Observing the wonders of Nature: From the camera obscura … to the 4-m International Liquid Mirror Telescope and Large Interferometers

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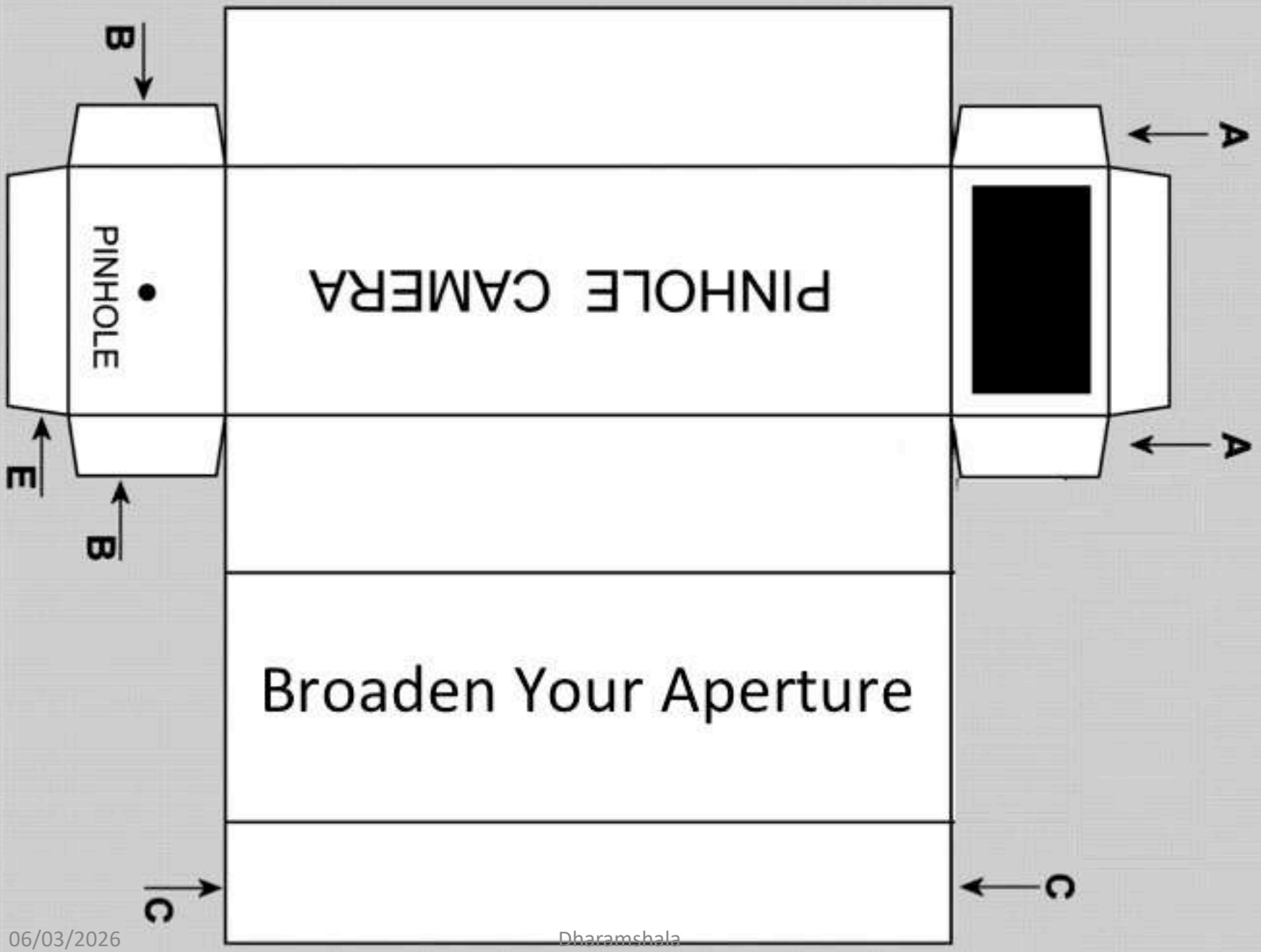
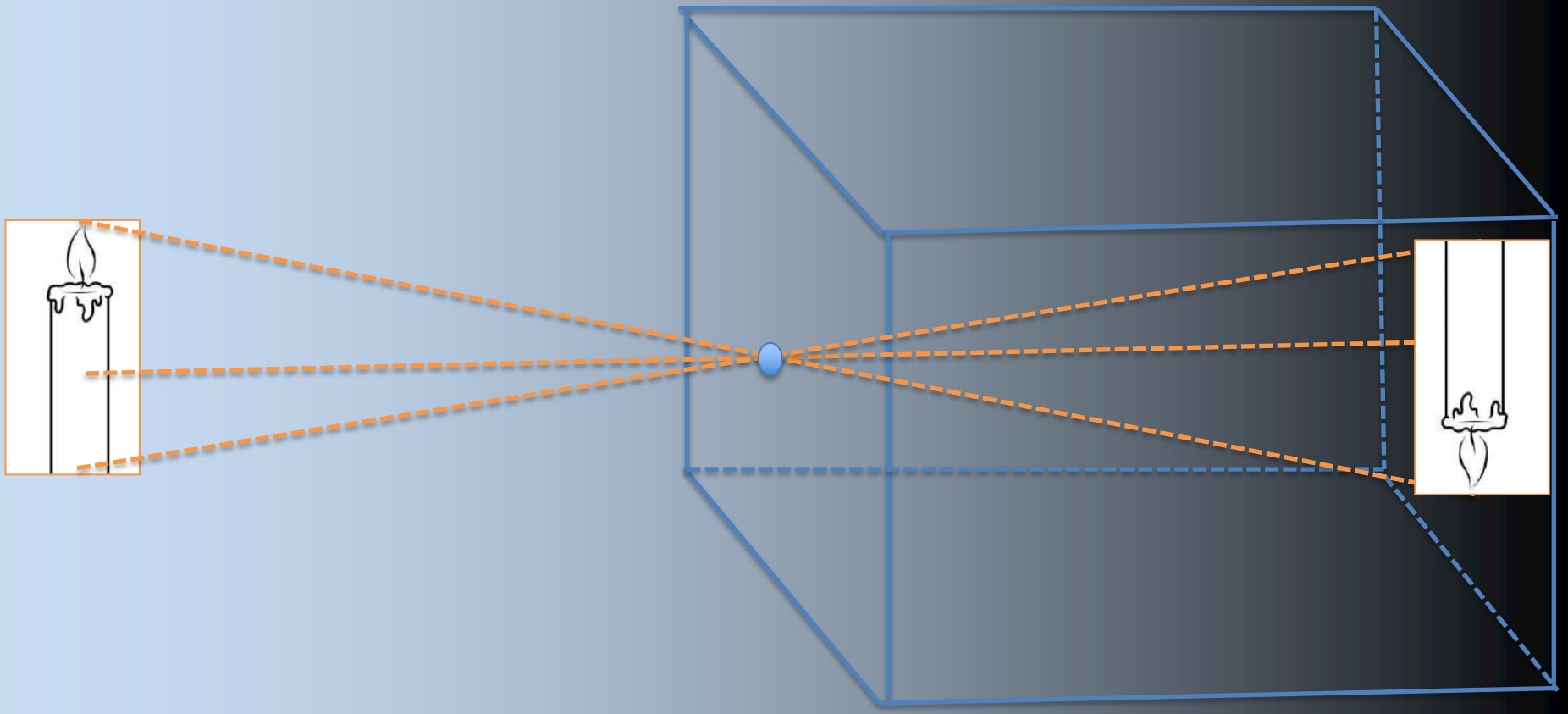
Camera obscura (pinhole camera)

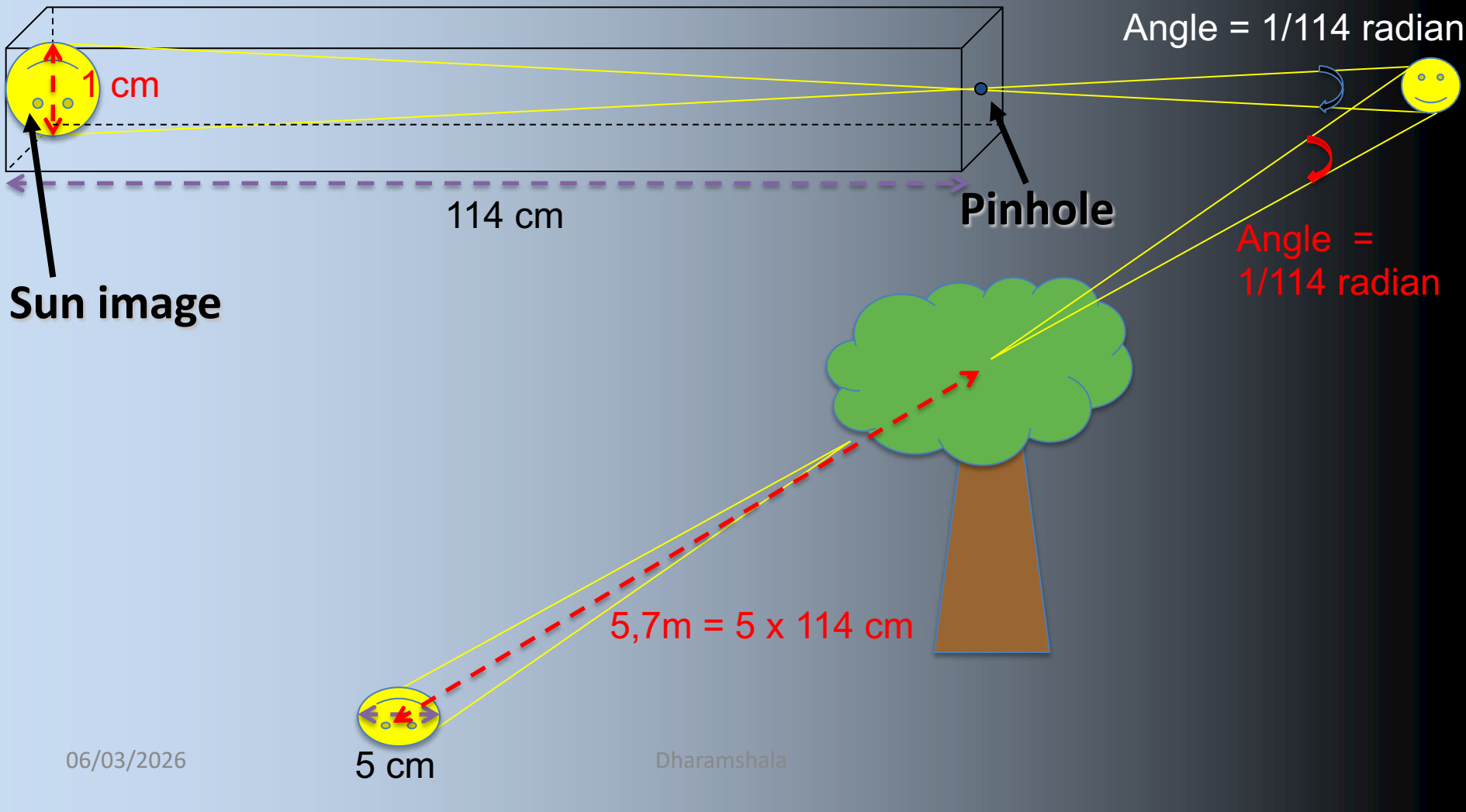

B
A
PINHOLE
PINHOLE CAMERA
E
A
B
Broaden Your Aperture
C
C

Camera obscura



Pinhole camera

Camera obscura



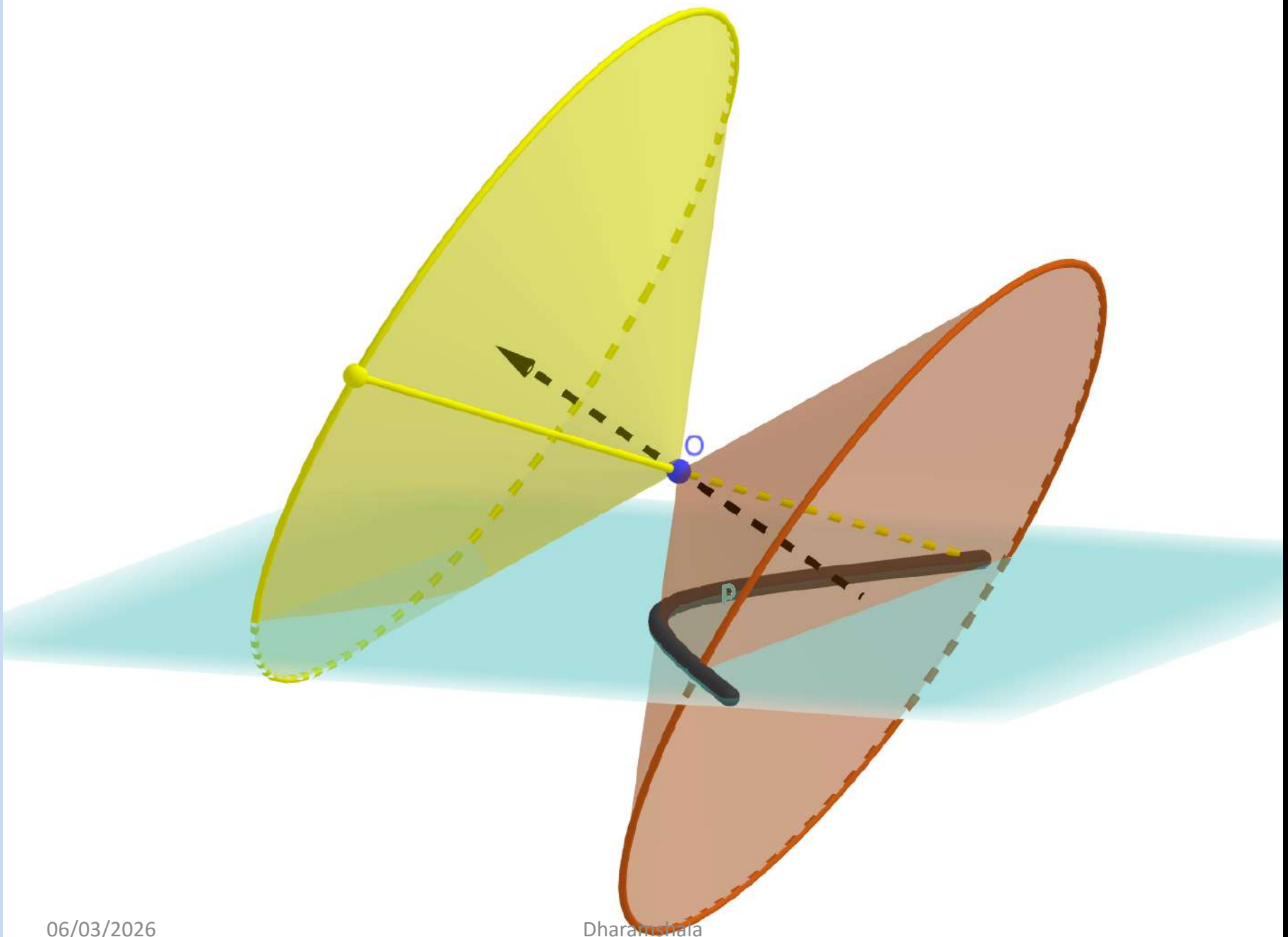
Formation of solar disks (convolution)

Earth rotation … Sun and star rotation

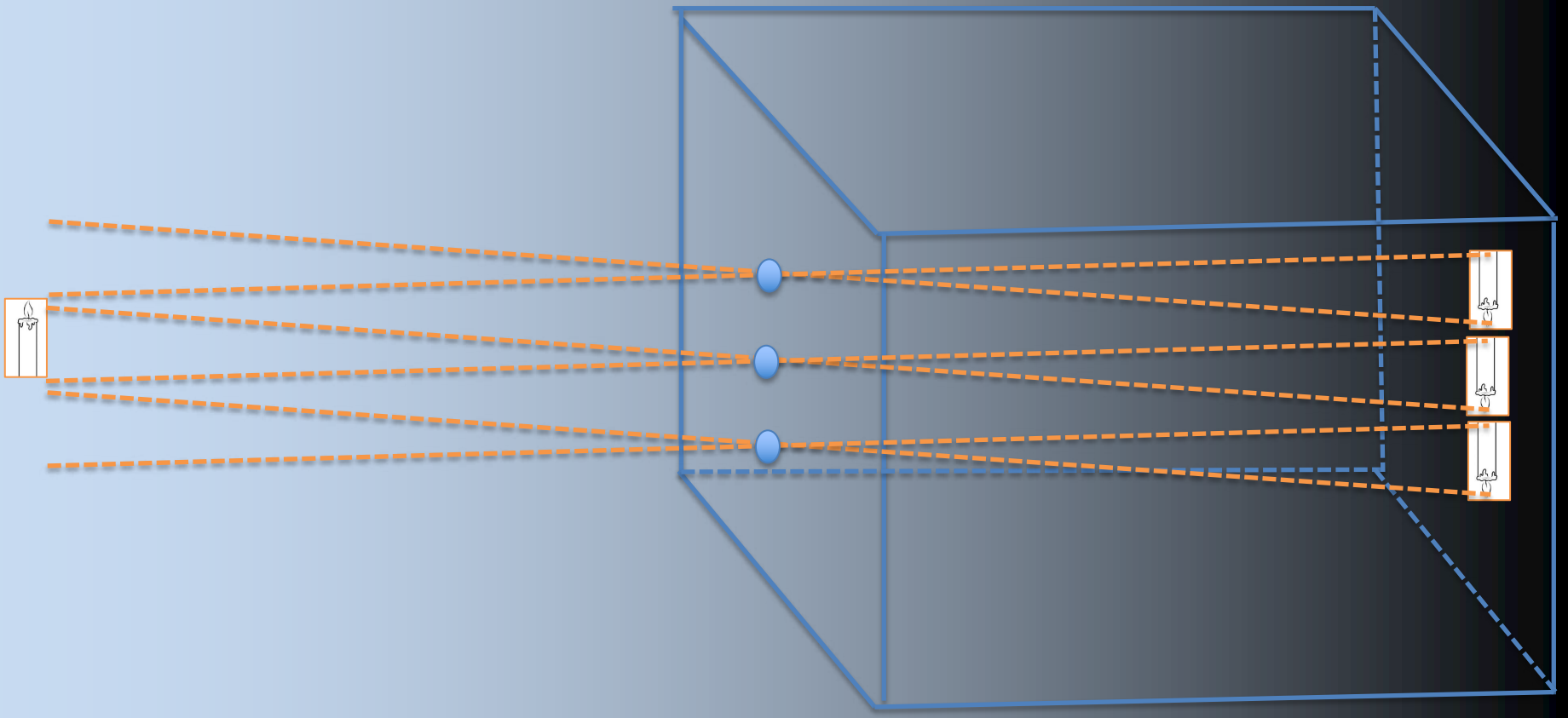
Dharamshala


Quiz?

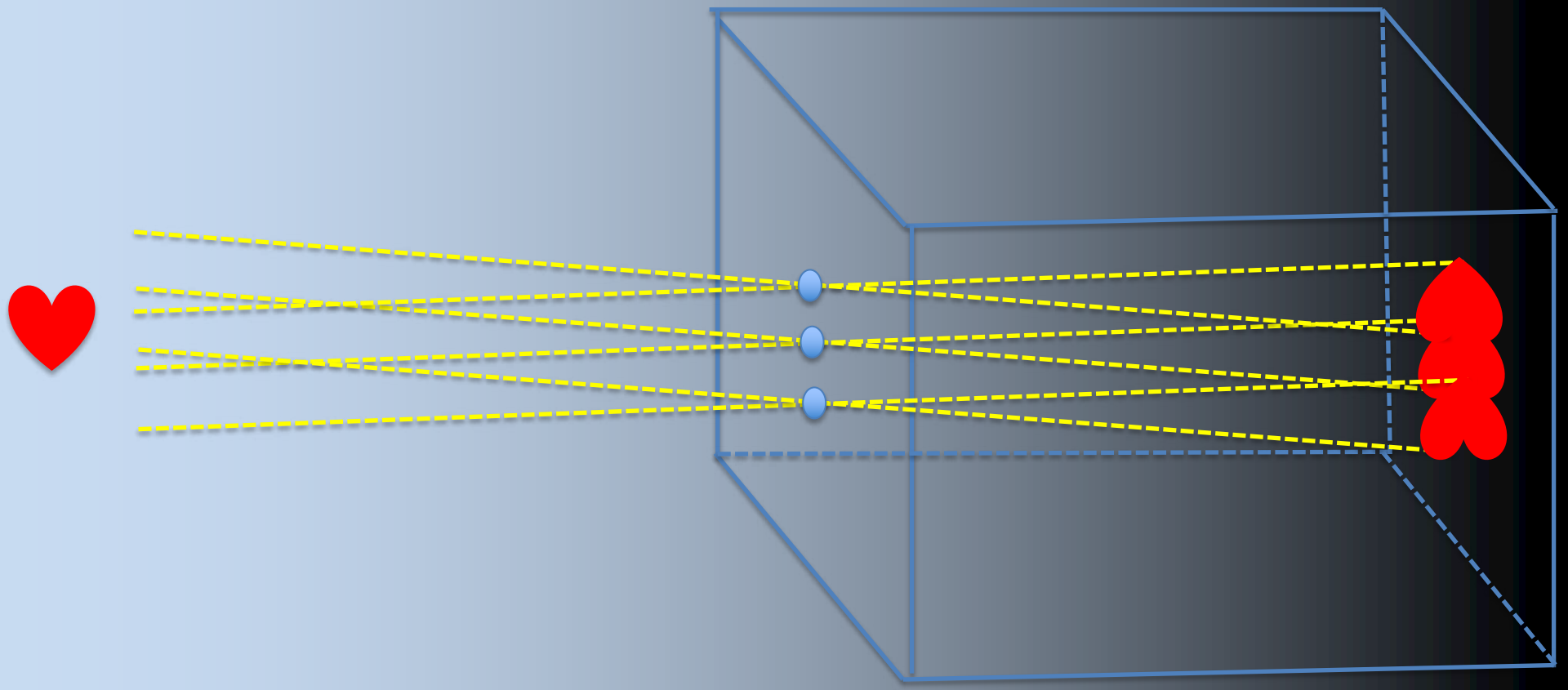
Quiz for You!


O
P

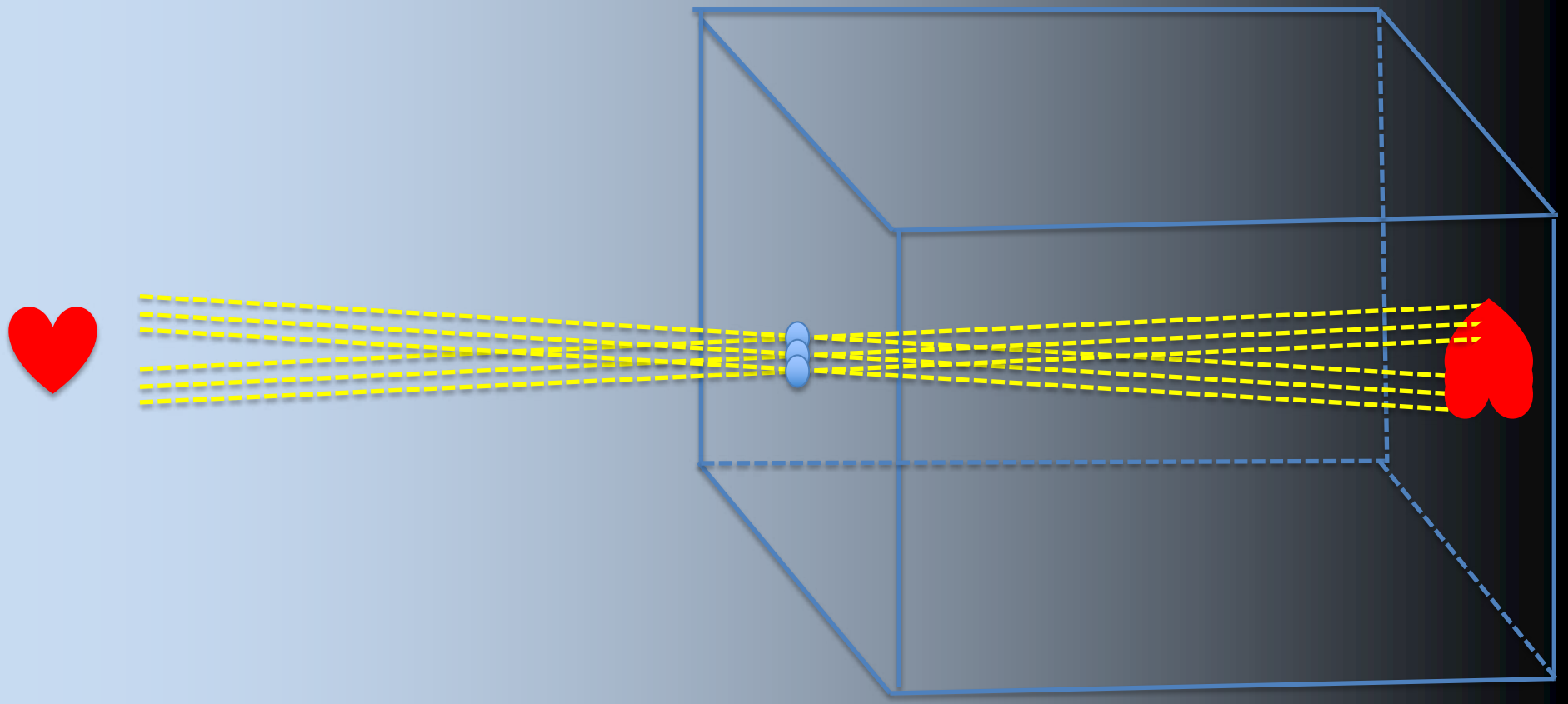
Camera obscura

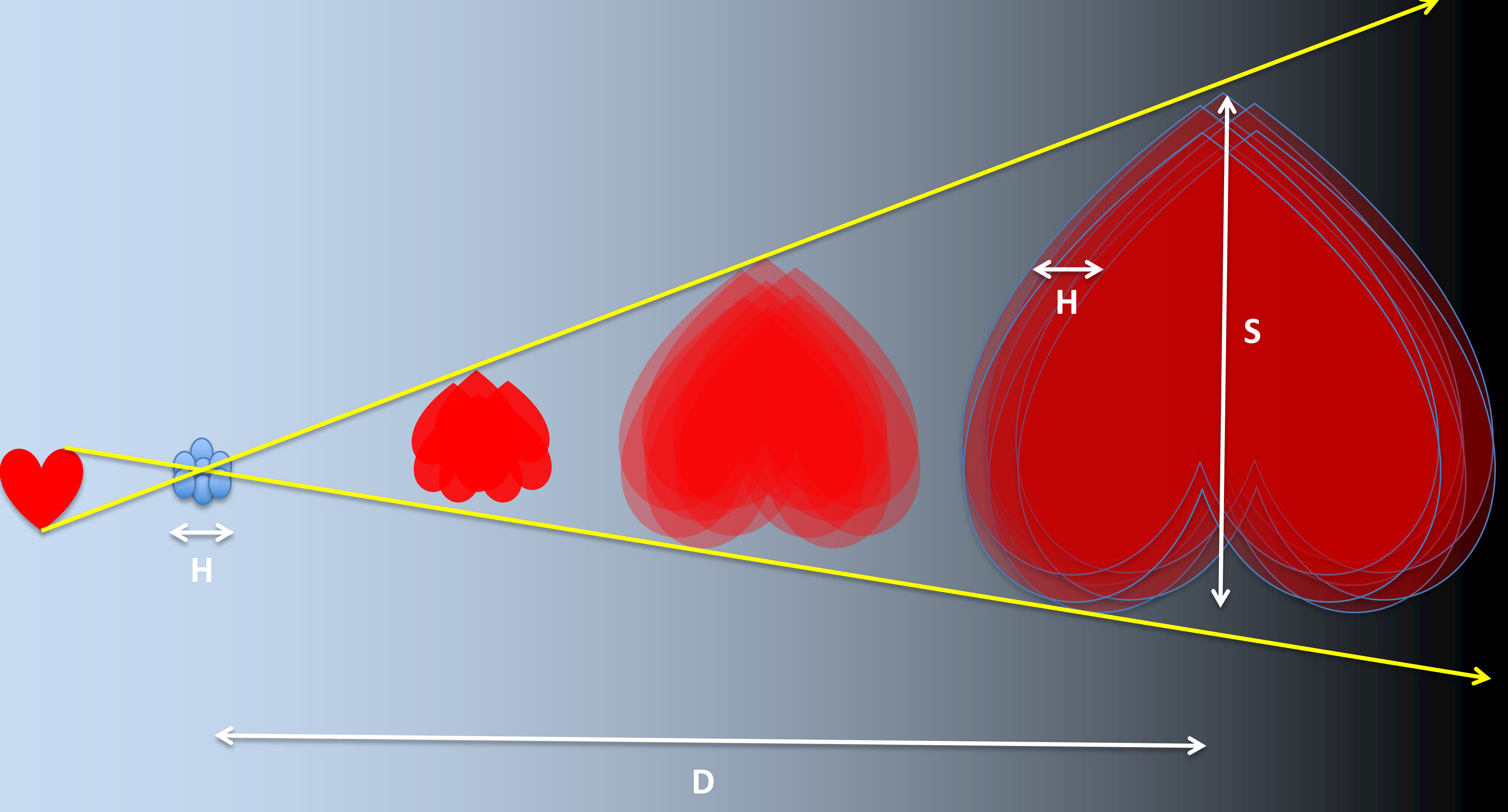


Camera obscura



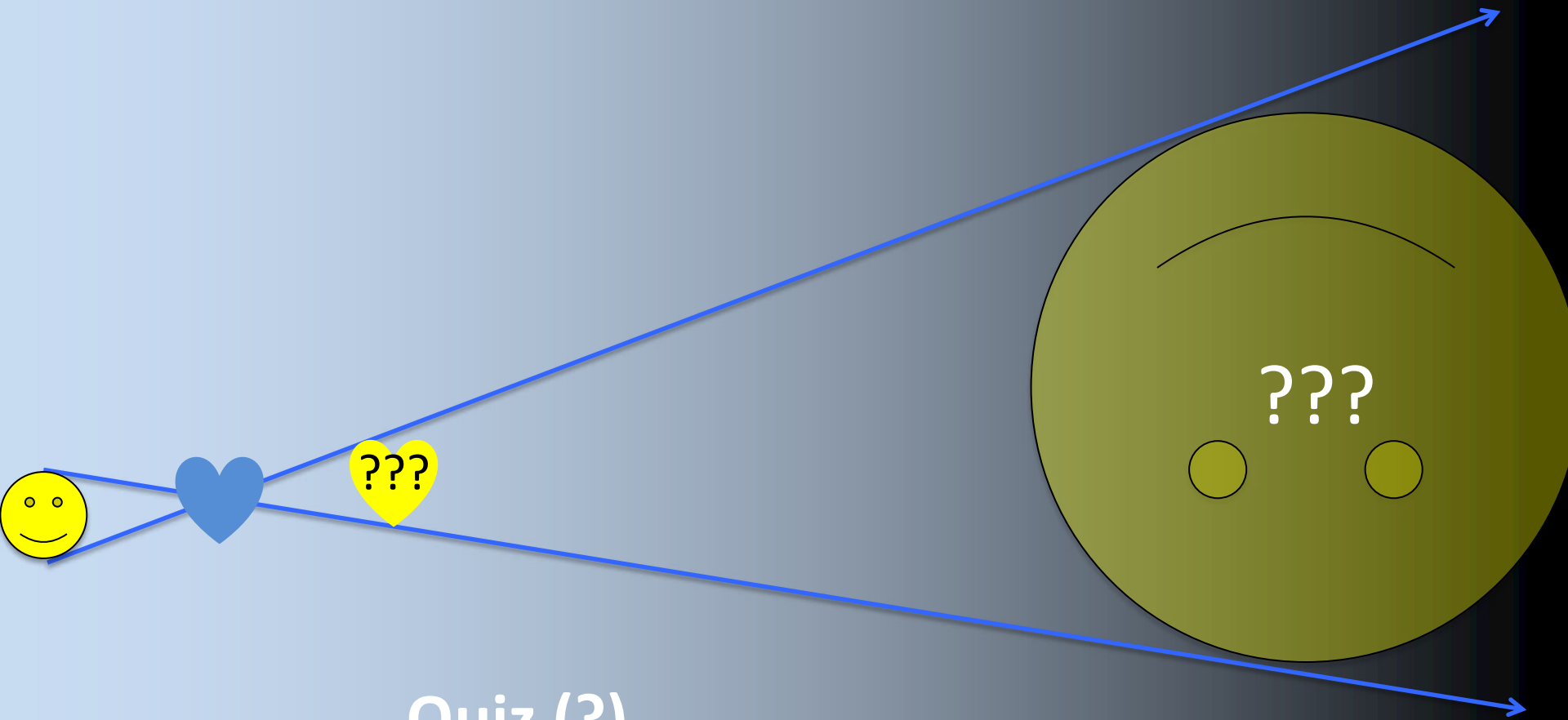
Camera obscura





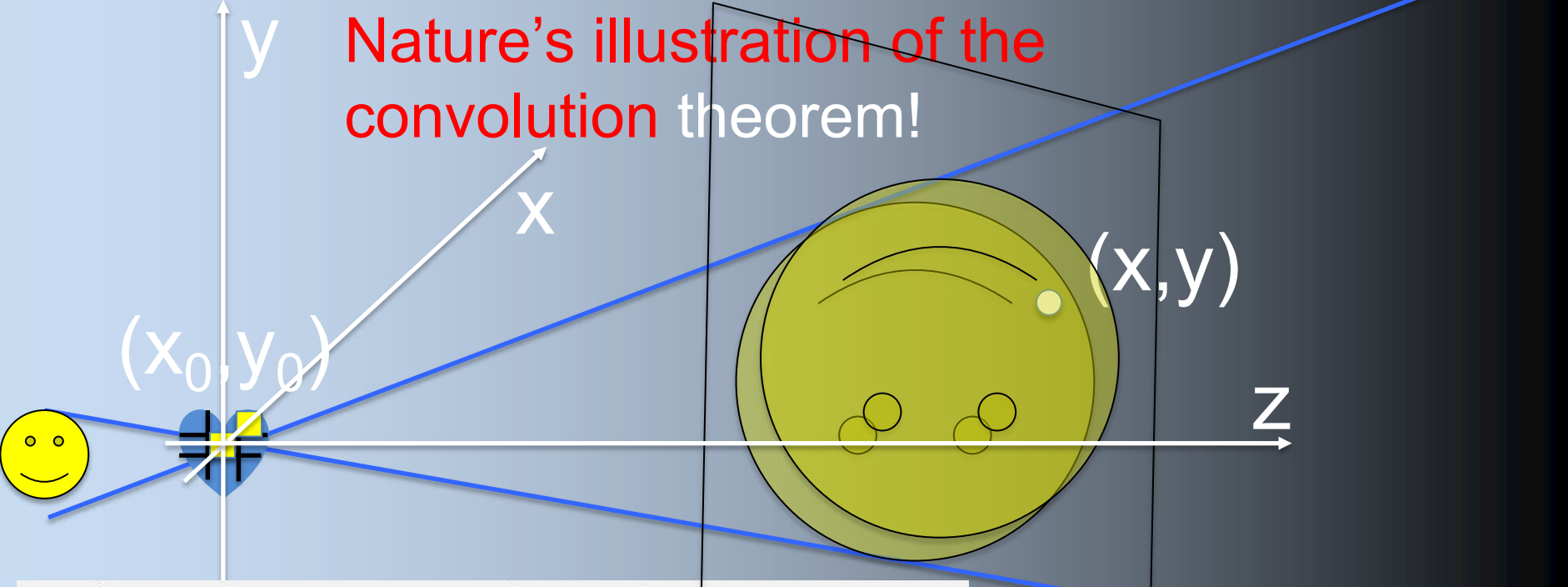
The blur B of the hearts is proportional to H^2, and inversely proportional to S^2, which is itself proportional to D^2 ➔ $B \div (H / D)^2$

The surface brightness SB of the hearts is proportional to H^2, and inversely proportional to S^2, and thus to D^2 ➔ $SB \div (H / D)^2$



Quiz (?)

Nature's illustration of the convolution theorem!

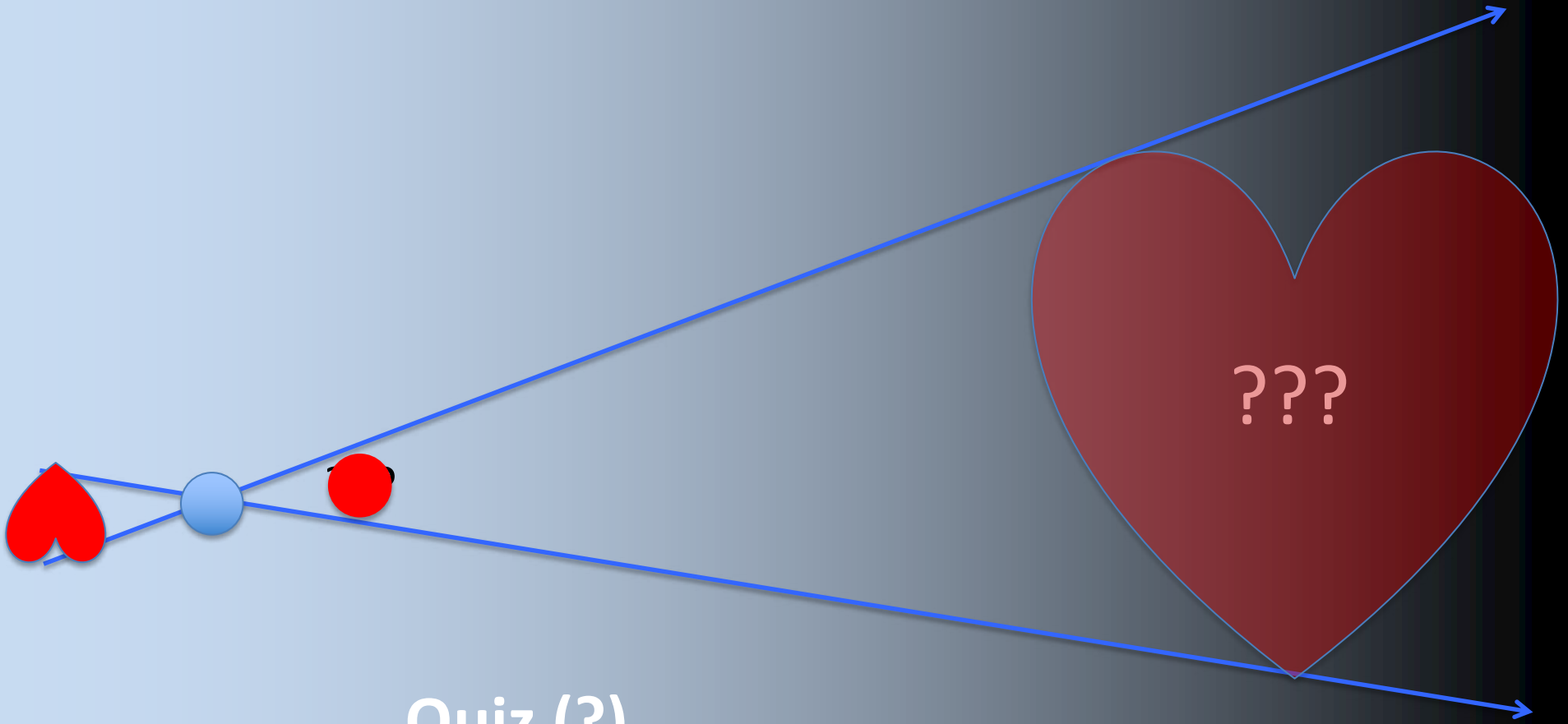


$$I(x,y) = SD(x,y)\Delta x_0 \Delta y_0$$

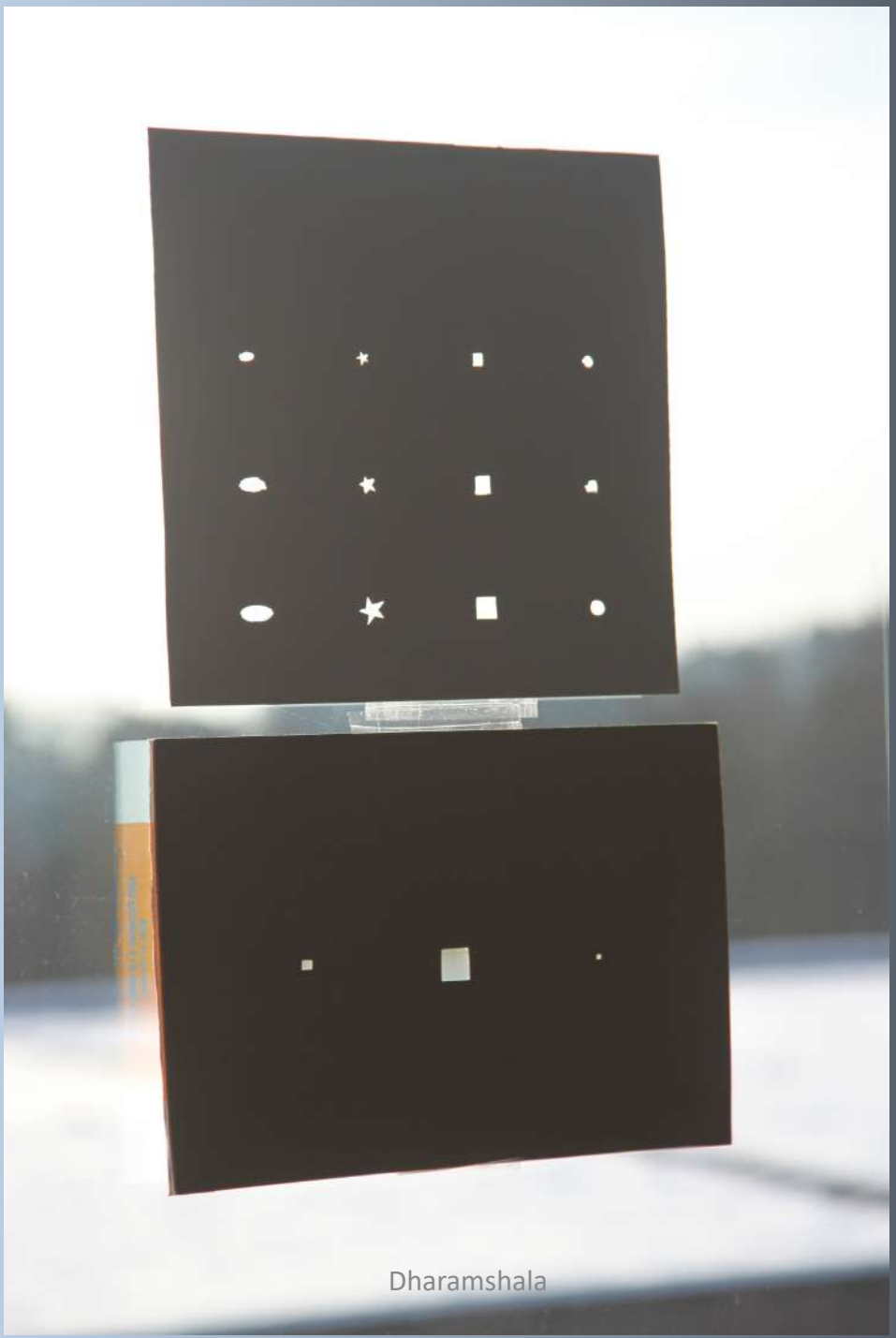
$$I(x,y) = [SD(x,y) + SD(x-x_0, y-y_0)]\Delta x_0 \Delta y_0$$

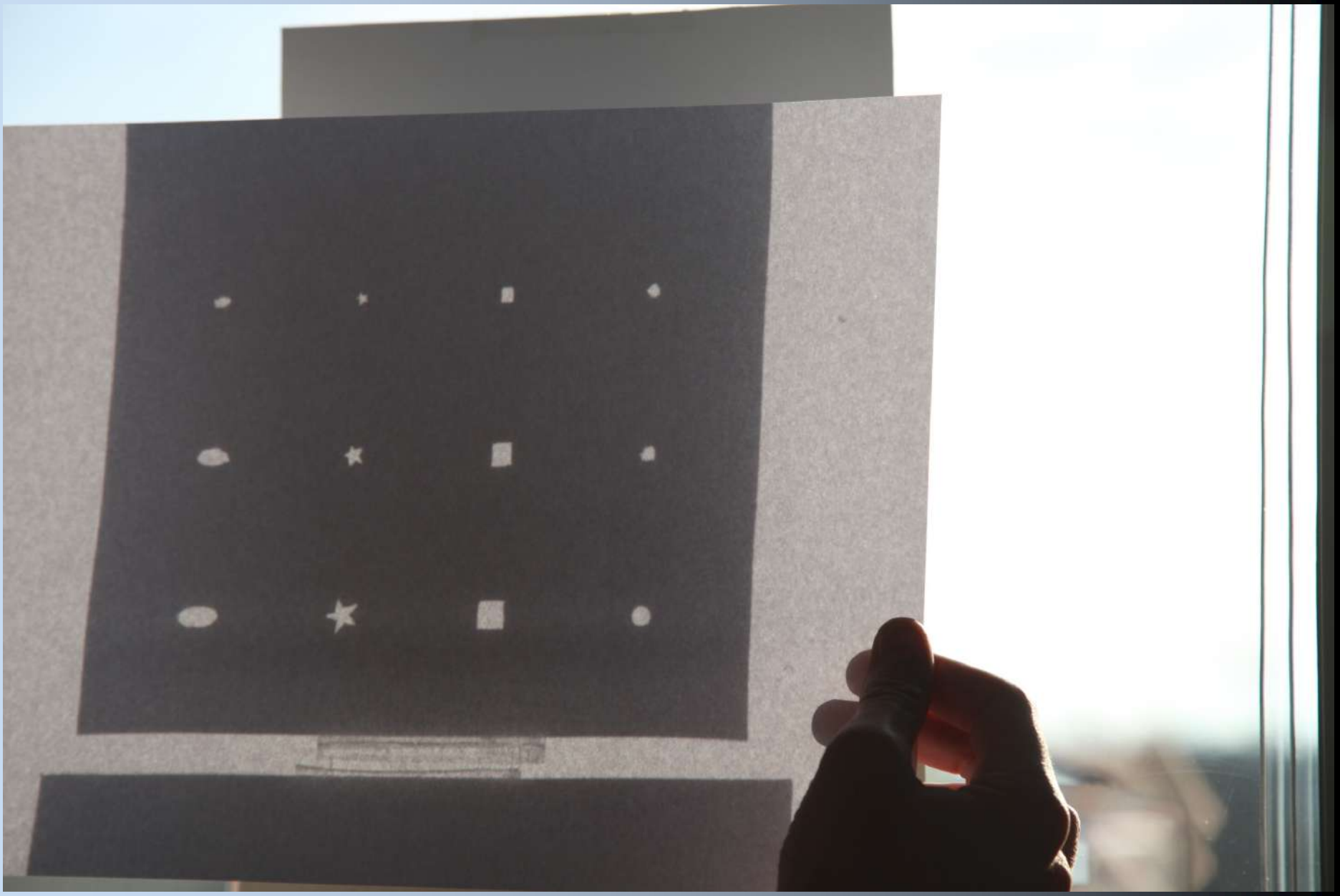
$$I(x,y) = \sum_{x_0=1}^{N} \sum_{y_0=1}^{N} SD(x-x_0, y-y_0)\Delta x_0 \Delta y_0$$

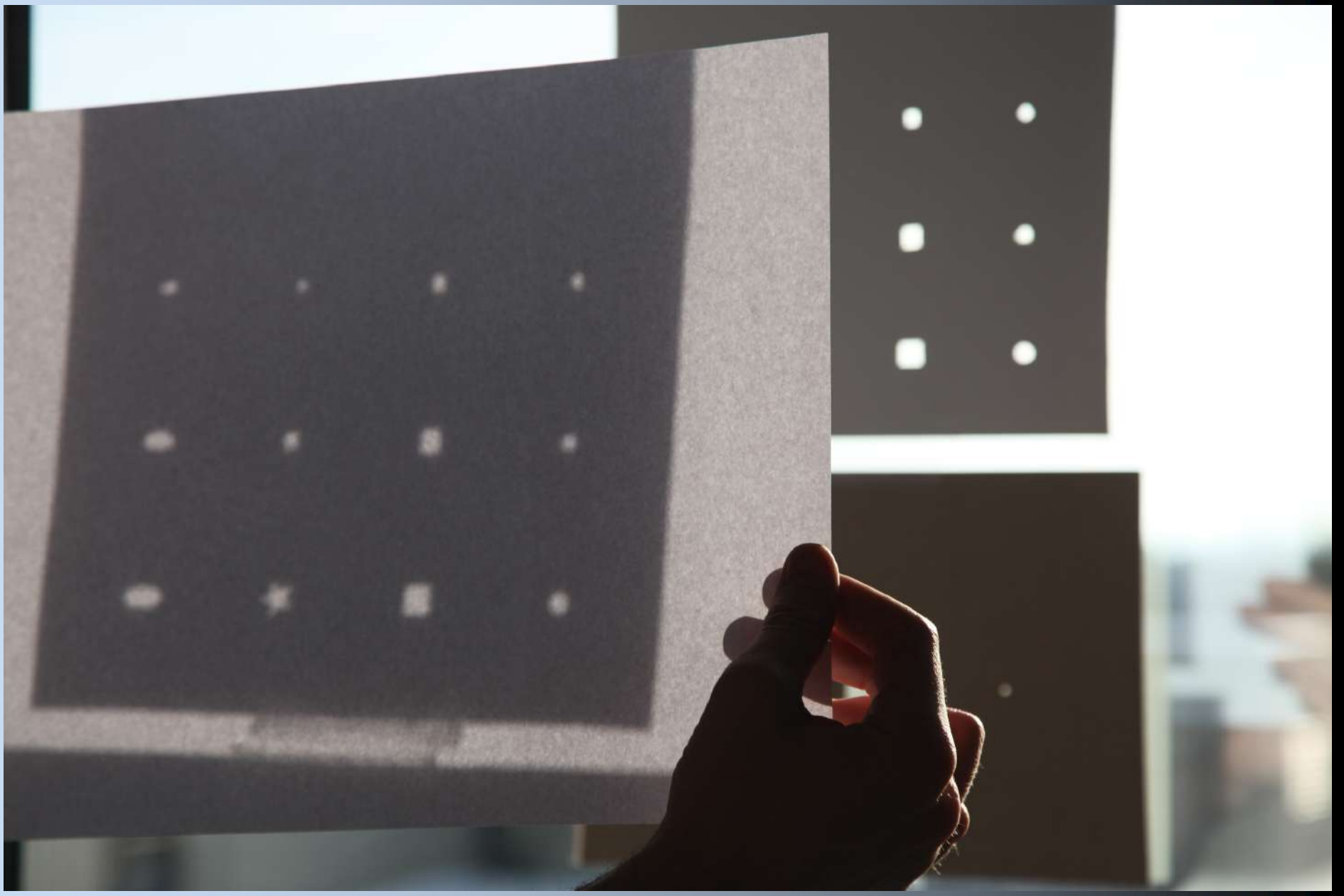
$$I(x,y) = \iint H(x_0,y_0) SD(x-x_0, y-y_0) dx_0 dy_0$$

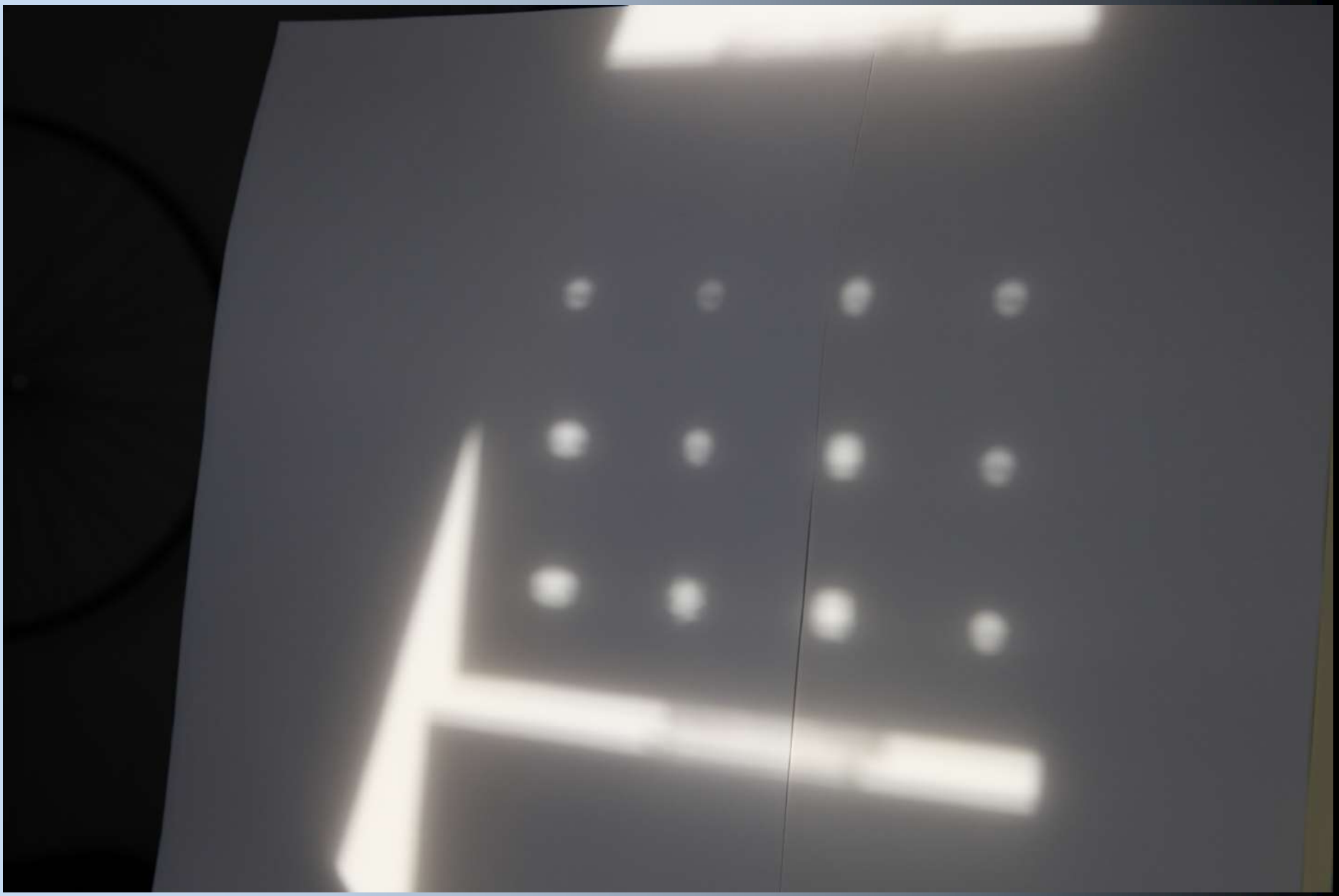


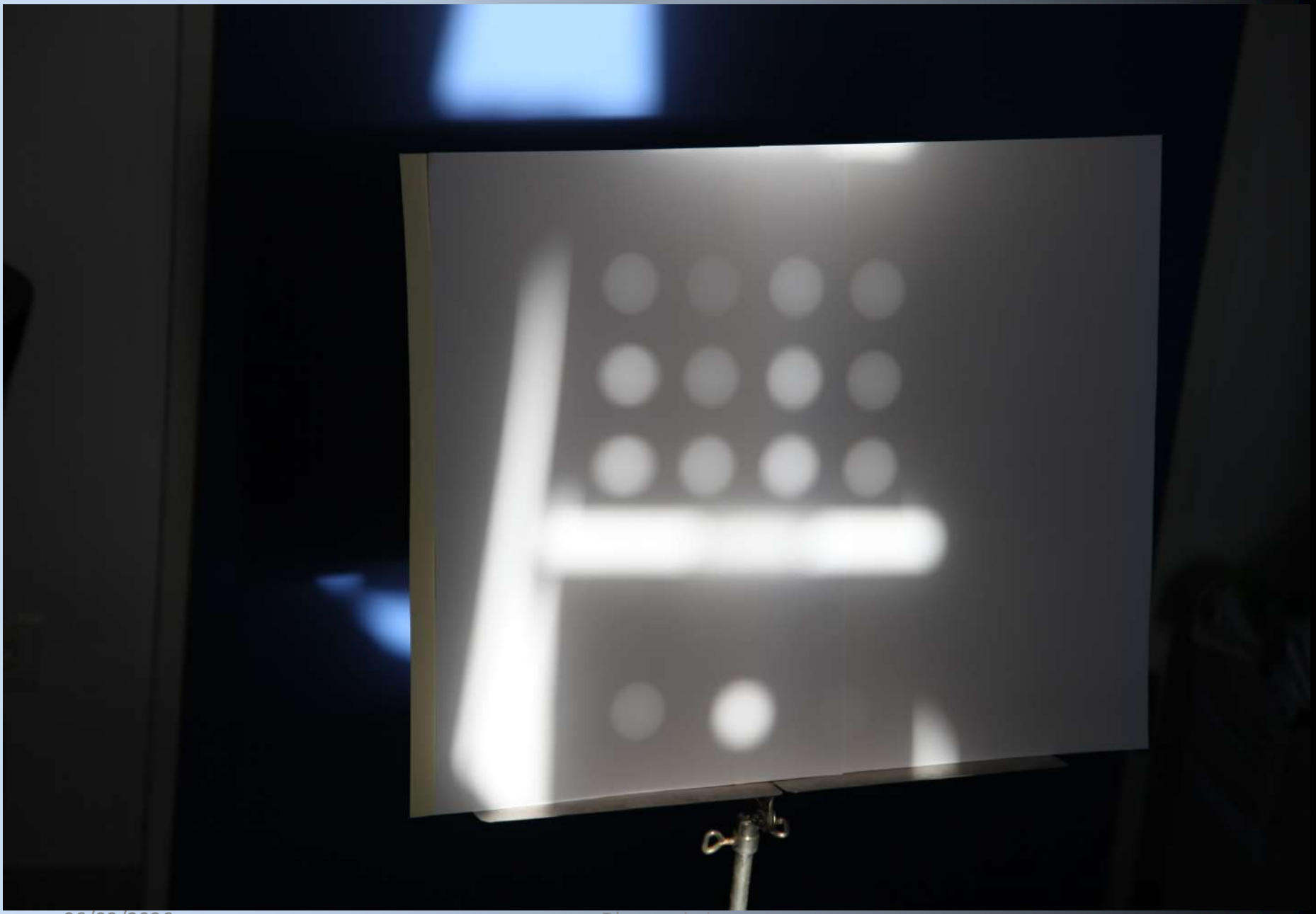
Quiz (?)

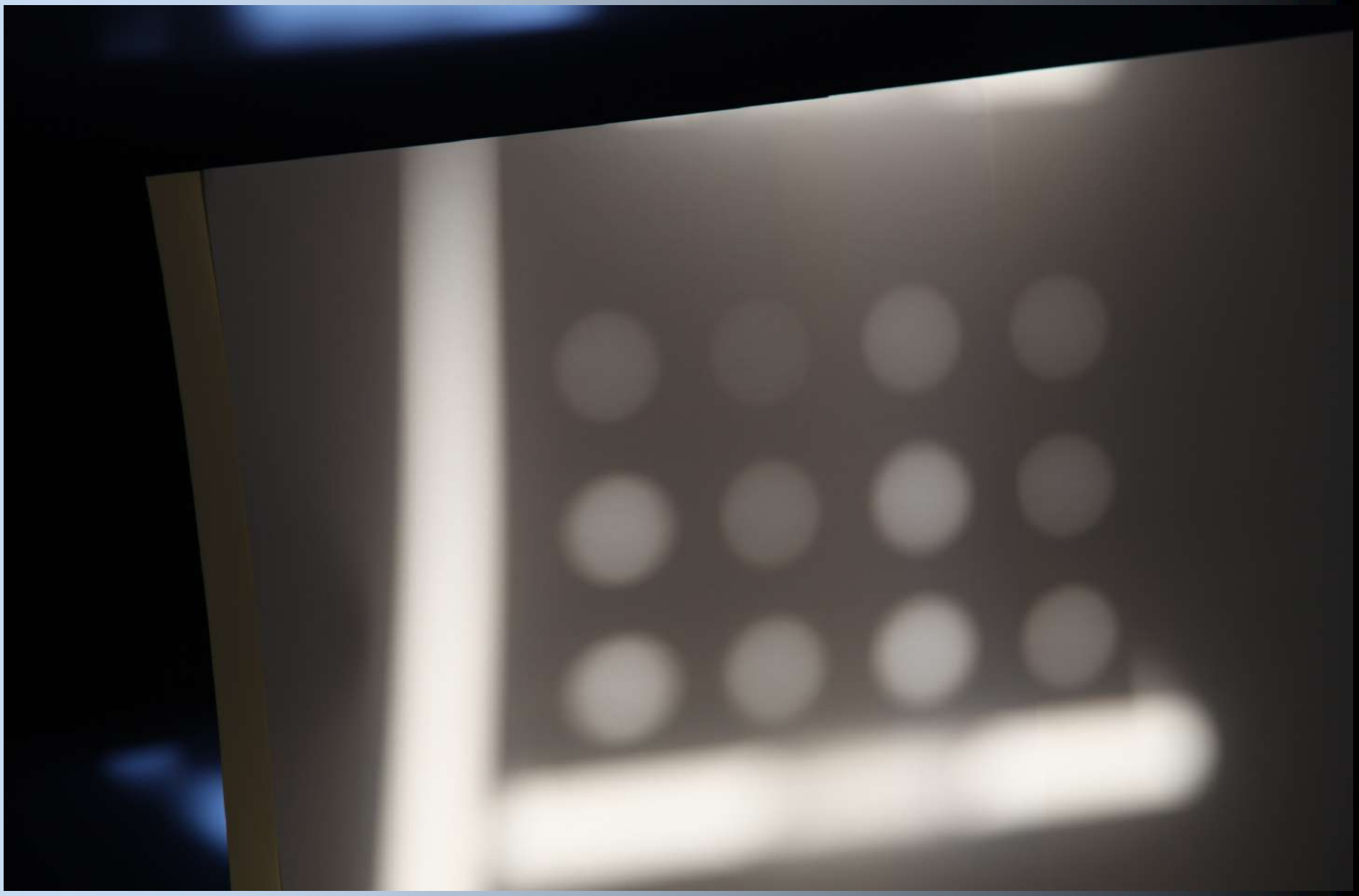




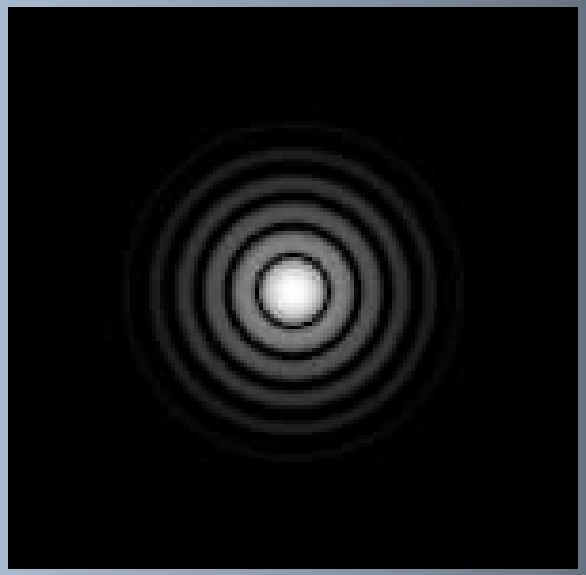








And if the diameter of the pinhole ➔ 0 ?



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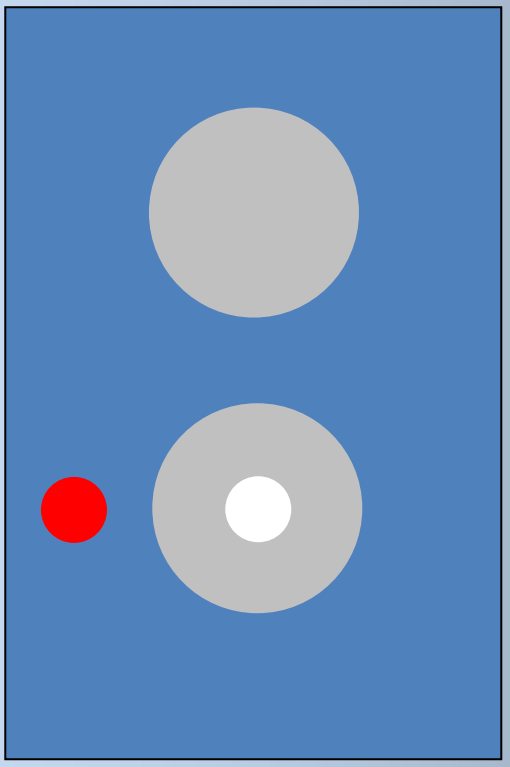

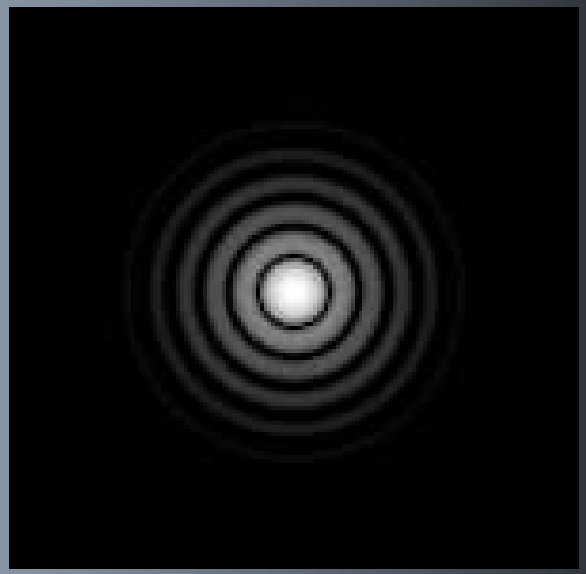

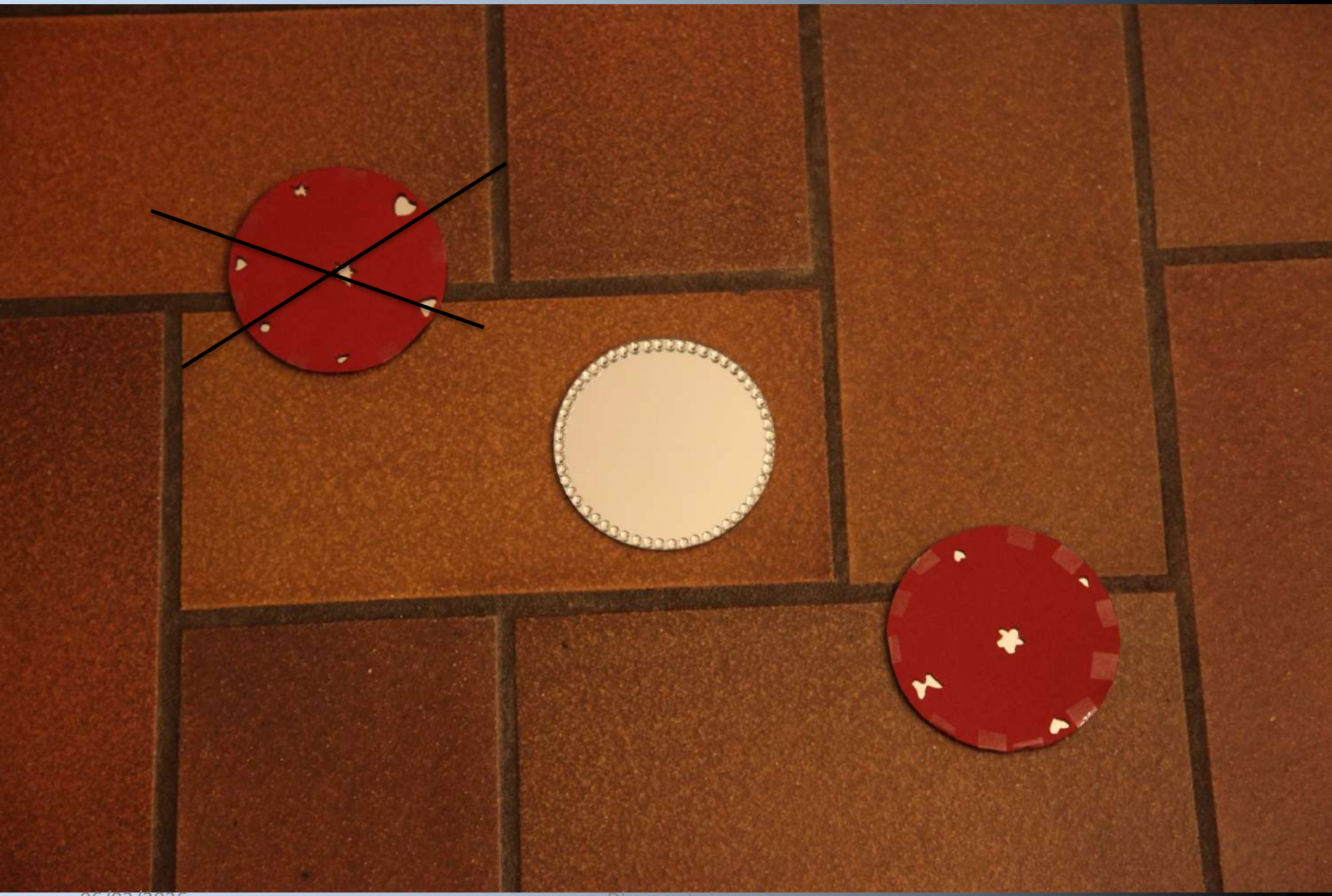

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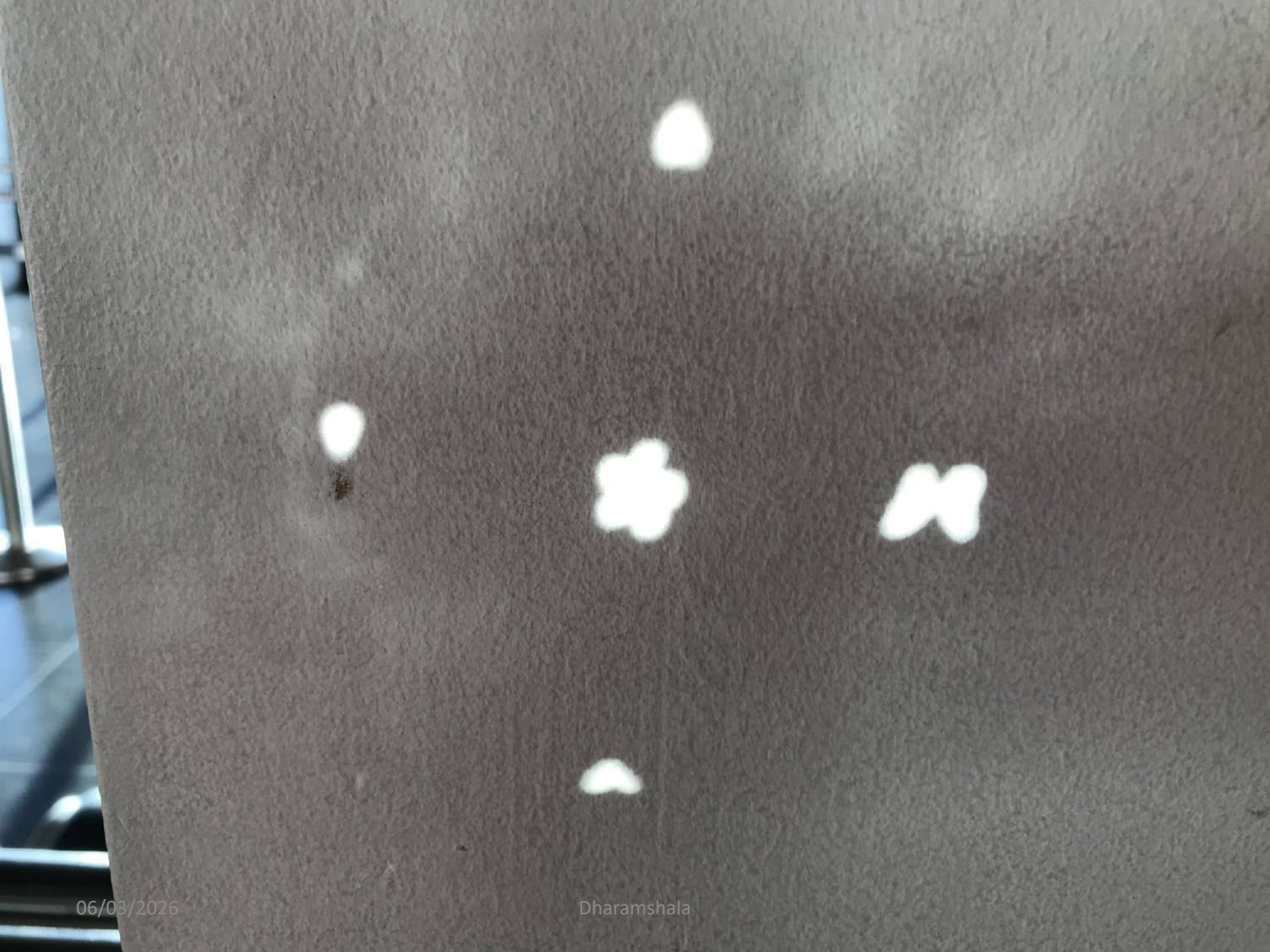

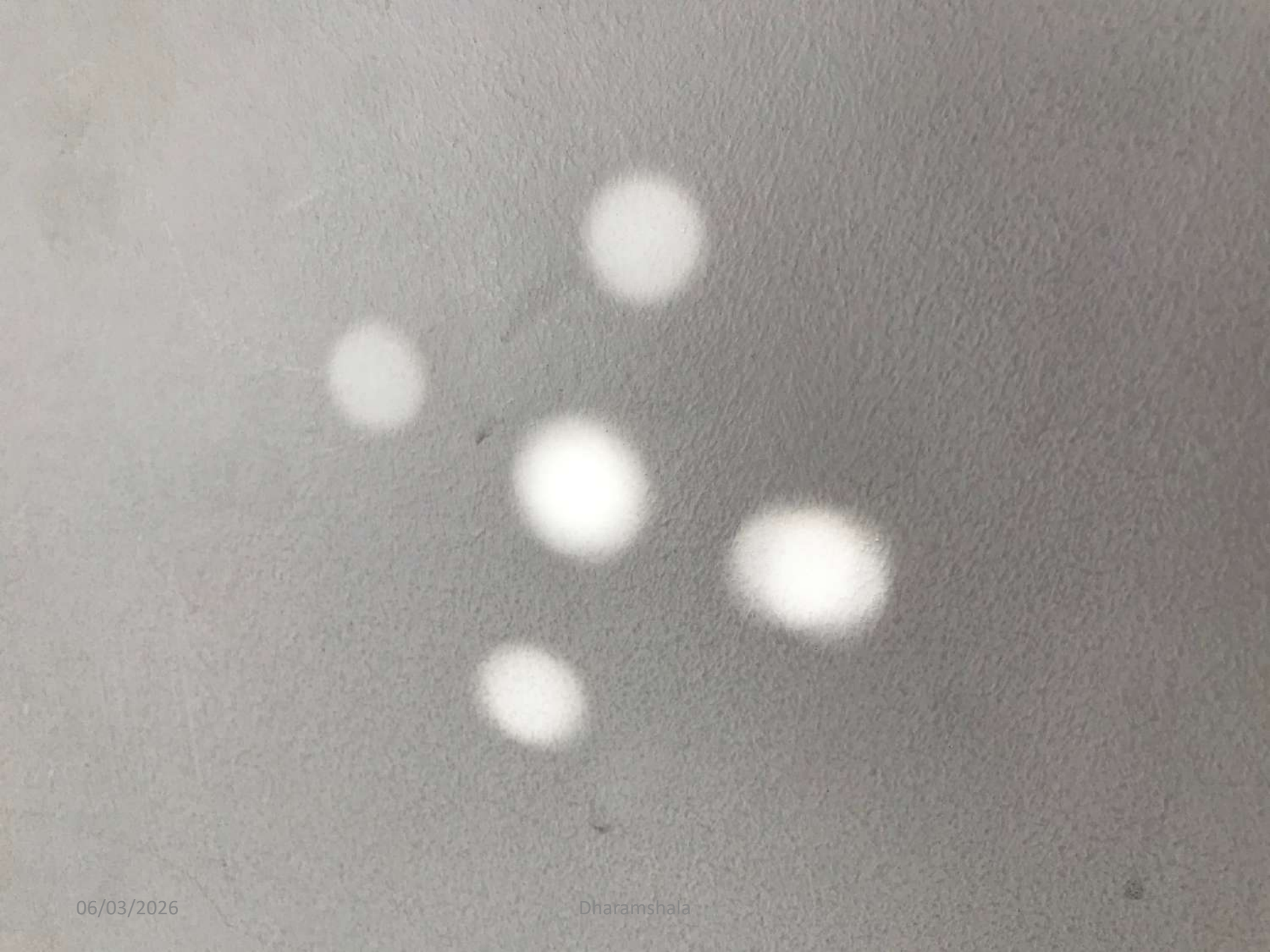


eat' Shop
eat' Shop
Tout bon, tout prêt
BRUSSELS SOUTH CHARLEROI AIRPORT
BRUSSELS SOUTH CHARLEROI AIRPORT
BRUSSELS SOUTH CHARLEROI AIRPORT

06/03/2026

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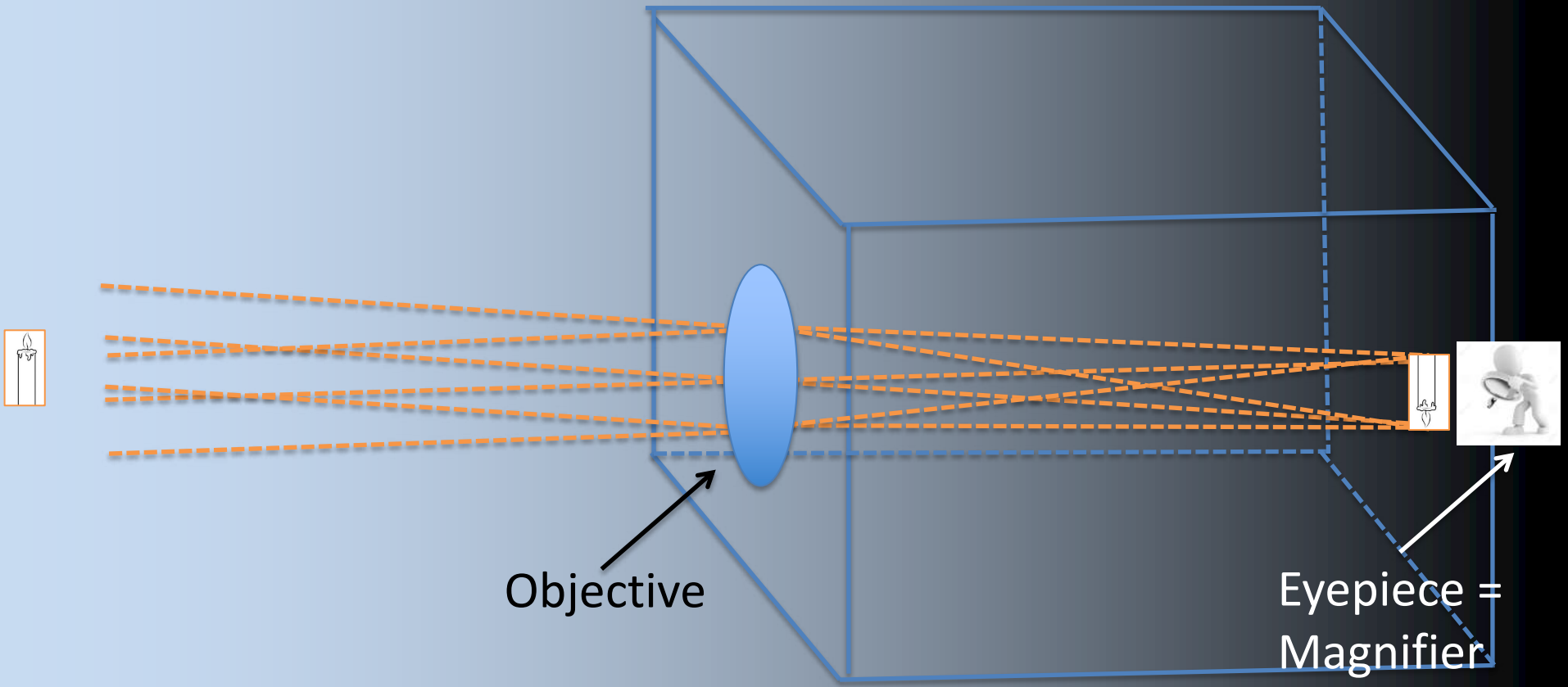
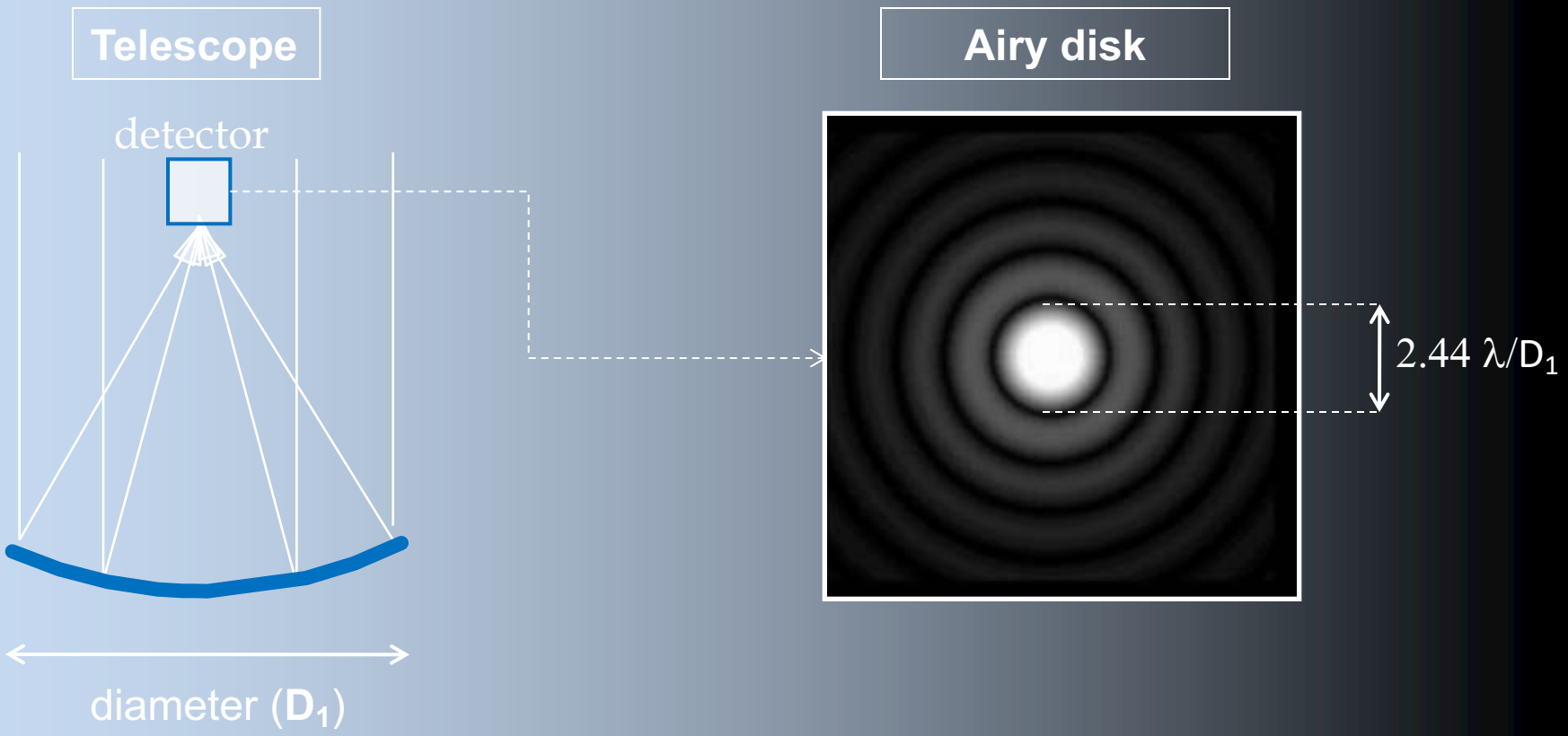
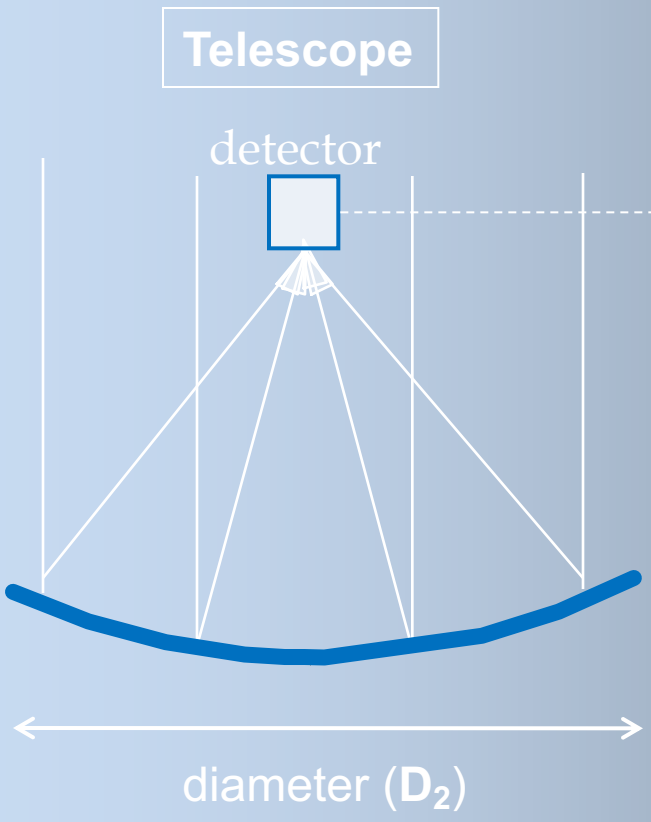
- **Basic principles of a telescope**

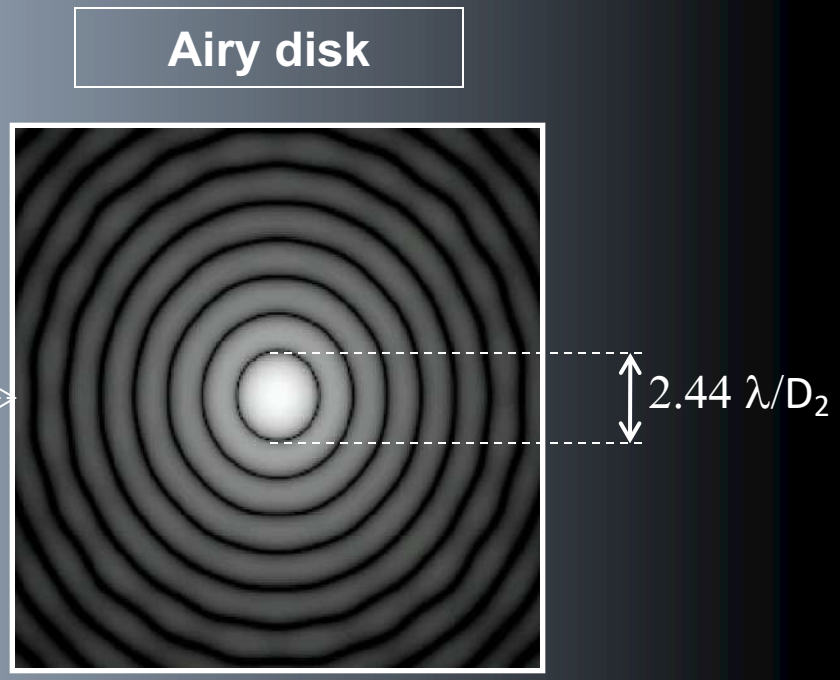
Camera obscura



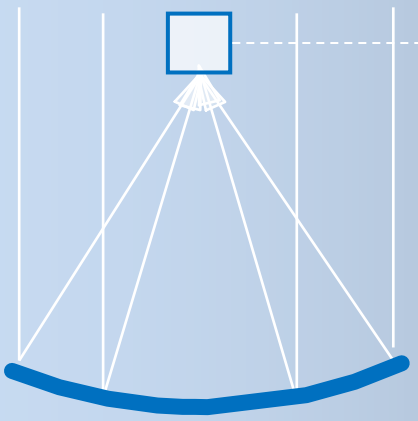


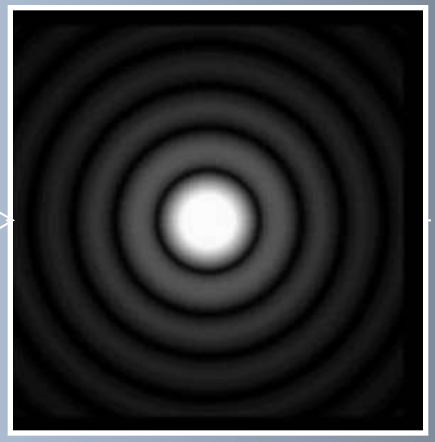
- The image of a star is like a dot!

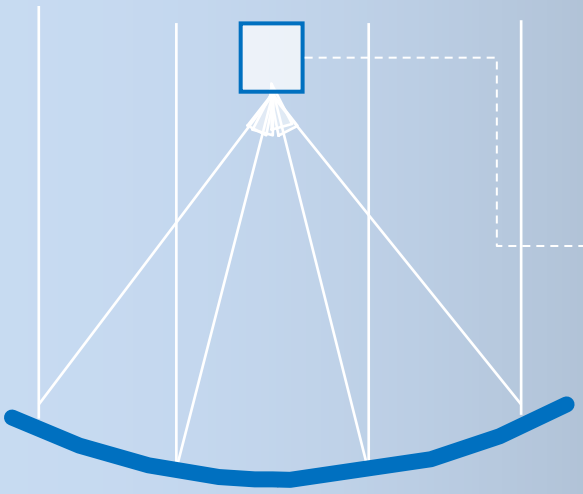


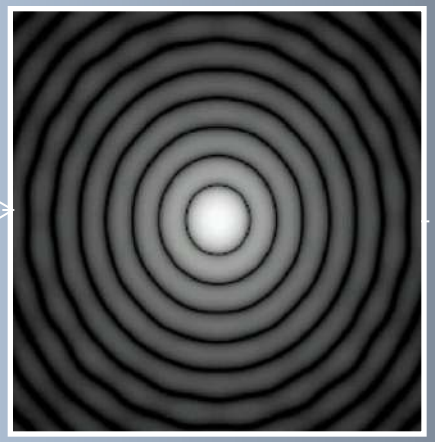


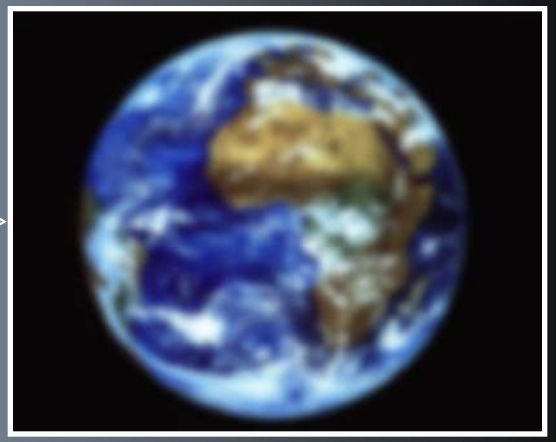
- The image of a star is still like a dot!









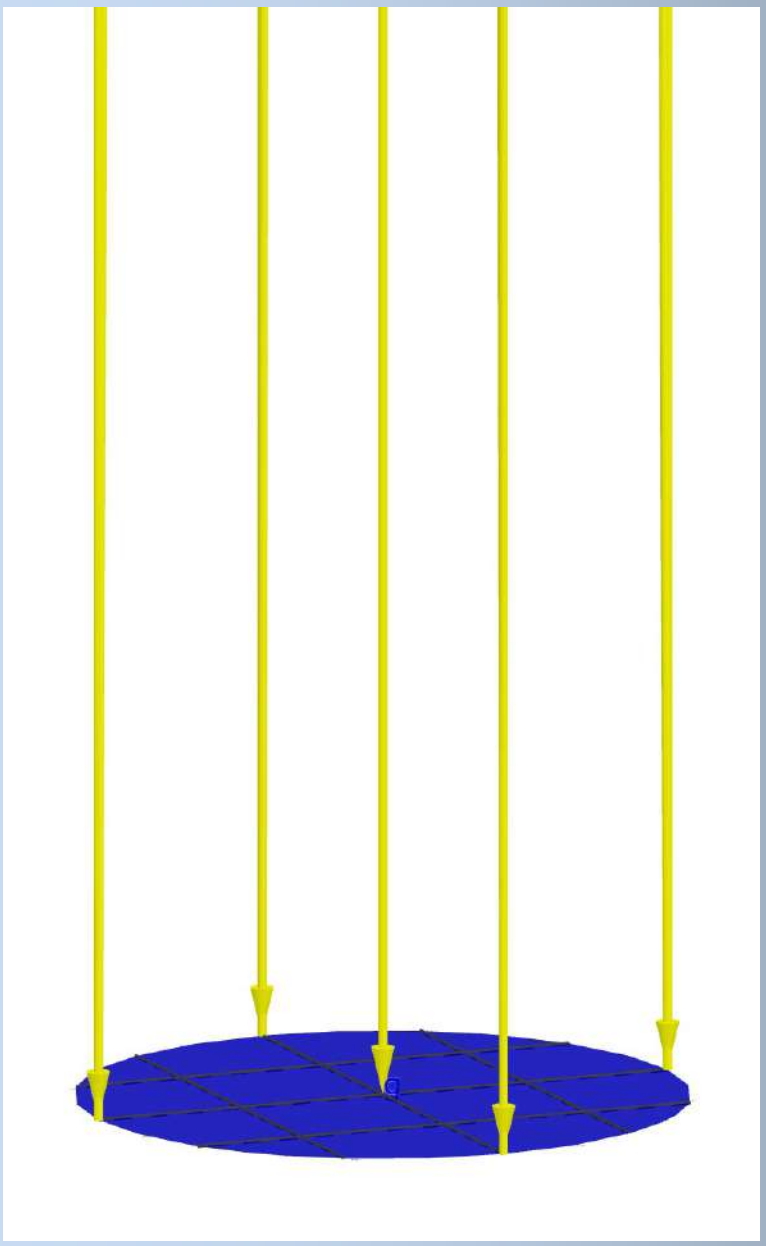


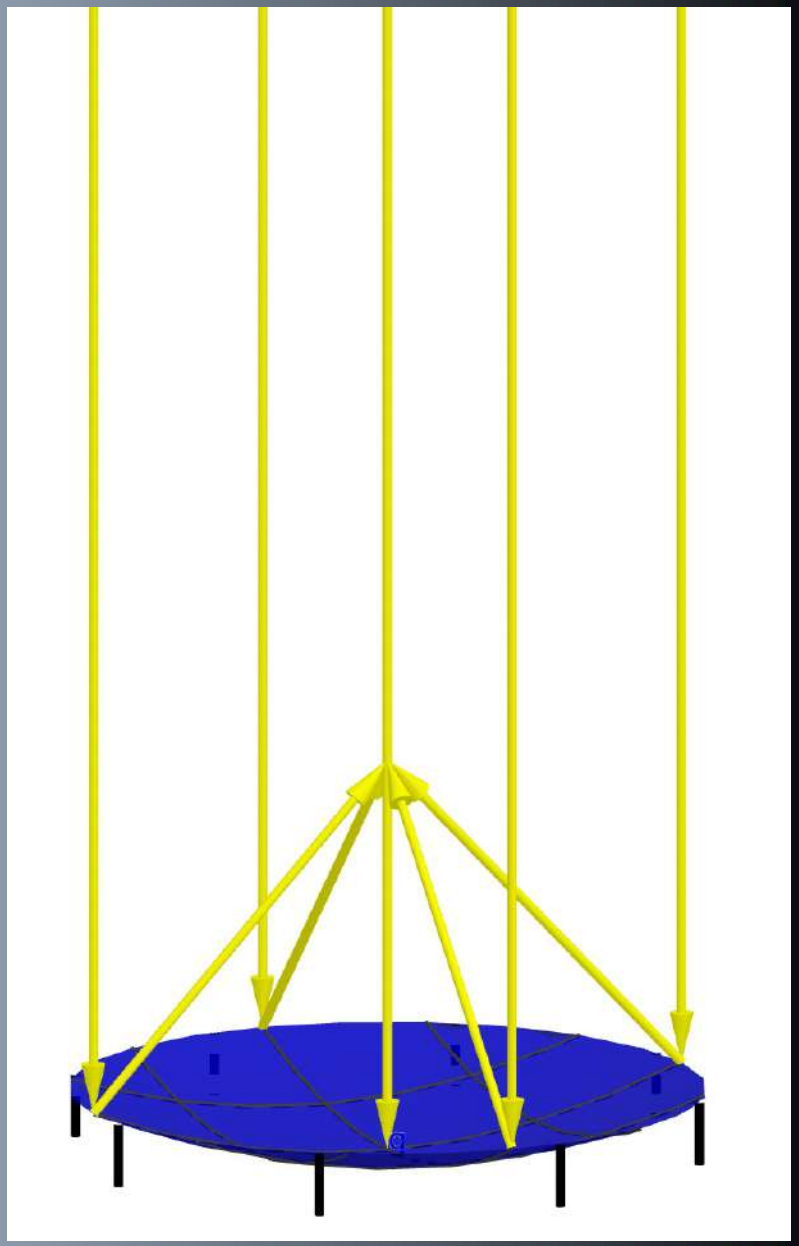
- Need for very large telescopes !!!

=

⊗

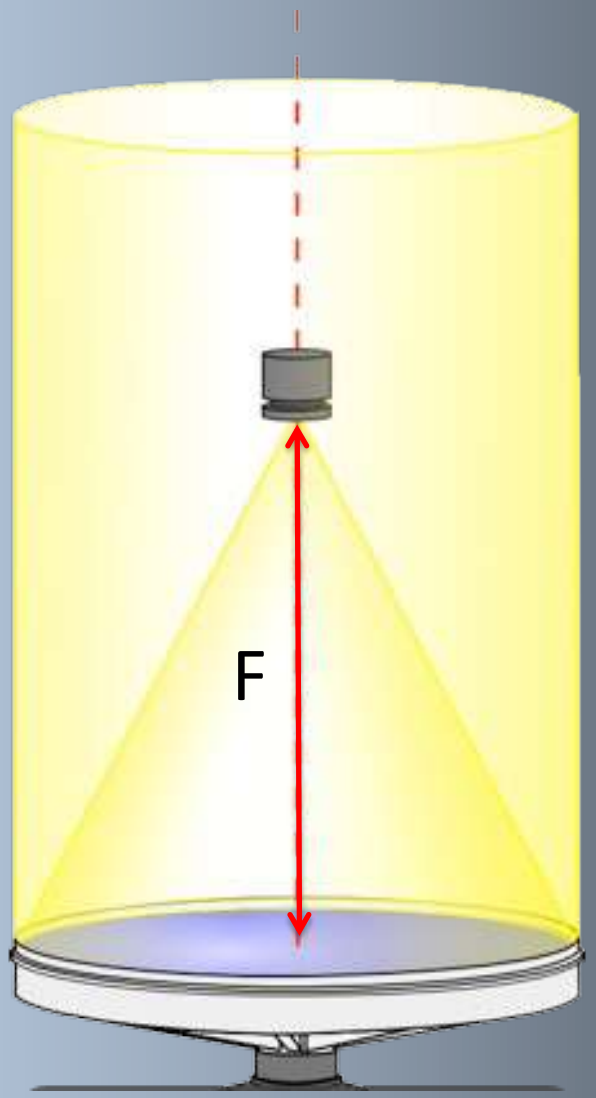
$$I(\zeta,\eta) = \iint PSF(\zeta-\zeta',\eta-\eta')\, O(\zeta',\eta')\, d\zeta'\, d\eta' = PSF(\zeta,\eta) \otimes O(\zeta,$$



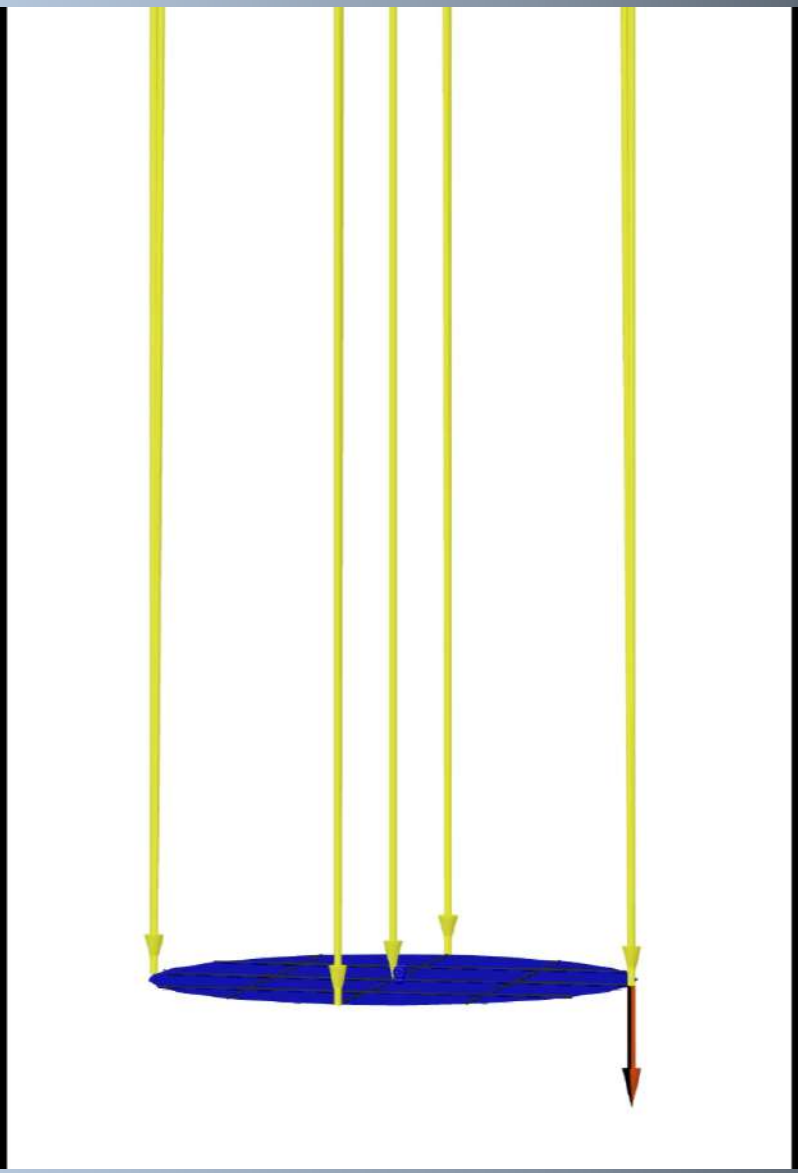


Liquid Mirror Telescope

The paraboloid consists of an ideal optical system to focus a beam of // light rays into a single point



$F = g / 2\omega^2$

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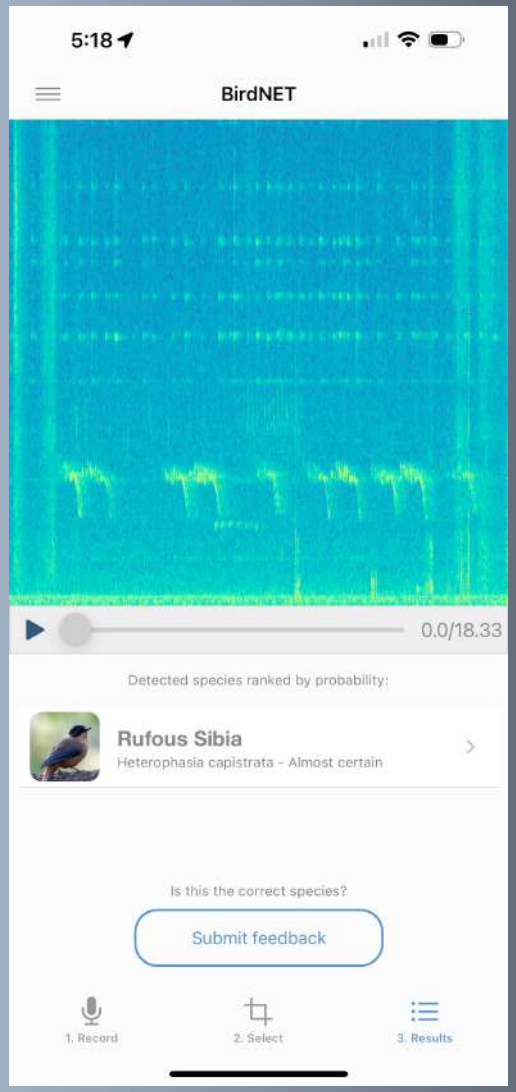
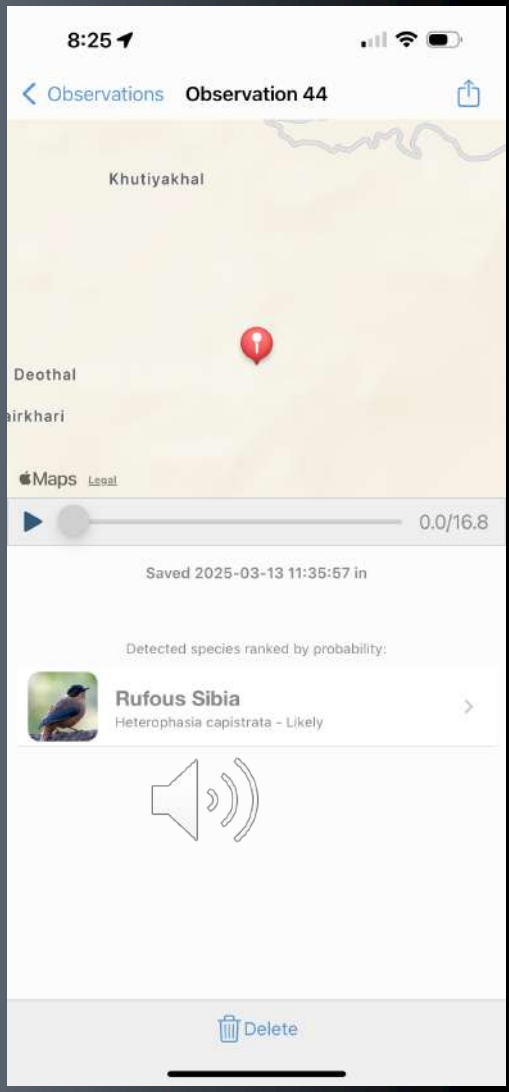
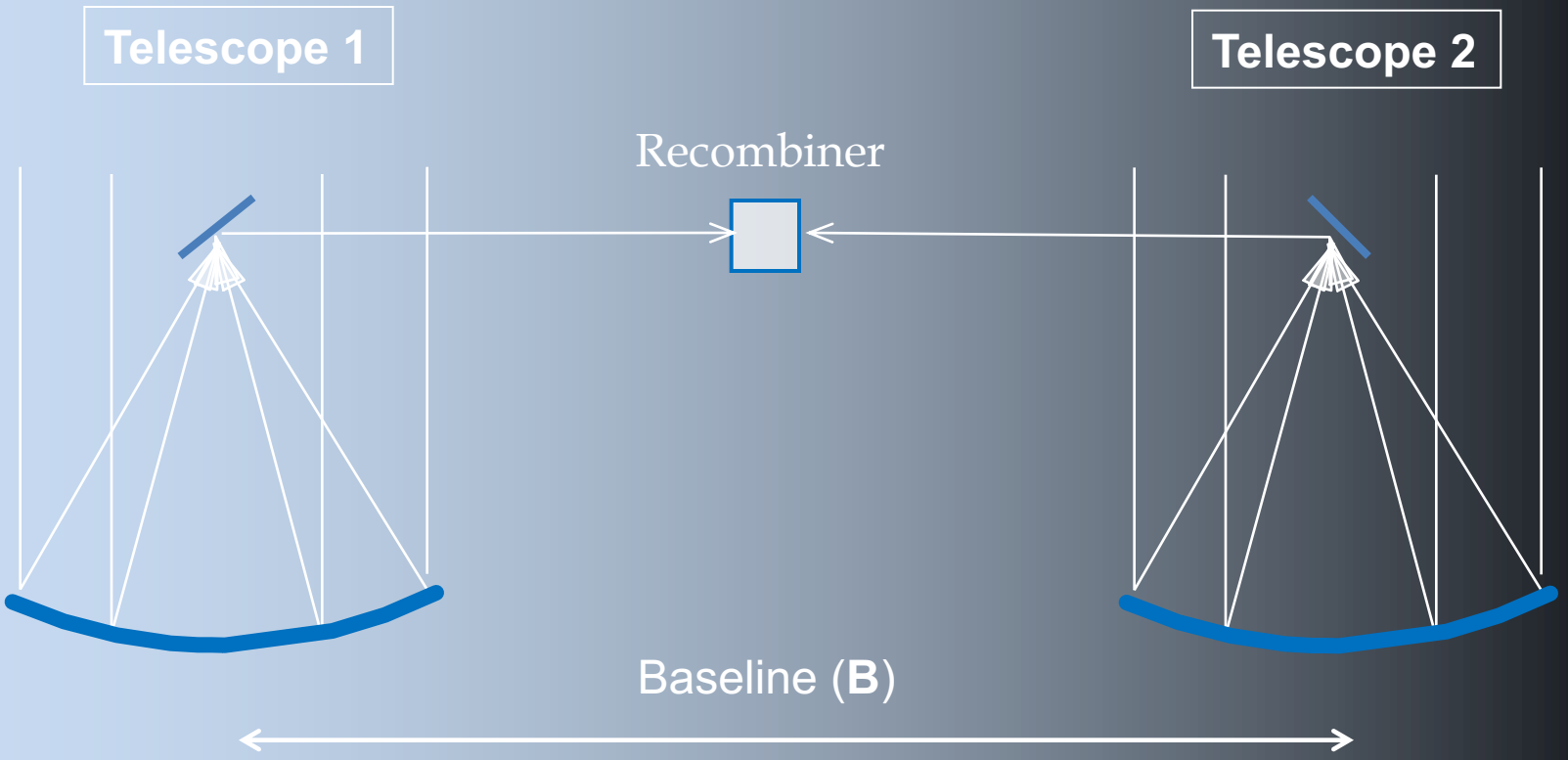
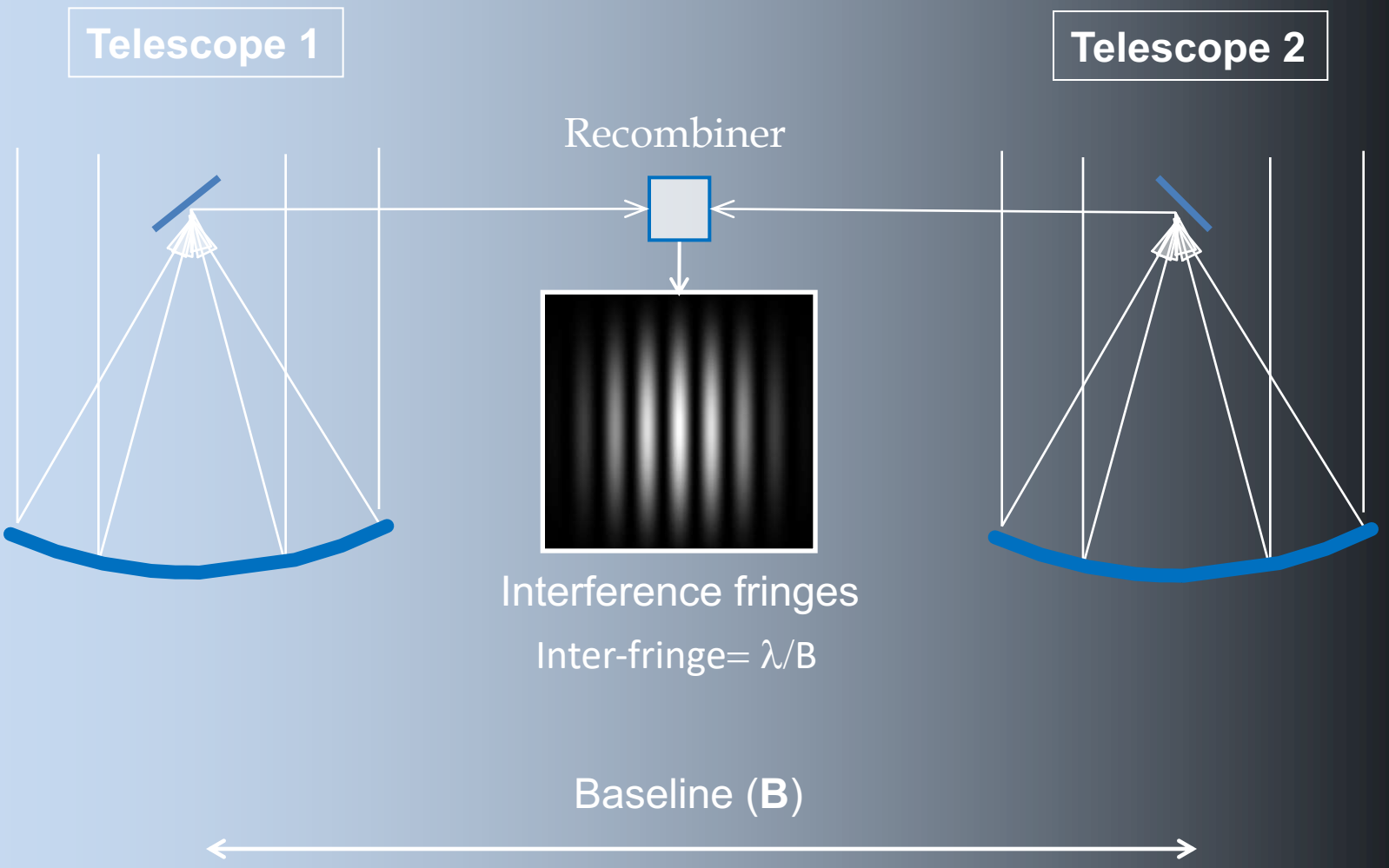

5:18
BirdNET
0.0/18.33
Detected species ranked by probability:
Rufous Sibia
Heterophasia capistrata - Almost certain
Is this the correct species?
Submit feedback
1. Record
2. Select
3. Results

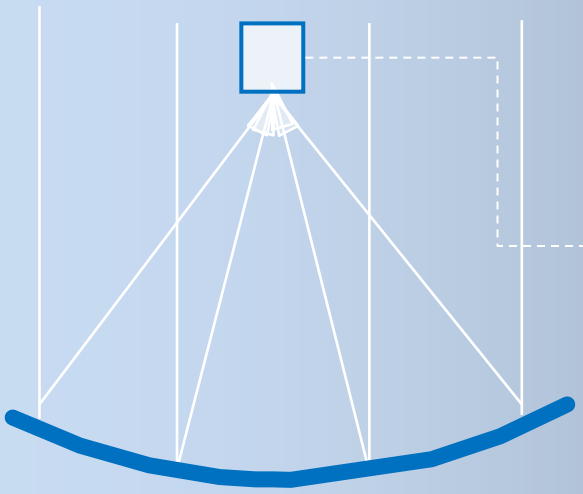

8:25
Observations
Observation 44
Khutiyakhal
Deothal
Maps
Legal
0.0/16.8
Saved 2025-03-13 11:35:57 in
Detected species ranked by probability:
Rufous Sibia
Heterophasia capistrata - Likely
Delete

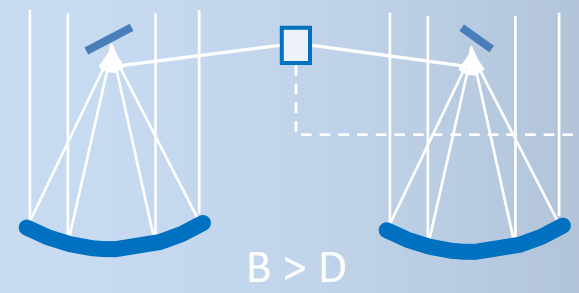
- H. Fizeau and E. Stephan (1868-1870):

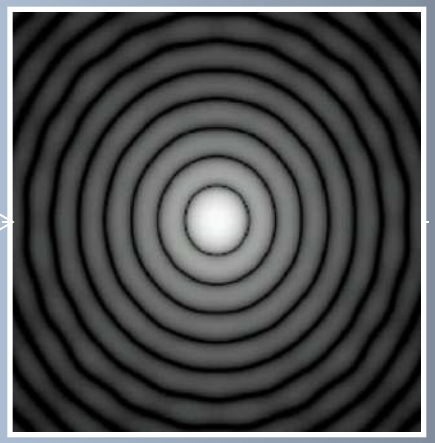
  "In terms of angular resolution, two small apertures distant of B are equivalent to a single large aperture of diameter B"

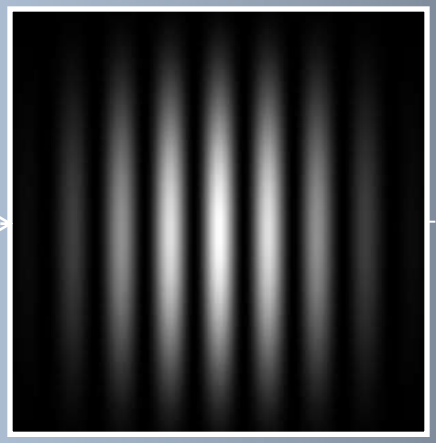


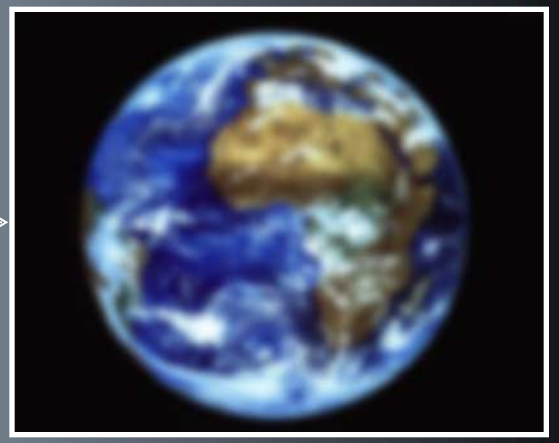

Telescope 1
Telescope 2
Recombiner
Interference fringes
Inter-fringe= λ/B
Baseline (B)




B > D





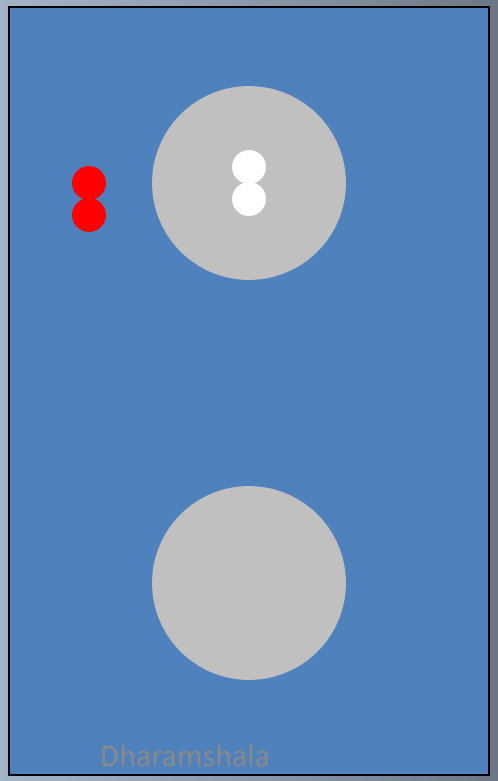


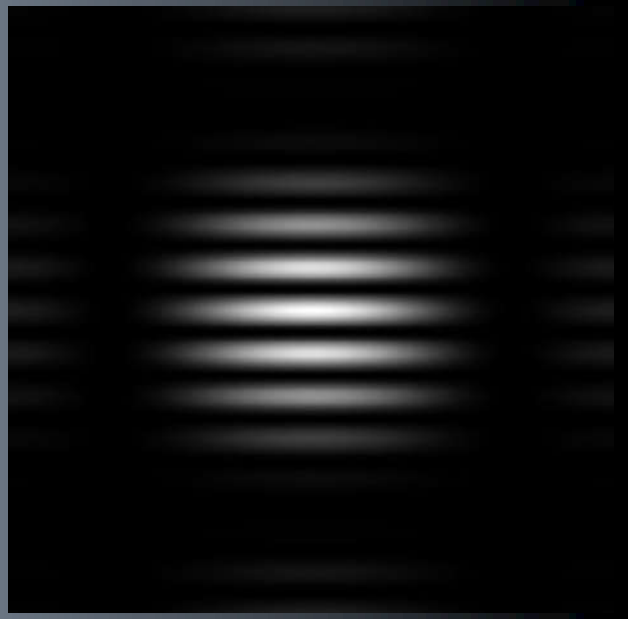
An introduction to optical/IR interferometry

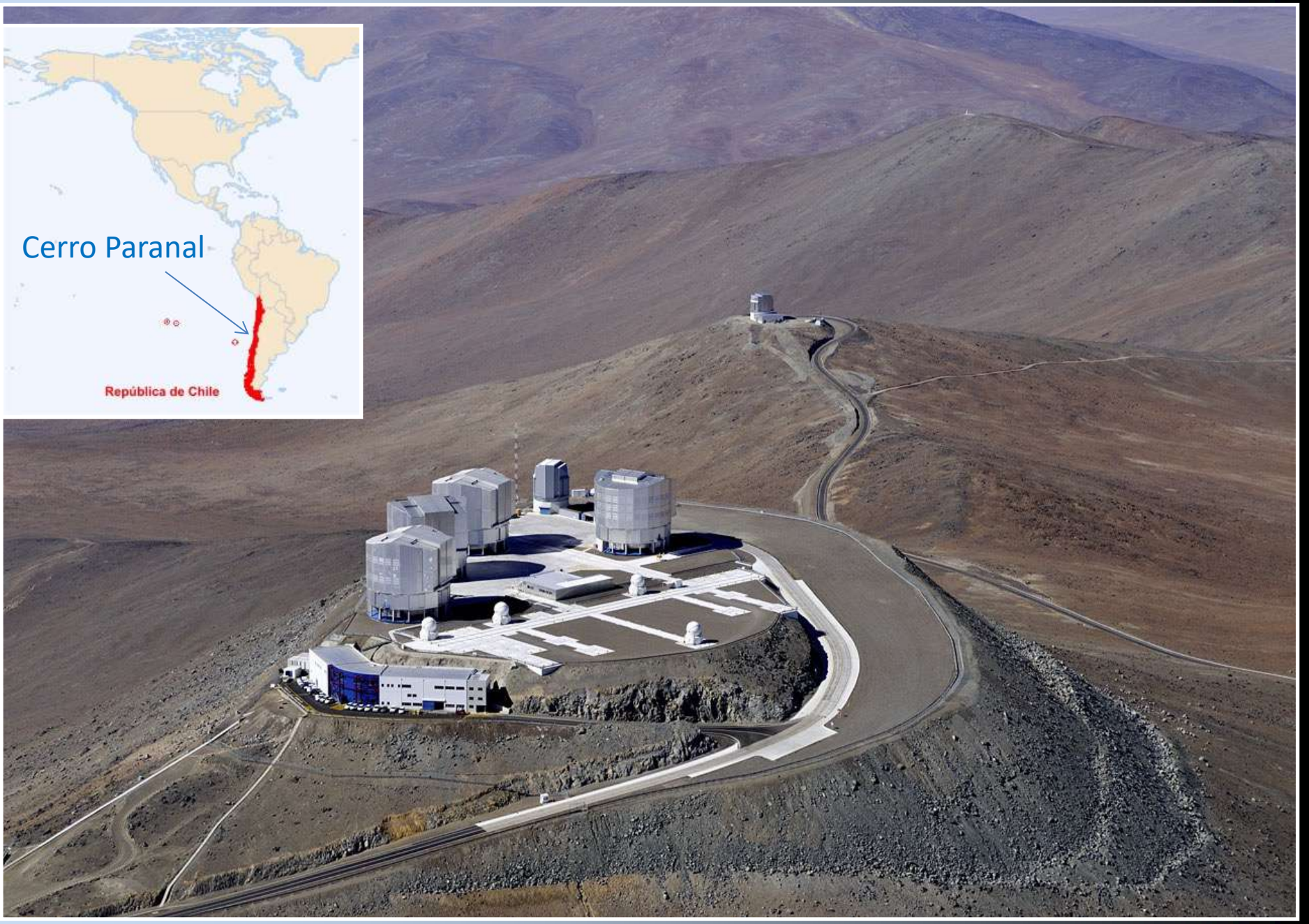
Interferometry with two independent telescopes

b) Fizeau … the father of stellar interferometry (1868)

2nd experiment!

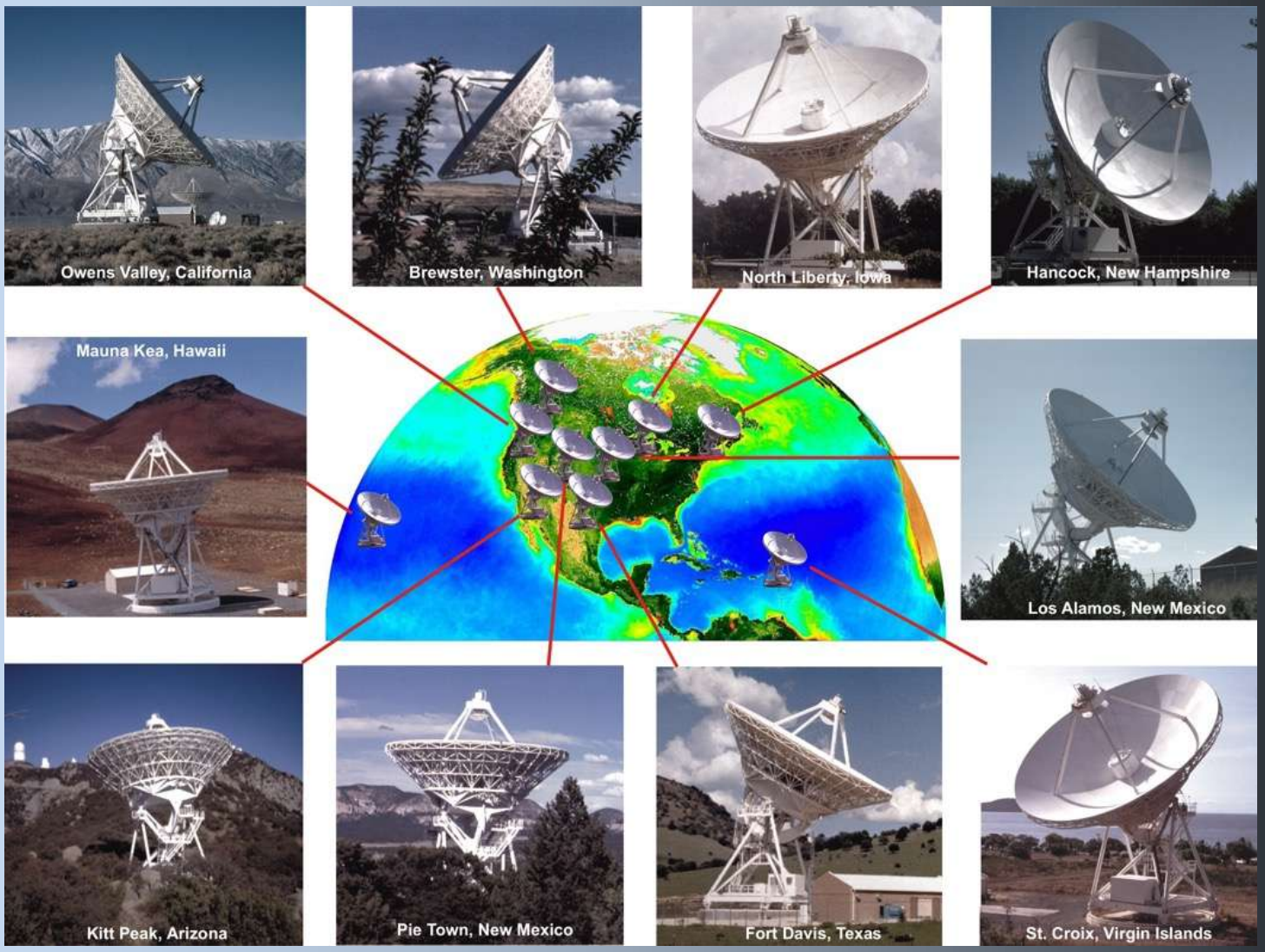





Cerro Paranal
República de Chile

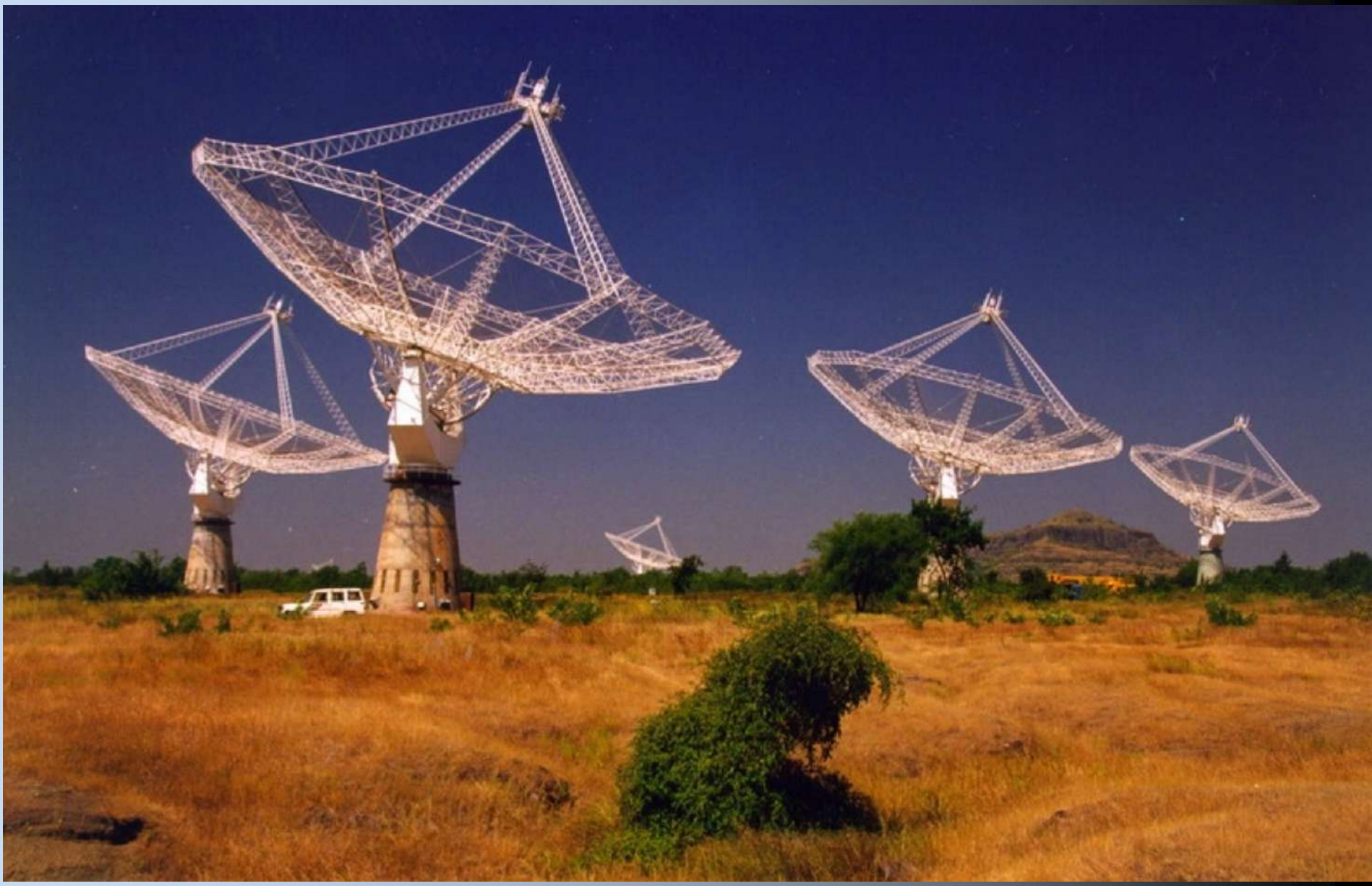
The Very Large Array (VLA) near Socorro (New Mexico, USA)

The Very Large Array (VLA) near Socorro (New Mexico, USA)

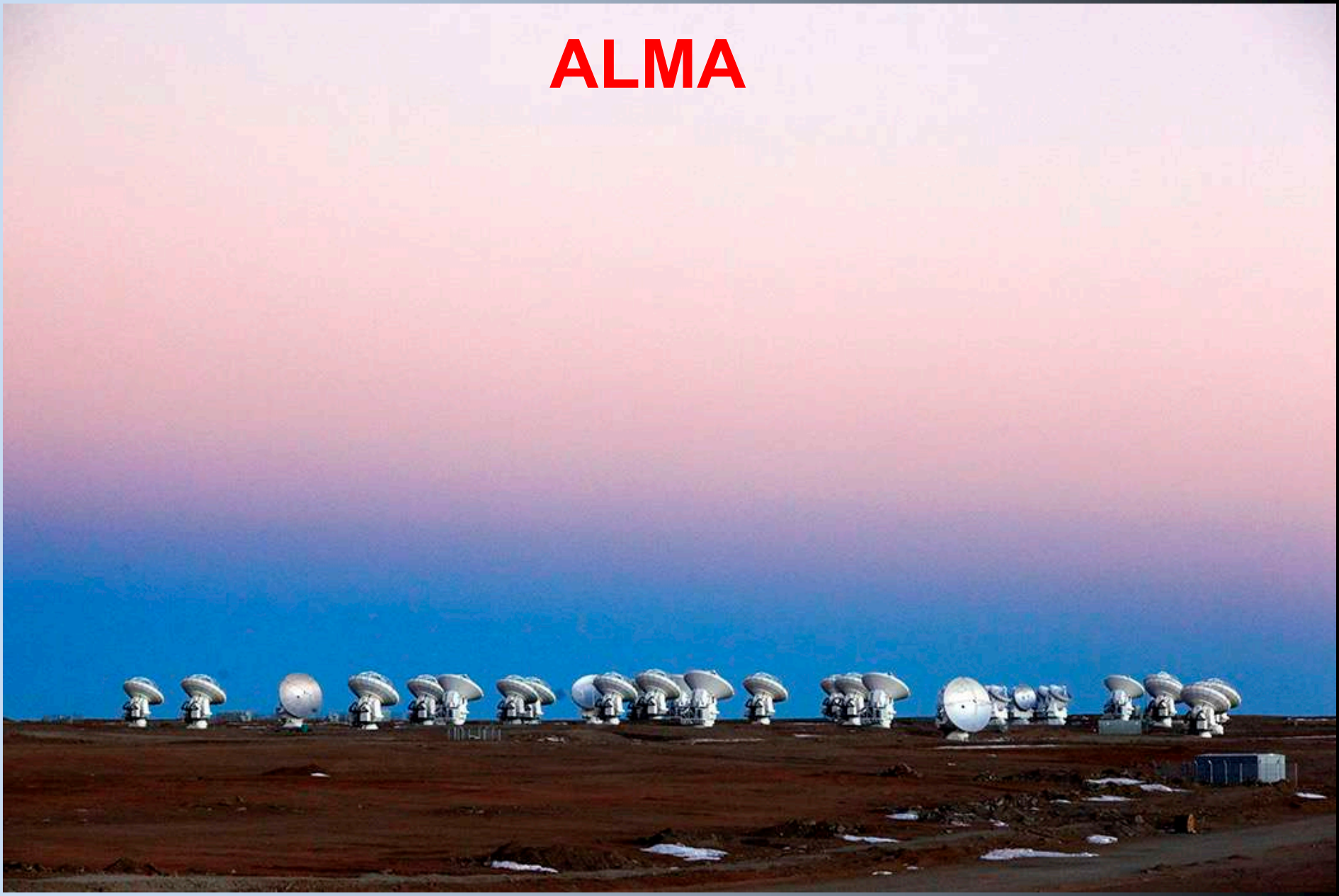


The Very Long Baseline Array (USA)

GMRT



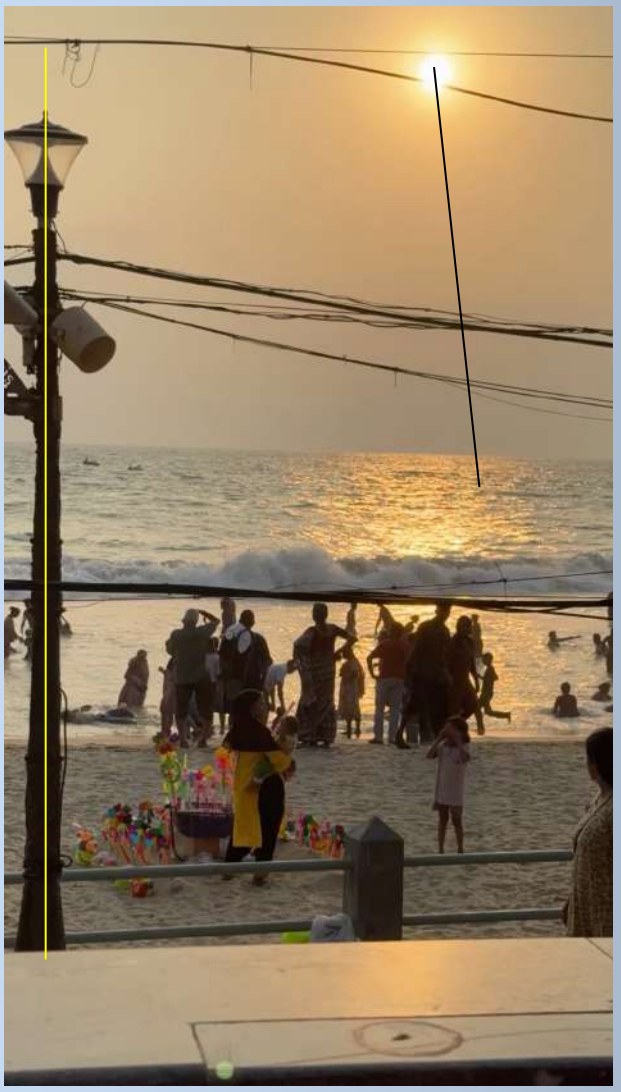
ALMA




Lore
SCHEUERLE

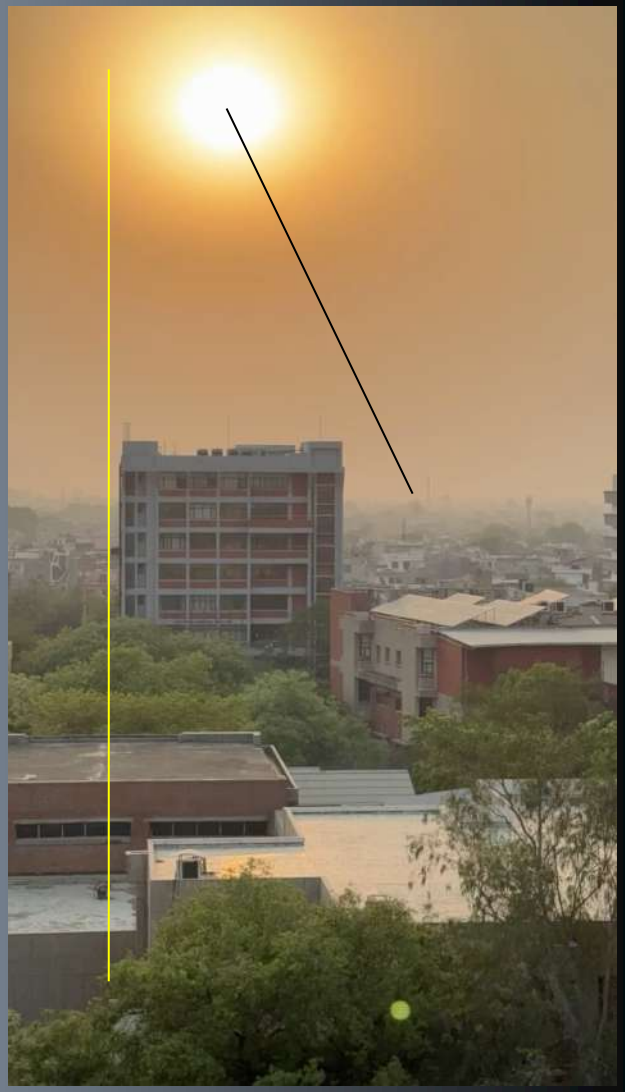
Rotation of the celestial sphere

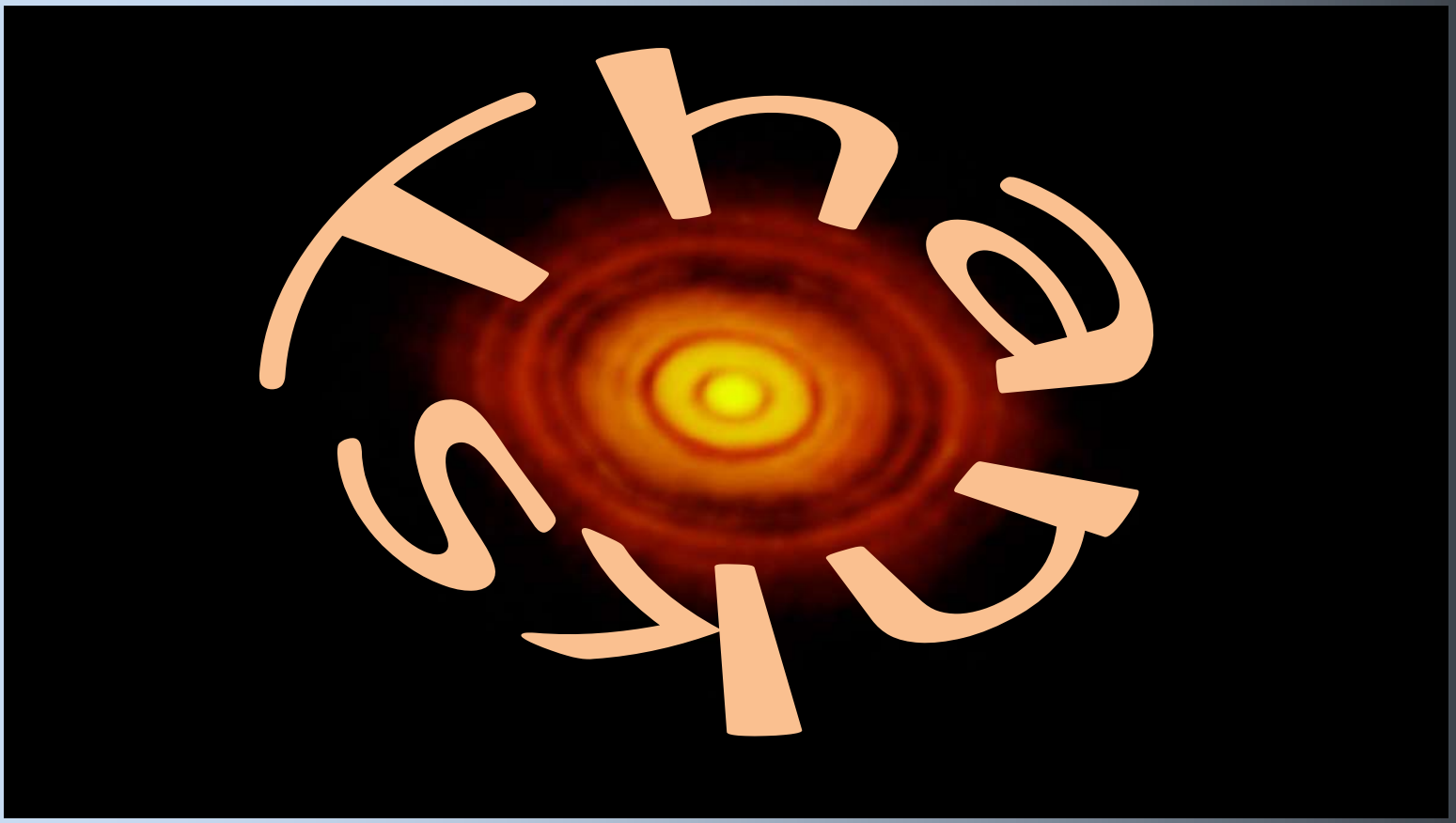
Devasthal
2nd December 2019



6.2°
Trivandrum
(8.5°)

26.5°
Kanpur
(26.4°)





Atacama Large Millimeter Array (Chili)

HL Tauri, 450 Light years, gas and dust disk (resolution near 5 AU)

See: http://www.eso.org/projects/alma/