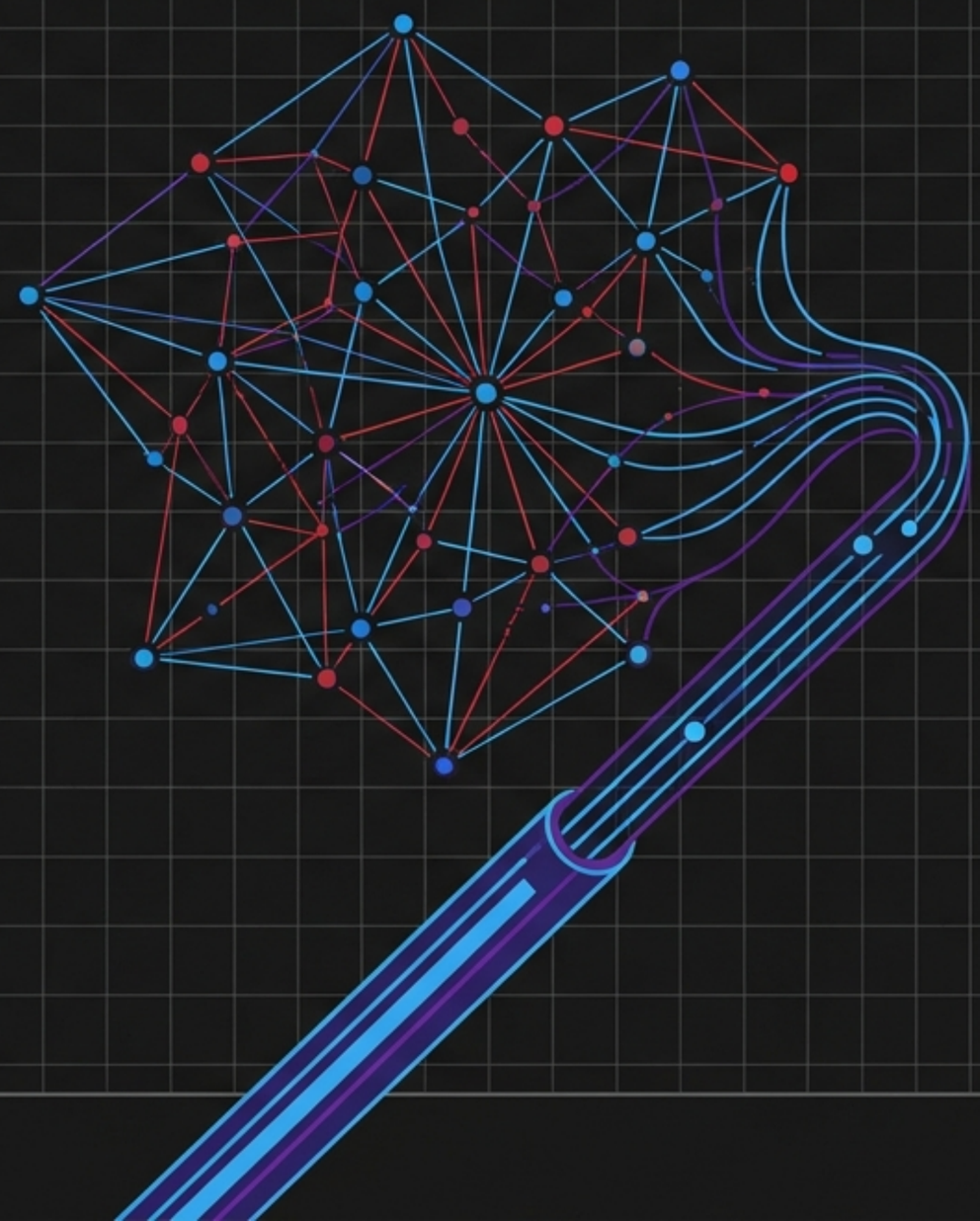
Mapping the Dark Universe

How the DESI Project is using 5,000 robots and 30 million galaxies to solve the mystery of Dark Energy.



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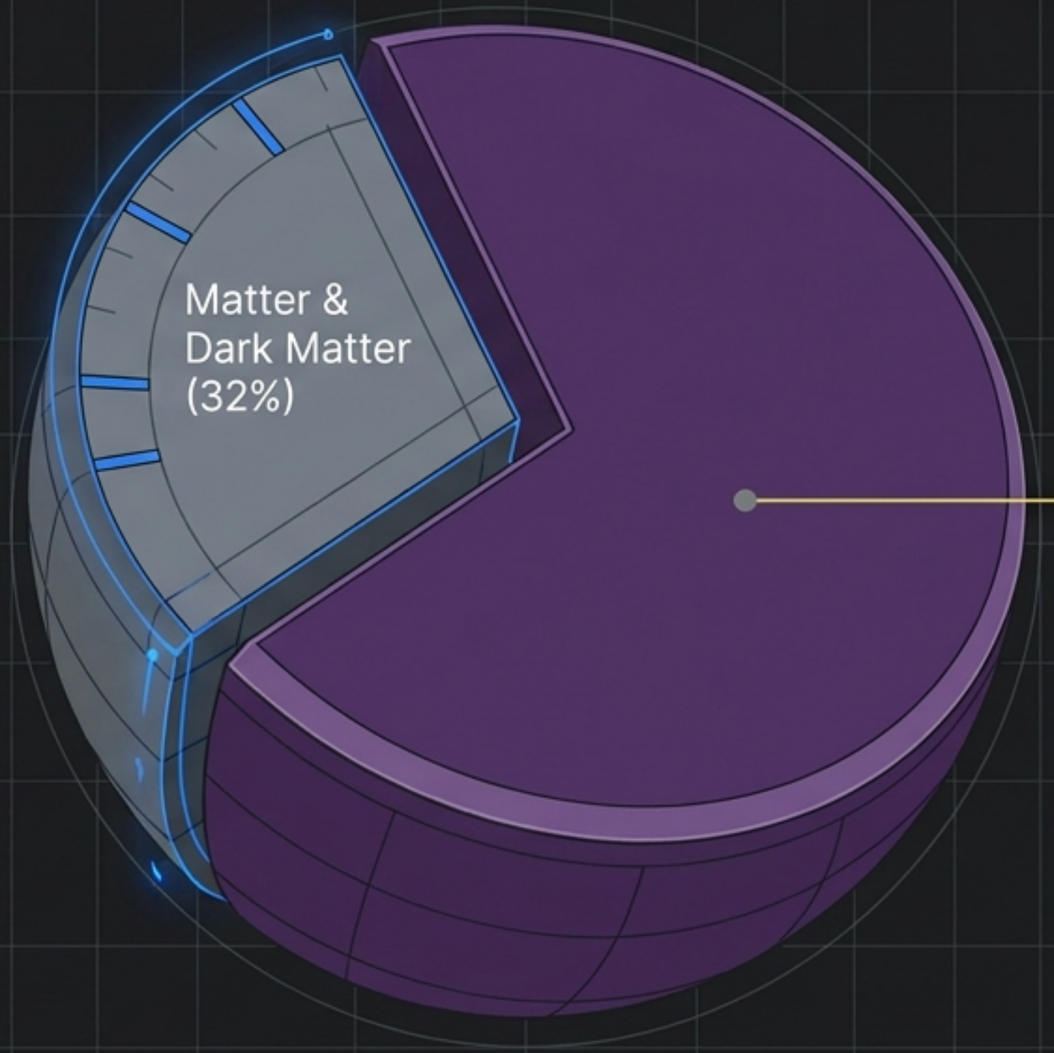
The Universe is Running Away from Us

The Expectation

Gravity (matter) should be acting as a brake, slowing down the expansion of the universe.

The Shocking Discovery

Twenty years ago, we realized the expansion is actually accelerating.



The Culprit: Dark Energy

An entirely unknown force that makes up a staggering

68%

of all energy in the cosmos.

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Meet the Ultimate Cosmic Magnifying Glass

The Instrument

DESI (Dark Energy Spectroscopic Instrument), analyzing visible light from near-UV to near-IR.

The Team

600+ researchers across 74 global institutes (over half are non-US scientists).



The Location

Kitt Peak Observatory, Arizona (featuring advanced cryostats and CCD detectors built by the French CEA).

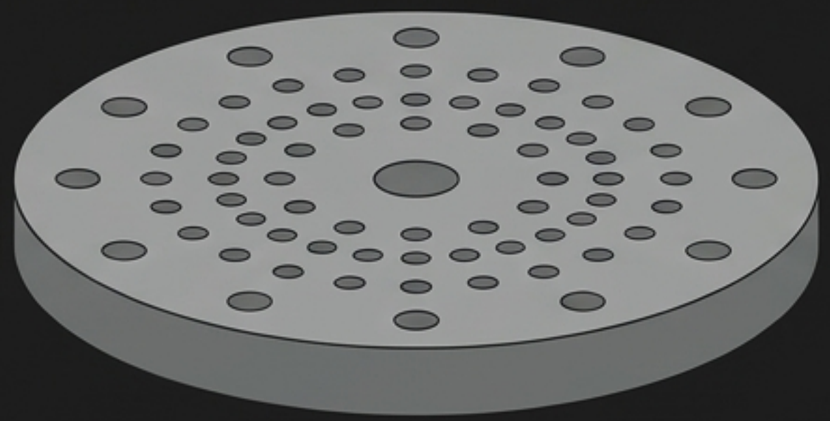
The Mission

Precisely measure the position and speed of 30 to 40 million galaxies over 5 years.

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The Industrialization of Astronomy

Before DESI (The Analog Era)

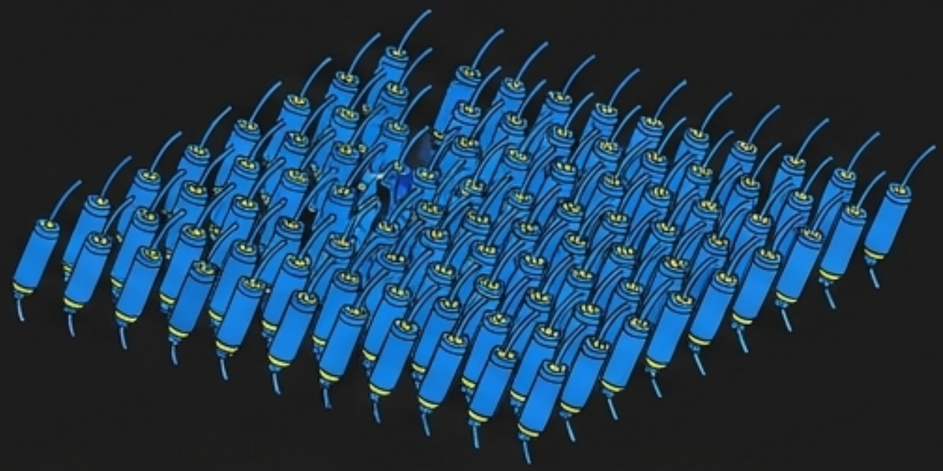


Tool: Heavy, custom-drilled aluminum plates.

Nature: Static and fixed for a single observation.

Setup Time: Months of manual preparation and shipping.

The DESI Era (The Robotic Era)



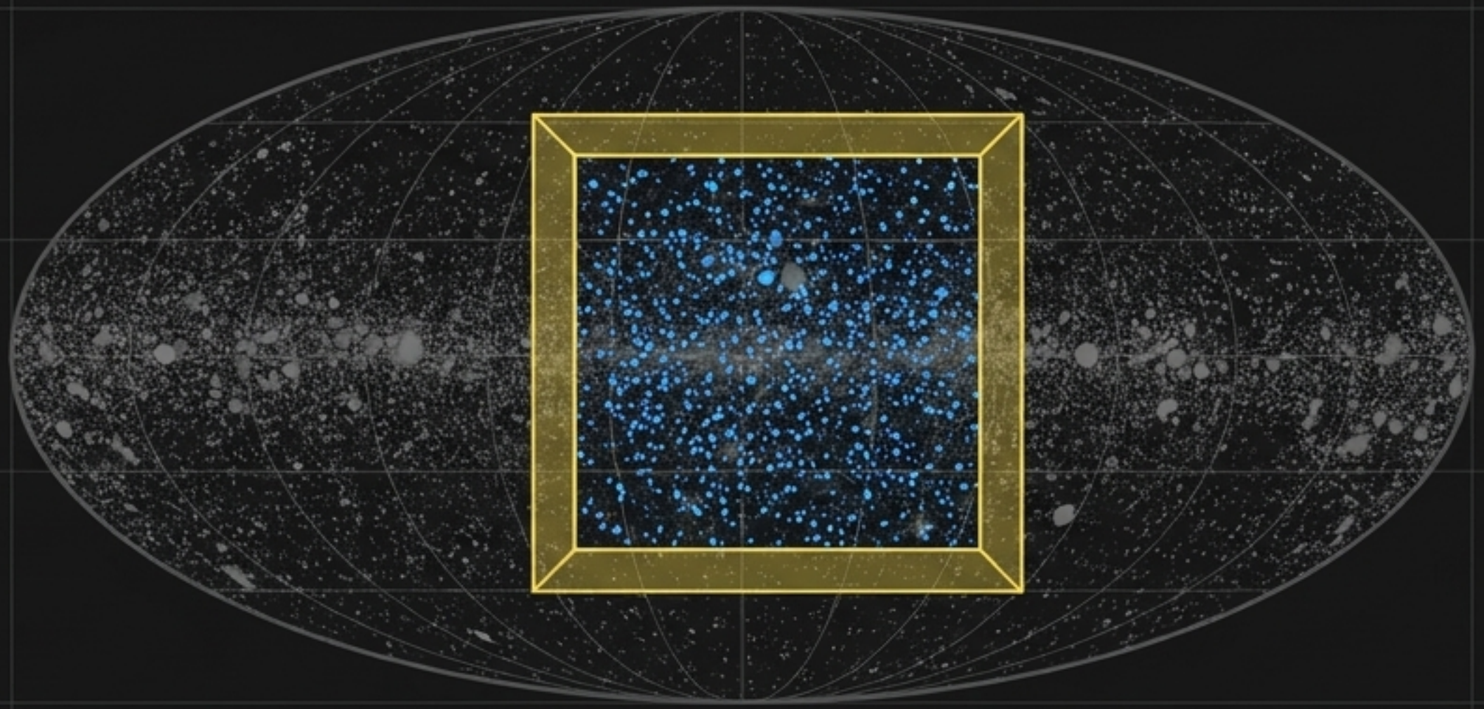
Tool: 5,000 microscopic robotic fibers (each just 100 microns, or 0.1mm, thick).

Nature: A dynamic, fully active focal plane.

Setup Time: 1 minute to reposition with micron-level precision.

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You Need a Map to Build a Map



The Prerequisite

Before DESI could measure in 3D, scientists had to build a massive, **10-trillion-pixel 2D map** of the sky.

The Raw Data & Filter

The map contains **2 billion objects** across **5 frequency bands**. DESI filters this, targeting only the **30–40 million specific galaxies** needed to trace cosmic history.

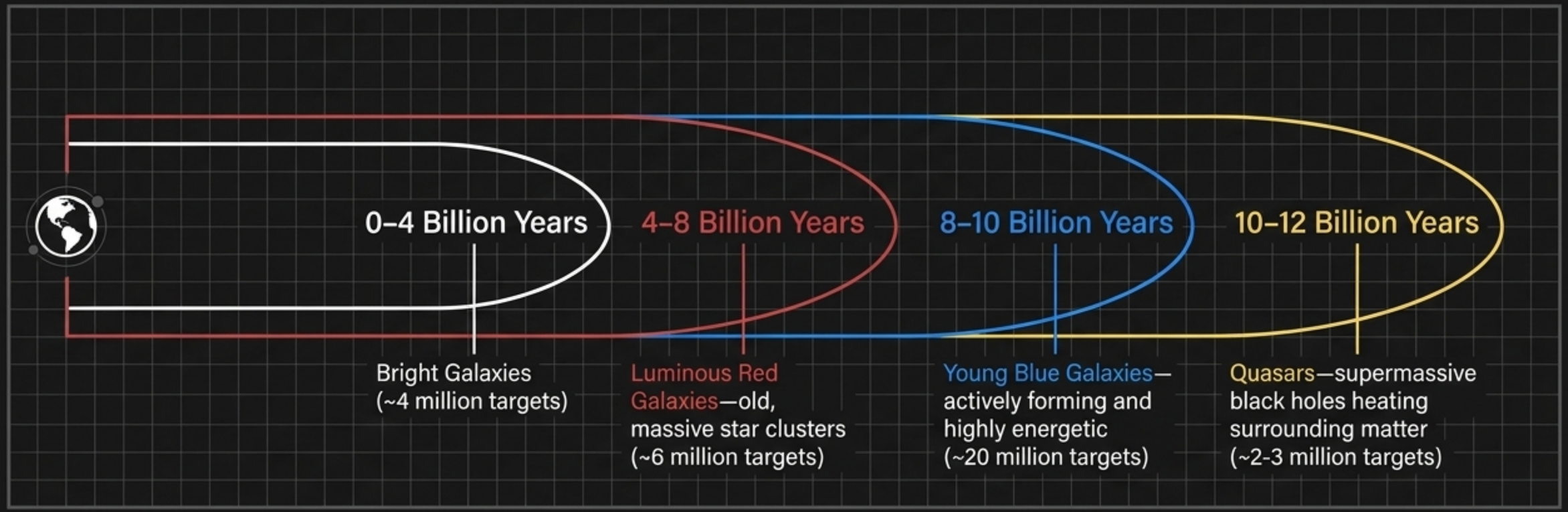
Open Science

This foundational 2D map is now **public**, allowing all astrophysicists to hunt for rare phenomena.

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Stepping Back Through Cosmic Time

To map 12 billion years of history (out of the universe's 14 billion), DESI targets specific fossil objects at specific distances:

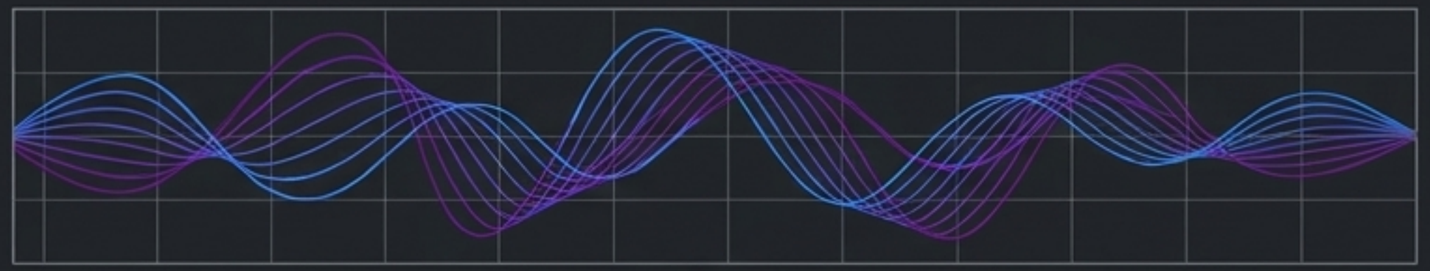


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Why Map Galaxies? To Find the Echoes of Creation

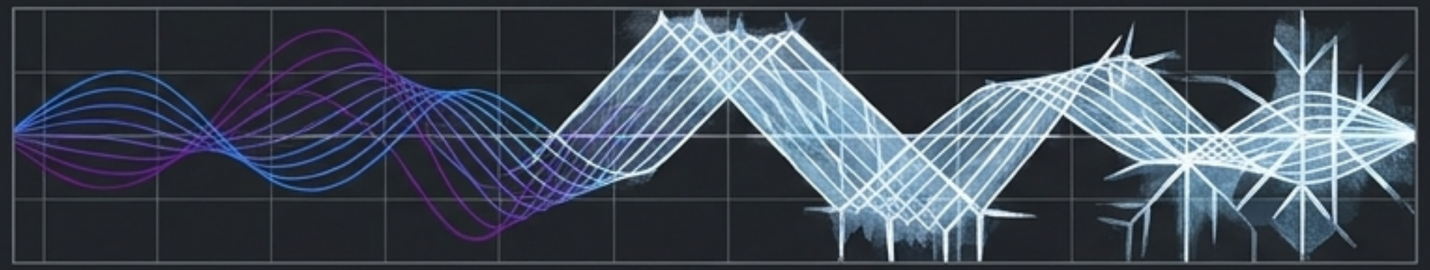
1. The Primordial Soup

The early universe was a hot, ionized plasma filled with pressure and sound waves.



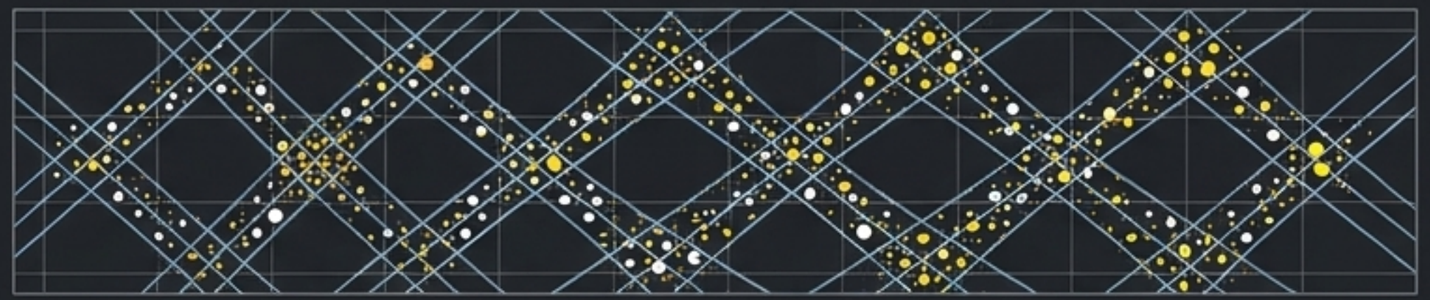
2. The Big Freeze

As the universe expanded and cooled, it became neutral. Light escaped, and the wave patterns froze in place.



3. The Fossil Record

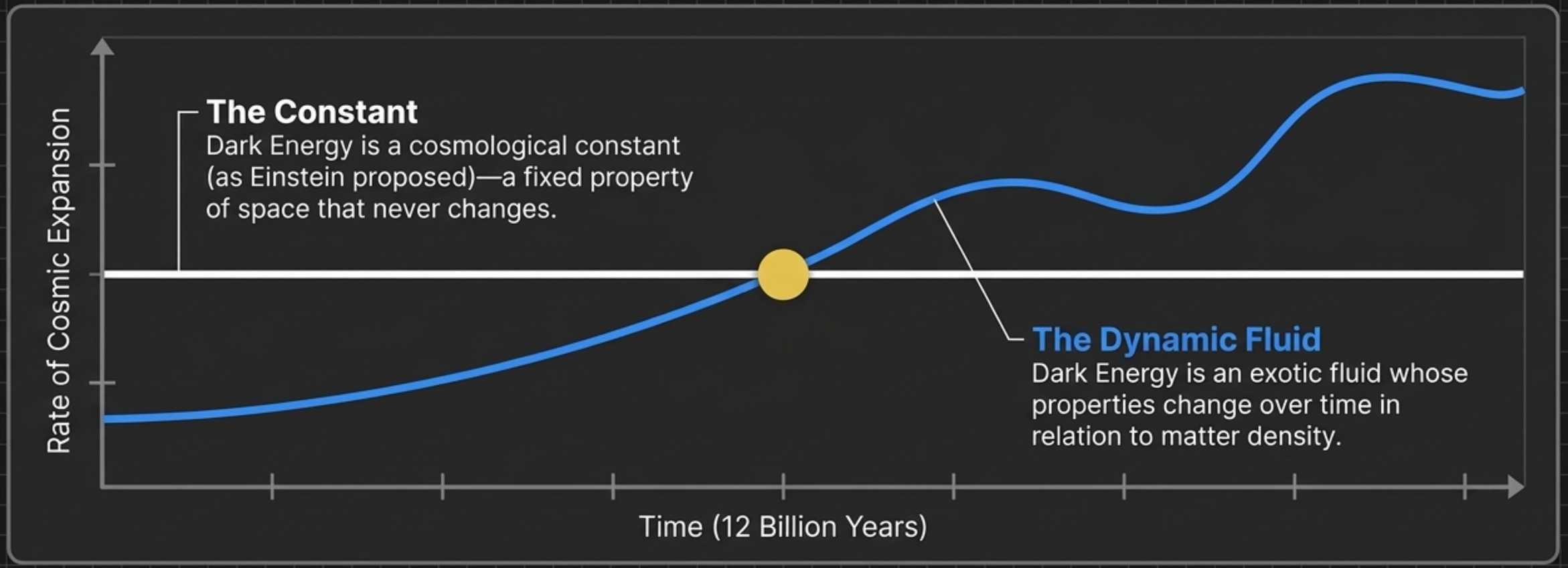
Today, galaxies cluster precisely on the crests of those ancient waves. By mapping 3D galaxy distribution, DESI reads the blueprint of the early universe.



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The Ultimate Question: Is Dark Energy Evolving?

By tracking fossilized galaxy clusters across 12 billion years, DESI measures exactly how fast the universe was expanding at different epochs. The goal is to determine which model is true:



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A Multi-Mystery Machine



Dark Matter

By watching how smaller galaxy clusters acc-ccumulated over time, DESI tracks the invisible mass holding them together.



General Relativity

Testing if Einstein's laws of gravity still function as expected at the absolute largest cosmic scales, or if they need to be rewritten



Open Science

Yearly public data releases provide a goldmine for the global astrophysics community to discover rare objects and unexpected phenomena

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The Road to Answers

Year 0 (Validation Phase)

Extreme high-density targeting to perfectly calibrate the 5,000 robots and validate target selection. (Complete)

Years 1–5 (The Deep Map)

Continuous deep-space mapping. New, highly precise public datasets will be released every single year.

The Finish Line

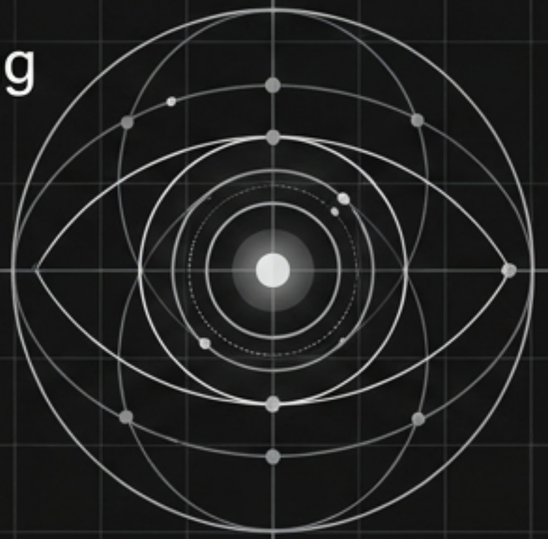
A definitive, high-precision answer on the evolution of Dark Energy and the fundamental nature of gravity.

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DESI at a Glance

The Mystery

Dark Energy is actively accelerating the universe, making up 68% of the cosmos, yet its nature is entirely unknown.



The Tool

An industrial-scale observatory using 5,000 agile, microscopic robots to capture light from 30 to 40 million targets.

The Method

Building a 12-billion-year 3D map of galaxies and quasars to trace the frozen ripples of the primordial universe.

The Goal

Discover if Dark Energy is a constant or an evolving fluid, while testing the true nature of Dark Matter and Gravity.

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