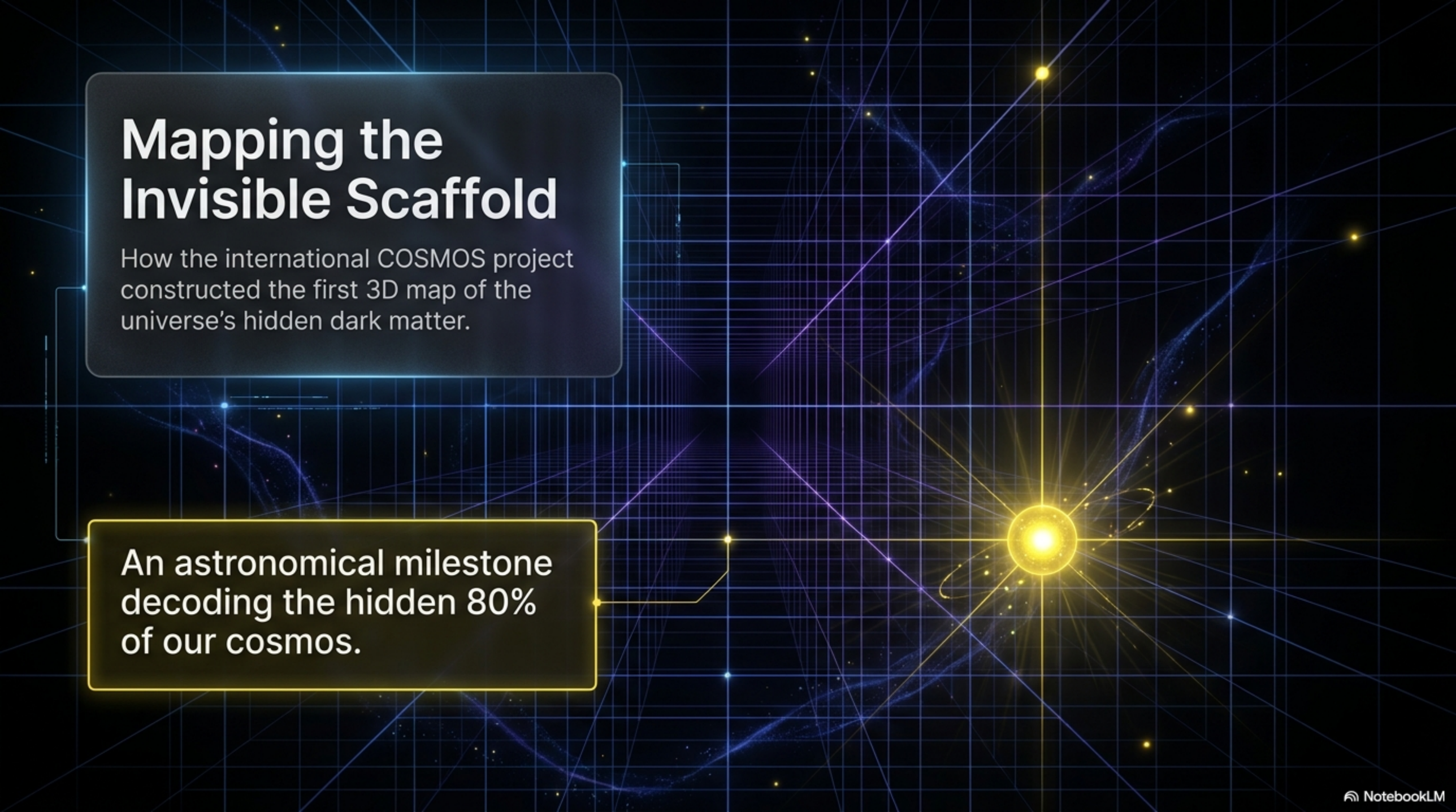
# Mapping the Invisible Scaffold

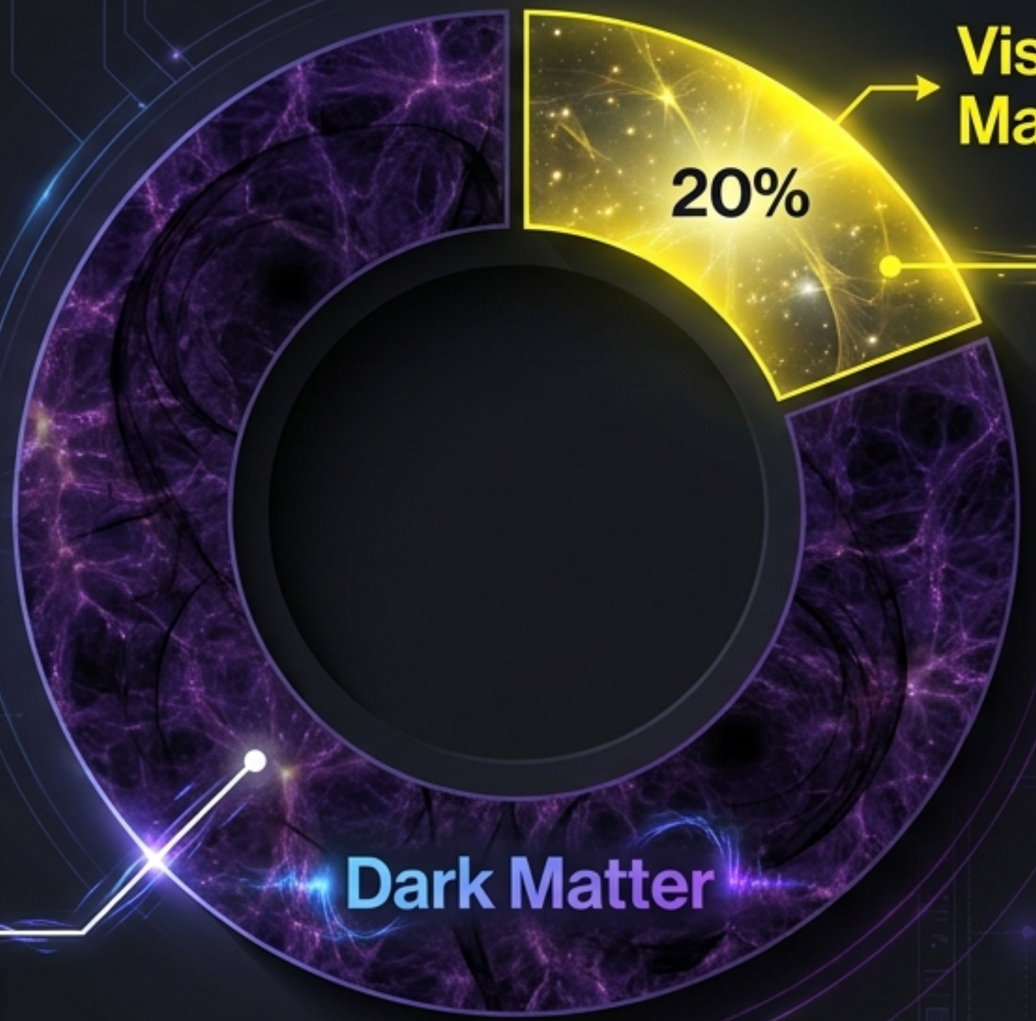
How the international COSMOS project constructed the first 3D map of the universe’s hidden dark matter.

An astronomical milestone decoding the hidden 80% of our cosmos.



NotebookLM

# The Universe We Cannot See




## The Single Clue

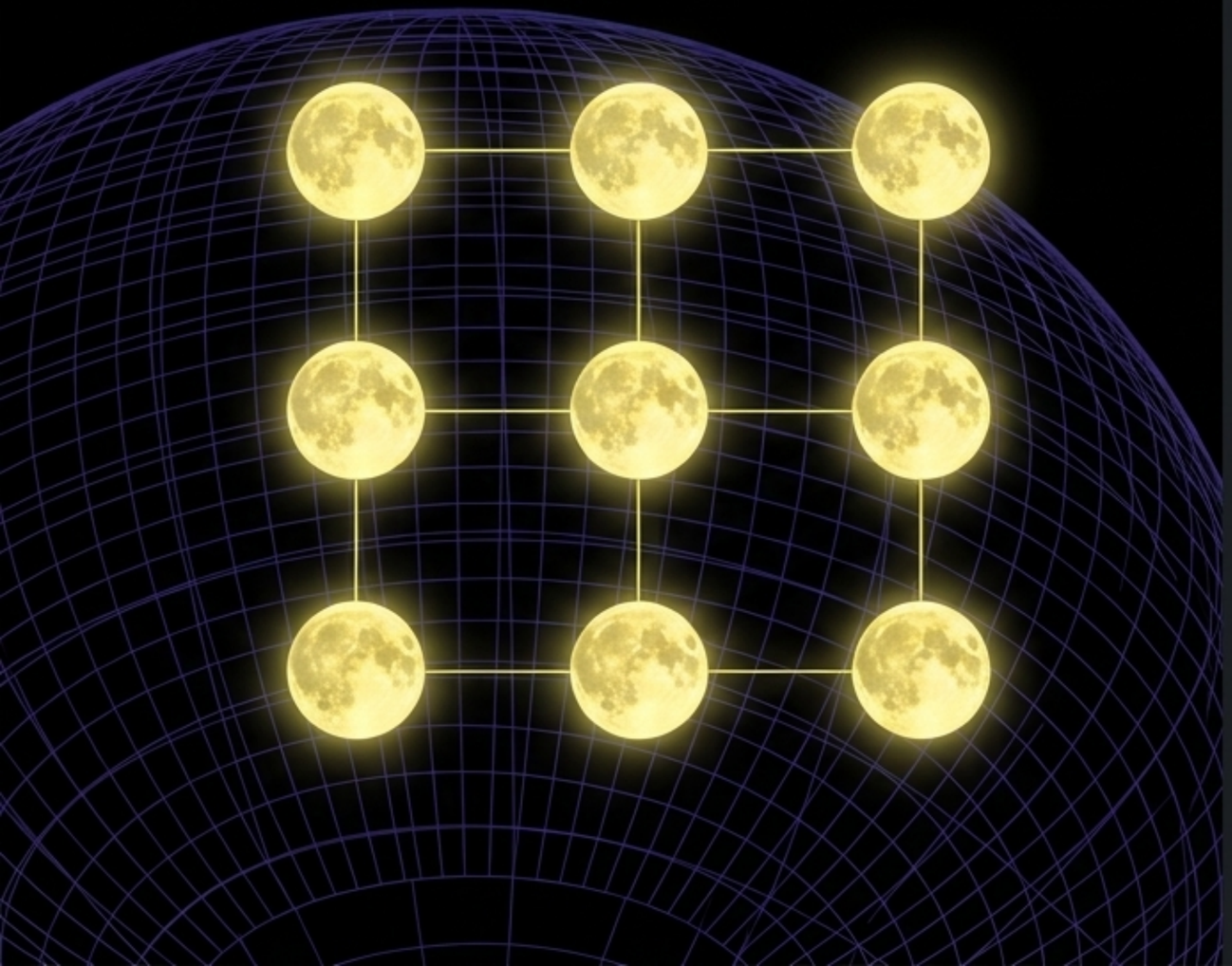
This dark matter interacts with the visible universe through only one fundamental physical force—Gravity.

## Key Concept

Current cosmological models dictate that approximately 80% of the universe's matter is entirely invisible. It emits no light and absorbs no light.

NotebookLM

# Surveying a Cube of the Universe



**9x**

The surface area of the full moon covered in the sky map.

**500,000**

Galaxies studied in granular detail (shape, color, star formation).

**1,000+**

Hours of combined observational exposure time.

**575**

Ultra-high-resolution images captured by global observatories.

NotebookLM

# A Synchronized Global and Orbital Effort



## Orbital Optical

### Hubble Space Telescope (USA)

Operating outside Earth's atmosphere to capture the most precise, high-resolution galaxy shapes.



## Orbital X-Ray

### XMM-Newton (Europe)

Operating in X-rays to map hot gas, a significant component of universal mass.



## Ground Optical

### VLT (Europe) & Subaru 8m (Japan)

Giant ground-based observatories used to measure galaxy color and calculate precise cosmic distances.

NotebookLM

# Einstein's Lens Reveals the Invisible




## Source

Distant background galaxies emit light traveling toward Earth.

## Obstacle

Massive clusters of invisible **dark matter** exert immense gravity, literally warping the fabric of space.

## Distortion

The light path **bends**. Comparing standard galaxy shapes against these warped images allows astrophysicists to calculate the invisible mass.

NotebookLM

# Slicing the Cosmos into Three Dimensions

The critical third dimension (Depth/Time) is achieved through precise distance mapping.

**Step 1**

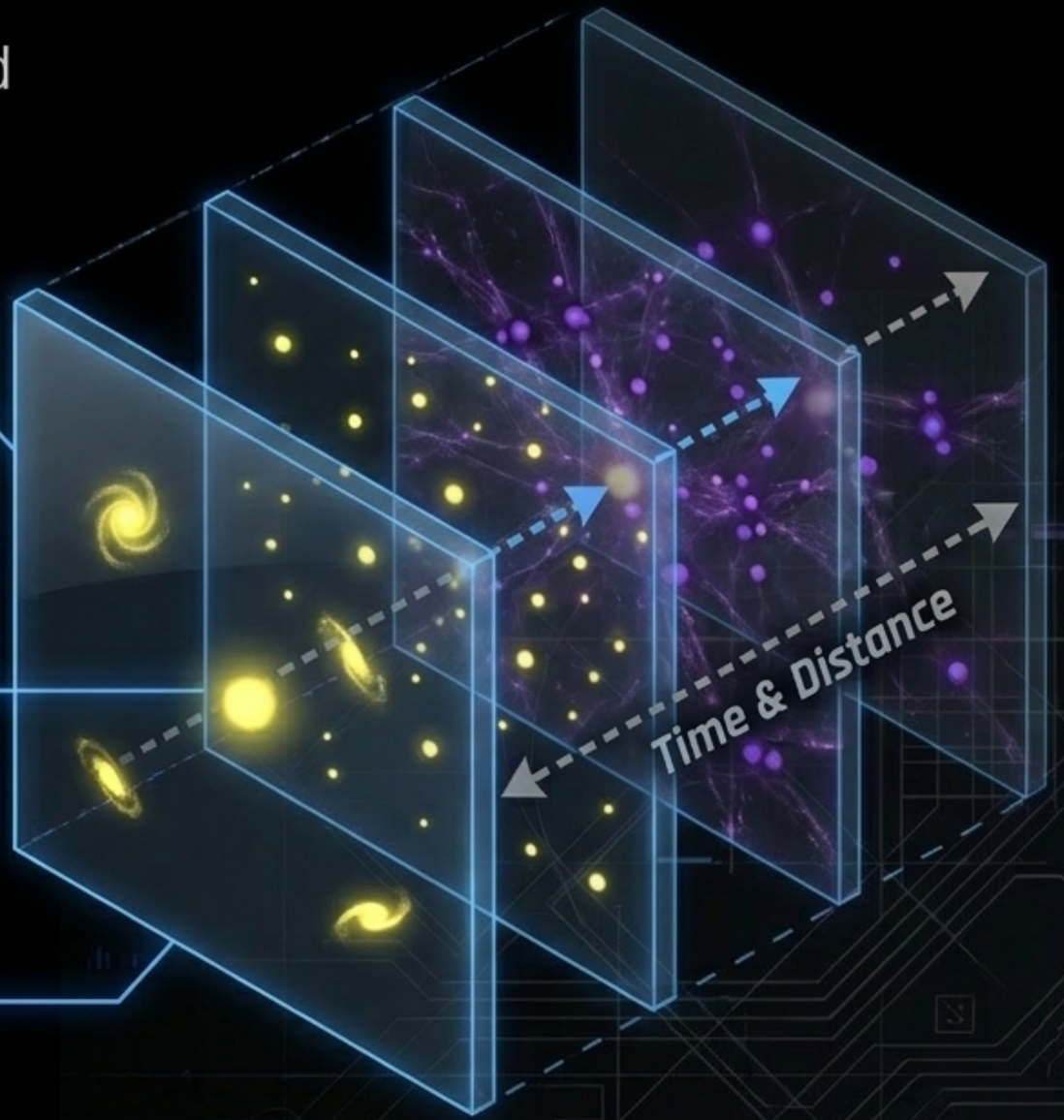
Measure the gravitational distortion of a foreground galaxy.

**Step 2**

Push deeper into space to measure the subsequent distortion of background galaxies.

**Step 3**

Stack consecutive slices to reconstruct a true 3D volumetric map of all light-bending matter.




NotebookLM

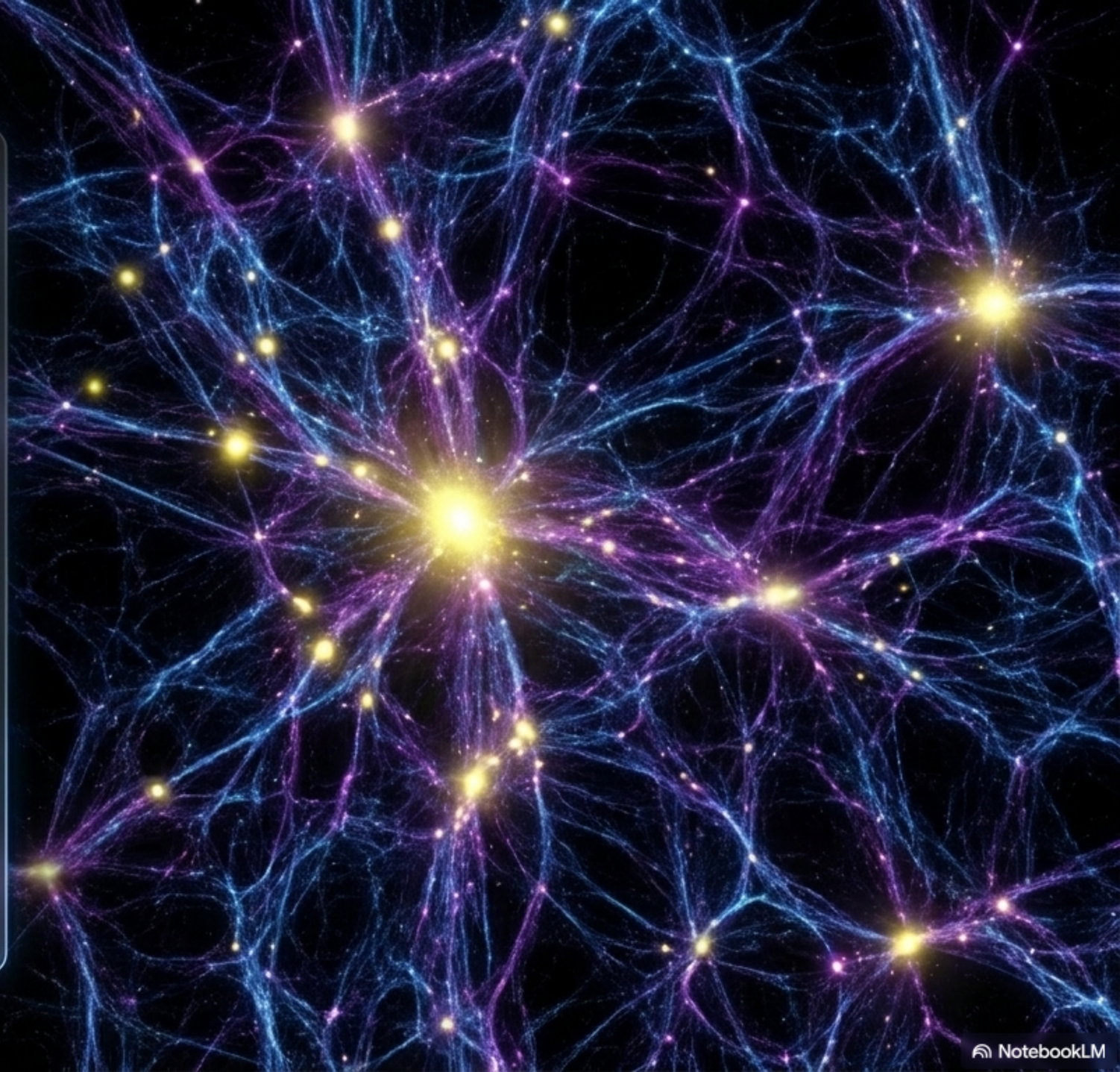
# The Primordial Scaffold

## The Architecture

Dark matter maps reveal a universe structured like a vast, interconnected web. Massive bubbles of empty cosmic void are surrounded by structural walls and filaments of dark matter.

## The Nodes

At the dense intersections of these invisible filaments, immense gravity aggregates visible matter, igniting star formation to build the universe's giant galaxy clusters.



NotebookLM

# The 50/50 Anomaly



## The Expectation

Dark matter (6x the mass of visible matter) should act as the gravitational anchor, trapping visible gas to form stars. They should strictly co-locate.



**Dark without Light:**
Dense clumps of dark matter with zero visible galaxies attached.



**Light without Dark:**
Visible galaxies missing their expected dark matter anchors.

**The Reality:** While massive clusters generally align, the COSMOS map revealed shocking 50/50 anomalies.

NotebookLM

# The Cosmic Tug-of-War

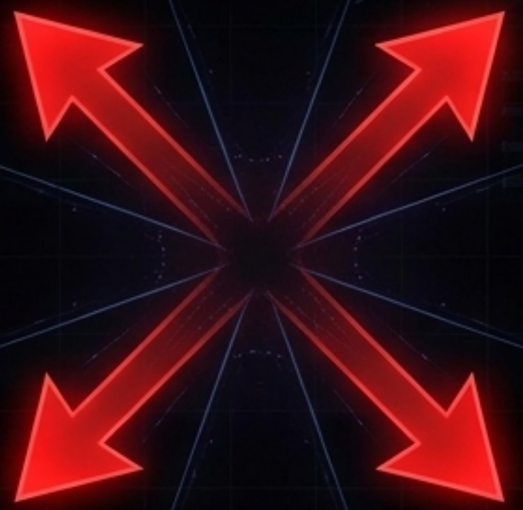
To truly map the universe, astrophysicists must weigh dark matter against its opposing force: Dark Energy.

## Dark Matter (The Brake)



- Physical mass (particles or unknown gas).
- Exerts gravitational pull to bind structures together.
- Acts as a frictional brake against the expansion of the universe.

## Dark Energy (The Accelerator)



- Unknown general physical phenomenon.
- Exerts a negative pressure, pushing outward.
- Drives the accelerated expansion of the universe.

NotebookLM

# Beyond the Cube: The DUNE Mission

## The Next Frontier

The Dark Universe Explorer (DUNE) space mission represents the next leap in cosmological cartography.

## The Objective

Move beyond sampling isolated cubes of space to map **half of the entire observable sky**.

## The Impact

A dedicated orbital satellite will eliminate regional clustering errors, providing a definitive, global map to finally resolve the most irritating and awe-inspiring mystery in physics.



NotebookLM