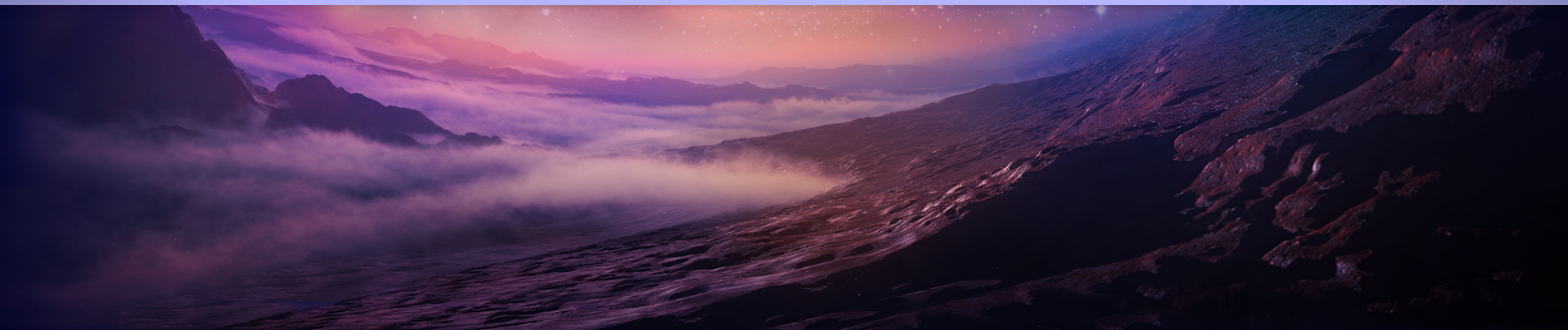
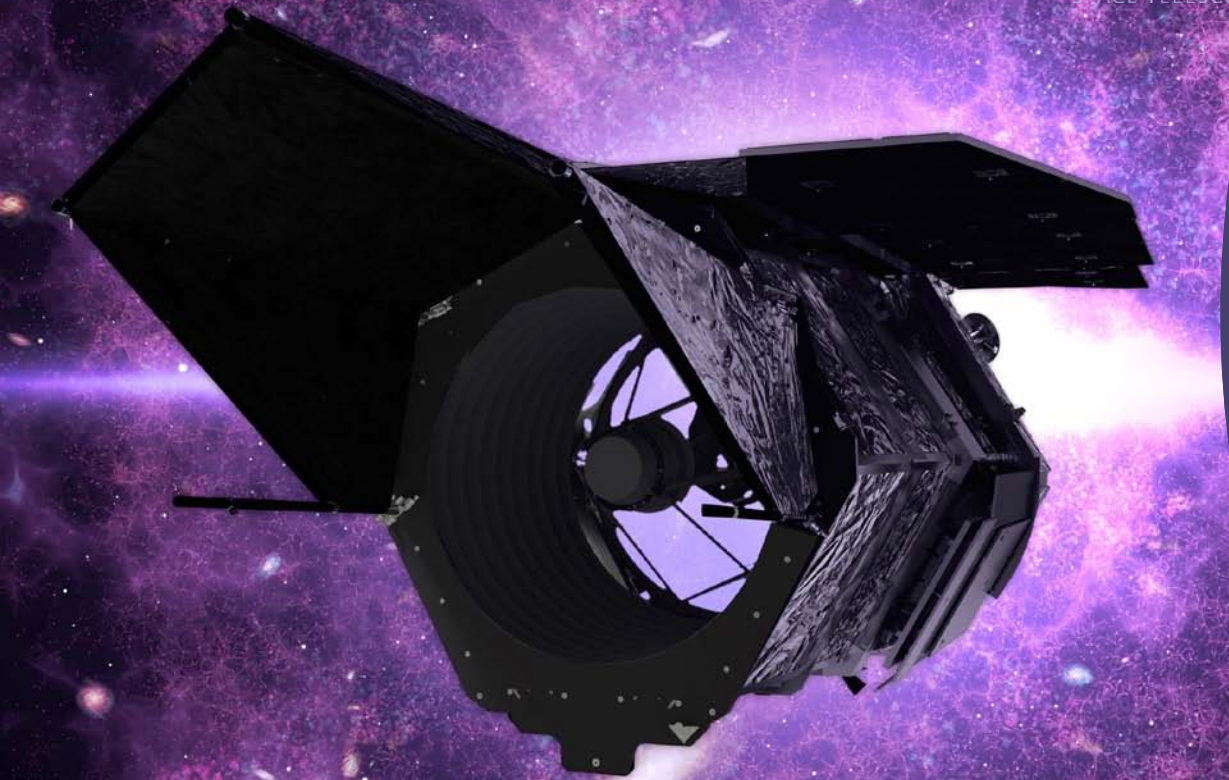
Roman Programmatic Status

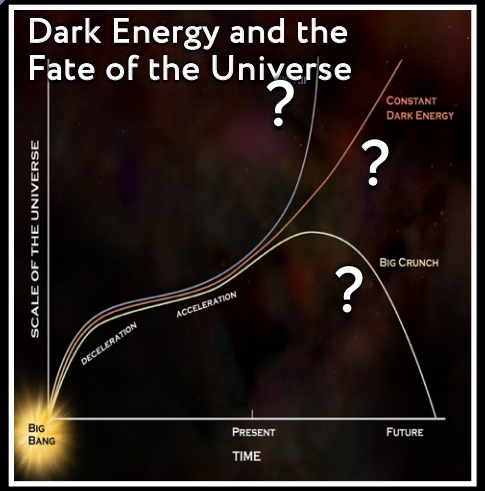
Dominic Benford

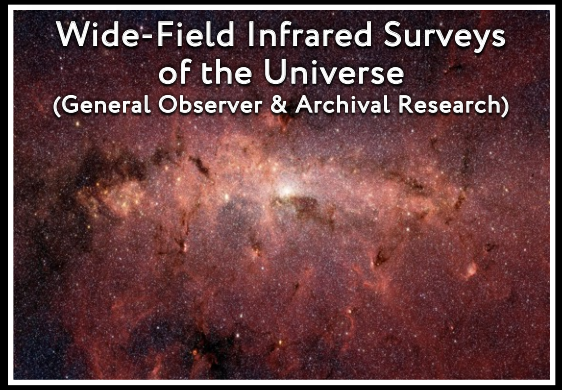


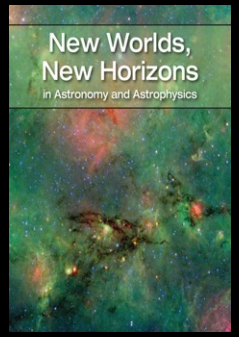
NANCY GRACE ROMAN SPACE TELESCOPE



May 20, 2020 – NASA has named its Wide Field Infrared Survey Telescope (WFIRST), in honor of Nancy Grace Roman, NASA's first chief astronomer, who paved the way for space telescopes focused on the broader universe.

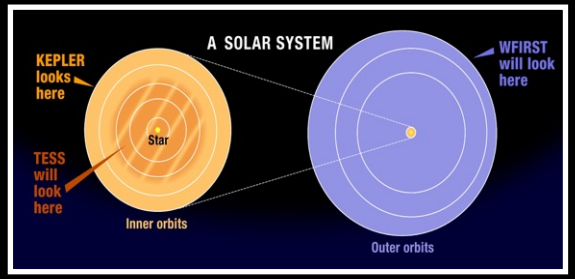




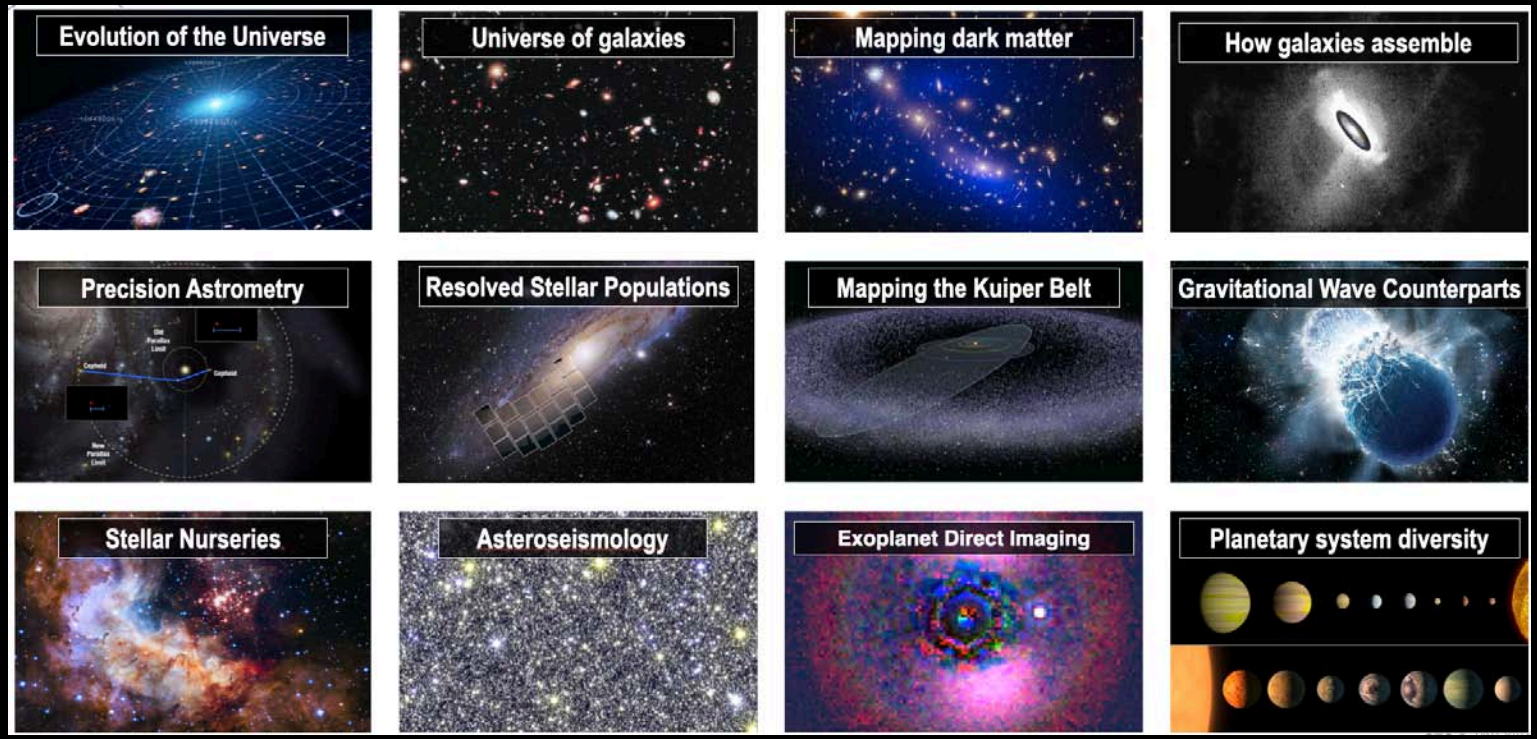


National Academy of Sciences
Astronomy & Astrophysics
Decadal Survey (2010)

The full distribution of planets around other stars



But That is Just the Beginning…

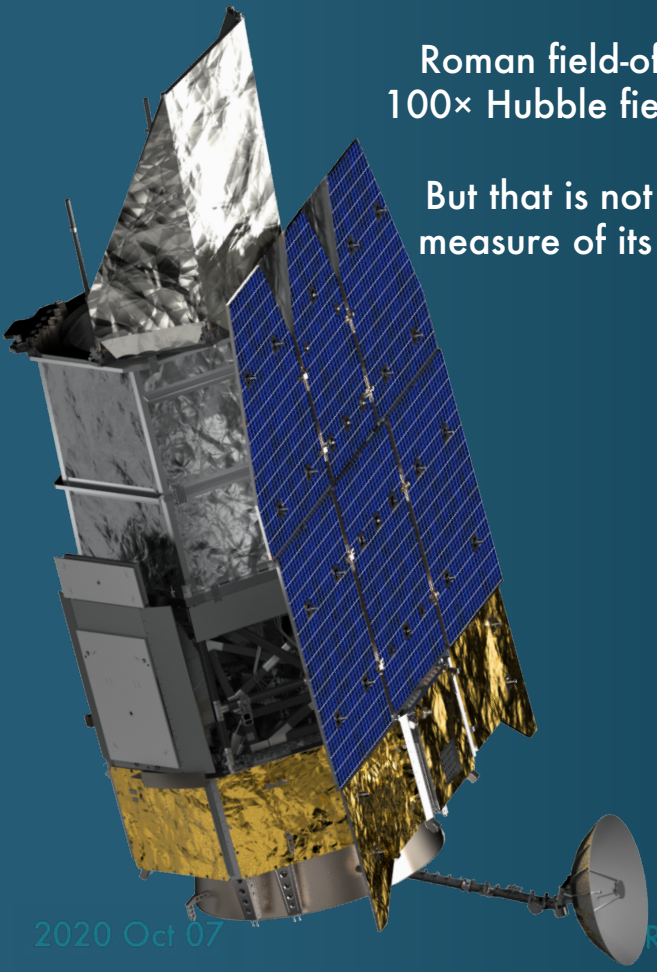


…Roman is a civilization-scale science platform

Roman is for the Community

- All Roman observing time is available through open processes
  - Major *Legacy Surveys* will be defined using a community-driven open process
  - *Key Projects* (funded science investigations using these surveys) will be openly competed
  - Roman observing time will be available for General Observer (GO) projects
  - All data will be available to the community with no period of limited access
- Roman operations will be based on community input
  - NASA and STScI have convened community groups to provide input on balance among observing programs and on trades during development, integration, and test
- Roman General Observers / Archival Researchers Program
  - Use observing time for conducting wide-field infrared surveys of the universe
  - Use data from Roman Legacy Surveys for compelling astrophysics investigations
  - Calls for proposals to be issued before launch and subsequently
- Roman Coronagraph Community Participation Program
  - Ensure "as built" coronagraph is an effective demonstration
  - Call for proposals at the appropriate time

NANCY GRACE ROMAN SPACE TELESCOPE



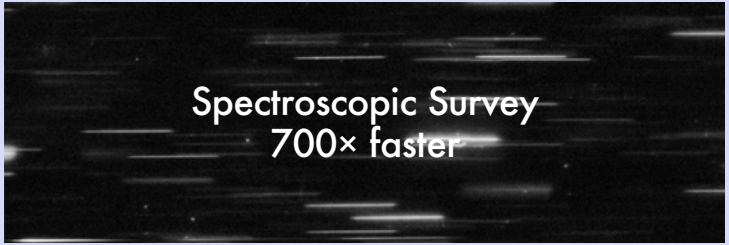
Roman field-of-view is
100× Hubble field-of-view

But that is not the full
measure of its power!

PHAT
PANCHROMATIC HUBBLE ANDROMEDA TREASURY

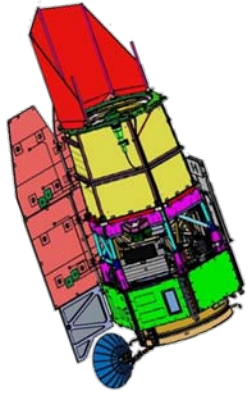
CANDELS
Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey

3D-HST

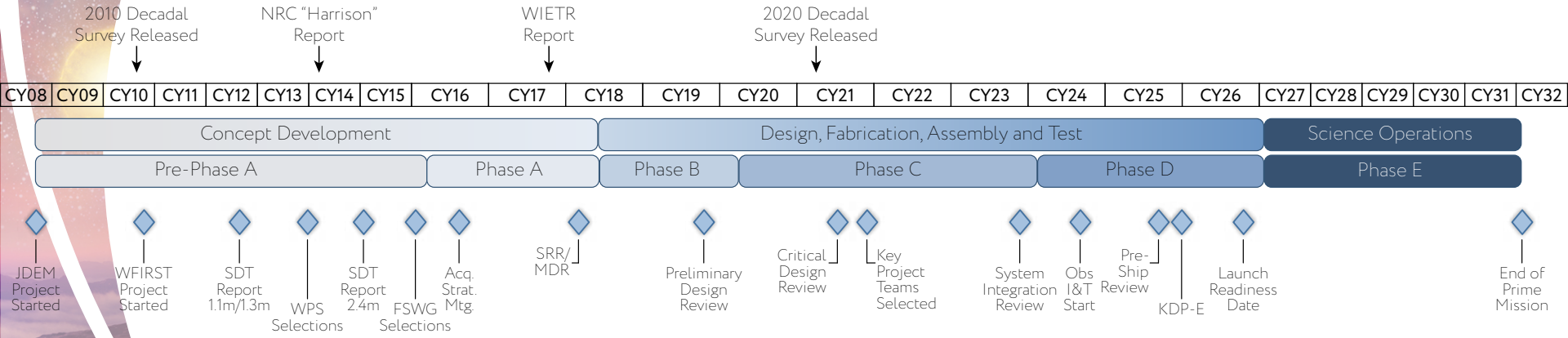


Mission Description

- **Objectives:**
  - Characterize the history of cosmic acceleration and structure growth
  - Understand how planetary systems form and evolve and determine the prevalence of planets in the colder outer regions
  - Provide a peer-reviewed General Observer & Archival Research program
  - Develop and fly a technology demonstration of advanced starlight suppression technology, which could be used for direct imaging and spectroscopy of planets and debris disks.
- **Mission Duration:** 5 years science; 10 year design
- **Orbit:** Sun-Earth L2
- **Instruments:** Wide Field Instrument
  Coronagraph Technology Demonstration
- **Telescope diameter:** 2.4m
- **Observatory size:** 12.4m
- **Dry Mass:** 7801kg
- **Data Volume:** 1.5 TB/day; 20PB in archive after 5 years
- **Science Interfaces:** Proposals via IPAC; Archive via MAST
- **Launch Date:** by October 2026 (NASA commitment)



Timeline

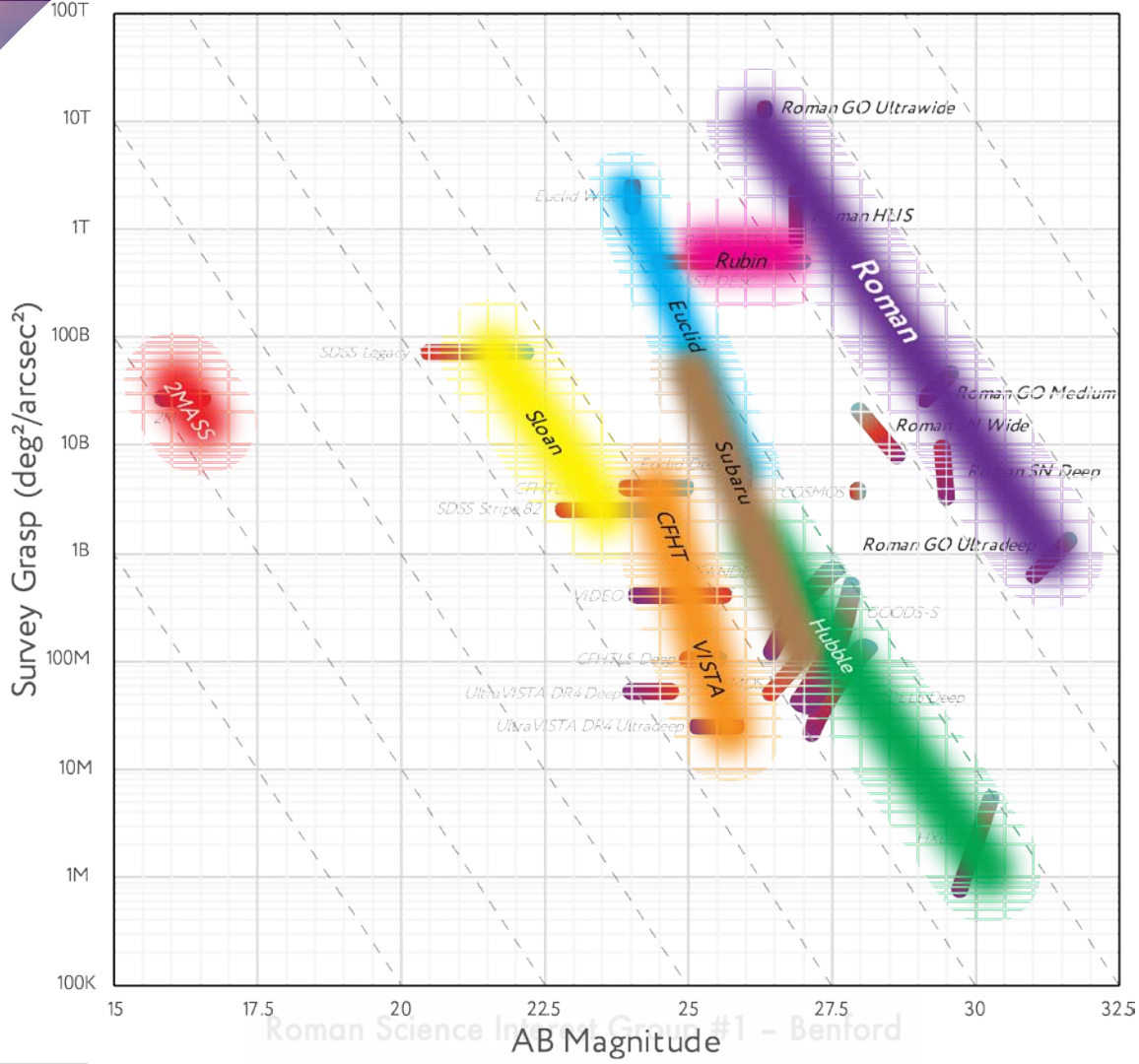

2010 Decadal Survey Released
NRC "Harrison" Report
WIETR Report
2020 Decadal Survey Released
CY08
CY09
CY10
CY11
CY12
CY13
CY14
CY15
CY16
CY17
CY18
CY19
CY20
CY21
CY22
CY23
CY24
CY25
CY26
CY27
CY28
CY29
CY30
CY31
CY32
Concept Development
Design, Fabrication, Assembly and Test
Science Operations
Pre-Phase A
Phase A
Phase B
Phase C
Phase D
Phase E
JDEM Project Started
WFIRST Project Started
SDT Report 1.1m/1.3m
WPS Selections
SDT Report 2.4m
FSWG Selections
Acq. Strat. Mtg.
SRR/ MDR
Preliminary Design Review
Critical Design Review
Key Project Teams Selected
System Integration Review
Obs I&T Start
Pre-Ship Review
KDP-E
Launch Readiness Date
End of Prime Mission

Roman Space Telescope: Where We Are

- Ground System Preliminary Design Review (last PDR) passed on July 24
- Instrument Carrier Critical Design Review (first CDR) passed on September 17
- Given Congressional markup in Summer 2020 that would fund Roman in FY21, during the FY21 CR NASA is continuing to make progress on Roman consistent with the budget profile planned at Phase C start in February 2020
- COVID impacts to schedule and cost: work delayed at NASA, JPL, international partners, contractors, and suppliers; unknown when will return to full efficiency

Roman Budget

- Roman is cost capped.
  - Project Management Agreement:
    Lifecycle cost of $3,000.0M (Roman) and $342.7M (CGI)
- HQ holds reserves to accommodate unforeseen problems
- All project decisions result in a trade of cost/benefit with other things



Roman's surveys are flexible!

How should they be designed?

First Principles (I)

- Roman is a survey mission; this is fundamentally different from prior Great Observatories, and science operations should be designed with that in mind.
- Roman's science program is designed with community involvement to optimize science in an evolving science landscape while enabling Astro2010 Decadal Survey science priorities
- All Roman time is openly competed, including Legacy Surveys (those that enable Astro2010 prioritized science investigations)
- All Roman data are public with no period of restricted access

First Principles (II)

- Roman mission design and science operations shall be able to execute Legacy Surveys
- Roman science program emphasizes surveys leading to major discoveries
  - Legacy Surveys capable of conducting key projects and also enable broad, diverse astrophysics investigations
  - Other surveys to enable broadest range of science
  - General observer program including observations and archival analysis for new, unforeseen science
- Science operations designed first from choices about how to do it (principles above), then about what to do

Evergreen Question for the RSIG

We want to ensure that Roman has the greatest possible scientific impact and intend to operate it for that outcome.

As a member of the astronomical community, what are you most worried about us getting wrong?

BACKUP

Roman Surveys in Context

Roman takes its scientific mandate from Astro2010, and the mission is designed to enable accomplishing that science mandate.

Roman can conduct the definitive supernova cosmology survey;

- Meaning: Roman can conduct a supernova survey that detects roughly 2000 high redshift supernovae, and that by doing this it would provide a constraint on cosmology that improves a metric (e.g., the dark energy task force figure of merit), by a factor of at least two, in isolation, over any prior or planned supernova survey.

Roman can conduct the most precise weak lensing survey;

- Meaning: Roman can conduct a survey for weak lensing that can detect 1 billion galaxies, has better control of systematics, and higher surface density than other prior/planned large surveys

Roman can conduct the most precise galaxy redshift survey;

- Meaning: Roman can conduct a survey of galaxy redshifts with millions of detections and nP greater than one at redshifts around $z \approx 2$.

Roman can conduct the definitive microlensing survey.

- Meaning: Roman can conduct a microlensing survey of exoplanets that find lots of Earth-mass planets near and outside the habitable zone.

Instrument Capabilities

Roman Space Telescope Imaging Capabilities							
Telescope Aperture (2.4 meter)		**Field of View** (45′x23′; 0.28 sq deg)		**Pixel Scale** (0.11 arcsec)		**Wavelength Range** (0.5-2.0 μm)	
Filters	**F062**	**F087**	**F106**	**F129**	**F158**	**F184**	**W146**
Wavelength (μm)	0.48-0.76	0.76-0.98	0.93-1.19	1.13-1.45	1.38-1.77	1.68-2.00	0.93-2.00
Sensitivity (5σ AB mag in 1 hr)	28.5	28.2	28.1	28.0	28.0	27.5	28.3

Roman Space Telescope Spectroscopic Capabilities				
	Field of View (sq deg)	**Wavelength (μm)**	**Resolution**	**Sensitivity (AB mag) (10σ per pixel in 1hr)**
Grism	0.28 sq deg	1.00-1.93	461	20.5 at 1.5 μm
Prism	0.28 sq deg	0.75-1.80	80-180	23.5 at 1.5 μm

Roman Space Telescope Coronagraphic Capabilities					
	Wavelength (μm)	**Inner Working Angle (arcsec)**	**Outer Working Angle (arcsec)**	**Detection Limit***	**Spectral Resolution**
Imaging	0.5-0.8	0.15 (exoplanets) 0.48 (disks)	0.66 (exoplanets) 1.46 (disks)	10^{-9} contrast (after post-processing)	47-75
Spectroscopy	0.675-0.785				

https://roman.gsfc.nasa.gov/science/WFIRST_Reference_Information.html

ACRONYM LIST

ACRONYMS

AA - Associate Administrator
ABC - Agency Baseline Commitment
ACS – Attitude Control Subsystem
AI&T – Assembly Integration and Test
APMC - Agency Program Management Council
ATO – Authority to Test
ATT – Authority to Operate
AU – Astronomical Unit
C&DH - Command and Data Handling
CANDLES –Cosmic Assembly Near-Infrared Deep Extragalactic Legacy Survey
CBE –Current Best Estimate
C&DH - Command and Data Handling
CDM – Continuous Diagnostics & Mitigation
CGI - Coronagraph Instrument
CISO – Center Chief Information Security Officer
CLA - Coupled Loads Analysis
CDM/TLM/TRK- Command/Telemetry/Tracking
CNES – Centre National d'Etudes Spatiales
COSMOS – HST Cosmic Evolution Survey
CTC – Coronagraph Technology Center
DAC - Deployable Aperture Cover
DLR - Deutsches Zentrum für Luft- und Raumfahrt
DM - Deformable Mirror
DPE – Deployments
DPM – Deputy Project Manager
DSN – Deep Space Network
ECP – Engineering Change Proposal
EEE – Electrical, Electronic, Electromechanical
ELT – Encumbrances/Liens/Threats
EPS – Electrical Power Subsystem
ESA – European Space Agency
EWTA – Element Wheel Thermal Analysis
FEM – Finite Element Model
FDOA – Flight Dynamics Operations Area
FSW – Flight Software
FSWG - Formulation Science Working Group
GCE – Ground Control Electronics
GI – Guest Investigator
GO - General Observer
GS - Ground System
GSFC – Goddard Space Flight Center
GW – Guide Window
Gyr – Giga Year
H – Hubble Constant
HDBK - Handbook
HGAS - High Gain Antenna System
HK – Housekeeping
HST – Hubble Space Telescope
HVA – High Value Asset
IA – International Agreement
IBR – Integrated Baseline Review
IC - Instrument Carrier
IC&DH – Instrument Command & Data Handling
IFA – Image Formation Assembly
IPAC – Infrared Processing and Analysis Center
JAXA – Japanese Aerospace Exploration Agency
JCL – Joint Confidence Level
JPL – Jet Propulsion Laboratory

ACRONYMS

Ka – Ka Band (Frequency)
KDP-C – Key Decision Point –C
KSC - Kennedy Space Center
L2 – LaGrange 2 Orbit
L3Harris – Contractor for OTA
LCC – Life Cycle Cost
LED – Light-Emitting Diode
LISS – Lower Instrument Sun Shades
LLVIS – Launch Lock & Vibration Isolation System
LOA – Letter of Agreement
LRD – Launch Readiness Date
LSP - Launch Services Program
LV – IRD Launch Vehicle Interface Requirements Document
MA - Management Agreement
MCE – Mechanism Control Electronics
MOC - Mission Operations Center
MOU – Memorandum of Understanding
MPDR - Mission Preliminary Design Review
MPIA - Max Plank Institute for Astronomy
NOA – New Obligation Authority
NEN – Near Earth Network
NGIS – Northup Grumman Innovation Systems
NPR – NASA Procedural Requirements
NRC – National Research Council
NWNH – New Worlds, New Horizons
NPR – NASA Procedural Requirements
NRC – National Research Council
NWNH – New Worlds, New Horizons
OBA - Outer Barrel Assembly
OTA - Optical Telescope Assembly
OTA/AOM – Optical Telescope Assembly/Aft Optics Module
PACE – Plankton, Aerosol, Cloud and ocean Ecosystem
PBR – President's Budget Request
PHAT – Panchromatic Hubble Andromeda Treasury
PLRA - Program Level Requirements Appendix
PM - Primary Mirror
PSP – Participating Science Program
PSF – Point Spread Function
PV - Passivation
RAO – Resources Analysis Office (GSFC)
RF – Radio Frequency
RFA - Request for Action
RFI - Request for Information
RFP - Request for Proposal
RMF – Risk Management Framework
RW – Reaction Wheel
SAPP – Space Asset Protection Program
SASS - Solar Array Sun Shield
SCaN- Space Communications and Navigation
SDL – Space Dynamics Laboratory
SDSS – Sloan Digital Sky Survey
SIT - Science Investigation Teams
SMD - Science Mission Directorate
SN1a – Supernova Type 1a
SOC - Science Operations Center
SRB – Standing Review Board
SSC – Science Support Center
ST/IRU – Star Tracker Initial Reference Unit
STOP – Structural, Thermal, Optical
STScI - Space Telescope Science Institute
SW – Software
TB – Terabytes
TBD – To Be Determined
TBR – To Be Resolved
TMC – Technical/Management/Cost
TB – Terabytes

ACRONYMS

TBD – To Be Determined
TBR – To Be Resolved
TMC – Technical/Management/Cost
TOMA - Tertiary Optical Mirror Assembly
TPM – Technical Performance Monitor
TWTA - Traveling Wave Tube Amplifier
UFE – Unallocated Future Expense
W - Watts
WFE – Wave Front Error
WFI - Wide Field Instrument
WFIRST - Wide Field Infrared Survey Telescope
WIETR – WFIRST Independent External Technical/Management/Cost Review
Z – Redshift quantity
Zn - Zinc