

THE NANCY GRACE ROMAN SPACE TELESCOPE



Exploring the Dark
Universe With
Roman

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July 2026



Jet Propulsion Laboratory
California Institute of Technology

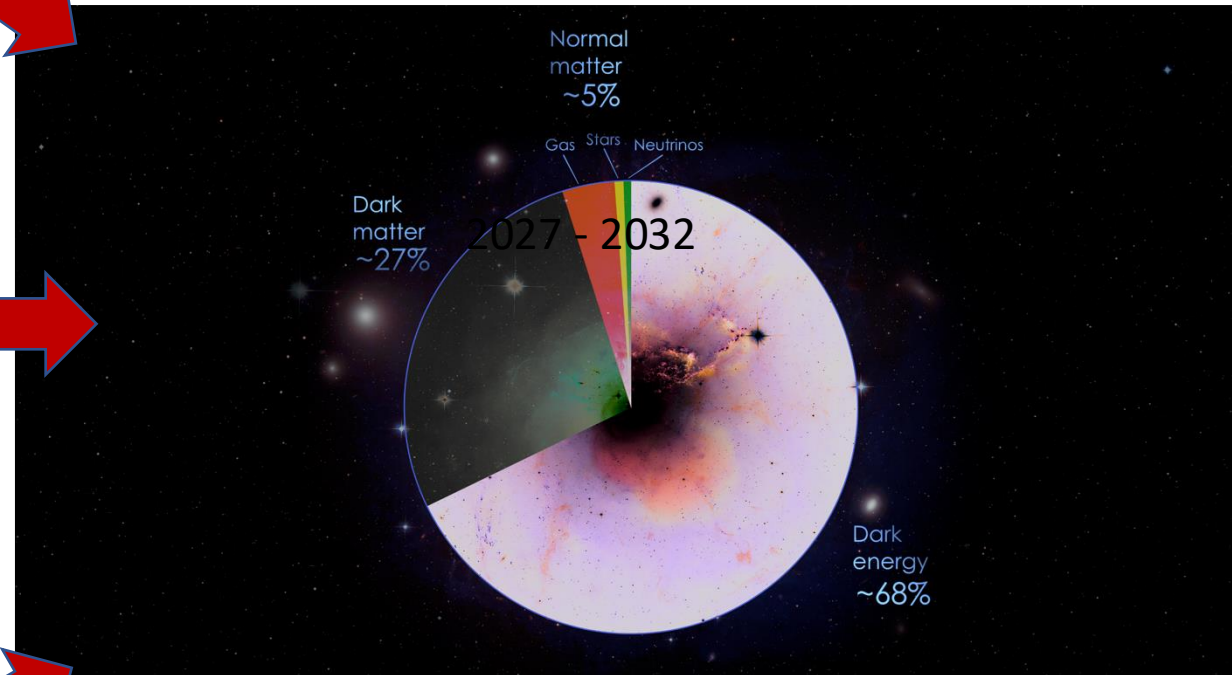
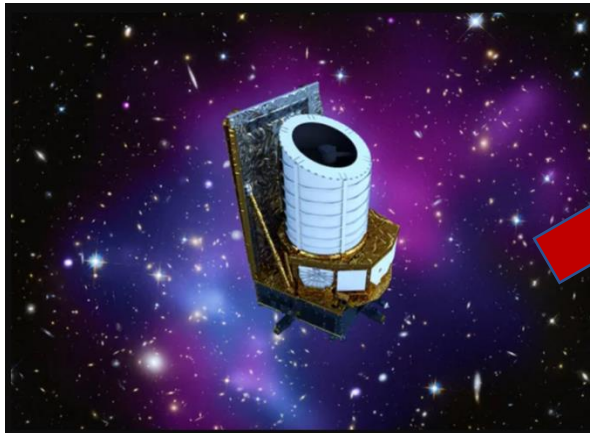
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The Golden Age!!



Proposed lifetime	2026 - 2036	2023 - 2030	2026 - 2032
Mirror size (m)	6.5 (effective diameter)	1.2	2.4
Survey size (sq deg)	~20,000	14,000	2200
Median z (WL)	0.9	0.9	1.2
Field of View (sq deg)	9.6	0.5 (Vis) 0.5 (NIR)	0.28
Mode	Photometry	Photometry/Grism	Photometry/Grism

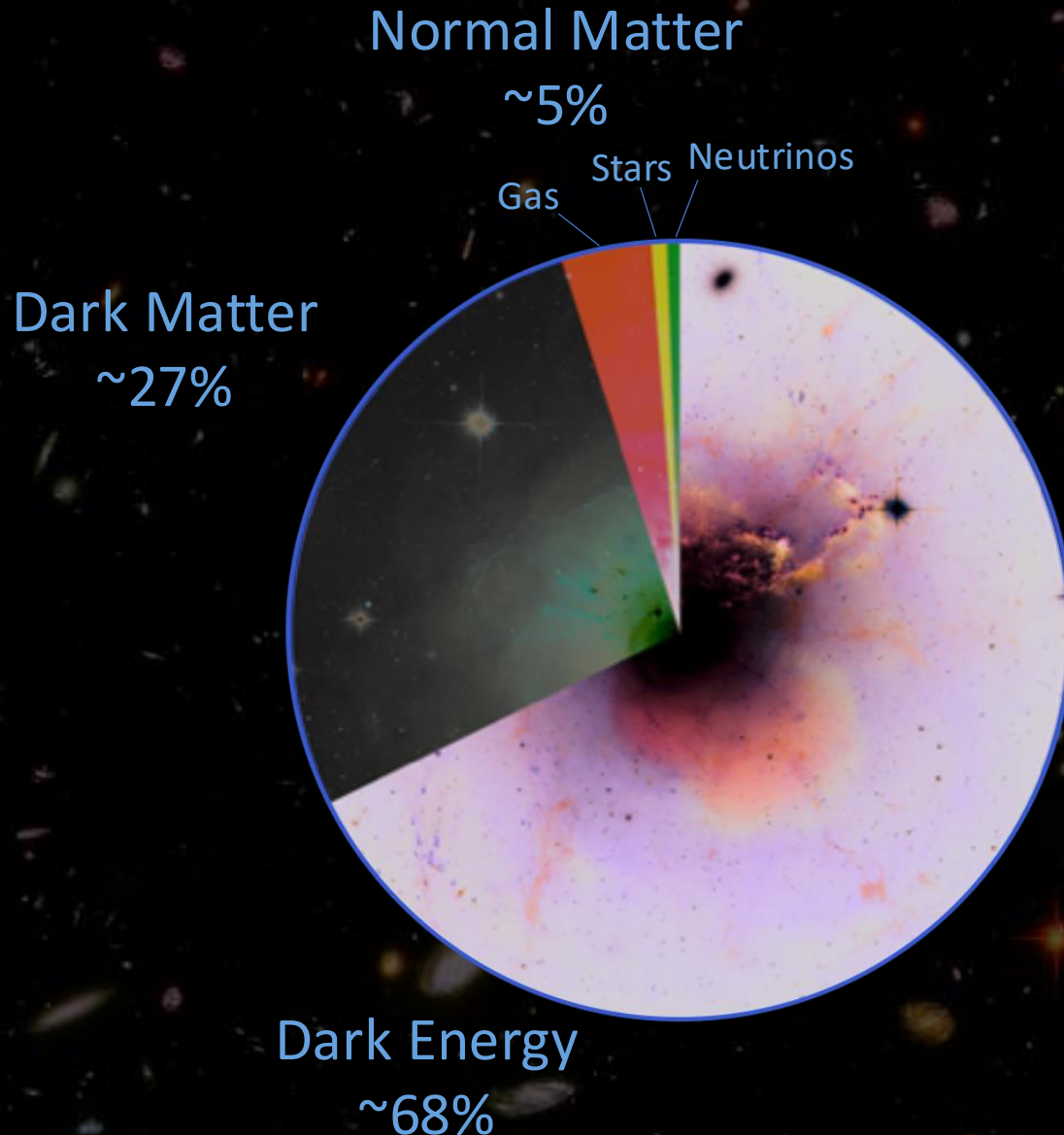
A Common Goal



- Dark Energy is a common design driver
- Current era energy experiments have **systematics control** as a primary concern
- All three will enable a wide breadth of science
- Some design requirements do not stem from dark energy (especially on Roman and Rubin)

Dark Energy is likely the most demanding use of these observatories

THE UNIVERSE AS A PIE CHART



Dark Energy equation of state

$$w \equiv \frac{P}{\rho} \approx -1$$

w_0 is the value now

w_a is the time evolution

- Λ CDM (Lambda-Cold Dark Matter)
- Standard model
- Cosmological constant Λ
- $w_0 = -1$ and $w_a = 0$
- Simplest model consistent with the data

PUSH-PULL: DARK ENERGY VS. DARK MATTER

Dark Energy



Is a

Affects
universe

Causes
expansion from everything else

Dark Matter



Affects

Affects

Causes
attraction toward one another

GRAVITATIONAL LENSING

If there is any intervening dark matter, light follows a **distorted path** (exaggerated here).

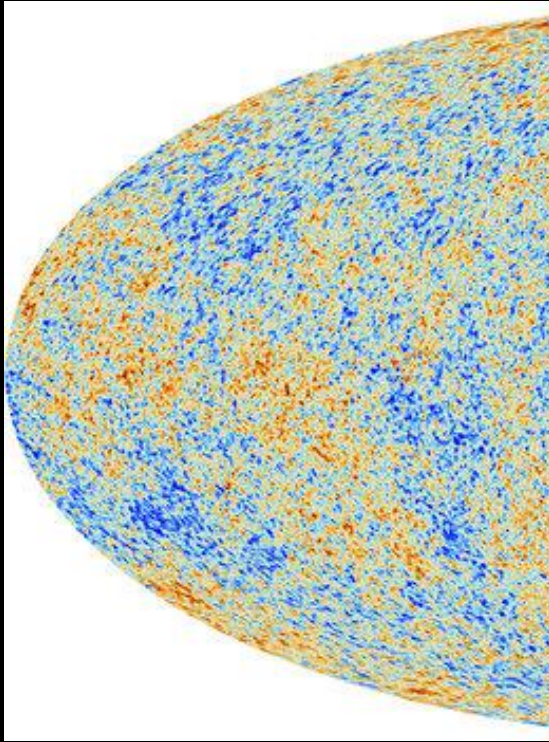


* Z is a measure of the object's distance from us

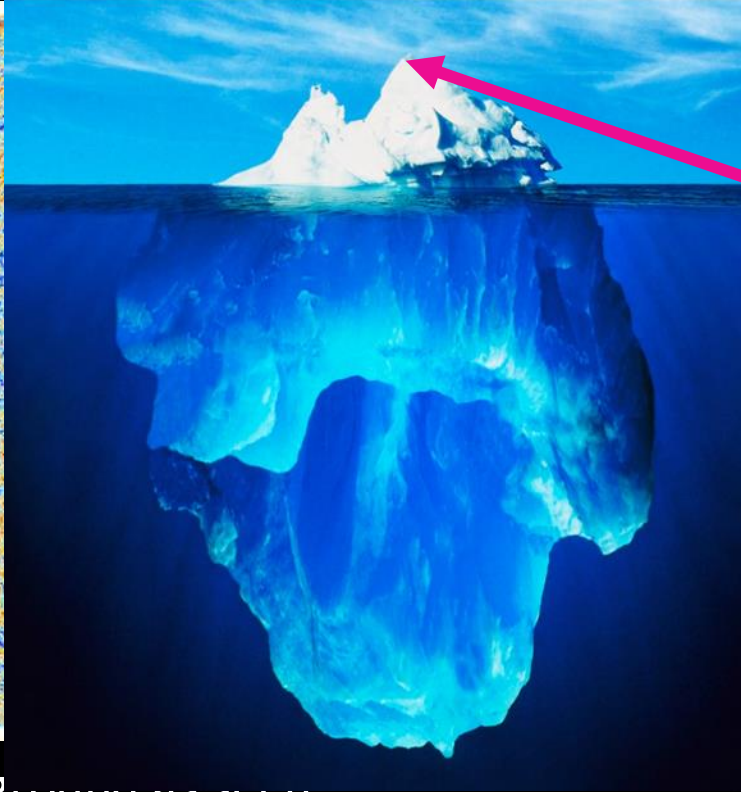
A PENNY IN THE POOL



THE GROWTH OF STRUCTURE

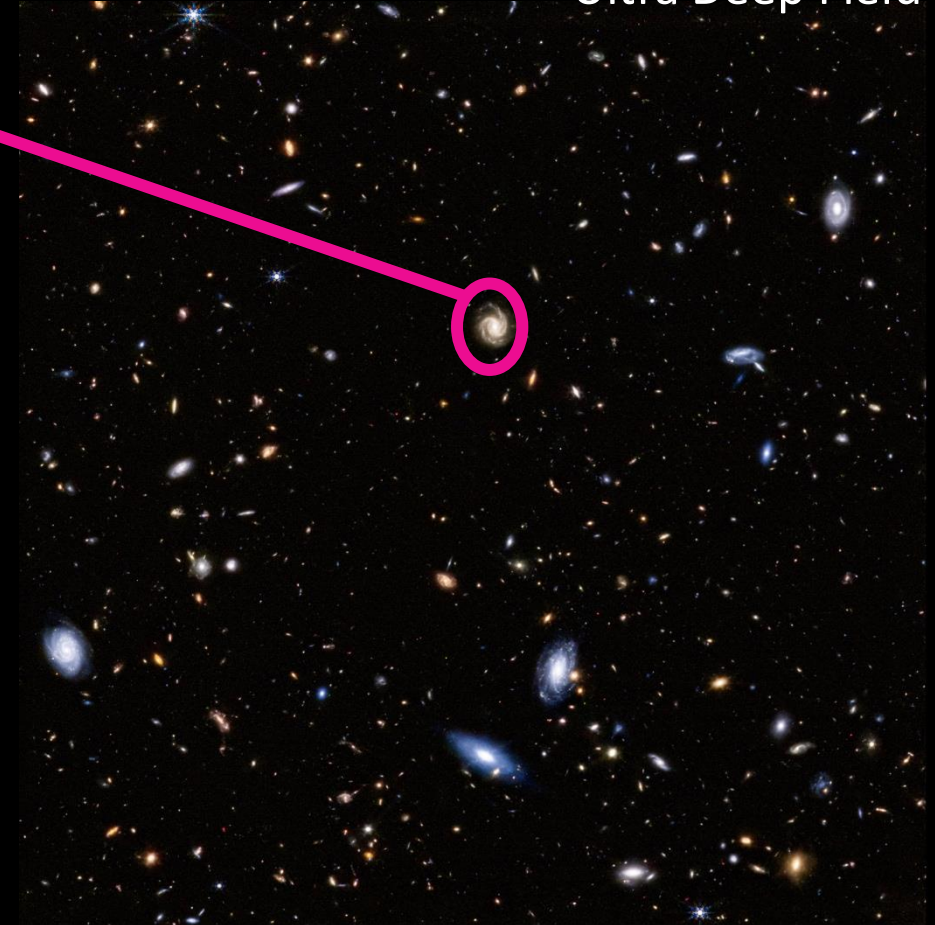


Cosmic Microwave Background as seen
by ESA's Planck satellite



Tip of the Iceberg © Ralph A. Clevenger/CORBIS (CC BY-NC 2.0)

Galaxies in a JWST image of the Hubble
Ultra Deep Field



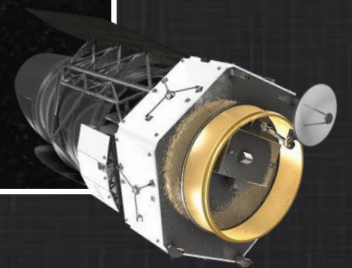
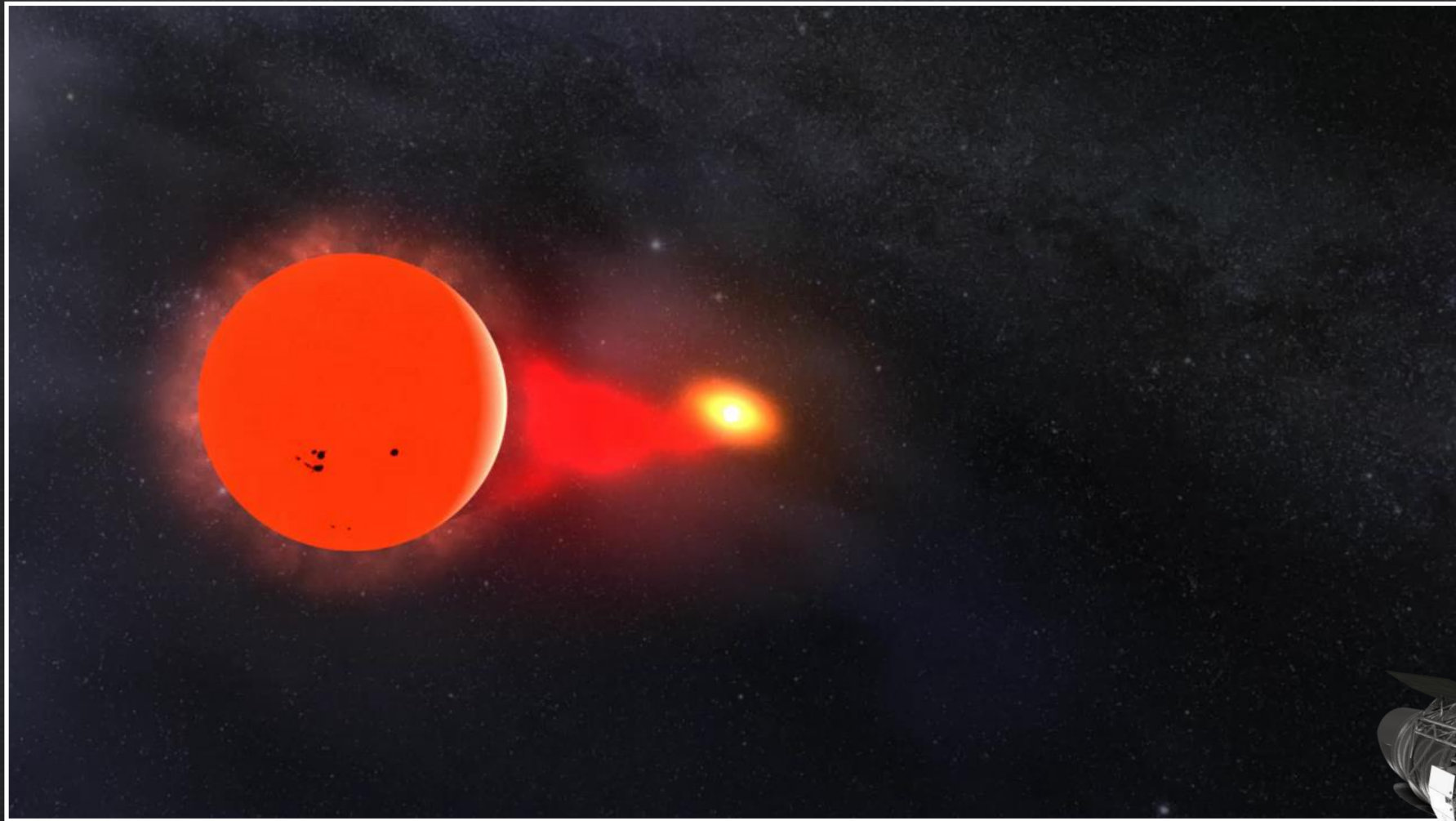
Credit: NASA, ESA, CSA, J. DePasquale (STScI).

Galaxy Clustering

map the positions of galaxies to establish a cosmic standard ruler to measure the Universe's expansion history

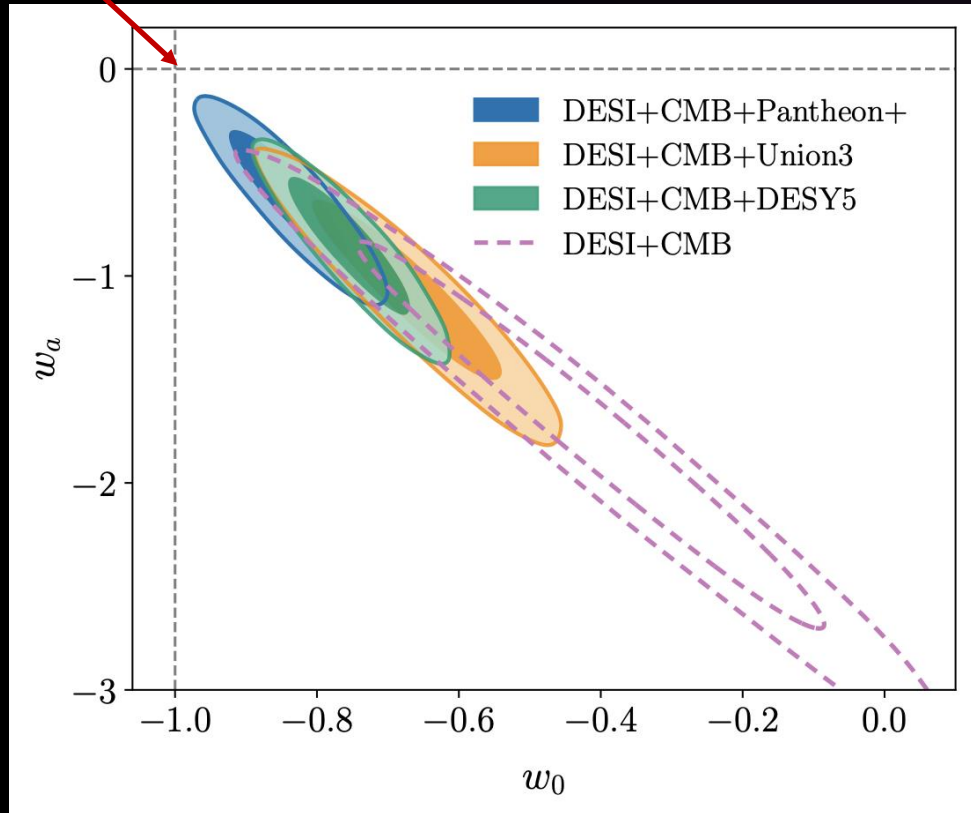
Roman will

discover exploding stars (supernovae) across cosmic time
to establish precise distances to galaxies

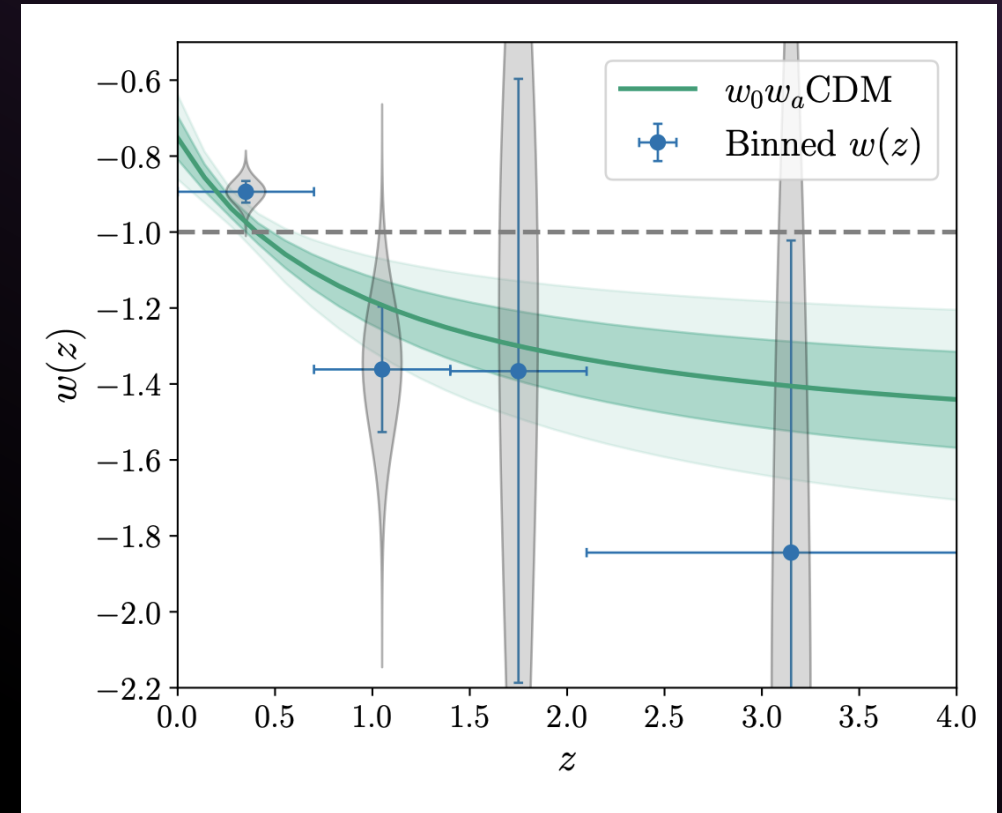


DESI results question Λ CDM

Cosmological constant Λ ($w_0=-1$, $w_a=0$)



arXiv:2503.14738



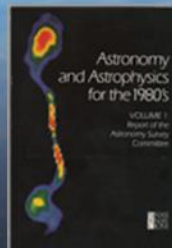
Question: What's the next logical step given the DESI results? Answer: Euclid, Roman, and Rubin

Astrophysics

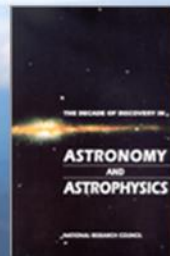
Decadal Survey Missions



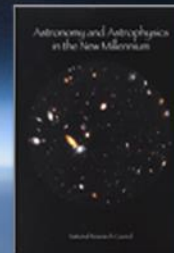
1972
Decadal Survey
Hubble



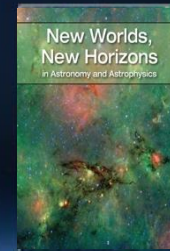
1982
Decadal Survey
Chandra



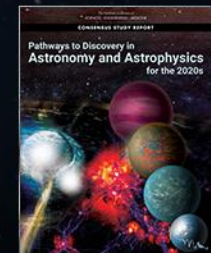
1991
Decadal Survey
Spitzer



2001
Decadal Survey
Webb

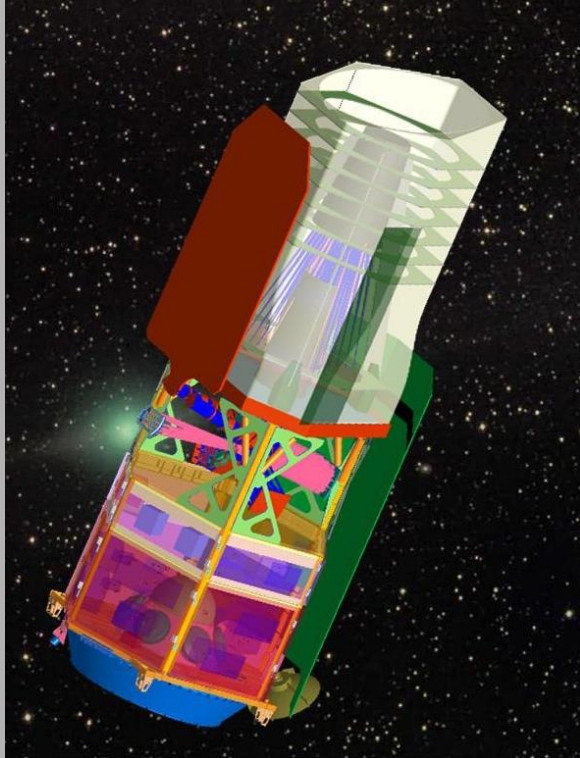


2010
Decadal Survey
Roman



2021
Decadal Survey
HWO

WFIRST =



JDEM-Ω

+



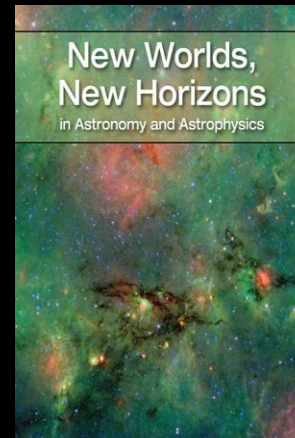
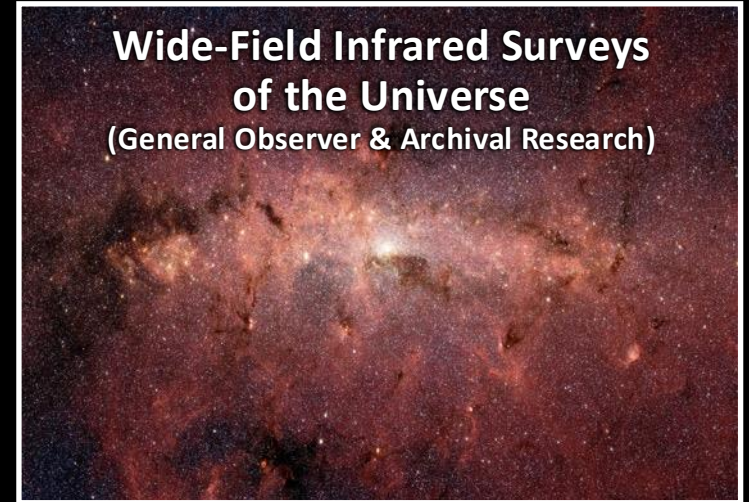
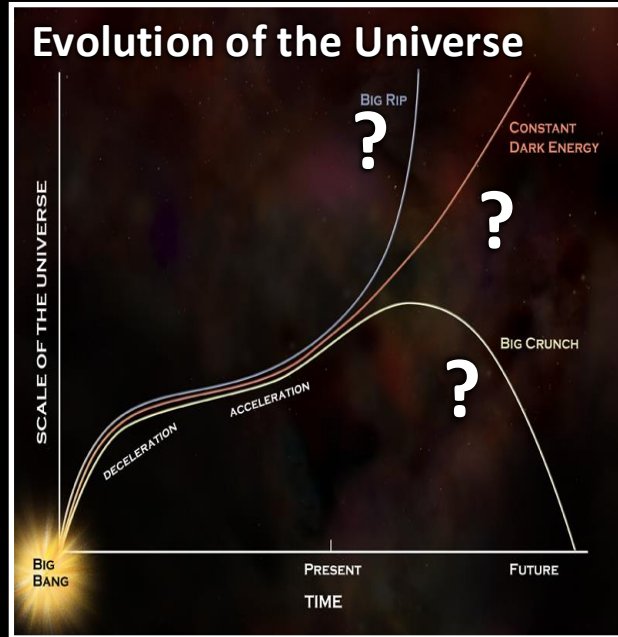
MPF

+

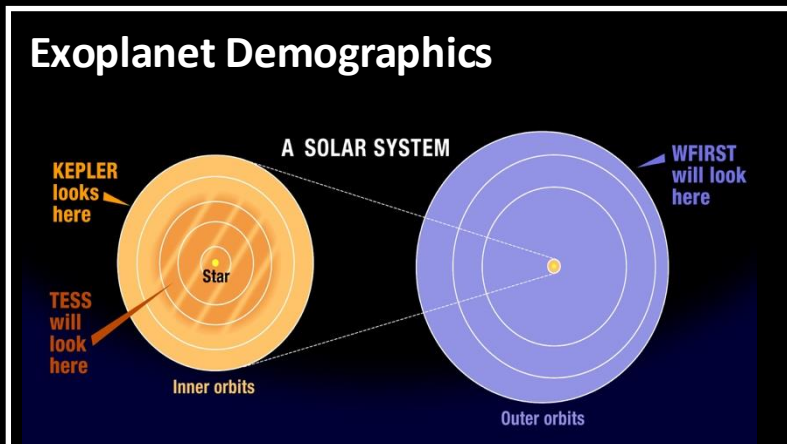


NIRSS

ROMAN SCIENTIFIC OBJECTIVES



National Academy of Sciences
Astronomy & Astrophysics
Decadal Survey (2010)



Nancy Grace Roman Space Telescope

- Named after NASA's first Chief Astronomer- 'the mother of Hubble'
- Born out of the 2010 Decadal Survey by combining 3 missions
- Budget and May 2027 launch date set at entry to Phase C in 2020
- *Ahead of schedule, under budget!*
 - *August 30 2026 is official launch date now*



- 2.4m primary mirror
- Two instruments:
 - Wide Field Instrument (WFI) for science
 - Coronagraph Instrument (Technology Demonstration)
- Will join Euclid @ L2
- 5 year primary mission (could be much longer)
- 75% defined surveys and coronagraph/25% guest observer surveys (open to anyone)
 - Cycle 1 proposals are in
- *No proprietary period on data!*



THE N

TELESCOPE

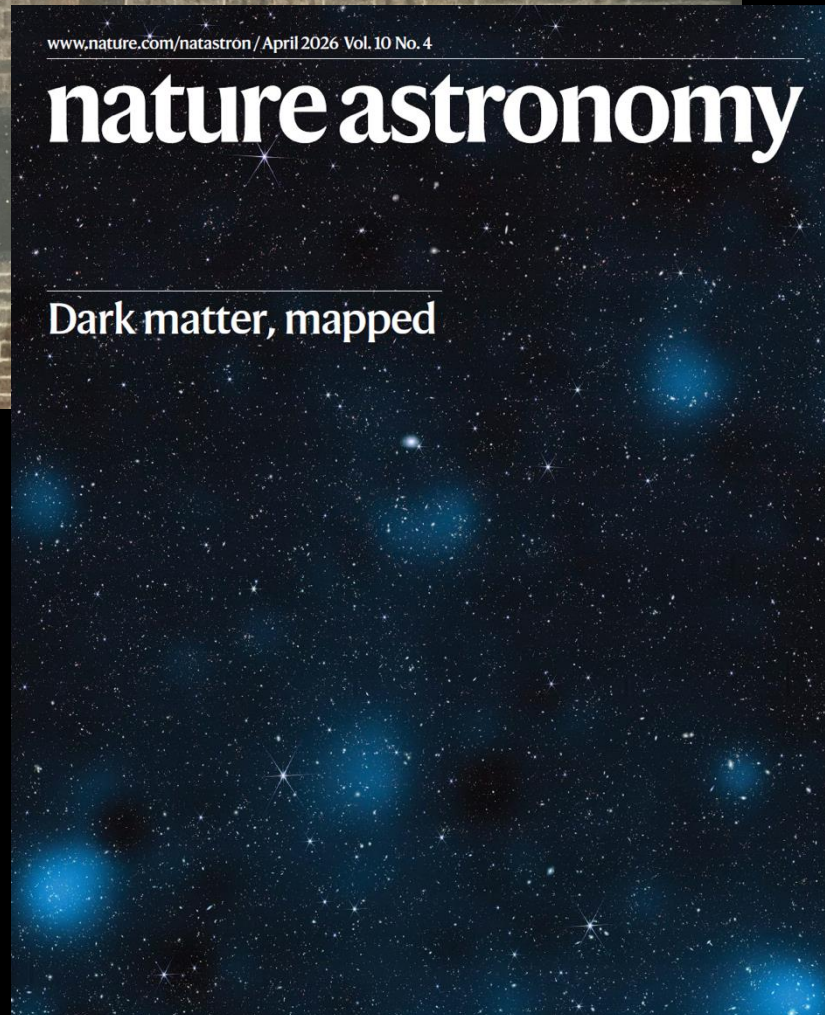
Field of View

roman.gsfc.nasa.gov

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WEAK LENSING COSMOLOGY



THINKING AT CALTECH - 2002



- I was a postdoc at NASA GSFC but spent the summer at Caltech
- 3 of us thinking deeply about weak lensing decided we needed a plan
- We were working with the Hubble Space Telescope but decided we wanted a telescope optimized for weak lensing

A PLAN FOR A TELESCOPE

Weak lensing from space I: instrumentation and survey strategy

Show affiliations Show all authors

Rhodes, Jason ; Refregier, Alexandre ; Massey, Richard  ; Albert, Justin ; Bacon, David ; Bernstein, Gary ; Ellis, Richard ; Jain, Bhuvnesh ; Kim, Alex ; Lampton, Mike ; McKay, Tim ; Akerlof, C. ; Aldering, G. ; Amanullah, R. ; Astier, P. ; Baltay, C. ; Barrelet, E. ; Bebek, C. ; Bergström, L. ; Bercovitz, J. ; ...

A wide-field space-based imaging telescope is necessary to fully exploit the technique of observing dark matter via weak gravitational lensing. This first paper in a three part series outlines the survey strategies and relevant instrumental parameters for such a mission. As a concrete example of hardware design, we consider the proposed Supernova/Acceleration Probe (SNAP). Using SNAP engineering models, we quantify the major contributions to this telescope's point spread function (PSF). These PSF contributions are relevant to any similar wide-field space telescope. We further show that the PSF of SNAP or a similar telescope will be smaller than current ground-based PSFs, and more isotropic and stable over time than the PSF of the Hubble Space Telescope. We outline survey strategies for two different regimes--a "wide" 300 square degree survey and a "deep" 15 square degree survey that will accomplish various weak lensing goals including statistical studies and dark matter mapping.

Publication: Astroparticle Physics, Volume 20, Issue 4, p. 377-389.

Pub Date: January 2004

DOI: [10.1016/j.astropartphys.2003.10.002](https://doi.org/10.1016/j.astropartphys.2003.10.002) 
[10.48550/arXiv.astro-ph/0304417](https://arxiv.org/abs/10.48550/arXiv.astro-ph/0304417) 

arXiv: [arXiv:astro-ph/0304417](https://arxiv.org/abs/astro-ph/0304417) 

Reprints: [2004 APS](#) [03-0775](#) 

- Took us 18 months to finally publish our ideas from summer 2002
- A telescope to study dark matter
- We started talking to space agencies about building it right away

PATH TOWARDS BIG SURVEYS

2002

2027



Dark Universe Explorer



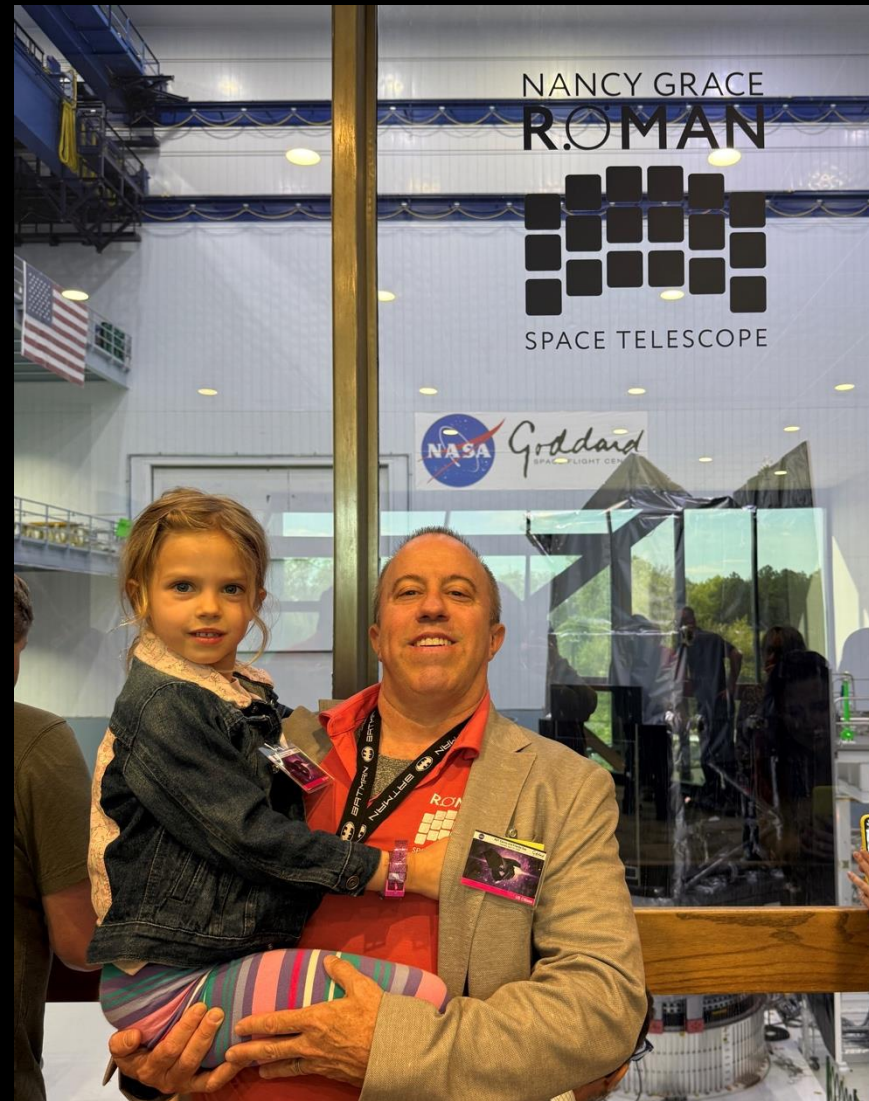
Vera C. Rubin
Observatory

A Golden Age of Survey Science

SAYING GOODBYE IN PERSON



Cannes, France in February 2023



NASA GSFC in April 2026



