



# *Euclid* das neue Weltraumteleskop

Knud Jahnke

@knud@mastodon.social

(Max-Planck-Institut für Astronomie, Heidelberg)

für das *Euclid* Consortium

@ec\_euclid@astrodon.social

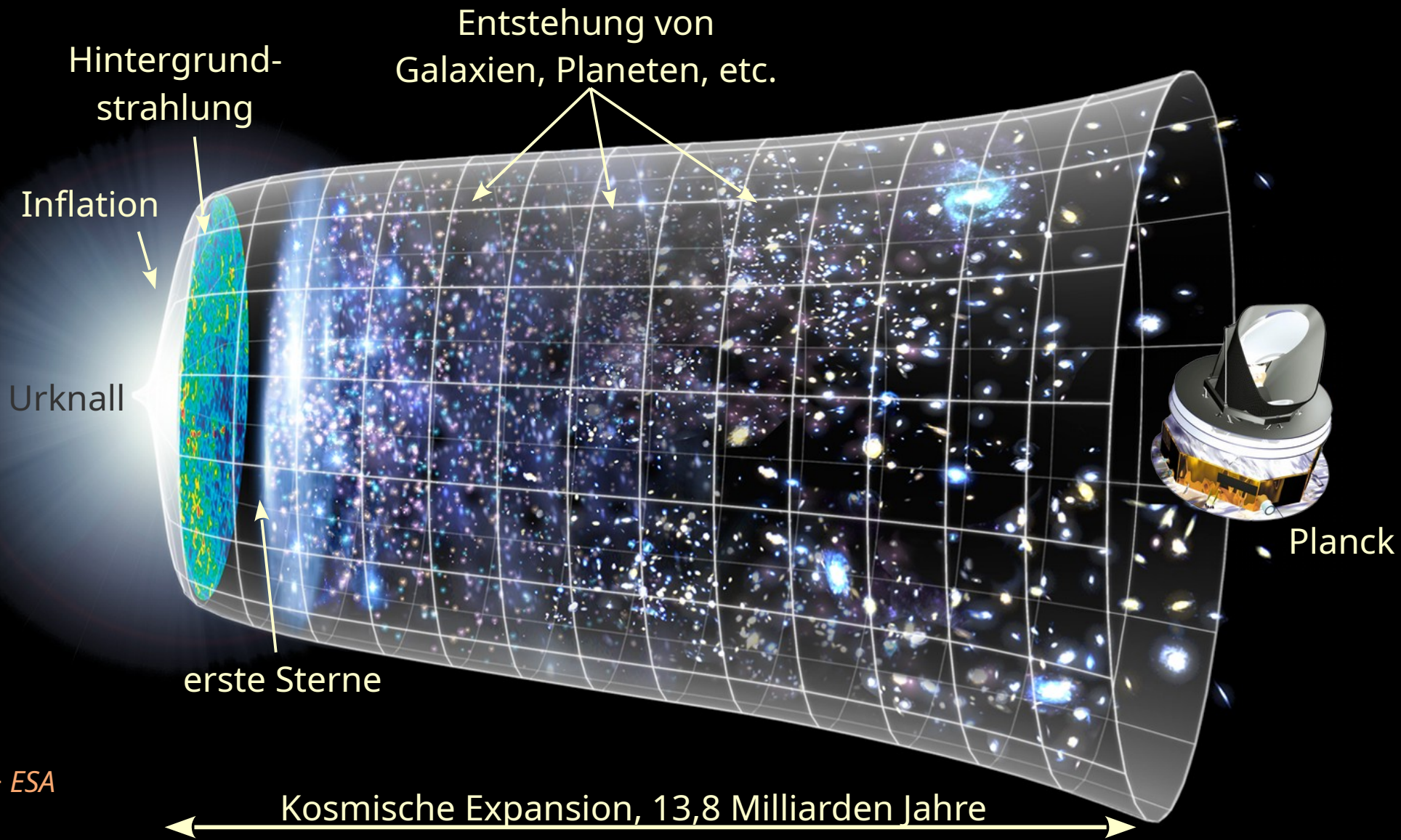


I. Dunkle Materie – Dunkle Energie

II. *Euclid*, die Mission

III. Schöne Bilder

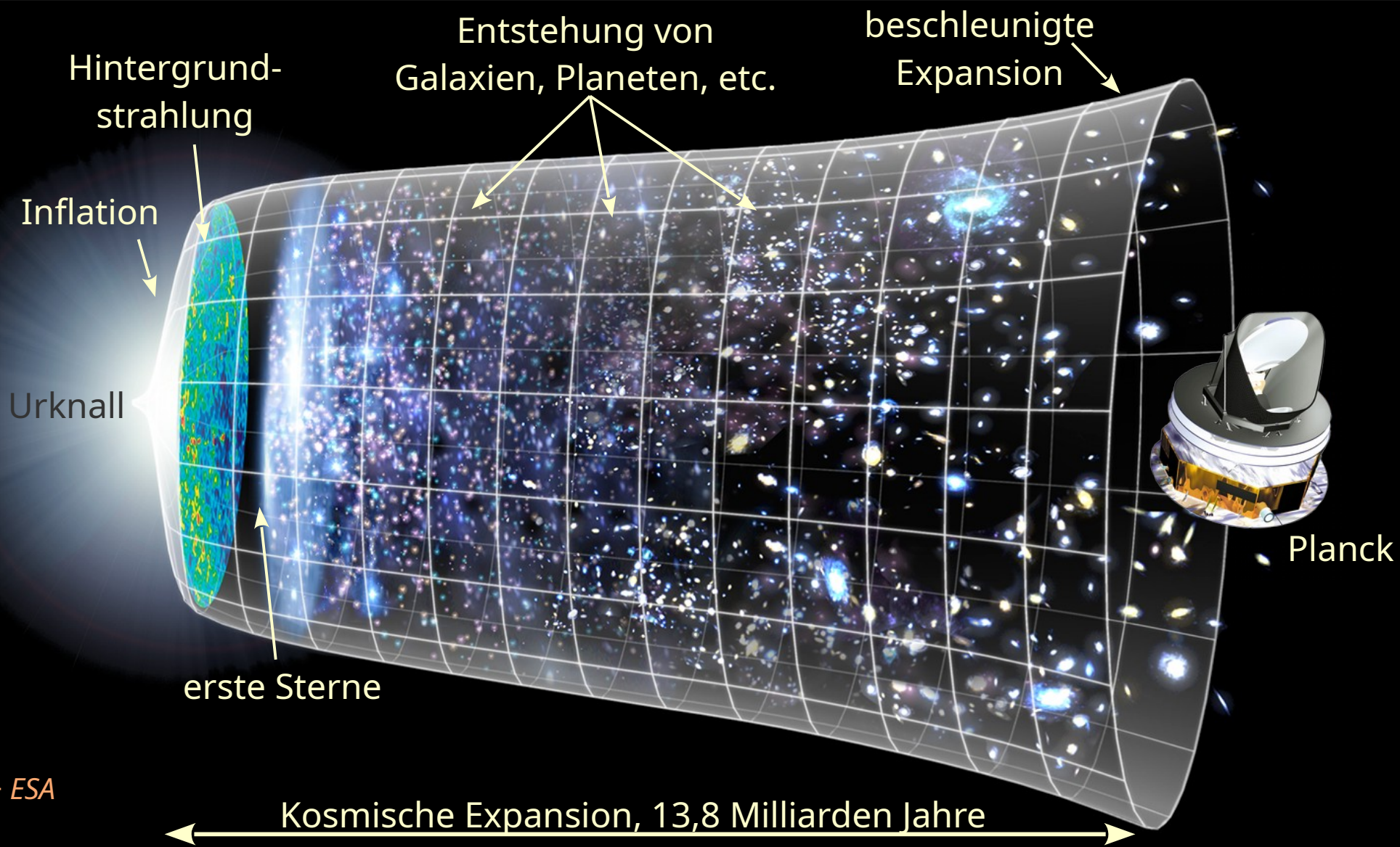
# I. Dunkle Materie – Dunkle Energie



Bilder:  
NASA + ESA

1. Universum ist “flach”, keine Krümmung

→ “kritische Masse” → Wissen um Gesamtenergie/-masse



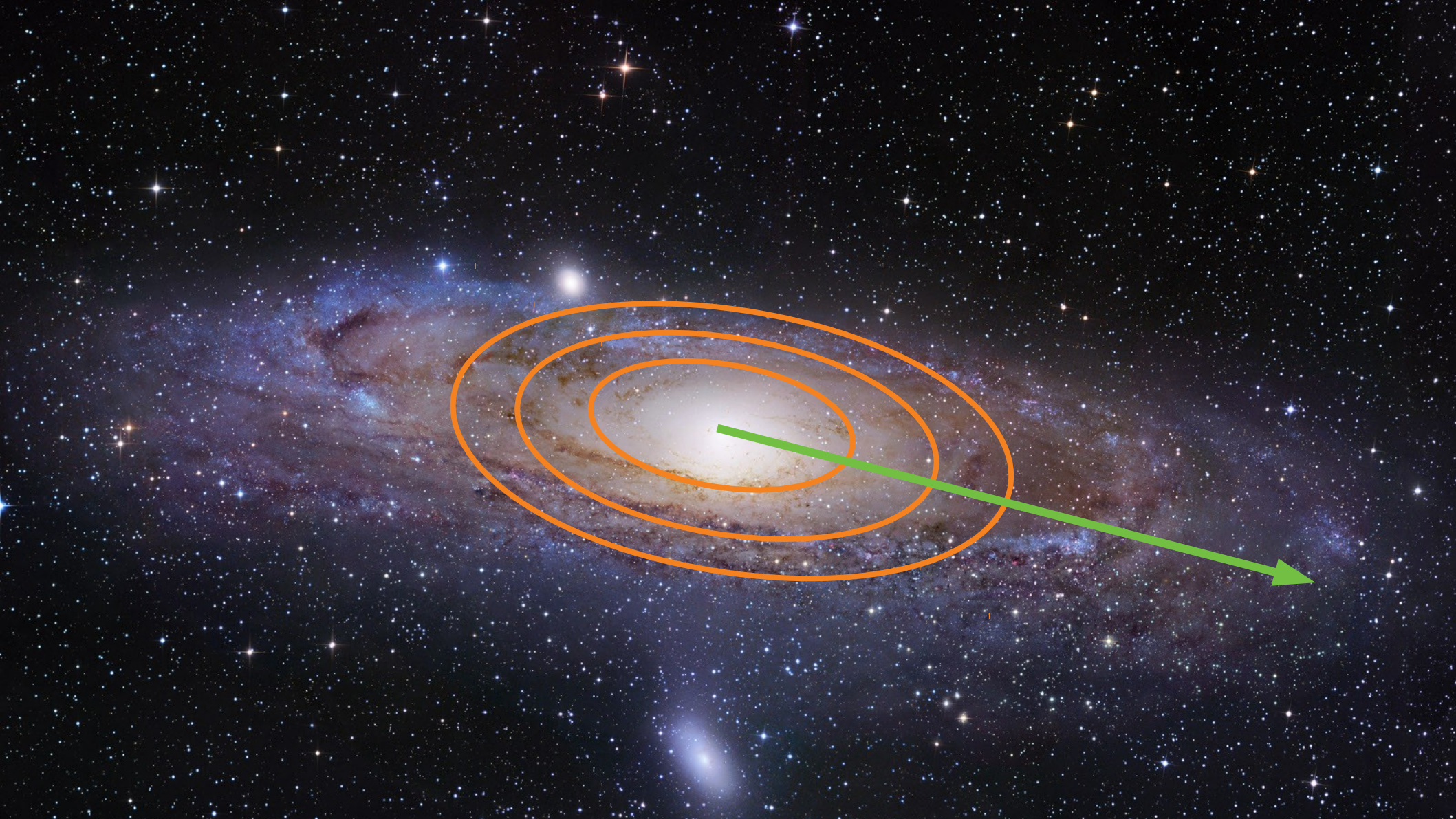
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2. Universum dehnt sich aktuell beschleunigt aus

→ "Energie" + "Druck" → Dunkle Energie





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→ "Energie" + "Druck" → Dunkle Energie

3. Es gibt viel Masse, die man nicht sieht

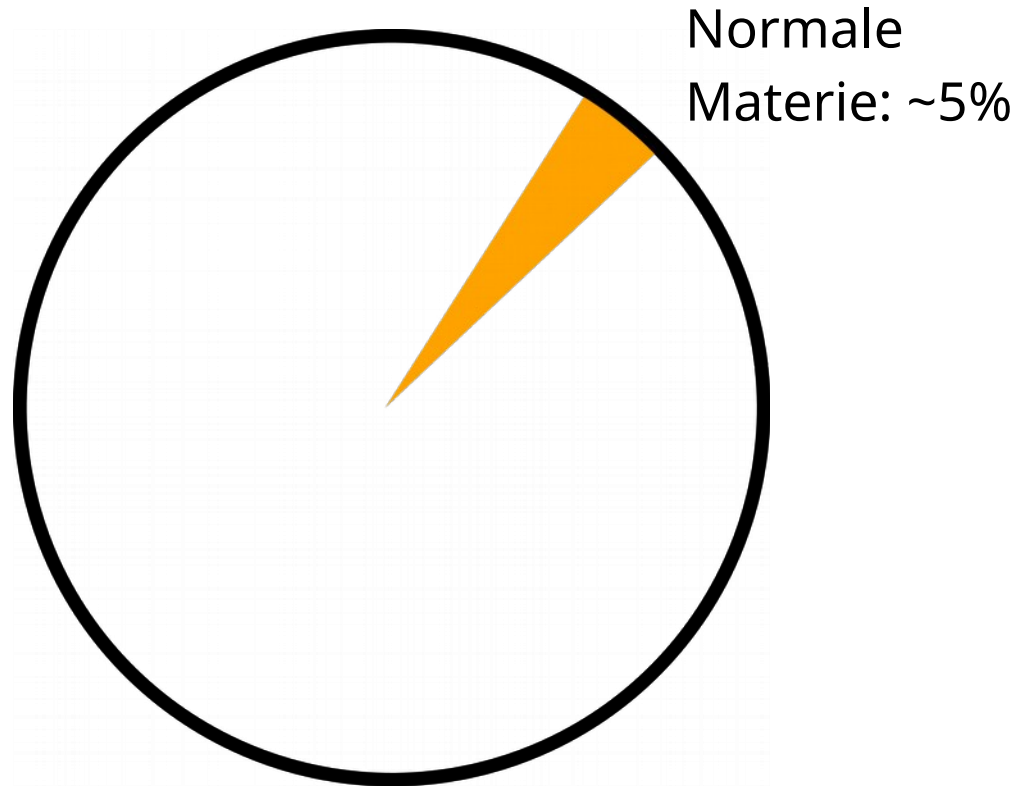
→ Masse = Dunkle Materie

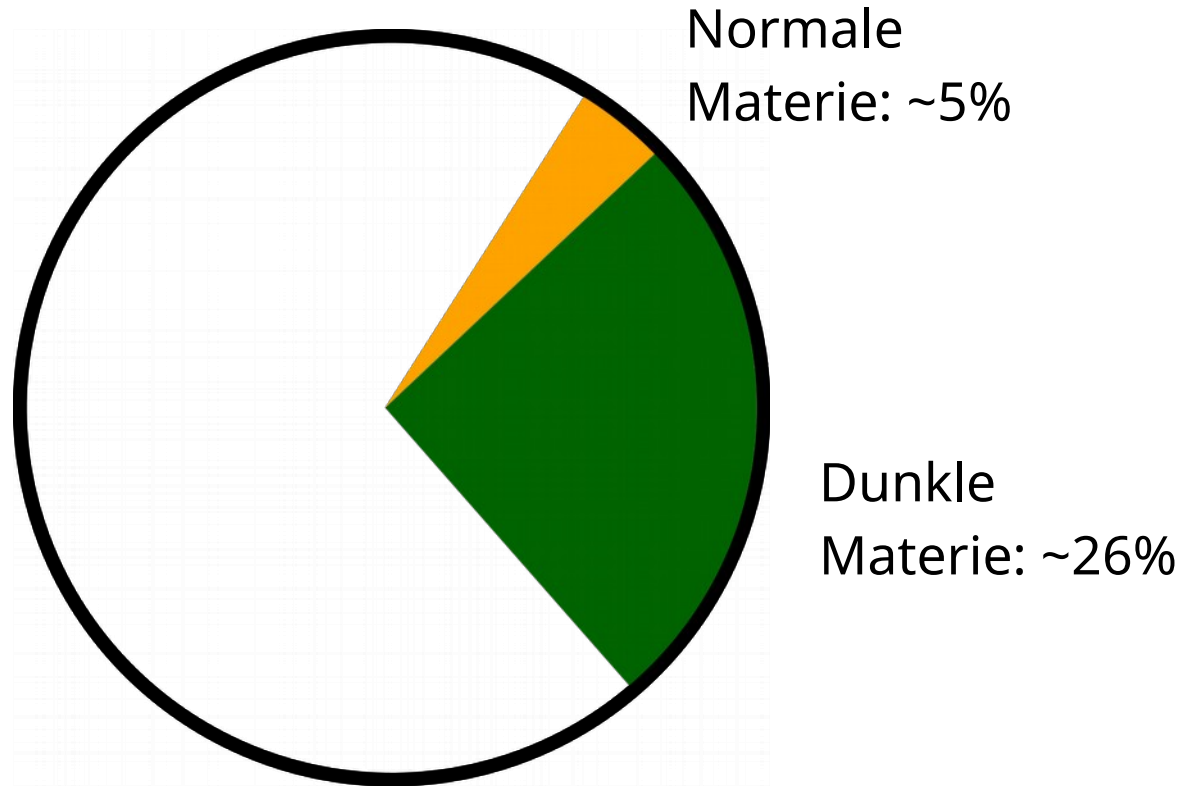
Hier im Saal:

Dunkle Materie:  $\sim 5$  Femtogramm ( $10^{-15}$  g)

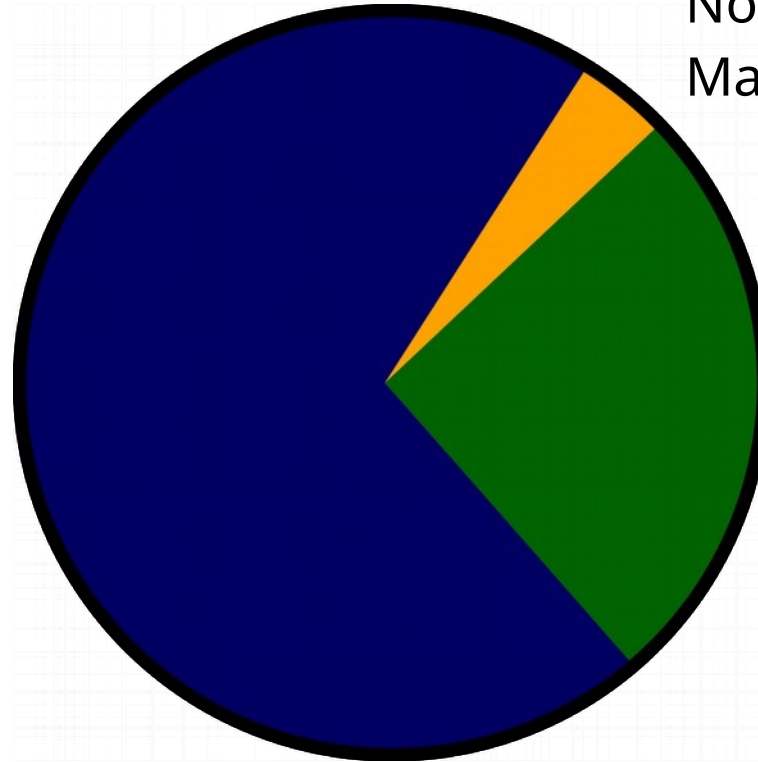
Dunkle Energie:  $\sim 1$  Attogramm ( $10^{-18}$  g)







Dunkle  
Energie: ~69%



Normale  
Materie: ~5%

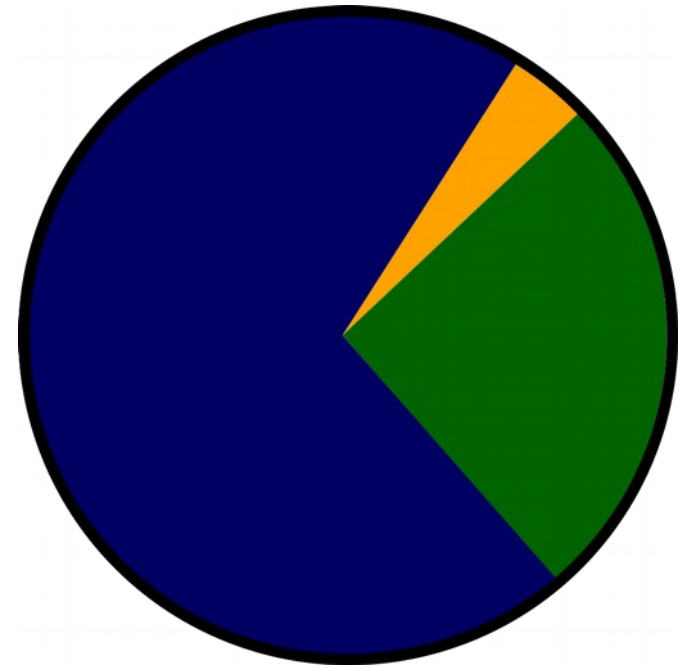
Dunkle  
Materie: ~26%



I. Dunkle Materie – Dunkle Energie

II. *Euclid*, die Mission

- ESA “Cosmic Vision 2015-2025”, “M-Klasse” (~1 Milliarde €)
- Ziel: Dunkle Energie einschränken, Dunkle Materie messen, Gravitation
- 2 (Haupt)Methoden:
  - Schwacher Gravitationslinseneffekt  
→ Dunkle Materie/Strukturbildung
  - “Baryon-Akustische-Oszillationen”  
→ Wachstums-Geschichte des Universums



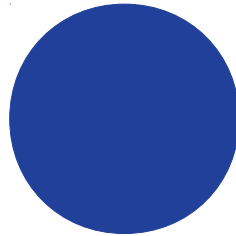




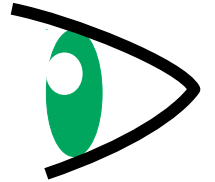
*Bild: Samantha Scibelli*



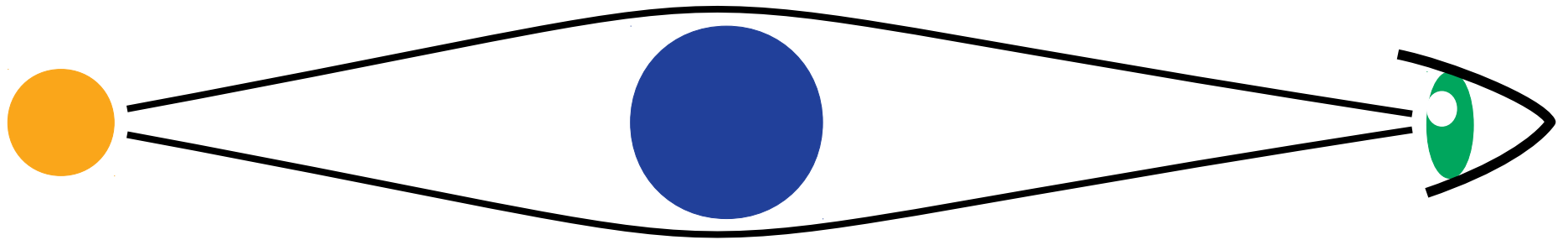
Quelle



große Masse



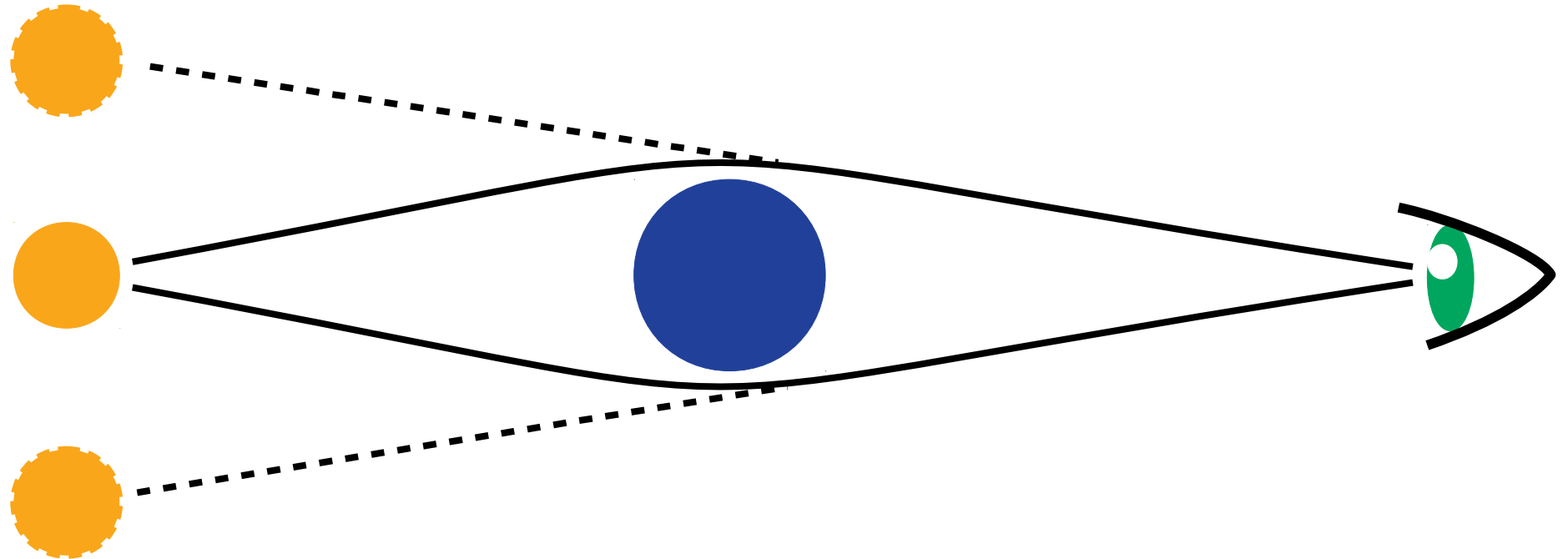
Beobachter\*in



Quelle

große Masse

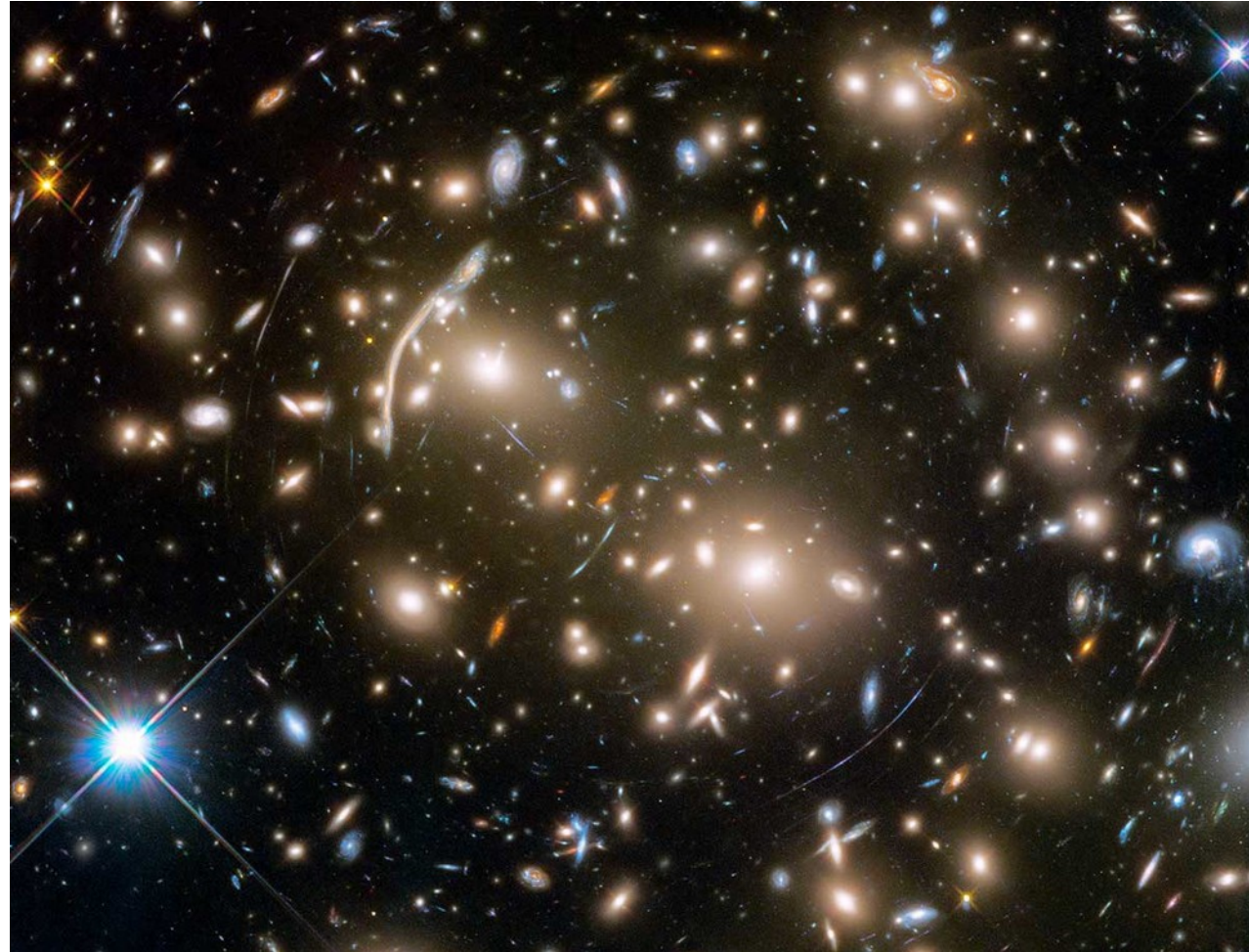
Beobachter\*in



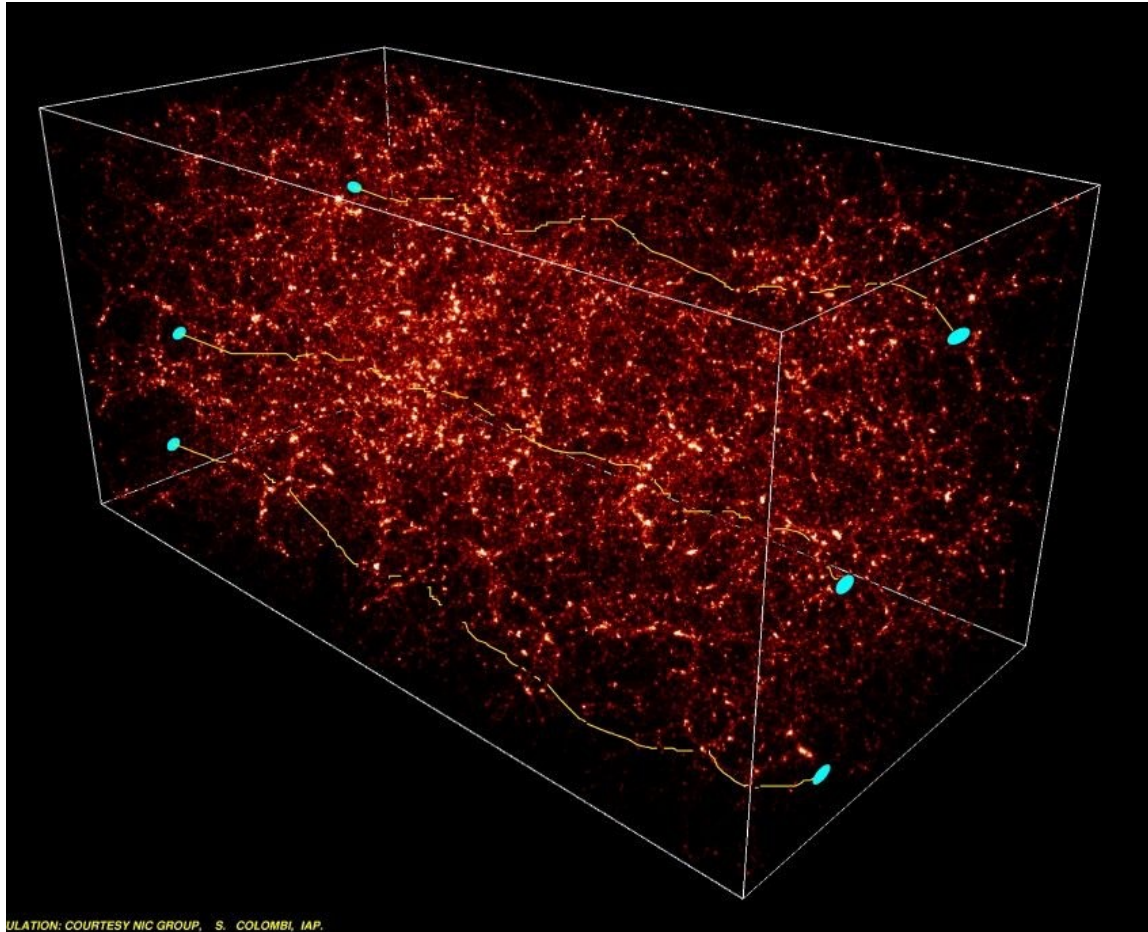
Quelle

große Masse

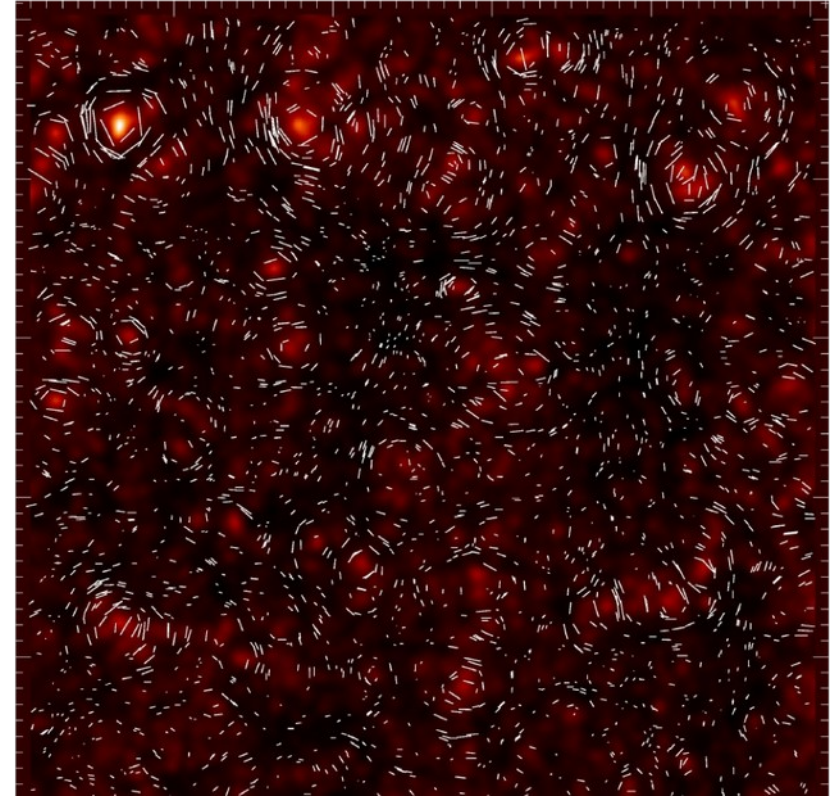
Beobachter\*in



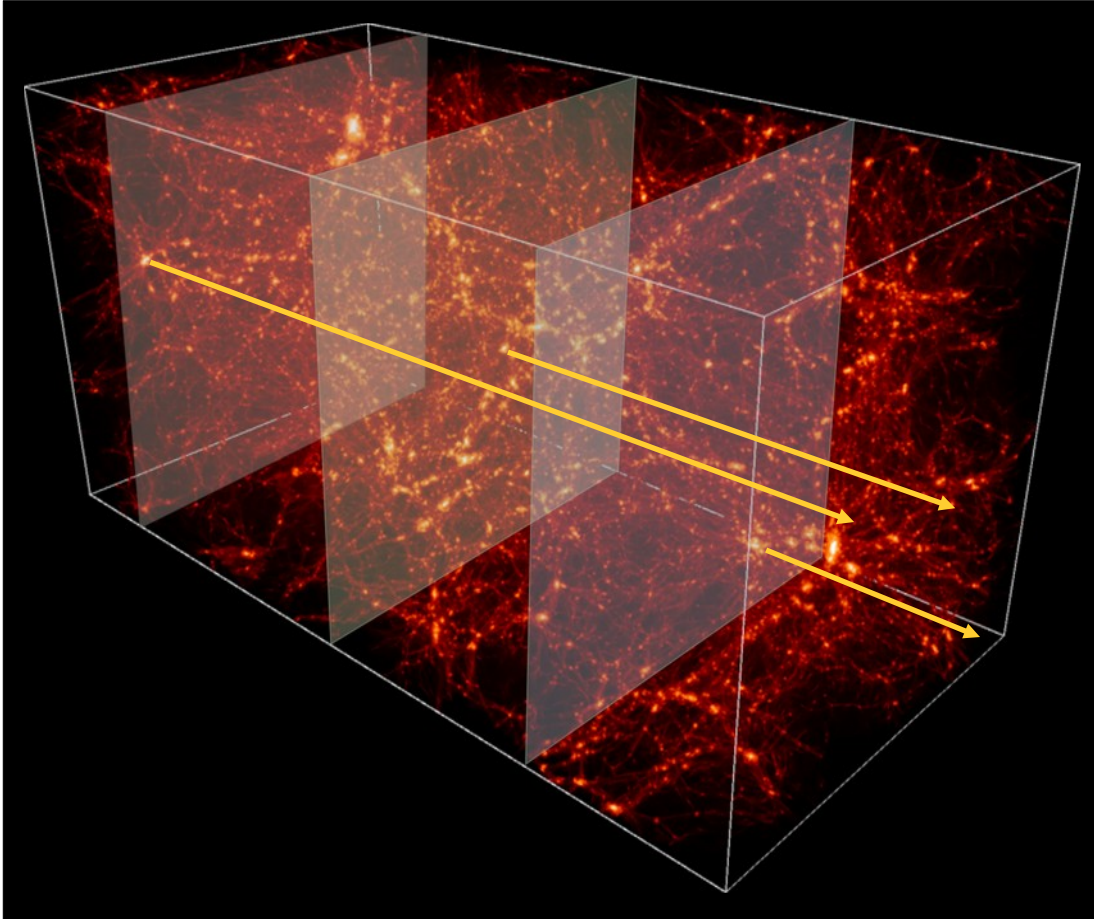
*Bild: NASA, ESA, and J. Lotz  
and the HFF Team (STScI)*



ULATION: COURTESY NIC GROUP, S. COLOMBI, IAP.



*Bilder: IAP Paris*

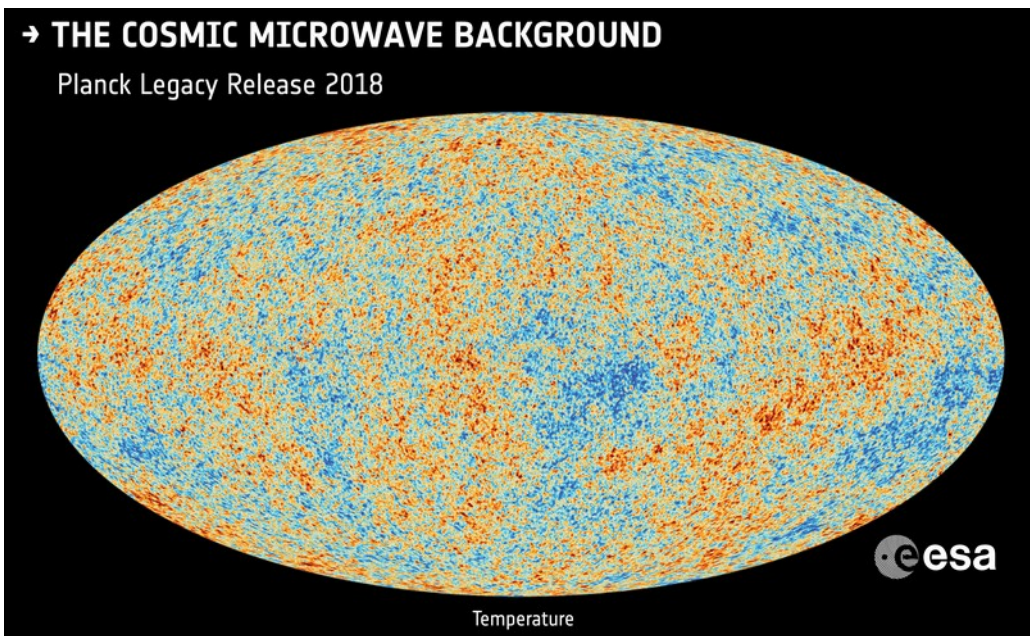


Mit Galaxien-Entfernungen

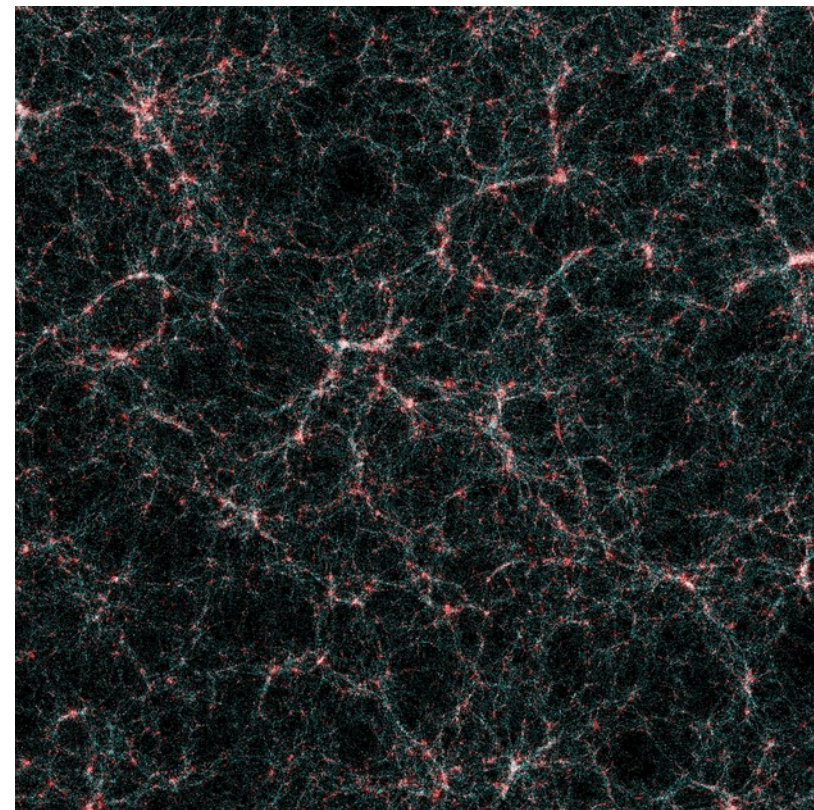
→ 3d-Massenverteilung

→ "leuchtende" und dunkle Materie

*Bild: IAP Paris*

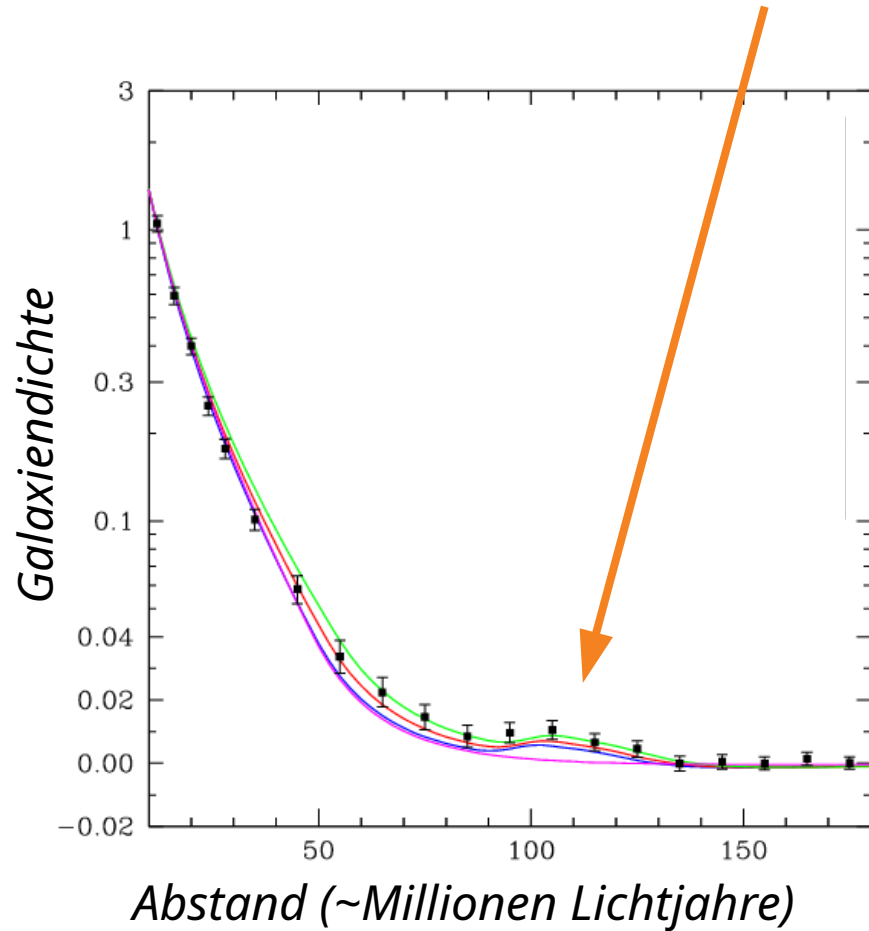


2,7K-Mikrowellenhintergrund  
(Weltalter: ~300.000 Jahre)



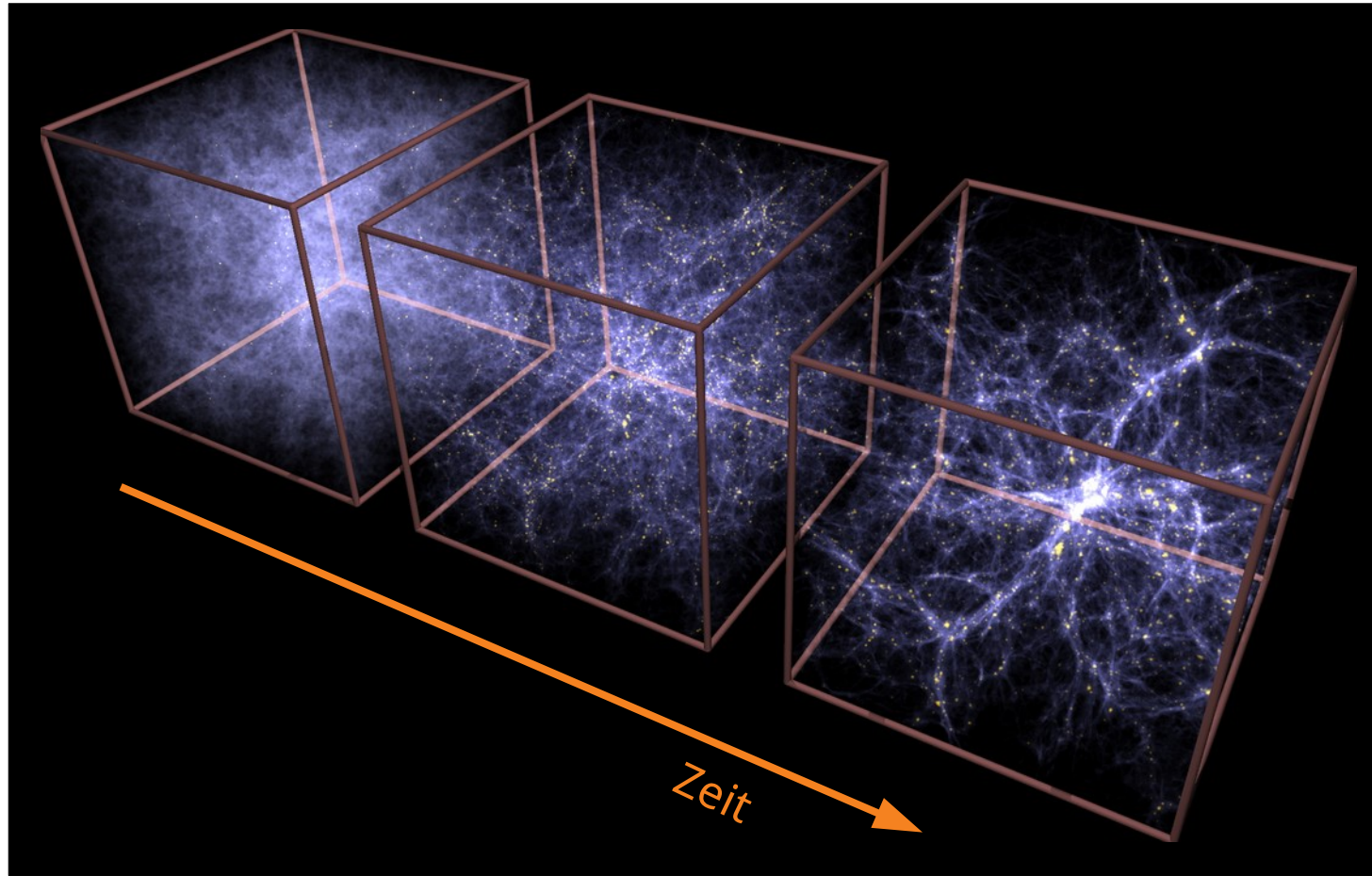
groß-skalige Galaxienverteilung  
(Weltalter: 1–10 Milliarden Jahre)

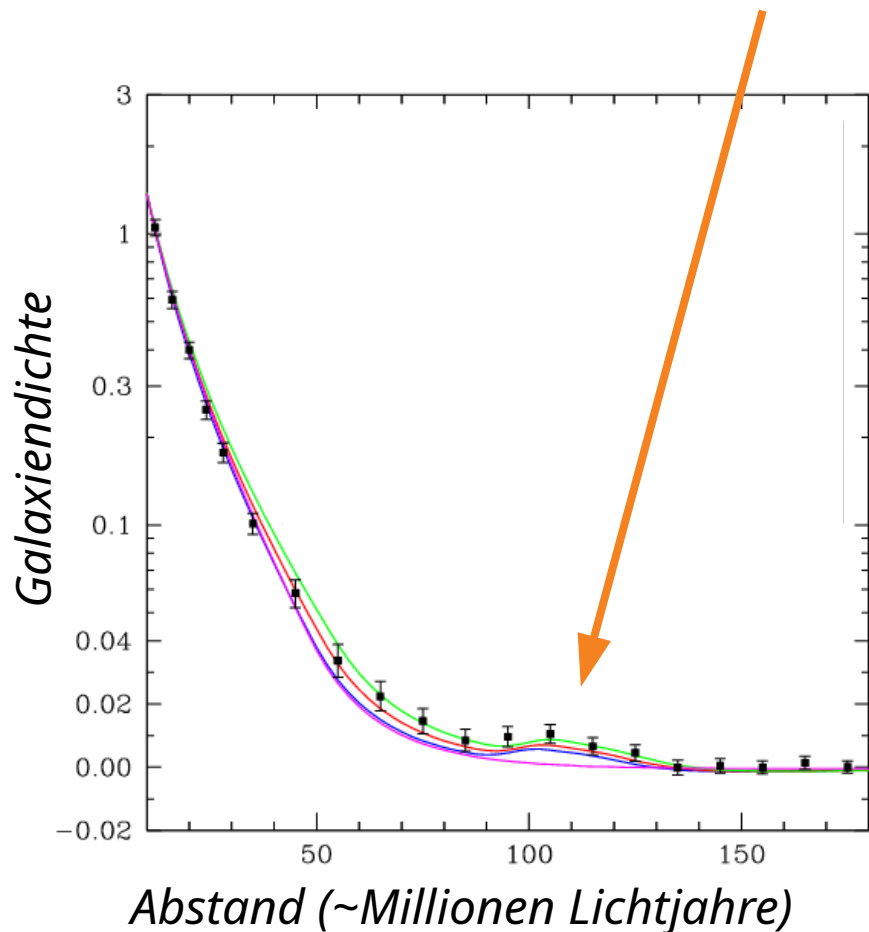




- Charakteristische Länge

*Eisenstein+ 2005*





- Charakteristische Länge
- Verändert sich mit Ausdehnung des Universums
- Universeller "Maß-Stab"

Wie?

- Gravitationslinsen: Entfernung & Form von 2 Milliarden Galaxien
- Baryon-Akustische-Oszillationen: exakte 3d-Position von 35 Millionen Galaxien

→ Durchmusterung, 1/3 des Himmels,  
Bilder & Spektren

→ "Euclid"

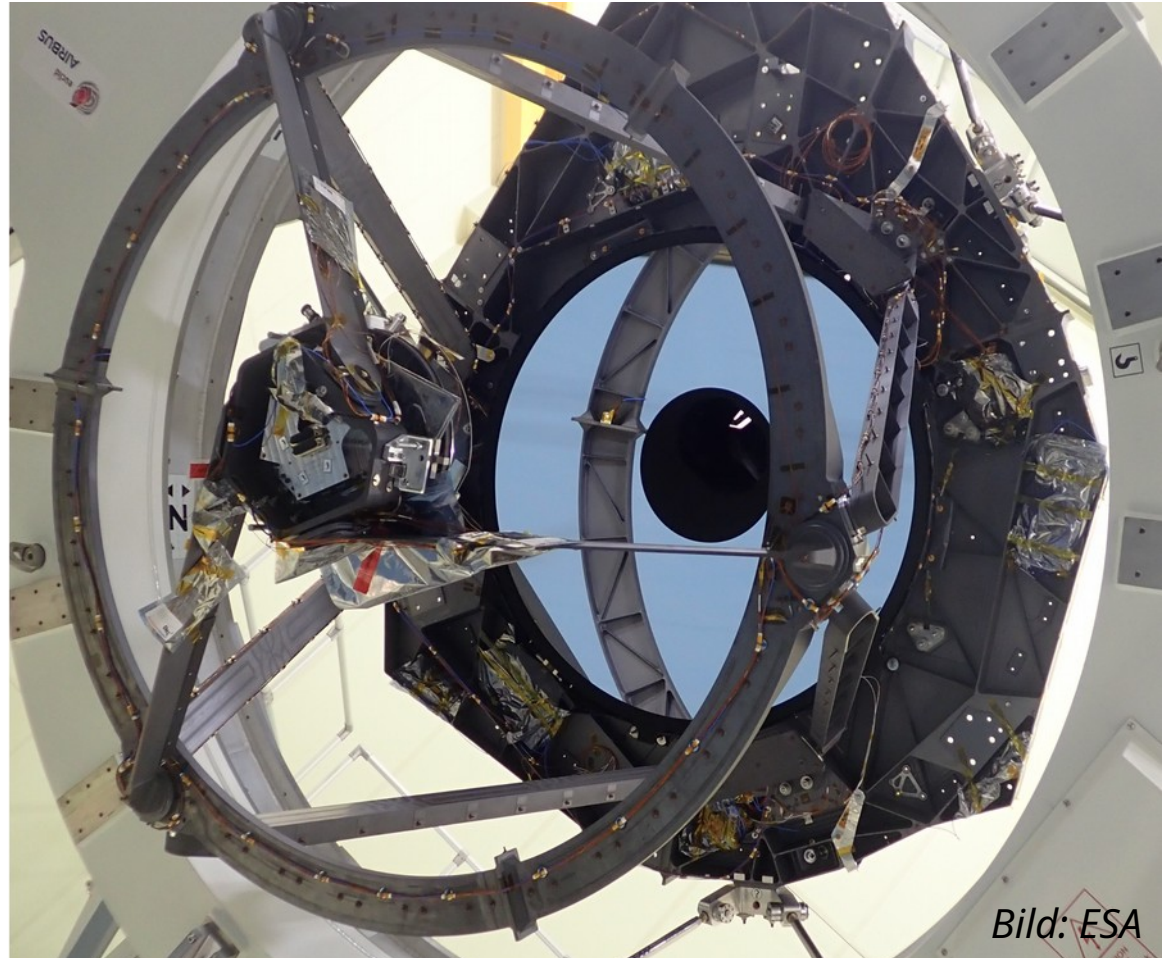


- 1,2m Spiegelteleskop



*Bild: ESA*

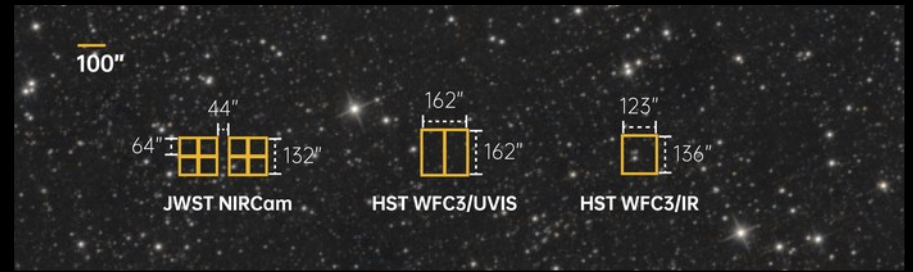
- 1,2m Spiegelteleskop
- 2 Instrumente
  - NISP (nah-Infrarot)
  - VIS (sichtbares Licht)



*Bild: ESA*

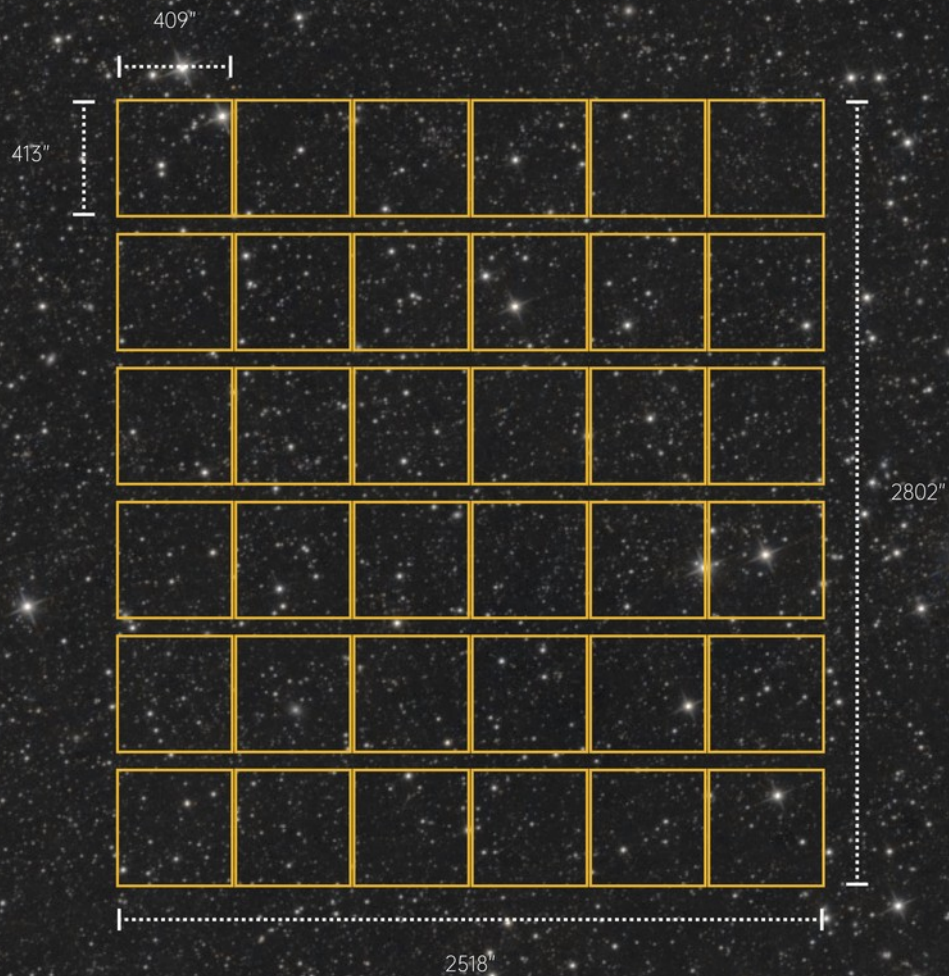


*Bilder: EC / Y. Kang*

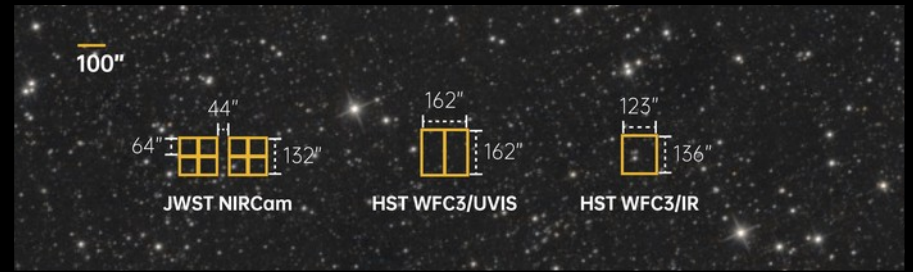


*Bilder: EC / Y. Kang*



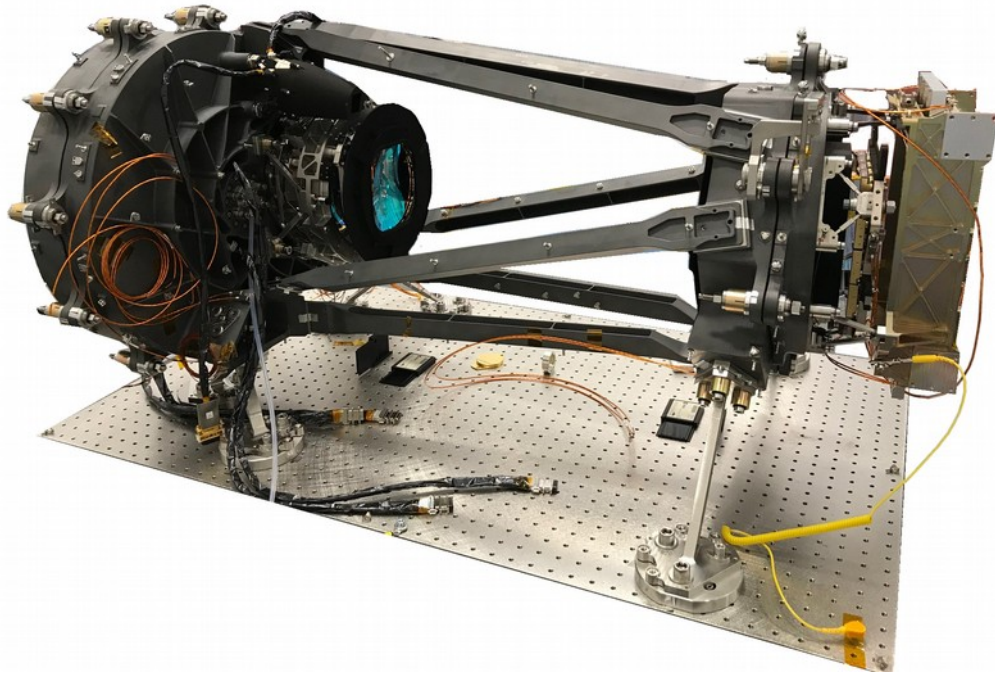


**EUCLID VIS**

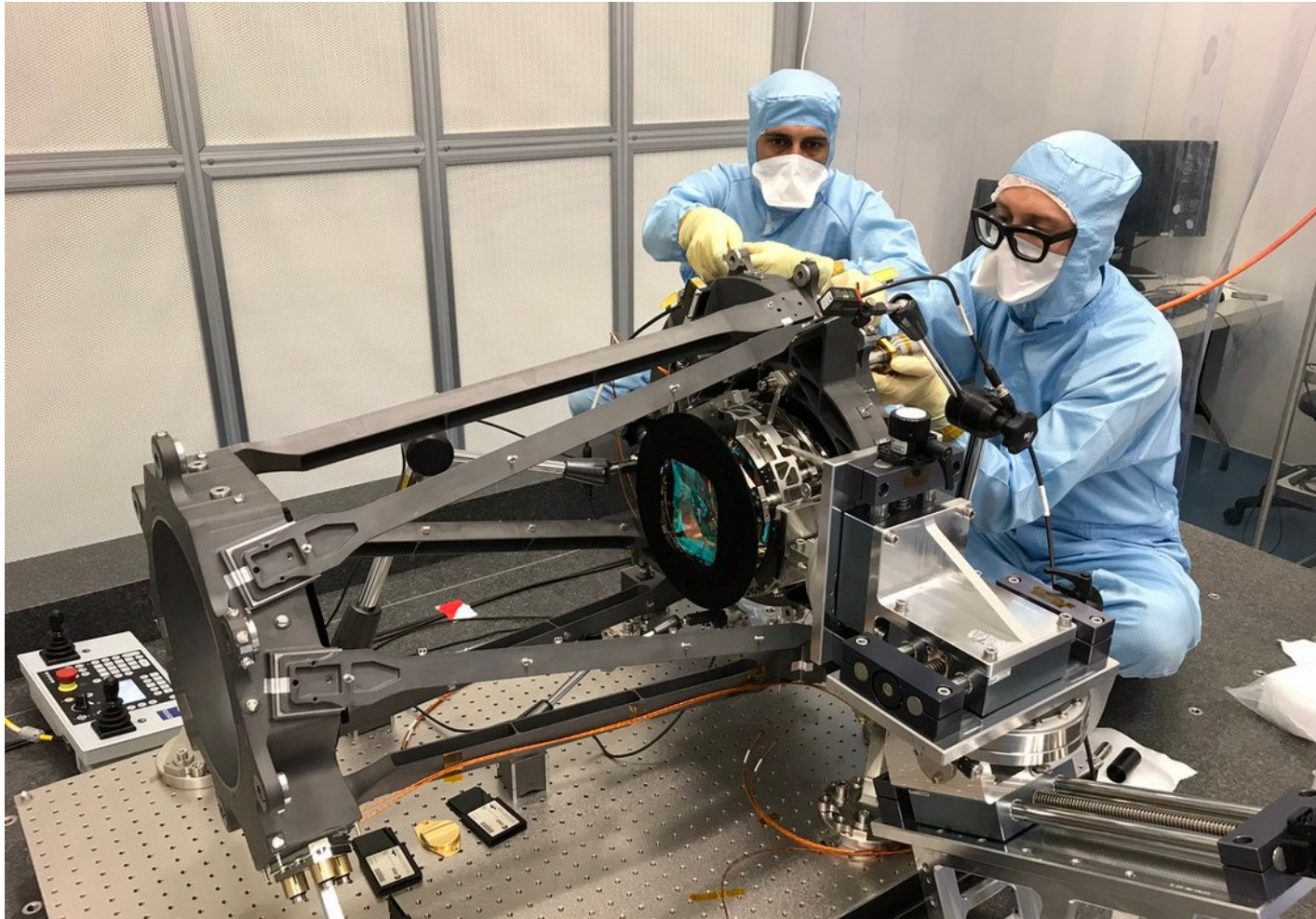


*Bilder: EC / Y. Kang*

## NISP: “Near-Infrared Spectrometer and Photometer”



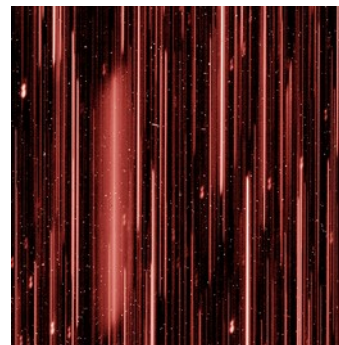
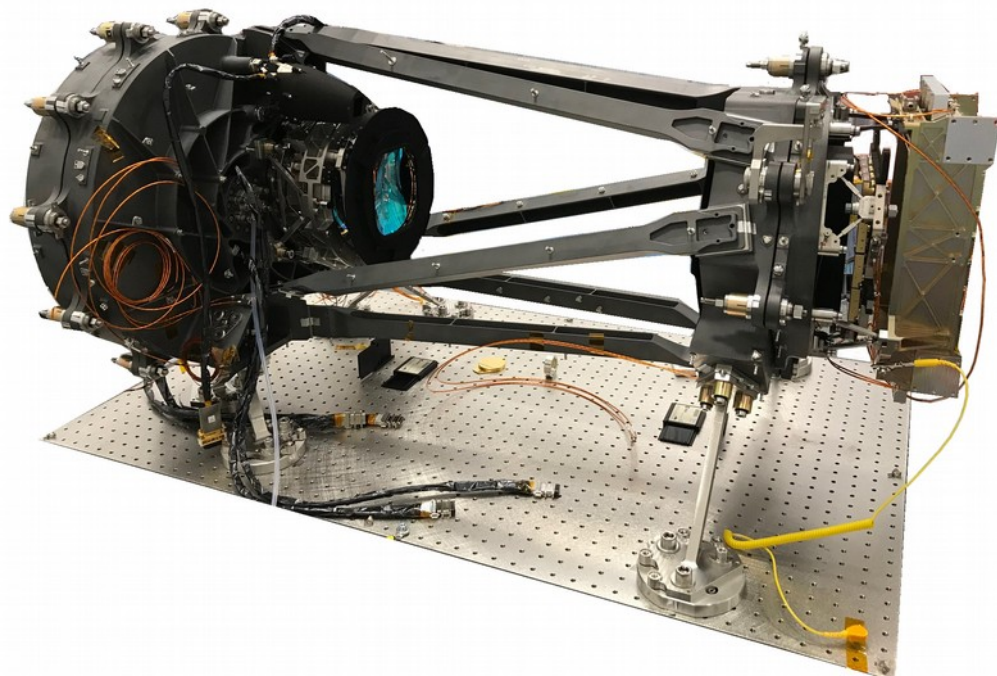
*Bild: NISP Team /  
Euclid Consortium*



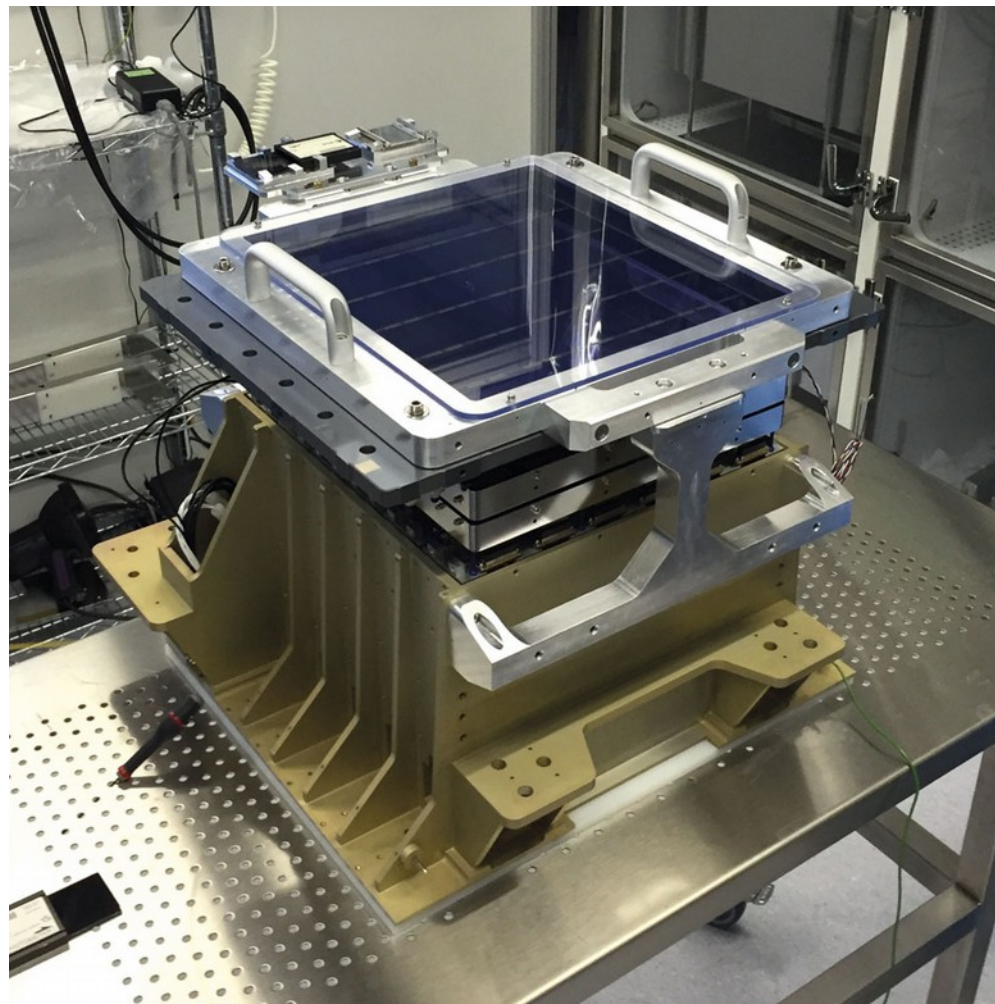
*Bild: NISP Team /  
Euclid Consortium*



## NISP: “Near-Infrared Spectrometer and Photometer”



VIS: "Visible instrument"



*Bild: VIS Team /  
Euclid Consortium*

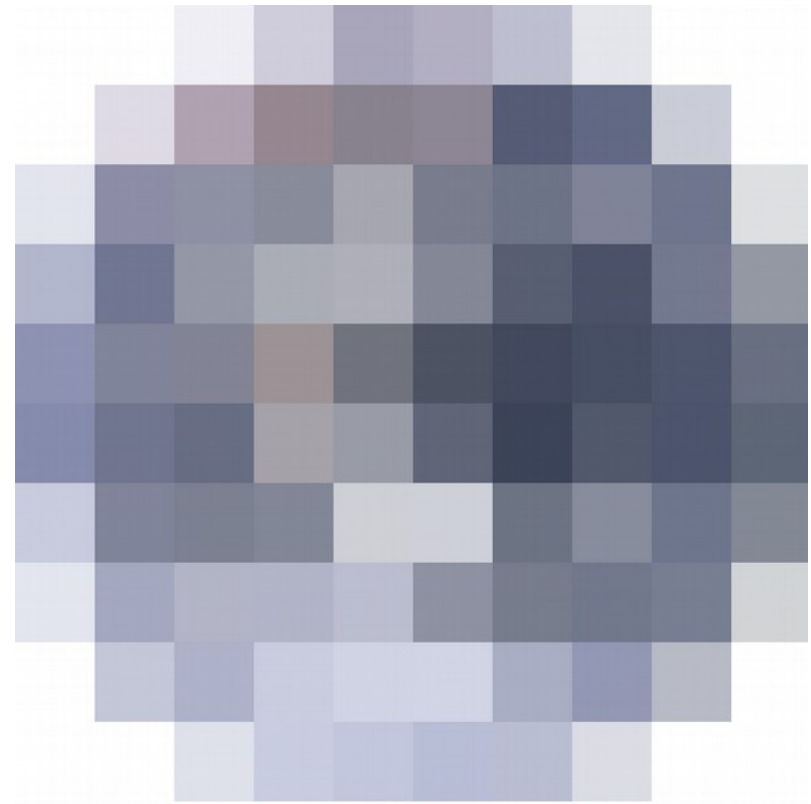
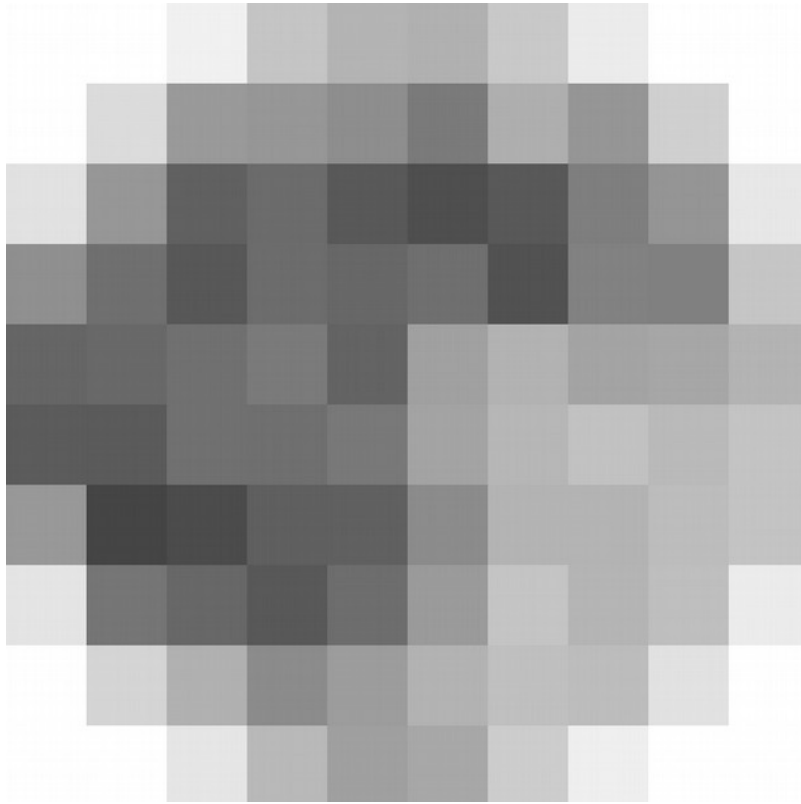




Exzentrizität:

Mond=0.00125

Erde=0.00335



Exzentrizität:

Mond=0.00125

Erde=0.00335

VIS: "Visible instrument"



*Bild: ESA*





esa

PAY ATTENTION

AIRBUS

AIRBUS

AIRBUS

AIRBUS

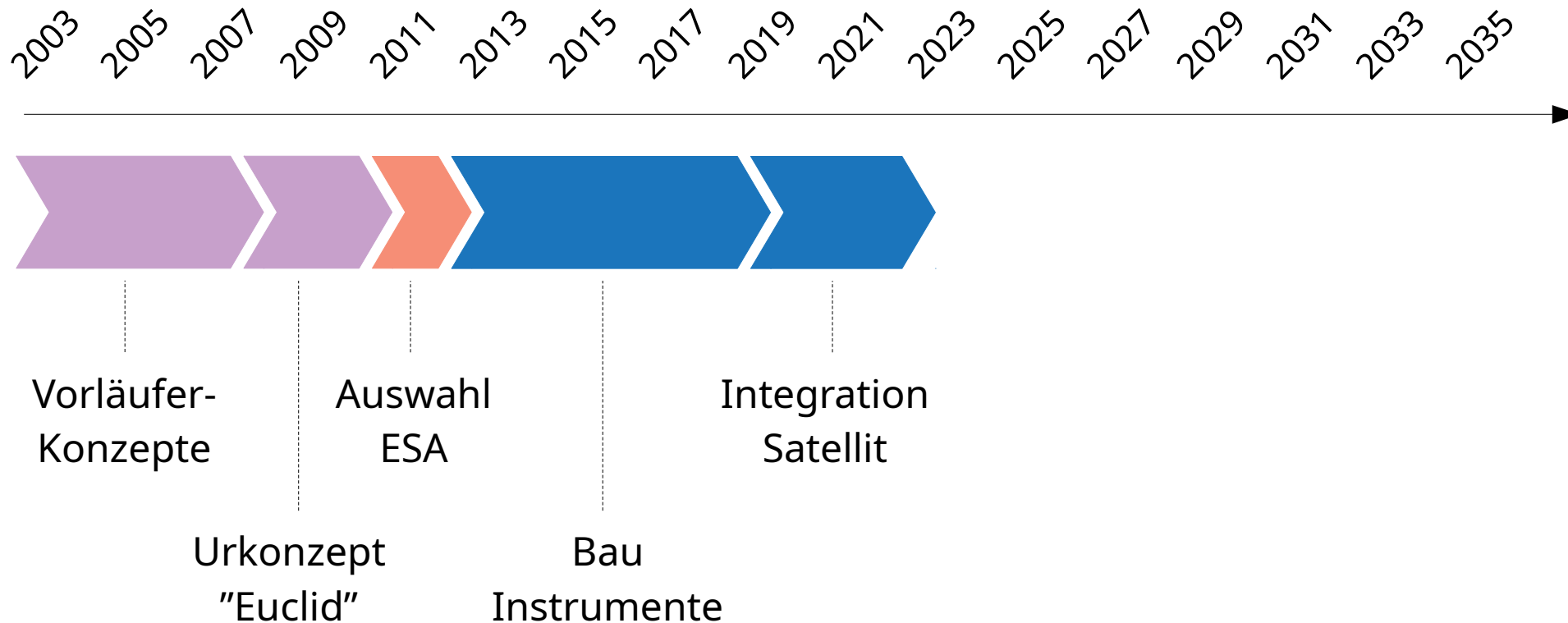
AIRBUS

AIRBUS

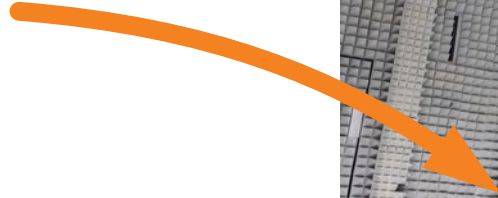
Euclid = ESA + Euclid Consortium (2000+ Leute, 15 Länder, 150+ Institute)

Euclid Consortium: Instrumente + wiss. Datenverarbeitung + Wissenschaft





(moi!)



*Bild: ESA / M.  
Pédoussaut*





*Bild: Thales Alenia  
Space / ImagIn*





*Bilder: Thales  
Alenia Space /  
ImagIn*



# 30. April 2023: Port Canaveral

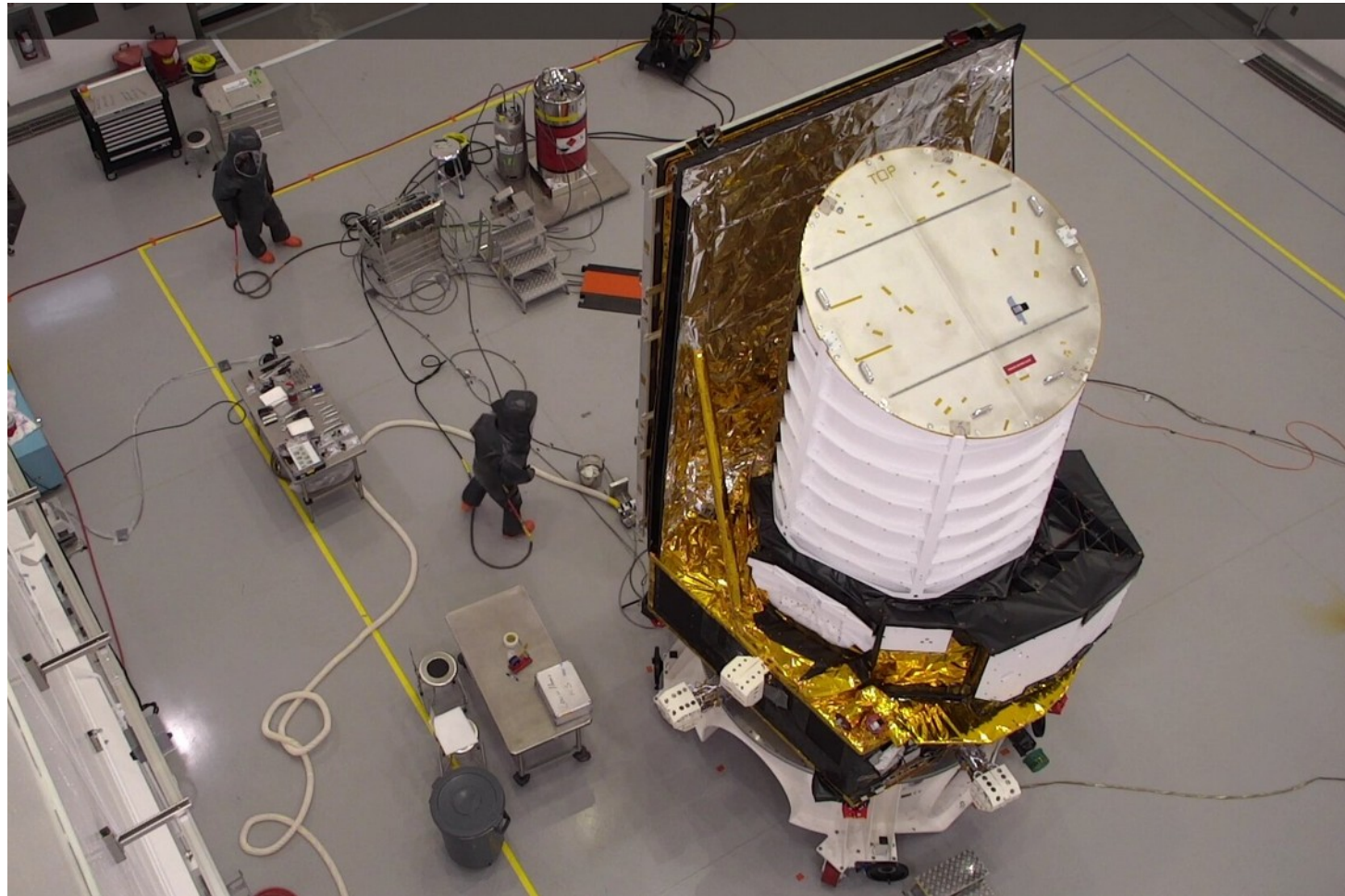


*Bilder: Thales  
Alenia Space /  
ImagIn*



37C3 – "Euclid"

Knud Jahnke + Euclid Consortium



*Bild: Astrotech  
(Mack Russo)*



1. Juli 2023



*Video: SpaceX, ESA*

1. Juli 2023

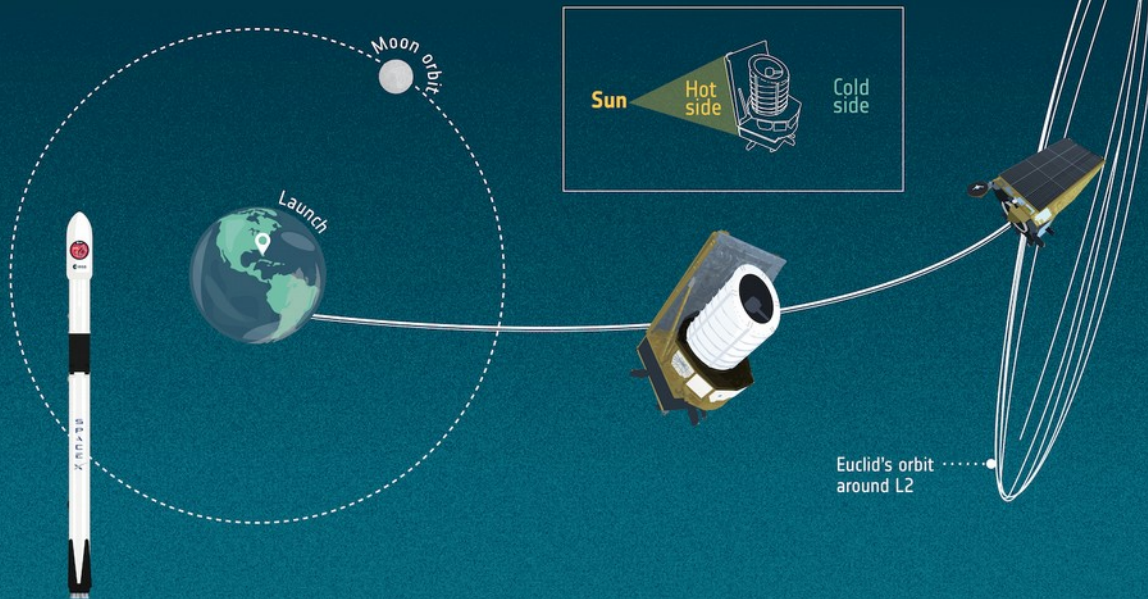


*Video Still: SpaceX, ESA*



## 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:

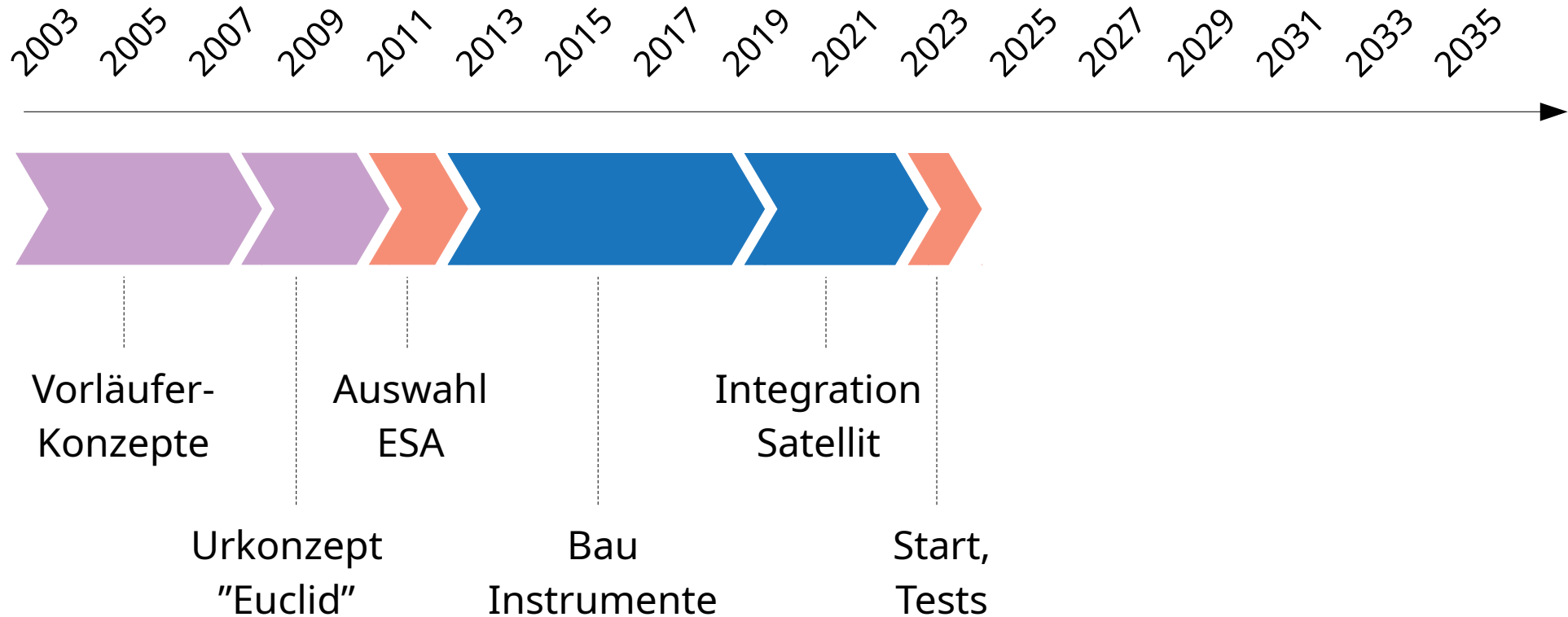
Telescope aligned and all instruments turned on

### • L+1-3 months:

Testing of scientific performance and readiness for science

### • L+3 months:

Euclid begins its survey



“Wide Survey”: 1/3 des Himmels ( $\sim 14000 \text{ Grad}^2$ )

- nicht Milchstraße
- nicht Ekliptik
- 6 Jahre

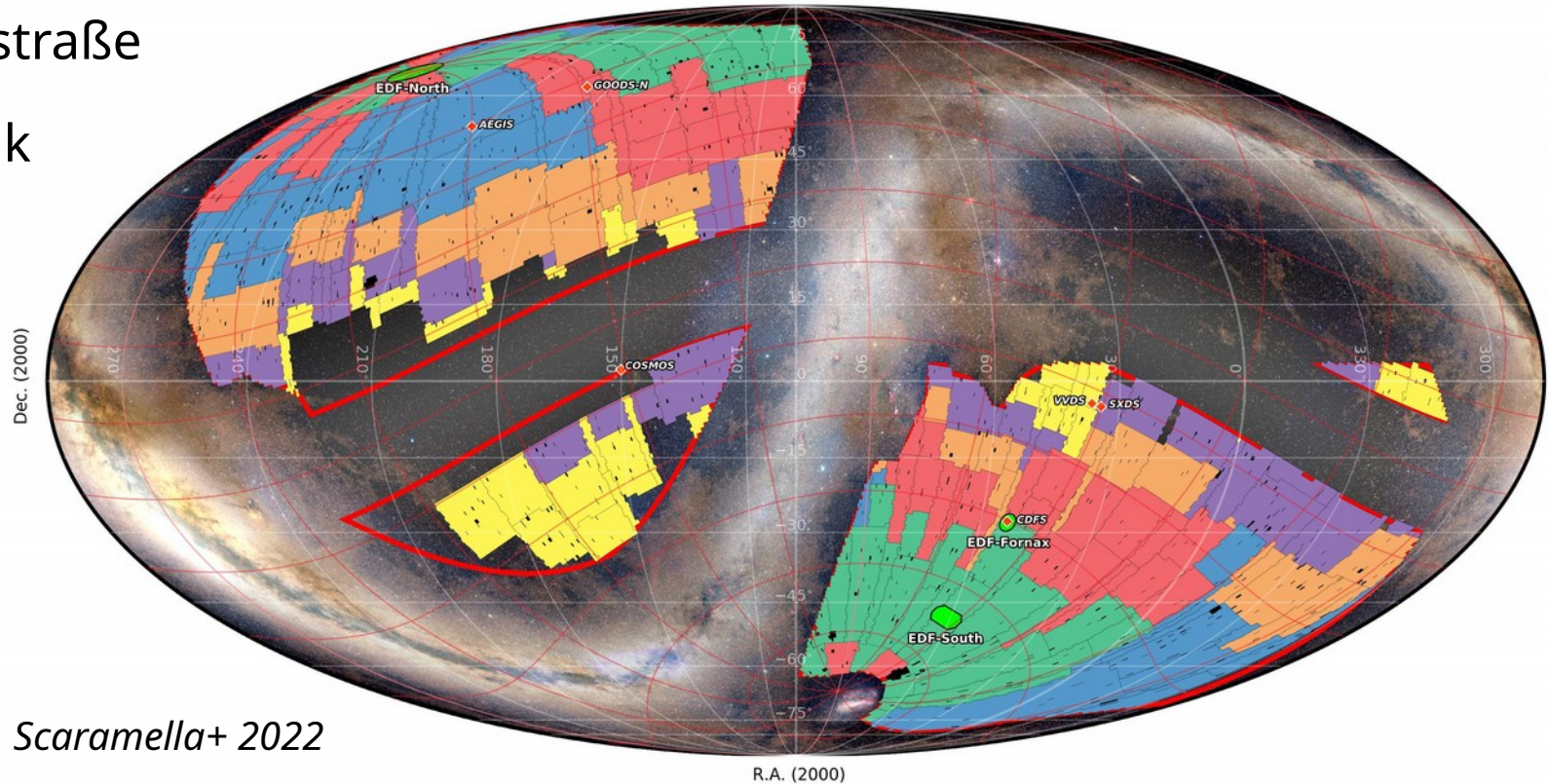


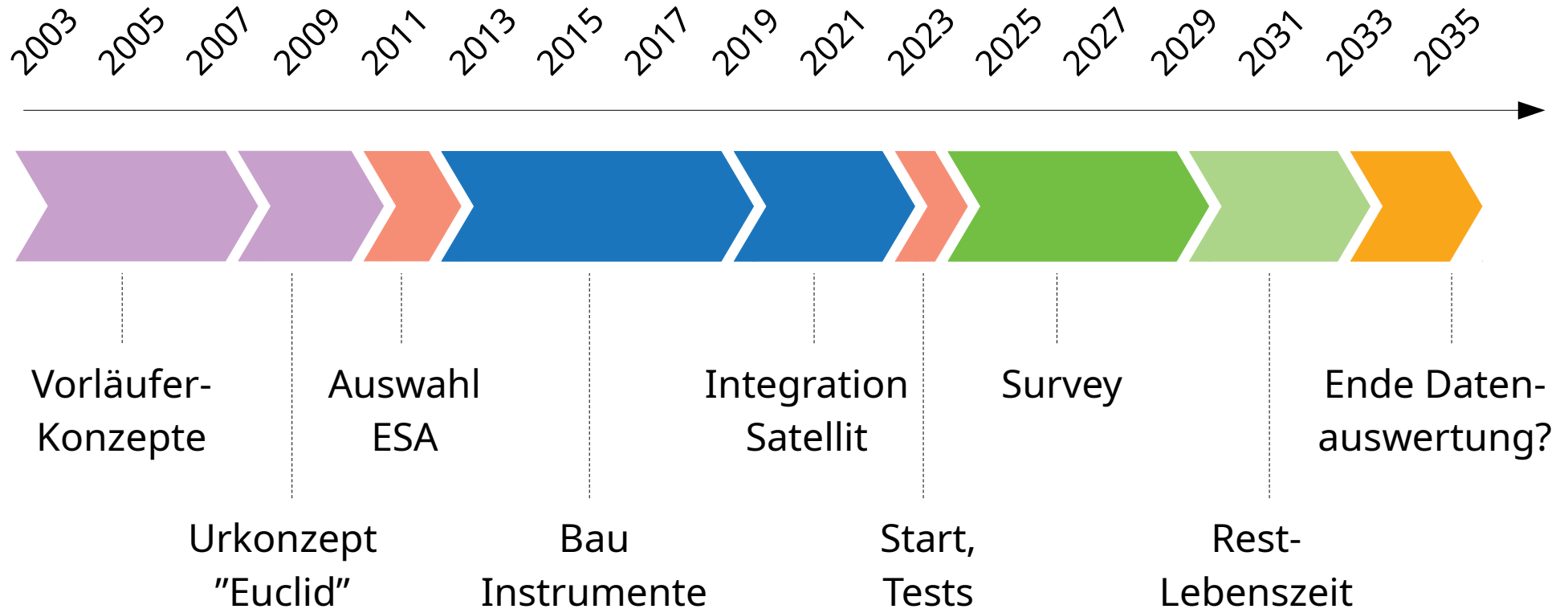
Bild: Euclid Consortium, Scaramella+ 2022

## Step-and-stare

- 1x pro Ort
- 4 Bilder
- weiter



*Video: ESA*



- 1,5 Millionen km Entfernung  
Euclid ↔ Darmstadt
- “Deep Space Antenna” Network
  - Malargüe (Argentinien)
  - Cebreros (Spanien)
- 4 Std. / Tag



35m

Malargüe (Argentinien), *Bild: ESA*



# Speedtest



75.00  
Mbps

Euclid (L2)  $\longrightarrow$  ESA

- 1,5 Millionen km Entfernung  
Euclid ↔ Darmstadt
- “Deep Space Antenna” Network
  - Malargüe (Argentinien)
  - Cebros (Spanien)
- 4 Std. / Tag
- 75 Mbps (!)
- ~100 GB / Tag



35m

Malargüe (Argentinien), *Bild: ESA*

- 10 Datenzentren (Europa + 1x USA)
- 10 Jahre x 50+ Leute Software

I. Dunkle Materie – Dunkle Energie

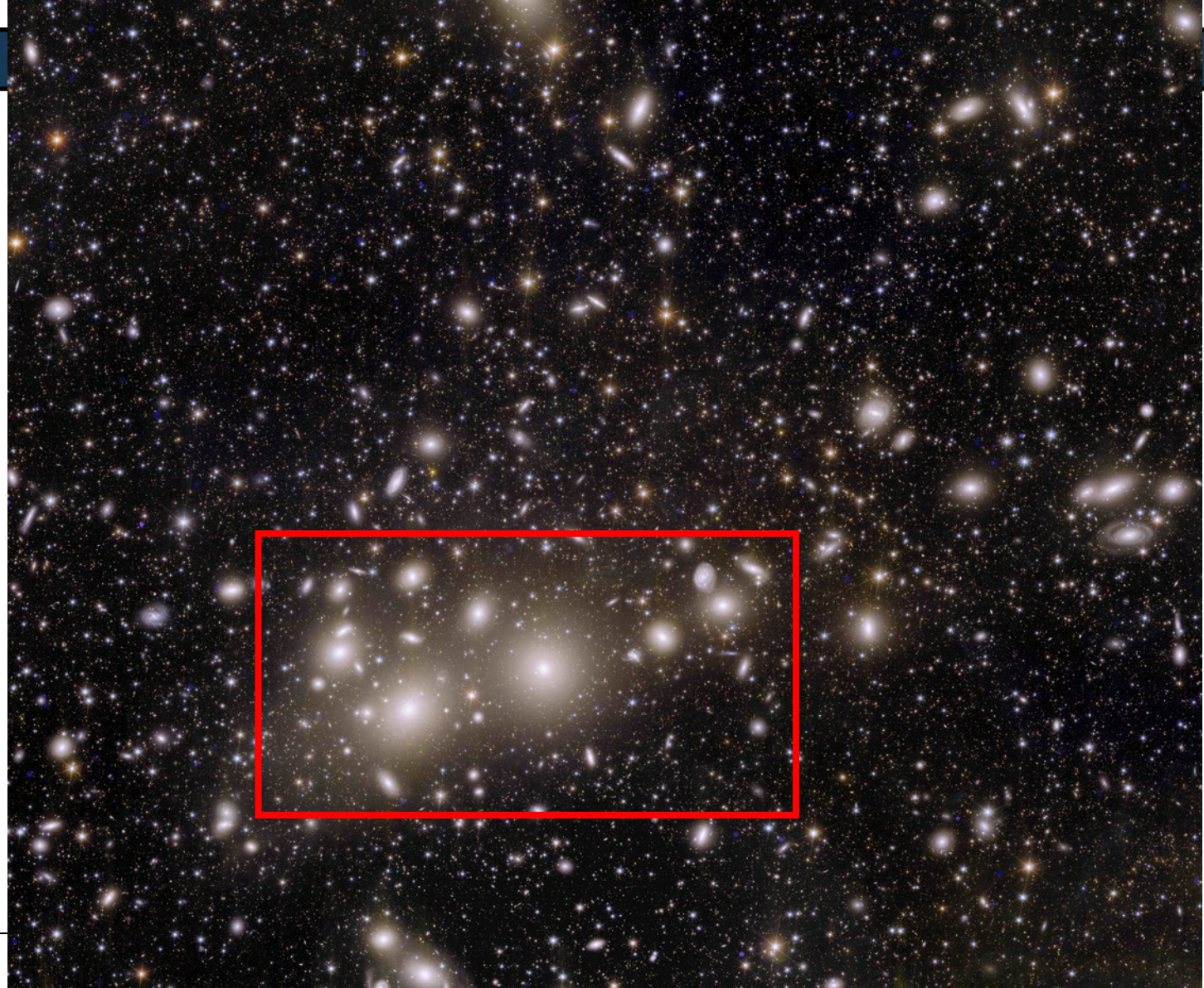
II. *Euclid*, die Mission

III. Schöne Bilder

- ESA “Early Release Observations” → für Öffentlichkeit + erste Ergebnisse
  - Jeweils nur 1 Pointing, je 70min (1x 4-fach)
  - VIS+NISP Bilder
  - Aufnahmen September–Dezember 2023
  - Datenverarbeitung separat
  - Erste Publikationen ~Januar

# Bilder: ERO

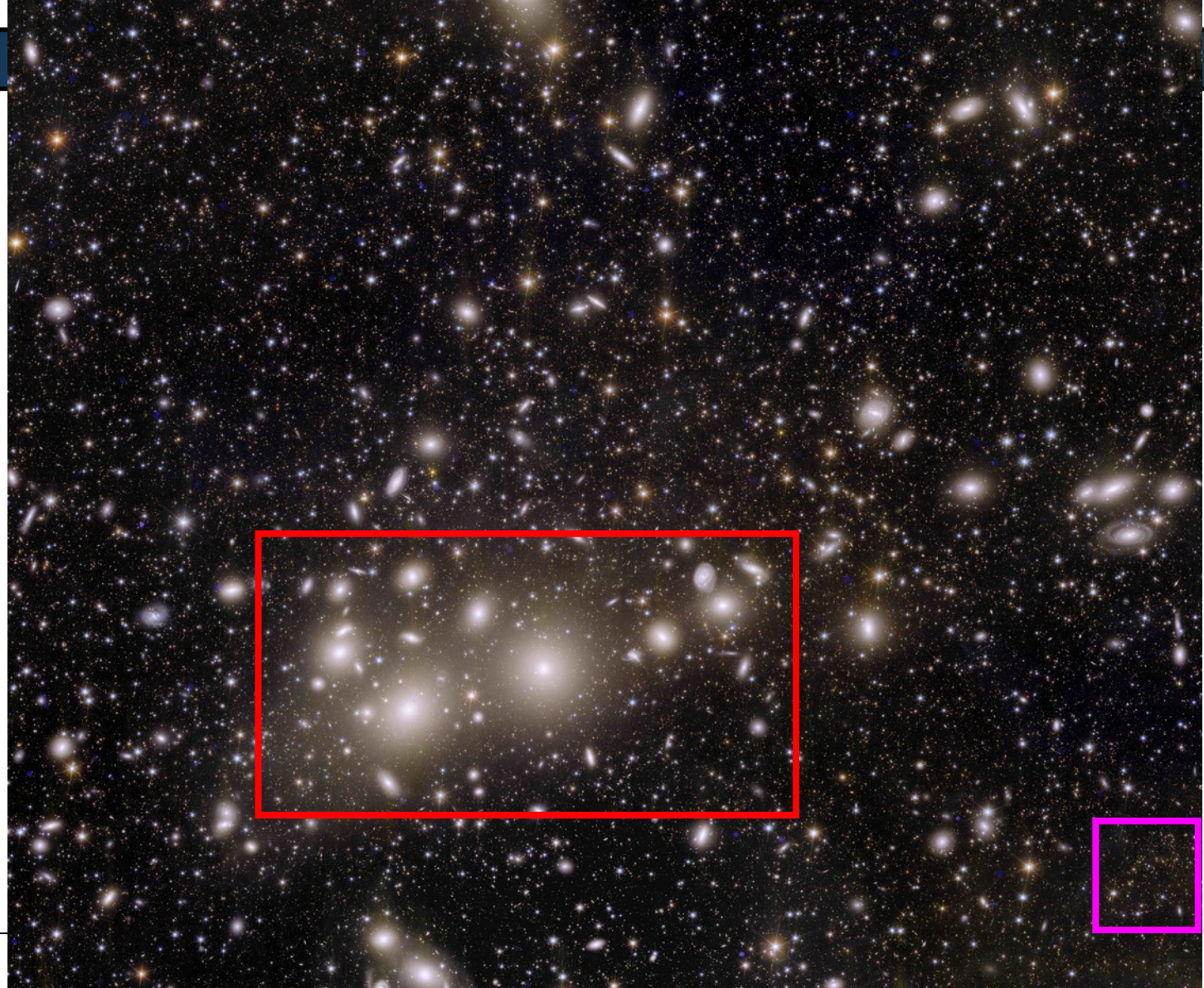
## Perseus- Galaxienhaufen





# Bilder: ERO

## Perseus- Galaxienhaufen







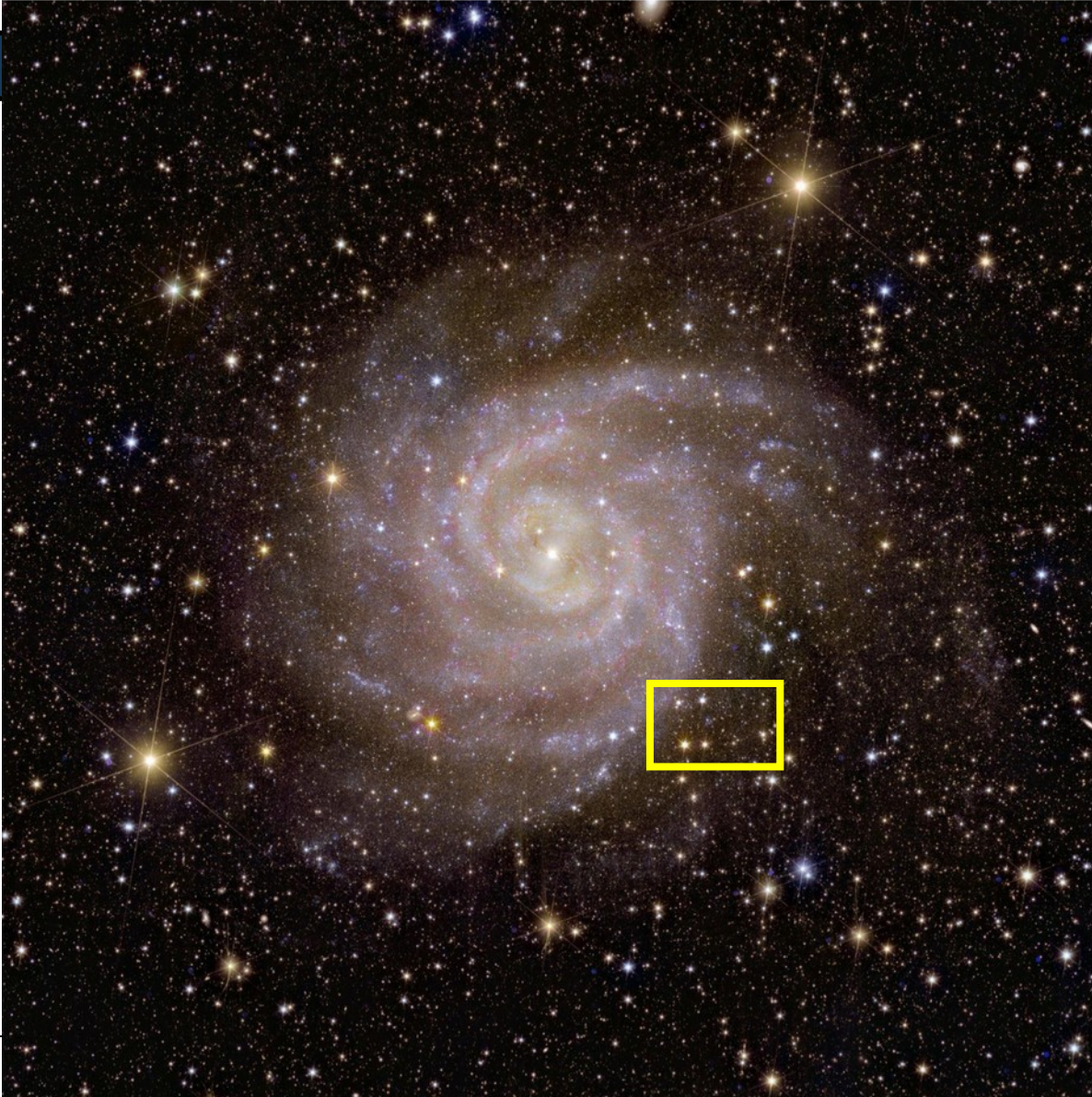
# Bilder: ERO

Perseus-  
Galaxienhaufen





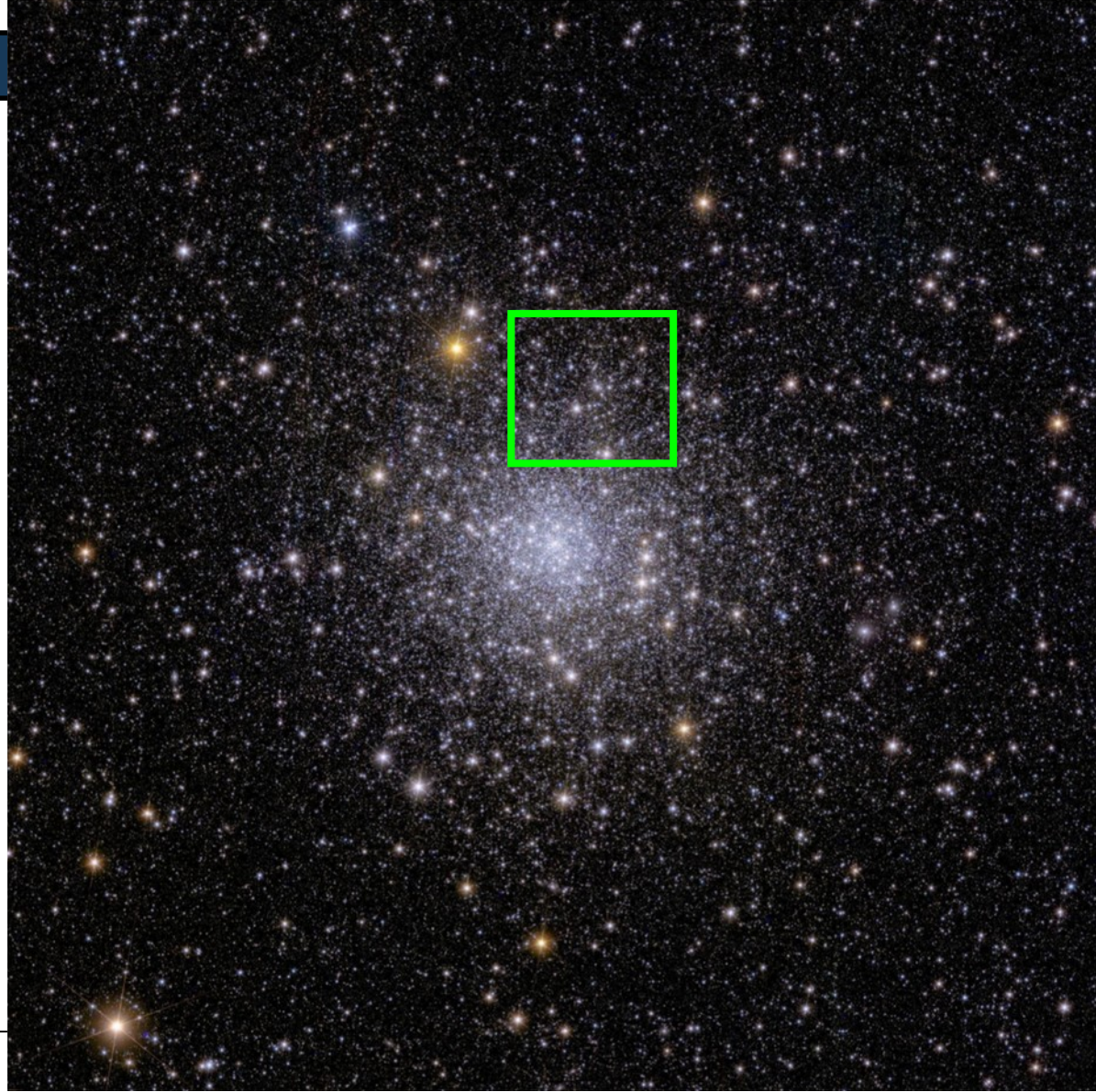
Spiralgalaxie  
IC 342





# Bilder: ERO

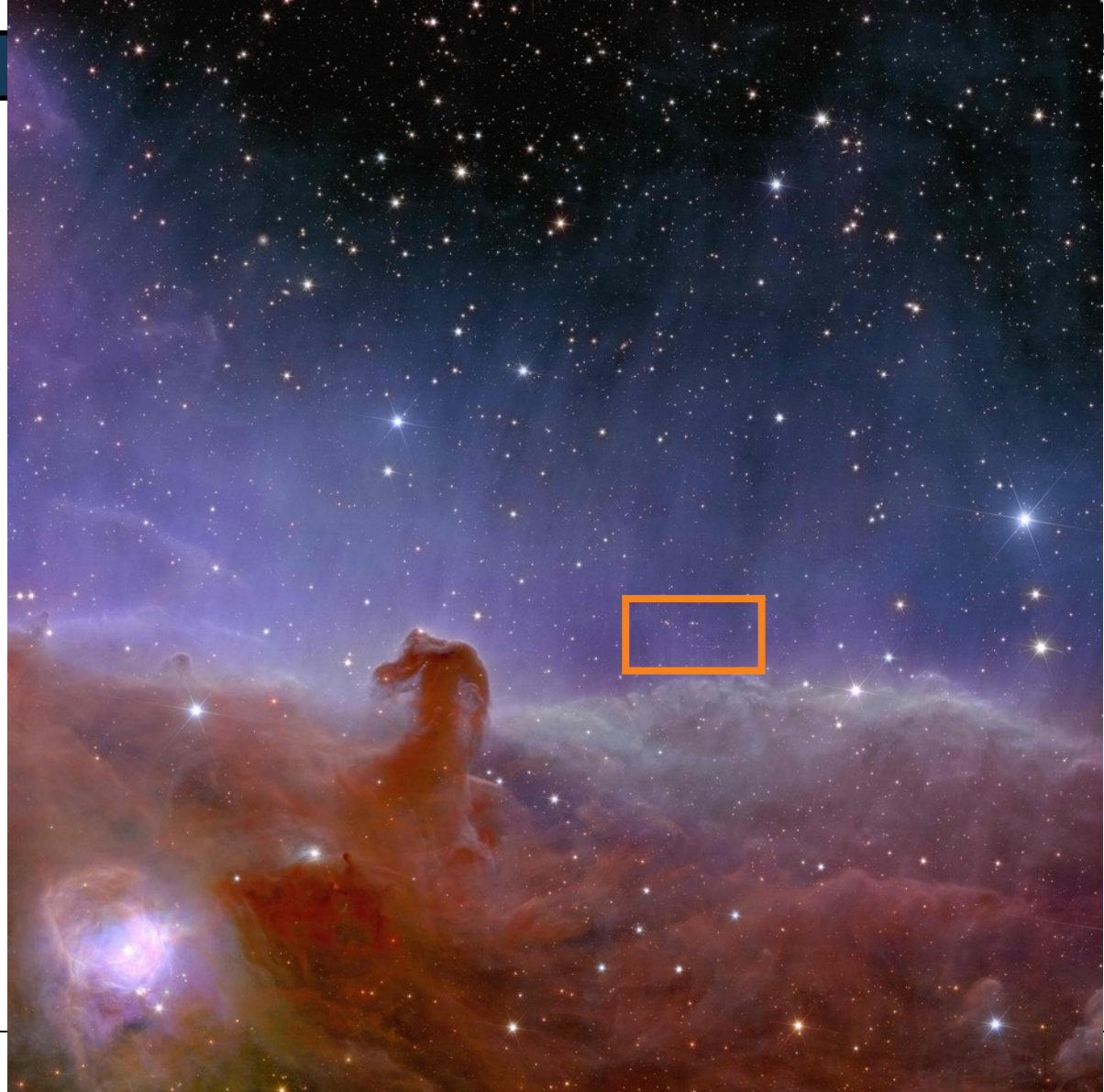
Kugelsternhaufen  
NGC 6397





# Bilder: ERO

## Pferdekopfnebel

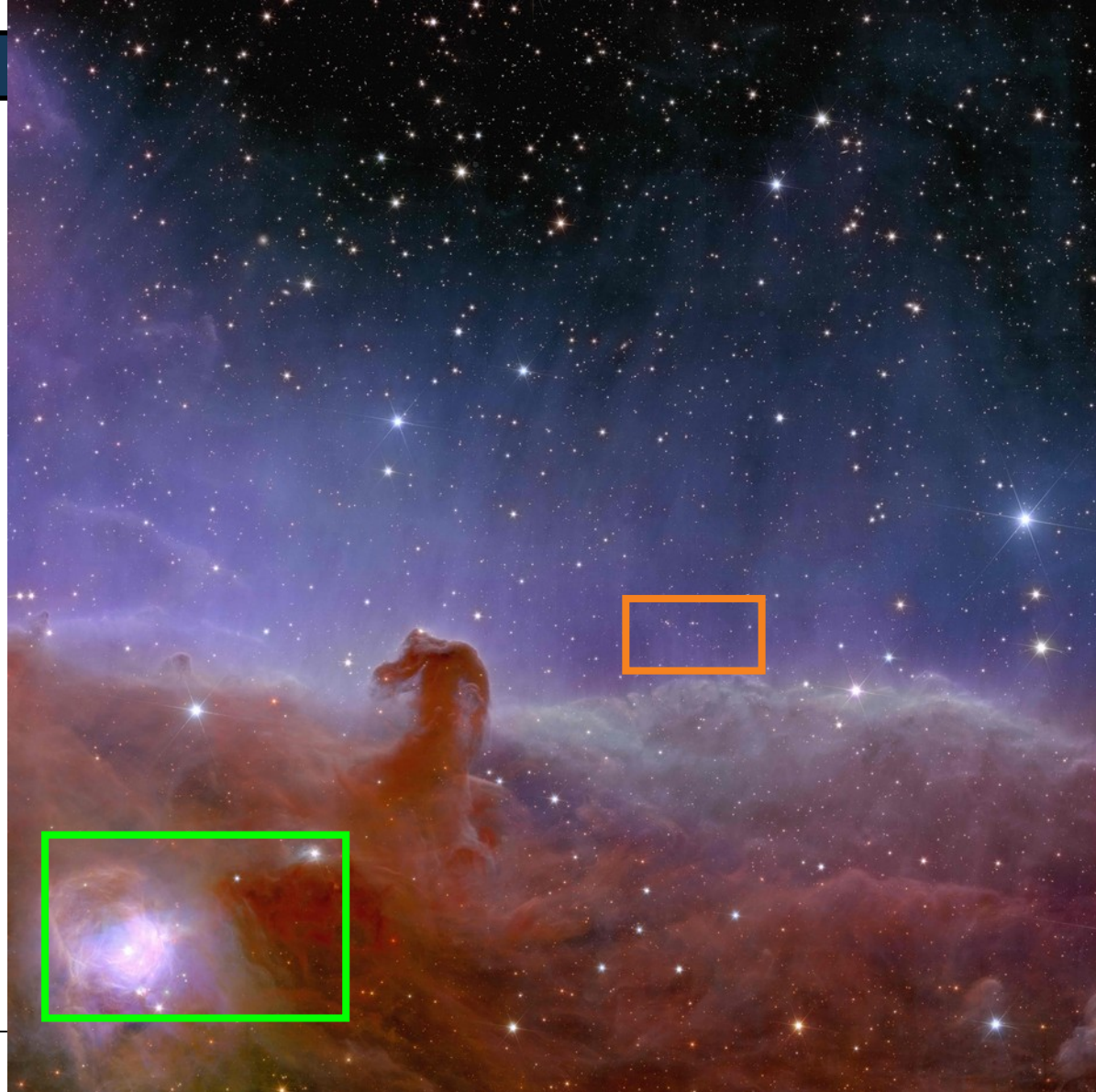






# Bilder: ERO

## Pferdekopfnebel





# Bilder: ERO

Pferdekopfnebel



...und jetzt?

- Ab Februar 2024: 6 Jahre Himmelsdurchmusterung
- ~Februar: mehr erste Bilder, auch Rohdaten
- Öffentlicher Data-Release, 50 Quadratgrad: März 2025
- Data-Release, 2500 Quadratgrad: März 2026
- ...
- Astronomie-Ergebnisse: 2024+
- Kosmologie-Ergebnisse: 2026+





Euclid Consortium  
([www.euclid-ec.org](http://www.euclid-ec.org))



Euclid @ ESA Sky  
(=ERO: Perseus Cluster)



Euclid @ ESA  
([https://www.esa.int/Science\\_Exploration/Space\\_Science/Euclid](https://www.esa.int/Science_Exploration/Space_Science/Euclid))

~fin~



- Marc Sauvage (Euclid Consortium)
- Yuzheng Kang (Euclid Consortium)
- Das Consortium und die ESA für die tolle Zusammenarbeit!