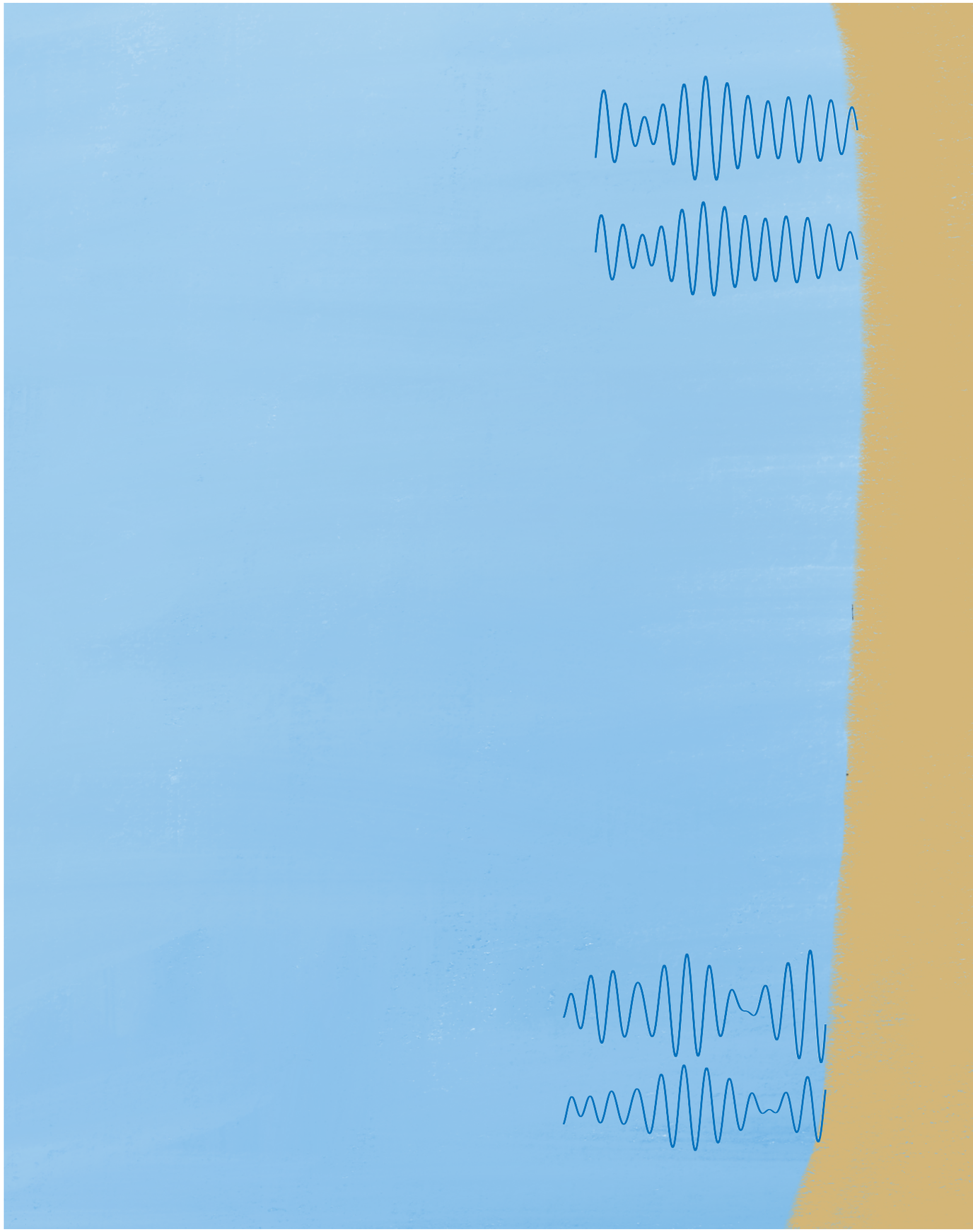
Hanbury Brown & Twiss

Interferometers

Combined ripple

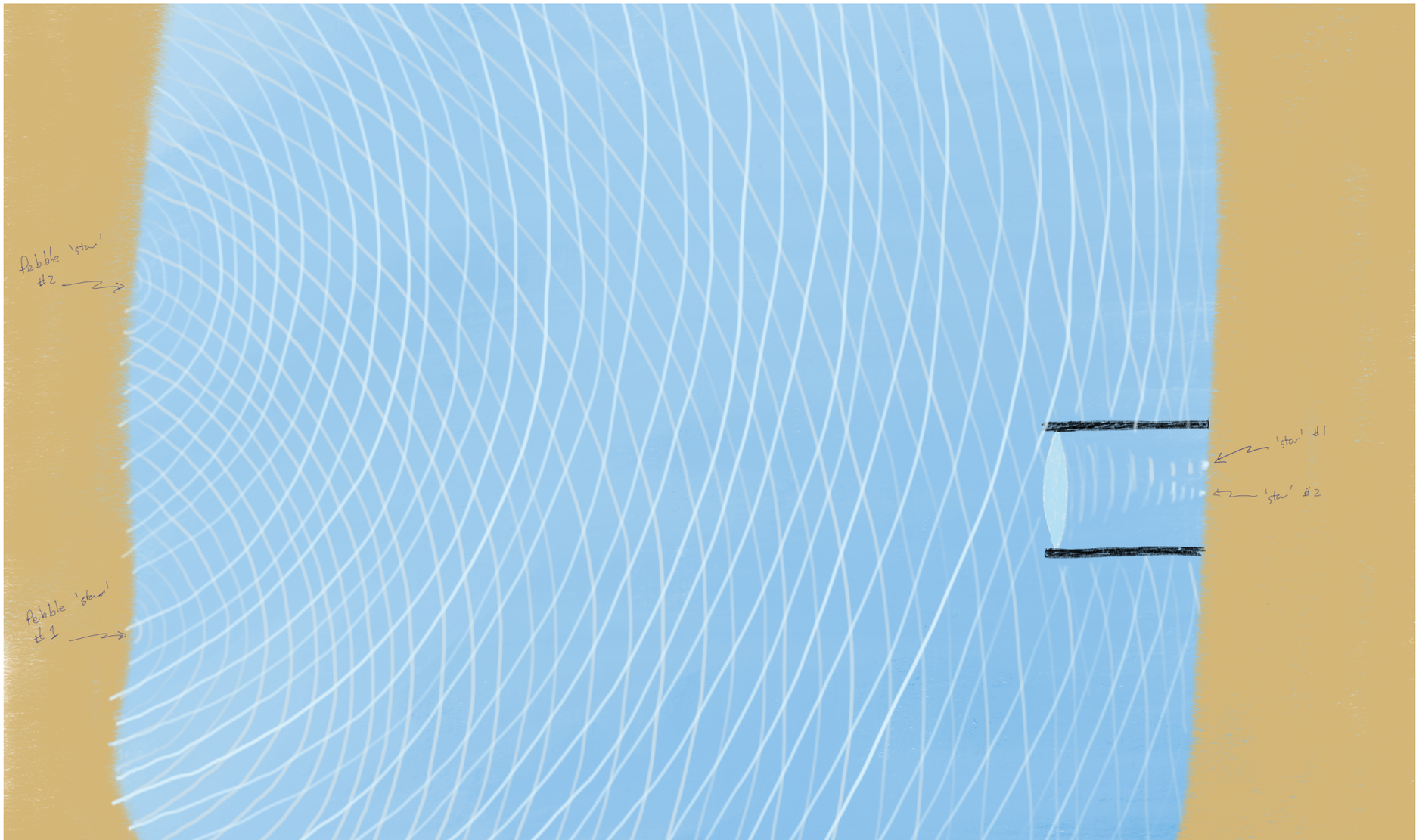
- If sources are close together, we need to walk a long way for the combined ripples to look different

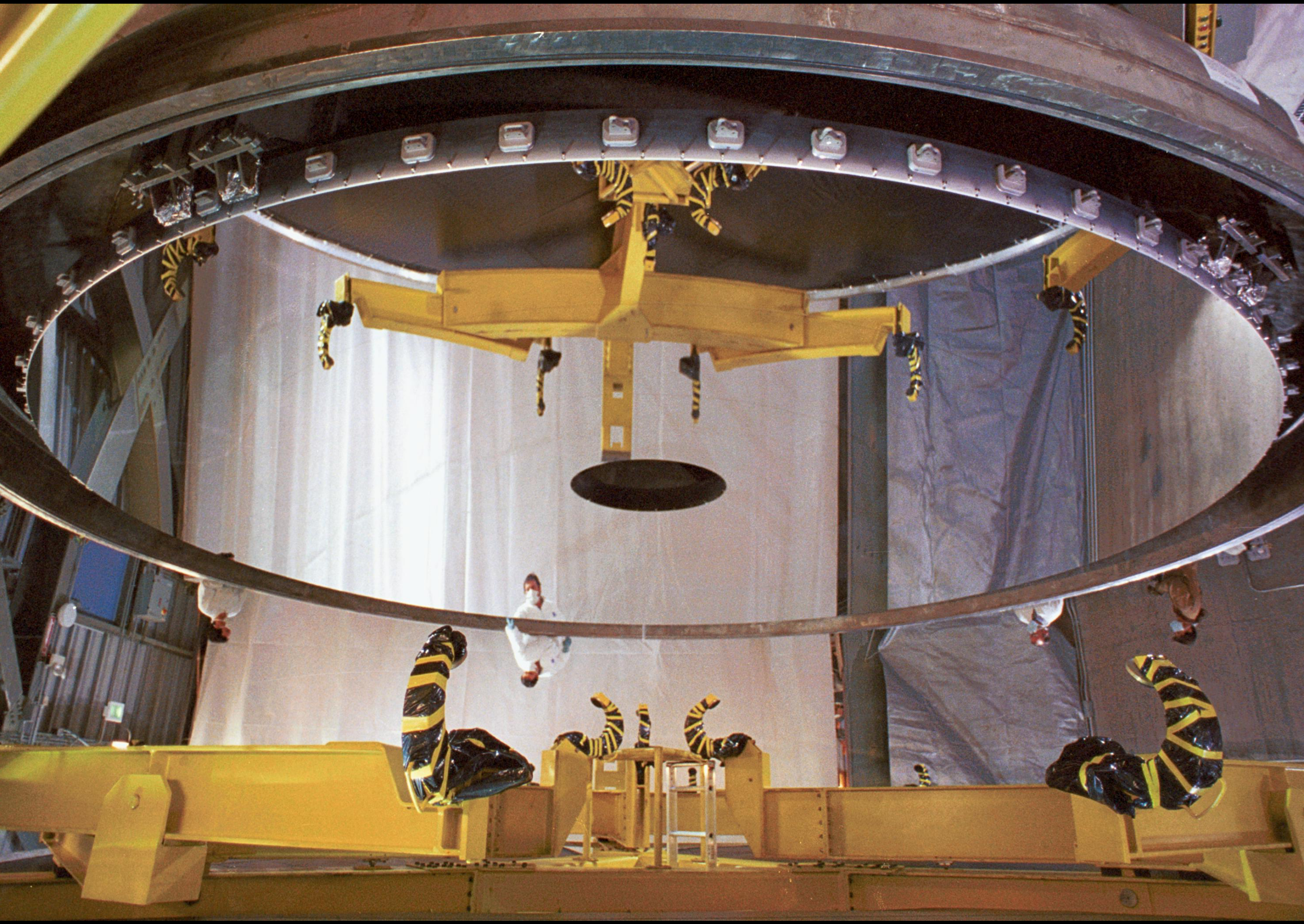
- If sources are far apart, we don’t need to walk very far for the ripples to look different

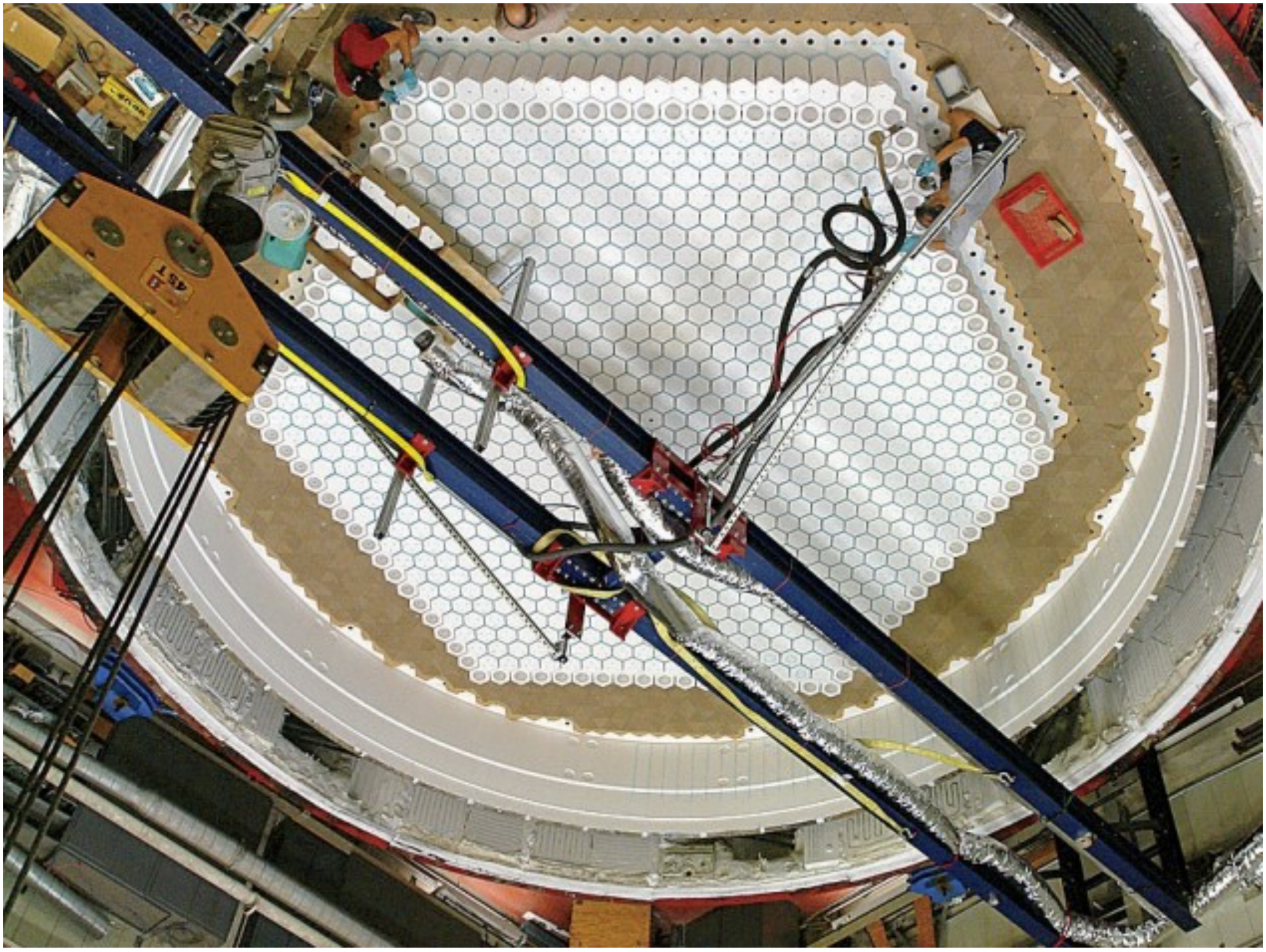


Telescope resolution

- **If waves look different at different edges of the telescope, it can sort the light**
- **Bigger the telescope, the better the resolution (ability to sort)**








ARIZONA
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502
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308


RICHARD F. CARIS
MIRROR LAB
RICHARD F. CARIS
MIRROR LAB
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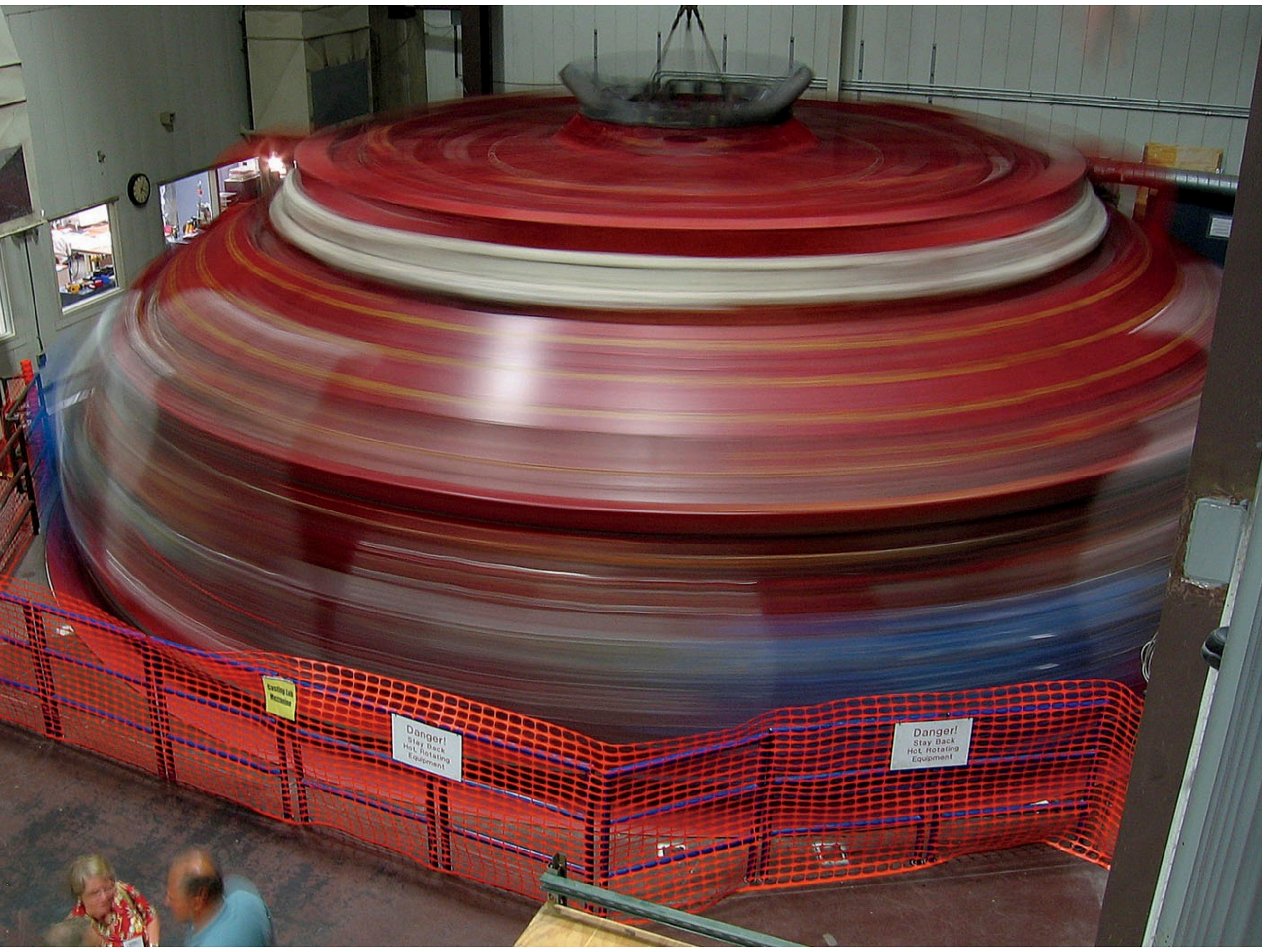
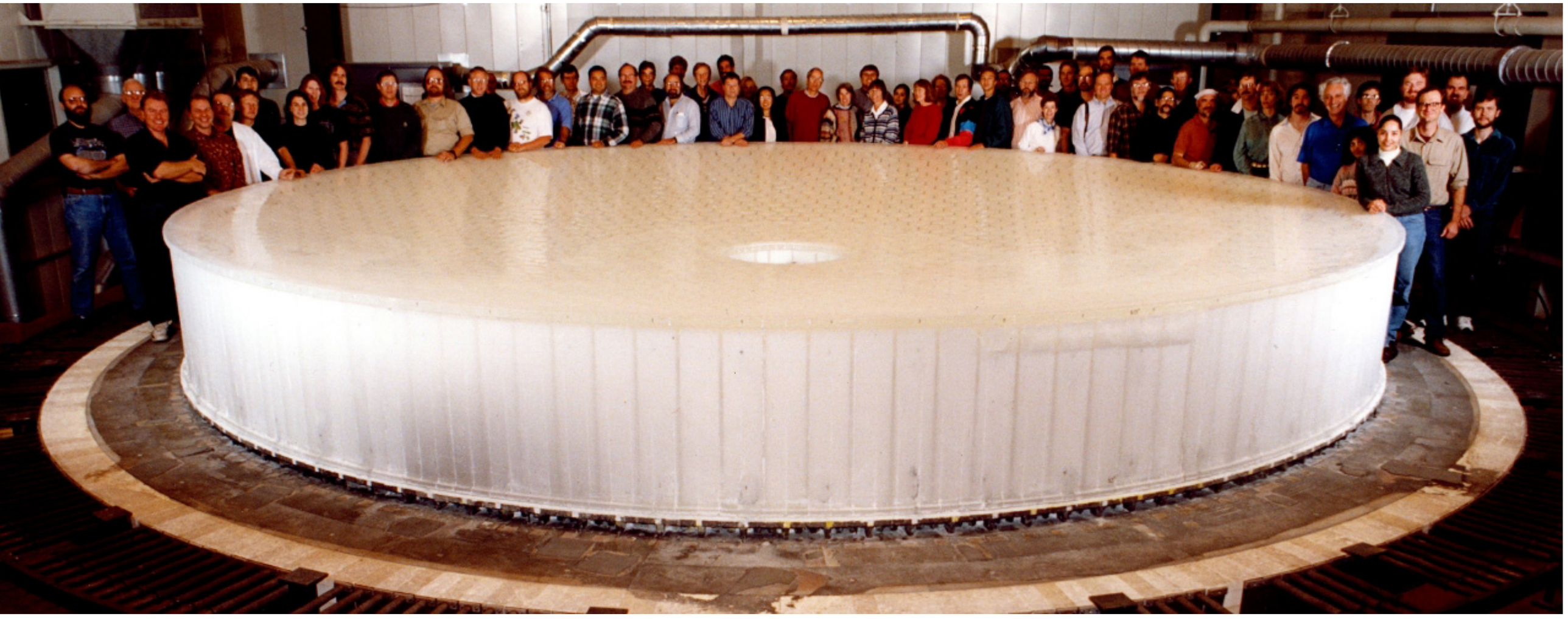
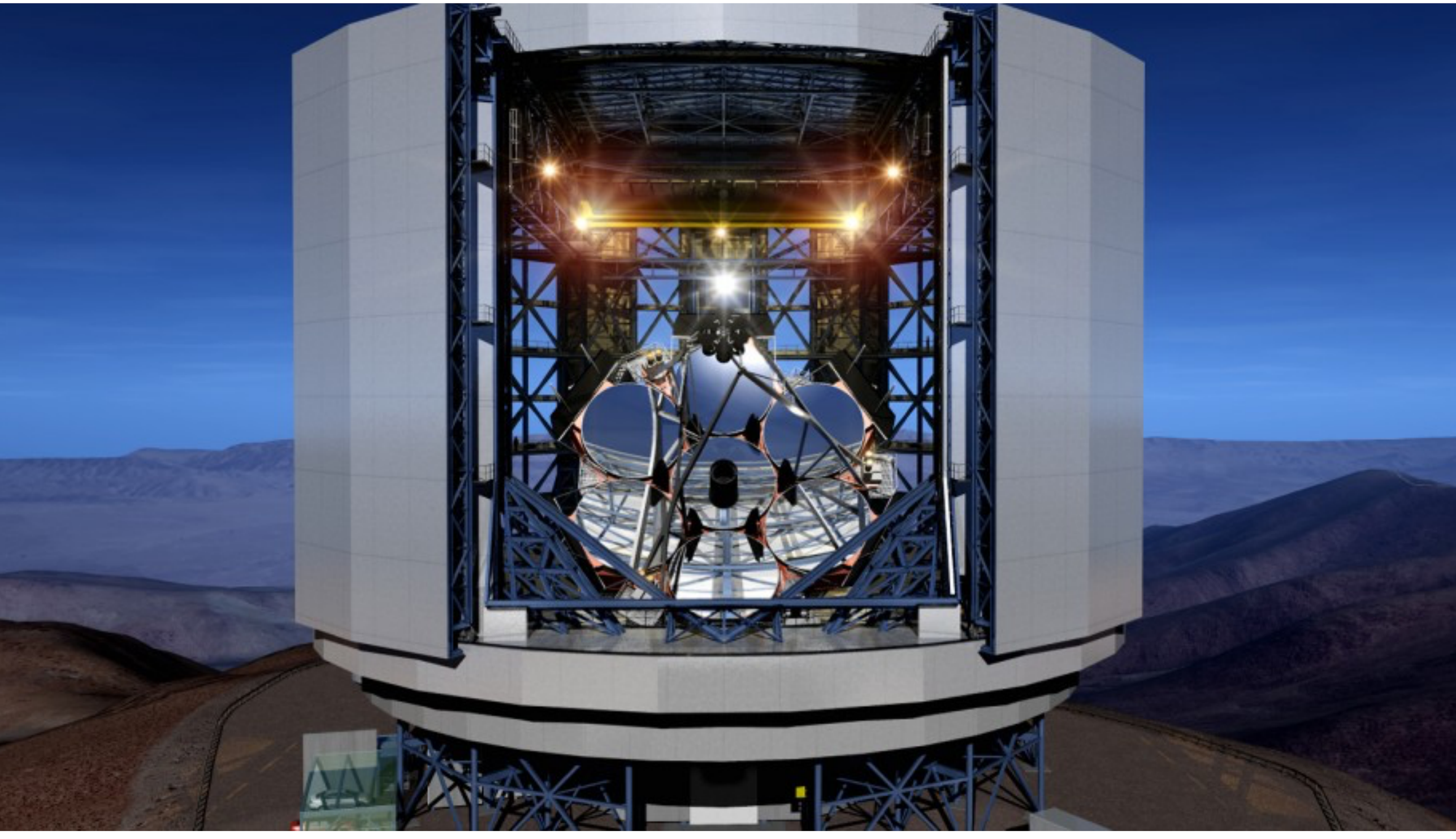

Danger!
Stay Back
Hot Rotating
Equipment
Danger!
Stay Back
Hot Rotating
Equipment

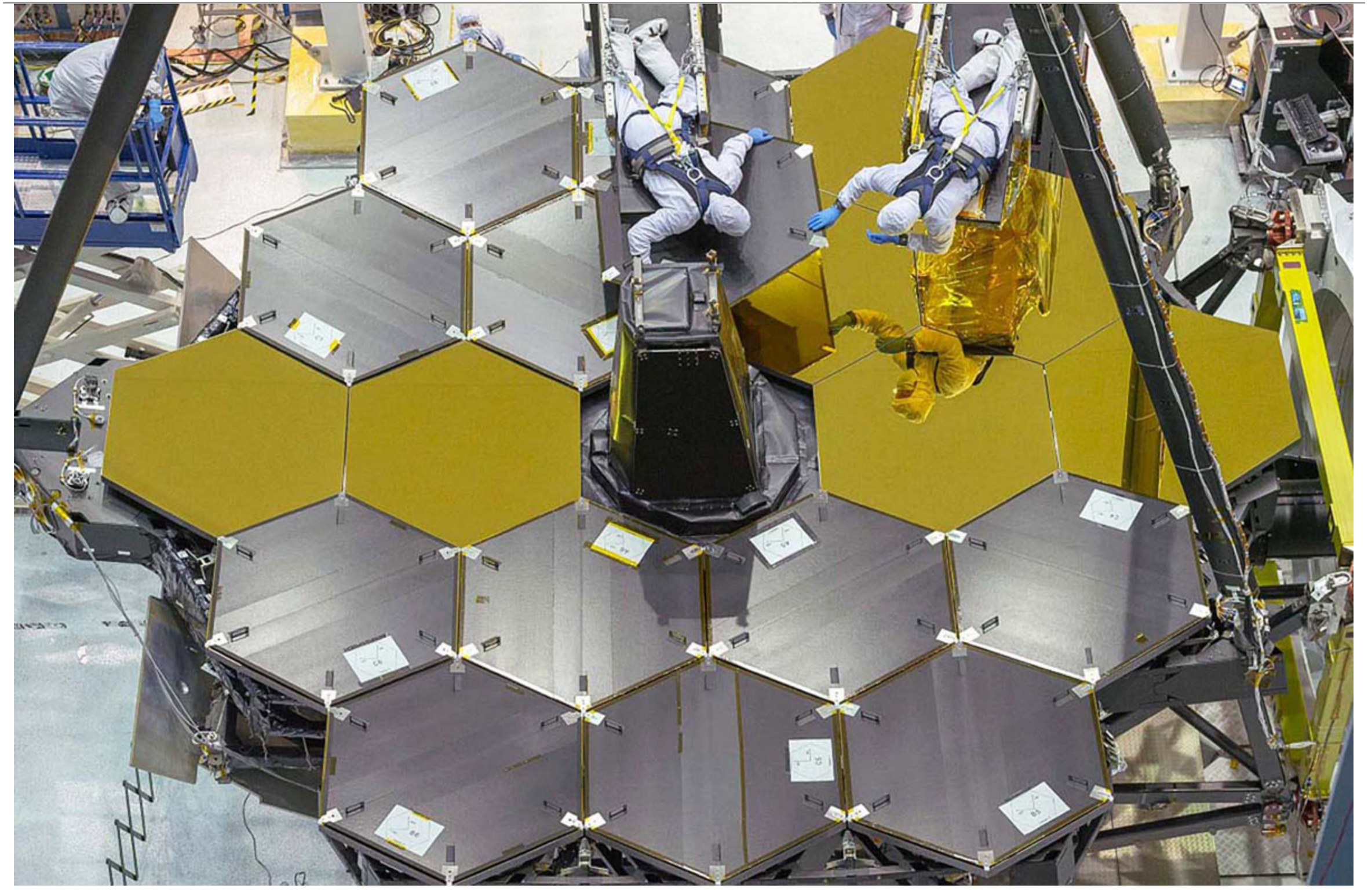


Keck telescope

Giant Magellan Telescope

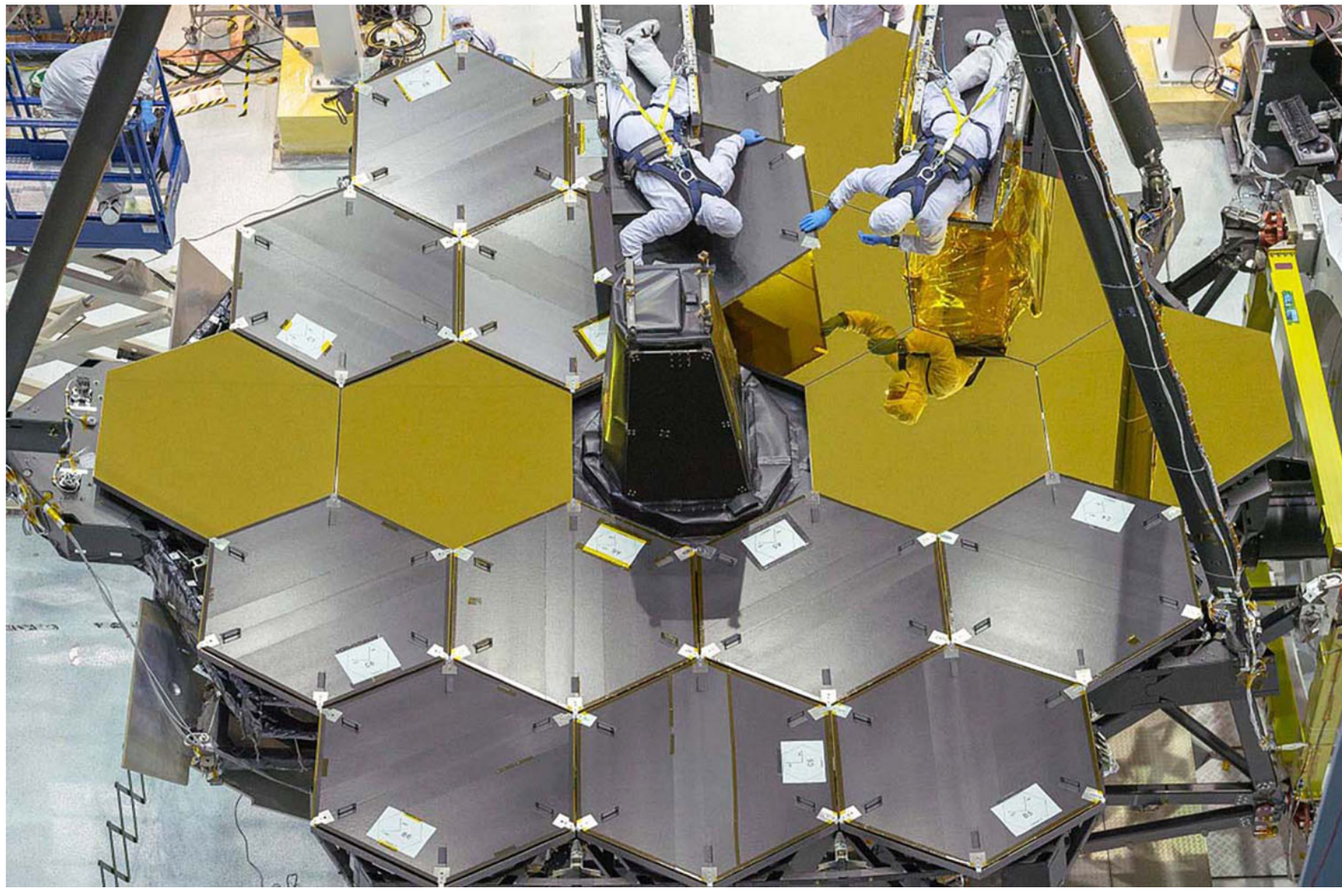


James Web Space Telescope



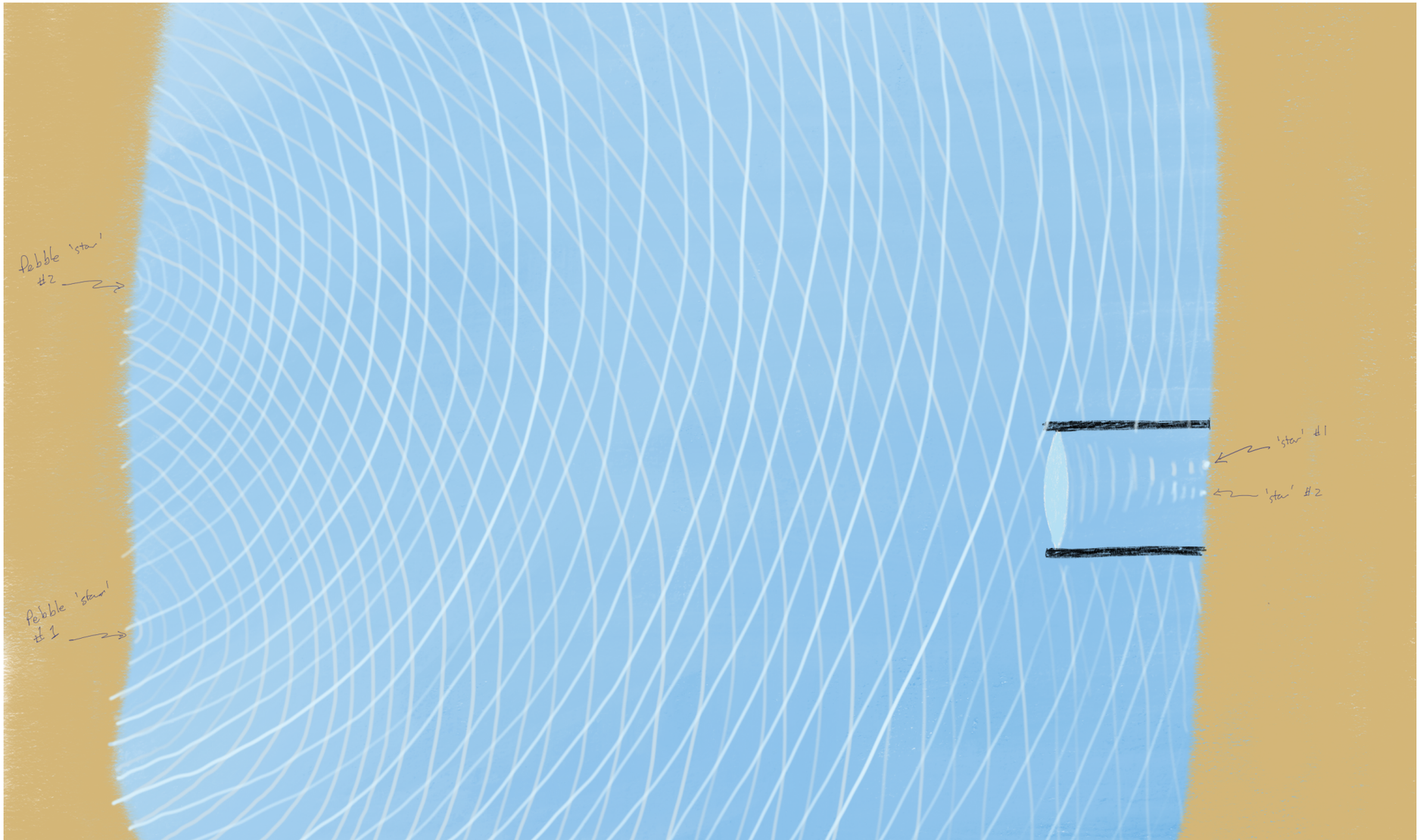
How to think of an interferometer

- Break a great big mirror into pieces
- Reassemble the pieces
- What happens if you don’t put them all back together?

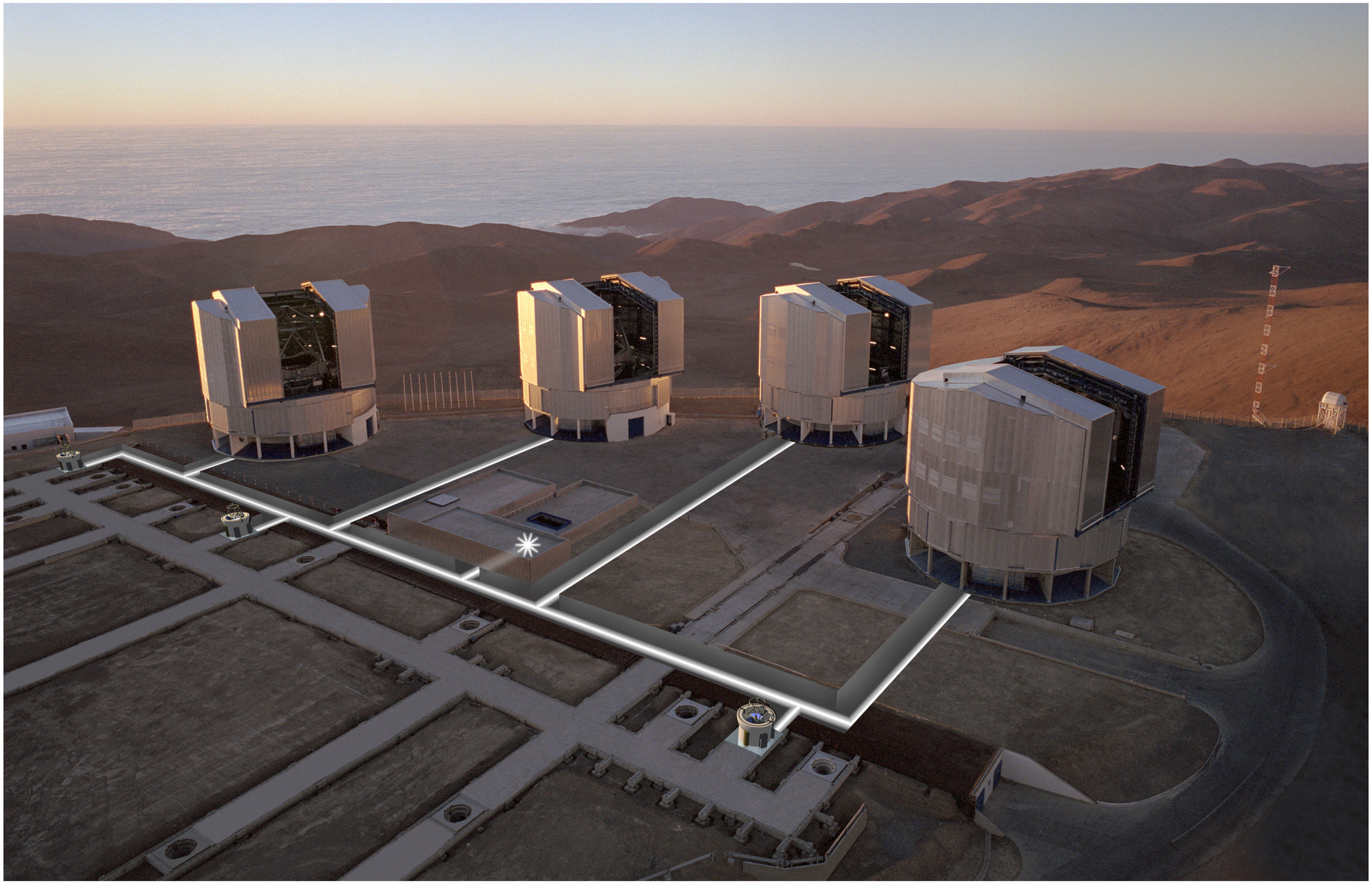


Interferometer resolution

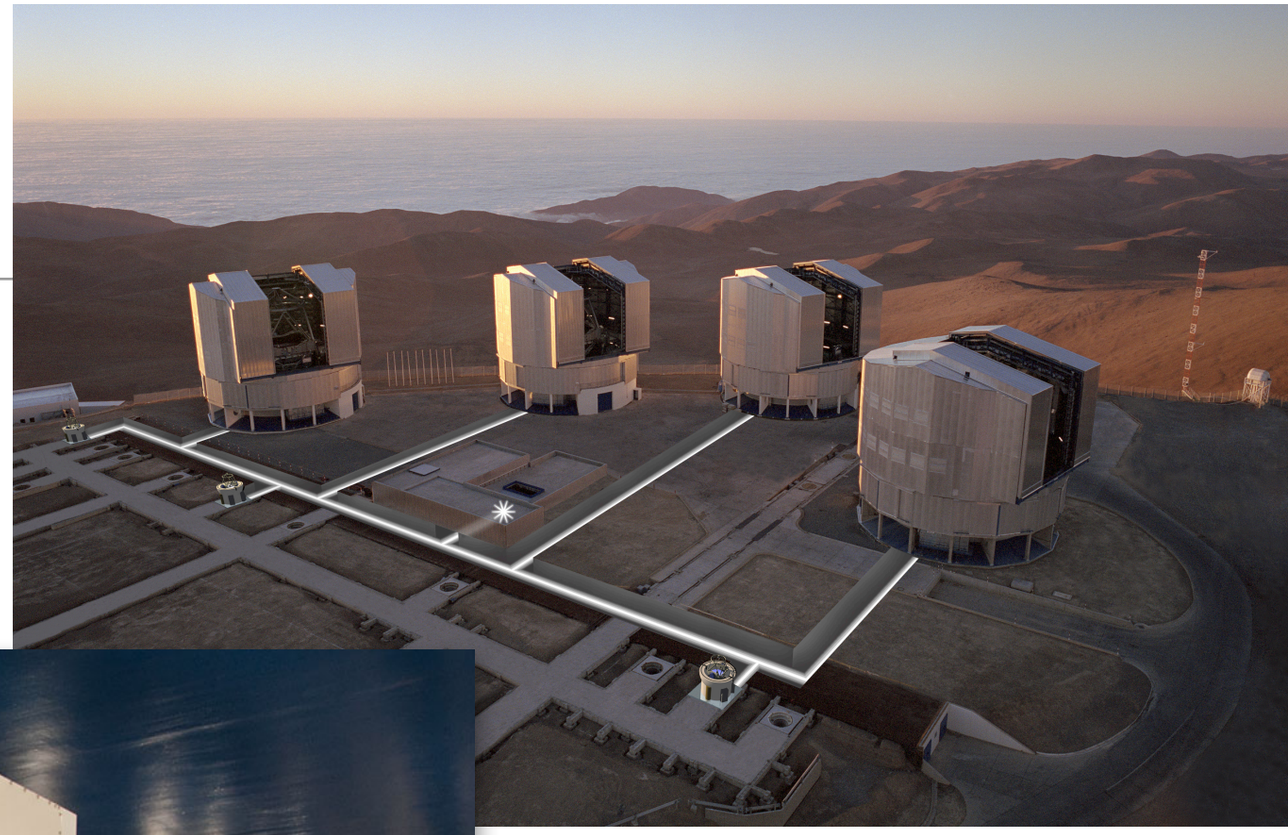
- **Great resolution (very large section of beach)**
- **Not as much light as full mirror of same size**

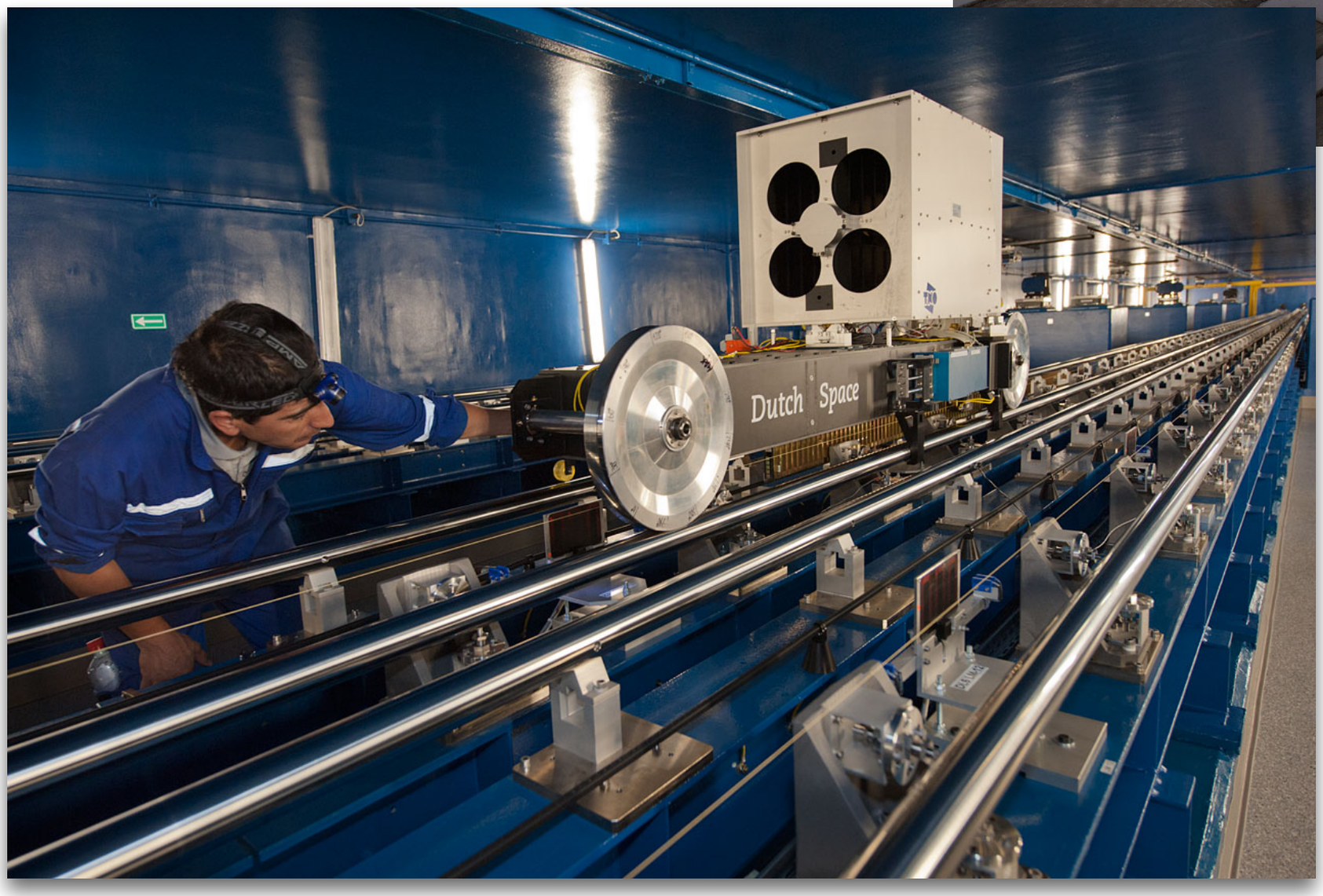


VLT optical interferometer



Aligning an interferometer





Must be kept in alignment to less than a micron

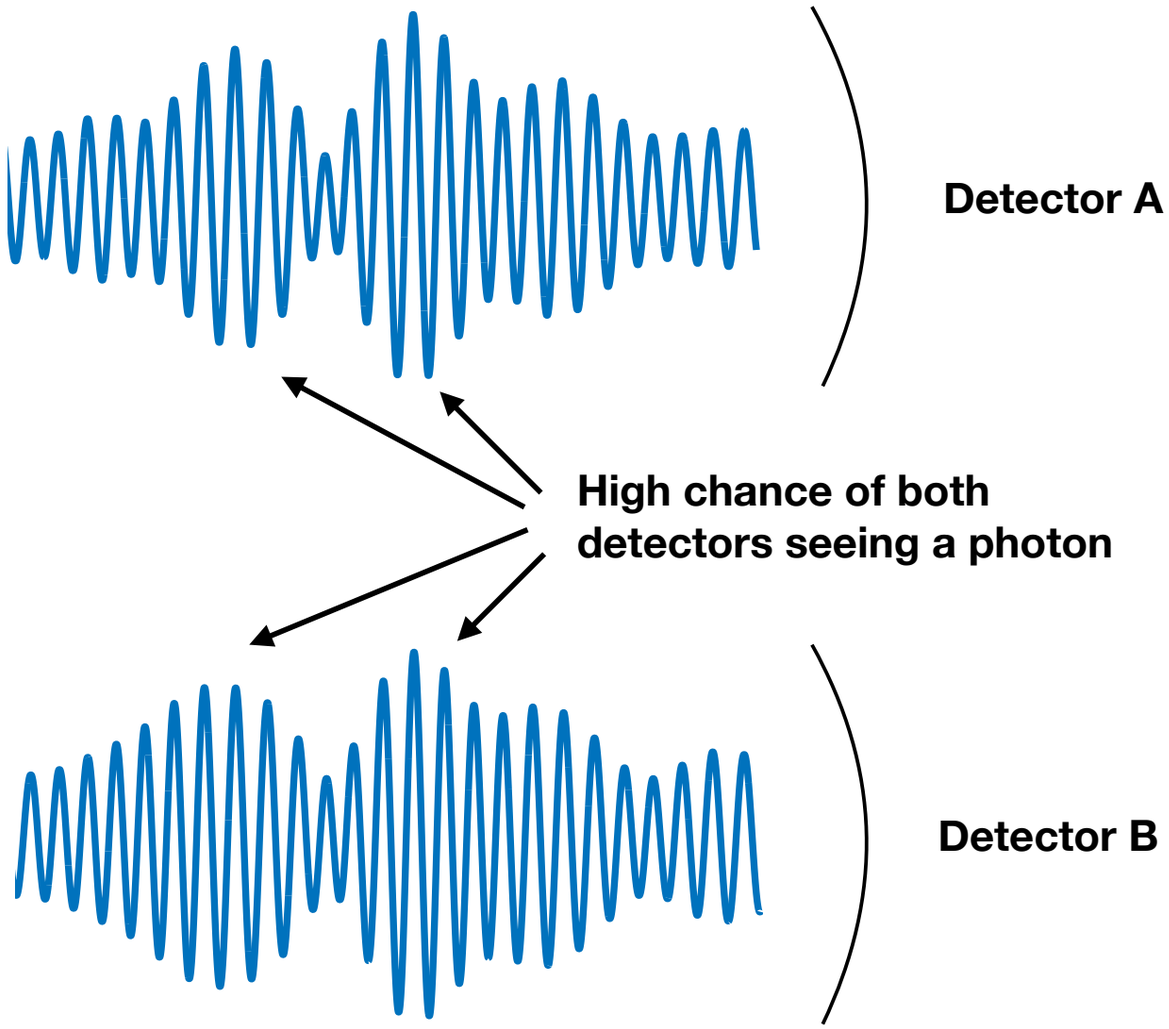
Australia Compact Array

Hanbury Brown & Twiss

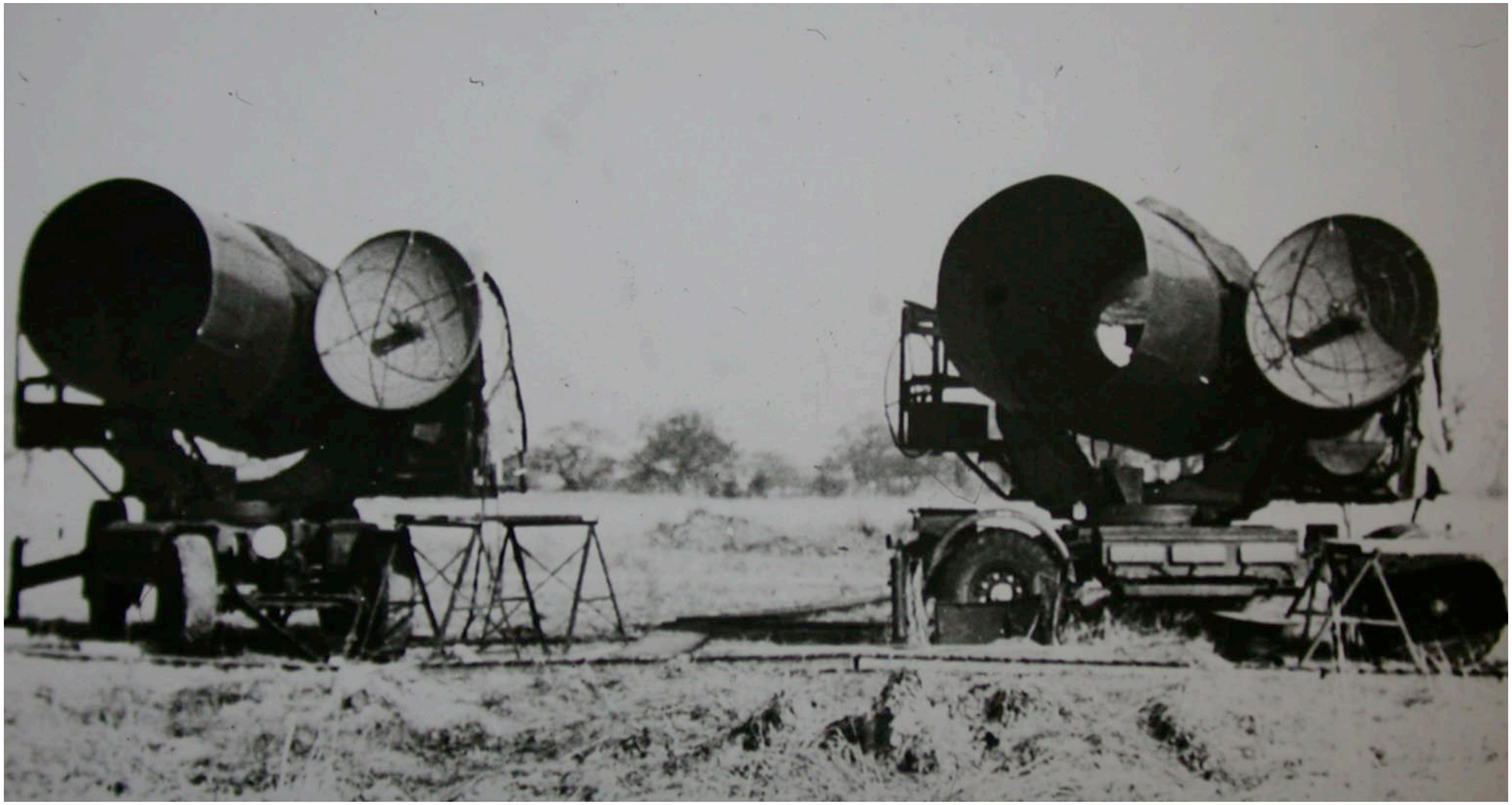
What if you can’t build an interferometer?

- Either can’t get alignment good enough
- Or can’t build mirrors and lenses

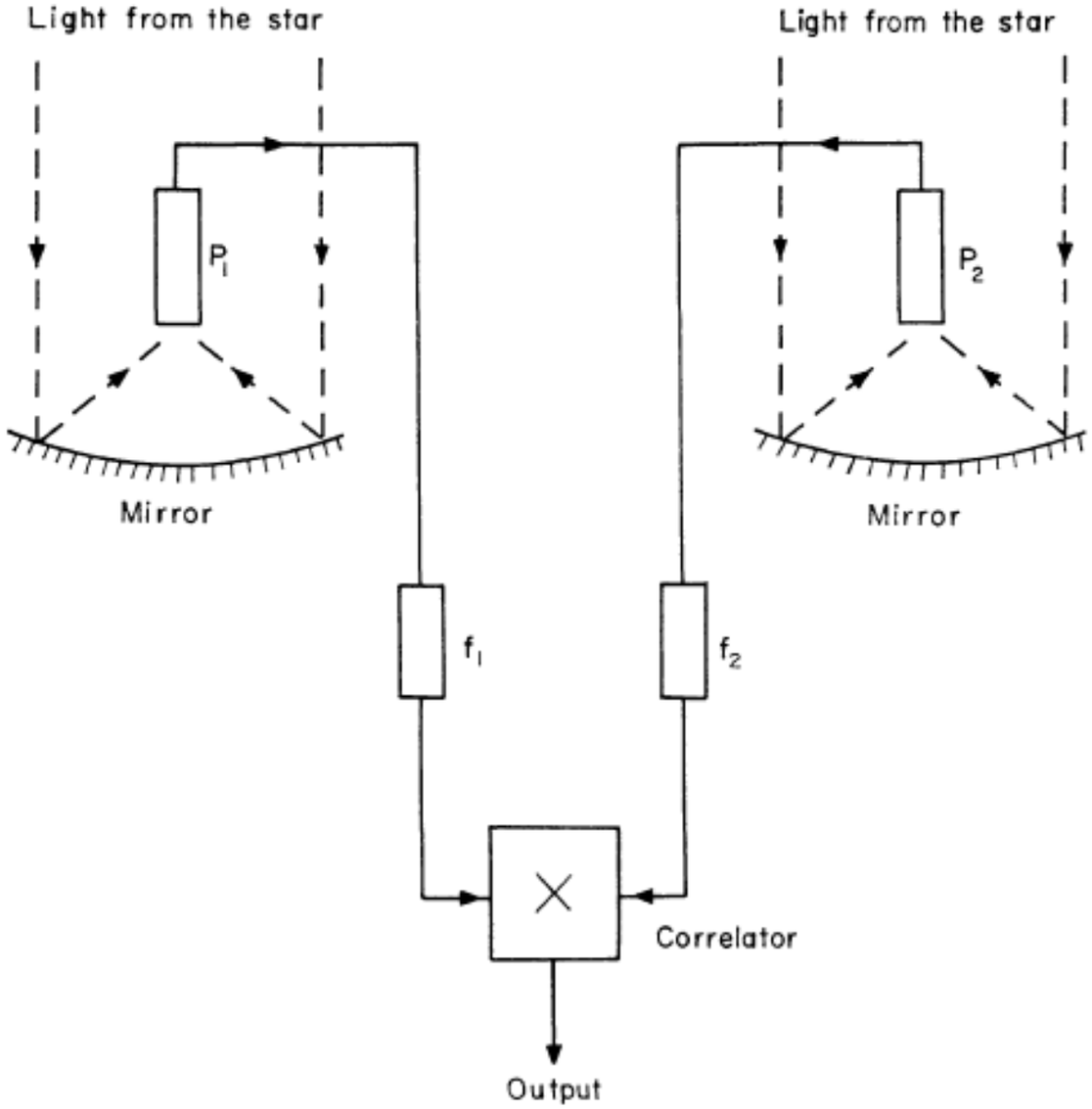
Correlated photon arrival in two telescopes

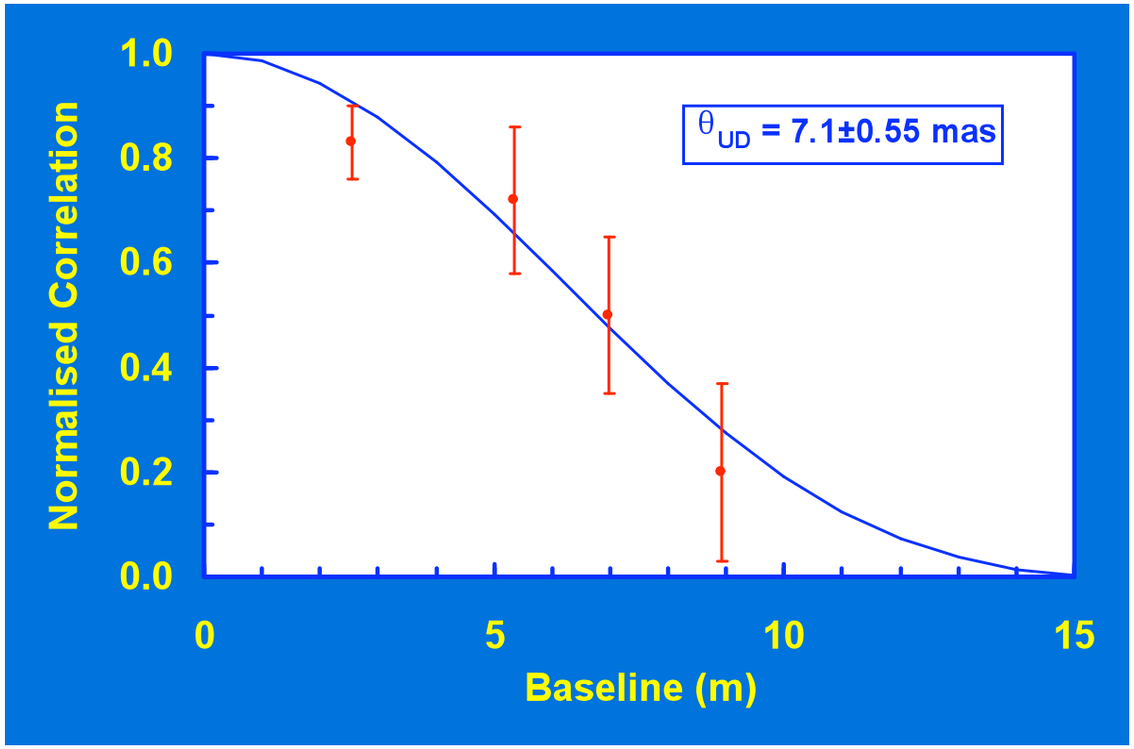


Original instrument with searchlights



Size of the star Sirius

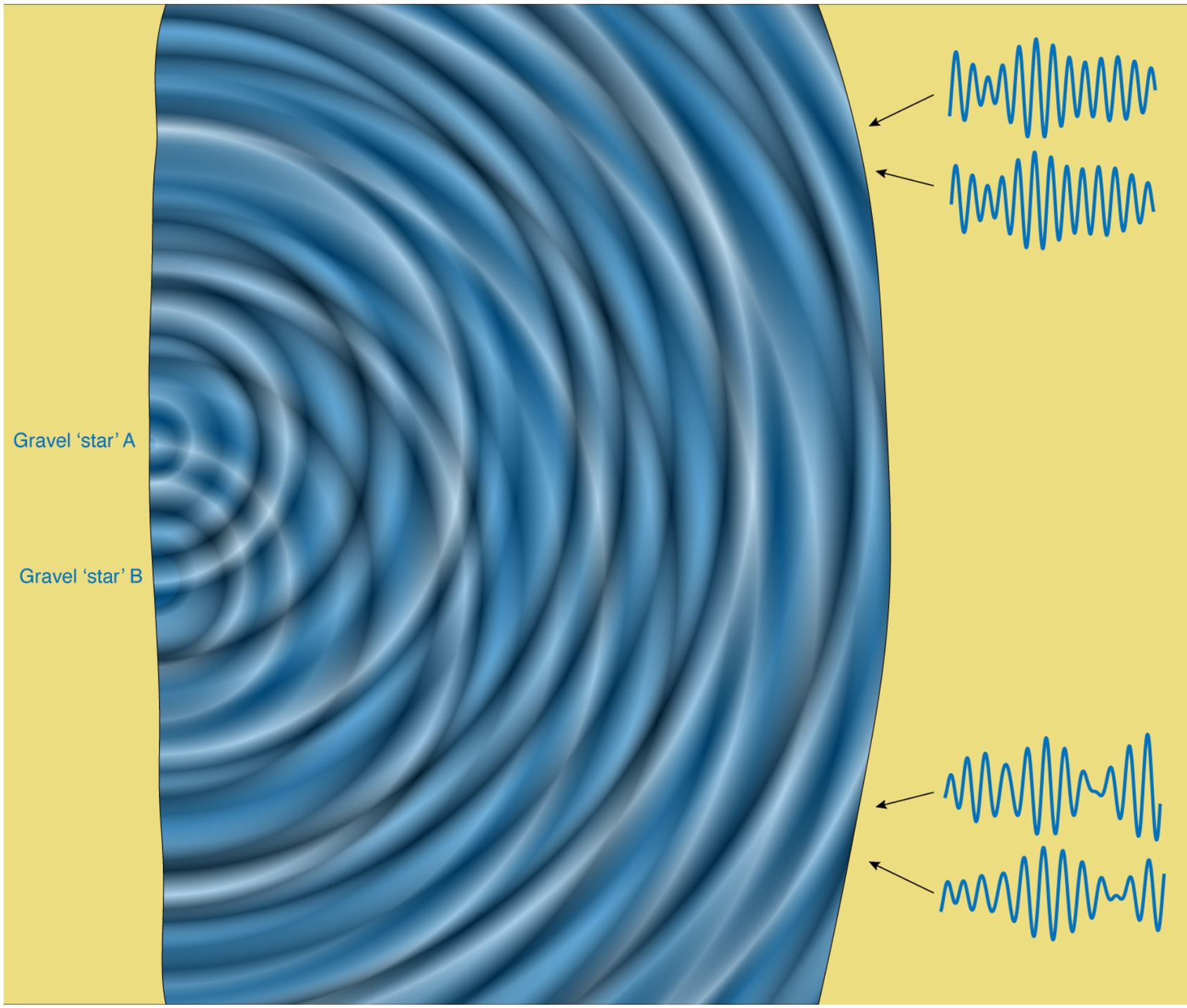




Baseline = distance between telescopes

Combined ripple

- Any two places near on the beach see very similar wave train
- Any two places far apart see very different wave train



Huge controversy at the time

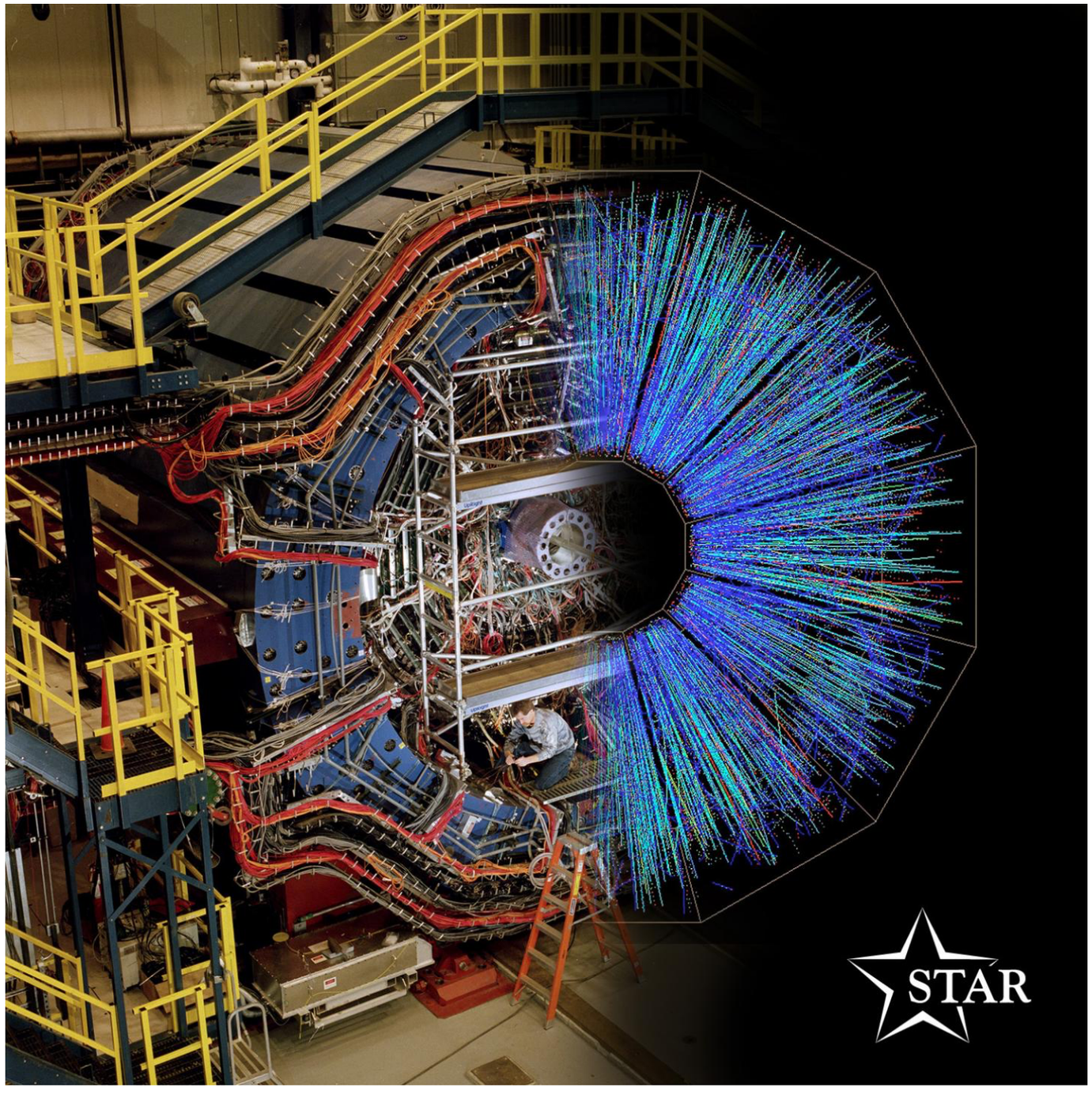
- Birth of quantum optics
- Spatial version of temporal bunching we saw last week

Narrabri Stellar Intensity Interferometer

“Building a steam roller to crack a nut” — HB

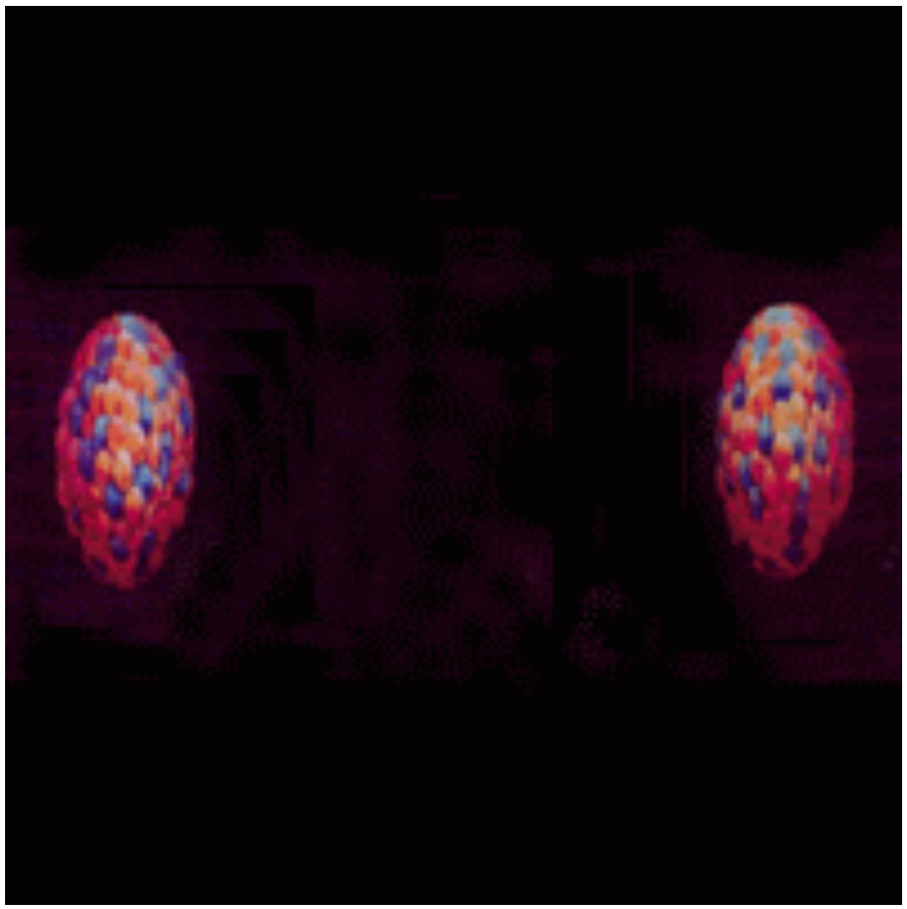
With light arrival correlation is no longer used, interferometers (pieces of a large mirror) are much more sensitive and we can do the alignment.

RHIC



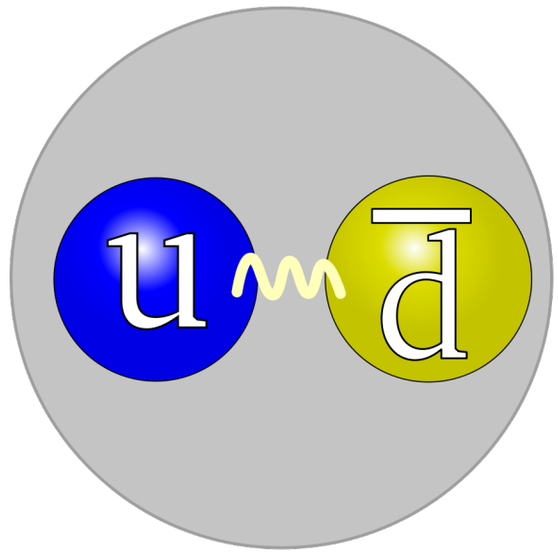
Collide two gold nuclei at nearly the speed of light

- Melt into a quark-gluon plasma
- Mimics conditions of very early universe, before protons and neutrons could form
- Radiates huge numbers of ***pions***

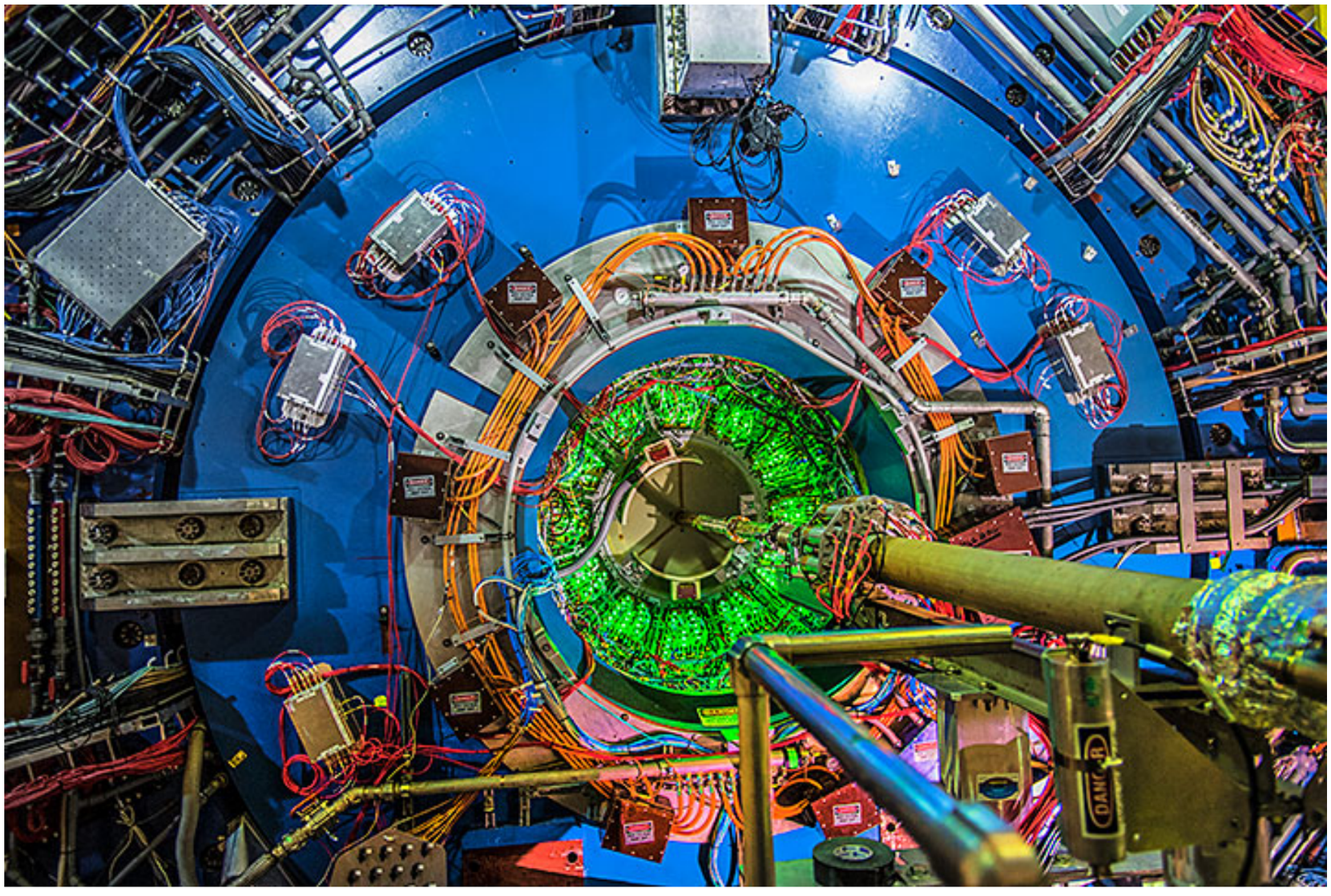


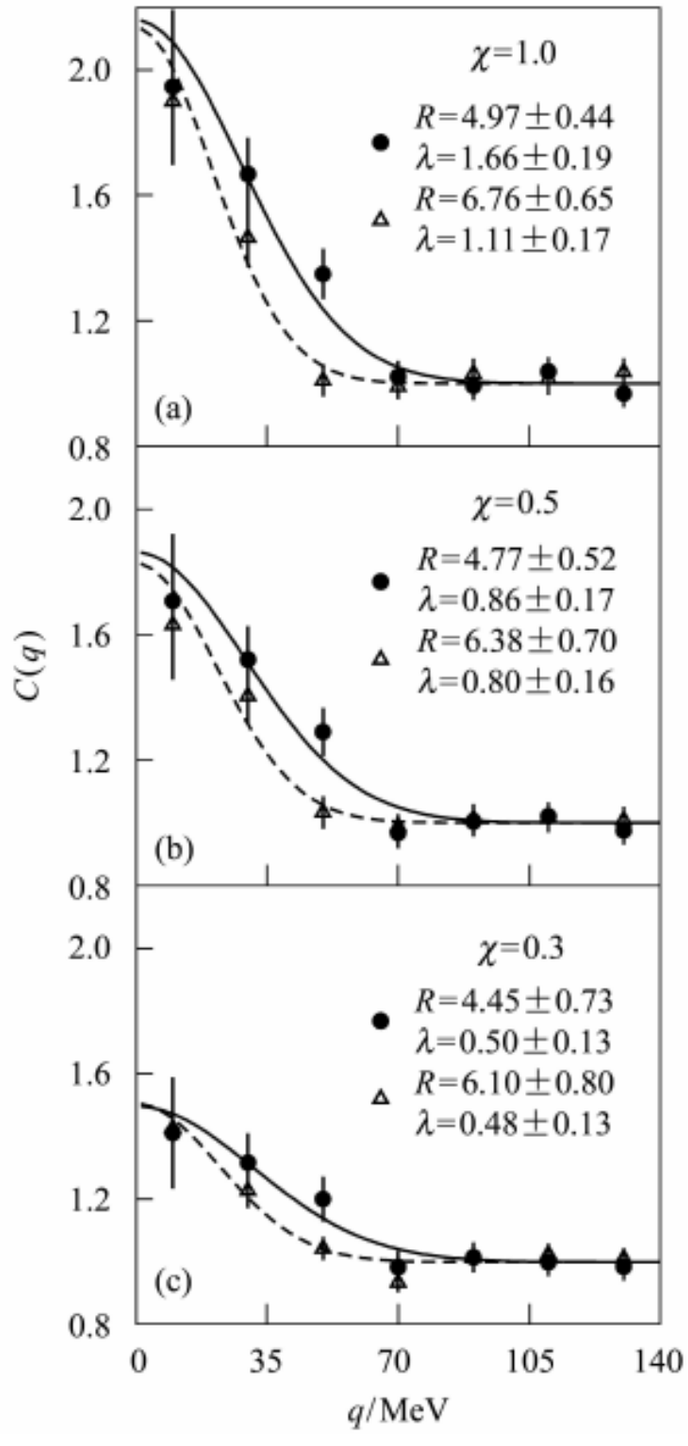
Pions

- Made up of two quarks
- Common but short lived
- Act like bosons (extroverts)



Surround with detectors, look for correlation in arrival





Using quantum bunching to study the earliest moments of the universe