Philanthropic Funding of

Next-Generation Telescopes

Experimenting with New Models for Scientific Infrastructure

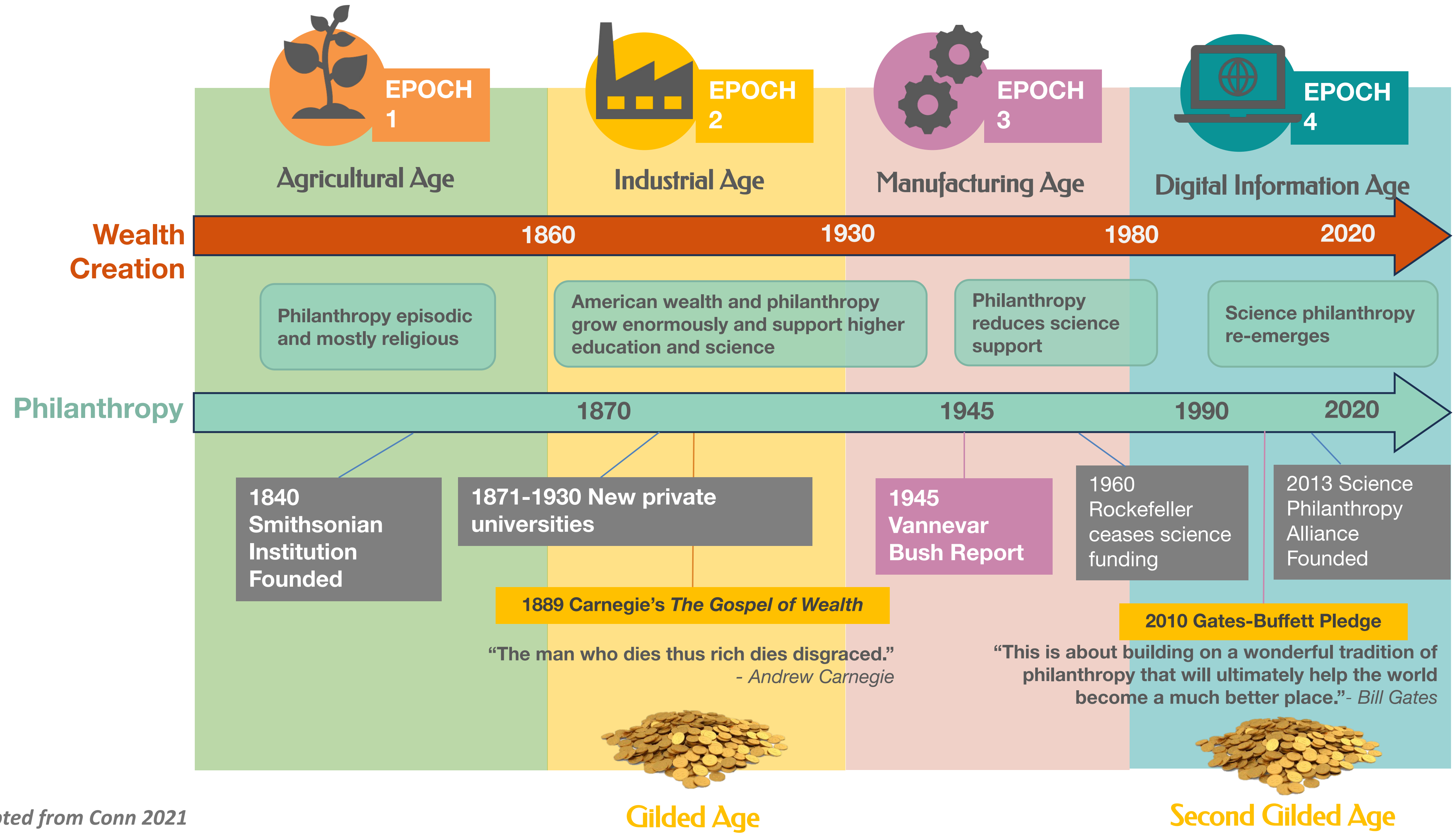
ARPITA ROY
SCHMIDT SCIENCES

The Eric and Wendy Schmidt Observatory System

“Science philanthropy has always played a **critical and leading role** in America’s approach to research and development, with a history that predates much of the federal funding apparatus.”

Michelson & Falk, 2021

The Four Epochs of American Wealth Creation & Philanthropy



Adapted from Conn 2021

What can science philanthropy uniquely contribute?

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Risk tolerance

Philanthropy can fund ideas too early-stage or uncertain for traditional peer review — creating space for high-risk hypotheses to develop before they're ready for public competition.

Speed and flexibility

Decisions can be made quickly and revised as evidence changes, without multi-year budget cycles or the accountability structures that discipline public investment.

Deliberate complementarity

Rather than duplicating existing strengths, philanthropy can identify gaps in the funding landscape and direct resources where public mechanisms are least likely to reach.

Experimentation with models

Philanthropy can test new approaches to how science is organized and infrastructure is built — informing how public investments are structured over time.

Schmidt Sciences

Bold science, deep and continuous collaborations

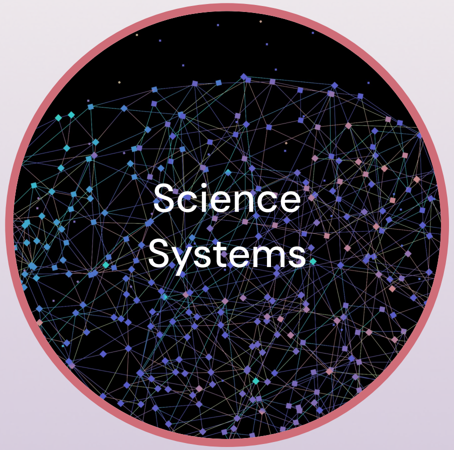
The Eric and Wendy Schmidt
Observatory
System

SCHMIDT SCIENCES MISSION

Accelerate scientific knowledge and breakthroughs with the most promising, advanced tools to support a thriving planet

Our team seeks out researchers pursuing **early-stage, high-risk** hypotheses that address everything from basic-science questions to pressing problems facing the planet.

Founded in 2024, Schmidt Sciences brings together the science-focused efforts of Eric and Wendy Schmidt, whose philanthropy works toward a healthy, resilient, secure world for all. We prioritize research in **five centers** poised for revolutionary impact:



Astrophysics & Space Center

The Eric and Wendy Schmidt
Observatory
System

GOALS

Astrophysics & Space

Expand the frontiers of astrophysics and spur discovery through the implementation of **cutting edge technology** and the cultivation of **world-class talent**

Drastically **reduce the cost and time curves** for development by **embracing risk**, **cross-pollinating** ground and space-based technologies, and encouraging **collaboration across industry and academia**

Democratize access to astronomy resources by supporting global usage and **open science** while **empowering early-career** researchers to be the first users of new assets

Promote **widespread and reliable integration of AI** and advanced computing into astrophysics

The Schmidt Observatory System

An experiment in new models for astrophysical infrastructure

The Eric and Wendy Schmidt Observatory System

- A philanthropic effort to **design, build, and operate** new astronomical observatories
- Shared philosophy: **modular** design, **rapid** development, **open** scientific access
- Ground-based and space-based components, developed together **with hybrid approach**
- An opportunity to test whether **alternative development and operating models** can provide world-class science

Why An “Observatory System”?

The Eric and Wendy Schmidt Observatory System

Technology enables science

- Coordination is much easier to build in from inception than to retrofit — shared scheduling, data standards, and interoperability require **shared decisions made early**

- **Shared infrastructure reduces duplication**: one time allocation process, common archives, and software tools designed to work across facilities

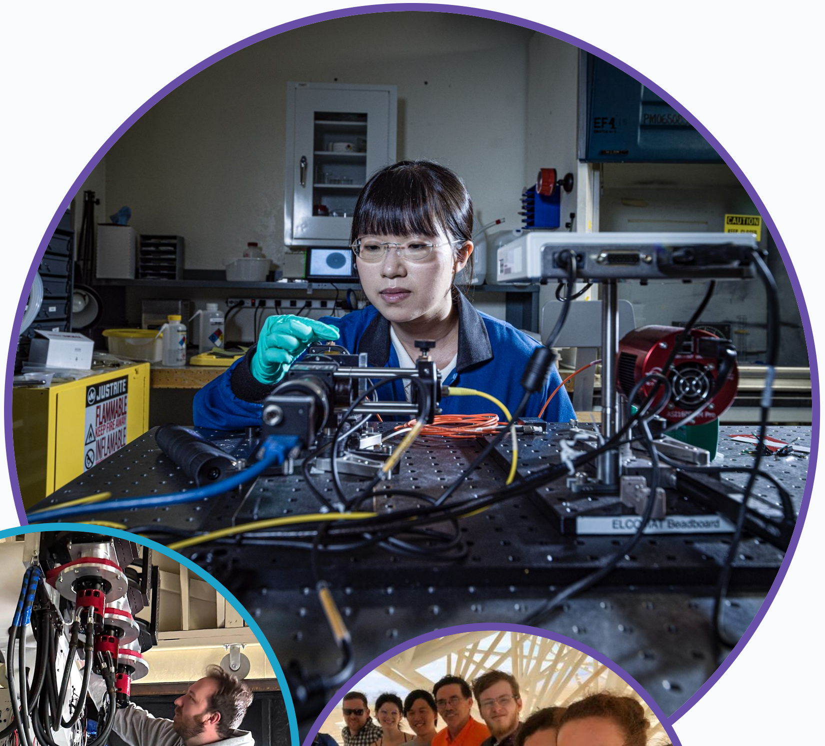
- Cross-observatory science — spanning radio, optical, and space — becomes a **first-class capability** rather than an afterthought

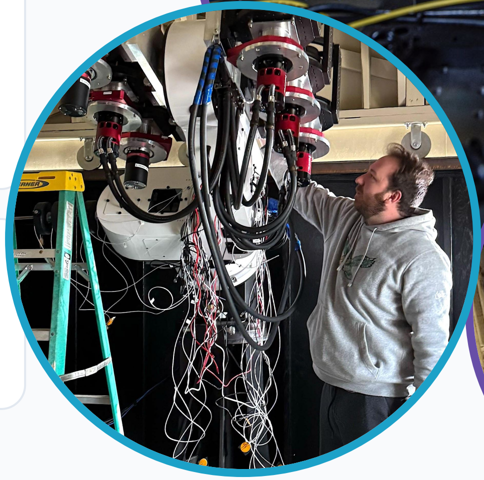
A Different Development Curve

Iteration, risk, and learning

The Eric and Wendy Schmidt Observatory System

- Earlier scientific return through **iterative development cycles**
- Acceptance of **calibrated risk** to enable lower-heritage technologies or teams
- **Learning through deployment** rather than prolonged derisking — real users must interact with the technology
- **Approach is an experiment** in itself: we are learning and tuning as we go





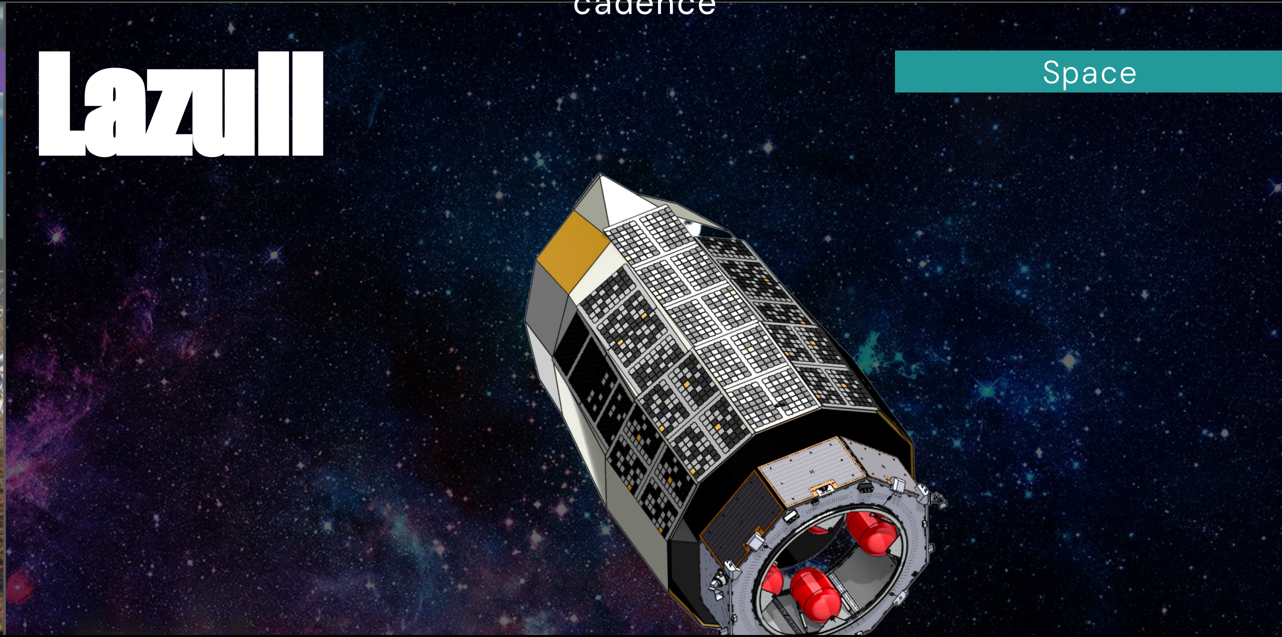
Meet the Observatories

Four facilities, each testing a different hypothesis about how astrophysical infrastructure can be built and operated

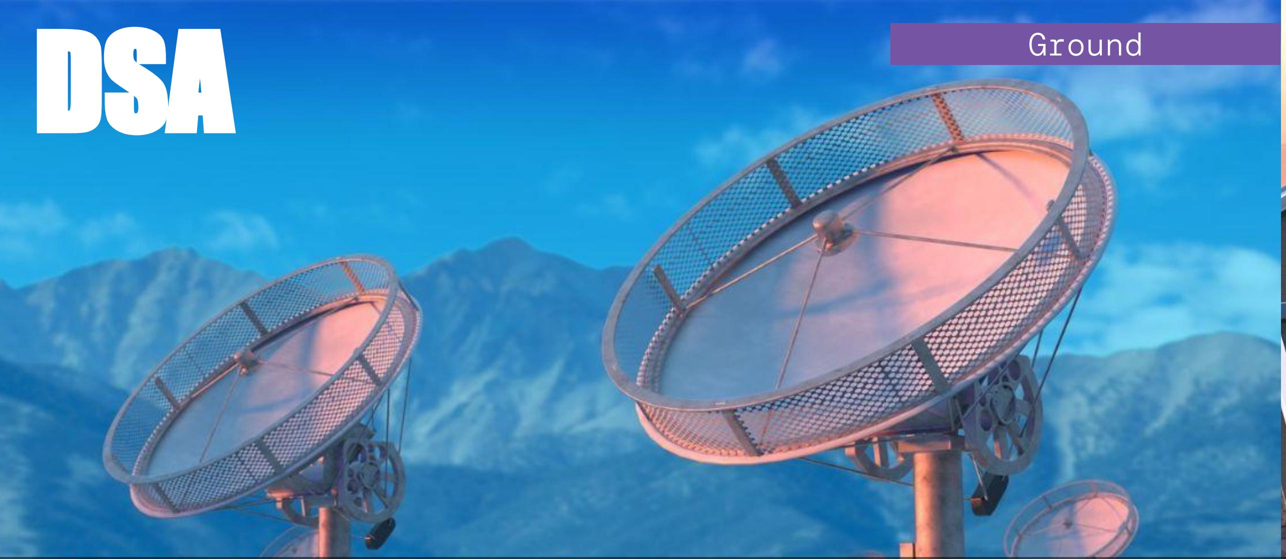
0.7-2 GHz · 3″ resolution · 500 nJy · >1B radio sources

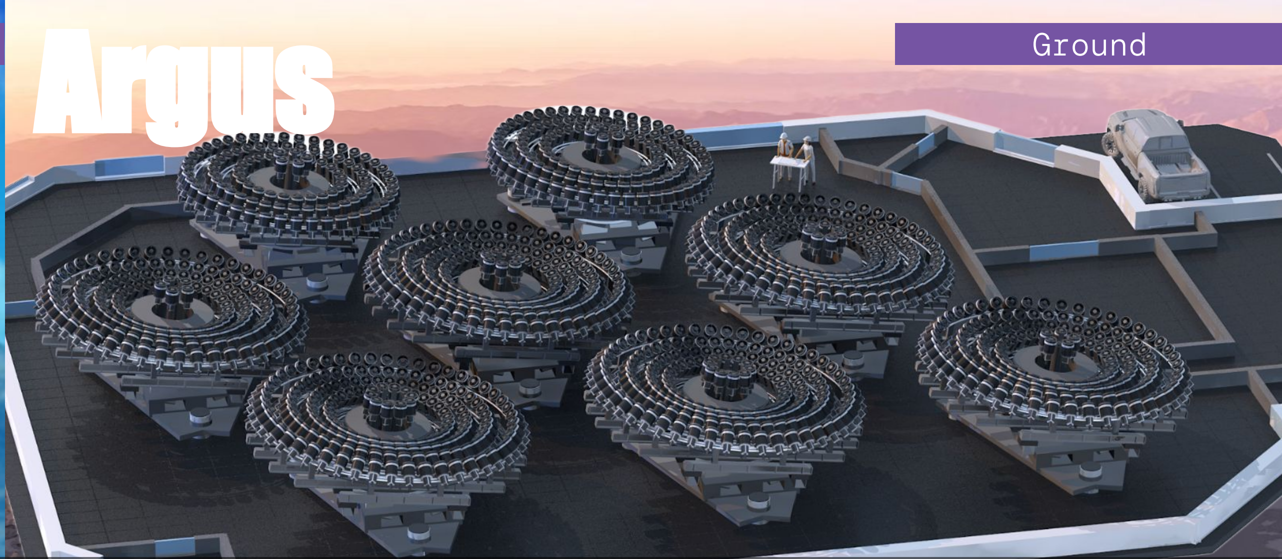
1,200 telescopes · 8,000 deg^2 · 122 Gpix · second-minute cadence

Modular array · R ~1k-100k · 0.35-2 μm · rapid turnaround



3m unobscured · 400-1700nm · 4hr response · 10^{-8} contrast

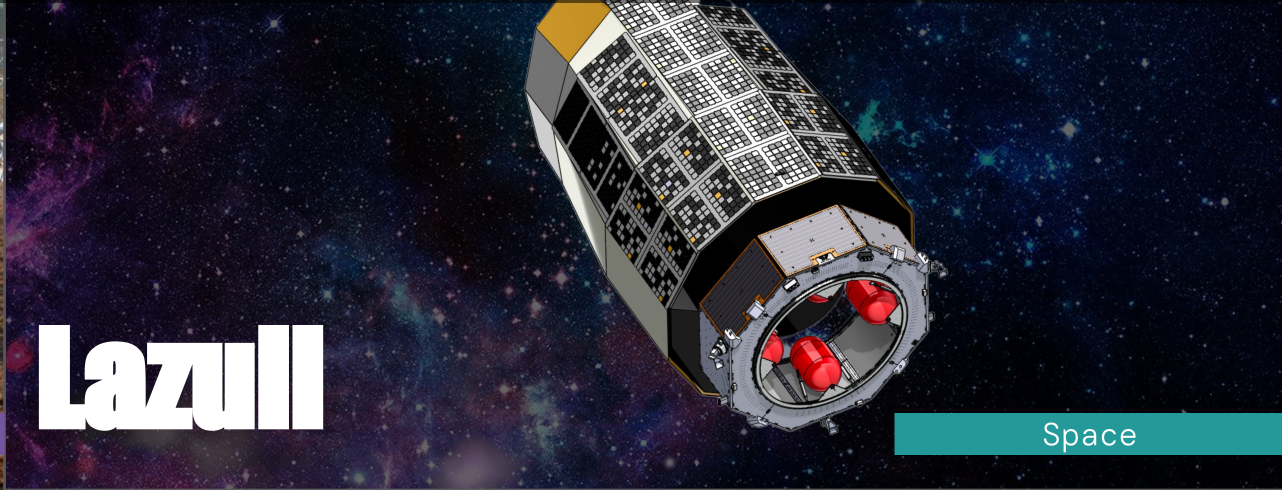




SCHMIDT OBSERVATORY SYSTEM SHARED INFRASTRUCTURE

- Time Allocation
- Dynamic Scheduling
- Operations Coordination
- Computing Power
- Analysis Software
- Data Archive
- Research Support

these shared systems are in active development alongside the observatories themselves



Ground-Based Observatory

DSA

Real-time images of the dynamic radio sky

Deep Synoptic Array

Capturing the Dynamic Radio Sky

The Eric and Wendy Schmidt Observatory System

Technical Specifications

- ~1650 x 6.15m dishes (20 x 16 km)
- Spring Valley, Nevada
- Frequency: 0.7 - 2 GHz band
- Spatial resolution: 3 arcseconds
- Field of view: 5 deg^2

Highly optimized for surveys

Enabled by two key technical innovations:

- The first radio camera
- An uncooled antenna/receiver

Credit: DSA Team

Credit: DSA Team

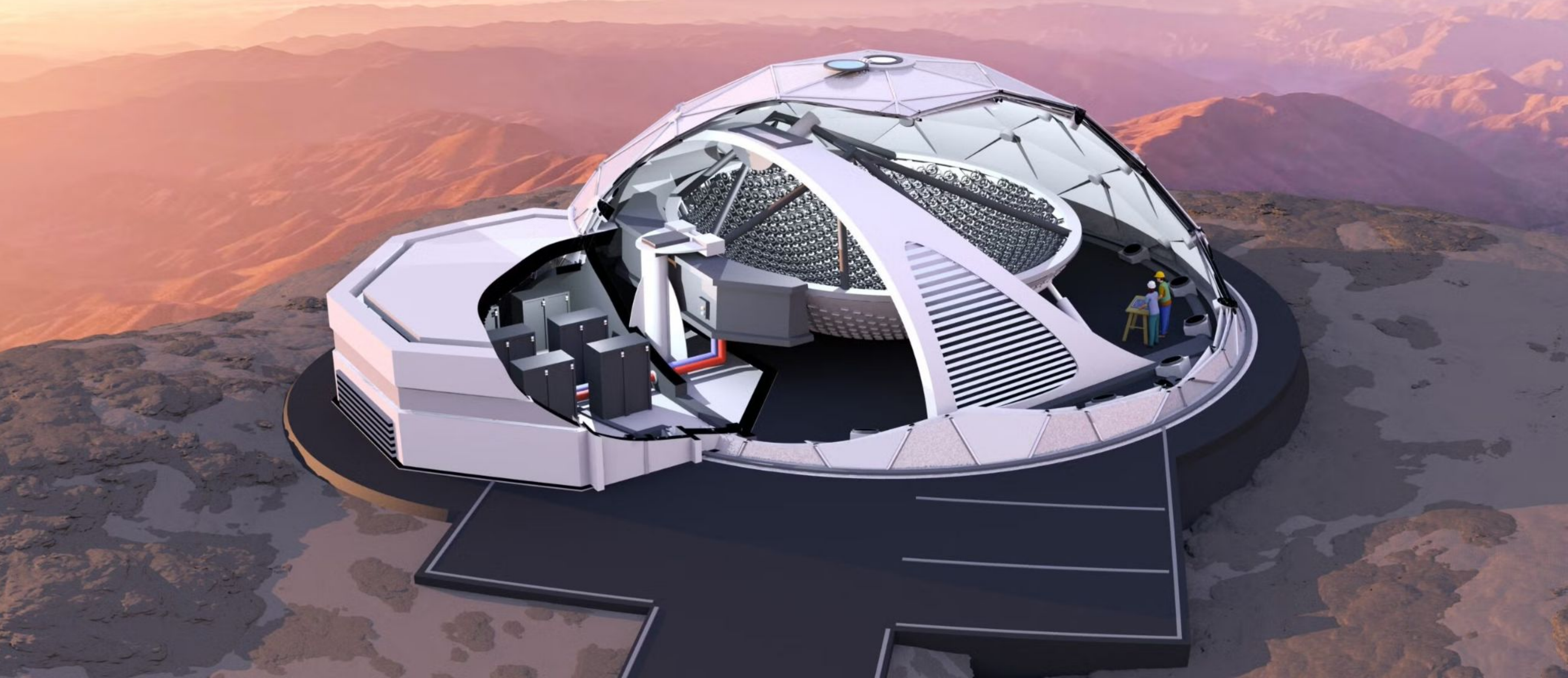
Fixing the 'Broken Mirror' Problem

Antenna Layout + Modern Compute


Google Earth
Landsat / Copernicus, Data SIO, NOAA

Argus

An action movie of the night sky



The Argus Array

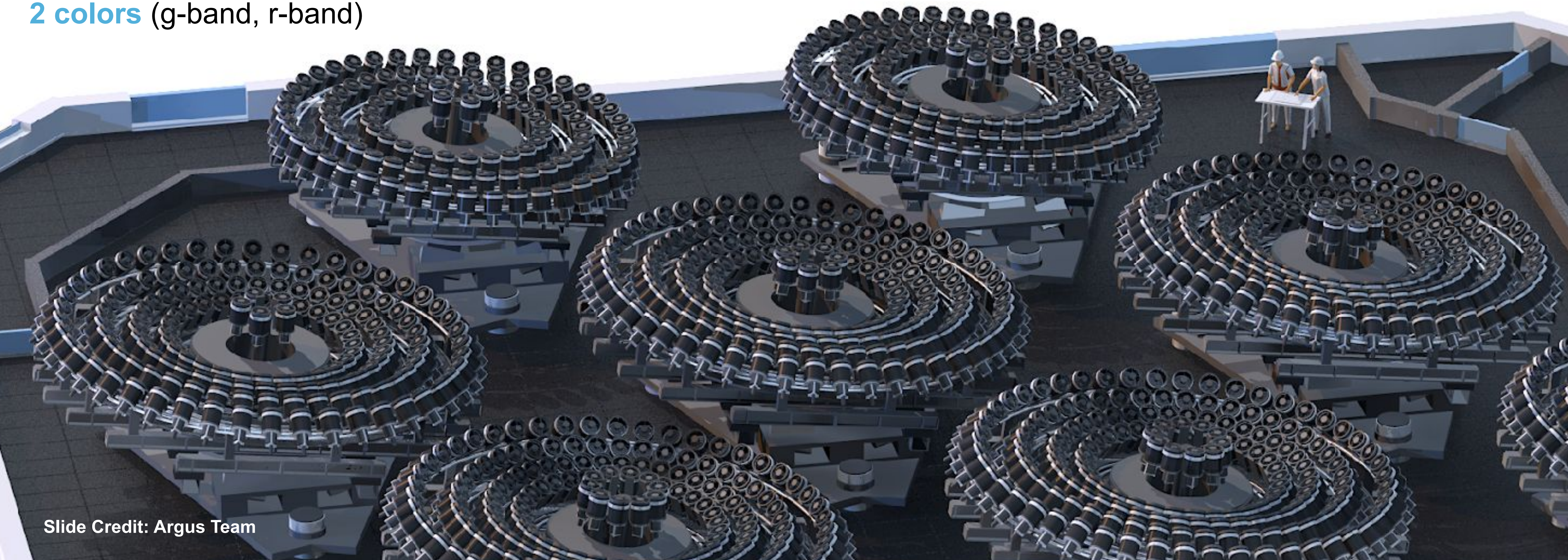
8m-class telescope, 1,212 sub-telescopes

122 gigapixel low-noise, high-speed camera system

8,000 square degree field of view

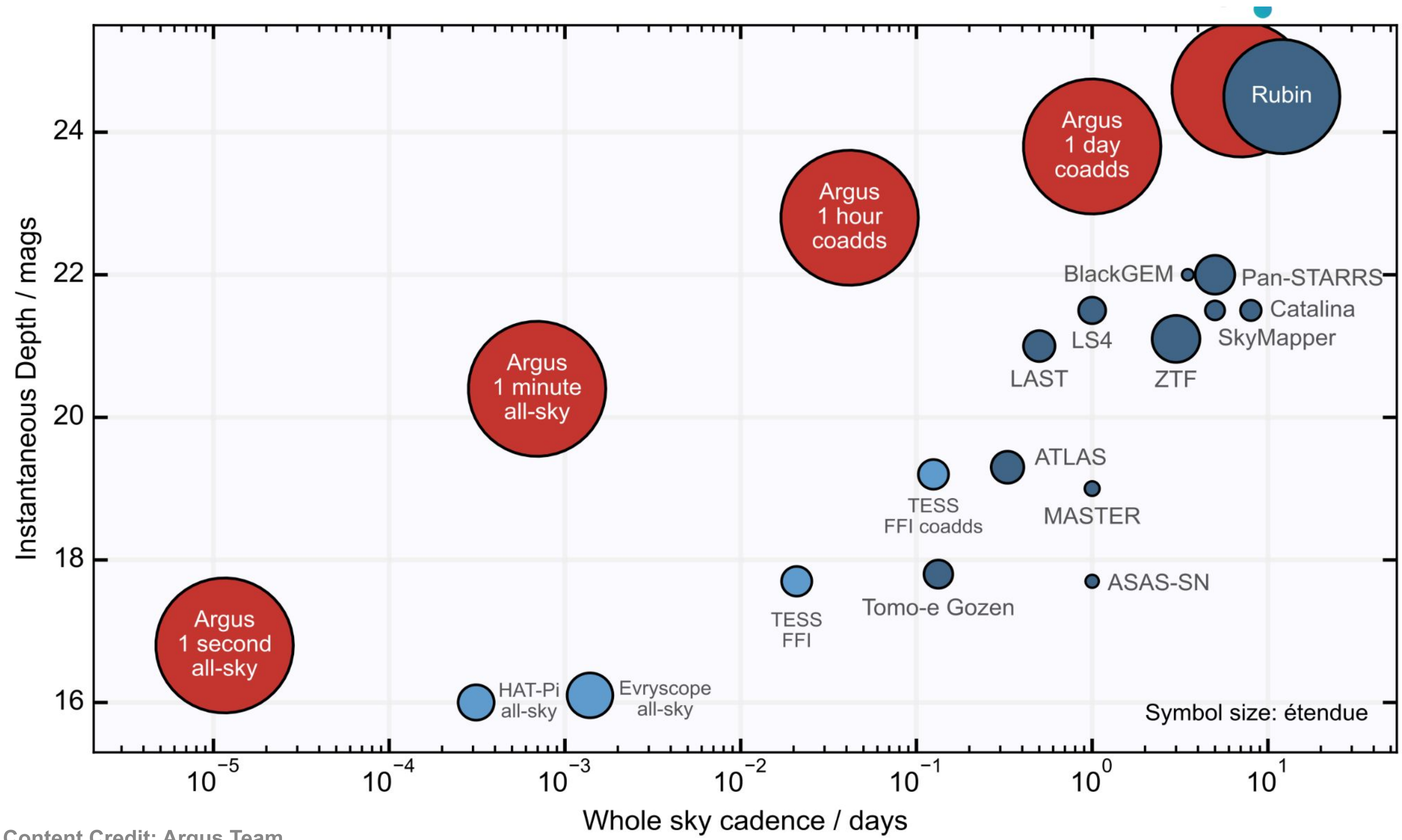
1.0 arcsec per pixel sampling

2 colors (g-band, r-band)



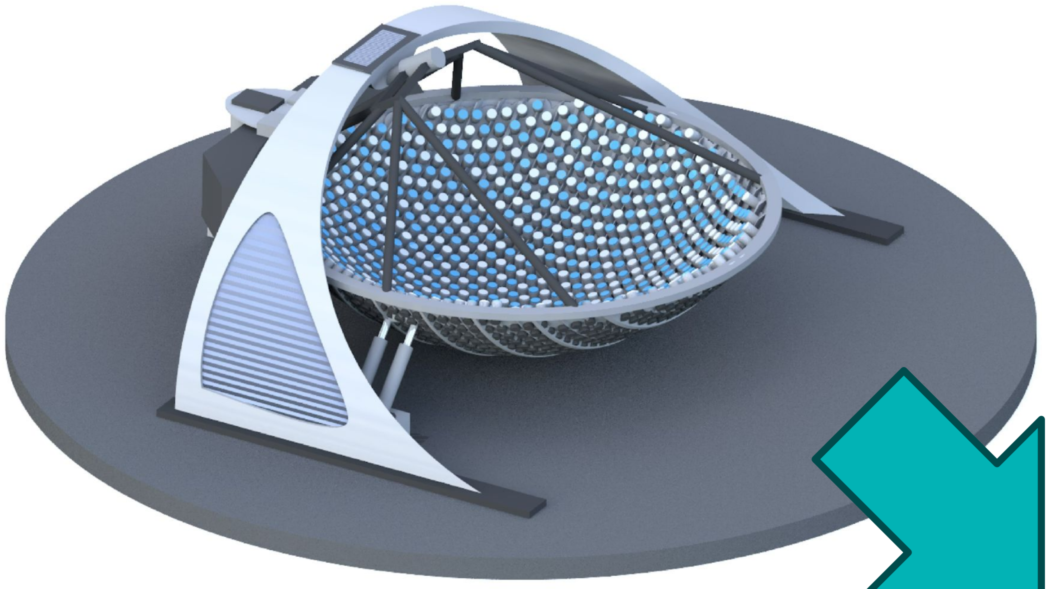
Slide Credit: Argus Team

Argus capabilities



Content Credit: Argus Team

Nimble engineering



2022-4 Baseline-Argus design

Since 2024 design, telescope & sensor improvements enabled:

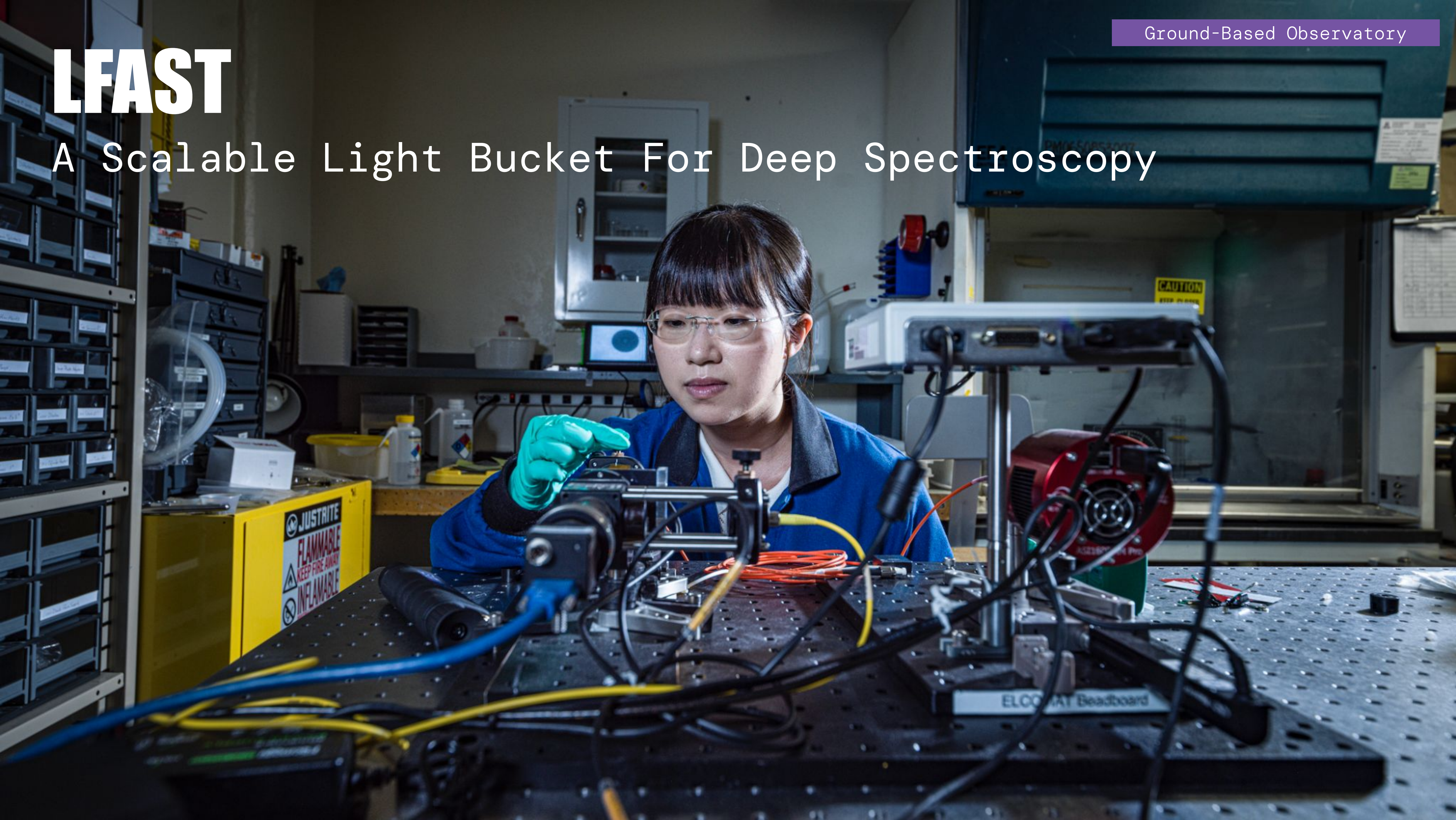
- 2x collecting area (to 8m-class)
- 2x number of pixels (to 122 gigapixels)
- => 3.6x survey volume increase

Slide Credit: Argus Team

Ground-Based Observatory

LFAST

A Scalable Light Bucket For Deep Spectroscopy



LFAST: A Scalable **Array** of Telescopes

The Eric and Wendy Schmidt Observatory System

Cost & Complexity Reduction

Unphased array lowers complexity while enabling large-aperture science.

Mass Replication Strategy

Prototype and build fast, take risks, apply industry-scale manufacturing approaches to optical fabrication

Technical Specifications

20 × 76cm f/3.3 telescopes on Alt-Az mounts connected by fibers.

- 1 unit = WIYN equivalent collecting area
- 10 units = 10m Keck equivalent

No Domes

Reduces site impact and cost. Each mirror has an individual mini-dome.

Credit: LFAST Team

Rapid **Fabrication** of Primary Mirrors

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1. Replication by slumping
2. Figuring with metal lap with Trizact
3. Polished with pitch lap with Cs2O

1. Interferometer Test & Fine Figure
2. Mech & Electrical Integration
3. Coating: Al + SiO_2

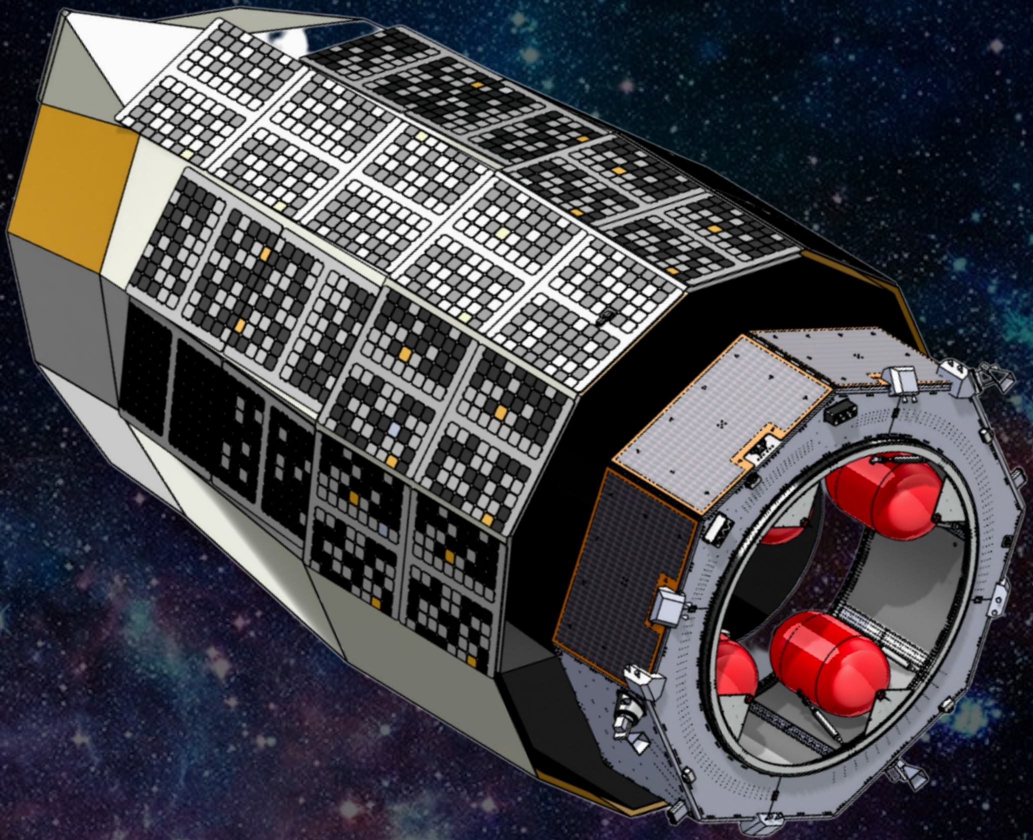
Slump 3 days → Trizact grind 6 hours → Pitch polish 1-2 days → Test & Figure 8 hours → Integration 24 hours → Coating 0.5 day

THE UNIVERSITY OF ARIZONA

Credit: LFAST Team

Lazuli

The largest rapid-response telescope in space



Mission Design Guidelines

A capabilities-driven approach to development

Designed within the **Schmidt Observatory System**

Schedule as a **design feature**, not a constraint

Risk tolerance as a driver of cost discipline

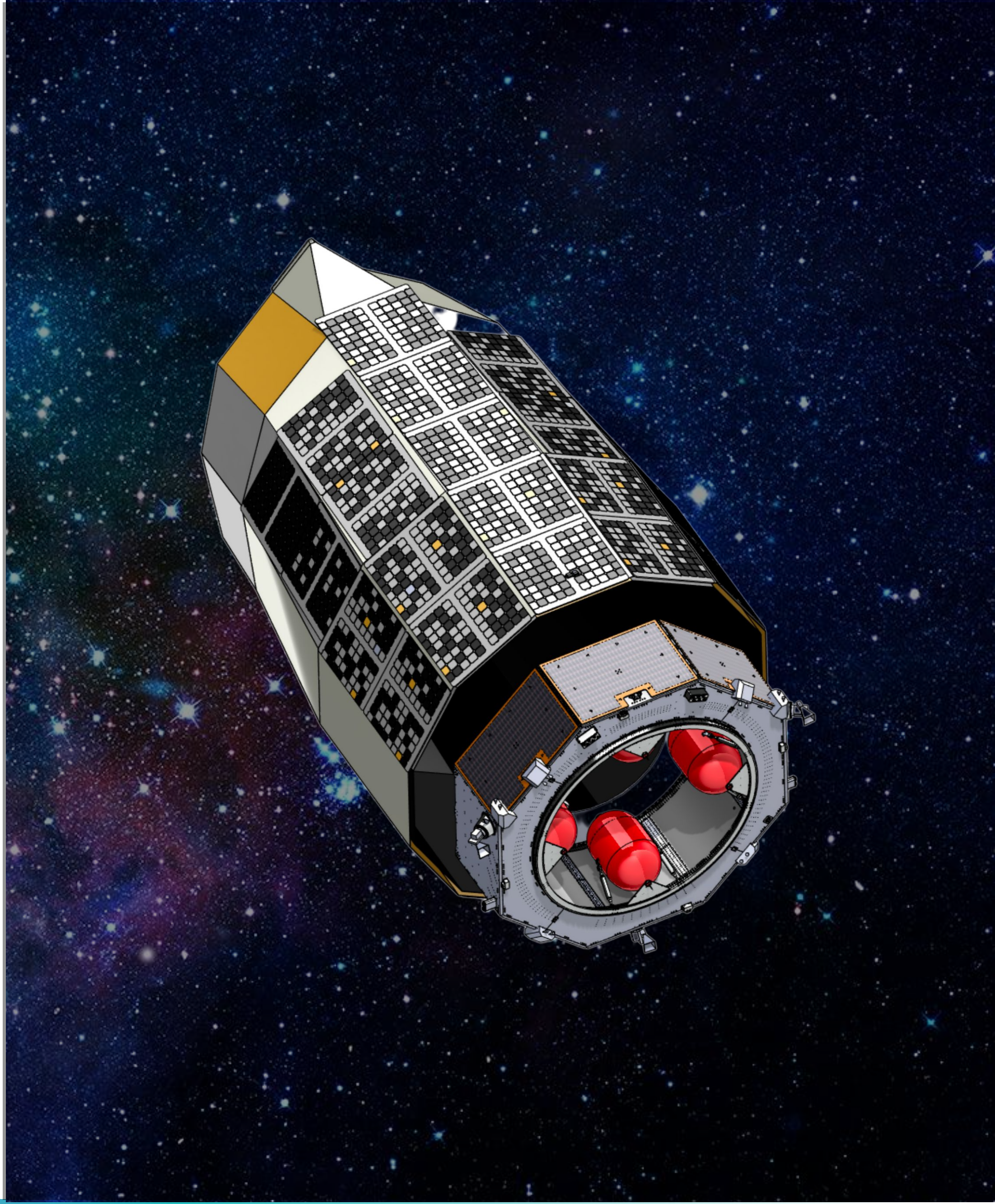
Application of **available technologies** in novel ways

Rapid response as a primary design driver

Focused instrument modes to limit complexity

General-purpose, open-access observatory

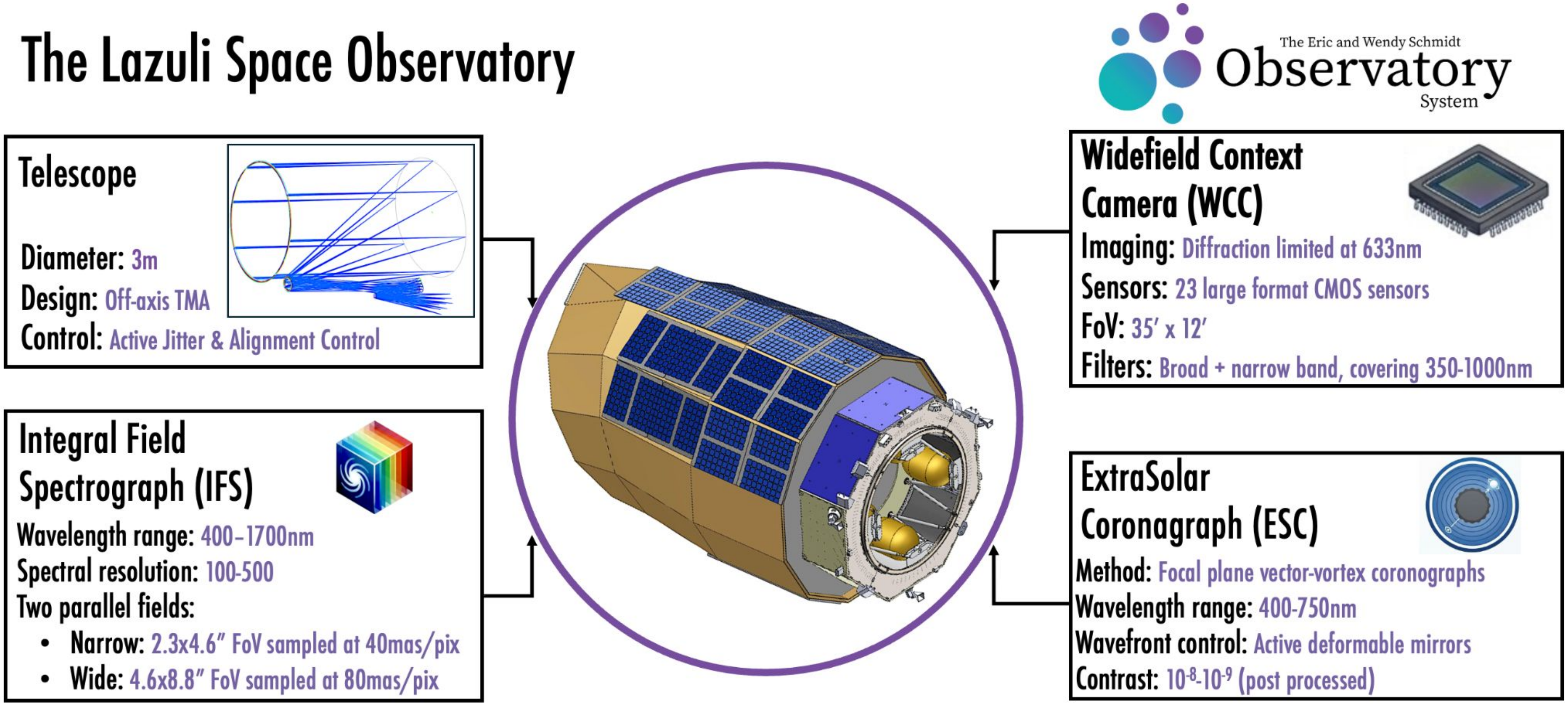
Complementary to Roman, JWST, future HabWorlds



Observatory Overview

Architecture at a glance

The Eric and Wendy Schmidt Observatory System



Mission Operations Concept

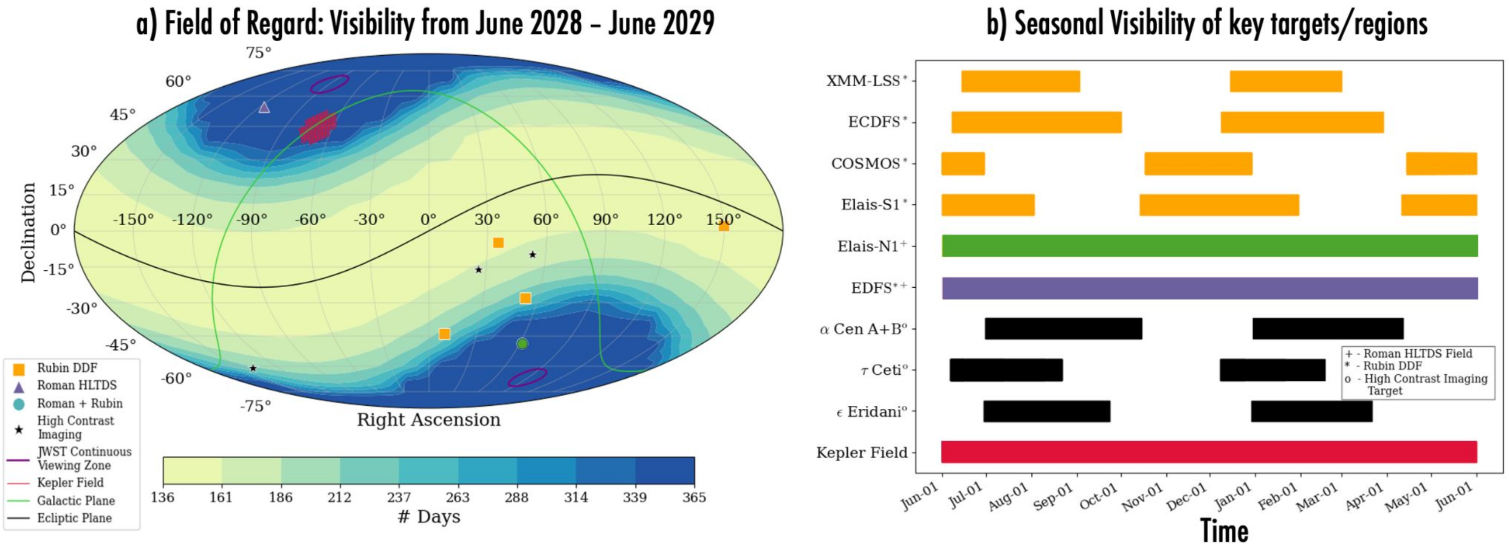
Dynamic Scheduling & Rapid Response

The Eric and Wendy Schmidt Observatory System

Orbit: 3:1 lunar-resonant HEO (9-day period; ~70,000–285,000 km), above trapped radiation belts with **~2.4 hr yr^{-1} eclipses**

Sky access: ≥130 days yr^{-1} per target; **continuous viewing zones** at $|\beta| \geq 54°$; full-sky coverage in **~106 days**

Target-of-Opportunity response < 4 hr from trigger receipt (goal ~90 min), planned through automation-first operations



Dynamic queue balancing ToO interruptions with long-term programs

Data flow: Near-continuous ground contact; average science downlink **~70 GB day^{-1}** with rapid data delivery

Time access for global scientific community, coupled with **open data and software**

We are not just building observatories

We are enabling the **people & technology** it takes to make science happen.

More Than Telescopes

People, Tools, and Access

Open data, open science for **global scientists**

One TAC process across the 4 observatories

Single-point access to data and software across ground and space components

Scheduling, archives, and analysis tools designed for **coordination and interoperability**

The Eric and Wendy Schmidt Observatory System

NEW PROGRAM

FirstLight Awards

Early Career | Early Adopters | Early Science

The Eric and Wendy Schmidt Observatory System

A program to empower early-career researchers to lead **ambitious cross-observatory science** using Schmidt Observatory System resources.

- Support for PI to build a **research group**
- **5 teams selected** per year
- Each team gets **up to $500k/year** for 5 years
- New cohorts every **12–18 months**
- **Integrated access** to observatories, data, and tools

NEW PROGRAM

The Eric and Wendy Schmidt Observatory System

Schmidt Observatory Postdoctoral Program

Shaping the System from Within

A cohort-based fellowship embedded directly within the development, calibration, operations, and scientific use of the Schmidt Observatory System.

Embedded Across the Observatory System

- Work across radio, optical, infrared, and space-based facilities
- Direct interaction with scientists, engineers, and mission leadership
- Contribute to observatory design before operational assumptions are fixed
- Combine publishable science with enabling technical contributions
- Small, high-impact cohort working on observatory-scale problems

What the Experiment Is Revealing

Observations from Early Phases

The Eric and Wendy Schmidt Observatory System

Trust scientists, not first concepts

The strongest ideas often emerge after initial assumptions are challenged; scientific goals should remain stable while implementation evolves.

Design is iterative, not linear

Technical pivots are not failures. New technologies, constraints, and opportunities frequently reshape the optimal solution.

Small expert teams are critical

Progress depends on highly capable scientists and engineers working with shared context and clear ownership.

Decisions create momentum

Making informed decisions quickly is often more valuable than waiting for perfect information — provided teams remain willing to revisit them.

Building teams is as important as building hardware

A significant fraction of observatory development involves culture, trust, communication, and alignment across new organizations.

Open, coordinated science requires deliberate design

Open access, interoperability, and cross-observatory coordination are widely supported in principle, but achieving them in practice requires sustained effort and intentional infrastructure.

Community readiness is distinct from observatory readiness

We can build and deploy technology; preparing the broader community to use it effectively is a separate and equally important challenge.

Many of our biggest challenges have been organizational rather than technological.

What Would Success Look Like?

The Eric and Wendy Schmidt Observatory System

New observational capabilities reach astronomers while the science is still active — Even in imperfect early forms, new facilities begin generating scientific value earlier in their development cycle — while the key questions that motivated them remain open and the broader survey landscape is still taking shape.

More pathways for high-risk ideas to mature — Concepts that are too early or uncertain for traditional funding mechanisms have opportunities to develop through prototyping, iteration, and early deployment.

Observatories become easier to use together — Coordination across facilities, wavelengths, and data systems becomes a first-class capability — something scientists can rely on, not work around.

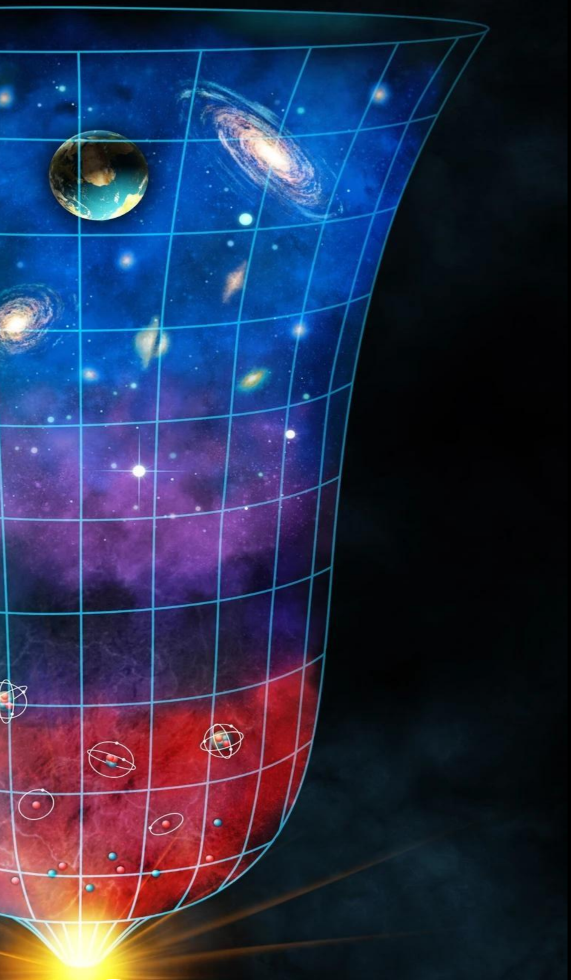
Public and private investments reinforce one another — Different funding models contribute complementary strengths, creating a more resilient and diverse scientific ecosystem.

Software, automation, and AI reduce routine burdens — Advances in data pipelines, scheduling, and analysis tools let researchers focus on interpretation, creativity, and discovery rather than infrastructure management.

The broader community derives scientific value from the system — The Schmidt Observatory System becomes useful not because it exists, but because astronomers around the world choose to use it.

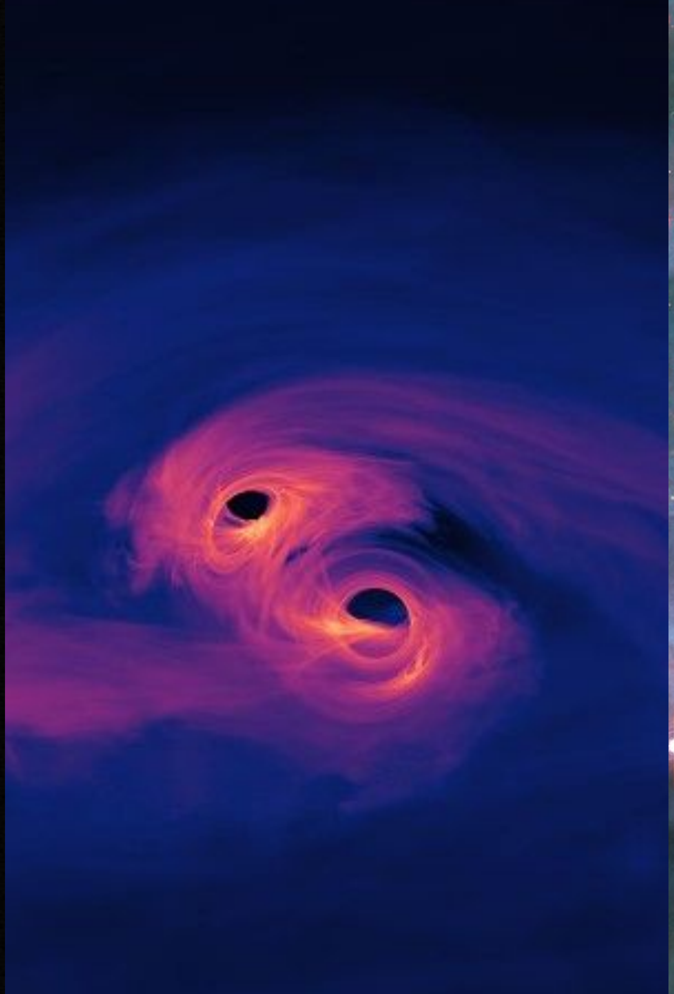
Success is not building observatories. Success is enabling more discovery.

The Four Science Pillars of the Schmidt Observatory System



Cosmology
Dynamic Universe
Does dark energy evolve over cosmic time?

Exoplanets
Dynamic Worlds
Could distant worlds support life?



Transients
Dynamic Sky
What drives fleeting cosmic explosions?

Explorations
Dynamic Knowledge
What questions arise as our understanding expands?

Thank You

www.schmidtsciences.org

The Eric and Wendy Schmidt Observatory System