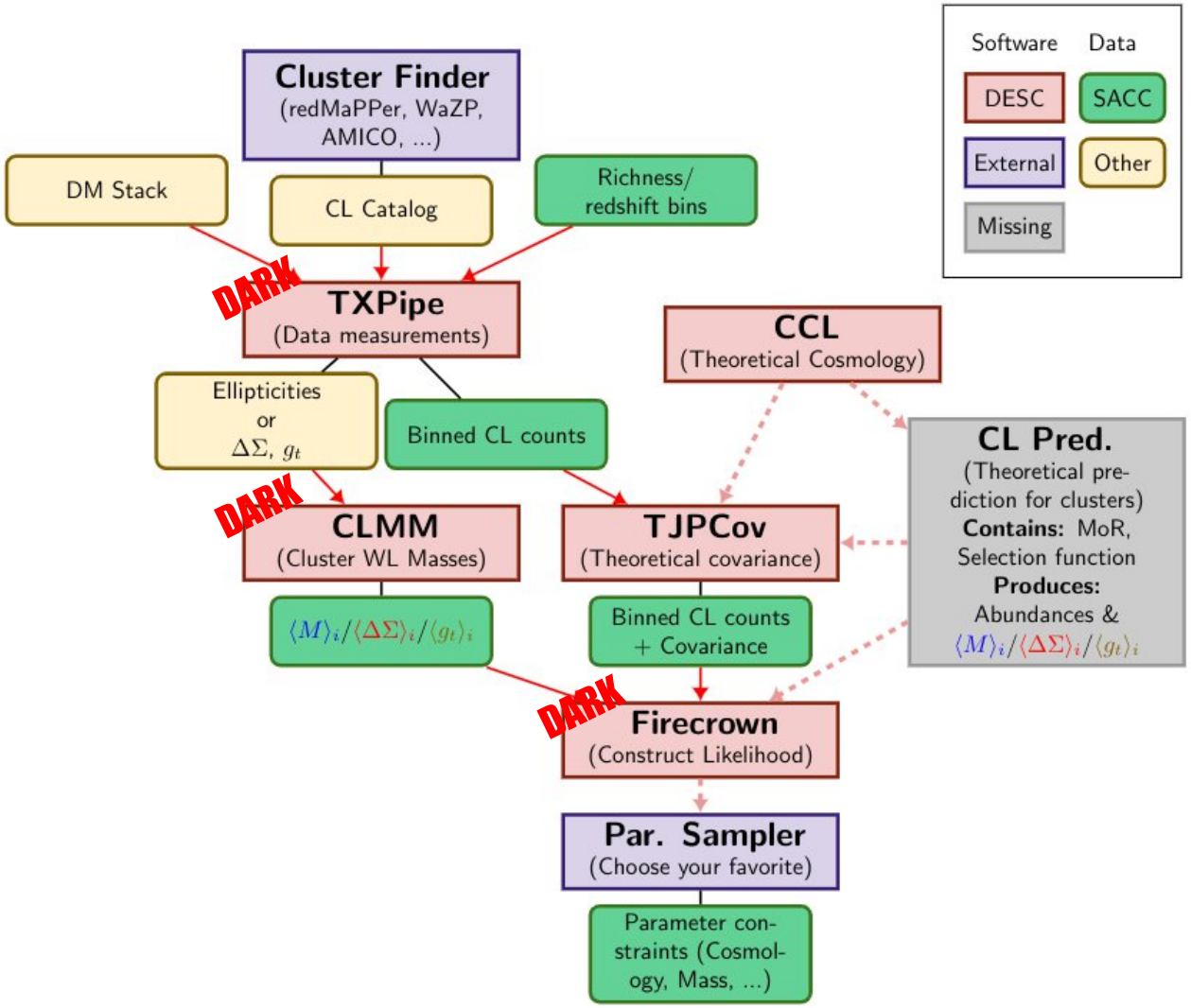
Troxel et al. (2022)

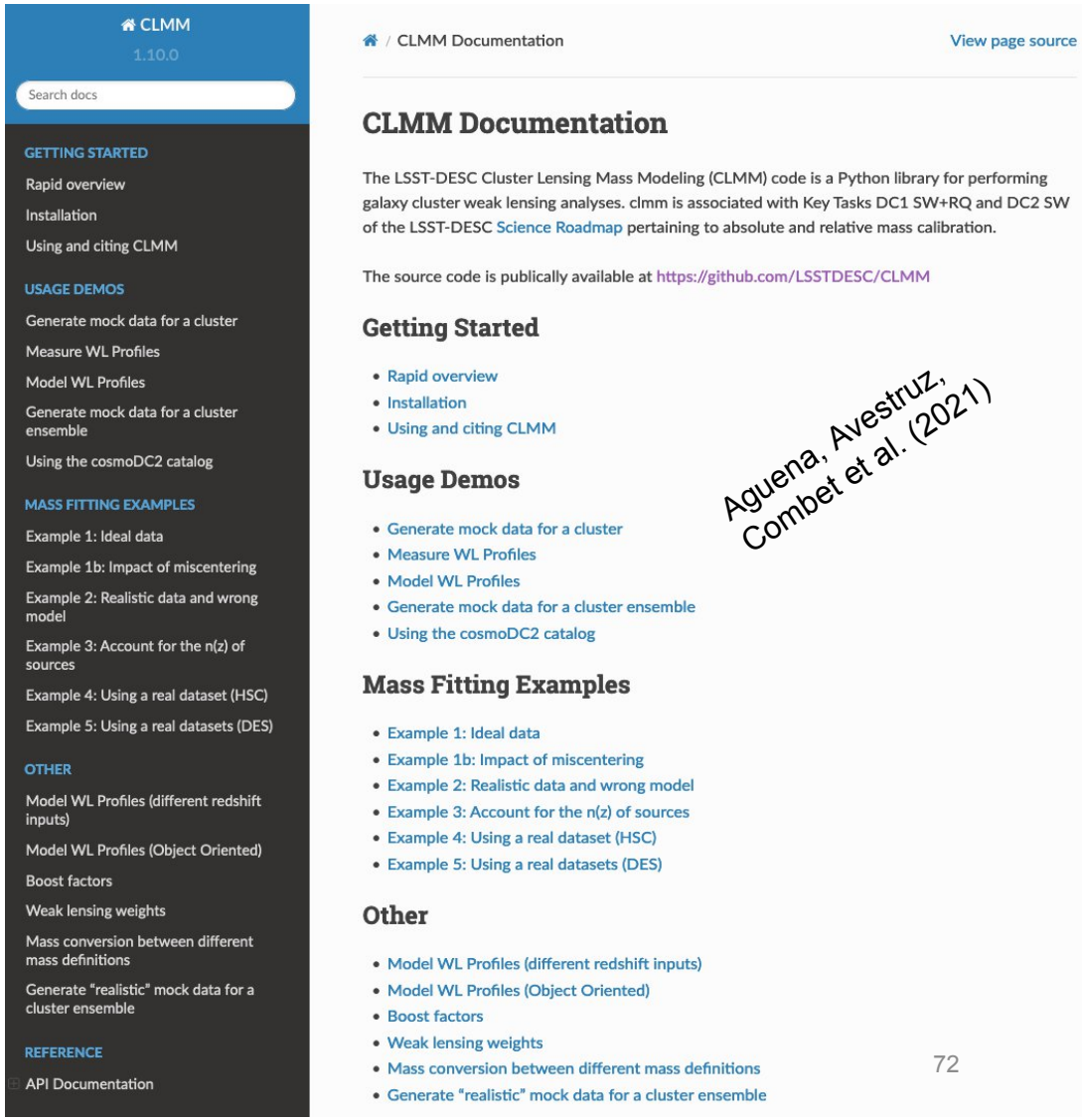
Implication dans Roman Space Telescope

- “Project Infrastructure Team” selectionnée par la NASA (juillet 2023) pour 5 ans renouvelable
- Analyse des données lensing/clustering et clusters
- Financement CNES envisagé (postdoc)
- Synergies avec LSST



Cluster cosmology in DARK: DESC CLcosmo pipeline

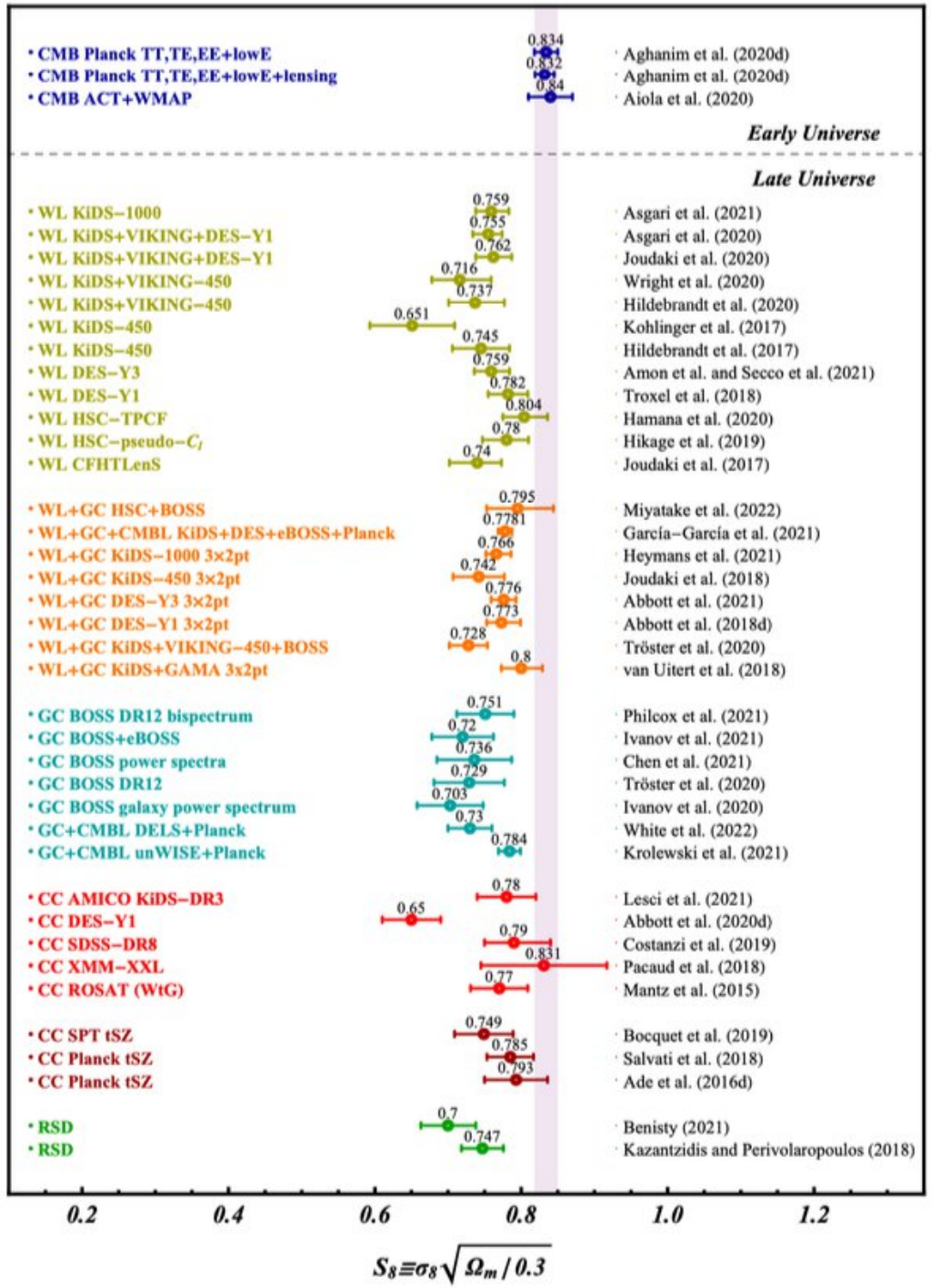




Aguena, Avestruz, Combet et al. (2021)

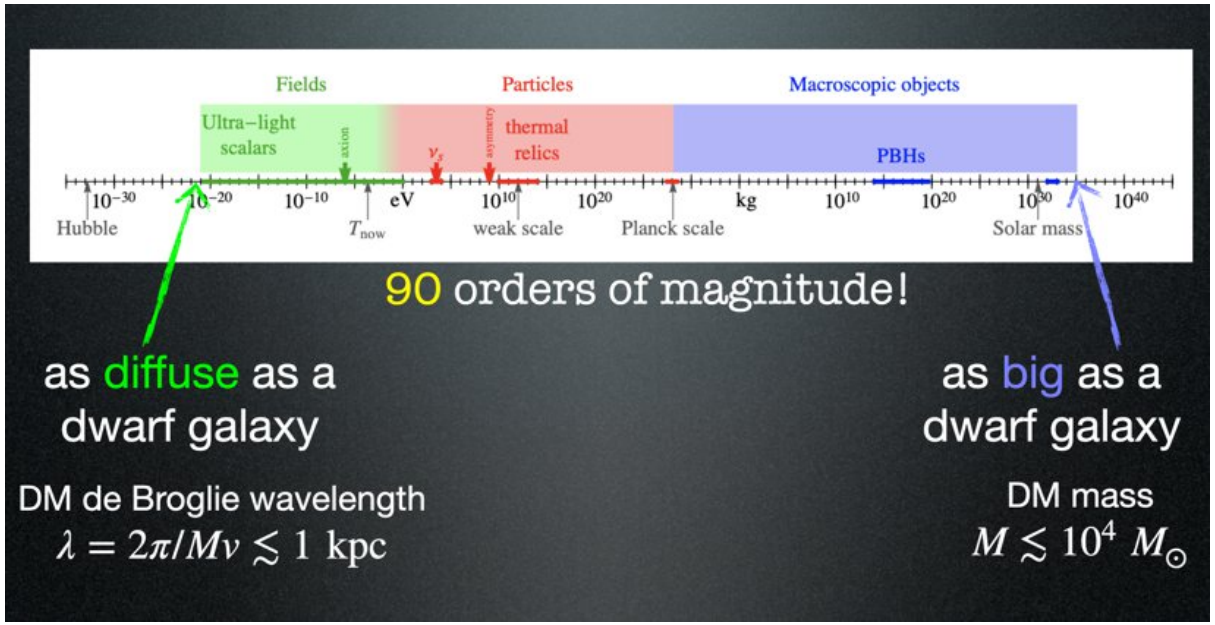
S8 tension

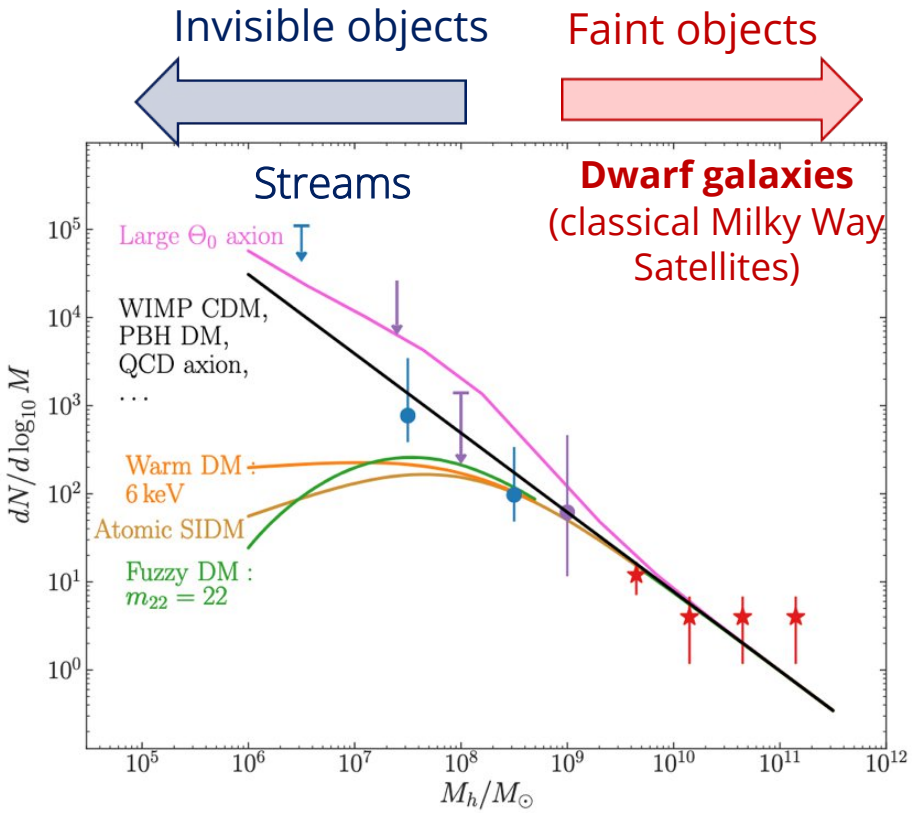
Abdalla et al. (2022)



Constraints on the nature of Dark Matter

- Some of best constraints from satellite galaxies.
- Can be improved with **lower mass halos**





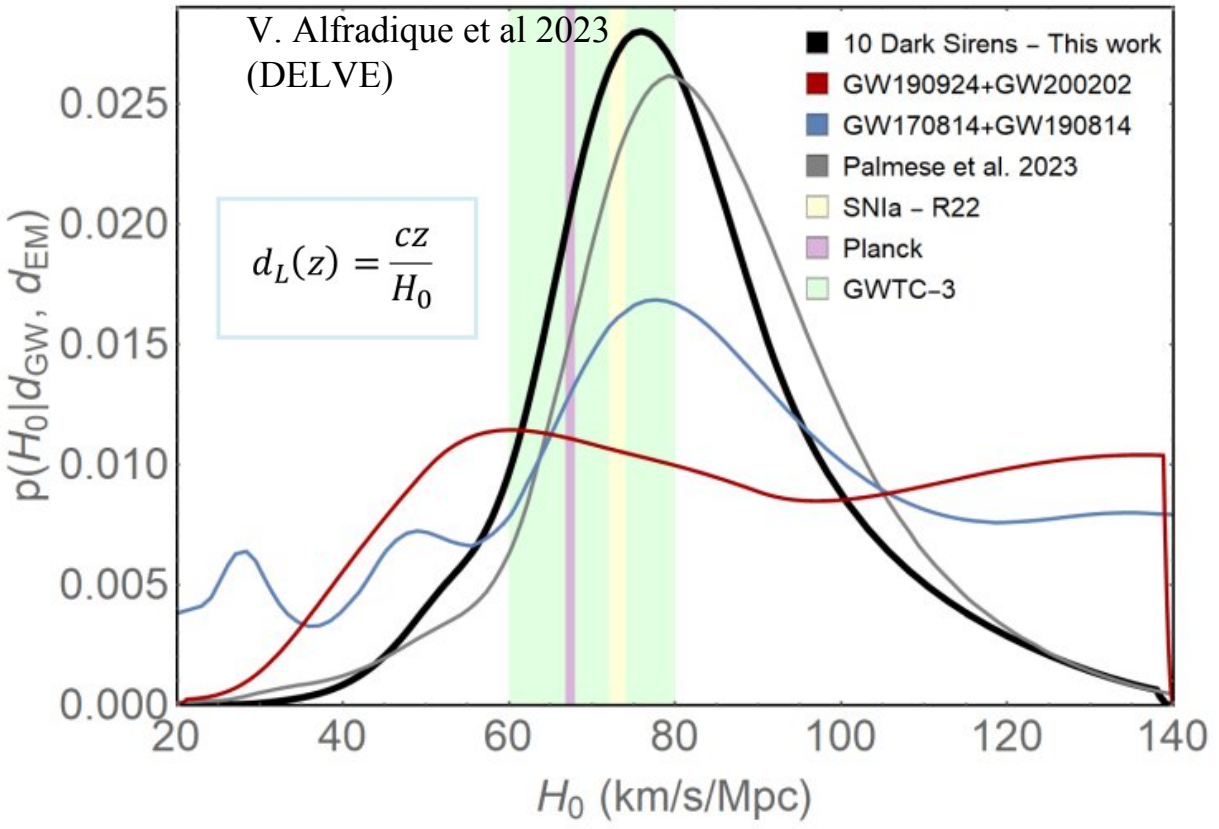
Sursauts gamma orphelins

GRB physics

- populations of short and long GRBs
- jet (structure, opening angle, content)
- progenitors (BNS, BHNS, SNe...)

Measurement of the Hubble constant

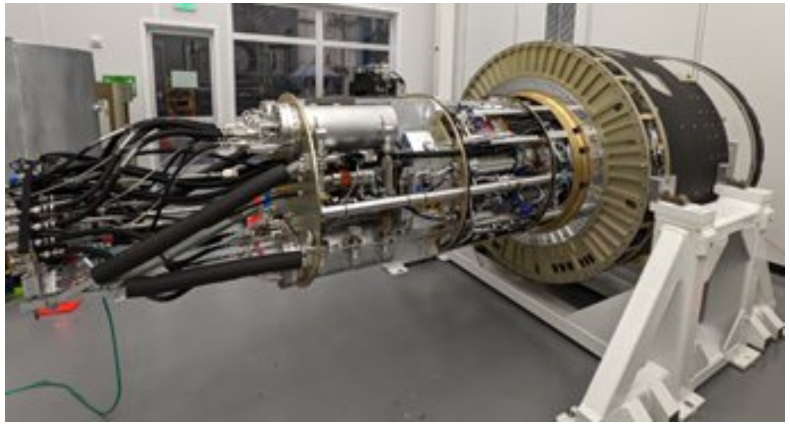
- Improve viewing angle constraints
- Shade the light on dark sirens

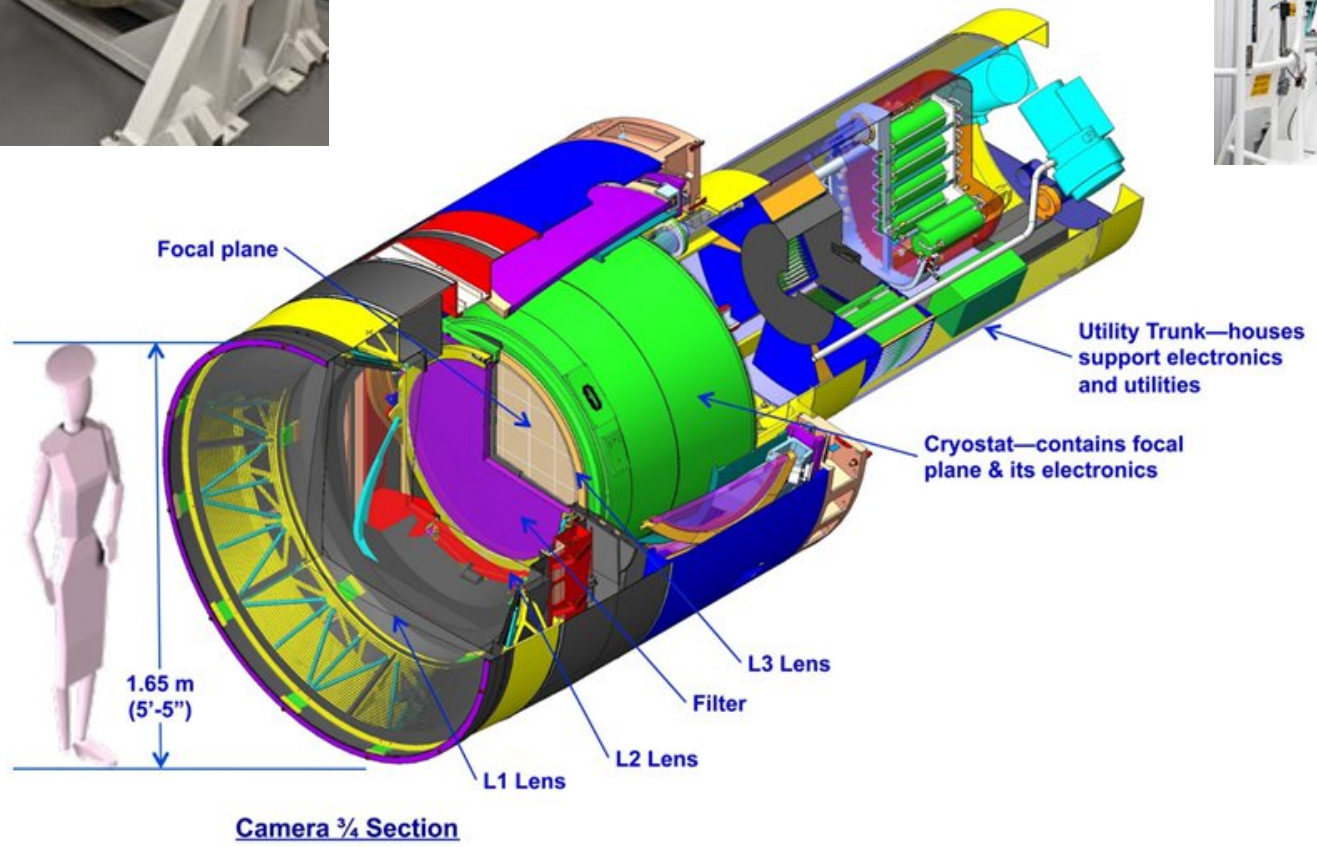


Rubin Early Science Data Release Scenario

Data Product	Jun 2021	Jun 2022	Jun 2023	Oct 2024 – Jul 2025	Nov 2025 – May 2026	May 2026 – Jan 2027	May 2027 – Jan 2028	May 2028 – Nov 2028
	DP0.1	**DP0.2**	**DP0.3**	**DP1**	**DP2**	**DR1**	**DR2**	**DR3**
	DC2 Simulated Sky Survey	**Reprocessed DC2 Survey**	**Solar System PPDB Simulation**	**ComCam or early LSSTCam Data**	**LSSTCam Science Validation Data**	**LSST First 6 Months Data**	**LSST Year 1 Data**	**LSST Year 2 Data**
Raw Images	●	●	–	●	●	●	●	●
DRP Processed Visit Images and Visit Catalogs	●	●	–	●	●	●	●	●
DRP Coadded Images	●	●	–	–	●	●	●	●
Object and ForcedSource Catalogs	●	●	–	–	●	●	●	●
DRP Difference Images and DIASources	–	●	–	–	●	●	●	●
DRP ForcedSource Catalogs including DIA output	–	●	–	–	●	●	●	●
PP Processed Visit Images	–	–	–	–	–	●	●	●
PP Difference Images	–	–	–	–	–	●	●	●
PP Catalogs	–	–	–	–	●	●	●	●
PP SSP Catalogs	–	–	●	–	●	●	●	●
DRP SSP Catalogs	–	–	–	–	–	●	●	●

TABLE 1: Summary of data products expected in each data preview and early survey data release.





Camera ¾ Section

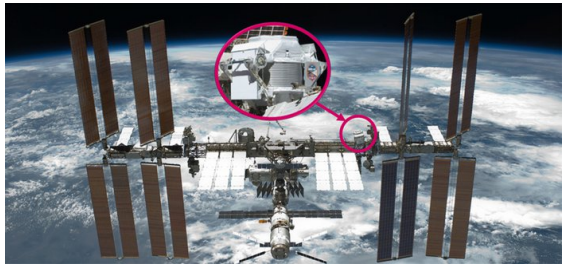
FTE (chargeur de filtre et CCOB)

	Qualité	Nom	Prénom	Catégorie	BAP	Quotité	ETP 2019 Total	ETP 2020 Total	ETP 2021 Total	ETP 2022 Total	ETP 2023 Total	ETP 2024 Total
16	M.	BOULY	Jean-Luc	IE	C	100.0	0.0	0.0	0.0	0.0	0	0
3	M.	DARGAUD	Guillaume	IR	E	100.0	20.0	20.0	20.0	20.0	3	2
19	M.	DE LAMBERTERIE	Pierre	IE	C	100.0	25.0	25.0	15.0	2.0	2	0
5	M.	ERAUD	Ludovic	IE	C	100.0	15.0	15.0	3.0	3.0	3	2
21	M.	FAURE	Remi	T	C	100.0	0.0	0.0	0.0	0.0	0	0
22	M.	FOMBARON	Dominique	T	C	100.0	0.0	0.0	0.0	0.0	0	0
7	M	KUSULJA	MILE	AI	C	100.0	0.0	60.0	60.0	40.0	40	15
8	M.	LAGORIO	Eric	IE	C	100.0	40.0	40.0	40.0	20.0	20	15
27	M.	MARTON	Marc	AI	C	100.0	20.0	8.0	8.0	8.0	8	0
28	M.	MENU	Johann	IE	C	100.0	0.0	0.0	0.0	0.0	0	0
12	Mme	MIGLIORE	Myriam	IR	C	100.0	70.0	70.0	30.0	30.0	5	2
31	M.	ODIEVRE	Yvan	T	C	100.0	10.0	15.0	0.0	0.0	0	0
32	M.	PERBET	Eric	T	C	80.0	60.0	50.0	20.0	0.0	0	0
36	M.	RONI	Samuel	T	C	100.0	15.0	15.0	5.0	0.0	0	0
38	M.	SCORDILIS	Jean-Pierre	T	C	100.0	35.0	35.0	20.0	0.0	0	0
39	M.	TOURBA	Emmanuel	T	C	100.0	10.0	10.0	0.0	0.0	0	0
40	M.	VESCOVI	Christophe	IR	C	100.0	20.0	20.0	0.0	0.0	0	0
15	M.	VEZZU	Francis	IR	C	100.0	70.0	70.0	70.0	50.0	50	20
42	Mme	VIVARGENT	Lucie	AI	C	100.0	20.0	20.0	5.0	0.0	0	0

Rayonnement cosmique galactique (RCG)

Analyse des données AMS-02 (L. Derome)
- Leader analyse flux de noyaux (jusqu'environ 2018)
- Leader sur analyses isotopiques (de Li, Be, et B)

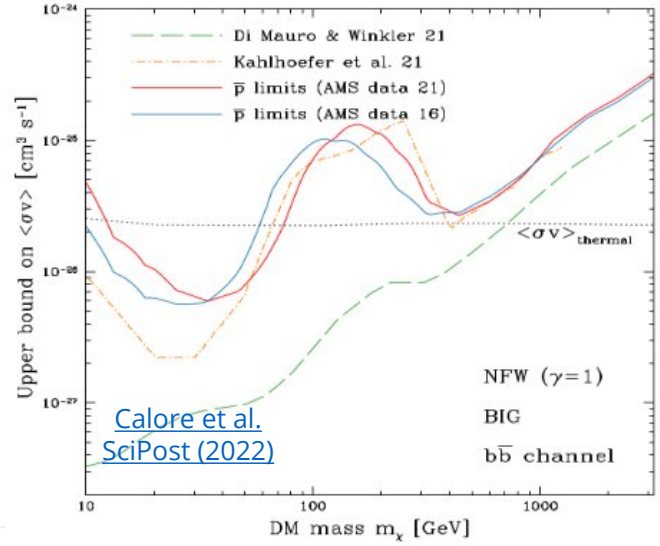
→ Activité résiduelle à partir de 2024



Collaboration ANR Micro (2020-2024) sur UHECR (J. Bregeon)

Interprétation des données AMS-02 (leader D. Maurin)
- *Collaboration multi-labos* (LAPP, LAPTh, LPSC, LUPM…)
  - Via PNHE et LabEx ENIGMASS
  - Via projet IN2P3 PHENOD (2016-2019)
- *10 publications et nombreux proceedings* (2019-2023)
  - Limites matière noire avec antiprotons
  - Évaluation temps de faisceau@NA61pour XS
- *16 stagiaires* L1-M2+Masterarbeit (2018-2023)

Activité en forte réduction



Outils publics pour la communauté (leader D. Maurin)
- *Code USINE* (propagation RCG) → 1 publi (2019)
- *CRDB* (base de données du RCG) → 3 publis (2014, 2020, 2023) avec support F. Melot (service info)

Dernier passage
au CS : 12/2016

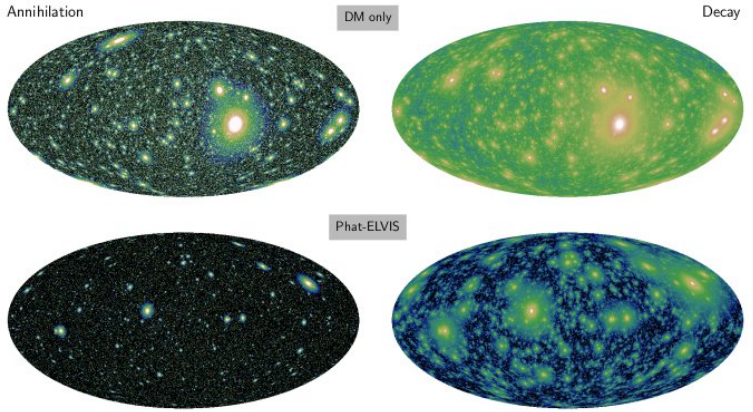
Détection indirecte de matière noire en γ et ν

Classification des cibles matière noire (pour Fermi-LAT et CTA)

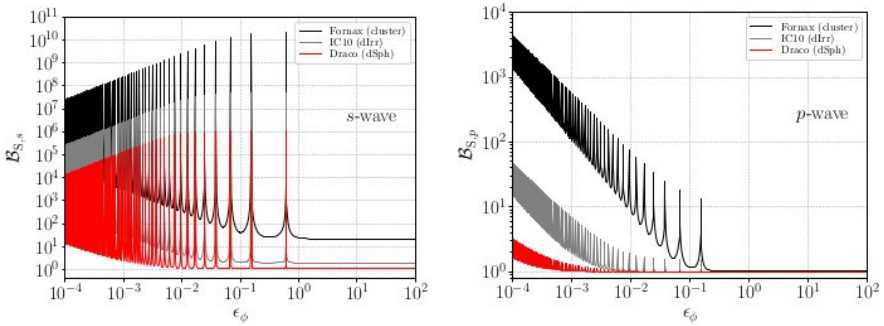
Cibles : halos sombres, dSphs, Voie Lactée, amas, diffus extragal.

Leaders : D. Maurin et C. Combet

- *Décroissance et annihilation (<σv> indépendant de v)*
  - Projet de longue haleine (2010-2020)
  - Collaboration LPSC/Allemagne/UK/US
- *Annihilation <σv> dépendant de v*
  - Projet plus récent (2020-2024?)
  - Collaboration LAPTh/LUPM/LPSC/Madrid



Hütten et al. JCAP (2019)



Lacroix et al JCAP (2022)

Outil public CLUMPY (calcul des signaux matière noire)

Leaders : D. Maurin et C. Combet

- *3 publications* (2012, 2016, 2019) → nouvelle "release" en prép.
- Utilisé (dans publis) par H.E.S.S., HAWC, Fermi-LAT, ANTARES… et aussi par théoriciens et astrophysiciens

Fin d'activité (?) après dernier release CLUMPY