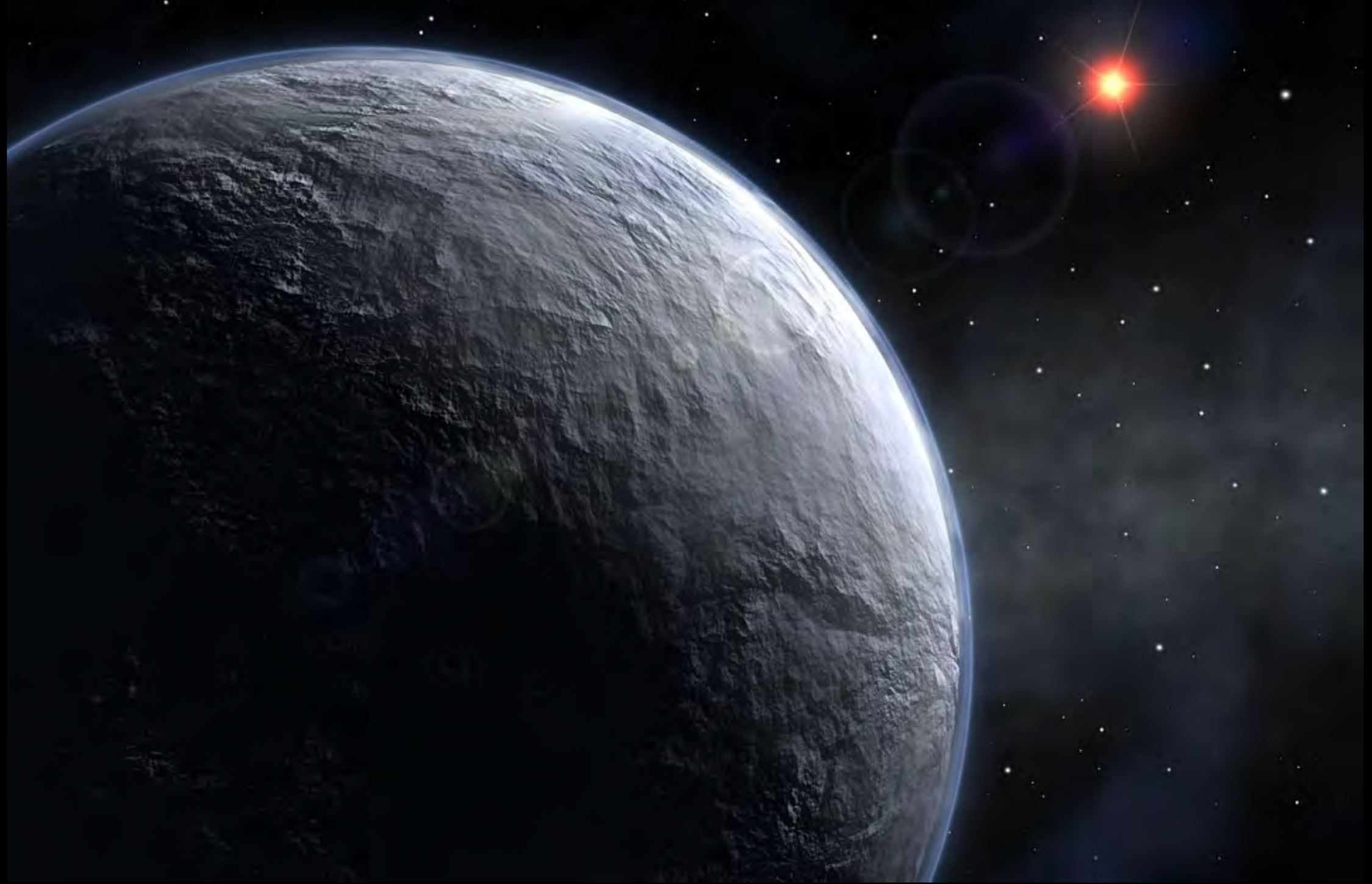
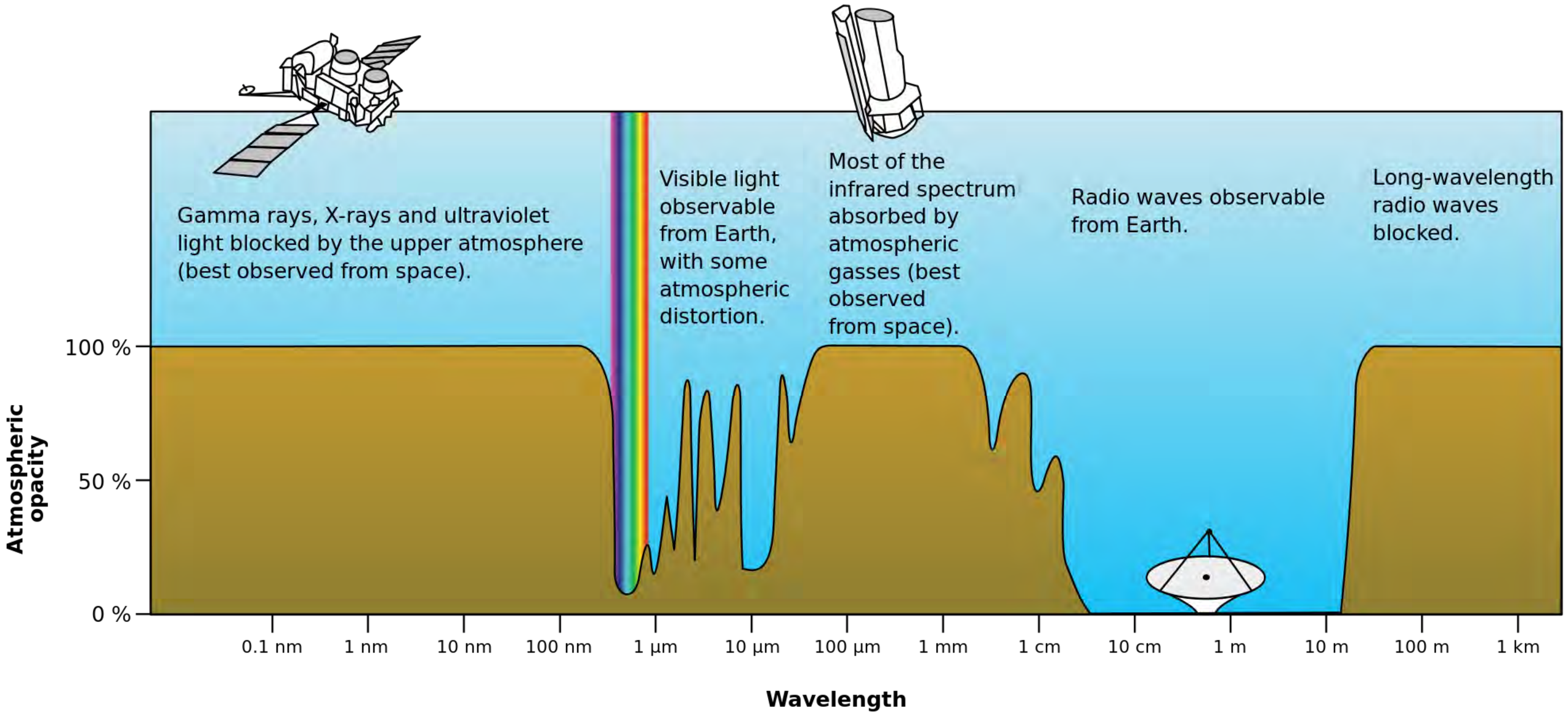
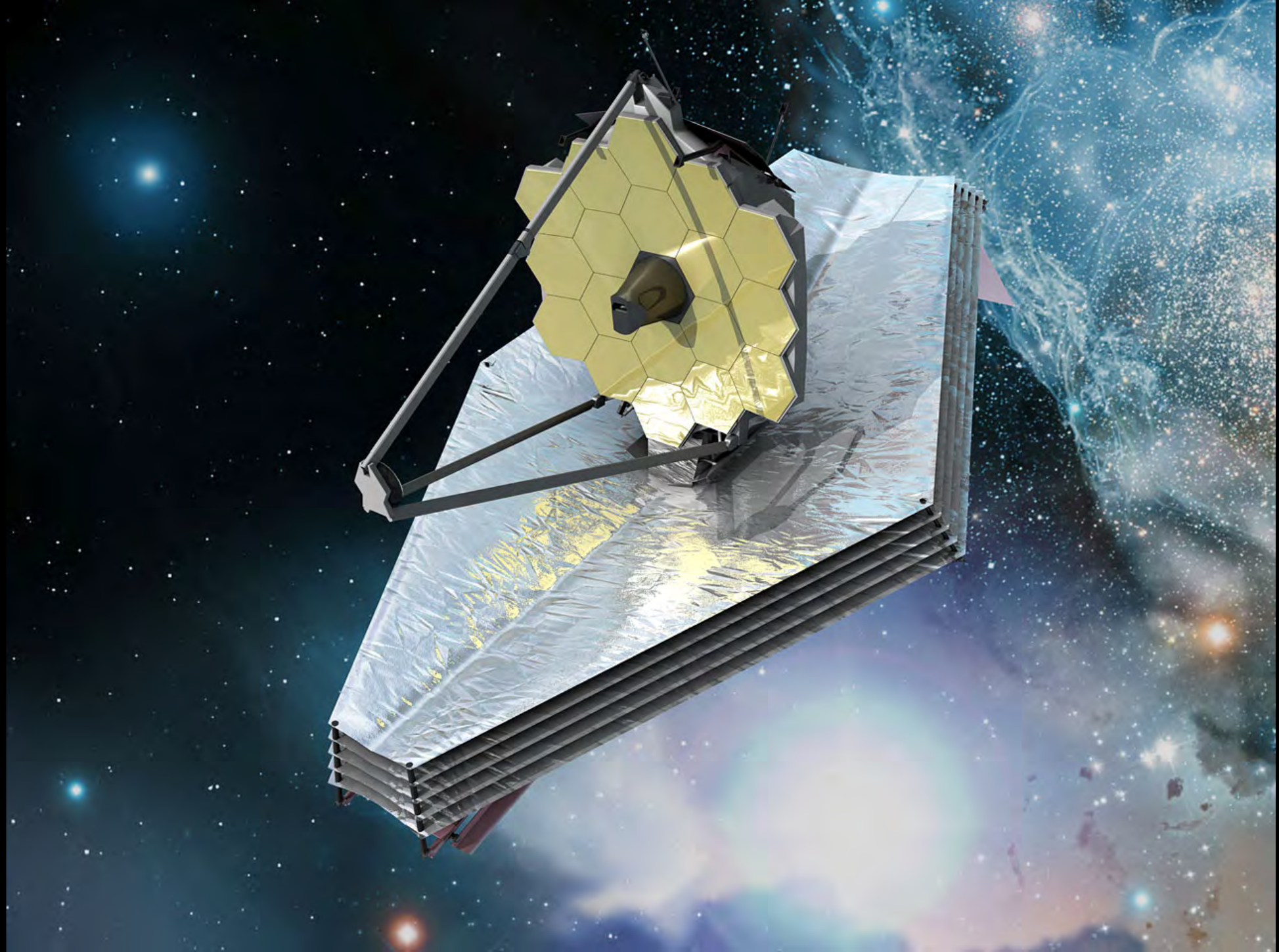
The Next Light Wave
why too much light is an issue.

Pedro Russo
russo@strw.leidenuniv.nl
@pruss

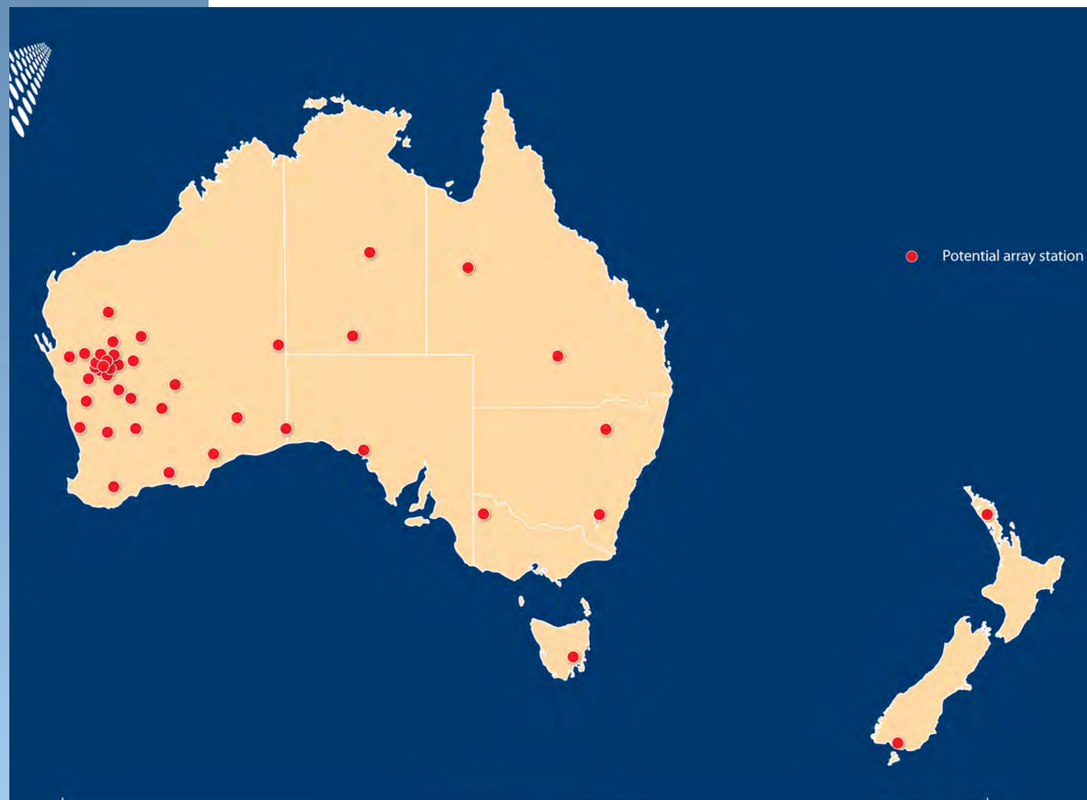
Universiteit
Leiden
The Netherlands




Gamma rays, X-rays and ultraviolet light blocked by the upper atmosphere (best observed from space).
Visible light observable from Earth, with some atmospheric distortion.
Most of the infrared spectrum absorbed by atmospheric gasses (best observed from space).
Radio waves observable from Earth.
Long-wavelength radio waves blocked.
100 %
50 %
0 %
Atmospheric opacity
0.1 nm
1 nm
10 nm
100 nm
1 µm
10 µm
100 µm
1 mm
1 cm
10 cm
1 m
10 m
100 m
1 km
Wavelength




SPDO / Swinburne Astronomy Productions


Potential array station

Big Data and Square Kilometre Array

- Exabyte (=1billion gigabytes) a day of raw data which could be compressed to around 10 Petabytes
- SKA will produce 10 times the current global internet traffic.

Astronomical Data Deluge

Megadata

In excess of 1 Exabyte of raw data in a single day - more than the entire daily internet traffic

Square Kilometre Array

€1.5b

+ A €1.5 billion global science project

+ Astronomers and engineers from more than 70 institutes in 20 countries

3000

+ 3000 dishes, each 15m wide

+ Using enough optical fibre to wrap twice around the Earth

1,000,000 m²

+ A combined collecting area of about one square kilometre

Enough raw data to fill over 15 million 64GB iPods every day

DOME Focus Areas

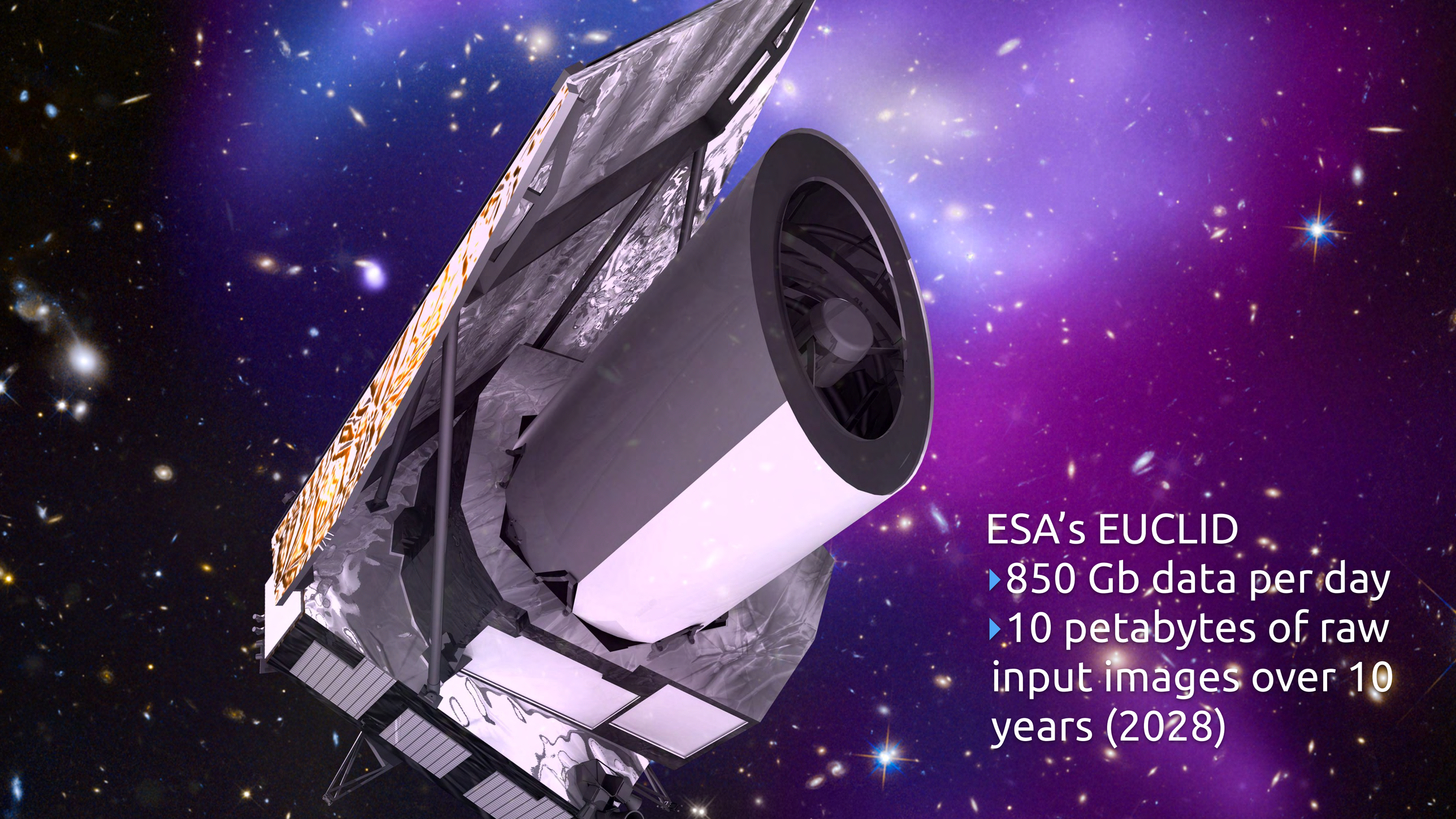
+ Advanced accelerators and 3D stacked chips for more energy-efficient computing

+ Novel optical interconnect technologies and nanophotonics to optimize large data transfers

+ High-performance storage systems based on next-generation tape systems and novel phase-change memory

ASTRON & IBM Center for Exascale Technology, Drenthe, the Netherlands

Top image: SPDO/Swinburne Astronomy Productions



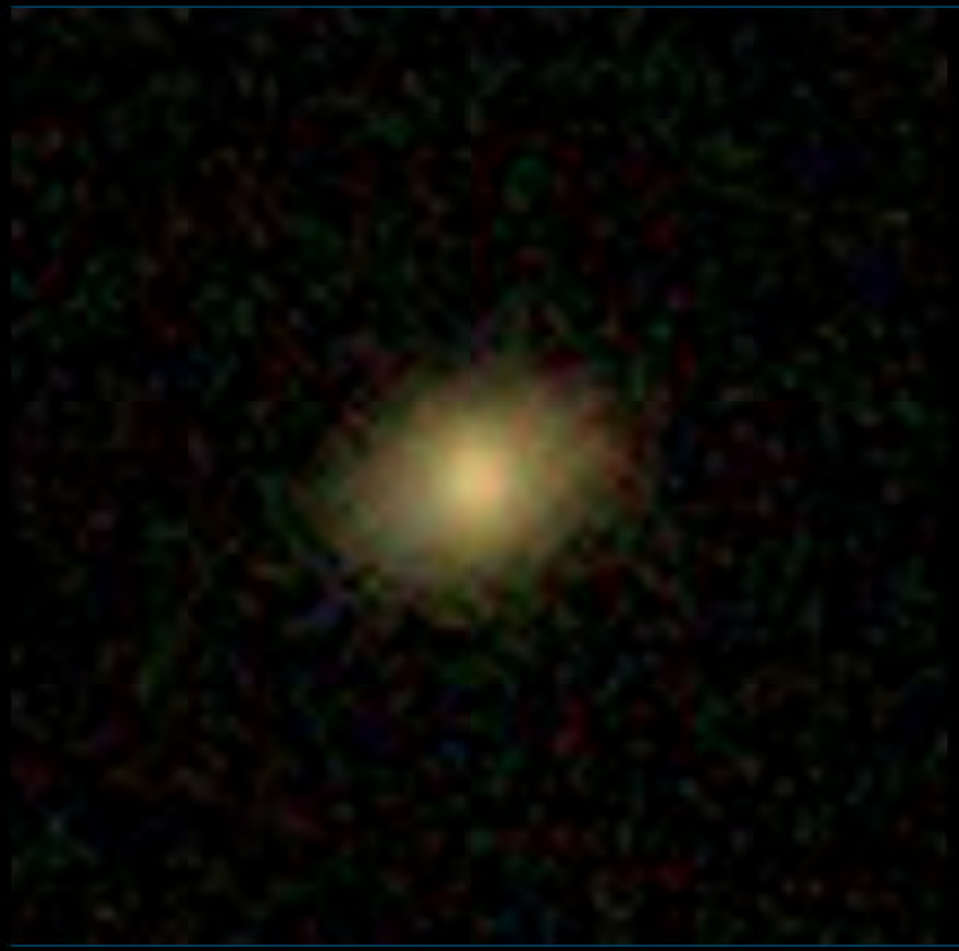
ESA’s EUCLID

- 850 Gb data per day
- 10 petabytes of raw input images over 10 years (2028)

Large Amounts of Light = Mega Data

Challenges for Big Data in Astronomy

- Visualisation of astronomical datasets
- Creation and utilisation of efficient algorithms for processing large datasets.
- The use of “machine learning” methodologies
- Engage society with large astronomical datasets.



Classify

SDSS Invert

Examples Restart

Note: Please always classify the galaxy in the center of the image.

SHAPE

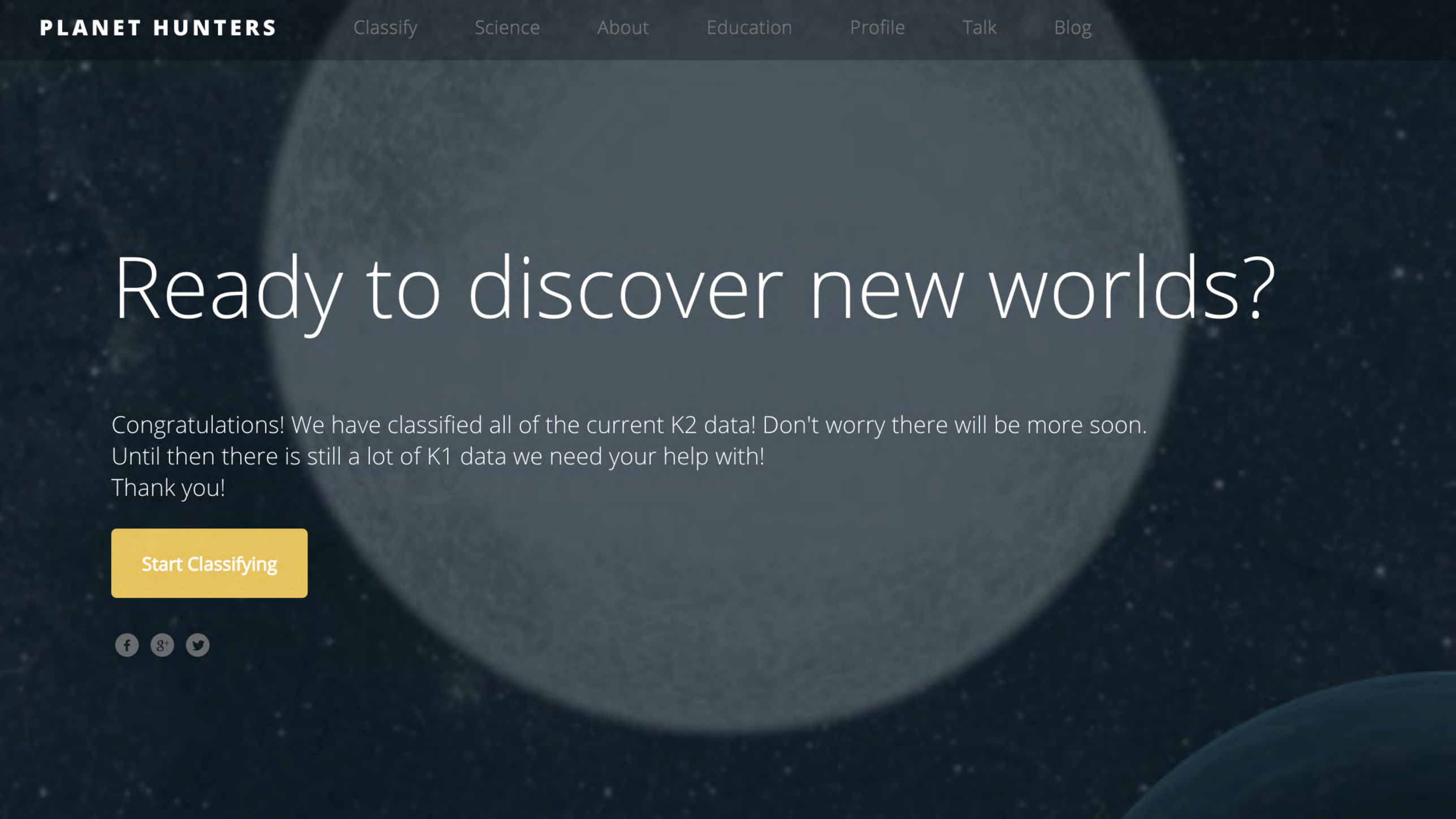
Is the galaxy simply smooth and rounded, with no sign of a disk?

Smooth

Features or disk

Star or artifact


Projects
About
Talk
Collect
Daily Zooniverse
Blog
BUILD A PROJECT
Sign in
Register
ZOONIVERSE
People-Powered Research
The Zooniverse provides opportunities for people around the world to contribute to real discoveries in fields ranging from astronomy to zoology. Welcome to the largest online platform for collaborative volunteer research.
Get involved now!
www.zooniverse.org


PLANET HUNTERS
Classify
Science
About
Education
Profile
Talk
Blog
Ready to discover new worlds?
Congratulations! We have classified all of the current K2 data! Don't worry there will be more soon.
Until then there is still a lot of K1 data we need your help with!
Thank you!
Start Classifying

Do you see a transit?

If so, highlight it on the light curve below!

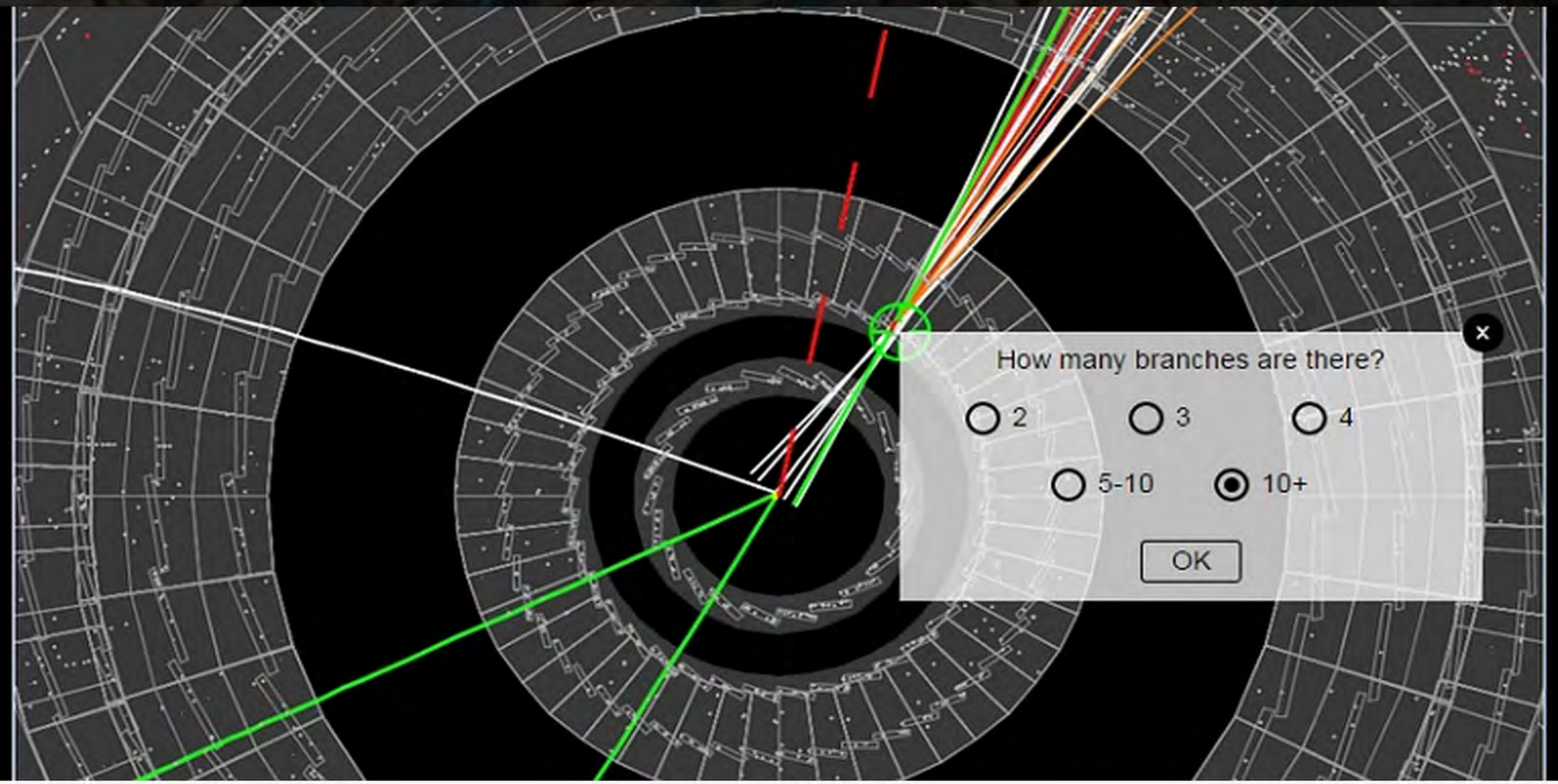
Currently classifying K1 data.

Please sign in or sign up to receive credit for your discoveries and to participate in the Planet Hunters mini-course. ×

Star Information

Magnitude 15.937 Type Dwarf Temp 3851(K) Radius 0.519x Sol

No Transits



Your task is to search for tracks appearing 'out of thin air' away from the centre. We call these off-centre vertices. Mark them by clicking on 'Off-centre vertex' on the right hand side, then click to mark the location of the vertex. Then choose how many new tracks appeared. If you don't see anything interesting in the image, just click "OK" to move to the next one.

Next

Off-center vertex
Something weird
OK
Need a hint?
See the FAQ!

自軫十二度於辰壽星三月之時万物始達於地春氣布養各盡其
性物不羅夫故曰壽星鄭之分也

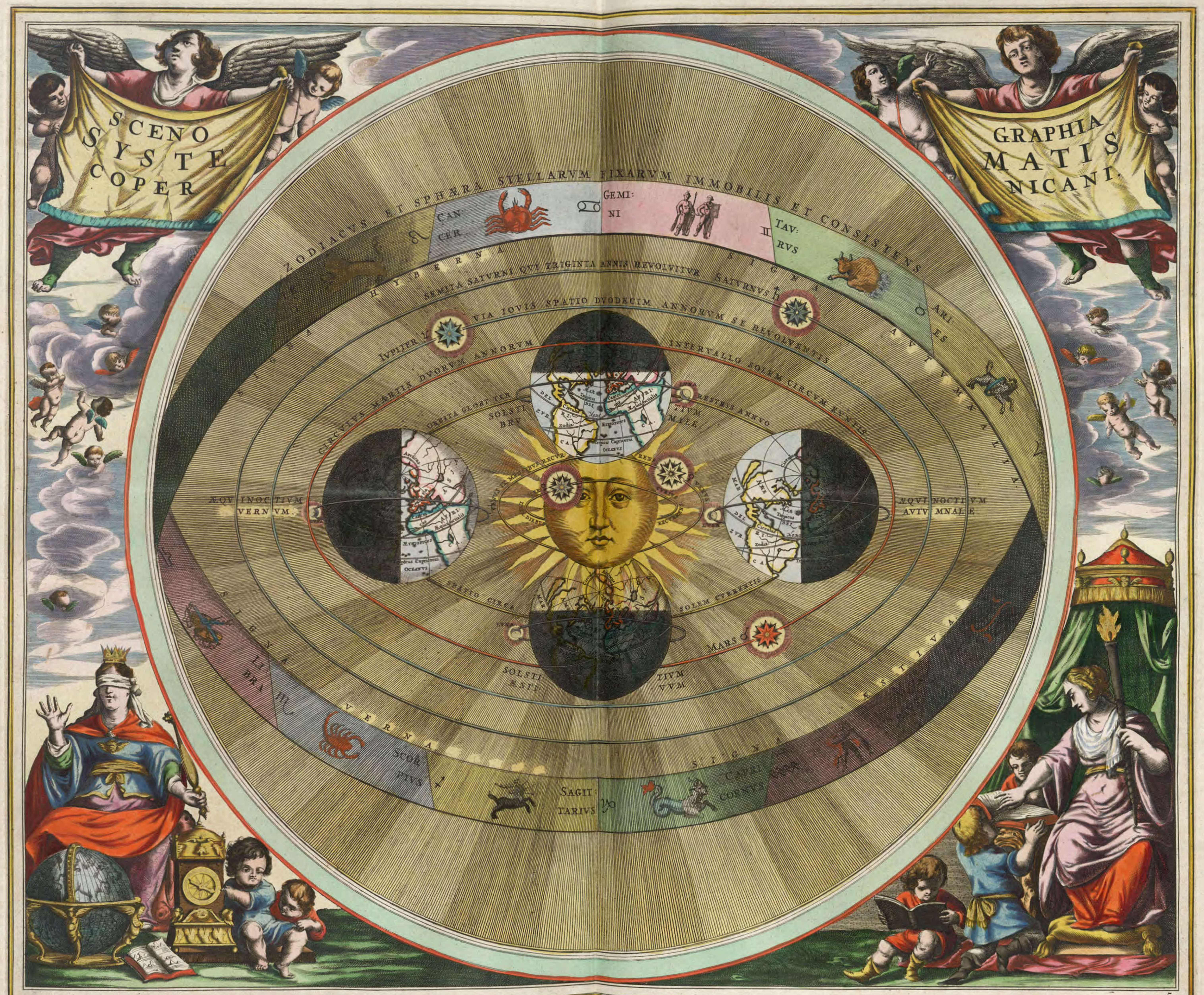
自氐五度至尾九度於辰在卯為大火東方為之心星在卯火故言大火宋之分也

古曰會尾箕
昏几中
旦星中

自尾十度至斗十二度於辰在寅為析木尾東方木之宿末斗北方水
宿之初次在其間隔別水木故曰析木燕之分也

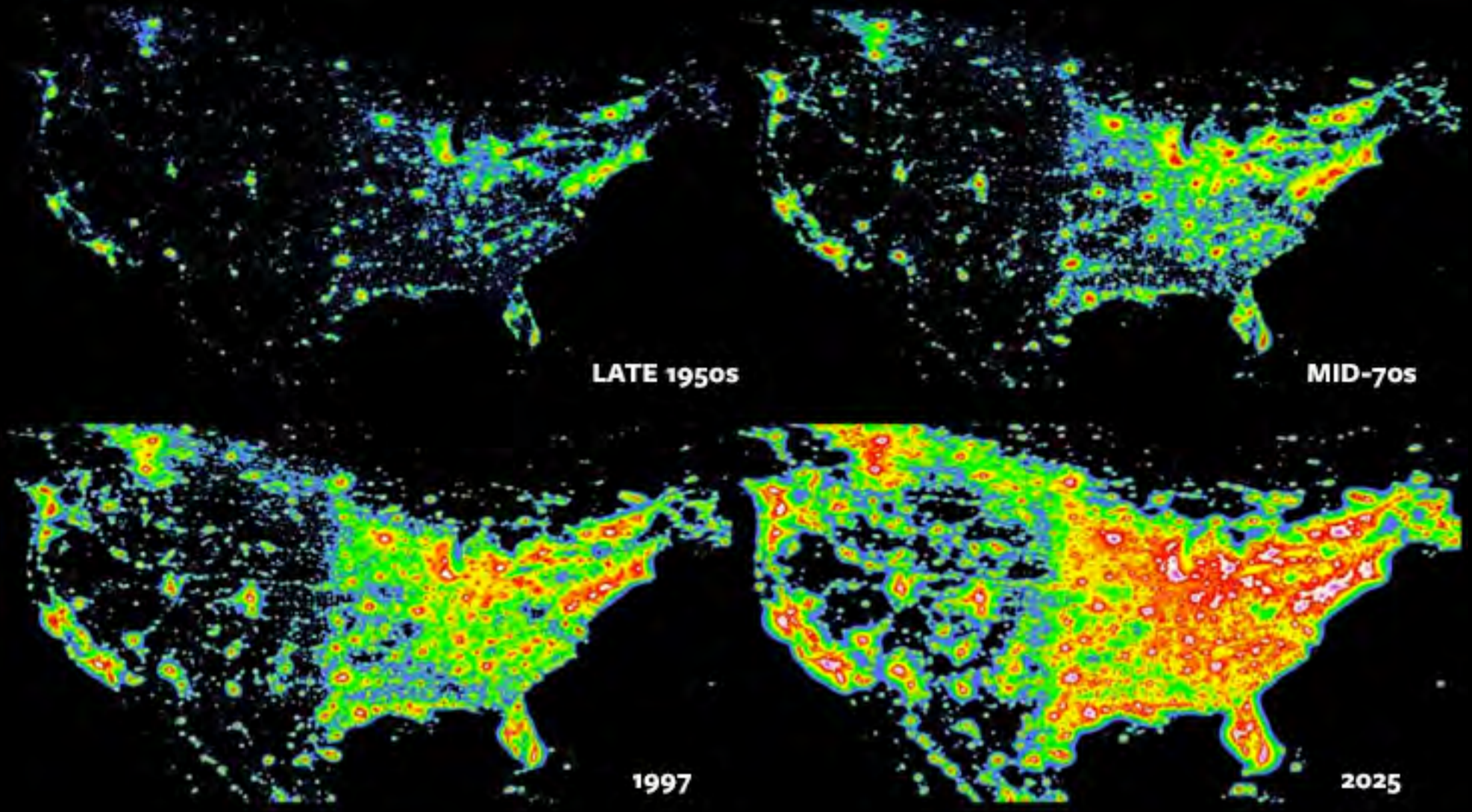
自斗十二度於辰在丑七度於辰在丑為星、紀、者言統己万物之終故曰星紀吳
越之分也

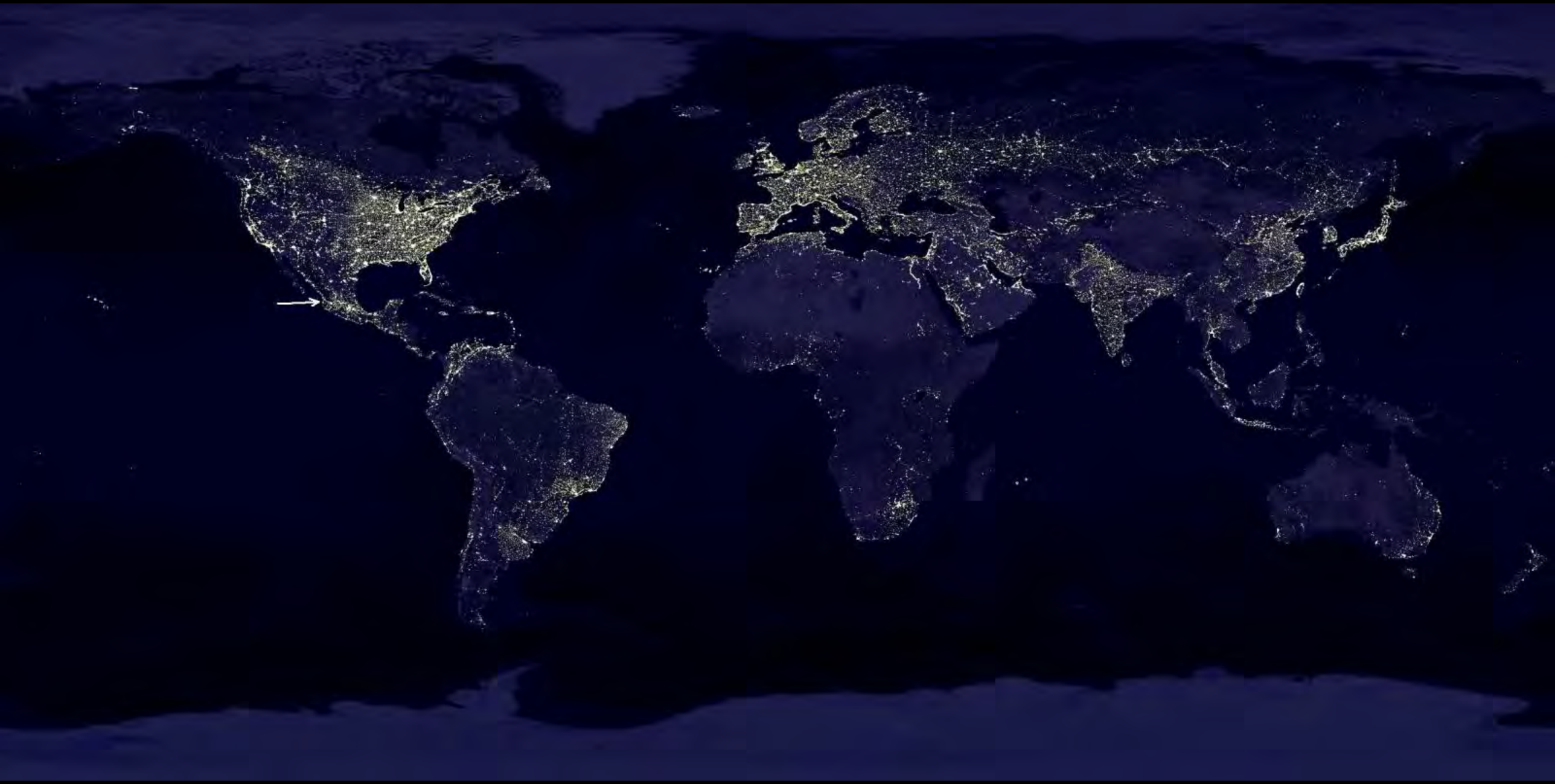

J.CLARK
INSTRUMENT MAKER
DRAYCOTT
SOMERSET
2008

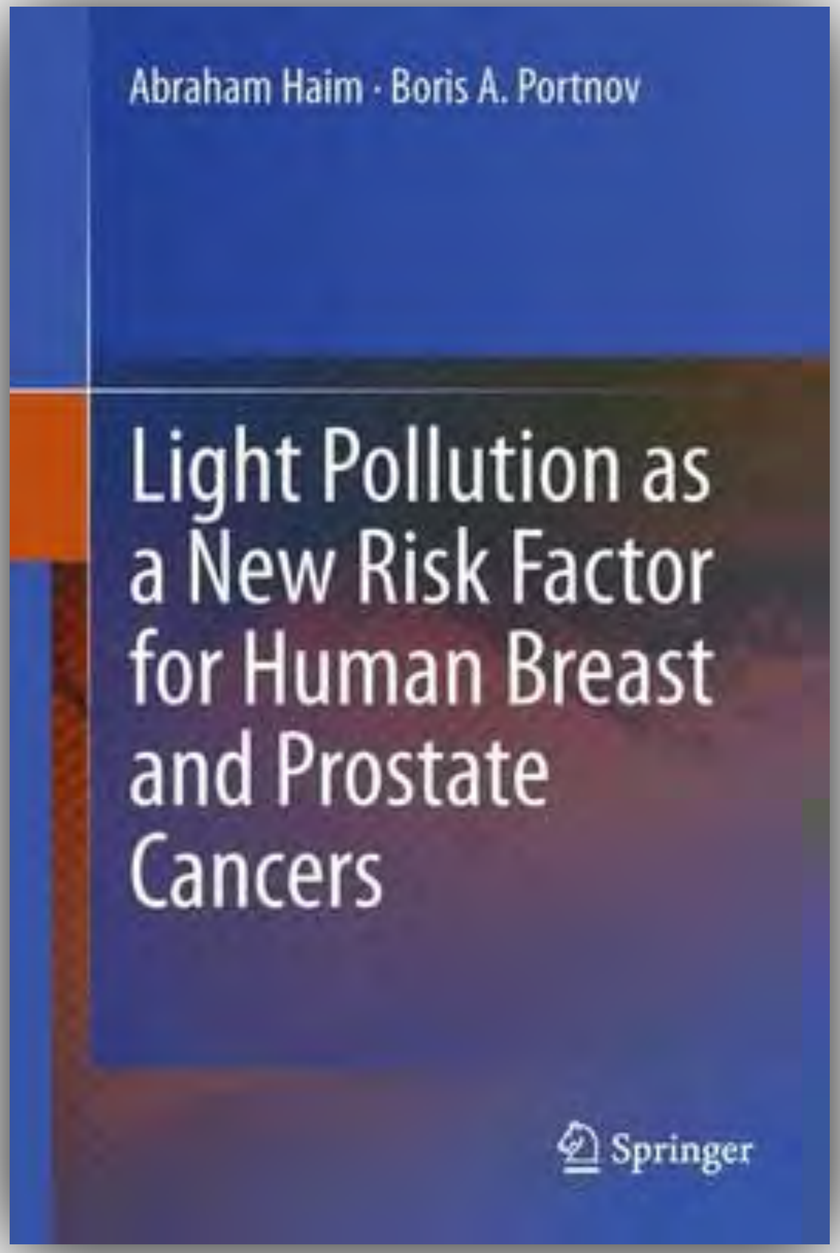

SCENO SYSTE COPER
GRAPHIA MATIS NICANI.
ZODIACVS ET SPHÆRA STELLARVM FIXARVM IMMOBILIS ET CONSISTENS
SEMITA SATVRNI QVI TRIGINTA ANNIS REVOLVITVR SATVRNVS
IVPITER
VIA IOVIS SPATIO DVODECIM ANNORVM SE REVOLVENTIS
CIRCVLVS MARTIS DVORVM ANNORVM INTERVALLO SOLEM CIRCVM EVNTIS
CAN CER
GEMI NI
TAV RVS
ARI ES
SCOR PIVS
SAGIT TARIVS
CAPRI CORNVS
LI BRA
ÆQVINOCTIVM VERNVM
ÆQVINOCTIVM AVTVMNALE
SOLSTITIVM ÆSTIVVM
MARS

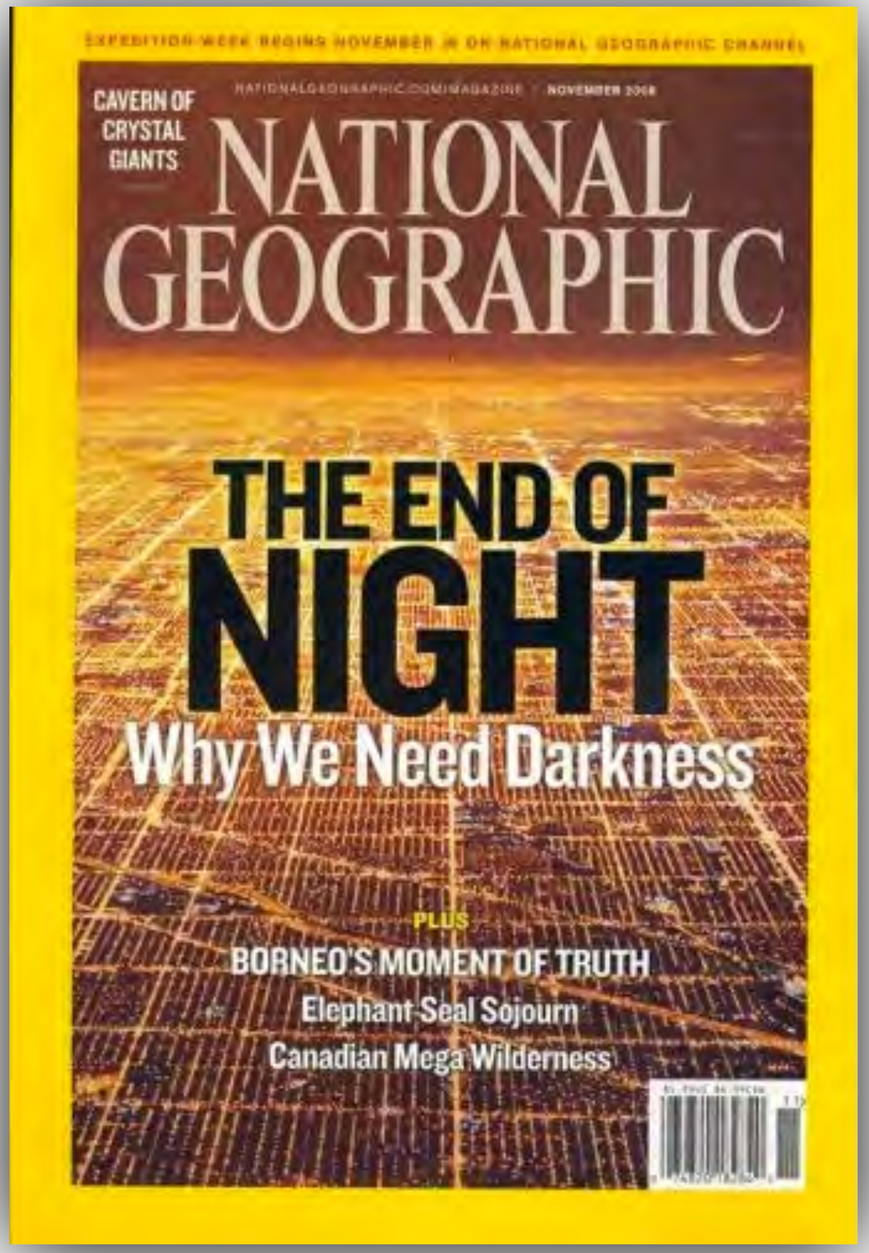
5


© Babak Tafreshi


LATE 1950s
MID-70s
1997
2025




Abraham Haim · Boris A. Portnov
Light Pollution as a New Risk Factor for Human Breast and Prostate Cancers
Springer


EXPEDITION WEEK BEGINS NOVEMBER 26 ON NATIONAL GEOGRAPHIC CHANNEL
CAVERN OF CRYSTAL GIANTS
NATIONAL GEOGRAPHIC
THE END OF NIGHT
Why We Need Darkness
PLUS
BORNEO'S MOMENT OF TRUTH
Elephant Seal Sojourn
Canadian Mega Wilderness


Enjoy Evening Ranger Night-Sky Programs
Where
"Half the Park
is After
Dark!"
SEE THE STARS
from
Assateague Island National Seashore


HALF THE PARK IS AFTER DARK
SEE THE MILKY WAY
IN ACADIA NATIONAL PARK


"Half the park is after dark."
SEE THE MILKY WAY
IN BADLANDS NATIONAL PARK

General Assembly

Distr.: General
12 February 2014

Sixty-eighth session
Agenda item 21 (*b*)

Resolution adopted by the General Assembly on 20 December 2013

[*on the report of the Second Committee (A/68/440/Add.2)*]

68/221. International Year of Light and Light-based Technologies, 2015

The General Assembly,

Reaffirming its resolutions 53/199 of 15 December 1998 and 61/185 of 20 December 2006, on the proclamation of international years, and Economic and Social Council resolution 1980/67 of 25 July 1980 on international years and anniversaries, particularly paragraphs 1 to 10 of the annex thereto, on the agreed criteria for the proclamation of international years, as well as paragraphs 13 and 14, which state that an international year should not be proclaimed before the basic arrangements for its organization and financing have been made,

Recognizing the importance of light and light-based technologies in the lives of the citizens of the world and for the future development of global society on many levels,

Stressing that enhanced global awareness of and increased education in the science and technologies of light are vital for addressing challenges such as

Recognizing the importance of light and light-based technologies in the lives of the citizens of the world and for the future development of global society on many levels,

Stressing that enhanced global awareness of and increased education in the science and technologies of light are vital for addressing challenges such as sustainable development, energy and community health, as well as for improving the quality of life in both developed and developing countries,

Considering that the applications of light science and technology are vital for existing and future advances in, inter alia, medicine, energy, information and communications, fibre optics, agriculture, mining, astronomy, architecture, archaeology, entertainment, art and culture, as well as many other industries and services, and that light-based technologies contribute to the fulfilment of internationally agreed development goals, including by providing access to information and increasing societal health and well-being,

Considering also that technology and design can play an important role in the achievement of greater energy efficiency, in particular by limiting energy waste, and in the reduction of light pollution, which is key to the preservation of dark skies,

Noting that 2015 coincides with the anniversaries of a series of important milestones in the history of the science of light, including the works on optics by Ibn Al-Haytham in 1015, the notion of light as a wave proposed by Fresnel in 1815, the electromagnetic theory of light propagation proposed by Maxwell in 1865,

INTERNATIONAL
YEAR OF LIGHT
2015

COSMIC LIGHT

IAU

www.cosmiclight.org

16h00 Abertura e boas vindas pelo Museu da Luz /EDIA,SA

16h15 **Os Programas científicos da UNESCO: O Ano Internacional da Luz e o Ano Internacional dos Solos**
Elizabeth Silva, membro da Comissão Nacional para o Ano Internacional da Luz (AIL) - UNESCO
A importância da luz nas sociedades de hoje Teresa Peña, presidente Sociedade Portuguesa de Física, membro da Comissão Nacional para o AIL
Os solos e a luz: soluções para um uso sustentável Maria José Roxo, prof. catedrática Geografia FCSH-UNL

17h15 Pausa para café

17h30 **Lentilhas & Luz** Miguel Proença, fotógrafo, doutorando FBAUL
Luz e Cosmos, um conto de encantar Rosa Doran, presidente NUCLIO, chair do Galileo Teacher Training Program
Luz Cósmica: para além da lâmpada Pedro Russo, Univ. de Leiden / International Astronomical Union

18h30 Inauguração da **exposição Luz Cósmica: para além da lâmpada**

20h00 **Jantar** ao pôr-do-sol no Monte dos Pássaros, junto ao lago Alqueva

21h30 Visita guiada ao **céu** da Luz com telescópio

Entrada livre.
Autocarro gratuito de ida e volta para Lisboa, mediante inscrição prévia para infomuseudaluz@edia.pt [partida às 13h]. Possibilidade de jantar ao pôr-do-sol no Monte dos Pássaros, mediante inscrição e pagamento prévios. Ver informações úteis em anexo.

EDIA MUSEUDALUZ
www.museudaluz.org.pt

ANO INTERNACIONAL DA LUZ 2015
UNESCO United Nations Educational, Scientific and Cultural Organization
Comissão Nacional da UNESCO Portugal
Portuguese National Commission for UNESCO

Apoio: Comissão Nacional para o Ano Internacional da Luz
Núcleo Interactivo de Astronomia

Museu da Luz | Largo da Igreja de N.S. da Luz 7240-100 Mourão
t. 266 569 257 | GPS Lon -7.381645 Lat 38.344322

Museum of Light

Aldeia da Luz, Mourão, Portugal

Saturday, 4 July

- Dark Sky Reserve
- Talks + Exhibition
- Dinner + Sky Observing Session

Free Shuttle: Lisbon ←→ Museum

www.museudaluz.org.pt

Universiteit Leiden
The Netherlands

MUSEUDALUZ