NANCY GRACE ROMAN SPACE TELESCOPE

SCIENCE AND TECHNICAL OVERVIEW

SUMMER 2023

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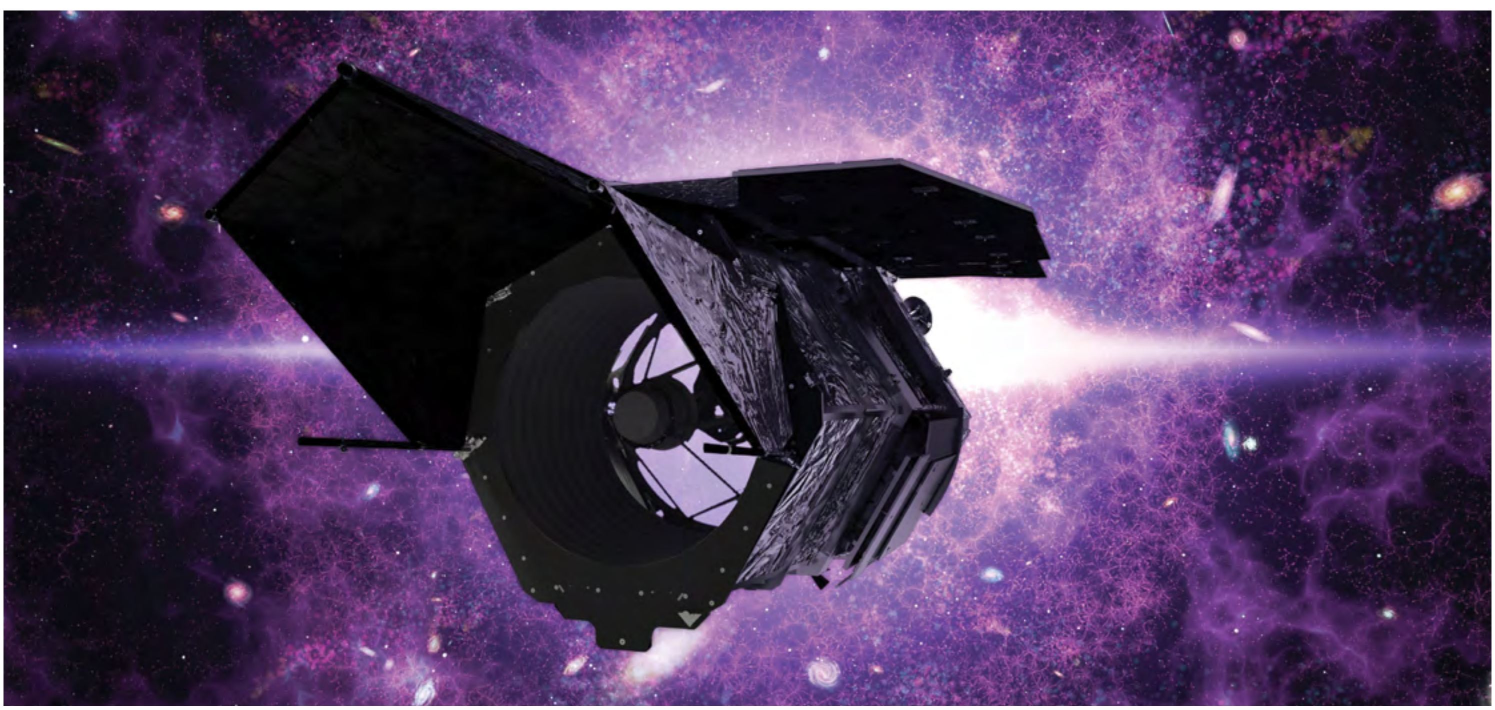


Credit: NASA's Goddard Space Flight Center

SET TO SURVEY THE SKY

RANKED AS THE HIGHEST SCIENTIFIC PRIORITY FOR A LARGE SPACE-BASED MISSION IN THE ASTRO2010 DECADAL SURVEY, THE NANCY GRACE ROMAN SPACE TELESCOPE WILL PLAY A PIVOTAL ROLE IN ASTROPHYSICS IN THE 2020s.

The Nancy Grace Roman Space Telescope, NASA's next great observatory, is designed to complement the capabilities of the Hubble and James Webb space telescopes and the next generation of large ground-based facilities such as the Rubin Observatory. Formerly known as the Wide Field Infrared Survey Telescope (WFIRST), the Roman Space Telescope is the first telescope to combine the high throughput and high-resolution imaging of NASA's flagship missions with the wide field of view of our most powerful ground-based surveys. Roman's Wide Field Instrument will provide Hubble-like resolution over a field of view 200 times greater than Hubble's infrared field of view, while its Coronagraph Instrument will be capable of suppressing starlight by nearly a billion to one. The mission is designed to enable cutting edge research across all areas of astrophysics, with all data nonproprietary and immediately available. Funding opportunities will be available for new observations and to support analysis of both core community science data and data collected through General Astrophysics Surveys. The Roman Project passed mission critical design review (CDR) in September 2021, and is currently planning for observatory launch in late 2026.

EXPAND
Your View

ROMAN WILL COLLECT HUBBLE-QUALITY DATA OVER A FIELD OF VIEW 200 TIMES GREATER THAN HUBBLE

The Roman Space Telescope will have the same sensitivity and resolution as NASA's Hubble Space Telescope. Each field of view will have a sub-arcsecond pixel scale on the 300-million-pixel camera. Roman's Wide Field Instrument (WFI) will operate in the 0.48–2.3 micron range, and will include eight imaging filters and a grism and prism for spectroscopy.

The observatory will survey thousands of degrees of the sky, producing contiguous data sets at incredible speeds. This amount of data will redefine how we understand the cosmos, providing an unrivaled clarity into populations, environments, evolution, and demographics across the field of astrophysics.

EXPLORE
All of
Astrophysics

ROMAN DATA WILL ENRICH ALL AREAS OF ASTROPHYSICS

The abundance of data from Roman will enable researchers to pursue their areas of expertise with ease. The mission will enable studies of nearly every class of astronomical object, phenomenon, and environment across the observable universe, including:

- Planets by the thousands
- Galaxies by the millions
- Stars by the billions
- Cosmology and fundamental physics

The majority of Roman's five-year prime mission will be devoted to three planned Core Community Surveys: the High Latitude Wide Area Survey (imaging and spectroscopy); the High Latitude Time Domain Survey; and the Galactic Bulge Time Domain Survey. While designed specifically for studies of dark energy and exoplanets, these surveys will provide a wealth of data to enrich all areas of astrophysics. The Core Community Surveys are being defined by the broader astronomical community through an open, community-oriented process.

Approximately 25% of Roman's time will be dedicated to new observations with additional funding opportunities to support analysis of both core community science data and data collected through General Astrophysics Surveys. These competed General Astrophysics Surveys will reveal new details about everything from our solar system to the edge of the observable universe.

DEMOCRATIZE
Data Access

THE ROMAN MISSION WILL PROVIDE OPEN ACCESS TO DATA AND TOOLS

All data collected by Roman—from General Astrophysics Surveys as well as Core Community Surveys—will be nonproprietary and available to all via the Mikulski Archive for Space Telescopes (MAST). To support data analysis, the mission will release cloud-based data products, including stacks, dithers, and mosaics, in addition to catalogs and other high-level science products. These assets will make it easy to access and analyze parallel, contiguous, homogeneous—and huge—data sets. The Roman mission will also partner with the astronomical community to create and release open-source data reduction and analysis tools.

The mission will fund programs to support researchers using the survey data to explore all facets of astrophysics. Compared to other missions, including Hubble, a larger portion of Roman's science funding will be dedicated to supporting analysis of both core community science data and data collected through General Astrophysics Surveys.

COMPLEMENT
Other Observatories

ROMAN DATA WILL ADD DEPTH AND BREADTH TO YOUR RESEARCH

The Roman Space Telescope will provide a unique window into astrophysics phenomena that complements other current and future space- and ground-based observatories. Roman will build on the work of other observatories, including:

- The Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST) by gathering high-resolution near-infrared images of large portions of the sky
- NASA's Hubble (HST) and James Webb (JWST) space telescopes by identifying targets for follow-up imaging and spectroscopy
- NASA's Kepler missions and Transiting Exoplanet Survey Satellite (TESS) by providing detections of cool and small exoplanets through microlensing

PROPEL
Future Discoveries

ROMAN'S INSTRUMENTS WILL HELP PAVE THE WAY FOR FUTURE OBSERVATORIES

Roman was ranked as the highest scientific priority for a large space astrophysics mission in the Astro2010 Decadal Survey. Its Wide Field Instrument (WFI) will address the science of dark energy, exoplanets, and general astrophysics. Its Coronagraph Instrument will conduct a technology demonstration and, depending on its performance, may contribute to our understanding of planets and circumstellar disks around carefully selected stars. This demonstration will also pave the way for large space-based missions discussed in the Astro2020 Decadal Survey, helping scientists develop instruments that will directly image Earth-like exoplanets.

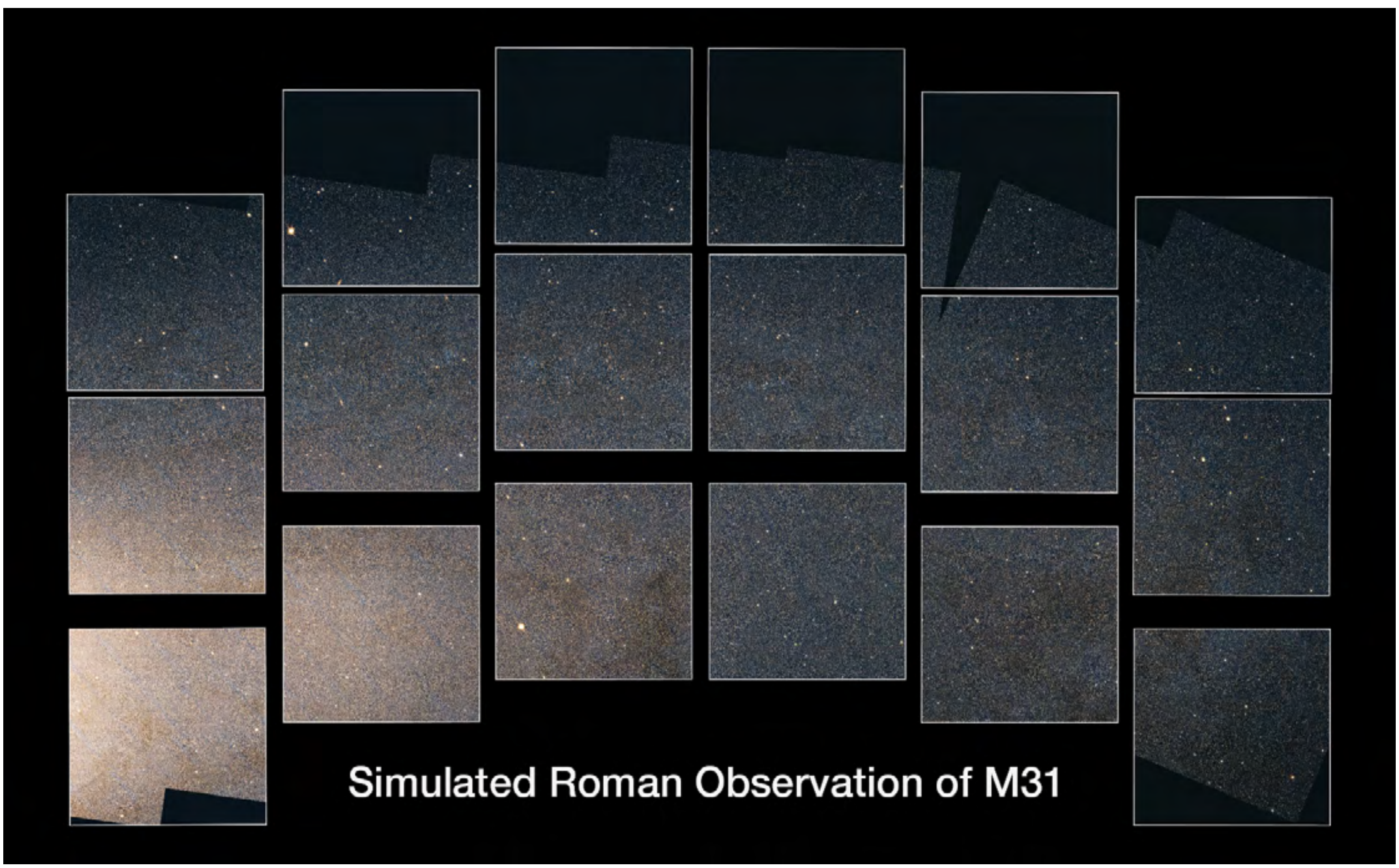
SCIENCE WITH ROMAN

A NEW NASA FACILITY FOR THE ENTIRE ASTRONOMICAL COMMUNITY

Roman's unprecedented ability to survey vast swaths of the sky at high resolution and efficiency in the near-infrared will support investigations across nearly all areas of astrophysics, from Solar System studies to cosmology. Potential science programs with Roman include:

- Surveying planets and small bodies in the Solar System
- Establishing the census of "cold" exoplanets
- Directly imaging and characterizing faint exoplanets and disks
- Mapping the history of galaxy evolution over cosmic time
- Understanding the fossil record of galaxy formation
- Characterizing the epoch of reionization
- Measuring the history of dark energy in the Universe

Science with Roman will be made possible through a set of Core Community Surveys and a General Astrophysics Survey program, with funding opportunities for both new observations and analysis of those survey data. Performance estimates provided in this science and technology overview are based on the current notional survey design and are intended to represent what to expect from the final survey design. The specific implementation of the Core Community Surveys is community driven. All proposed programs for new observing time, as well as associated funding, will be competed and selected through peer review. All cloud-hosted data will be available to the public with no period of limited access. Scientists will be able to interact with Roman data through a dedicated science platform.



Simulated Roman image of a portion of the Andromeda galaxy showing the 0.28-square-degree field of view and unique footprint of Roman's Wide Field Instrument. Image made using data from the Panchromatic Hubble Andromeda Treasury Program. Credit: NASA, STScI, and B.F. Williams, University of Washington

CORE COMMUNITY SURVEYS

Approximately 75% of Roman's five-year nominal mission will be devoted to a set of Core Community Surveys. While these surveys will be optimized for studies of dark energy and exoplanets, the data collected will be useful for a wide variety of studies in cosmology, planetary and exoplanetary science, stellar populations, and galactic evolution. Possible survey implementations as defined in the design reference mission are presented below. The specific details of the surveys are being determined through a community process.

HIGH LATITUDE WIDE AREA SURVEY

A High Latitude Wide Area Survey is currently planned to include imaging in four bands spanning 1–2 microns at magnitude 26.5 and grism spectroscopy, covering approximately 2000 square degrees. The survey will be optimized for studies of dark energy, cosmic lensing, high redshift galaxies, and galactic halo substructure in nearby galaxies.

HIGH LATITUDE TIME DOMAIN SURVEY

A High Latitude Time Domain Survey is planned to include high-cadence imaging (every ~5 days) and slitless spectroscopy potentially over several ~10 square-degree fields at 28–29th magnitude. The survey will be optimized for supernovae discoveries ($z < 1.7$) and light curve characterization, and will also support galaxy evolution studies.

GALACTIC BULGE TIME DOMAIN SURVEY

A Galactic Bulge Time Domain Survey is planned to include high-cadence imaging (~ every 15 min) of a total of 2.2 square degrees of the Milky Way bulge. The survey will be optimized for a census of exoplanets and free-floating planets, and will support studies of stellar populations in the Milky Way as well as structure of the Galaxy.

GENERAL ASTROPHYSICS SURVEYS

Approximately 25% of Roman's five-year nominal mission will be devoted to General Astrophysics Surveys chosen through a competed peer-review process. Funding will also be available for research that uses archival data from the Core Community and General Astrophysics Surveys, all of which will be available via the Mikulski Archives for Space Telescopes (MAST) for immediate use.

RESEARCH AND SUPPORT PARTICIPATION OPPORTUNITIES

The Nancy Grace Roman Space Telescope Research and Support Opportunities is a program element in the Research Opportunities in Space and Earth Sciences (ROSES) 2022 announcement by NASA's Science Mission Directorate (SMD). Proposals related to this Program Element are aimed at supporting Roman progress and exploiting the scientific and technical data from Roman.

This solicitation represents a tripartite opportunity to provide for participation of the astrophysics community in the Roman mission through the categories of:

- Wide Field Science for investigations spanning a broad range of science preparation efforts with WFI
- Project Infrastructure Teams for the development of scientific infrastructure needed to enable science goals that are part of mission's success criteria
- Coronagraph Community Participation to work in collaboration with the coronagraph team in addressing the set of requirements and objectives associated with an in-space technology demonstration of a high-contrast coronagraph

As of May 2023, proposals have been submitted and are in review.

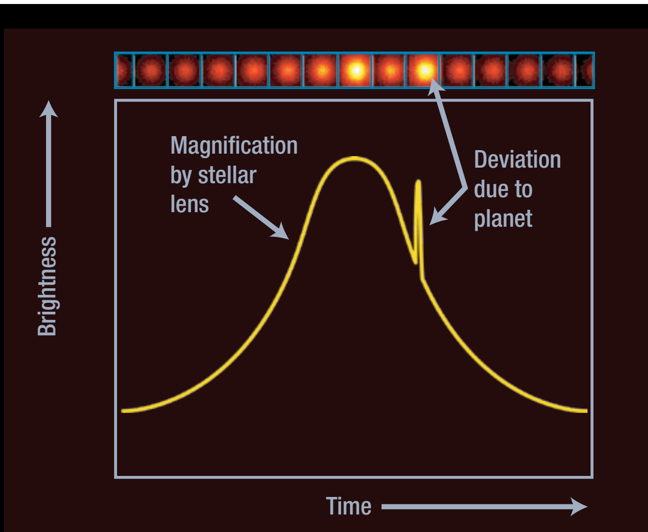
PLANETS BY THE THOUSANDS

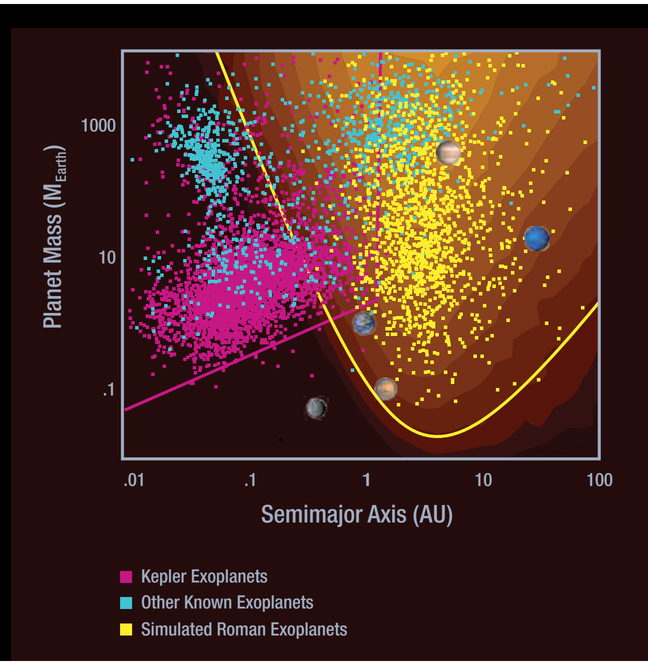
With its ability to repeatedly survey vast swaths of the sky with unprecedented photometric and astrometric precision, NASA's Nancy Grace Roman Space Telescope will have the power to detect thousands of planetary bodies in the Milky Way, filling significant gaps in our understanding of the demographics of both exoplanets and small bodies in our own solar system. At the same time, Roman's high-contrast direct imaging demonstration will provide the necessary technical bridge to achieve coronagraphic performances required to confidently image Earth-like exoplanets in the future.

MICROLENSING DETECTION OF EXOPLANETS

The combination of high spatial resolution, high photometric precision, wide field of view, and extreme stability provided by Roman's Wide Field Instrument (WFI) will enable collection of hundreds of millions of precise light curves needed to detect tens of thousands of microlensing events, expanding our ability to detect cold low-mass exoplanets beyond 1 AU, and providing the large data set needed to test theories of planet formation and evolution. Roman's WFI will provide:

- A planned Galactic Bulge Time Domain Survey potentially covering 7 or more contiguous fields with a total area of ~2 deg^2
    - ◊ Repeated observations over at least 6 seasons (60–72 days/season) at cadences of ~15 min
    - ◊ Total survey time of >370 days over Roman's 5-year nominal mission
- Infrared sensitivity (1–2 μm) and high angular resolution (~0.1") needed to see through dust and resolve main sequence stars in the Galactic bulge
- Detection of >50 million stars at S/N ~100 down to H_{AB} = 21.4 mag
- Ability to detect microlensing events caused by objects with masses as low as ~0.025 $M_\oplus$ (~Ganymede)
- Estimated detection of ~1400 bound planets with a mass >0.1 $M_\oplus$ (including ~200 planets <3 $M_\oplus$ and a > 1 AU) and several hundred free-floating planets
- High-precision astrometry (3–10 μas) providing parallaxes and proper motions for more than 100 million stars
- Ability to calculate planetary masses using a combination of microlensing and precise measurements of astrometric shift of the lensed star
- Contemporaneous observations of fields with Rubin and other ground-based observatories at 1.5 × 10^6 km separation, making it possible to measure distances to planetary systems
- Open access to archived data for research into other lensing objects, such as white dwarfs, neutron stars, and stellar mass black holes



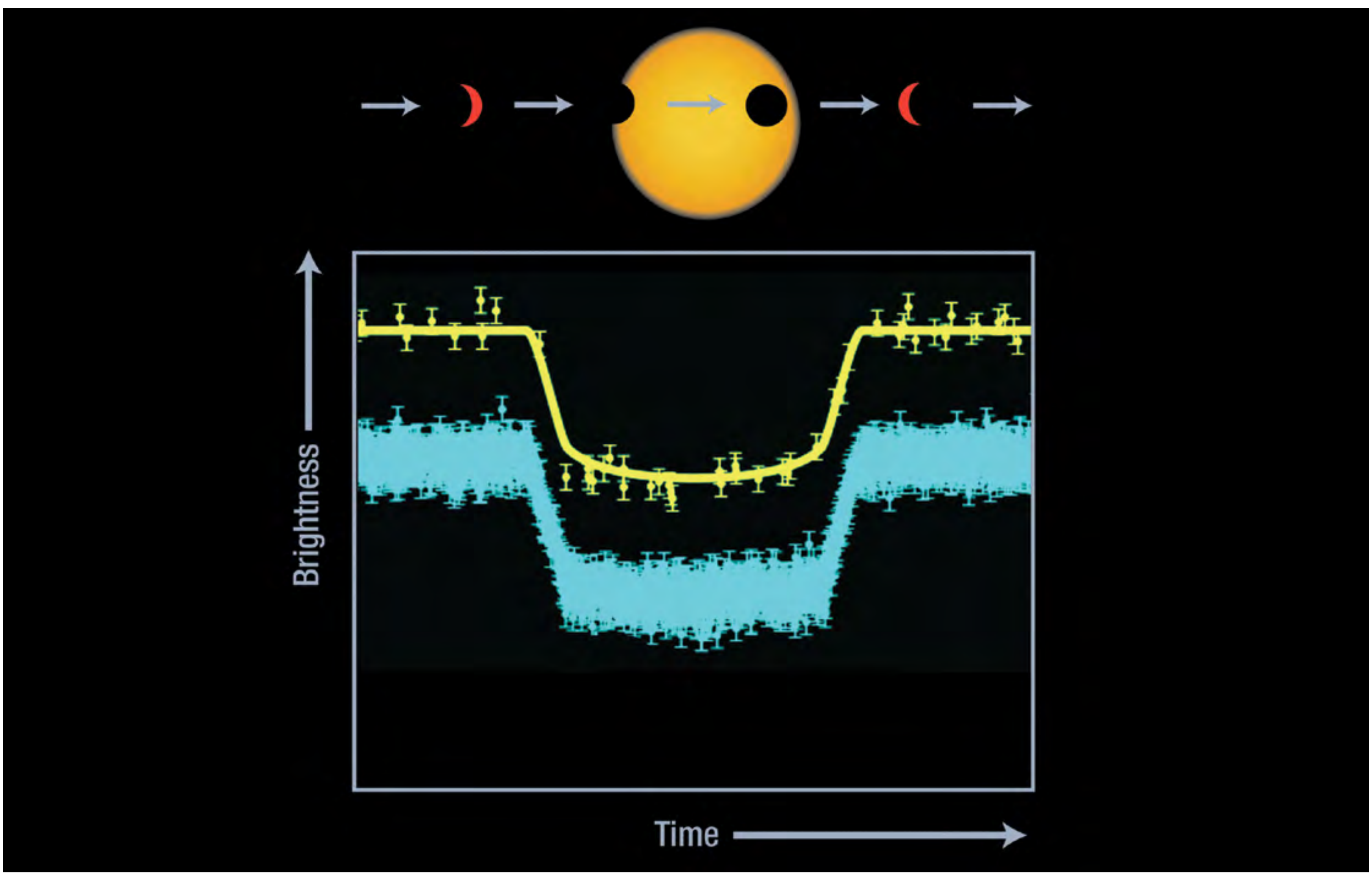


(Left) Illustrated time series and light curve of a star lensed by a foreground star and its planet. (Right) Potential exoplanet mass/orbit discovery space filled by Roman microlensing observations; contours correlate to detection rates, with lighter shades for higher detection rates. Credit: NASA, ESA, A. Feild, STScI; Penny et al. 2019, ApJS, 241, 3

TRANSIT DETECTION OF EXOPLANETS

The precise light curves and relative parallax data collected for hundreds of millions of stars will enable the transit detection of more than 100,000 short-period planets deep into the Galactic bulge, significantly increasing the exoplanet discovery space and providing the big data necessary to understand how planetary systems vary with environment. Roman's WFI will provide:

- Open access to all data products generated during planned Galactic Bulge Time Domain Survey potentially covering ~2 deg^2 with ~15 min cadence over at least 6 seasons of 60–72 days/season
- High precision time-series photometry for >50 million stars (H_{AB} < 21.4 mag), including ~15 million Sun-like stars
- High-precision astrometry (3–10 µas) providing relative parallaxes and proper motions of host stars deep into the Galactic bulge
    - ◊ Ability to calculate distances based on correlations to absolute parallax data from Gaia
- Transit detection of an estimated 100,000 planets with R > 2 $R_\oplus$ to distances >10 kpc
- Detection of several thousand hot Jupiters via secondary eclipse observations, with IR sensitivity needed for studies of atmospheric properties
- Large number statistics needed for demographic studies of exoplanets in the disk and bulge, and studies of planet formation as a function of star metallicity
    - ◊ Detections complementing discoveries of exoplanets in nearby regions of the Milky Way by Kepler and TESS
- Repeated surveys over the five-year nominal mission, enabling detection of non-transiting planets via gravitational perturbations of transiting planets in their system



Simulated Roman transit photometry over the full mission (six seasons) for a hot Jupiter with a 3-day orbit around a Sun-like star with F146 mag = 15; top curve: F087 bandpass; bottom: F146 bandpass. Credit: Montet et al. 2017, PASP, 129, 044401

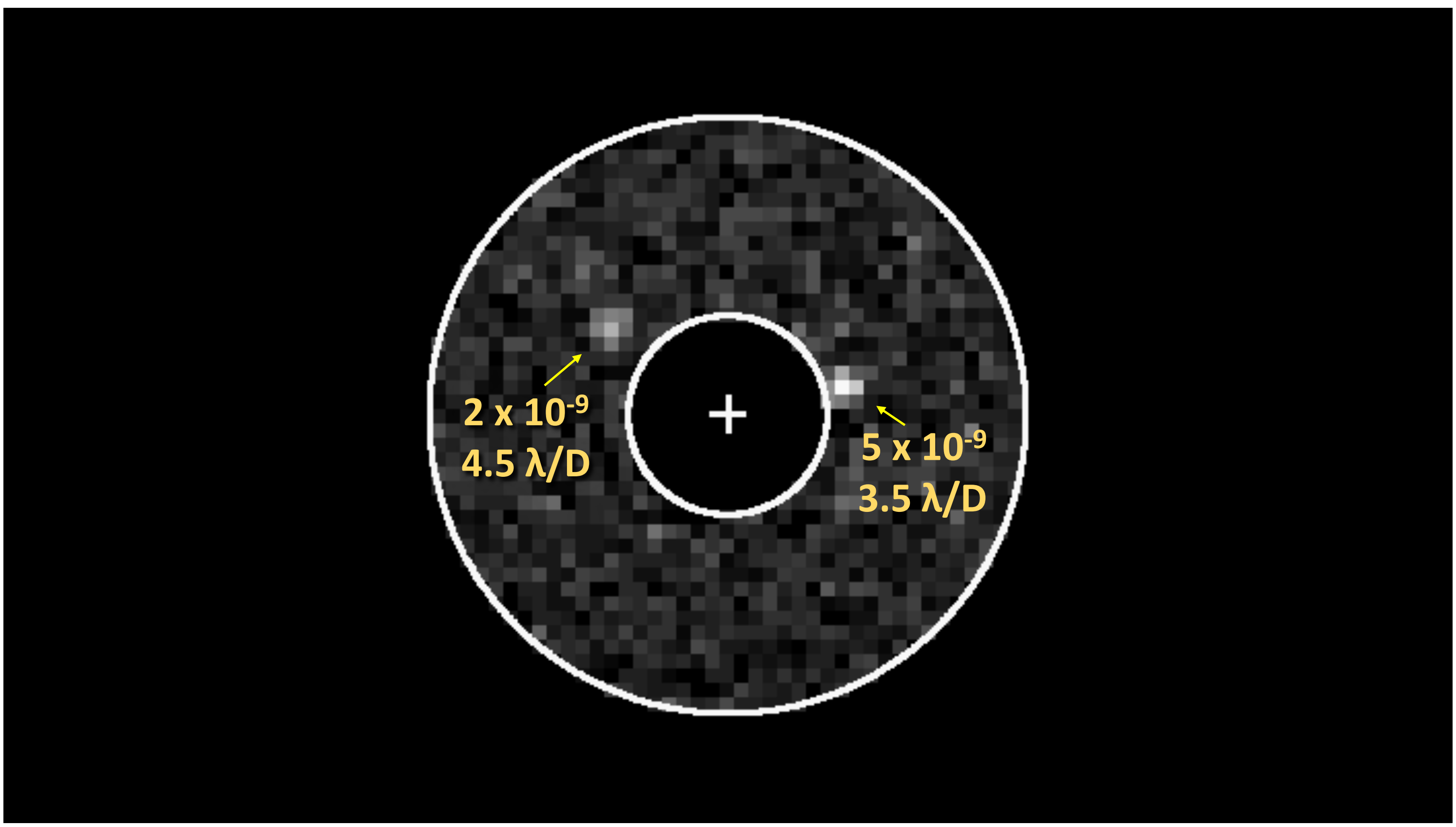
HIGH CONTRAST IMAGING DEMONSTRATION

The Roman Coronagraph Instrument will serve as a technological bridge between current space- and ground-based direct imaging technologies and the starlight suppression required to image Earth-like exoplanets around Sun-like stars with the next generation of space telescopes (~10^{10}). Roman's direct imaging technology demonstration will consist of:

- First space demonstration of low noise photon-counting EMCCD detectors, large-format deformable mirrors, and high-order active wavefront sensing and control
- ~Three months of observation time to meet the technology demonstration requirement, with the opportunity to tackle additional goals as time permits
    - ◊ Requirement: Successfully demonstrate the capability of the Roman Coronagraph Instrument to measure the brightness of a point source with S/N > 5 located 6–9 λ/D (0.3–0.5") from a star of $V_{AB} \leqslant 5$ mag, and flux ratio of at least 10^{-7} in its 0.575-μm Hybrid Lyot Coronagraph photometric configuration

Additional goals include:

- Target star (V < 7 mag) light suppression of 10^8 (10× greater than technical requirement)
- Ability to resolve objects with 0.15–1.5'' separation
- Observations in additional filters, including direct imaging in 0.825 μm and spectroscopy in 0.660 and 0.730 μm
- Capturing the first reflected visible-light images of mature Jupiter analogs and exozodiacal dust disks around Sun-like stars
- Polarimetry to observe and infer properties of debris disks (0.575 and 0.825 μm)
- Obtaining R ~ 50 single-slit spectra for characterization of mature Jupiter analogs and self-luminous young Jupiters using Shaped Pupil Coronagraph (0.730 μm)
- Repeated observations, combined with radial velocity measurements of host stars from ground-based observatories, for precise astrometric measurements and calculations of planetary orbits, inclinations, and dynamical masses



Simulated Roman Hybrid Lyot Coronagraph image of reflected visible light (0.575 μm) from two exoplanets orbiting a G1V star (V = 5 mag); labels indicate planet-to-star flux ratio and angular separation. Credit: Krist 2022, Observing Scenario 11

SURVEYING SMALL BODIES IN THE SOLAR SYSTEM

Roman's ability to survey wide fields repeatedly with extreme stability and efficiency over short periods of time will provide access to new areas and depths of the sky, making it possible to detect and map the distribution of small bodies throughout the Solar System to build a more complete picture of Solar System composition, structure, formation, and dynamical evolution. Roman's WFI will provide:

- Ability to significantly increase the number of known small bodies in populations such as Earth Trojans, irregular satellites, Jupiter Trojans, Centaurs, short-period comets, Kuiper Belt Objects (KBOs), and interstellar objects, enabling statistical/population studies
- Open access to data from planned Core Community Surveys, such as:
    - Galactic Bulge Time Domain Survey (~2 deg^2; ~15-min cadence) enabling identification and orbital characterization of asteroids and slow-moving KBOs, as well as construction of high time-resolution rotation light curves of asteroids
    - High Latitude Wide Area Survey covering ~2,000 deg^2 providing the ability to detect long-period comets, interstellar objects, and high-inclination KBOs
- General Astrophysics program for new observations and analysis of archived data, for example:
    - Detection of ~5000 Trans-Neptunian objects (F146 < 30, D ~ 10 km), with potential detection of minor bodies (D = 20–2000 km) in the Inner Oort Cloud (100 AU < d < 800 AU)
    - Efficient surveys of the giant planet Hill spheres (Jupiter's in 17 pointings, V < 27.7 mag with F146) for detection of faint irregular satellites
    - Multi-band spectrophotometry for surface compositional studies
    - Targets for follow-up observations by other observatories for confirmation of detections, full spectrum photometry, and improvement of orbital determination and rotation light curves

Illustration of objects in the Kuiper Belt. Credit: ESO/M. Kornmesser

STARS BY THE BILLIONS

NASA's Nancy Grace Roman Space Telescope will have the power to resolve billions of stars, providing the detailed observations and the large-number statistics needed to fill substantial gaps in our knowledge of stellar astrophysics in the Milky Way and neighboring galaxies.

STELLAR POPULATIONS OF THE MILKY WAY BULGE AND DISK

The Roman Space Telescope's unique combination of Hubble-like resolution, near-infrared sensitivity, and wide field of view will provide key insights into star formation processes in the Milky Way bulge, bar, and disk. Roman will provide:

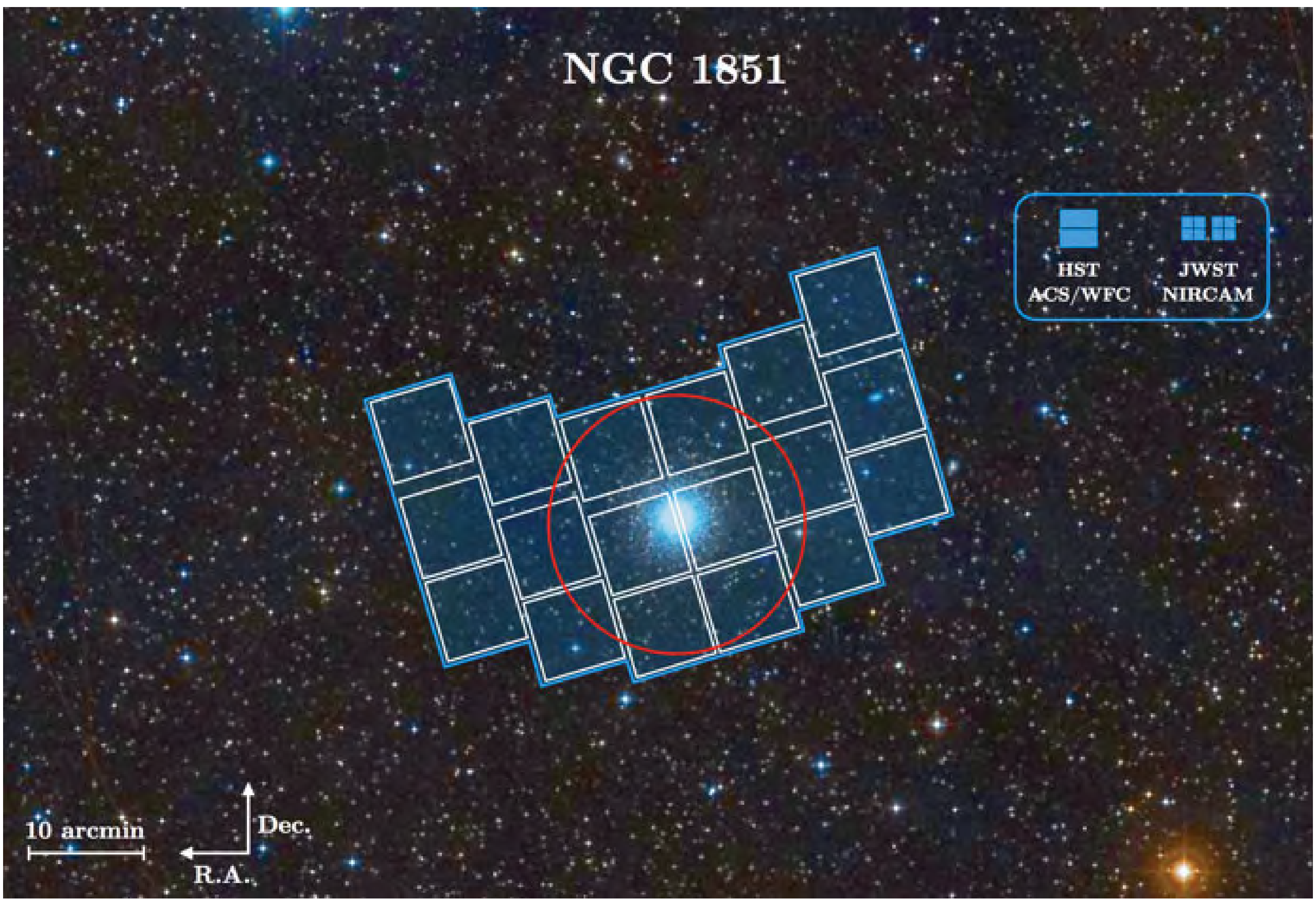
- Funding opportunities to mine data collected during the Galactic Bulge Time Domain Survey, including:
  - ◊ Photometric measurements of ~240 million stars brighter than 25th magnitude in F146
  - ◊ Repeated observations over 6 seasons (60–72 days/season) at cadences of 15 min in F146, 12 h in F062 or F087, and 12 h in F106 or F129, covering a total field of ~2 deg^2
  - ◊ One of the deepest views of the Milky Way bulge ever captured, in multiple filters (e.g., ~2 × 10^6 s in F146 and ~3 × 10^5 s in F087)
  - ◊ High-precision astrometry (3–10 μas) providing parallaxes and proper motions for more than 100 million stars
  - ◊ Near-infrared sensitivity and high resolution required to study stellar populations otherwise hidden from view due to dust extinction, intrinsic faintness, and confusion
  - ◊ The ability to study multiple stellar population properties, including luminosity and mass functions down to the hydrogen-burning limit
- Funding for new observations, affording access to the wide field, high resolution, and IR sensitivity needed to:
  - ◊ Observe entire stellar environments, such as the central molecular zone and star-forming regions, in one pointing
  - ◊ Investigate multiple stellar properties, including T_{eff}, [M/H], age, luminosity, and A_H
  - ◊ Map the structure and history of the MW bulge, bar, and disk
- Immediate open access to all data from the Core Community Surveys and General Astrophysics Surveys, including those of the MW bulge or disk

Probing stellar populations of the Milky Way: Simulated Roman image of a Milky Way bulge field covering 1/140th of Roman's field of view in three filters: F087, F146, F184. Credit: M. Penny 2019, ApJS, 241, 3.

STELLAR POPULATIONS OF THE MILKY WAY HALO

Roman's ability to resolve faint stars over vast swaths of the sky will play a crucial role in our understanding of multiple stellar populations in globular clusters (GCs) of the Milky Way halo. In addition, Roman will be able to detect and resolve faint halo stars and structures such as stellar streams, filling key gaps in our understanding of the composition, structure, formation, and evolution of the galaxy as a whole. Roman will provide:

- Field of view wide enough to cover the entire tidal radius of a typical GC in a single pointing
- Near-infrared sensitivity needed to optimally probe faint, low-mass stars that typically populate the mostly uncharted outskirts of GCs
- Resolution required for high-precision astrometry and deblending of stars in GC cores and outskirts
- Extension of time baselines for relative proper motion studies with precision $\lesssim$25 μas/yr, and improved to ~10 μas/yr when anchored by Gaia reference stars
- Ability to differentiate the various kinematics within a GC, as well as more accurate determinations of GC orbital motion
- Immediate open access to imaging and spectroscopic data of low-density portions of the halo collected during the High Latitude Time Domain Survey and High Latitude Wide Area Survey
- Opportunities to propose specific individual observations and time-domain surveys for composition, demographic, kinematic studies of the halo, with the potential for discoveries of new stellar streams

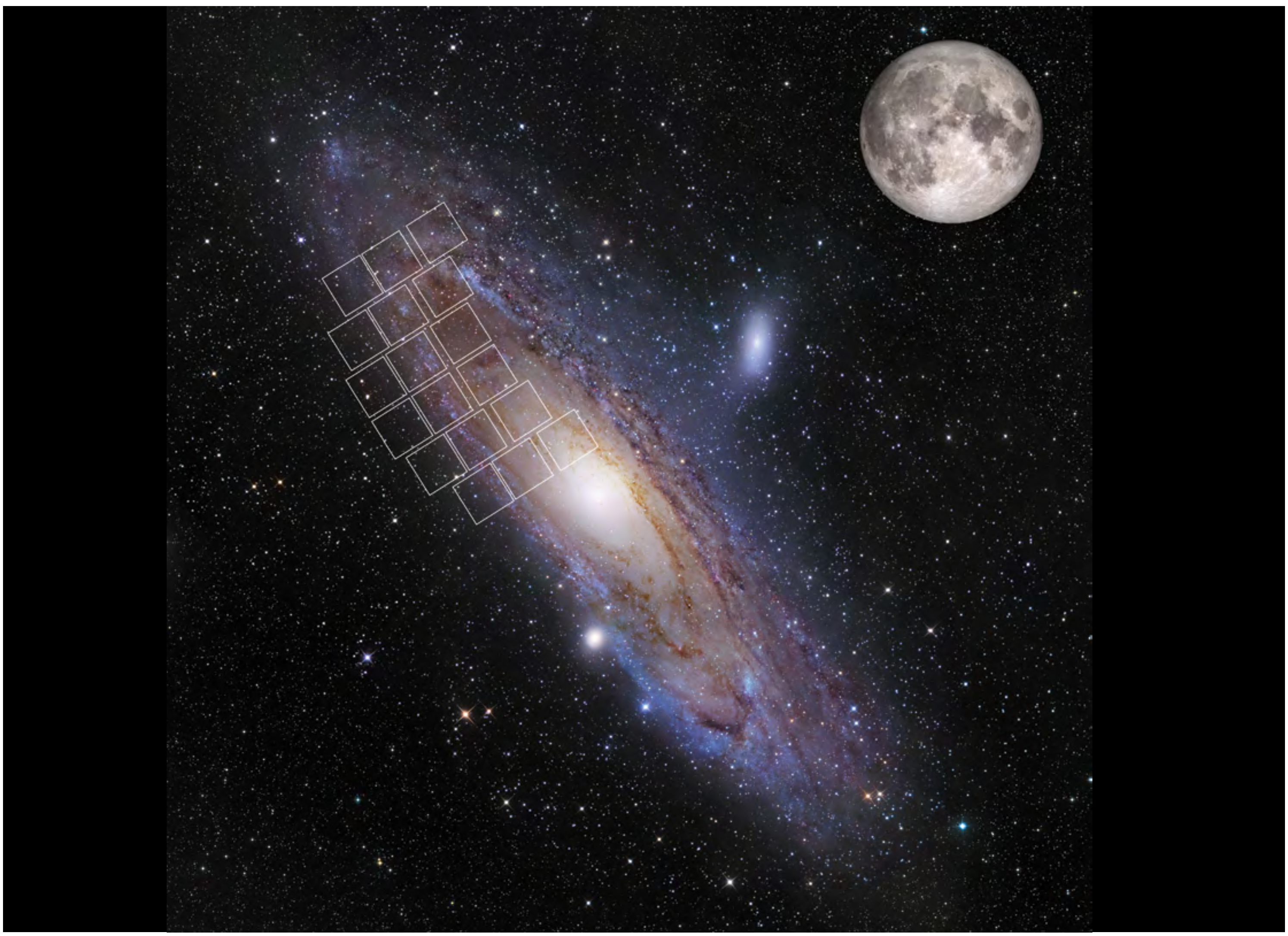


Charting the faint outskirts of globular clusters: Roman's footprint superimposed on the globular cluster NGC 1851, with the nominal tidal radius of the cluster outlined in red. Credit: A. Bellini, et al. 2019, arXiv:1903.05085 (Astro2020 White Paper)

RESOLVED STELLAR POPULATIONS IN NEIGHBORING GALAXIES

Roman's high resolution and rapid survey speed will enable comprehensive population studies of stars in the main bodies, extended halos, and satellites of neighboring galaxies. Roman will provide:

- Hubble-quality resolution needed to resolve and characterize billions of individual stars in galaxies as far as ~10 Mpc
- Near-infrared sensitivity (H_{AB} ~28 in 1-hr exposure) needed to image faint halo stars, as well as stars in the spiral arms and inner region that are otherwise obscured by dust
- Field of view large enough to survey the entire disk of Andromeda in a few pointings; and the ability to survey the halo and satellites as well as the main body of smaller and more distant targets like M33, providing a holistic view of both a galaxy and its immediate environment
- Survey speed 1475 times faster than Hubble for coverage similar in depth and area to the Panchromatic Hubble Andromeda Treasury (PHAT) program
- Ability to differentiate faint, large-scale structures like tidal streams to better understand the physical and evolutionary relationships between various stellar populations within the galaxy
- Opportunities to propose comprehensive surveys of interacting galaxies
- Immediate open access to imaging and spectroscopic data of halo stars of neighboring galaxies in fields covered by other proposed surveys



Mapping nearby galaxies: Roman's footprint overlaid on Andromeda (M31), with the apparent size of the Moon for scale. Credit: Background: Digitized Sky Survey and R. Gendler; Moon: NASA, GSFC, and Arizona State University

TRANSIENT AND VARIABLE PHENOMENA

Roman is capable of detecting and characterizing transient events and variable phenomena with milli-magnitude changes on time scales of minutes to years. Roman will provide:

- Funding opportunities to mine large photometric datasets with varying time cadences for characterization of stellar phenomena such as pulsating variable stars, stellar flares, and star spots, with immediate open access to:
    - ◊ Data collected via the Galactic Bulge Time Domain Survey (2 deg^2 with 15-min cadence over 6 seasons with 60–72 days/season)
    - ◊ High Latitude Time Domain Survey, with medium and deep fields (5–20 deg^2) observed on a cadence of 5 days
    - ◊ Resolution and sensitivity needed to detect SNe in dusty environments, including light echoes in the Milky Way and neighboring galaxies
- Precision astrometry (3–10 μas) in the Galactic Bulge Time Domain Survey, enabling detection of hundreds to thousands of isolated black holes in the MW bulge via photometric and astrometric microlensing
- Monitoring of stars in the MW bulge via the Galactic Bulge Time Domain Survey, with the ability to conduct asteroseismology of ~10^6 red giant stars of $H_{AB} < 14$ with known distances
- Near-IR observations supporting multi-wavelength and multi-messenger studies of phenomena such as binary neutron star mergers and Pop III explosions, to propel our understanding of unique events and discover new classes of transients
- Opportunities to propose targeted observations and follow-up studies of specific stellar oddities

Capturing transient phenomena: Infrared Hubble image of variable star V838 Mon and its light echo: HST ACS/WFC, F606W (V) and F814W (I). Credit: NASA, ESA, and H. Bond, STScI

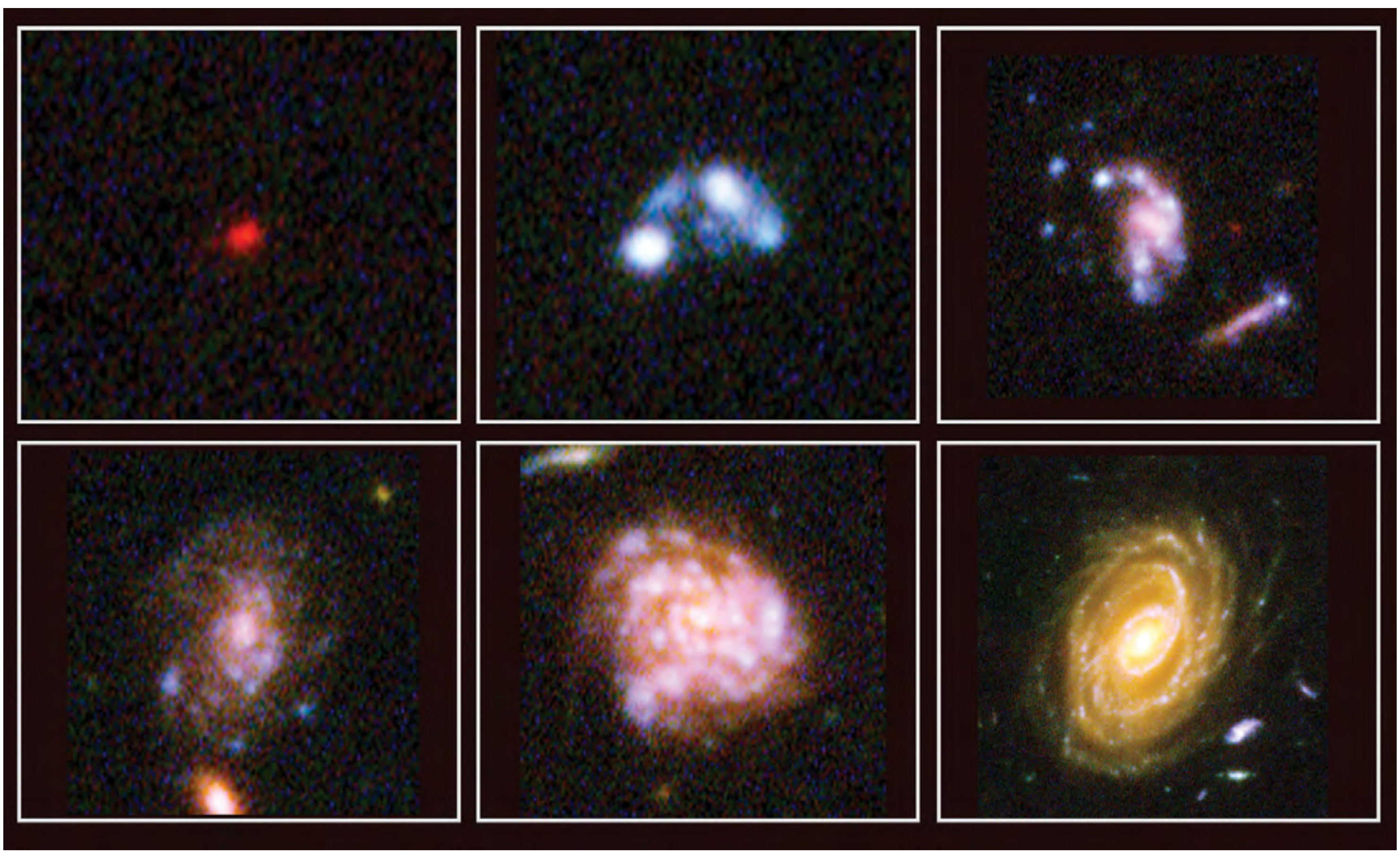
GALAXIES BY THE MILLIONS

NASA's Nancy Grace Roman Space Telescope will have the power to collect an unprecedented volume of high-resolution near-infrared imaging and spectroscopic observations of galaxies across vast fields of view and spans of time, providing the large data sets needed to understand how different types of galaxies form, grow, interact with their environments, and evolve over time.

GALAXY FORMATION AND EVOLUTION

Roman will enable observations of hundreds of millions of galaxies at numerous stages of development, providing imaging and spectroscopy required to build a clear and detailed picture of how different types of galaxies form and evolve. Roman will provide:

- Large data sets with homogeneous observing conditions needed to identify statistically significant correlations between various galaxy properties as a function of mass, environment, and redshift
- High Latitude Wide Area Survey covering ~2,000 deg^2 with NIR imaging and spectroscopy over the same fields of view:
  - ◊ Imaging depth (5σ) of 26.9, 26.95, 26.9, and 26.25 in Y, J, H, and F184 filters
  - ◊ Grism (1.00–1.93 μm) spectroscopy depth of 1.0×10^{-16} ergs/s/cm^2 at 1.80 μm (5σ integrated line flux)
  - ◊ Estimated detection rate of 27 million galaxies per month, with a total of more than one billion galaxies over the full survey
  - ◊ Survey being defined through a community-driven open process
- Immediate open access to all mission data via the Mikulski Archives for Space Telescopes (MAST), and funding opportunities for new observations and analysis of core community science data and data collected through General Astrophysics Surveys

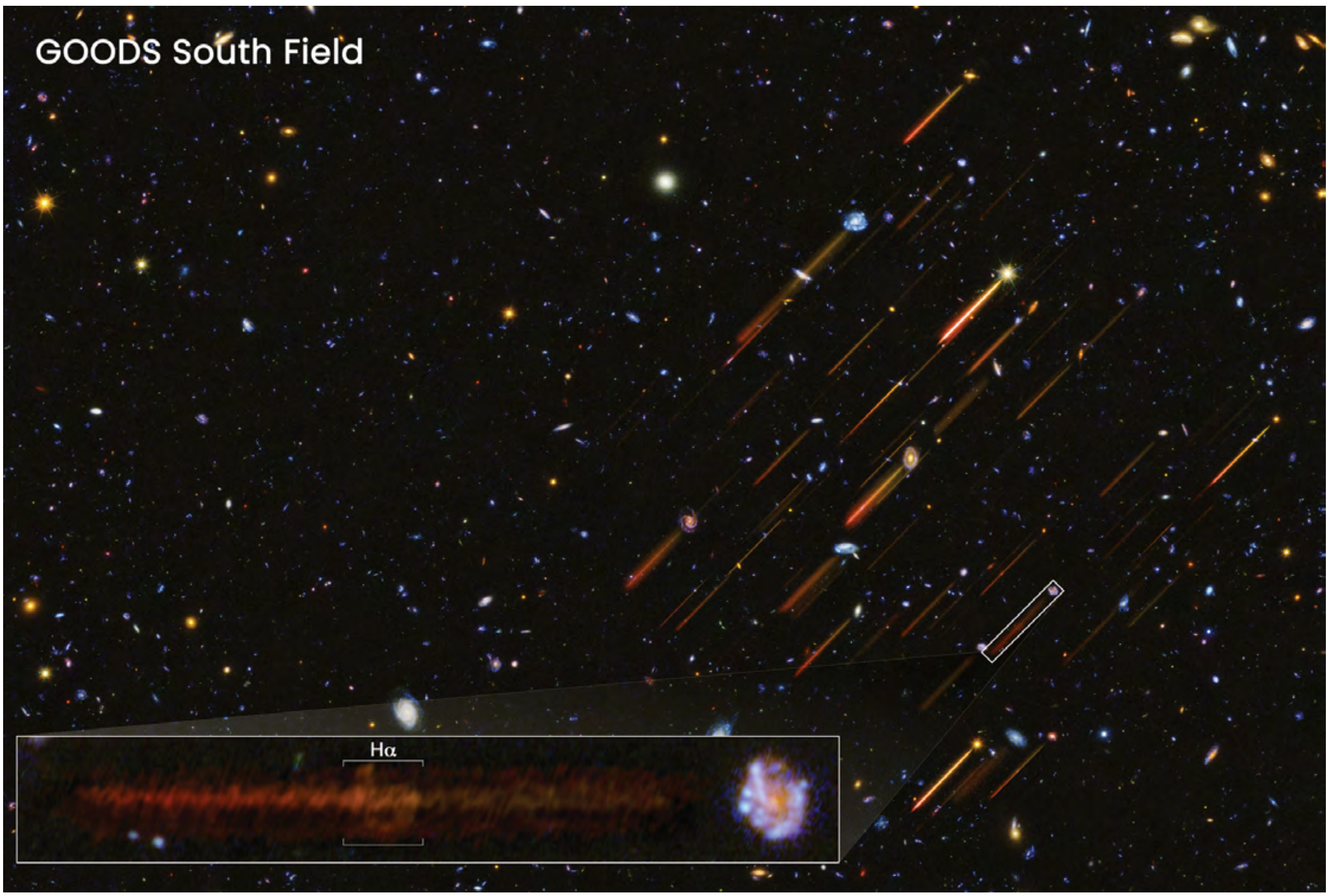


Galaxies at different stages of formation at $z = 5.79$ (top left) to $z = 0.49$ (bottom right) from the Hubble Ultra Deep Field 2004. Credit: NASA, ESA, and the HUDF Team

GALAXY PROPERTIES

With its 0.11" resolution, two slitless spectroscopy modes covering 0.75–1.93 µm, and survey speeds 100–1000× Hubble, Roman will provide the large datasets needed for unprecedented statistical analysis of galaxy populations and evolutionary relationships across multi-dimensional parameter space. Roman will enable:

- Extragalactic surveys for measurements of redshift, luminosity, color, size, shape, clumpiness, and clustering from 10^8–10^9 galaxies over the mission lifetime
- Grism observations to provide robust spectroscopic redshifts for >100 million galaxies, and to create spatially resolved maps of Hα surface brightness, dust extinction, mass-to-light ratio, and metallicity at ~1 kpc resolution
- Detection of ~10 million Hα-emitting galaxies at z = 0.5–1.9 and ~3 million [OIII]-emitting galaxies at z = 1.0–2.8; up to z = 4.2 with star-formation rate (SFR) >200 M /yr
- Modeling of spectral energy distributions, including spectral lines from grism spectra, to measure SFR, stellar mass, dust extinction, mass-to-light ratio, and metallicity
- Detection of 10^4 galaxy-galaxy strong lenses (~10/deg^2) for mass density profile models of luminous and dark matter in foreground galaxies of z = 1–2 and M* = 10^{10}–10^{12} M



Portion of the Hubble GOODS-South ACS and WFC3 observations with a representative overlay of slitless spectroscopy. Credit: NASA, ESA; Joseph DePasquale (STScI); University of Geneva, Pascal Oesch (University of Geneva), Mireia Montes (UNSW)

GALAXIES, BLACK HOLES, AND AGN

Roman will facilitate a more complete census of black holes, quasars, and AGN, and a more comprehensive understanding of the coevolution of supermassive black holes and their host galaxies. Roman will enable:

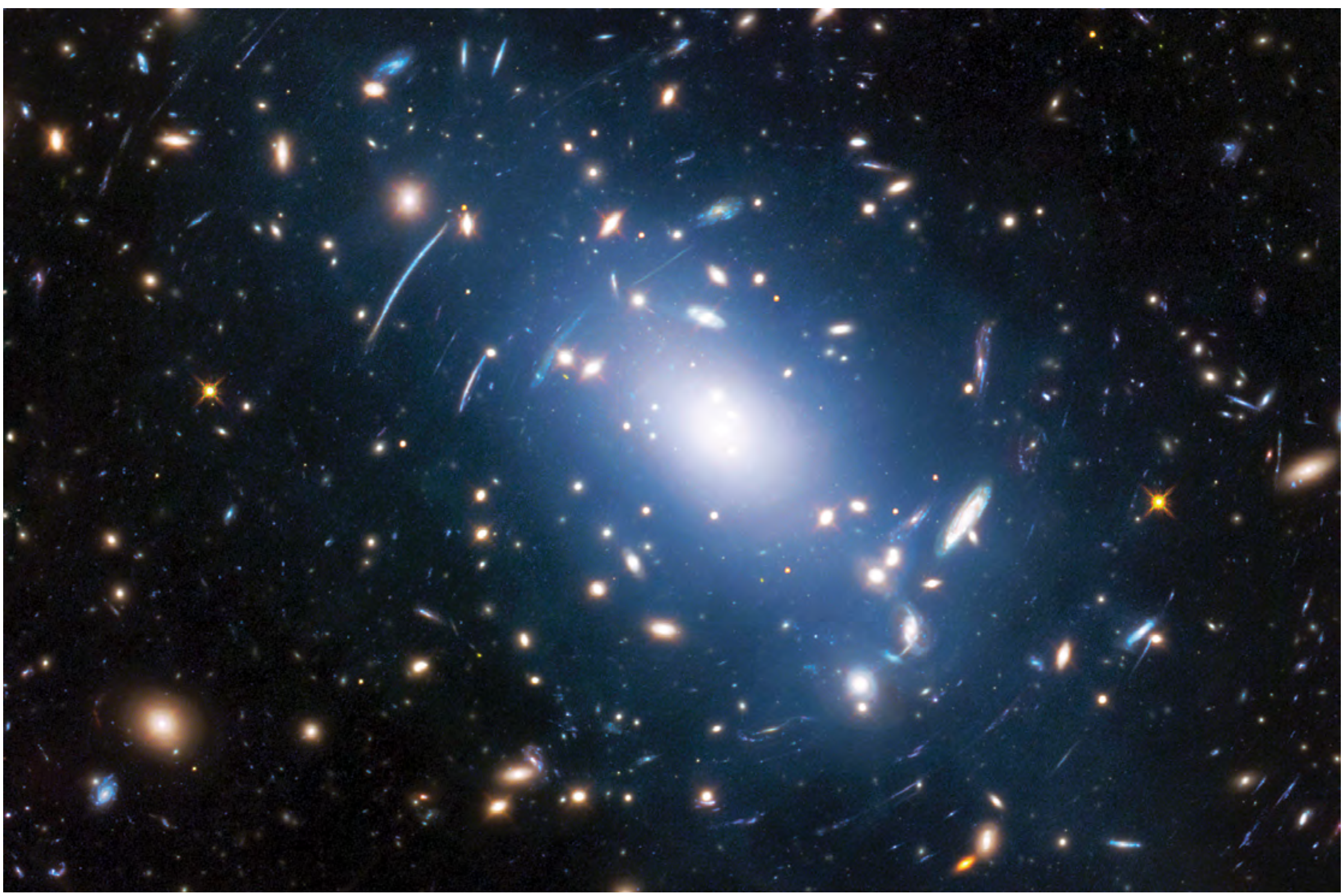
- Surveys with the potential to reveal the mass of accreting black holes at peak growth of $z \approx 2$–7, as well as the clustering and properties of their host galaxies
- Studies of the effects of black hole accretion on the growth of galaxies via feedback mechanisms at $1 < z < 7$
- Investigations of the AGN/star-formation relationship in the most massive galaxies
- Characterization of differences in clustering amplitude of obscured and unobscured AGN to probe AGN unification scenarios and possible correlations with galaxy evolution
- Discovery of ~2600 quasars at $z > 7$ to track the assembly of 10^9-M black holes during the Epoch of Reionization
- Characterization of the faint end of the quasar luminosity function at $z > 3$–4
- Detection of strongly lensed quasars to map mass distribution of lensing systems, as well as properties of their host galaxies

Multi-wavelength image of active radio galaxy Centaurus A. Credit: X-ray: NASA/CXC/SAO; optical: Rolf Olsen; infrared: NASA/JPL-Caltech; radio: NRAO/AUI/NSF/Univ. Hertfordshire/M. Hardcastle

GALAXIES AND THEIR ENVIRONMENTS

Roman's ability to capture vast swaths of the sky will provide insights into the relationships between galaxies and their environments over a wide range of scales, building a better understanding of how a galaxy's environment affects its properties, growth, and evolution. Roman will make it possible to:

- Test models of galaxy evolution by measuring clustering as a function of galaxy properties
- Survey galaxies at $z = 1–2$ and combine grism redshift data with weak-lensing imaging data to create the densest map of structure on linear scales of 11–12 Mpc
- Investigate links between galaxies, AGN and supernova feedback mechanisms, and dark matter halos at $z > 1$ as a function of galaxy mass
- Detect dwarf galaxies in large enough numbers to provide constraints on dark matter models and compare to cosmological simulations
- Map substructure in galaxies' stellar halos to track past accretion history
- Survey galaxy groups and clusters to identify environmental influences on galaxy properties
- Use strong and weak gravitational lensing to map dark matter on spatial scales of 10–50 kpc within galaxy clusters to compare to simulated dark matter profiles from cosmological models and better understand interactions between mass components in merging/colliding clusters

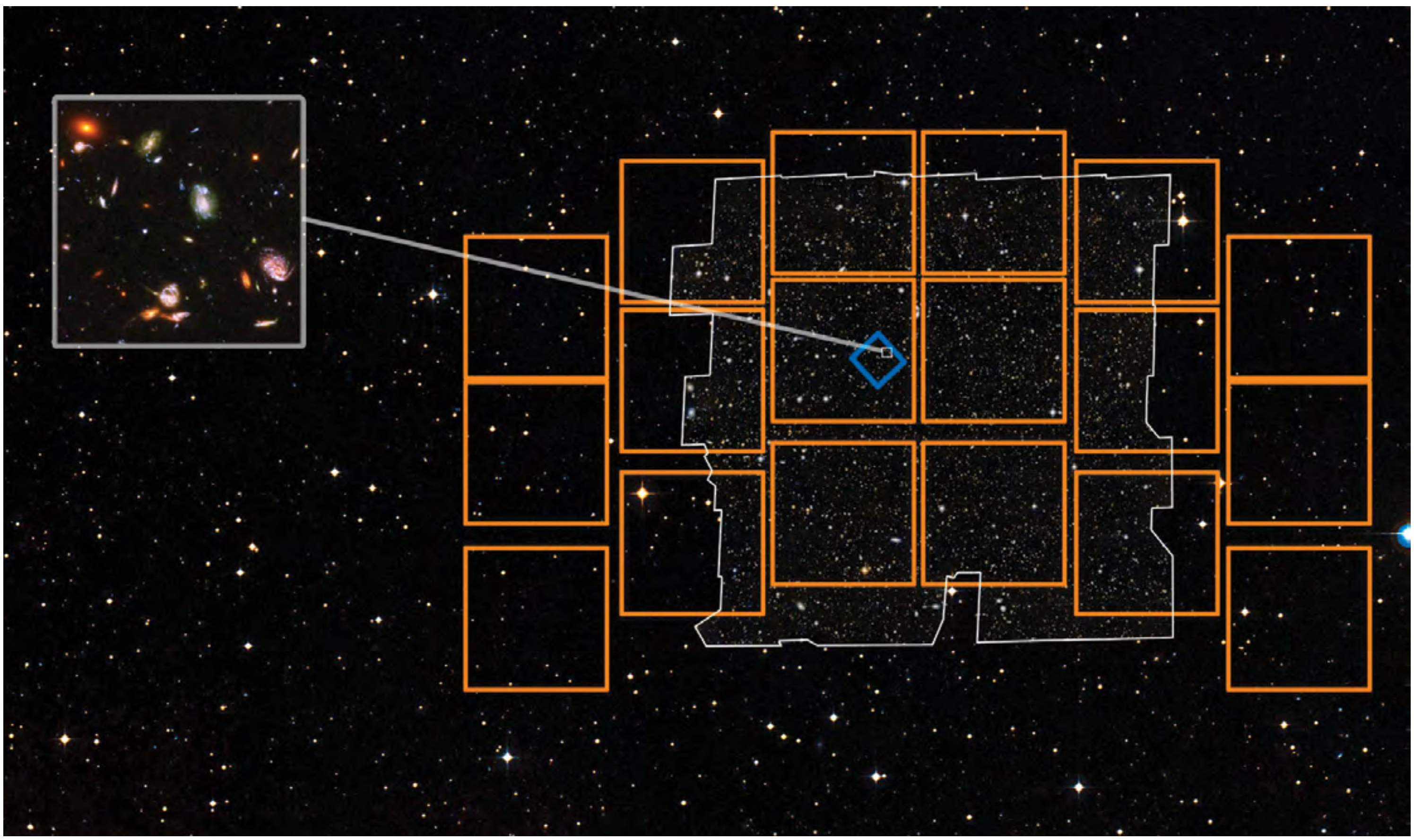


Optical/infrared Hubble image of galaxy cluster Abell S1063, showing intracluster light and lensed background galaxies. Credit: NASA, ESA, M. Montes, and the HFF team

HIGH-REDSHIFT GALAXIES

Roman's unique combination of near-infrared sensitivity, high resolution, and extreme survey speed will dramatically increase our sample of galaxies and quasars in the early universe, providing the data needed to revolutionize our understanding of early star formation, the Epoch of Reionization, and the early structure of the universe. Roman will enable:

- High Latitude Wide Area Survey with estimated detection of 2.8×10^5 galaxies of ≤26.5 mag at $z = 8$; 7.5×10^4 galaxies at $z = 9$; and 1.9×10^4 galaxies at $z = 10$
- Discovery of high-z Ly-α emitting galaxies ($8 < z < 15$), Lyman-break galaxies, AGN, and quasars to determine their luminosity functions and investigate their impact on cosmological reionization
- Detection of Ly-α and Hα emission features to constrain SFR, amount of ionizing radiation, and escape fraction from the neutral intergalactic medium, and to understand their impact on structure formation
- Treasury-scale observation programs with survey speeds 10^2–$10^3\times$ Hubble, including potential Roman Ultra Deep Field and Wide Deep Grism programs for probing galaxies in the early universe

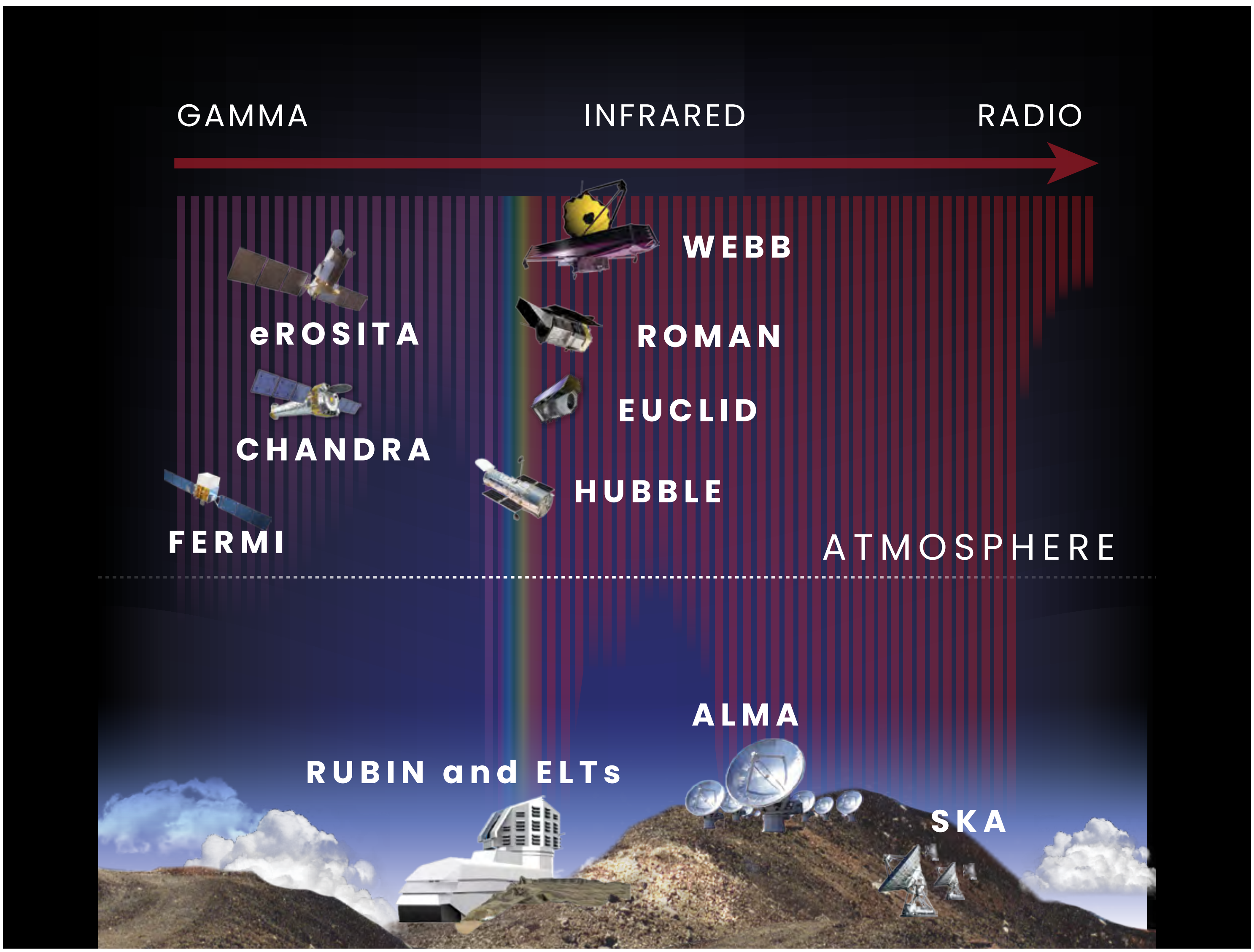


Footprint of an example Roman Ultra Deep Field (orange) compared to the Hubble Ultra Deep Field (blue), and wider, shallower Hubble observations (white). Credit: NASA, ESA, DSS, and Anton M. Koekemoer, STScI

SYNERGIES WITH OTHER OBSERVATORIES

Roman's power to capture high-resolution near-infrared observations of hundreds of millions to billions of galaxies and their environments over a wide range of redshifts will complement the capabilities of other observatories, including Rubin, Euclid, eRosita, Webb, and Hubble.

- Combining data from Roman, Rubin, and Euclid will improve photo-*z* measurements by mitigating systematic errors arising from incomplete wavelength coverage, low resolution, blending, and biases in galaxy sample selection.
- The combined broad wavelength coverage will enable better SED modeling and more accurate determinations of galaxy properties such as star-formation rate and stellar mass.
- Synergies with radio, optical, and X-ray observatories will advance our understanding of obscured and unobscured AGN and the coevolution of AGN with their host galaxies.
- Cross-correlating Ly-α emitting galaxy positions mapped by Roman and neutral hydrogen mapped by the Square Kilometer Array (SKA) can be used to probe conditions of the Epoch of Reionization.
- Roman's ability to conduct deep surveys of large regions of the sky will increase the statistical probability of finding rare objects, which can then be observed with additional telescopes for higher-resolution spectroscopy and panchromatic imaging.



Wavelength range of select space and ground-based observatories to complement Roman in the 2020s. Credit: A. James, P. Jeffries, STScI

COSMOLOGY WITH ROMAN

NASA's Nancy Grace Roman Space Telescope will have the near-infrared sensitivity, high-resolution imaging and spectroscopy, expansive field of view, precise pointing control, and high survey speed required to collect the big data needed to address—and perhaps answer—the most important questions driving cosmological research today.

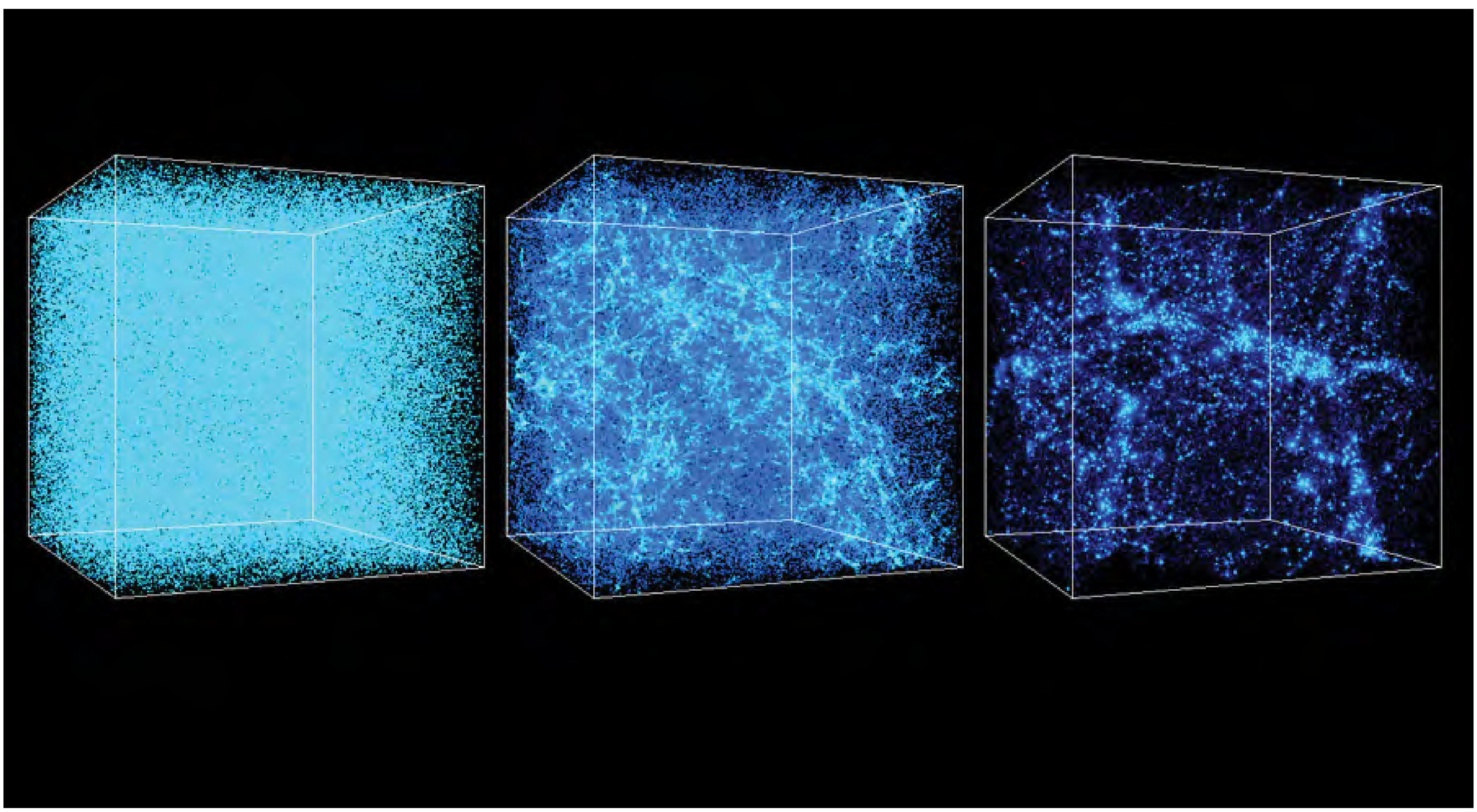
BIG DATA TO ADDRESS BIG QUESTIONS

Roman is uniquely designed to collect the data needed to significantly narrow constraints surrounding the nature of dark energy and dark matter, and the evolution of large-scale structure in the universe. Roman's survey programs and other investigations will provide exceptionally large sample sizes and repeat observations, ideal for robust statistical and machine learning analyses, to address cosmological questions such as:

- How and why has the expansion rate of the universe changed over time?
- How has the structure of the universe changed over time?
- Does our current understanding of gravity explain cosmic structures at large scales?

To answer these questions, Roman will:

- Employ a Wide Field Instrument comprising 18 4k × 4k near-IR detectors; eight filters spanning 0.48–2.3 μm; and two slitless spectroscopy modes spanning 0.75–1.93 μm
- Provide wavefront stability of <1 nm for precise measurements of position, brightness, and redshift
- Enable multiple robust, independent probes of gravity and cosmological parameters
- Grant open access to all data via the Mikulski Archives for Space Telescopes (MAST), providing opportunities for cross-checks and development of new analytical methods



Simulation of the formation of clusters and large-scale filaments in the CDM model with dark energy, from $z \approx 30$ (l), to $z \approx 5$ (m), to present (r); box dimension = 43 million parsecs. Credit: Simulations performed at the National Center for Supercomputer Applications by Andrey Kravtsov (the University of Chicago) and Anatoly Klypin (New Mexico State University); visualizations by Andrey Kravtsov

DETECTING AND MONITORING TYPE Ia SUPERNOVAE

Roman's High Latitude Time Domain Survey will enable detection and light-curve monitoring of thousands of Type Ia supernovae to $z \approx 2$. The combination of high-resolution imaging and spectroscopy for precision brightness and redshift measurements will make it possible to reduce the uncertainty of the dark energy equation of state by 70%, quantify temporal variations, and identify inflection points in the recent expansion rate. Roman will provide:

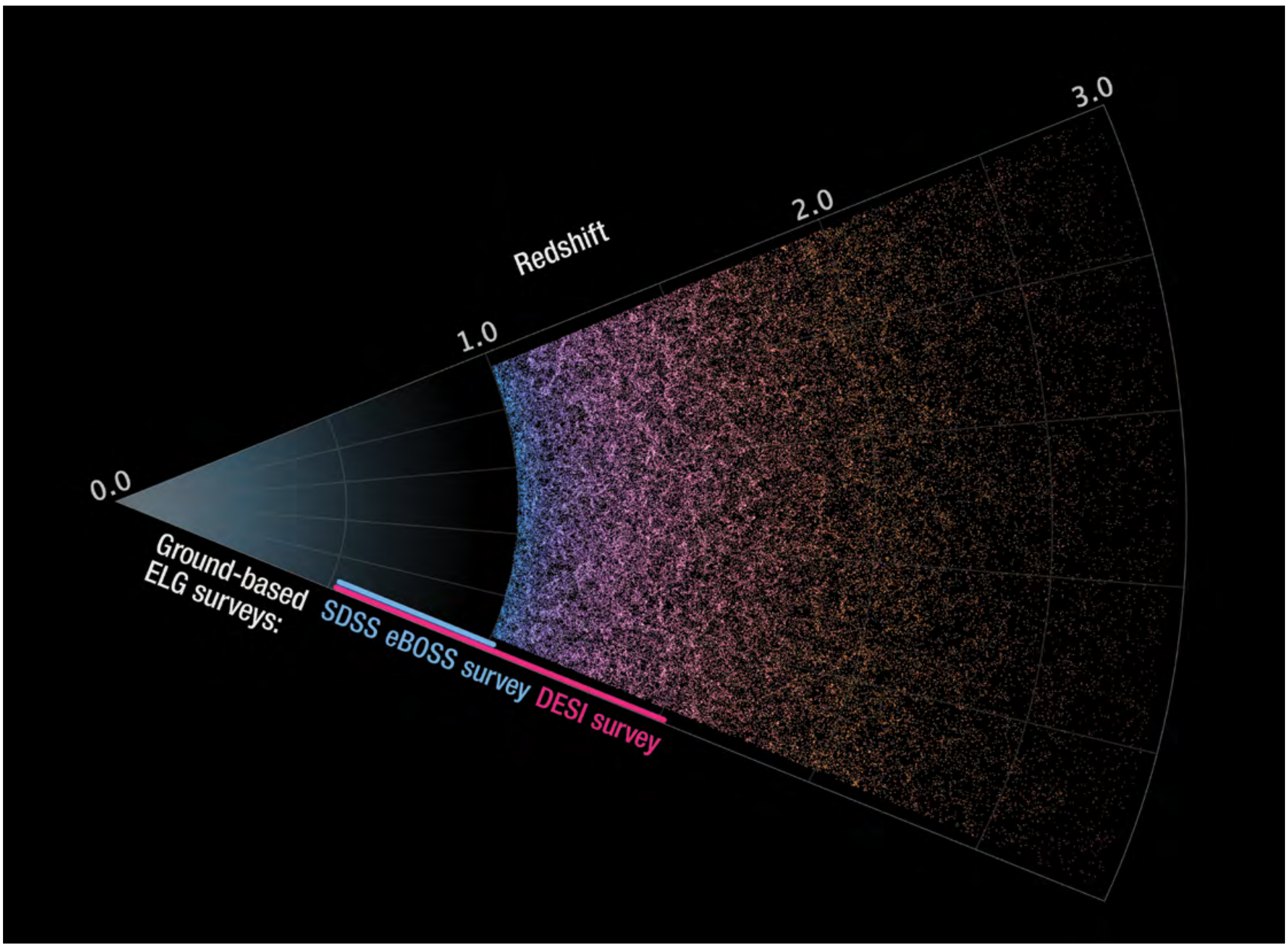
- Wide and deep time-domain surveys with 5-day cadence, and an estimated yield of more than 500 SNIa per month
- A multi-tier imaging approach, with one sample realization achieving wide-tier point source depths >25.4 mag (0.5–1.3 μm) and deep-tier depths >26.5 mag (1.0–2.0 μm) for single visits, and co-added depths >28.1 and 29.1 respectively.
- Slitless spectroscopy mode covering 0.75–1.8 μm with R = 80–180, enabling redshift measurements of SNe and their host galaxies
- Opportunities to propose new observations of additional fields with deep imaging and spectroscopy, or new observations to supplement or extend the planned cadence

Hubble image of SN 1994D, a Type Ia supernova located in NGC 4526. Credit: NASA, ESA, the Hubble Key Project Team, and The High-*z* Supernova Search Team

MAPPING DISTRIBUTION OF GALAXIES

Roman will enable precise measurements of the position and redshift of millions of distant galaxies, further probing the cosmic expansion history based on baryonic acoustic oscillations (BAO), and the growth-rate of large scale structures based on redshift space distortions (RSD). Roman will provide:

- High Latitude Wide Area Survey covering 2,000 deg^2 with imaging and slitless spectroscopy over the same fields of view
- Imaging in four near-IR bands with imaging depth of 26.5 mag and expected spectroscopic depth of 1.0×10^{-16} erg/s/cm^2 at 1.80 μm (integrated line flux)
- Expected total yield of ~10 million Hα redshifts at z = 0.5–1.9 and ~3 million [OIII] redshifts at z = 1.0–2.8, enabling detailed 3D mapping of galaxy and galaxy cluster distribution from $z \approx 0.5$–3
- Sample sizes large enough for precisely measuring BAO in both radial (probing expansion history) and transverse (probing angular diameter distance) directions
- Sufficiently dense sampling of redshifts at $z \approx 1$–2 to enable higher-order statistical measures of the evolution of large-scale structure and tighten the constraints on dark energy
- The ability to differentiate galaxies from QSOs and other objects used as tracers of larger-scale structure, and the potential to use quasars to map BAO out to $z > 7$

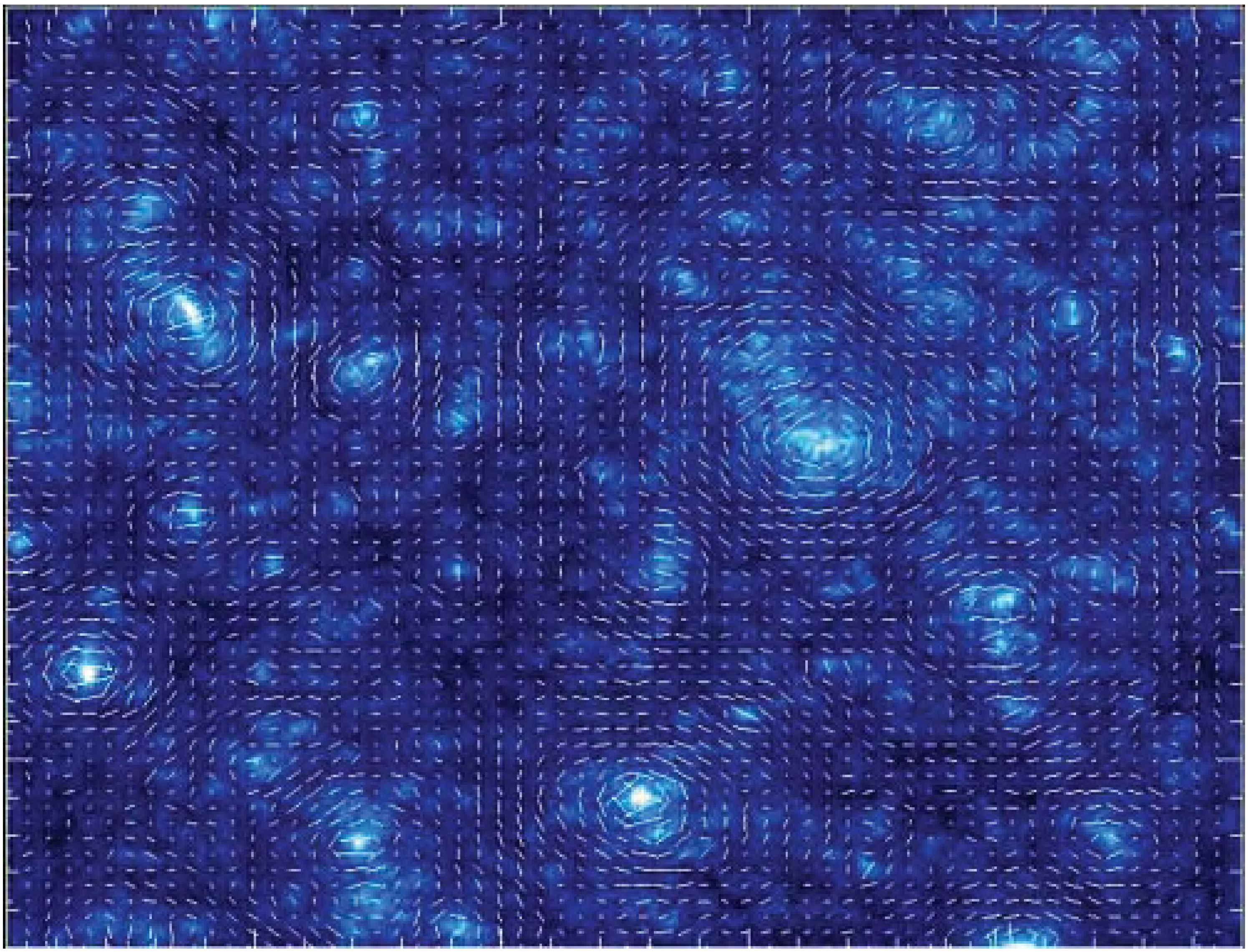


Visualization of simulated Roman emission-line galaxy distribution data used to measure BAO and RSD. The wedge shown covers an RA sweep of 45° with a DEC thickness of 1°, and includes more than 215,000 galaxies. Credit: Data provided by Z. Zhai and Y. Wang, Caltech/IPAC, and A. Benson, Carnegie Observatories; visualization by J. DePasquale, STScI

WEAK LENSING

Roman will enable measurements of millions of galaxy shapes with high signal-to-noise in four bands, providing the best controlled weak-lensing experiment: unique in depth, detail, and control of measurement and astrophysical systematics. The high density of lensed galaxies will make it possible to produce high-resolution maps of dark matter with redshift that can be used to better understand the growth of large-scale structures and provide additional constraints on key cosmological parameters. In addition to mapping galaxy distributions, Roman's High Latitude Wide Area Survey will enable:

- Wide-area, 4-NIR-band imaging of 170 deg²/month; possible total yield of 4×10^8 weak-lensed shapes (40–50 galaxies per square arcminute in the stacked images)
- 4-band photometric redshifts for all of the galaxies, complemented with slitless spectroscopy (1.0–1.93 μm) for the same areas of sky
- Detection of >20,000 galaxies/month at $z > 8$, and 1,500 galaxies/month at $z > 10$
- Imaging depth of 26.5 in Y, J, H bands

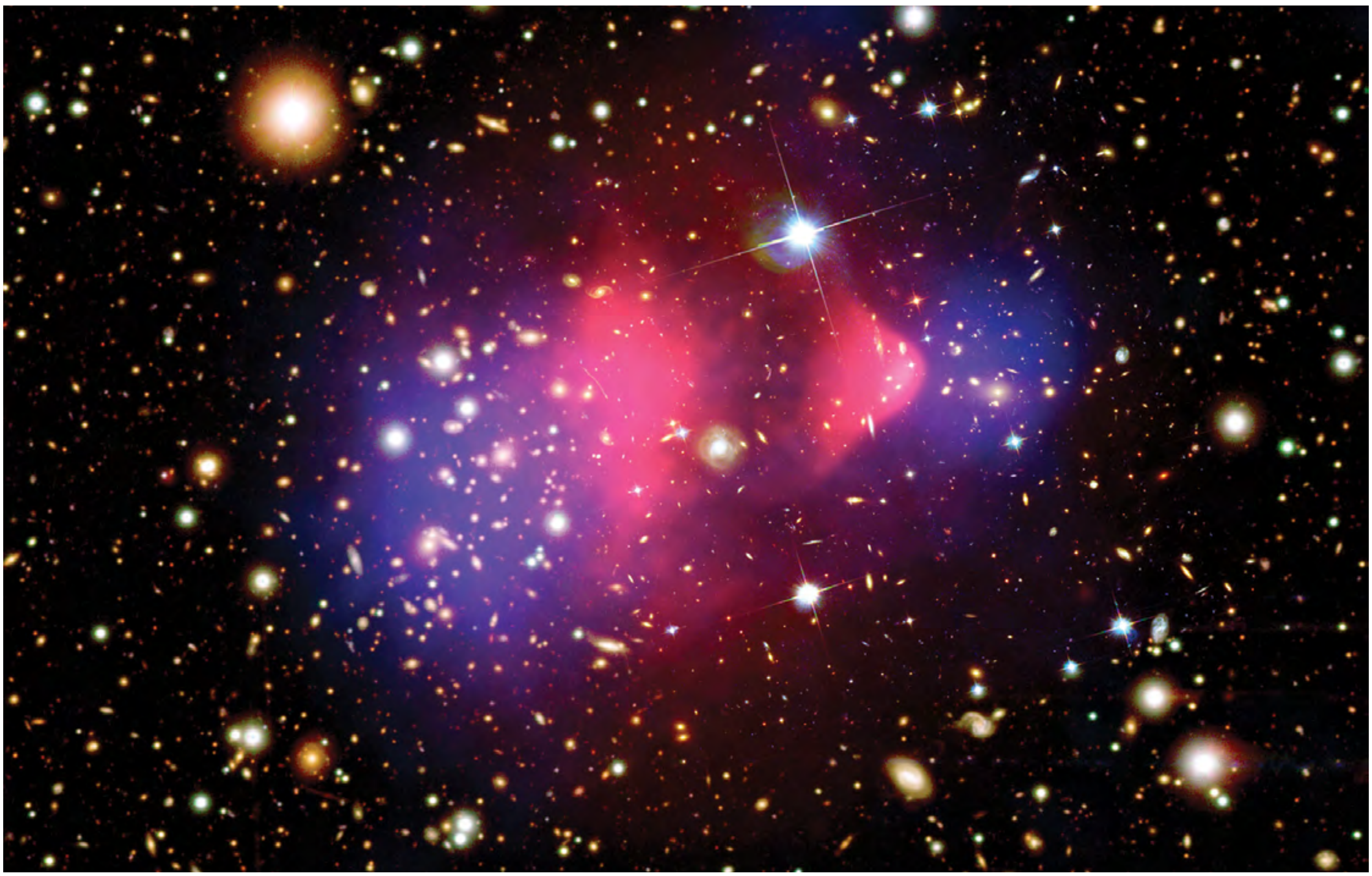


Simulation of cosmic shear in a CDM model. Line segments represent amplitude and direction of lensing shear produced by over-densities (light blue) and voids (dark blue). Credit: B. Jain, U. Seljak, & S. White 2000, ApJ, 530, 547

OTHER COSMOLOGICAL STUDIES

With powerful Core Community Surveys, 25% of the 5-year primary mission dedicated to new observations, and all data nonproprietary and immediately available, Roman will provide the ability to develop innovative investigation methods and explore a wide variety of other cosmological phenomena, including:

- Measuring the halo growth factor via galaxy cluster counts, weak lensing, and topological measurements of the filamentary structure to test models of modified gravity
- Using gravitationally lensed QSOs to measure the Hubble expansion parameter at a variety of redshifts and constrain expansion history, and to test whether the substructure within galaxy-sized dark-matter halos agrees with the predictions of the CDM model
- Using weak and strong lensing to build maps of dark matter in merging clusters of galaxies to provide upper limits to the dark matter self-interacting cross-section
- Using galaxy redshift surveys to constrain the mass of neutrinos
- Determining the abundance of high-mass galaxy clusters to describe the non-Gaussianity of the power spectrum at 1 Mpc scales

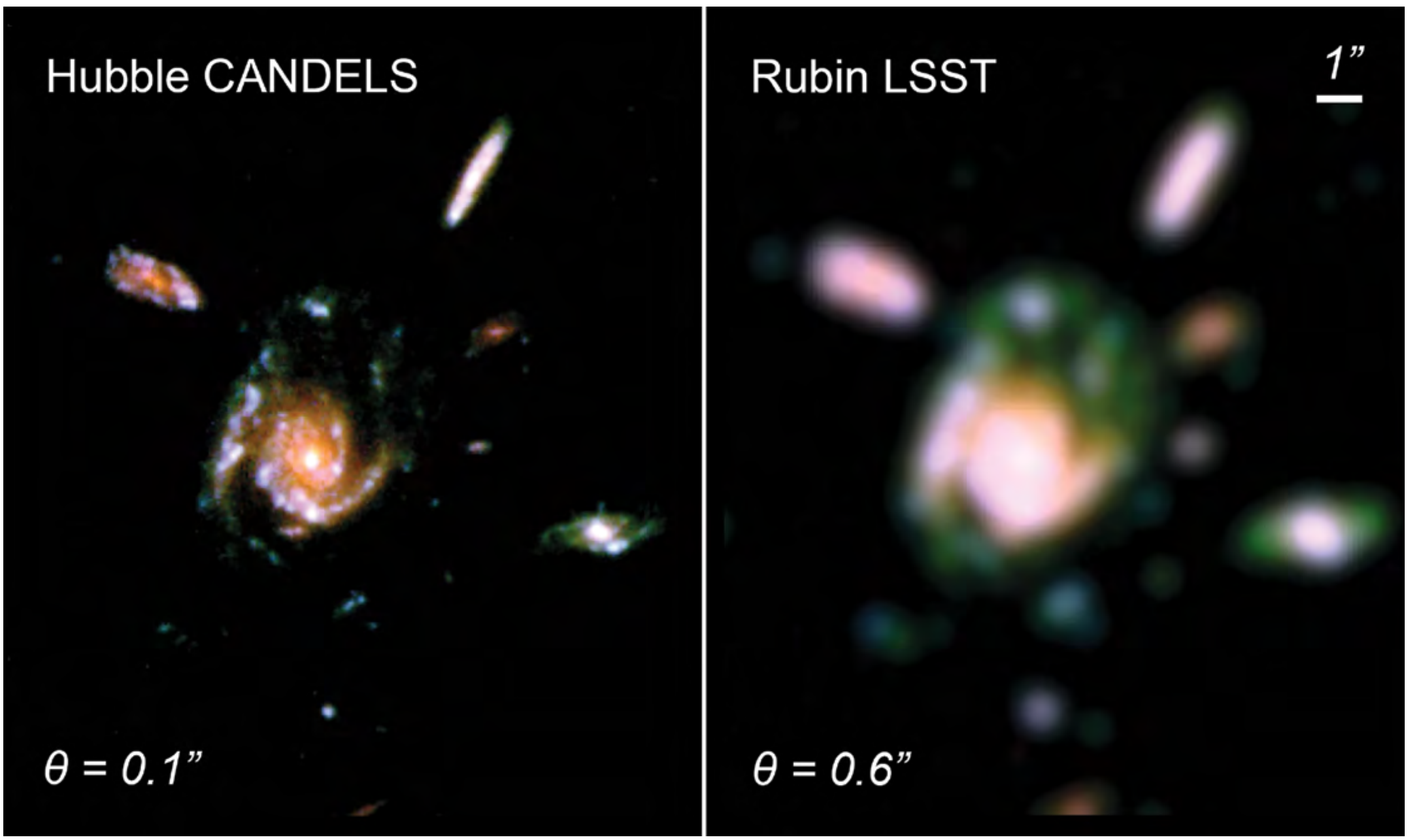


Optical image of galaxy cluster MACS J0025, overlaid with X-ray image of cluster gas (pink) and map of dark matter lensing (blue). Credit: NASA, ESA, CXC, M. Bradac, and S. Allen

SYNERGIES WITH OTHER OBSERVATORIES

Roman's investigative power will be magnified through collaborations with numerous other observatories, including the Vera C. Rubin Observatory, Euclid, and the James Webb Space Telescope. Combining data sets with different sky and wavelength coverage, image resolution and blending, and biases in galaxy sample selection will help better characterize and correct for systematic errors in all of the datasets, providing much greater precision on cosmological parameters than would be possible with each facility individually.

- As the primary sky survey facilities of the 2020s, Roman, Rubin, and Euclid will complement each other in terms of wavelength space, resolution, sky coverage, and depth.
- In combination with advanced machine learning algorithms, Roman and Euclid data will enable astronomers to disentangle overlapping galaxies and decrease source confusion from ground-based surveys such as Rubin's Legacy Survey of Space and Time.
- Complementary data from Roman, Rubin, and Euclid will improve constraints on measured cosmological parameters through better photometric redshift estimates and galaxy shape measurement validation.
- Roman observations will enable weak-lensing mass measurements for galaxy clusters detected by other future and current space- and ground-based observatories, including eROSITA and Athena (X-ray), and CMB-S4 and SPT (microwave to sub-millimeter).



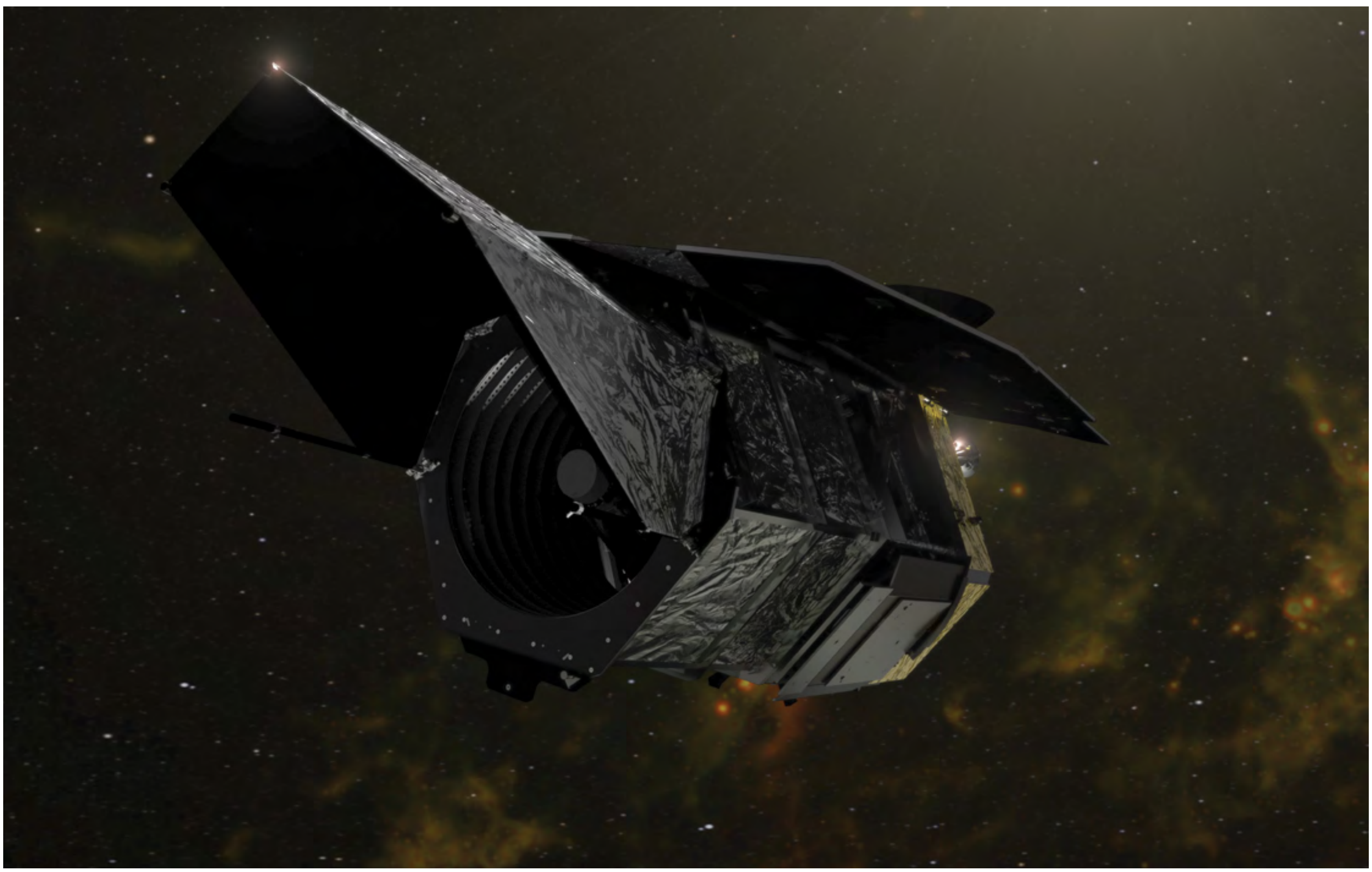
Comparison of Hubble and expected Rubin Observatory LSST data resolution. (Left) BVz color image from the Hubble CANDELS field with $\theta = 0.1''$ and $r \approx 28.5$. Roman will have comparable resolution. (Right) Simulated Rubin LSST image made by degrading Hubble data to Rubin resolution of $\theta = 0.6''$. In the Rubin image, the galaxy is blended with surrounding objects. Correlating overlapping Rubin and Roman imagery would make it possible to develop machine learning algorithms to deblend Rubin imagery that does not overlap with Roman. Credit: B.E. Robertson, et al. 2019, Nat Rev Phys, 1, 450

ROMAN TECHNICAL SPECIFICATIONS

The Nancy Grace Roman Space Telescope is a Hubble-sized, 2.4-meter aperture, space observatory optimized for wide-field infrared astronomy (0.48–2.3 μm) and high-performance coronagraphy.

GENERAL SPECIFICATIONS

- 2.4-meter (Hubble-sized) primary mirror, 3-mirror anastigmat
- Heliocentric orbit at Earth-Sun Lagrange Point 2
- 5-year nominal mission with 10-year goal
- Wide Field Instrument (WFI) with 18 4k-by-4k near-infrared detectors (300 megapixels)
- WFI field of view of 0.281 square degrees
- Imaging mode covering 0.48–2.3 microns
- 8 broad-band filters
- WFI angular resolution of 0.1 arcsec
- 2 slitless spectroscopy modes covering 0.75–1.93 microns
- WFI survey speeds of 100–1000× Hubble
- Data collection rate of 4 petabytes/year
- Coronagraph Instrument Imaging Demonstration with high-contrast requirement at least 10^{-7}
- 100% data open-access



Credit: GSFC

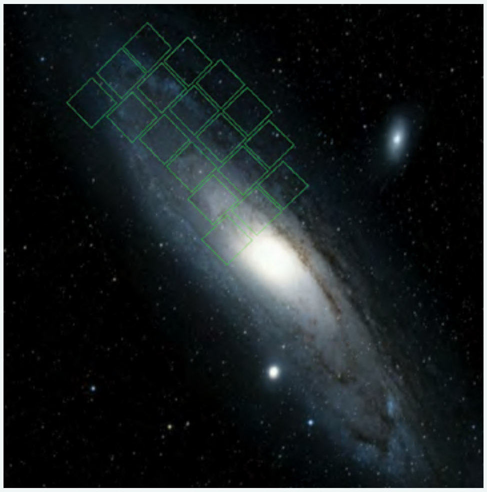
WIDE FIELD INSTRUMENT: IMAGING		
Filter	**Wavelength (μm)**	**Point-source sensitivity (AB Mag) 5σ in 1 hour**
F062 (R)	0.48–0.76	27.9
F087 (Z)	0.76–0.98	27.6
F106 (Y)	0.93–1.19	27.5
F129 (J)	1.13–1.45	27.5
F146 (I/H)	0.93–2.00	27.9
F158 (H)	1.38–1.77	27.4
F184 (H/K)	1.68–2.00	26.7
F213 (Ks)	1.95–2.30	25.4

WIDE FIELD INSTRUMENT: SPECTROSCOPY			
Instrument	**Wavelength (μm)**	**Continuum sensitivity (AB Mag) 5σ per pixel in 1 hour**	**Spectral Resolution**
G150 (Grism)	1.00–1.93	21.4 at 1.5 μm	461
P127 (Prism)	0.75–1.80	23.7 at 1.5 μm	80–180

CORONAGRAPH INSTRUMENT: IMAGING & SPECTROSCOPY									
Band	**Wavelength Center (μm)**	**Full Width Half Max (μm)**	**Band Width (%)**	**Mode**	**Field of View radius (arcsec)**	**Field of View coverage (deg)**	**Polarimetry**	**Mask Type**	**Support Status**
1	0.57	0.06	9.8	Narrow FOV Imaging	0.14-0.45	360	Y	Hybrid Lyot	Required (TTR5)
2	0.66	0.11	16.8	Slit + R~50 Prism Spectroscopy	0.17-0.52	2 × 65	--	Shaped Pupil	Unsupported
3	0.73	0.12	16.8	Slit + R~50 Prism Spectroscopy	0.18-0.55	2 × 65	--	Shaped Pupil	Best effort
4	0.83	0.10	11.7	Wide FOV Imaging	0.45-1.4	360	Y	Shaped Pupil	Best effort

ROMAN TOOLS AND SIMULATIONS

A variety of open-access software and simulation tools gives researchers the ability to explore Roman's capabilities and plan observations.

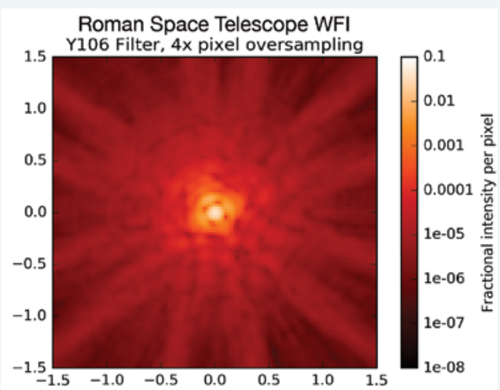


WFI footprint on DSS image of Andromeda

FIELD OF VIEW OVERLAY

A tool that allows for quick display of the Wide Field Instrument or Coronagraph footprint over a DSS, SDSS, or GALEX image of a specified target

- Object catalogs can be extracted and shown in a separate window
- Uses functionalities of the Mikulski Archive for Space Telescopes (MAST)
- As MAST Portal functionality expands, tool features will improve

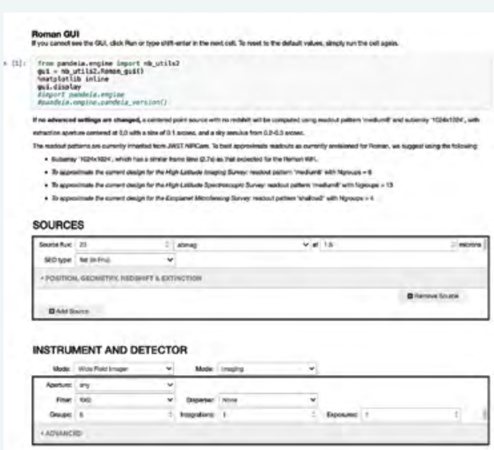


Simulated Roman/WFI PSF
in the Y106 filter

PSF SIMULATION (WEBBPSF)

A customizable multi-mission interface to perform realistic, field-dependent point-spread function (PSF) simulations and calculations

- Simulated PSFs are critical to predict the performance of the observatory and to simulate scenes
- WebbPSF accounts for pupil shapes, source spectral energy distributions, filter bandpasses, and field-dependent aberrations
- WebbPSF contains flexible Python tools for analysis or export of PSFs



Pandeia provides a GUI as a Jupyter notebook
for ease of use

SOURCE SIMULATION AND EXPOSURE TIME CALCULATION (PANDEIA)

A multi-mission data cube simulator and signal-to-noise ratio/exposure time calculator (ETC)

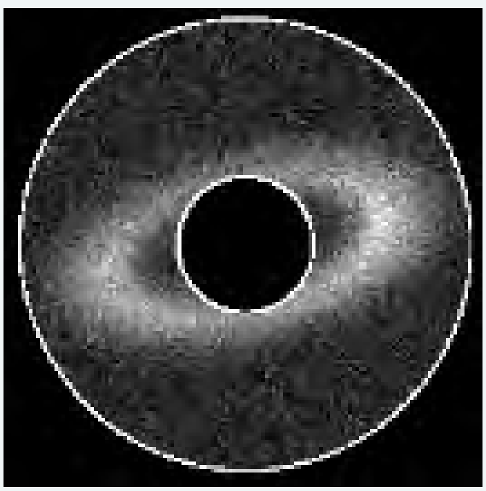
- Accounts for the effects of wavelength-dependent PSFs and pixel-to-pixel correlations inherent to modern IR detectors
- Self-contained Python package designed for scripting calculations

Simulated composite-color Roman/WFI globular cluster image

COMPLEX SCENE SIMULATION (STIPS)

A tool designed to produce full-scene pipeline-processed simulated data of complex astronomical scenes

- Generate complex astronomical scenes through user-specified inputs (e.g., star cluster structural and population characteristics)
- Possibility to include post-pipe-line data reduction residuals

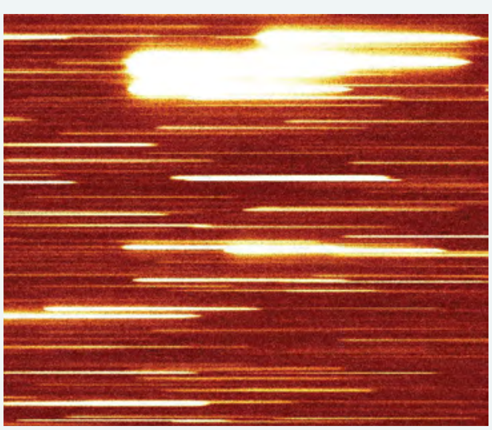


Shaped Pupil Coronagraph Mode simulation: difference image between a target and reference star

SIMULATIONS SUPPORTING THE CORONAGRAPH INSTRUMENT

A set of simulations for demonstrating and planning direct imaging investigations

- Instrument Models (e.g., Coronagraph Pupil, Off-axis PSF, additional instrument parameters)
- Astrophysical Data and Models (e.g., Exoplanet Characterization, circumstellar Disks)
- Public Simulated Coronagraph Instrument Data (e.g., Observing scenarios, dark hole algorithms)



Portion of simulated WFI grism observation of 3,300 individual objects; 7.5' × 3.75' FOV

SIMULATIONS SUPPORTING SPECTROSCOPY MODE

Simulations demonstrating WFI grism observations in support of galaxy redshift surveys

- Generation of the sky scene using lists of galaxies with difference fluxes, sizes, and SEDs
- Realistic sky simulations to test the effects of crowding and contamination, in particular as a function of the grism dispersion
- Galaxy parameter simulations to test a range of $H\alpha$ emission line fluxes at different redshifts
- aXeSIM adopted from HST/WFC3 spectral simulations to Roman/WFI

https://www.stsci.edu/roman/science-planning-toolbox
https://roman.ipac.caltech.edu/sims/Simulations_csv.html

ROMAN OPERATIONS

The Nancy Grace Roman Space Telescope is managed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, with participation by the Space Telescope Science Institute in Baltimore, Maryland; Caltech/IPAC in Pasadena, California; and NASA's Jet Propulsion Laboratory in Pasadena, California; and a science team comprising scientists from various research institutions. The primary industrial partners are Ball Aerospace and Technologies Corporation in Boulder, Colorado; L3Harris Technologies in Melbourne, Florida; and Teledyne Scientific & Imaging in Thousand Oaks, California.

STScI SCIENCE OPERATIONS CENTER

The Space Telescope Science Institute serves as Roman's Science Operations Center (SOC). The SOC is responsible for the mission's observation scheduling system, WFI data processing system for the imaging mode, high-level science products for all imaging, and the mission's entire data archive. STScI has performed pre-formulation, formulation, and design activities for Roman, and continues its role in science operations system engineering, design, science research support, scientific community engagement, and public outreach. Technical reports on various mission topics are available at the STScI Roman Space Telescope Documentation webpage.

IPAC SCIENCE SUPPORT CENTER

IPAC is home to the Roman Science Support Center. IPAC is responsible for operations and support for the coronagraph instrument technology demonstration, high-level data processing of grism and prism data from the Wide Field Instrument (WFI), high-level data processing of WFI microlensing data, and community engagement for Roman exoplanet science and wide field spectroscopy. IPAC will also manage the Guest Investigator proposal, peer review, and community grant process; curate telescope instrument and simulation efforts; and engage the greater scientific community in preparing for science with Roman.

JPL CORONAGRAPH INSTRUMENT CONSTRUCTION AND DEVELOPMENT

NASA's Jet Propulsion Laboratory is building Roman's Coronagraph Instrument and is involved with detector validation and developing the coronagraph's science capabilities. JPL will also provide technical support to IPAC during coronagraph operations and data analysis.

GSFC MISSION OPERATIONS CENTER

Goddard Space Flight Center hosts Roman's mission operations center, which communicates with and sends commands to the observatory, monitors the health and safety of Roman, and plans and executes all propulsion and spacecraft activities. Goddard also leads the development of the Wide Field Instrument (WFI), including detector and optical validation, is building the Spacecraft Bus, and is responsible for integrating the instruments, telescope and spacecraft into the complete observatory (system integration).

LEARN MORE ABOUT THE ROMAN SPACE TELESCOPE

STSCI

www.stsci.edu/roman

GODDARD

roman.gsfc.nasa.gov

IPAC

roman.ipac.caltech.edu

JPL

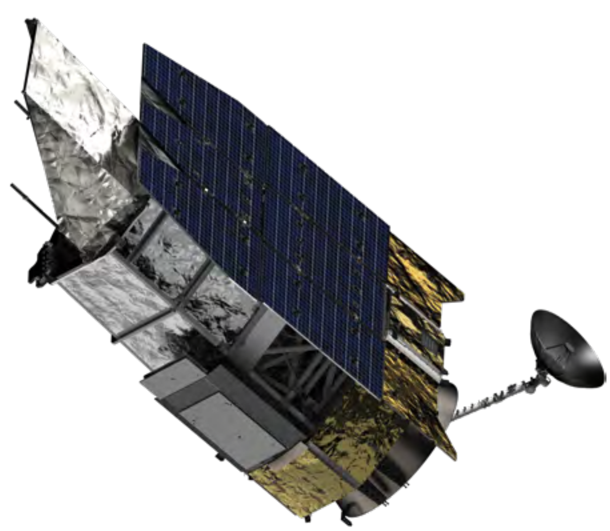
jpl.nasa.gov/missions/the-nancy-grace-roman-space-telescope

SCIENCE PUBLICATIONS AND TECHNICAL DOCUMENTATION

stsci.edu/roman/documentation

ROMAN USER DOCUMENTATION (RDox)

roman-docs.stsci.edu



A NEW NASA FACILITY FOR THE ENTIRE ASTRONOMICAL COMMUNITY

NANCY GRACE ROMAN SPACE TELESCOPE

Hubble-Like Resolution: ~0.1''

Near-Infrared Imaging and Spectroscopy: 0.48–2.3 μm

High-Contrast Coronagraph Demonstration: Potentially 10^{-9} Post-Processed Contrast

Expansive Field of View: 0.281 deg^2

All Data Nonproprietary: ~4 PB/yr

Complementing Other Observatories: HST, JWST, Rubin, Gaia, Euclid, TESS, and more

Propelling Future Discoveries: All of Astrophysics

Learn more about the Roman Space Telescope

The Nancy Grace Roman Space Telescope is managed by NASA's Goddard Space Flight Center (Mission Operations Center), with participation by the Space Telescope Science Institute (Science Operations Center), Caltech/IPAC (Science Support Center), and NASA's Jet Propulsion Laboratory (Coronagraph Instrument).

STScI

ipac

Goddard: https://roman.gsfc.nasa.gov **STScI:** https://www.stsci.edu/roman **IPAC:** https://roman.ipac.caltech.edu

June 2023