



euclid

LAUNCH KIT

#ESAEuclid #CosmicMystery



EUCLID: EXPLORING THE DARK UNIVERSE

ESA's Euclid mission is designed to map the large-scale structure of the Universe and help us to understand two mysterious components: dark matter and dark energy.

For centuries, astronomers have aimed to learn more about the luminous sources of the cosmos, that is, planets, stars, galaxies and gas, for example. But these objects make up only a small fraction of what the Universe contains.

95% of the Universe appears to be made up of unknown 'dark' matter and energy. Dark matter and energy affect the motion and distribution of visible sources, but do not emit or absorb any light, and scientists do not know yet what these entities actually are. Understanding their nature is therefore one of the most compelling challenges of cosmology and fundamental physics today.

Euclid will create the largest, most accurate 3D map of the Universe. It will observe billions of galaxies out to 10 billion light-years, across more than one third of the sky.

With this map, Euclid will reveal how the Universe has expanded and how large-scale structure has evolved over cosmic history. And from this we can learn more about the role of gravity and the nature of dark energy and dark matter.

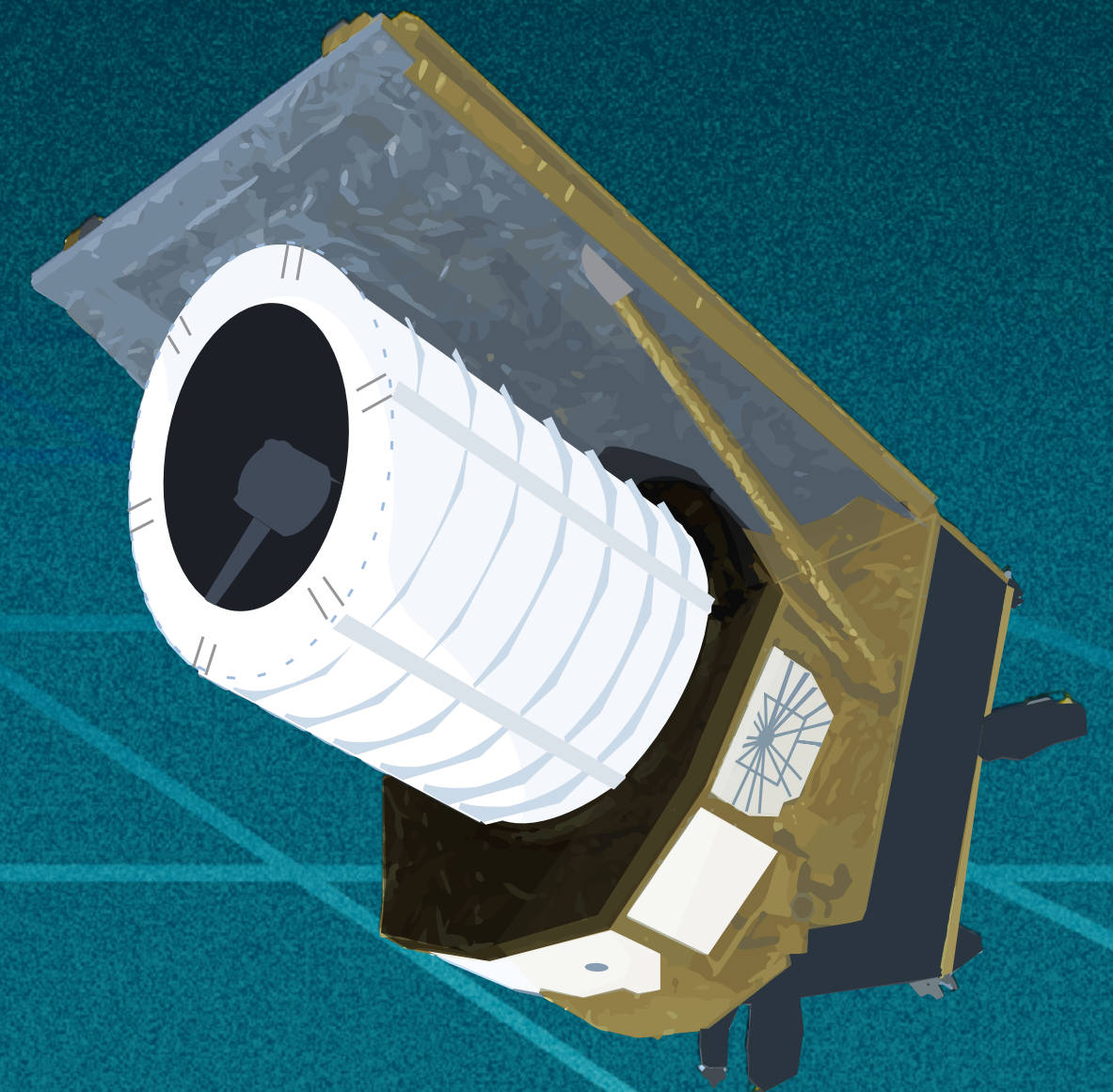
ABOUT THIS MEDIA KIT

This is an **interactive media kit**. Navigate between pages from the contents page or with the arrows    at the bottom of each page.

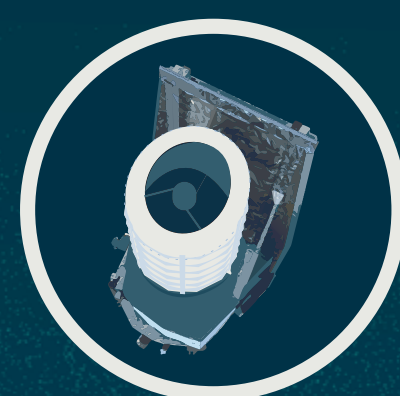
Explore scientific and technological themes of the Euclid mission through the series of infographics. **Roll over** the graphic elements to discover **hyperlinks** to more information on related webpages.

Click on the symbol  to directly access the infographic download page. Links to recommended images, videos and animations are provided towards the end of this media kit.

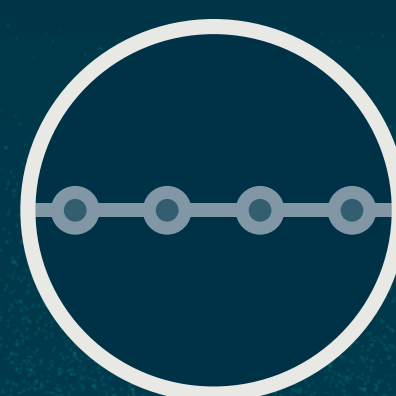
An internet connection is required to access the external webpages.



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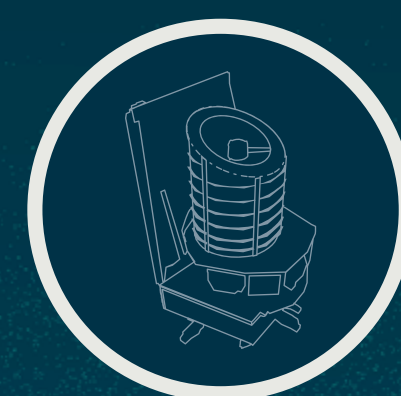
**Euclid in
a nutshell**



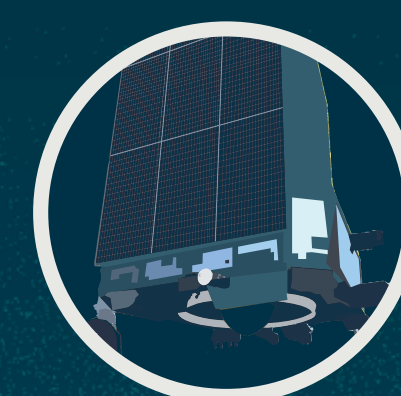
**Euclid's journey
to L2**



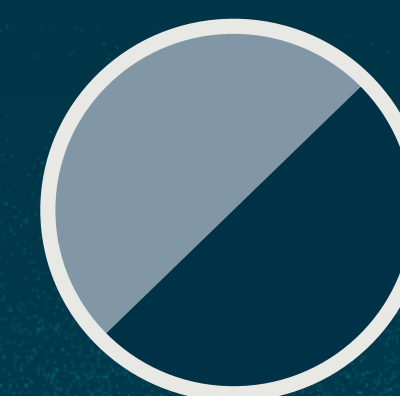
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**Euclid
spacecraft**



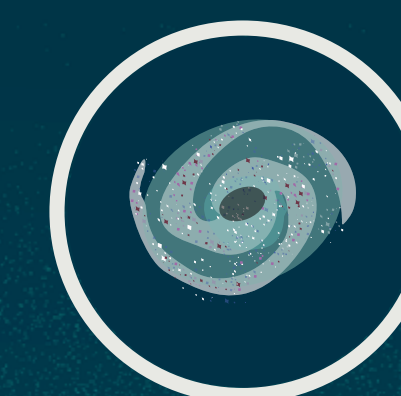
**Euclid
instruments**



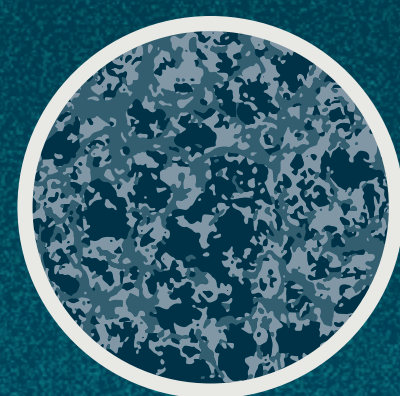
**The light and
dark Universe**



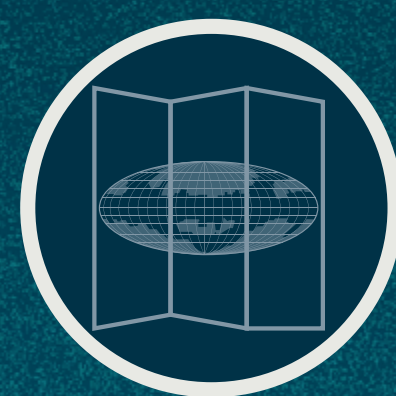
**The Universe across
space and time**



Weak lensing



**Baryonic acoustic
oscillations**



**Euclid's treasure
trove**



**Astronomy Science
Archive**



**An ESA-led global
collaboration**



**European
partners**



Spokespeople



Multimedia

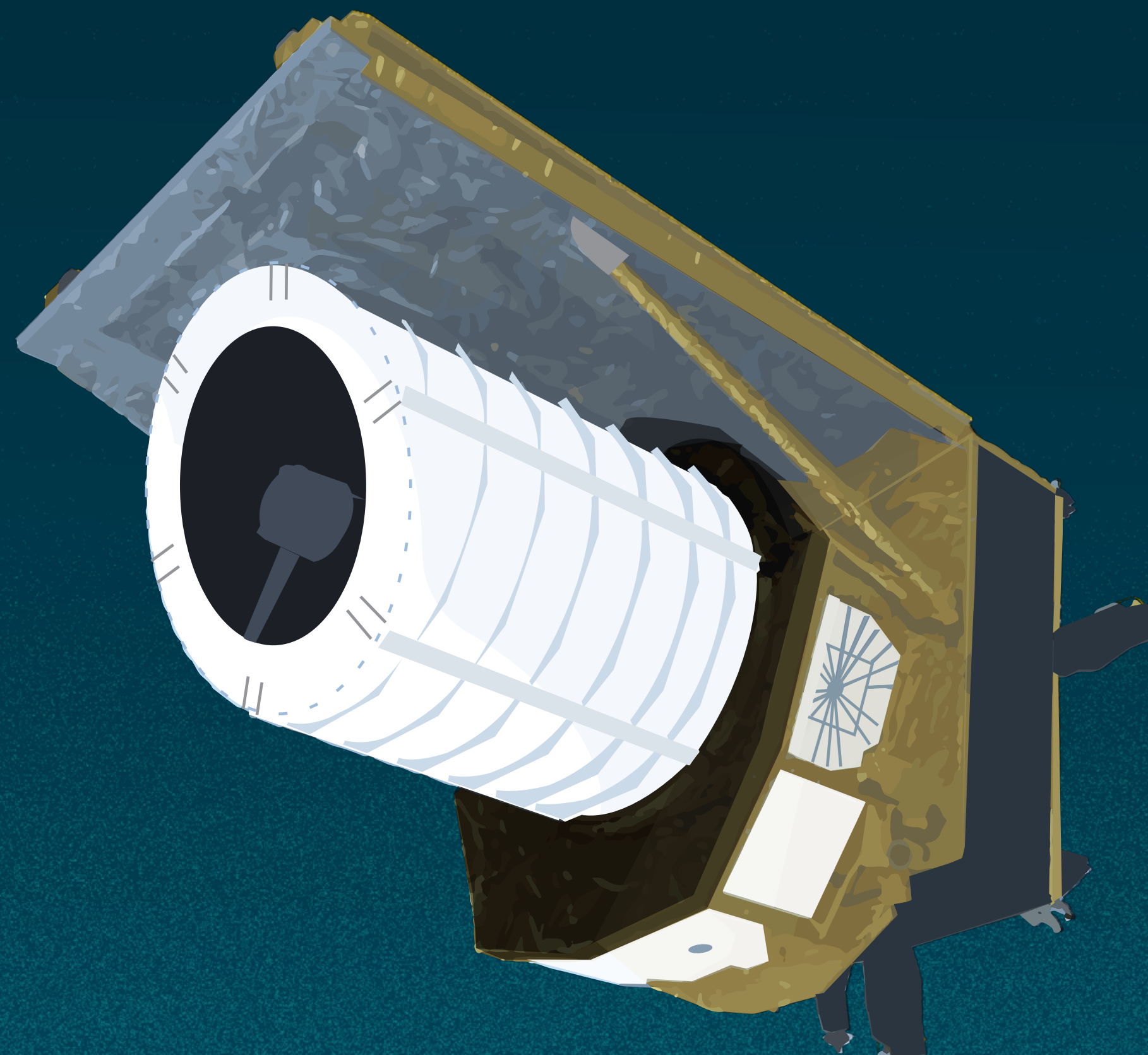


FAQ

EUCLID IN A NUTSHELL



Euclid is an ESA mission



Euclid will:



Observe 1/3 of the sky



Measure the shape, position and distance of galaxies out to **10 billion light-years**



Create the largest, most accurate 3D map of the Universe ever produced



Euclid launches on a **SpaceX Falcon 9 rocket** from Cape Canaveral Space Force Station in Florida, USA

Its destination is Sun-Earth Lagrange point 2, 1.5 million km from Earth

Two science instruments

1 VISible-wavelength camera (VIS)

1 Near-Infrared Spectrometer and Photometer (NISP)

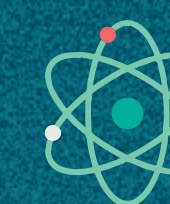
The Euclid Consortium has delivered to ESA the VIS and NISP instruments

NASA provided the near-infrared detectors of NISP

Euclid will address two core themes of ESA's Cosmic Vision 2015–2025:



What are the fundamental physical laws of the Universe?

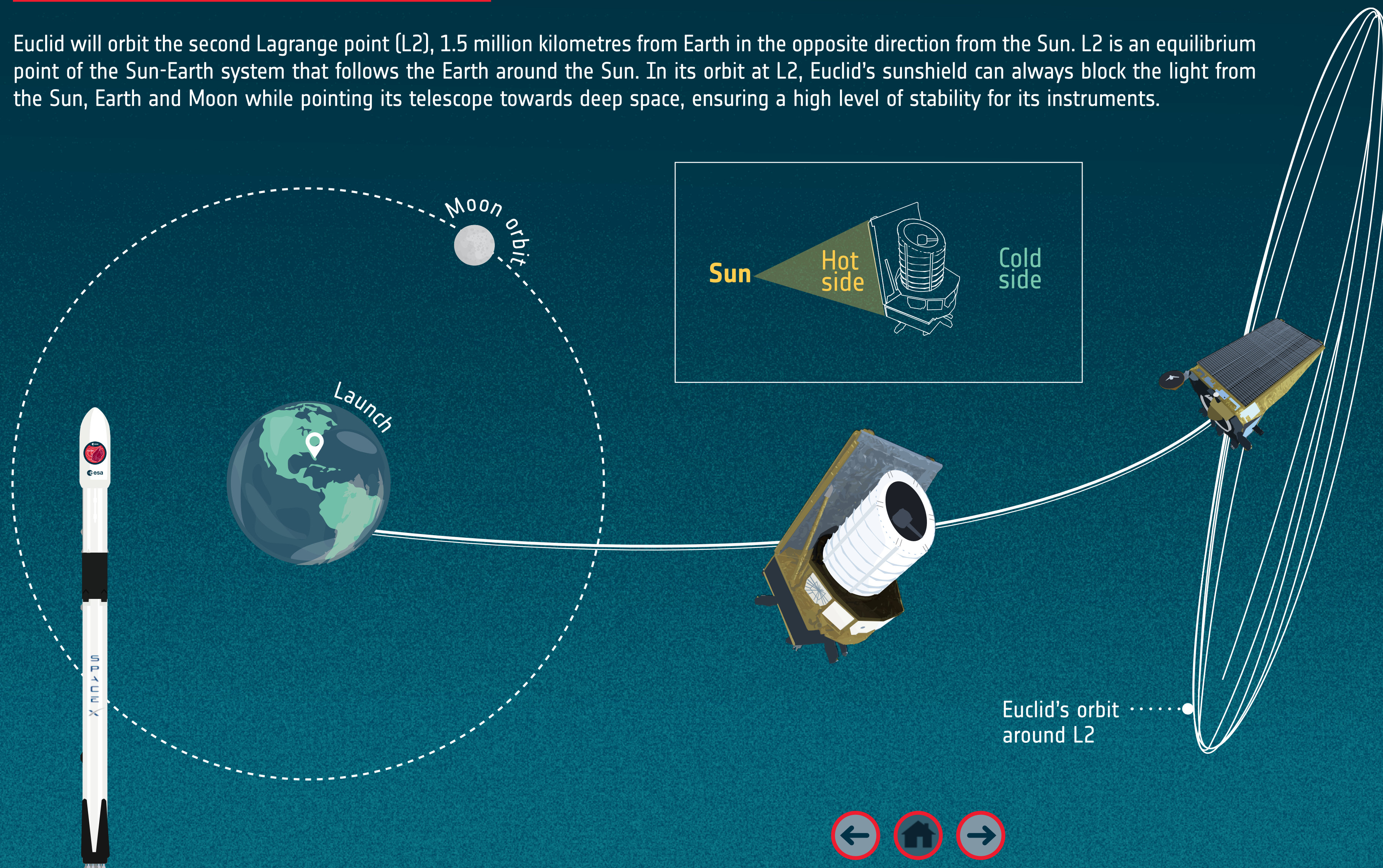


How did the Universe originate and what is it made of?



EUCLID'S JOURNEY TO L2

Euclid will orbit the second Lagrange point (L2), 1.5 million kilometres from Earth in the opposite direction from the Sun. L2 is an equilibrium point of the Sun-Earth system that follows the Earth around the Sun. In its orbit at L2, Euclid's sunshield can always block the light from the Sun, Earth and Moon while pointing its telescope towards deep space, ensuring a high level of stability for its instruments.



- **Launch (L)**
- **L+2 days:**
Euclid is on its way to L2
- **L+2 weeks:**
Euclid cool-down is complete
- **L+4 weeks:**
Euclid in orbit around L2
- **L+4 weeks:**
Telescope aligned and all instruments turned on
- **L+1–3 months:**
Testing of scientific performance and readiness for science
- **L+3 months:**
Euclid begins its survey



EUCLID SCIENCE: FIVE MYSTERIES EUCLID WILL HELP SOLVE

Five mysteries in cosmology Euclid will address:

What is the structure and history of the cosmic web?

What is the nature of dark matter?

***How has the expansion of the Universe
changed over time?***

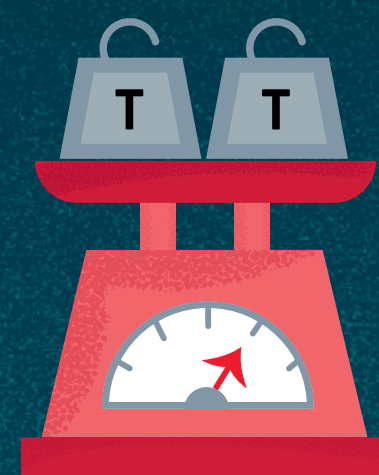
What is the nature of dark energy?

Is our understanding of gravity complete?



EUCLID SPACECRAFT

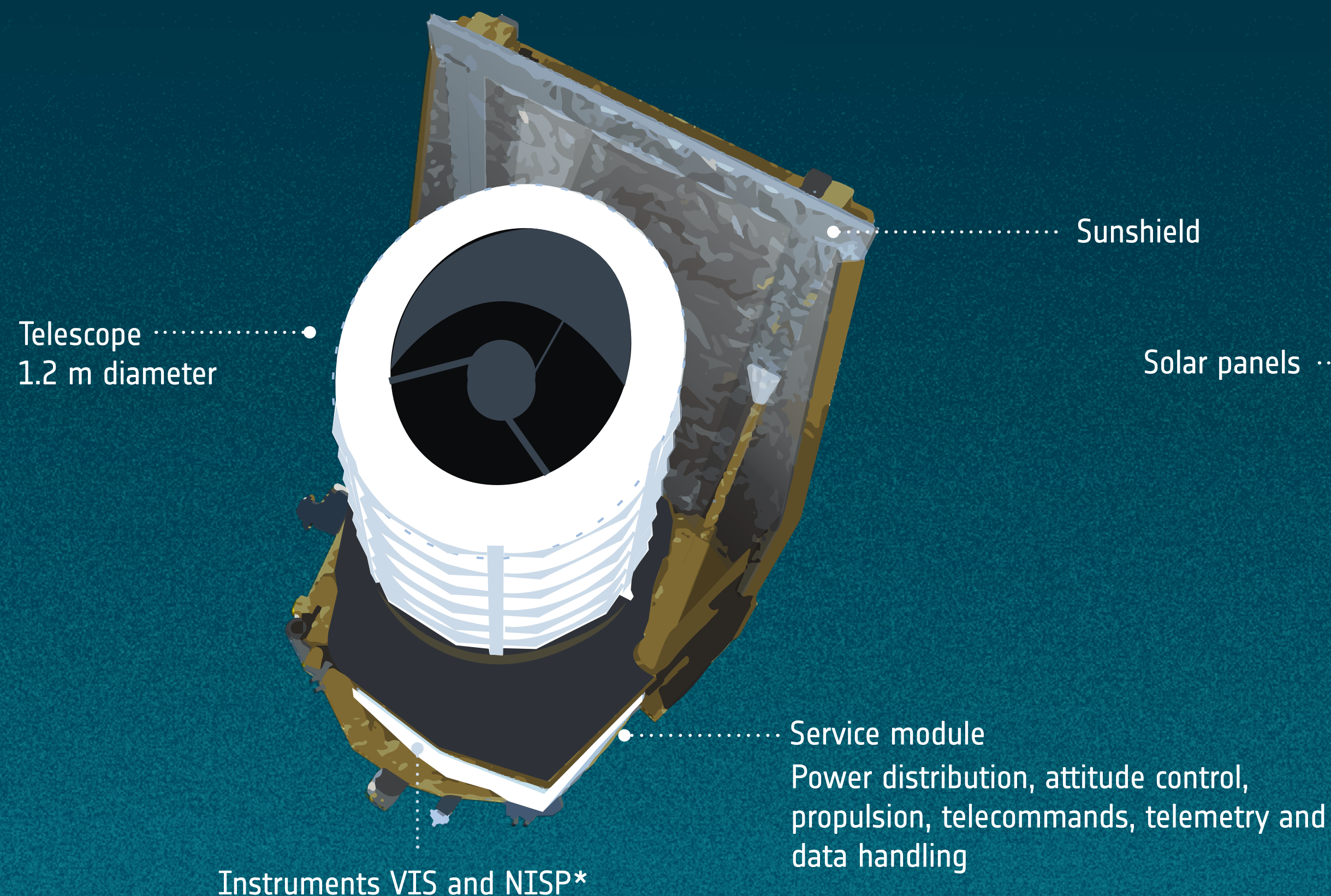
Euclid is designed to provide both excellent quality imaging in the visible, and spectroscopy and photometry in the near-infrared. The sunshield keeps the telescopes and instruments shaded from the Sun to ensure thermal stability and highly sensitive measurements. It will make sure **VIS operates at -120 °C** and **NISP at -180 °C**. To store the large data volume that will be accumulated during observations, Euclid has a mass memory of 4 terabits.



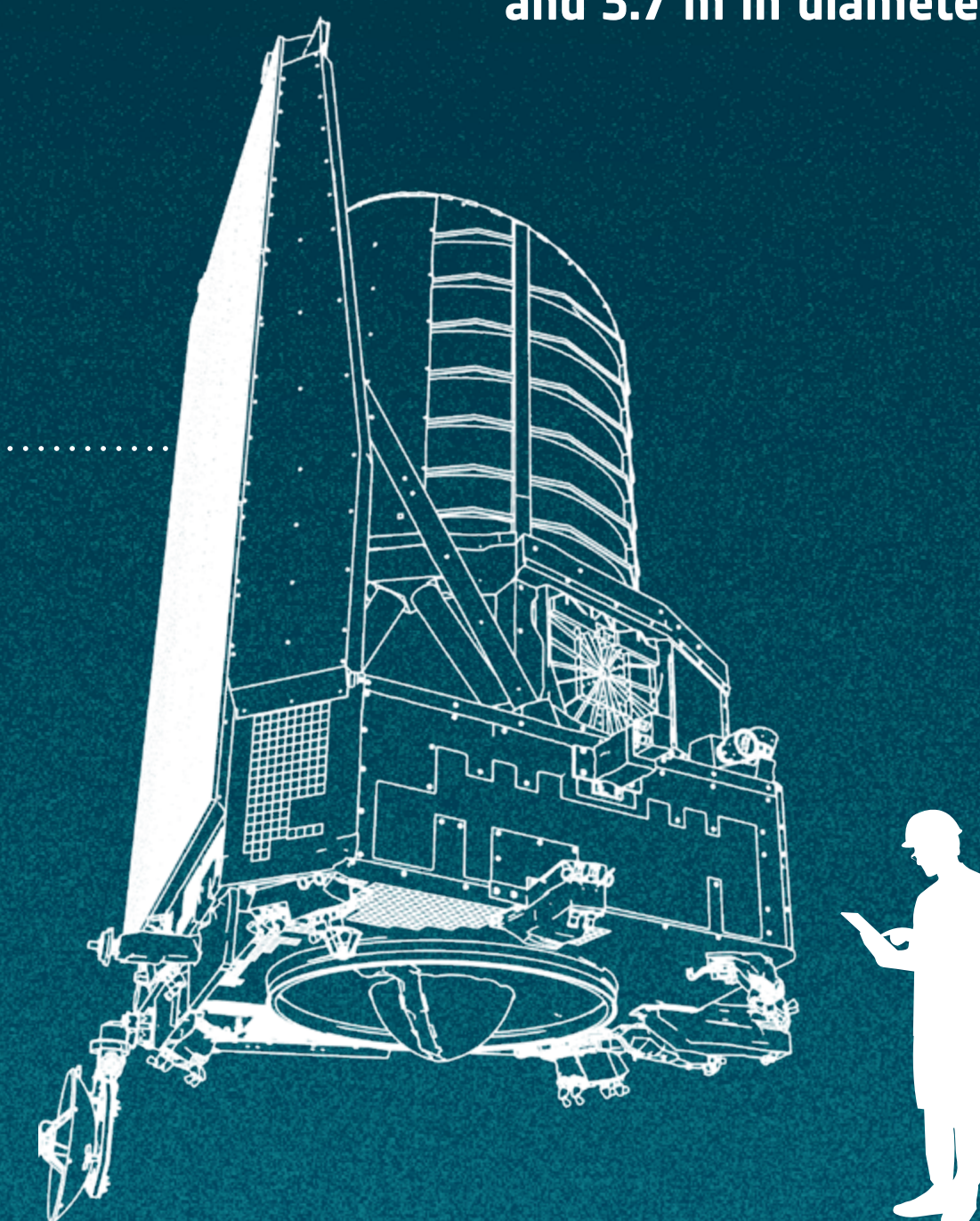
Euclid's mass in orbit will be
2 tonnes

- 800 kg payload module
- 850 kg service module
- 40 kg balancing mass
- 210 kg propellant

* VIS: VISible instrument
NISP: Near-Infrared Spectrometer and Photometer

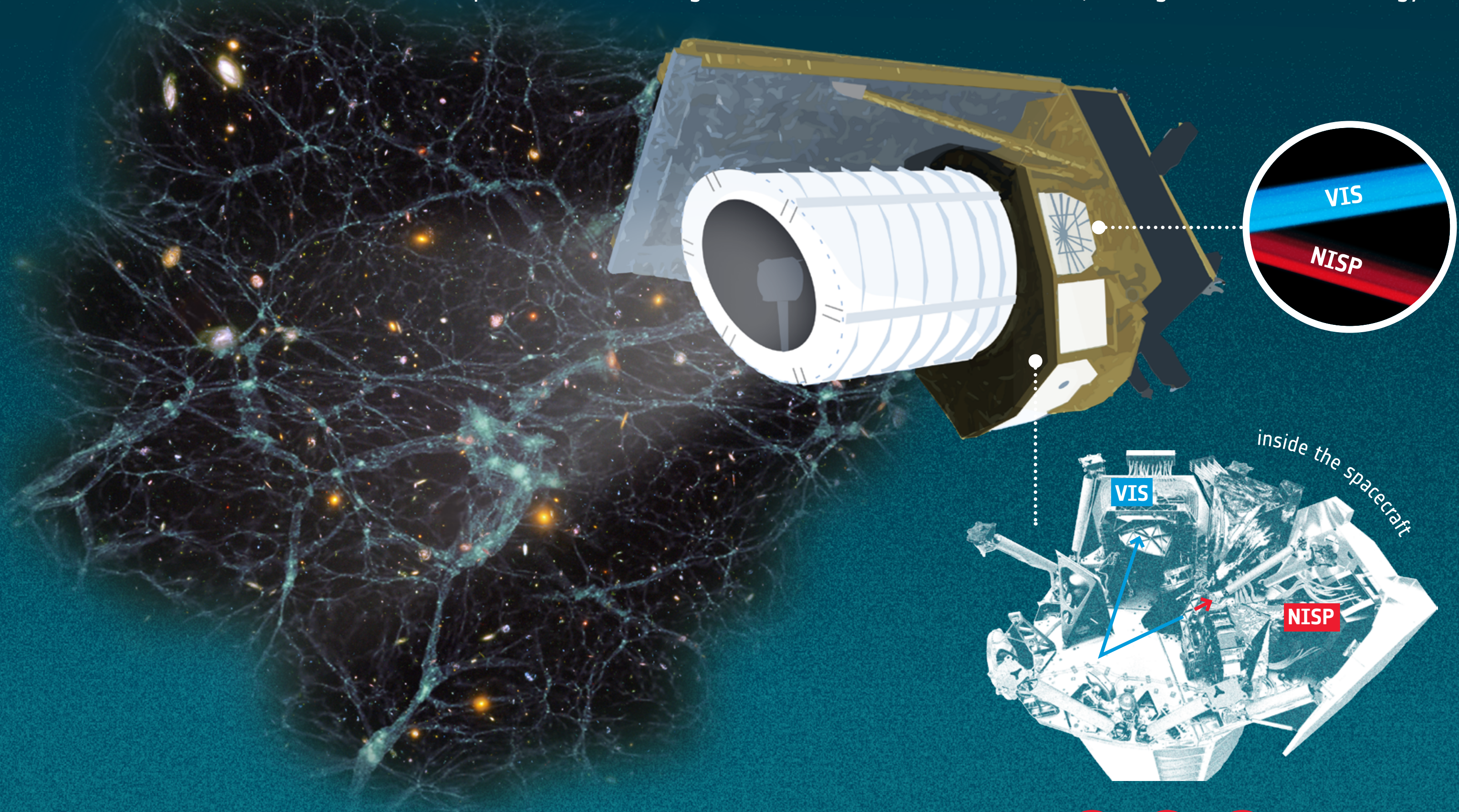


The Euclid spacecraft is 4.7 m tall and 3.7 m in diameter



EUCLID'S VISIBLE AND INFRARED INSTRUMENTS

Euclid will examine visible and infrared light from distant galaxies using two scientific instruments on board. These instruments will measure the accurate position and shapes of galaxy in visible light, and their redshift (from which their distance can be derived) in infrared light. With these data, scientists can construct a 3D map of the distributions of both the galaxies and the dark matter in the Universe. The map will show how large-scale structure evolved over time, tracing the role of dark energy.



VIS

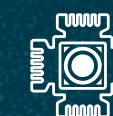
The visible instrument



Measures the shapes of billions of galaxies



550–900 nm wavelength



Mosaic of 36 CCDs, 4k x 4k pixels each



Special feature

very sharp images of galaxies

NISP

Near-infrared spectrometer and photometer



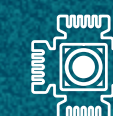
Measures brightness and intensity of light from galaxies



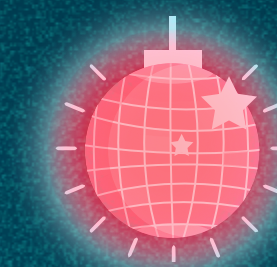
Used to calculate redshift/distance



900–2000 nm wavelength



Mosaic of 16 detectors, 2k x 2k pixels each



Special feature

largest infrared field-of-view from space



THE LIGHT AND DARK UNIVERSE

The Euclid mission aims to uncover the mysteries of the 'dark' Universe. This ominous-sounding invisible part of the cosmos makes up more than **95% of the mass and energy in our Universe**.

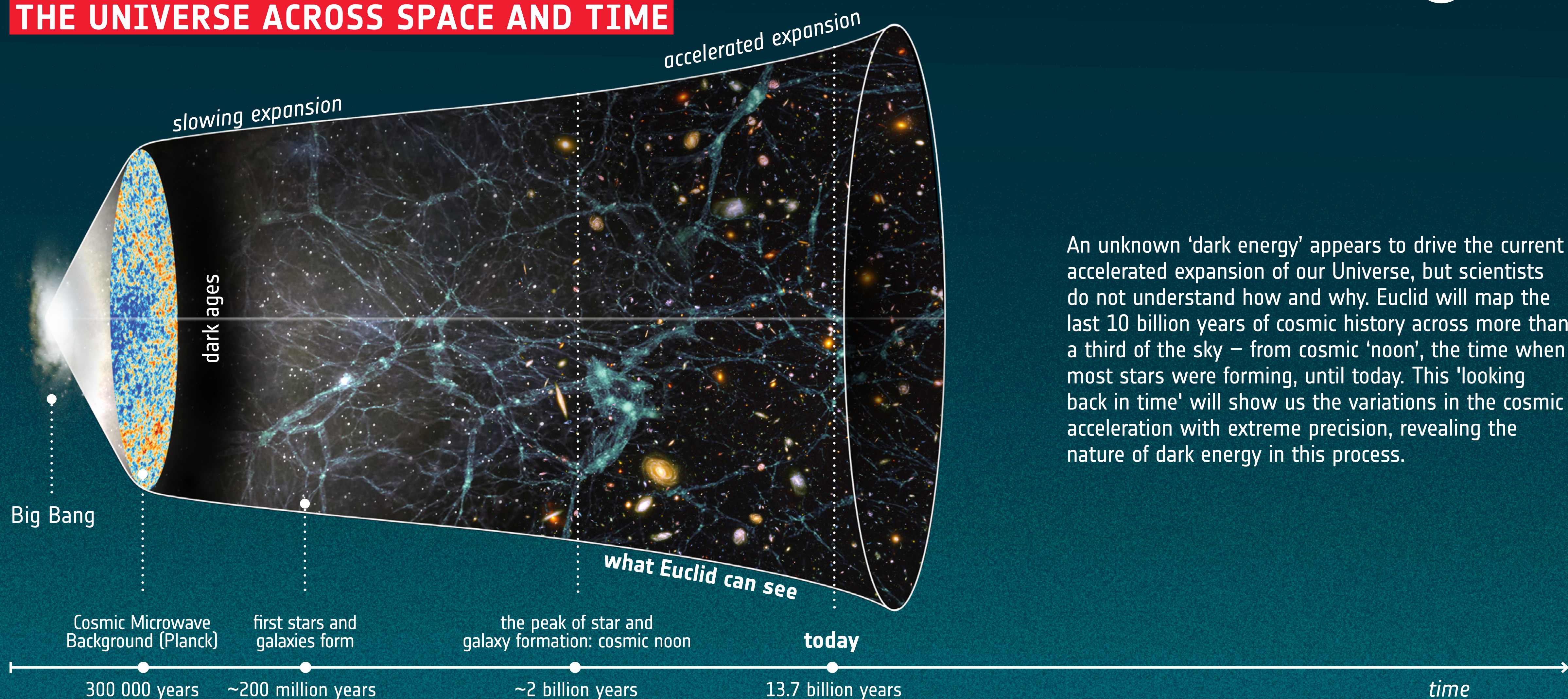
Ordinary matter that makes up everything we see – from stars and galaxies to planets and people – amounts to only **5%** of the cosmos

Dark matter makes up **~25%** of the cosmos

Dark energy makes up **~70%** of the cosmos



THE UNIVERSE ACROSS SPACE AND TIME



An unknown 'dark energy' appears to drive the current accelerated expansion of our Universe, but scientists do not understand how and why. Euclid will map the last 10 billion years of cosmic history across more than a third of the sky – from cosmic 'noon', the time when most stars were forming, until today. This 'looking back in time' will show us the variations in the cosmic acceleration with extreme precision, revealing the nature of dark energy in this process.

WHAT EUCLID WILL MEASURE: WEAK LENSING

A concentration of matter along the line of sight can act like a magnifying glass, bending and distorting light from galaxies and clusters behind it. This effect is called gravitational lensing. Scientists distinguish between strong gravitational lensing, when the distortions are very apparent, like in the case of Einstein rings, arcs, and multiple images, and weak gravitational lensing, when the distortions of background sources are much smaller. In this case, distortions (of a few percent) can only be detected by analysing large numbers of sources in a statistical way.

Euclid will measure the distorted shapes of billions of galaxies over 10 billion years of cosmic history, providing a 3D view of the dark matter distribution in our Universe. The map of the distribution of galaxies over cosmic time will also teach us about dark energy, which affects the spatial evolution of the large-scale structure.

Strong lensing



Unlensed sources

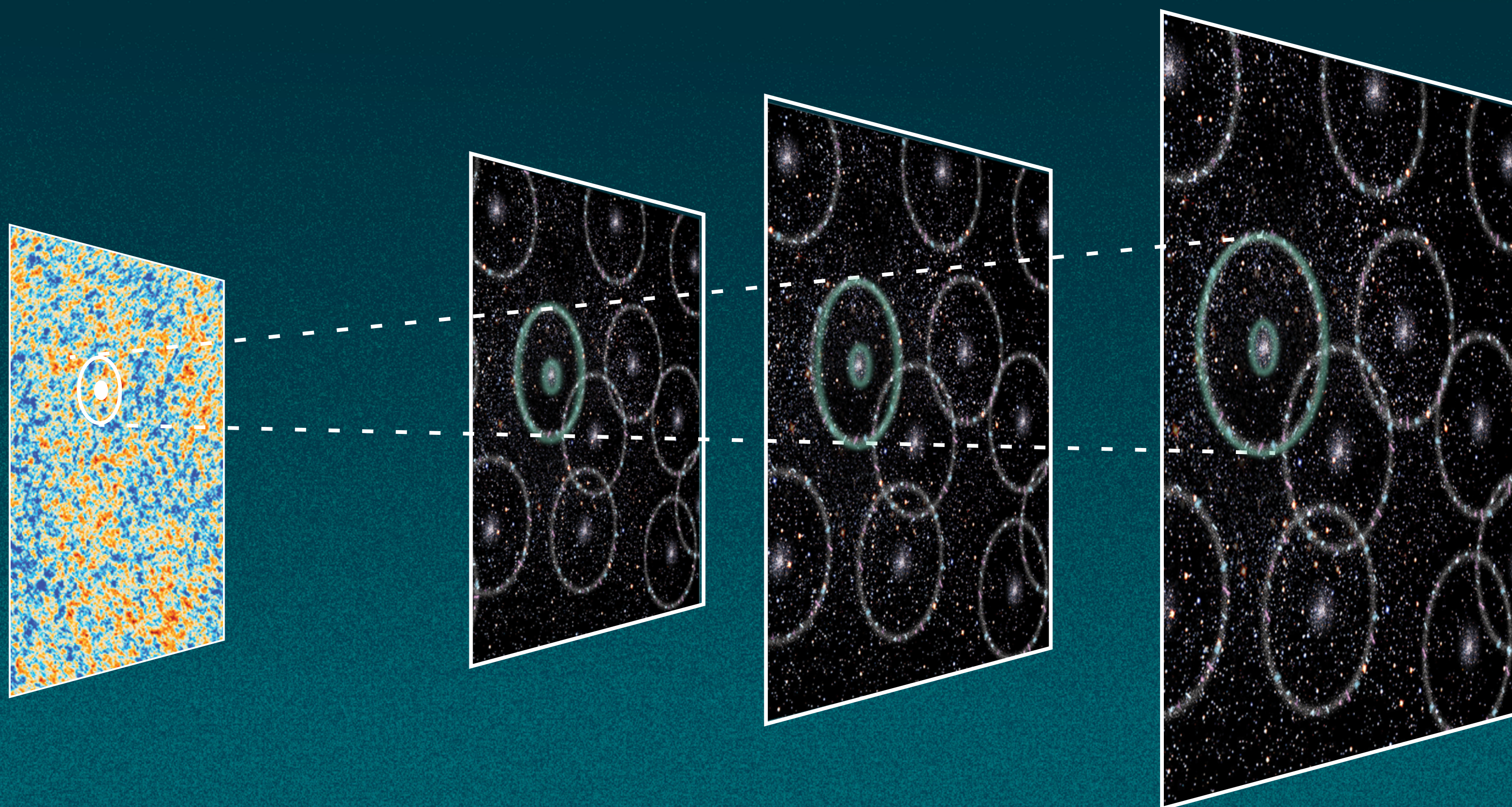


Weak lensing



WHAT EUCLID WILL MEASURE: BARYONIC ACOUSTIC OSCILLATIONS

During the first 300 000 years after the Big Bang, density fluctuations in the hot plasma (of protons, neutrons, electrons and photons) behaved as sound waves (bubbles) that rippled through this primordial particle-radiation soup. At the end of this period, slightly more galaxies formed in clusters along the frozen ripples. The ripples stretched as the Universe expanded, increasing the distance between galaxies. Euclid will study the distribution of galaxies over immense distances, teasing out these ripple patterns and determining their size. This enables us to measure accurately the accelerated expansion of the Universe and teaches us about the nature of dark energy and dark matter.



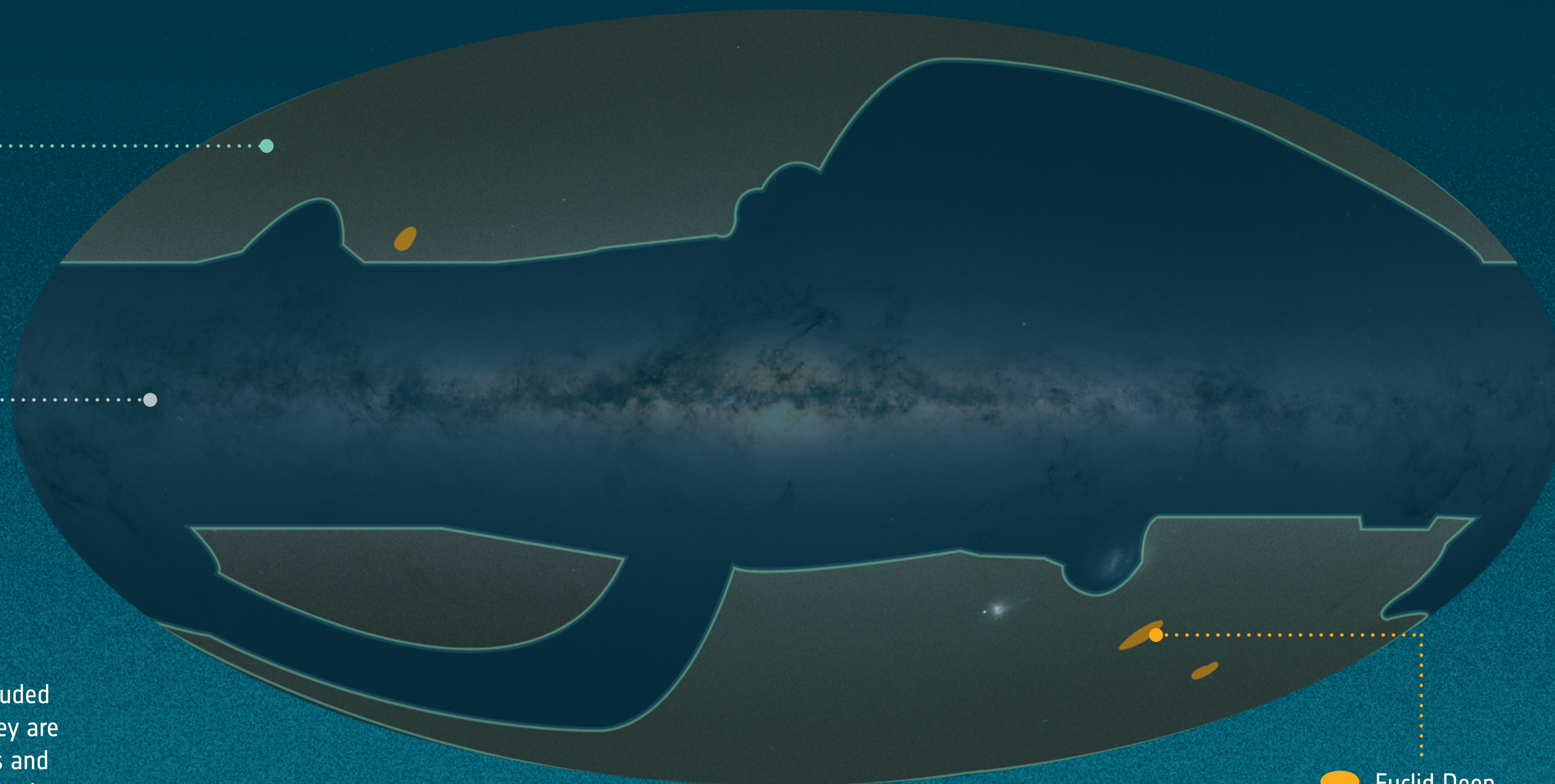
Artist's impression of the pattern of baryonic acoustic oscillations imprinted on the large-scale distribution of galaxies (exaggerated)

EUCLID'S TREASURE TROVE

By observing more than a third of the sky during its mission, Euclid will provide a gigantic catalogue of billions of galaxies and stars. This will be a treasure trove of data that can be used to improve our understanding of many aspects of astronomy: from merging galaxies to the physics of small and cool stars.

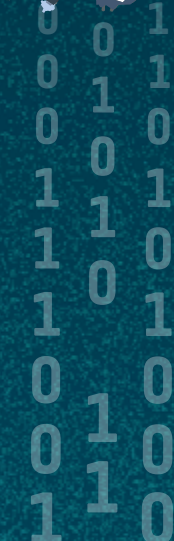
● Portions of the sky that will be covered by the wide survey

Other regions: These are excluded from observations because they are dominated by Milky Way stars and interstellar matter, or by diffuse dust in the Solar System – the so-called zodiacal light



● Euclid Deep Fields, covering 10% of observations

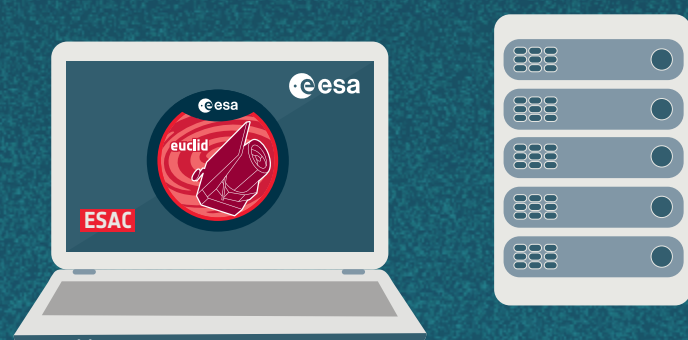




.....> Raw data>

ESA's Science Operations Centre (ESAC) in Spain

Data products (images, spectra, measurements, catalogues...)



Raw data are processed by the EC Science Ground Segment, responsible for providing data centres and software.

The **processed data products** include calibrated images and spectra, catalogues of scientific measurements, and documentation.

The EC includes over 2000 international scientists and contributed Euclid's instruments, VIS and NISP.

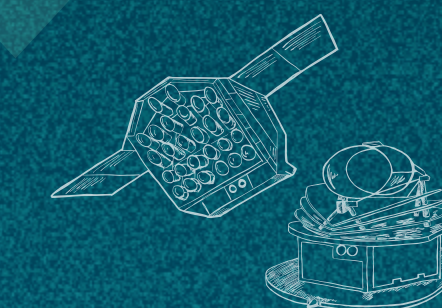


Scientific community

Data are available to all for decades, ensuring long-term science return and supporting future missions



Science



Planning future missions



EUCLID: AN ESA-LED GLOBAL COLLABORATION

Through developing and implementing the Euclid mission, ESA is leading a global collaboration that is already bringing socio-economic benefits to Europe and the rest of the world. These benefits are set to continue once the mission has launched.



>300
institutions



21
countries



80
companies



140
industry
contracts



>3500
people



~1.4
billion euros
(mission cost)

EUROPEAN PARTNERS

Many agencies, organisations and companies have contributed to the development of Euclid. This map highlights the main contributing ESA Member States and their funding agencies.

Belgium
Belgian Science Policy Office

Denmark
National Space Institute

France
National Centre for Space Studies (CNES)

Finland
University of Helsinki

Germany
German Space Agency at DLR

Italy
Italian Space Agency (ASI)

Netherlands
Netherlands Research School for Astronomy (NOVA)

Norway
Norwegian Space Centre

Portugal
Portuguese Space Agency

Romania
Romanian Space Agency

Spain
Ministry of Economy and Competitiveness

Switzerland
Swiss Space Office

United Kingdom
UK Space Agency

Beyond Europe:



United States
National Aeronautics and Space Administration (NASA)



SPOKESPEOPLE

All spokespeople can be reached via ESA Media Relations: media@esa.int.



Flags represent spoken languages.

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Project Scientist
ESTEC, Netherlands
 

Giuseppe Racca
Project Manager
ESTEC, Netherlands
  

Roland Vavrek
Deputy Project Scientist
ESAC, Spain
 

Pierre Ferruit
Mission Manager
ESAC, Spain
 

Guadalupe Cañas Herrera
Research Fellow
ESTEC, Netherlands
 

Alexander Short
Mission and Payload Manager
ESTEC, Netherlands


Andreas Rudolph
Head of Astronomy &
Fundamental Physics Missions
ESOC, Germany
   

John Hoar
Science Operations Manager
ESAC, Spain


Xavier Dupac
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Ralf Kohley
Euclid Instrument Operations
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Micha Schmidt
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Tiago Loureiro
Deputy Flight Operations
Director
  

Gaitee Hussain
Head of Science Division
ESTEC, Netherlands


Mark McCaughrean
Senior Advisor for Science
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ESTEC, Netherlands
 

Markus Kissler-Patig
Head of Science and
Operations Department
ESAC, Spain
 

Guillermo Buenadicha
Science Operations
Coordinator
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Bruno Altieri
Euclid Archive Scientist
ESAC, Spain
  

Elena Maiorano
Euclid Spacecraft
Engineering Manager
ESTEC, Netherlands
   

Tobias Bönke
Euclid Mission System Engineer
ESTEC, Netherlands
 

ESA Directors

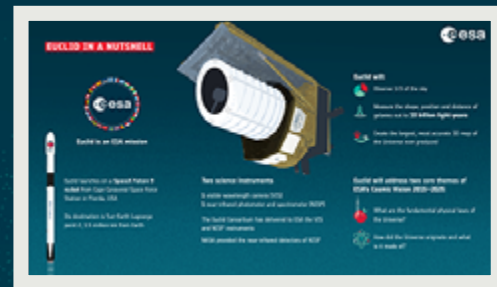
Josef Aschbacher
Director General
ESA HQ, France
 

Carole Mundell
Director of Science
ESAC, Spain

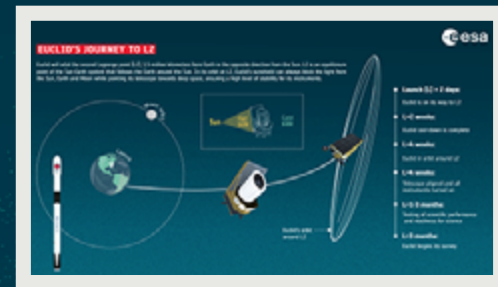

Rolf Densing
Director of Operations
ESOC, Germany
  



INFOGRAPHICS



Euclid in a nutshell



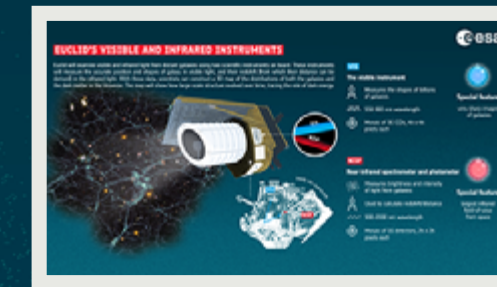
Euclid's journey to L2



Euclid science



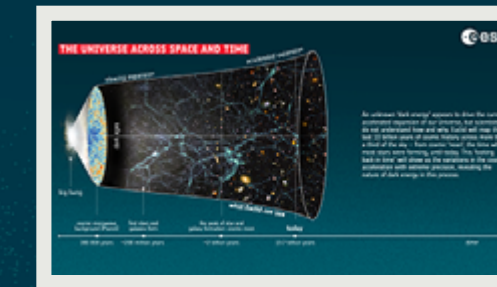
Euclid spacecraft



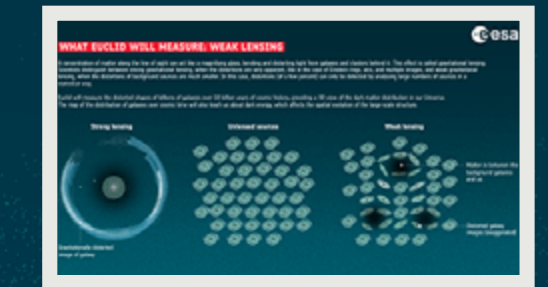
Euclid's visible and infrared instruments



The light and dark Universe



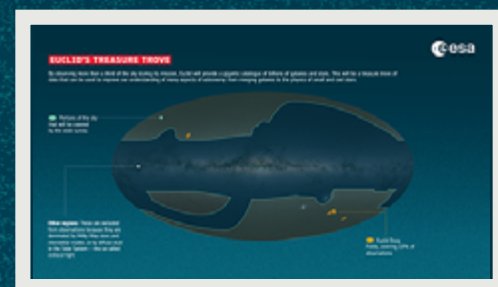
The Universe across space and time



Weak lensing



Baryonic acoustic oscillations



Euclid's treasure trove



Euclid Science Archive



An ESA-led collaboration

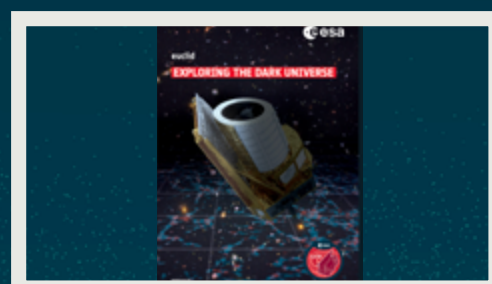


European partners

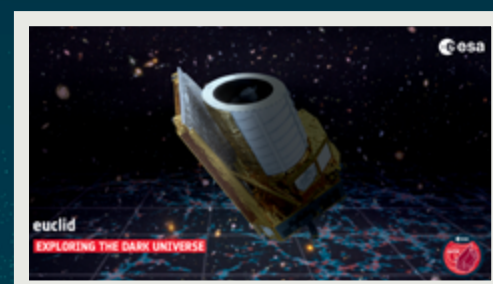
IMAGES AND VIDEOS

ESA images: www.esa.int/ESA_Multimedia/Images

ESA videos: www.esa.int/ESA_Multimedia/Videos



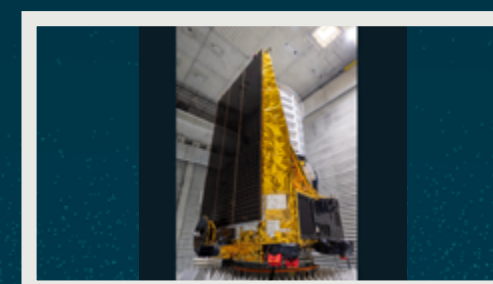
Euclid mission poster
(vertical)



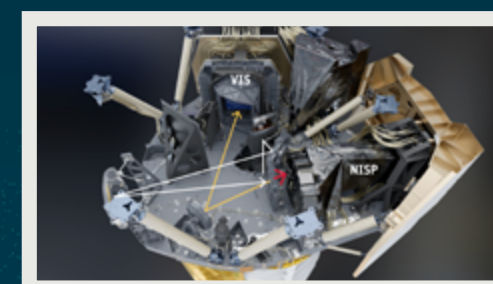
Euclid mission poster
(horizontal)



Euclid looking into
the Universe



Euclid in cleanroom



Euclid instruments



Euclid VIS and NISP



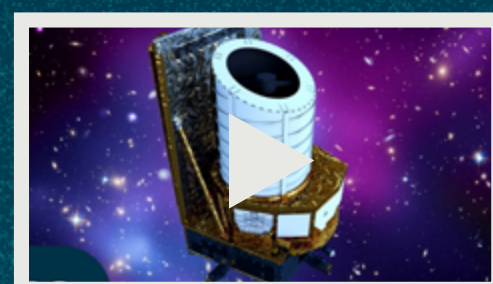
Euclid NISP
instrument



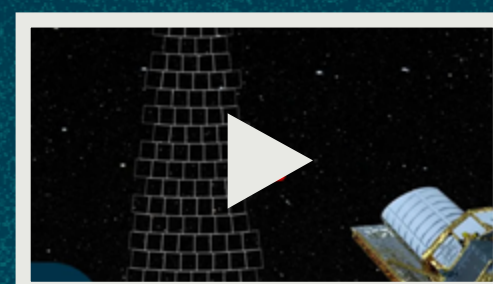
Euclid VIS
instrument



Instruments
installed



Euclid in a nutshell



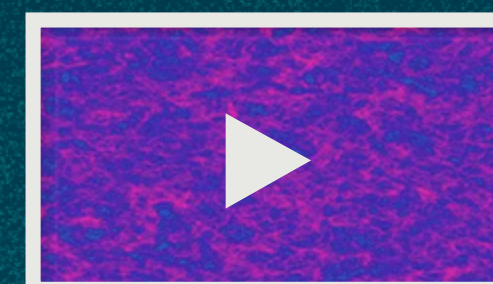
How Euclid scans
the sky



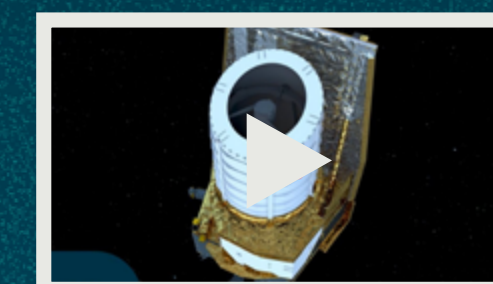
Euclid survey



Dark cosmic web



Structure of dark
matter



Spacecraft animation



The Fingertip Galaxy



Euclid testing



Euclid gains solar
power



Euclid eyes meet
brain



Spacecraft
integration

FREQUENTLY ASKED QUESTIONS 1/2



Why are we interested in dark matter and dark energy?

Scientists discovered that the distribution and movement of objects in the Universe like stars and galaxies are affected by the presence of two invisible entities that they named dark matter and dark energy. These names indicate that the scientists don't know what these forms of matter and energy are. If we want to understand the Universe we live in, we need to learn more about the details of these 'dark' entities and uncover their nature.



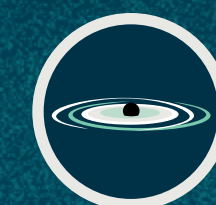
What can Euclid do that the Webb space telescope can't?

Where Webb can observe extremely far back in time and zoom into the details, Euclid can go fast and wide. In a single observation Euclid can record the data from an area of the sky more than one hundred times bigger than that imaged by Webb's camera, NIRCam. This means that Euclid can map one third of the sky to the required sensitivity in six years in space – a feat that would be impossible with Webb.



What will Euclid's image quality be?

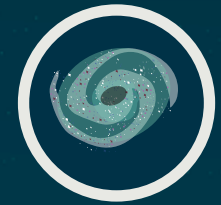
Euclid's images will be at least four times sharper than that achieved by ground-based sky surveys. In the absence of Earth's atmosphere, and with optics of the highest quality, the angular resolution of a telescope is determined by the size of the primary mirror. Since Euclid has a smaller primary mirror than Hubble, it will resolve fewer fine details, but the image quality is outstanding and the lower resolution is adequate to achieve its scientific goals. The telescope and its optics are designed to deliver a large field of view and a stable image quality throughout the survey.



Will Euclid study black holes?

Euclid will be able to study giant black holes at the centre of galaxies by observing the magnified and distorted shapes of background galaxies whose light passes in the vicinity of the black hole and is affected by strong gravitational lensing. Additionally, thanks to its observations of the effects of weak lensing and galaxy clustering, Euclid will be able to test theories that predict the existence of primordial black holes. These are hypothetical black holes (of smaller mass) that could have formed soon after the Big Bang and could be (partially) the origin of dark matter.

FREQUENTLY ASKED QUESTIONS 2/2



Why must Euclid observe so many (billions of) galaxies?

This is necessary to build a detailed map of the distribution of matter in the Universe. It is also needed to record how fast all these cosmic objects are receding from each other, over a large area of the sky and across distances of 10 billion light years. Only with such an extensive map of the large-scale structure of the cosmos can we pin down the characteristics of dark energy and dark matter, and possibly spot deviations from the laws of gravity as we currently know them (described by the theory of General Relativity).



Do dark matter and dark energy affect my everyday life?

No. If dark matter is indeed made of particles, it will interact so rarely with normal matter (that we, animals, plants and the entire planet are made of) that it can be completely and safely ignored. The effects of dark energy can only be perceived by astronomical sources over distances of 100 million light years, so again it can be safely ignored at the human scale (but also at the scale of our Solar System!).



Will Euclid build on the results of ESA's Planck mission?

Planck's results are a fundamental starting point for the investigations enabled by Euclid. Using the observations made by the Planck mission of the temperature fluctuations of the Cosmic Microwave Background and of its polarisation properties, scientists were able to fundamentally improve our understanding of the initial phase of the Universe and gain further evidence of the presence of dark energy and dark matter. But the question of what these entities are remains. Euclid is about to pick up the baton from Planck and help us further our understanding of the Universe we live in.



What is the relation between the Euclid mission and ground-based surveys with similar scientific goals?

Thanks to its vantage point outside Earth's atmosphere, Euclid will be able to perform the most comprehensive study of dark energy and dark matter. There are, however, mutual benefits between the Euclid mission and ground-based surveys, and scientists in the Euclid collaboration will also make use of observations from partners ground-based surveys for the study of the Universe. In particular, the area of the Euclid survey has been defined to achieve great overlap with the 10-year Legacy Survey of Space and Time (LSST) that will be conducted by the Vera C. Rubin Observatory in Chile.

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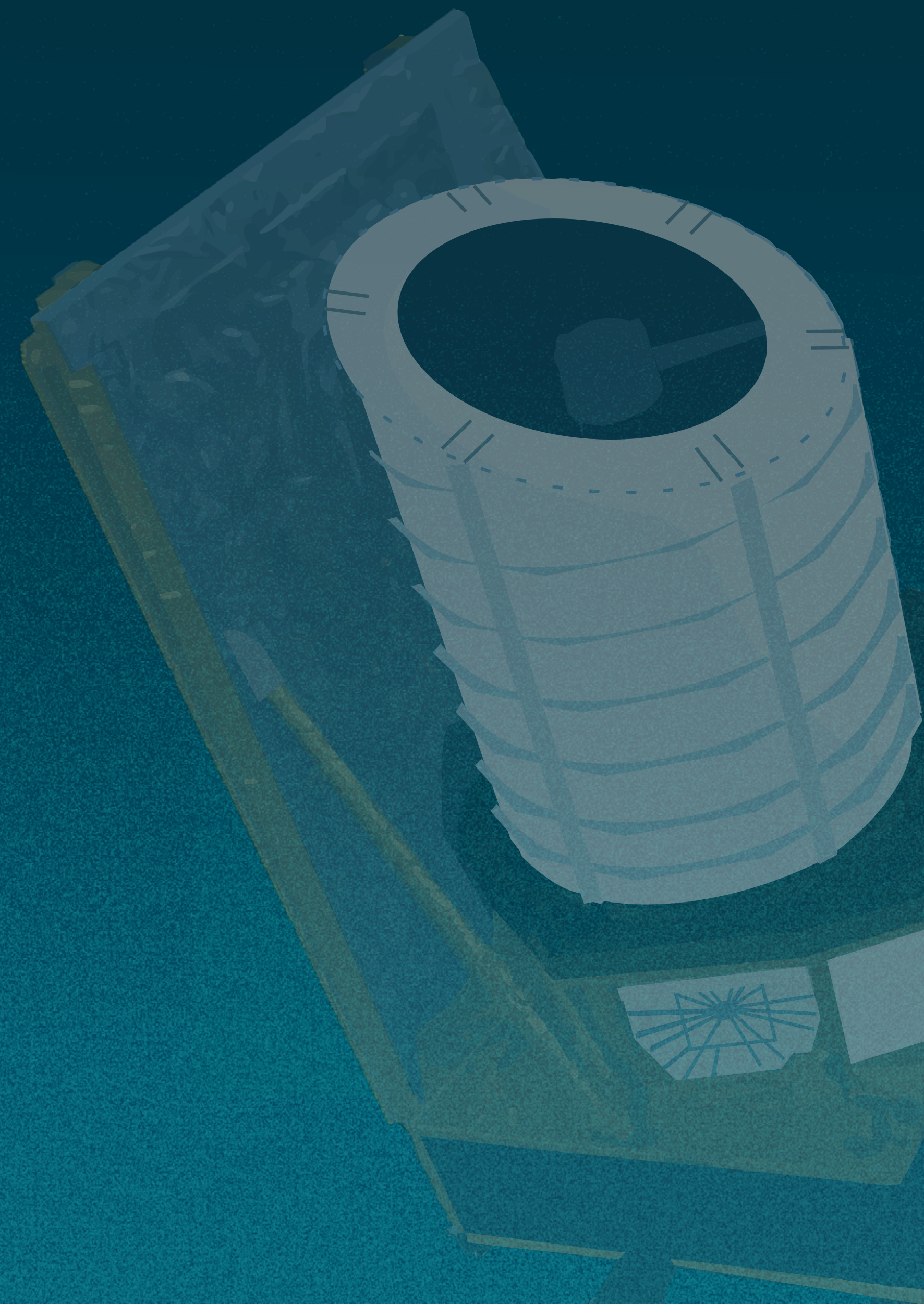
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