



HURTIGRUTEN

Astronomy Voyage



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LECTURE PROGRAMME

- Tonight's Night Sky
- Astrophotography
- The Aurora
- Our Solar System
- Our Galaxy
- **Our Universe**
- **Modern Astronomy: Life as a
Astronomer & Tools of the Trade**
- **Why We Are Here: A 13.8-billion
year-old story**





Royal Observatory,
Greenwich, London

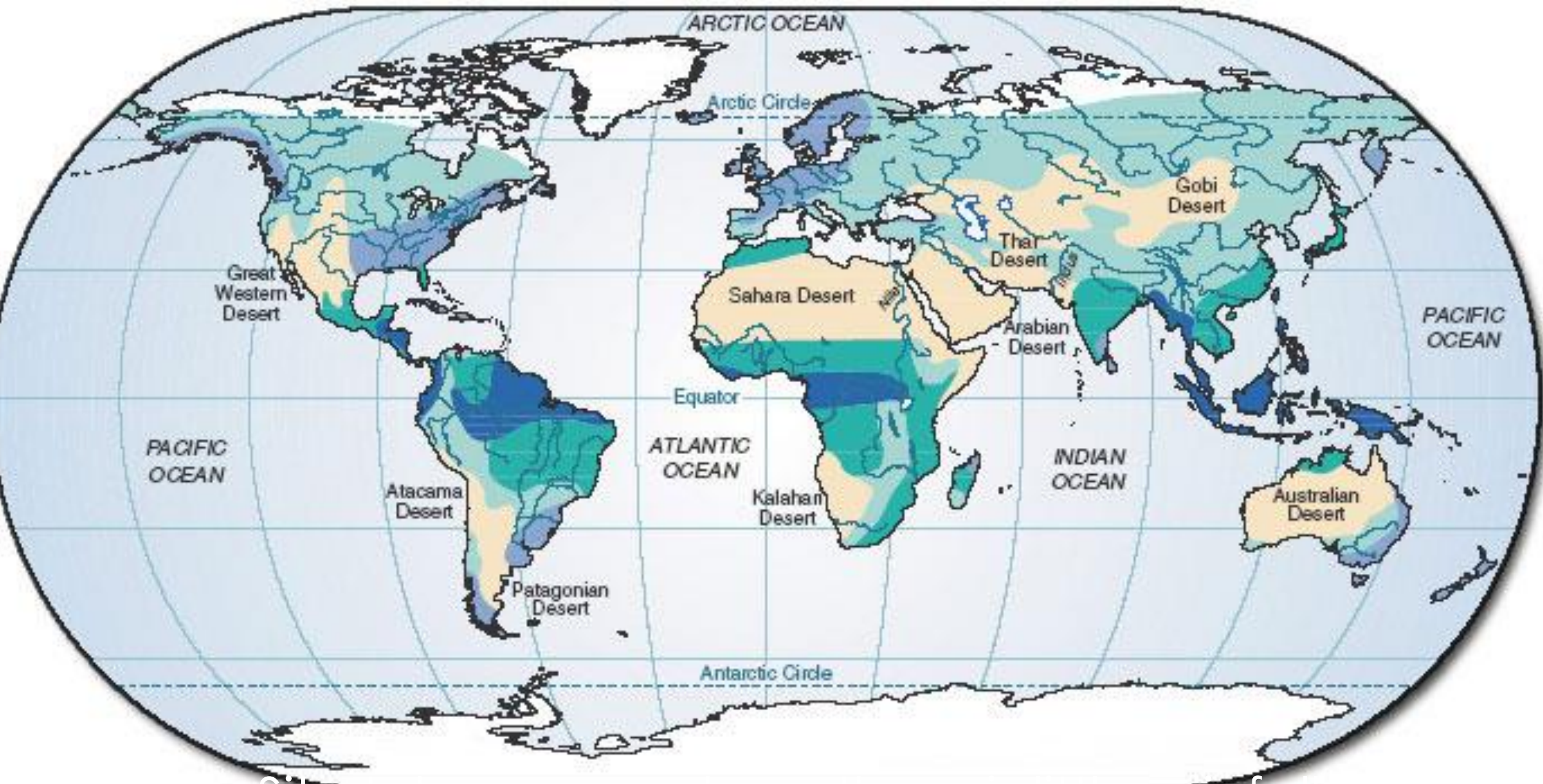


Royal Observatory,
Greenwich, London



Royal Greenwich Observatory, Herstmonceux, Sussex





Site telescopes where there is little rain







Hawai'i, for example

Mt Everest
Summit 8,848m
Pressure ~330mb

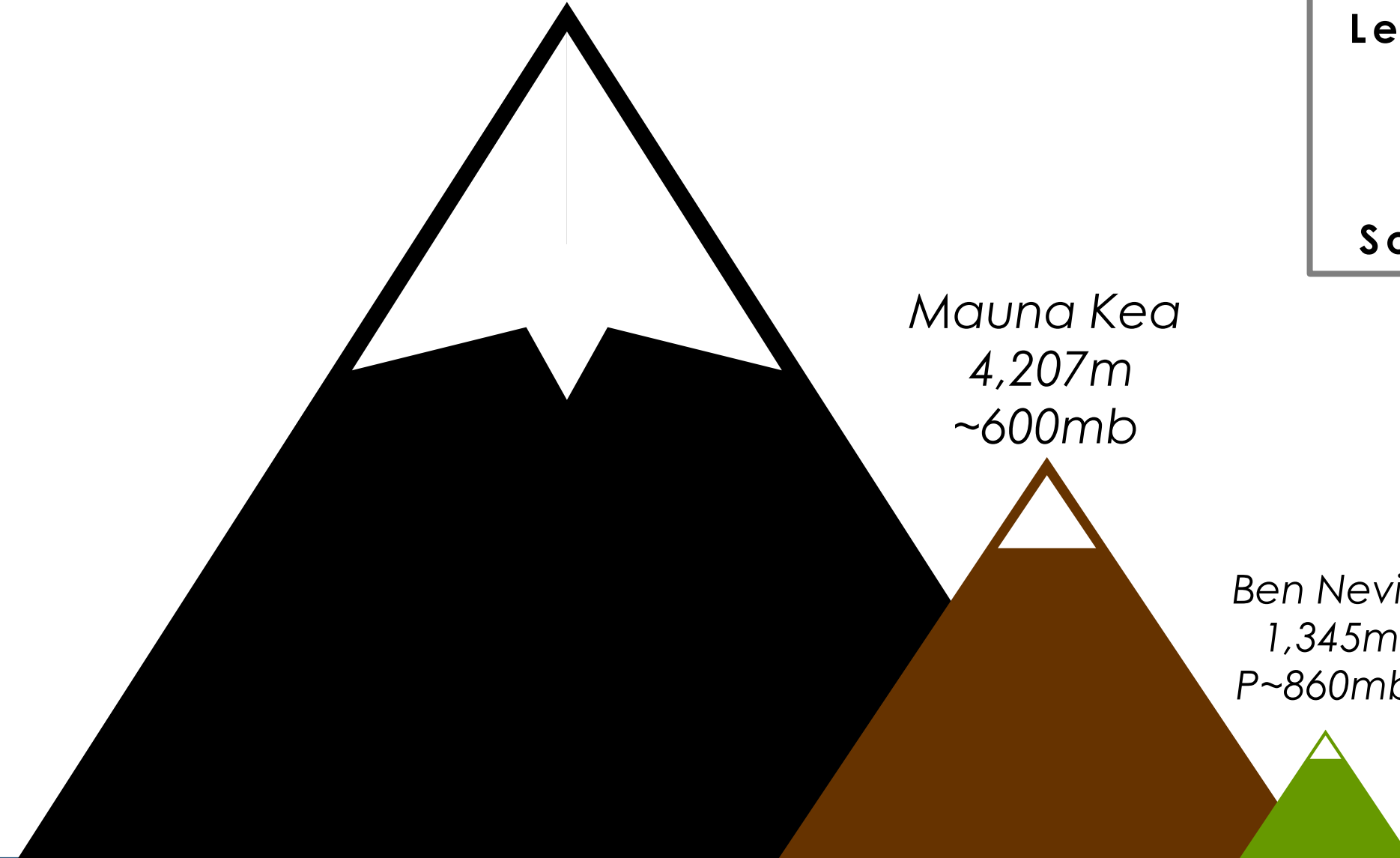
Higher altitude
↓
**Less atmosphere to
look through**
↓
So sharper images

Mauna Kea
4,207m
~600mb

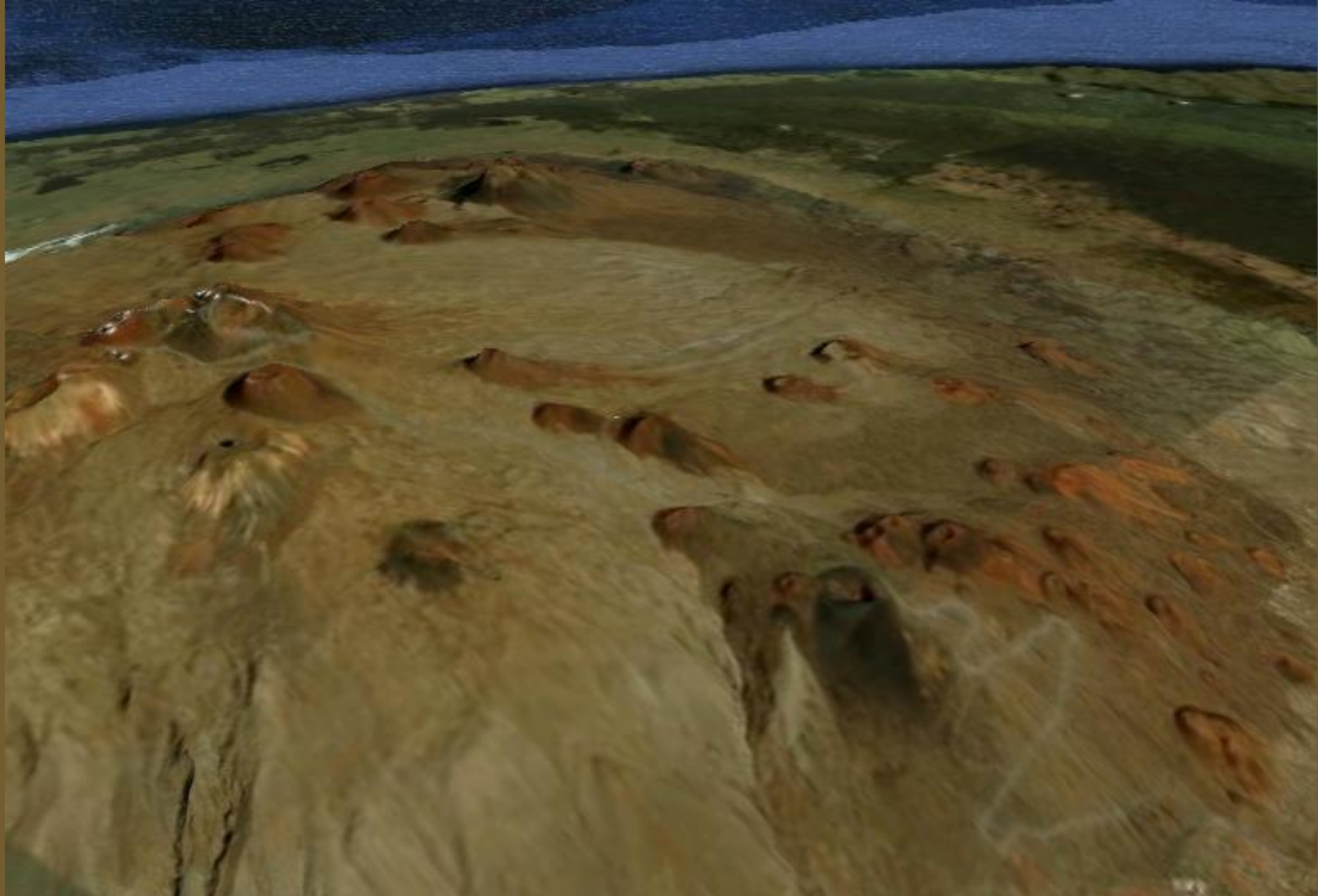
Ben Nevis
1,345m
P~860mb

Sea level

Brighton
P~1023mb









MAJOR EMERGENCY High Altitude Sickness

MAJOR SYMPTOMS

Severe Unrelenting Sudden
Headaches

Shortness of Breath

Chest Pain

Abdominal Pain

MAJOR SIGNS

Slurred Speech

Visual Disturbance

Loss of Coordination

Paralysis

Seizures

Collapse

Slow or Rapid Heart Beat

Labored Breathing

Unrelenting Nausea or Vomiting

MINOR EMERGENCY High Altitude Sickness

MINOR SYMPTOMS

Mild shortness of breath

Dizziness

Lightheadedness

Headaches

Visual Change

Palpitations

Chest Tightness

Nausea

MAUNA KEA HAZARDS

EXPOSURE TO ALTITUDE

The summit elevation is 13,796 feet (4,205 m). The oxygen level is greatly reduced and a person can experience shortness of breath and/or impaired judgement. Reduced atmospheric pressure at high altitudes may cause **altitude sickness** or result in the development of other life threatening conditions such as **pulmonary edema** (fluid in the lungs) and **cerebral edema** (fluid on the brain). Also because the summit is above much of the atmosphere that blocks the sun's damaging ultraviolet rays, individuals risk exposure to serious sunburn and eye damage, especially if there is snow on the ground.

Precautions Before Ascending the Summit

- Prior to ascending the summit, acclimatize by spending at least 1/2 hour at the Visitor Information Station located at the 9,200 feet (2,804 m) elevation. This may lessen the intensity or onset of altitude sickness. If symptoms occur at this elevation, **do not** travel beyond the Visitor Information Station.
- Apply sunscreen and wear sunglasses and protective clothing.
- Hikers should register at the Visitor Information Station and use the buddy system.
- **DO NOT DRINK ALCOHOLIC BEVERAGES BEFORE OR DURING YOUR VISIT.**

Persons at Risk

It is strongly advised the following individuals not travel above the Visitor Information Station:

- Pregnant women
- Individuals in poor physical condition
- Individuals with heart or respiratory problems
- Children under the age of 16*
- * Extended exposure to high altitudes could cause permanent damage to children whose bodies are still developing.

Symptoms of ALTITUDE SICKNESS include:

- Headaches
- Drowsiness
- Altered mental state
- Loss of balance
- Nausea
- Impaired reason

Symptoms of PULMONARY EDEMA and CEREBRAL EDEMA include:

- Severe headaches
- Vomiting
- Breathing difficulties
- Coughing
- Blue lips or fingernails
- Disorientation
- Extreme drowsiness (could result in a coma)

**IF SYMPTOMS PERSIST OR BECOME SEVERE,
IMMEDIATELY DESCEND TO A LOWER ELEVATION
IT COULD MEAN A MATTER OF LIFE OR DEATH!**

SNOW RECREATION

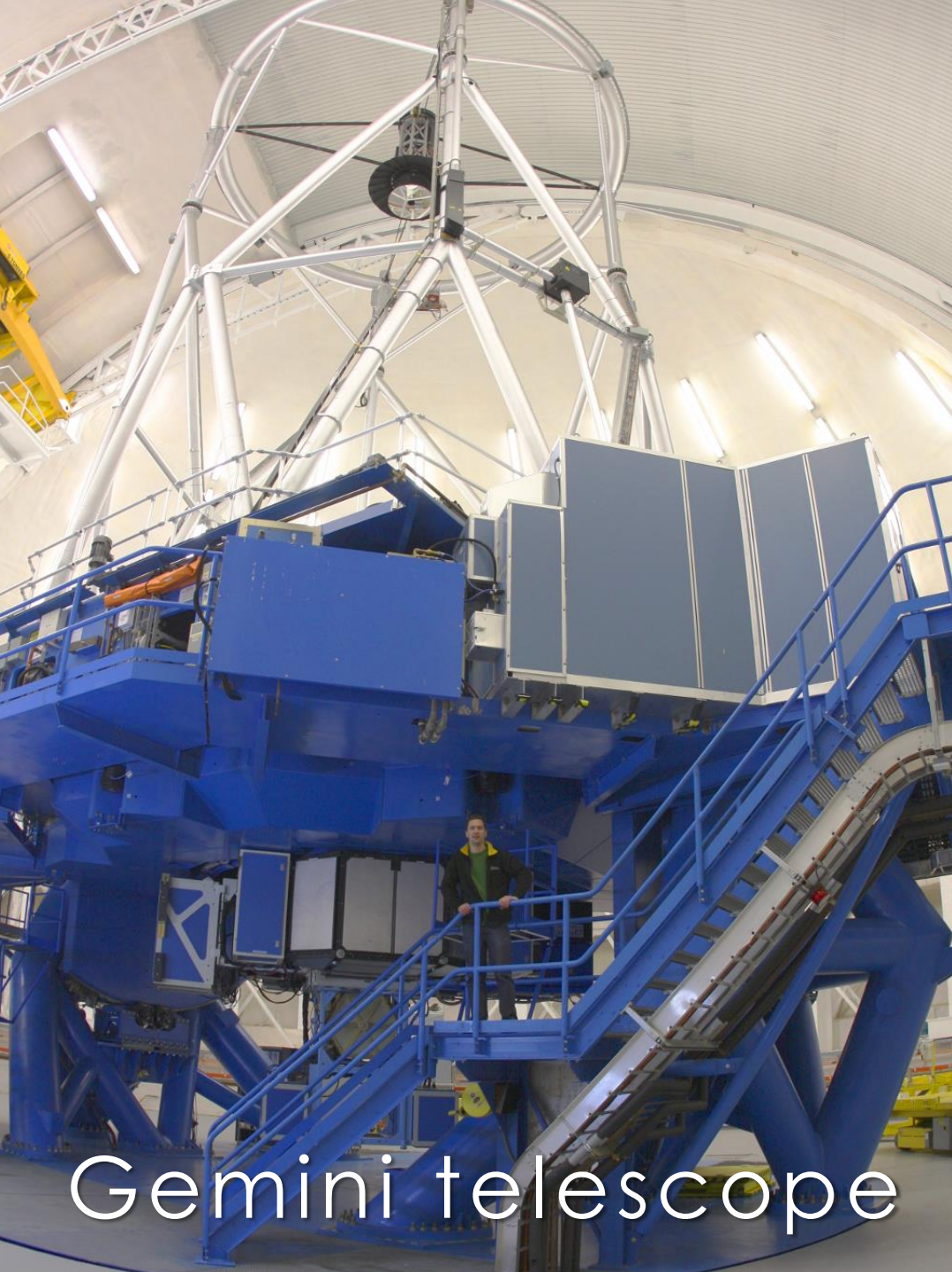
Because some of the slopes are very steep with rock outcroppings at the bottom, you are strongly advised NOT TO USE the following: **inner tubes, boogie boards, or other devices that are NOT equipped with braking mechanisms or which do NOT provide directional control on snow or ice.**

Due to the fragile environment and cultural significance of Mauna Kea AND safety to you and others using the mountain, **SNOW MOBILES OR ANY TYPE OF OFF-ROAD VEHICLES ARE PROHIBITED.**

- **THERE IS NO EQUIPMENT OR INFRASTRUCTURE AVAILABLE FOR ORGANIZED SNOW PLAY ON MAUNA KEA**
- **ALL SNOW RECREATION IS AT THE RISK OF THE INDIVIDUAL**



Add timelapse



Gemini telescope





Large Binocular Telescopes, Arizona, two 8.4m

Gran Telescopio, La Palma, 10.4m

Bigger is better
for astronomers
– but why?





XMM-Newton



Nordic
Optical
Telescope

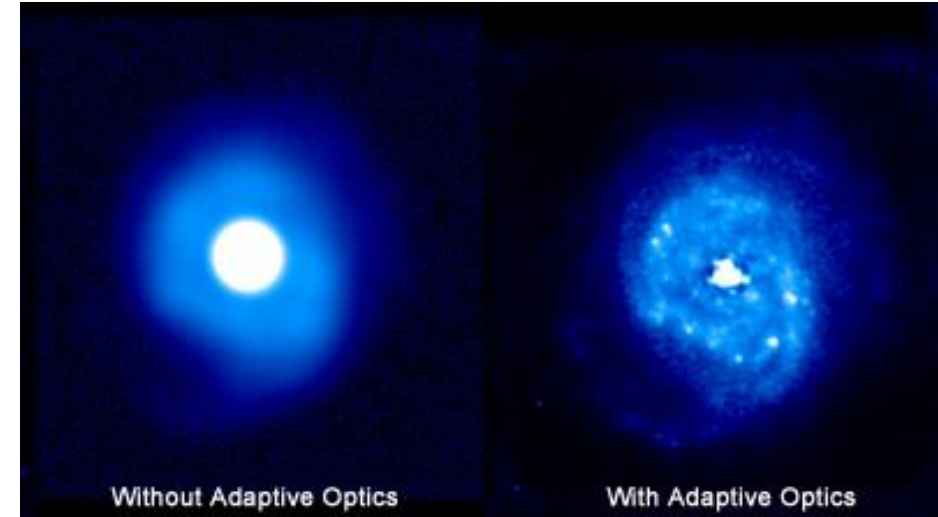
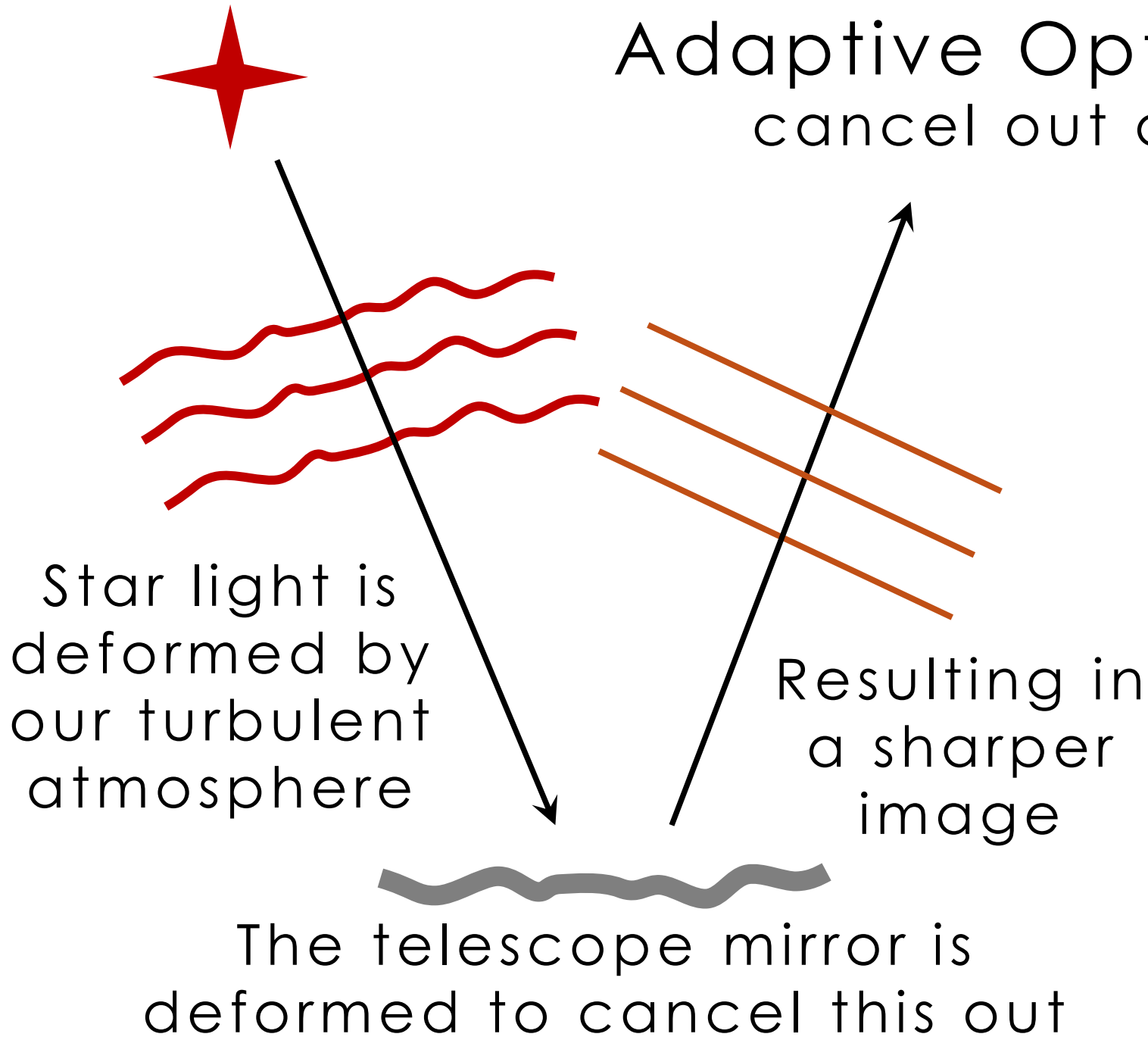


The Very Large Telescope Paranal, Atacama desert, Chile



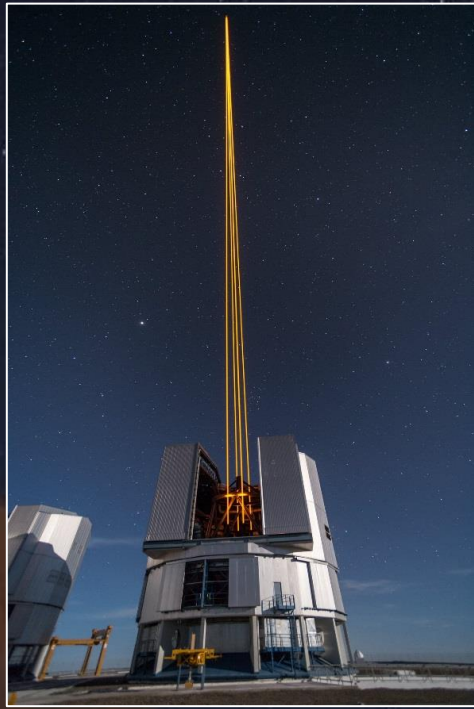


Adaptive Optics - Flexible mirrors cancel out atmospheric distortions



ESO VLT

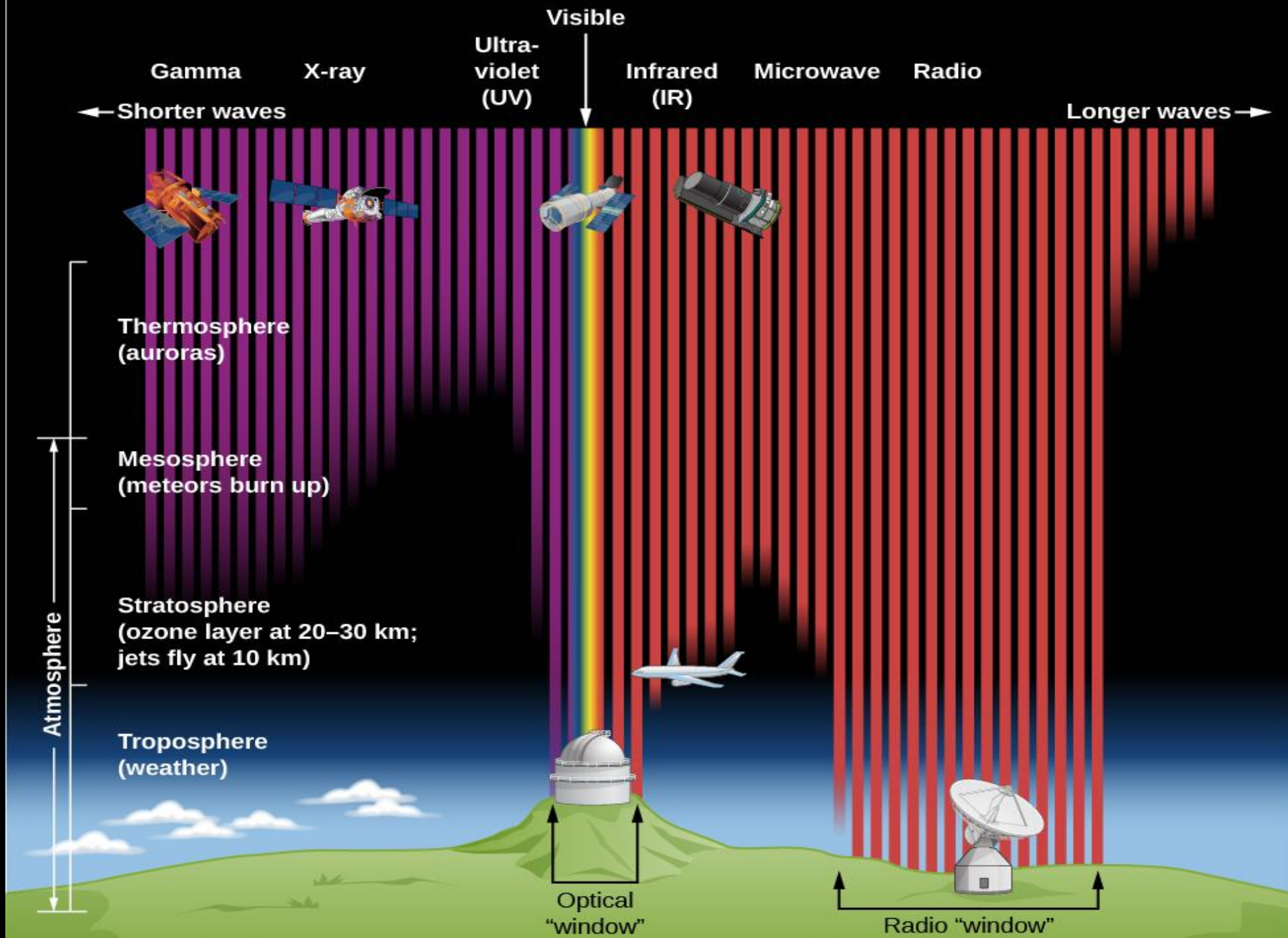
Laser Guide star



Hubble Space Telescope

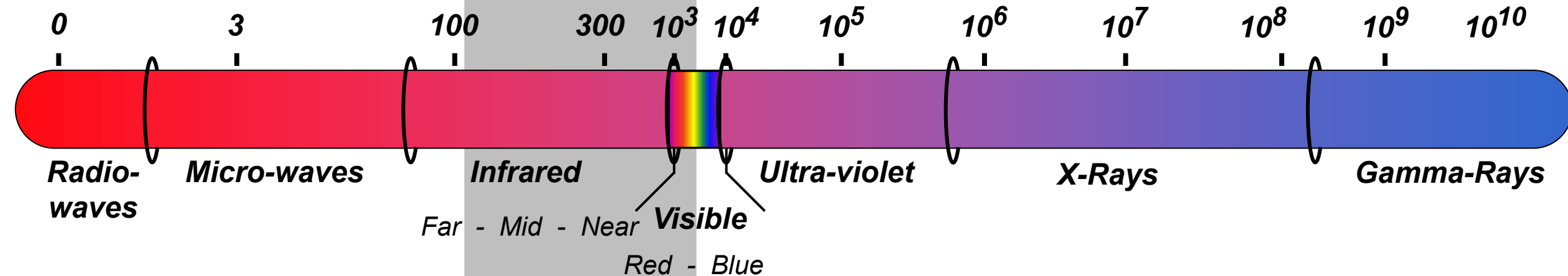


Mirror built 1979
Launched 1990
Cost ~\$10bn



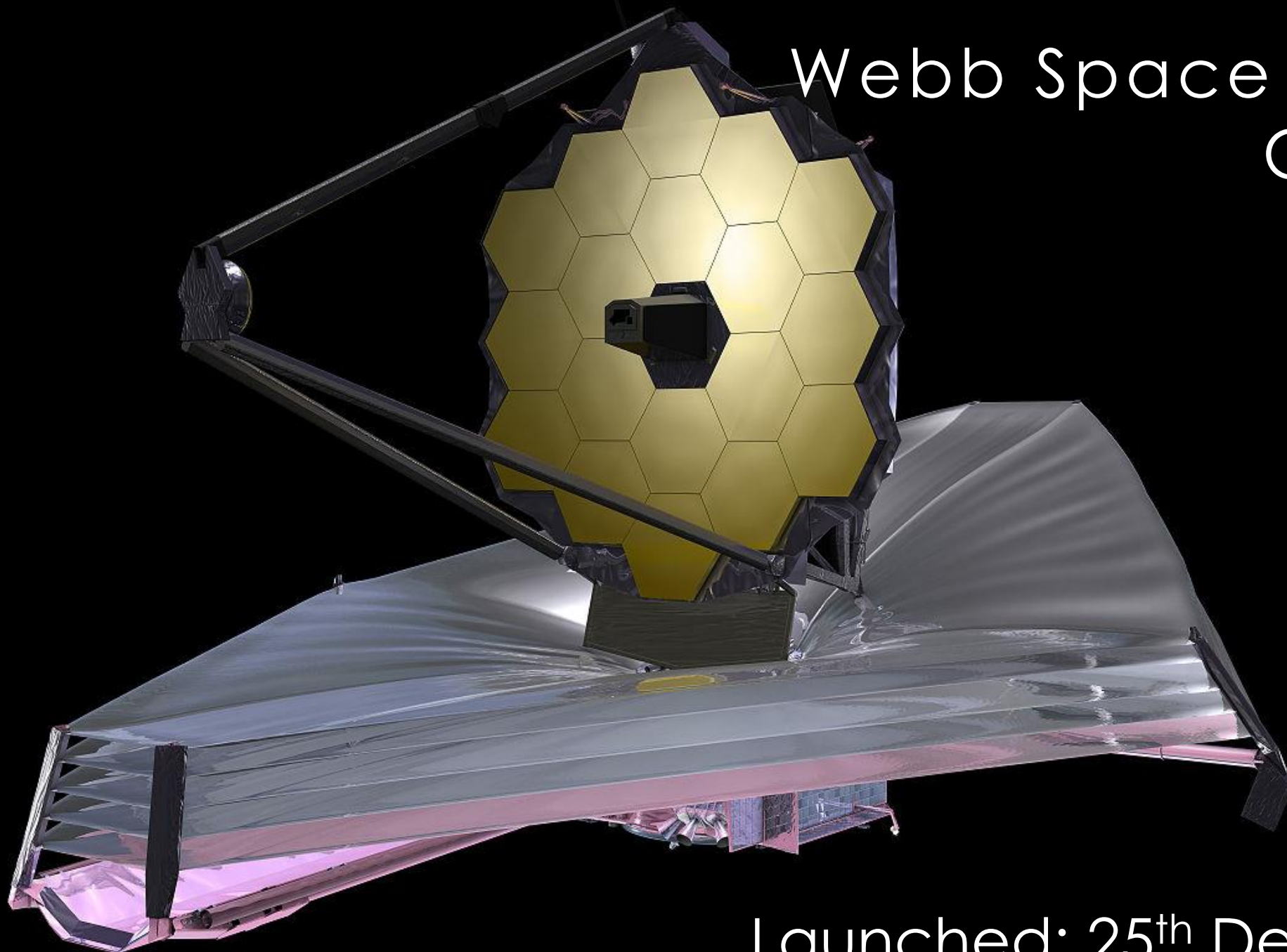
Gas at different temperatures,
emits light at different wavelengths.

Kelvin



Radio waves
originate from
electrons in
magnetic fields

1 Kelvin = 1° Celsius
But Kelvin scale starts at 0
Celsius starts at -273.15°

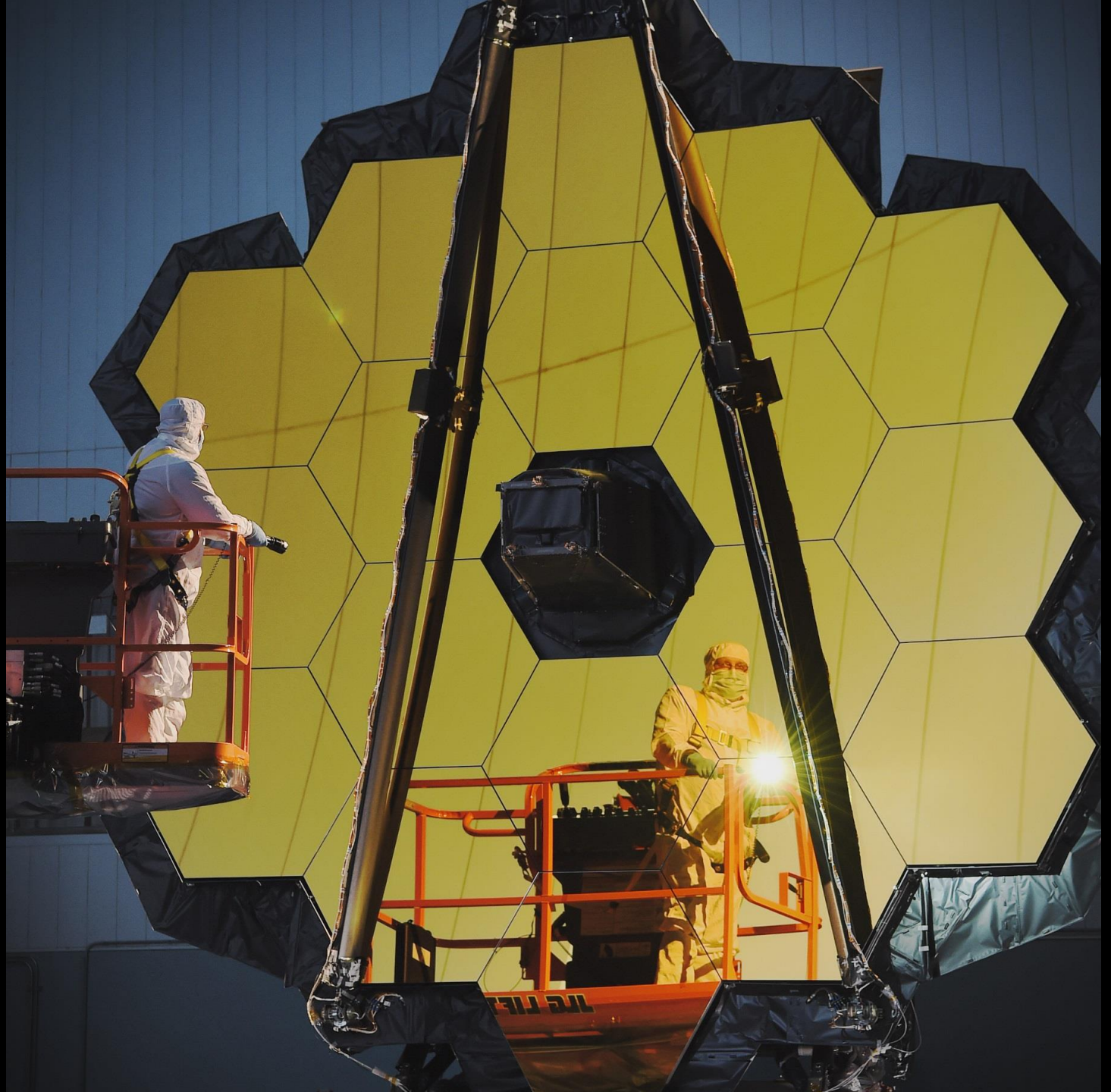


Webb Space Telescope
Cost \$10bn

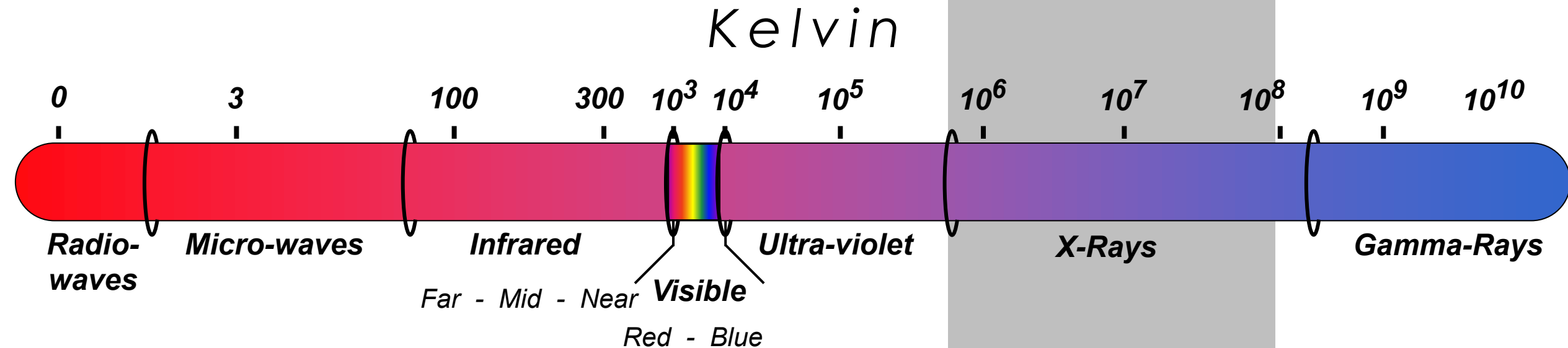
Launched: 25th December 2021

JWST

Consists of a
6.5m mirror
made of 18
Segments,
including the
MIRI camera
built in Scotland.

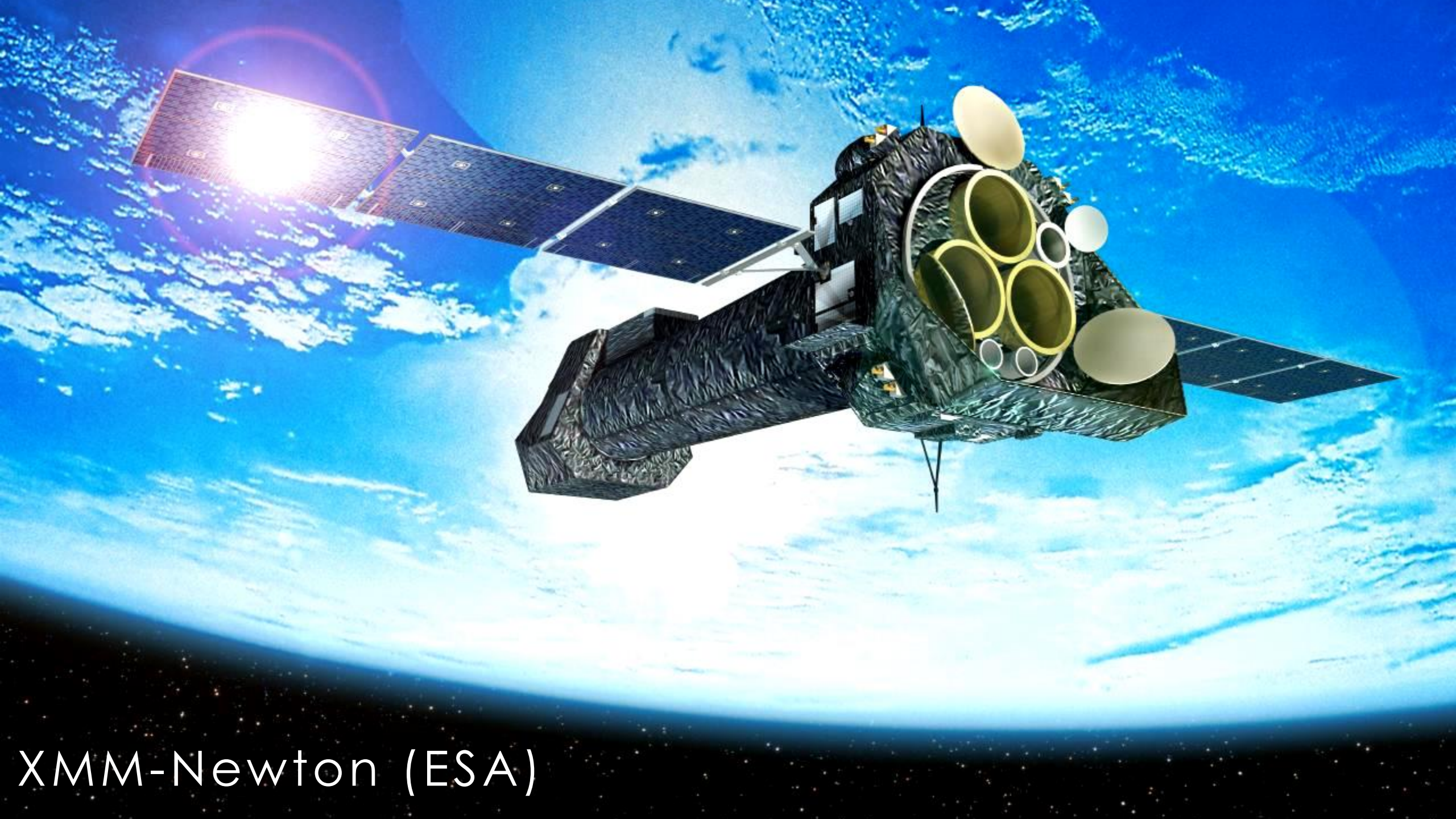


Gas at different temperatures,
emits light at different wavelengths.



Chandra (NASA)





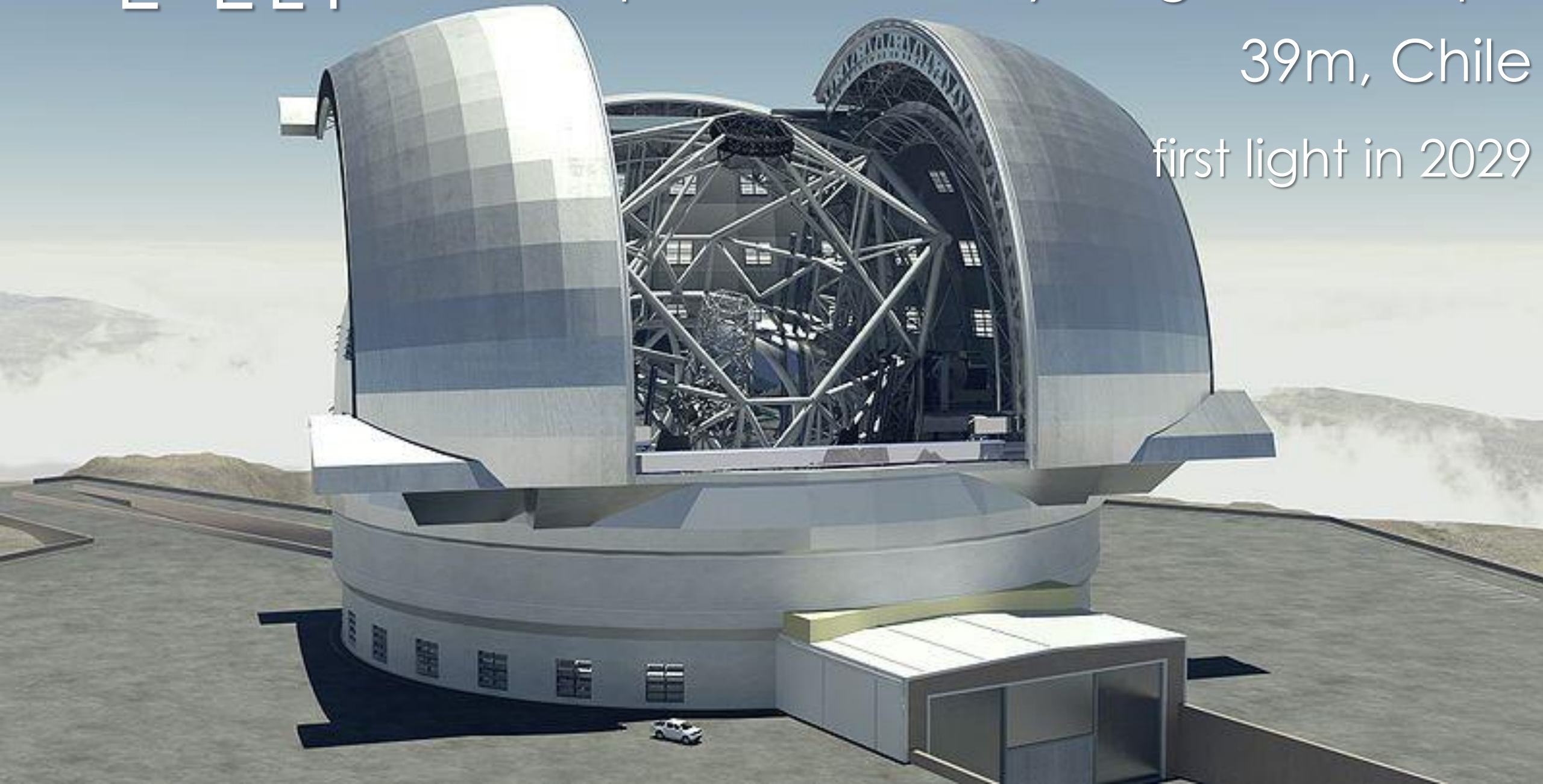
XMM-Newton (ESA)

E-ELT

– European Extremely Large Telescope

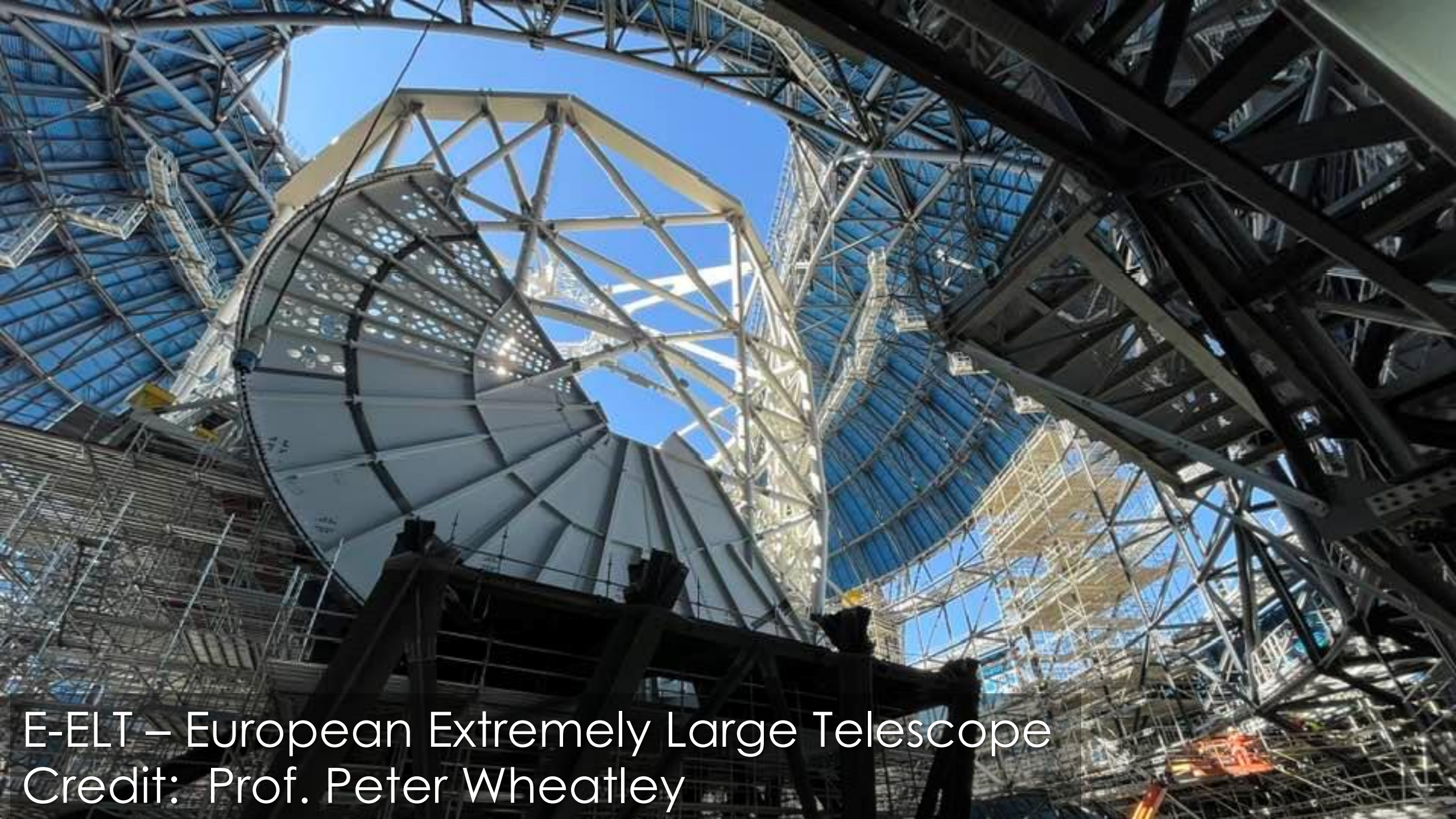
39m, Chile

first light in 2029





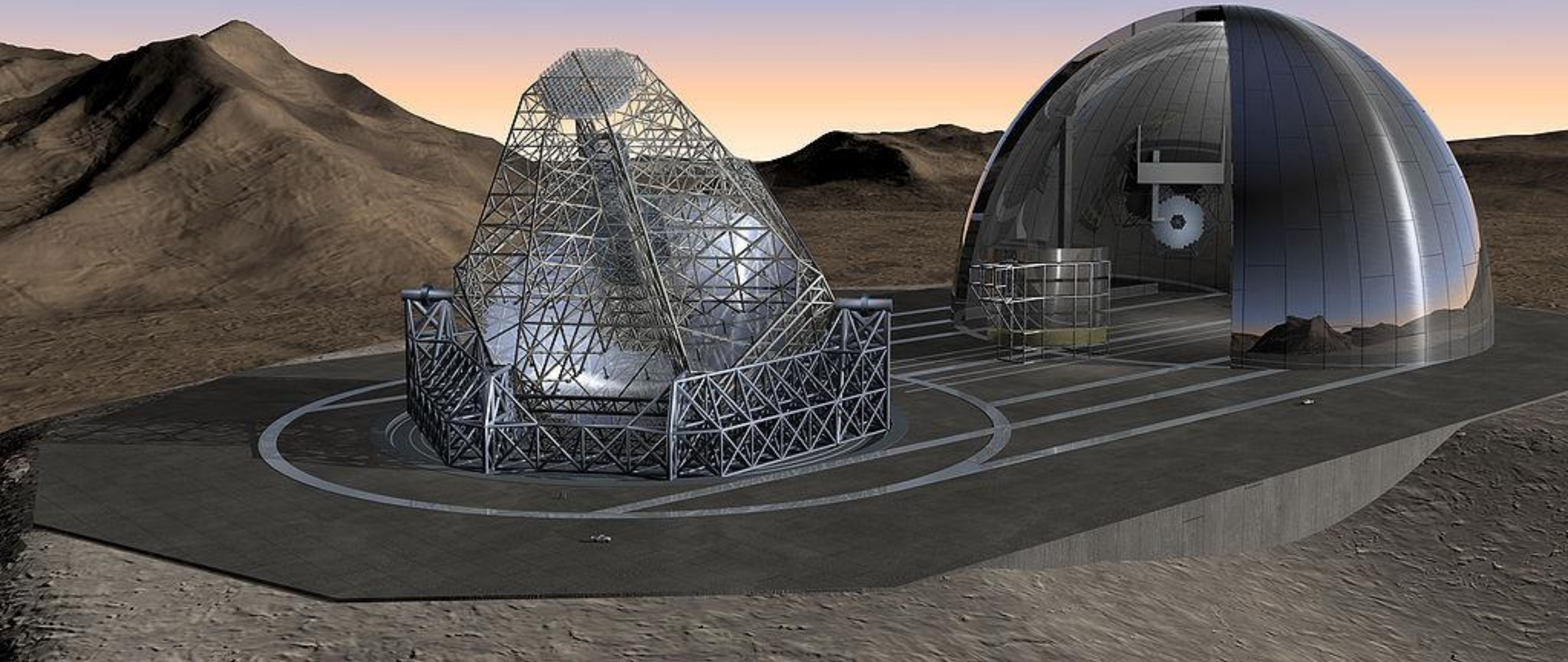
E-ELT – European Extremely Large Telescope



E-ELT – European Extremely Large Telescope
Credit: Prof. Peter Wheatley

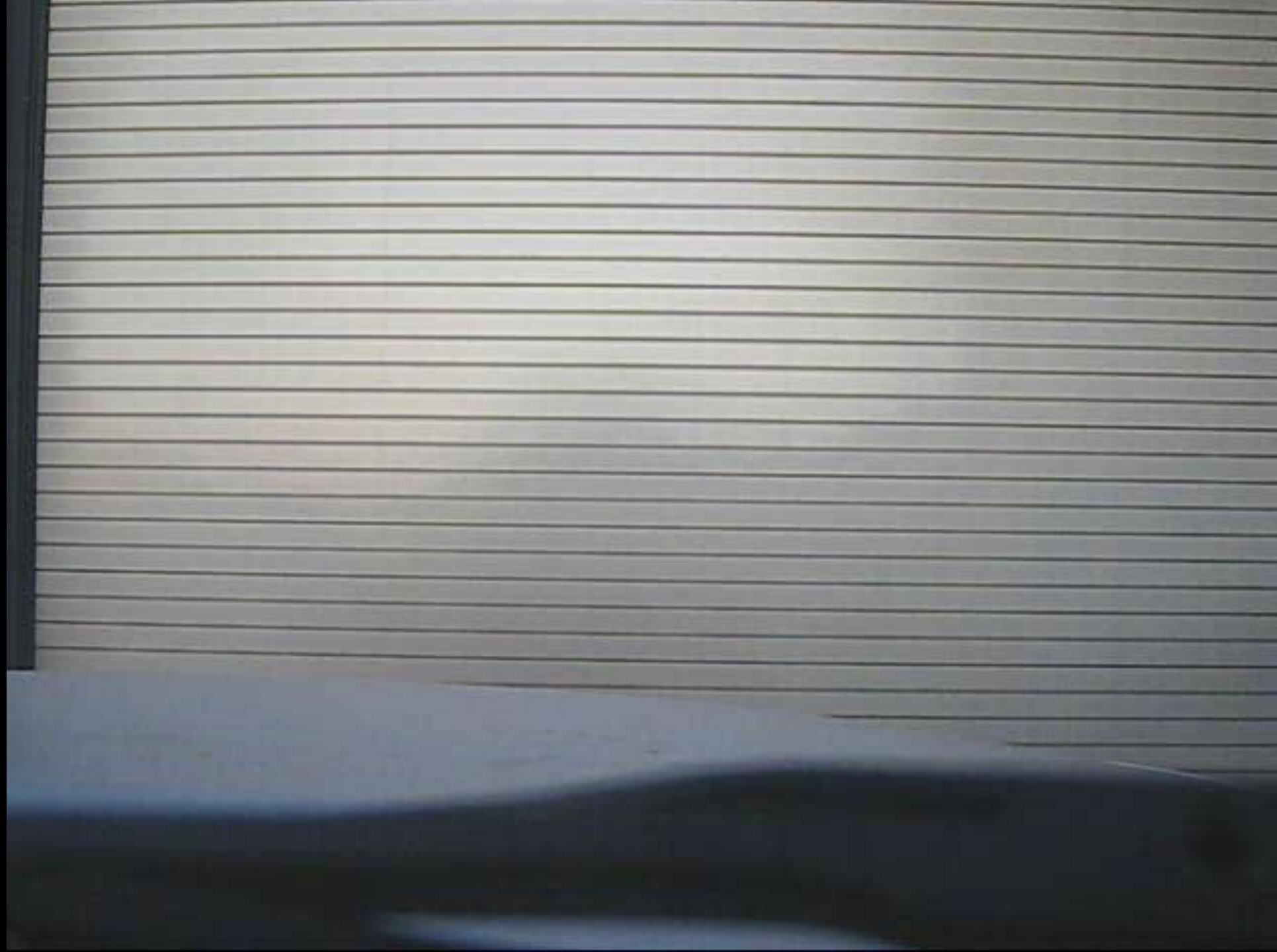
OWL – the Overwhelmingly Large Telescope

100m telescope idea, cancelled due to €1.5bn cost





Gemini & UKIRT





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Astronomy Voyage



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