
HOLOGRAPHY

Questions about RUBY LASER?

Q. ***What is the pumping source in Ruby laser?***

A. Electrical Pumping
B. Optical
C. Chemical
D. None of the above

Q. ***What is the output in wavelength of ruby laser?***

A. 6943 angstroms
B. 6328 angstroms
C. 5400 angstroms
D. 8000 angstroms

Q. ***Ruby laser is a _____ level laser.***

A. Three
B. Four
C. Five
D. Two

Q. ***Laser medium in Ruby laser is:***

A. Aluminium oxide
B. Chromium oxide
C. Chromium oxide doped with aluminium ions
D. Aluminium oxide doped with chromium ions

Questions about He-Ne LASER?

Q. ***What is the pumping source in Helium – Neon laser?***

A. Electrical Pumping
B. Optical
C. Chemical
D. None of the above

Q. ***What is the output in wavelength of Helium-Neon laser?***

A. 6943 angstroms
B. 6328 angstroms
C. 5400 angstroms
D. 8000 angstroms

Q. ***Which laser has continuous output?***

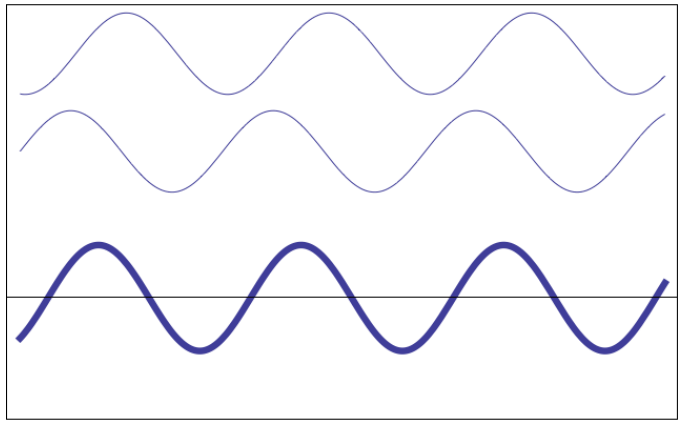
A. Ruby laser
B. Helium-Neon laser
C. Both
D. None of the above

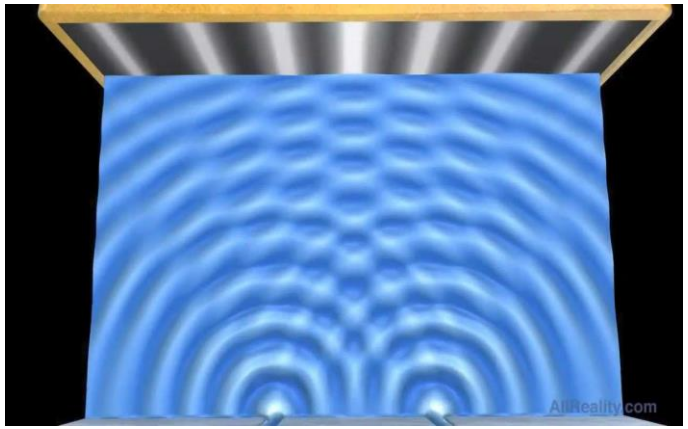
Q. ***Helium-Neon laser is a _____ level laser.***

A. Three
B. Four
C. Five
D. Two

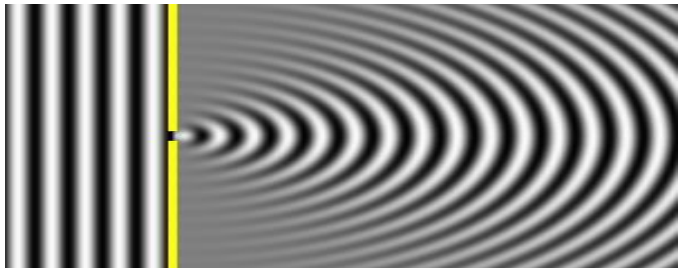
Important terms

- Interference

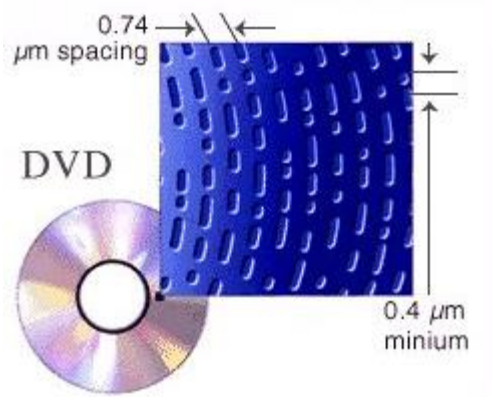


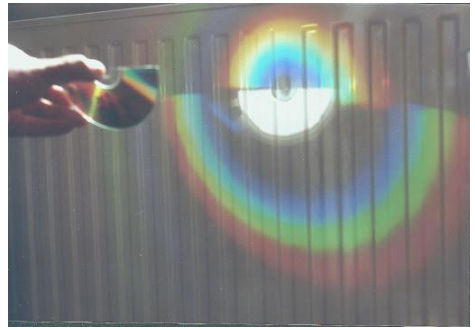


- Diffraction



- Diffraction Grating



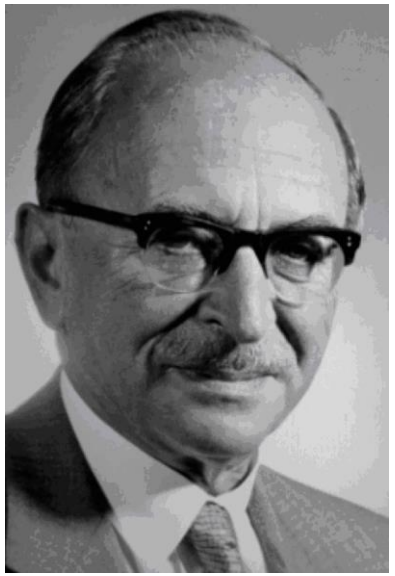


What is Holography?

- Holography is the ***production of three-dimensional images*** of objects.
- The physics of holography (different type of photography) was developed by ***Dennis Gabor*** in 1947-48.
- Holography is a technique that allow the light scattered from an object (to be recorded) and later re-constructed so that it appears the same when it was recorded. The recorded image of an object is called hologram.
- The hologram has no resemblance with the recorded object, though it contains all the information about the object in a special kind of optical code.
- When hologram is illuminated by a coherent source of light, a three dimensional image of the original object is formed. The formation of image from hologram is called the ***re-construction process.***
- For this work, Gabor was awarded ***Nobel Prize*** in Physics in 1971.

Holos + gramma

Complete + Writing



Dennis Gabor

A regular photograph only captures the ***brightness,*** or ***intensity of light*** at different places.

A hologram captures not only the ***brightness***, but also the ***direction and shape of the light waves*** that hit it.

Holography

- In Holography both the amplitude and phase components of light wave are recorded on a light sensitive medium such as a photographic plate.

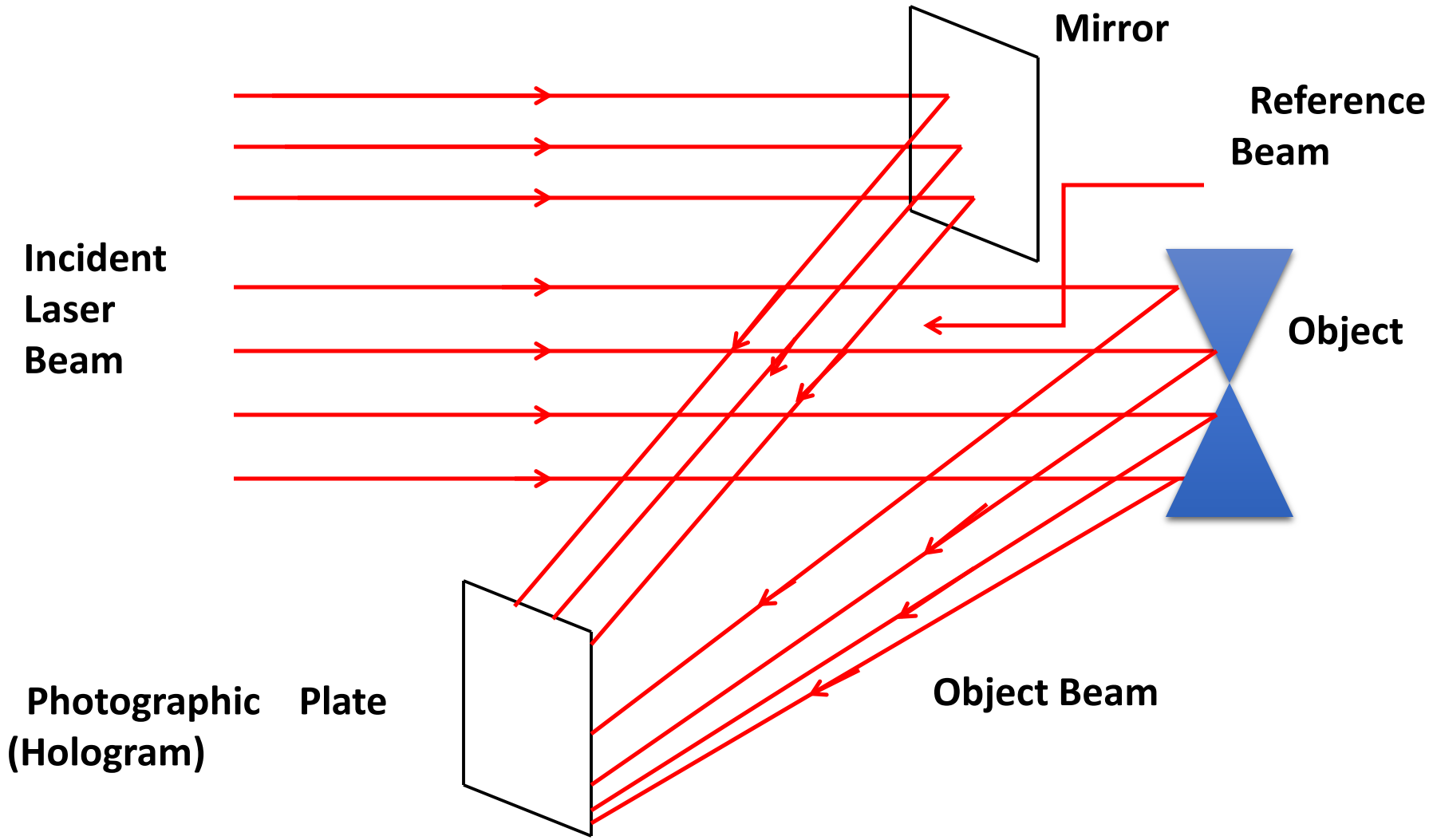
- Holography is a two step process.

  A. First step is the recording of the Hologram, where the object is transformed into a photographic record.

  B. Second step is the reconstruction in which the Hologram is transformed into the image.

- The laser (1960) met the requirement of coherent light needed for making holographic images.

Principle of Holography; Construction



Principle of Holography; Construction

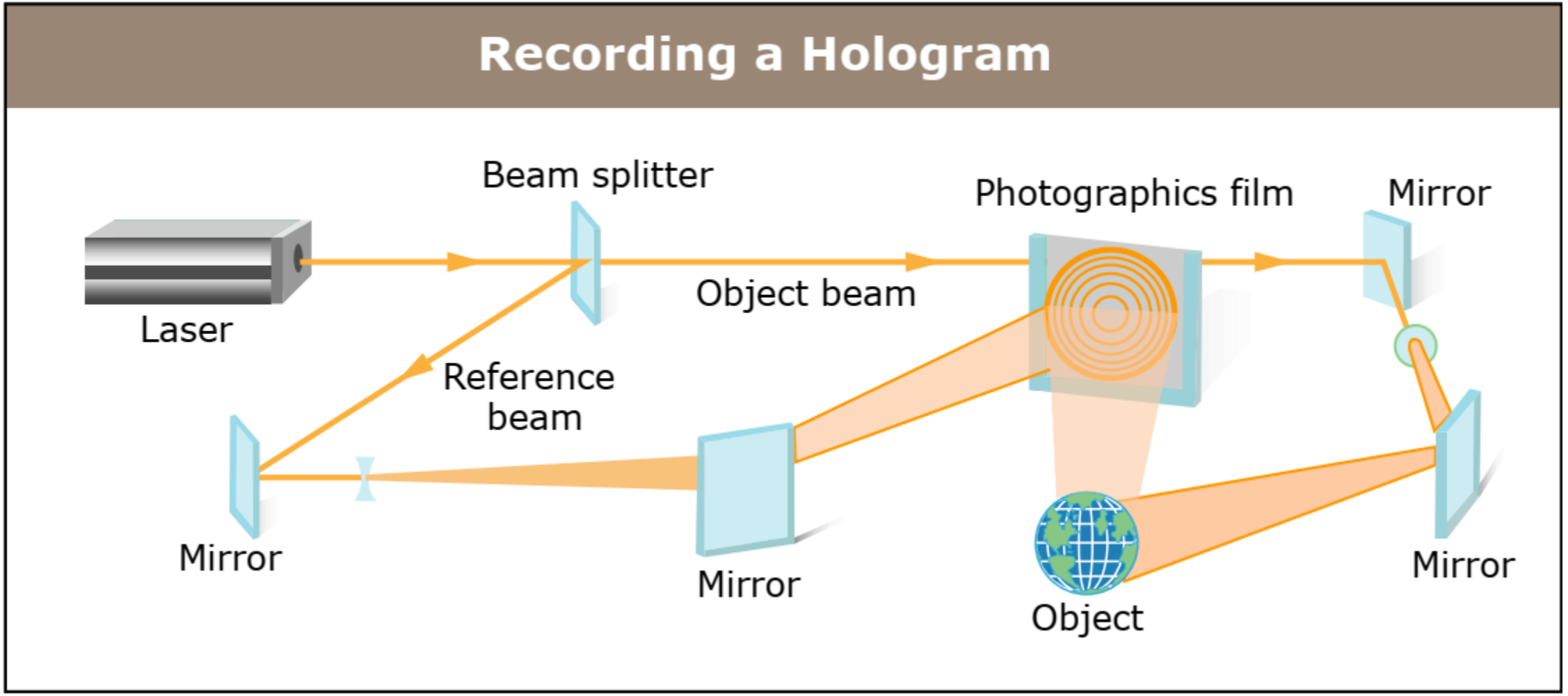
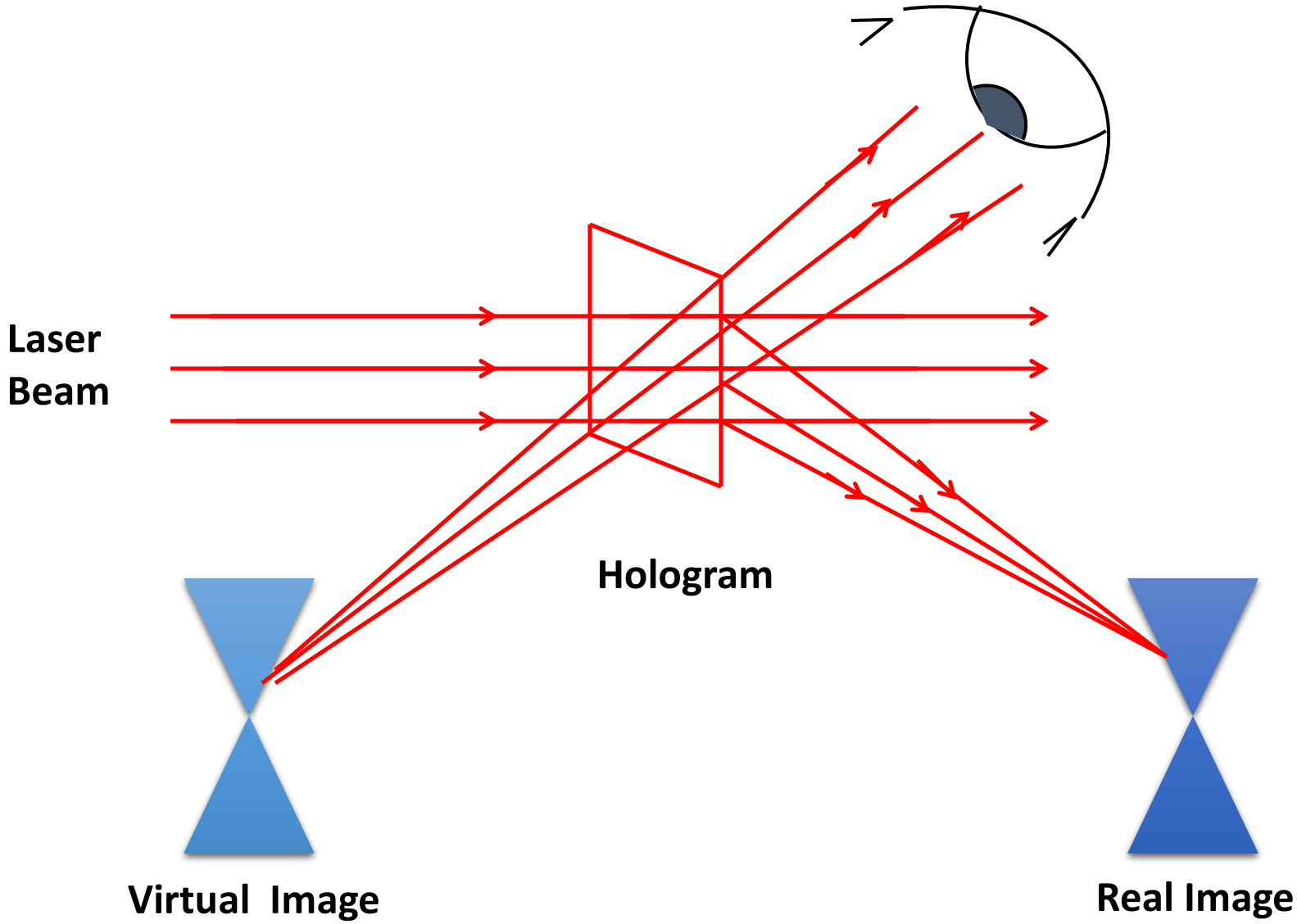


Image by MIT OpenCourseWare.

Principle of Holography; Construction

- Gabor recorded the wave pattern on the photo-graphic plate by mixing of two beams namely reference beam and object beam.
- An object to be recorded, is illuminated by highly monochromatic and coherent laser beam. Light is reflected from the object and fall on the entire photo-graphic plate.
- A part of the incident beam is also allowed to fall on a plane mirror which reflects it towards the photo-graphic plate. This is called reference beam.
- Holography is the interference between two waves, an object wave, scattered from the object and the reference wave, which is the light reaching the photographic plate directly after reflecting from mirror. The film records the intensity of the light as well as the phase difference between the scattered object and reference beams.
- The phase difference results in the 3-D perspective.

Principle of Holography; Re- Construction



Principle of Holography; Re- Construction

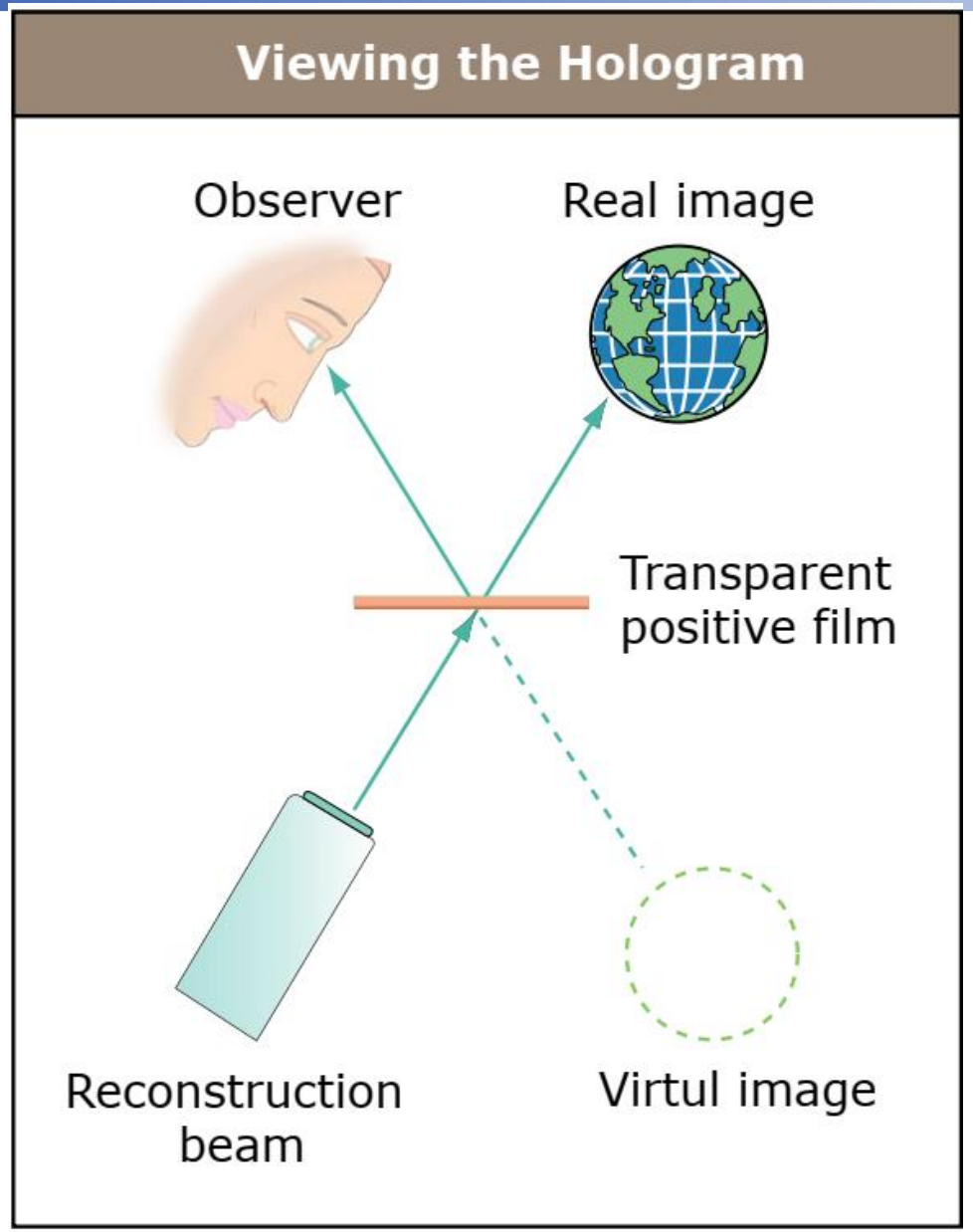


Image by MIT OpenCourseWare.

Principle of Holography; Re-Construction

- In the re-construction process, the hologram is illuminated by a collimated laser beam which undergoes diffraction phenomenon. A hologram works as a diffraction grating.

- One of the diffracted beam emerging from the hologram, when projected back, a virtual image is formed and can be observed by looking through the hologram.

- The other beam produces a real image which can be recorded on the a photographic plate.

- Thus the holography is a two stage process.

A. In the first stage, the hologram is recorded in the form of interference pattern.

B. And in the second stage, the hologram acts as a diffraction grating for the re-construction beam and the image of the project is reconstructed from the hologram.

Principle of Holography; Re-Construction

- According to diffraction theory, each point in the object acts as a point source of light.
- Each of these point sources interfere with the reference beam, giving rise to an interference pattern.
- The resulting pattern is the sum of large number of point sources plus the reference beam interference pattern.
- Conventional Photography:
  - 2-d version of a 3-d scene
  - Photograph lacks depth perception or parallax.
  - Phase relation (i.e. interference) are lost

Holographic photography:

- Freezes the intricate wave-front of light that carries all the visual information of the scene.
- Provides depth perception and parallax.
- Gives information about amplitude as well as phase of an object.
- The hologram is a complex interference pattern of microscopically spaced fringes.

APPLICATIONS OF HOLOGRAPHY

- ***Data storage:*** can store information at very high density inside crystals and polymers.

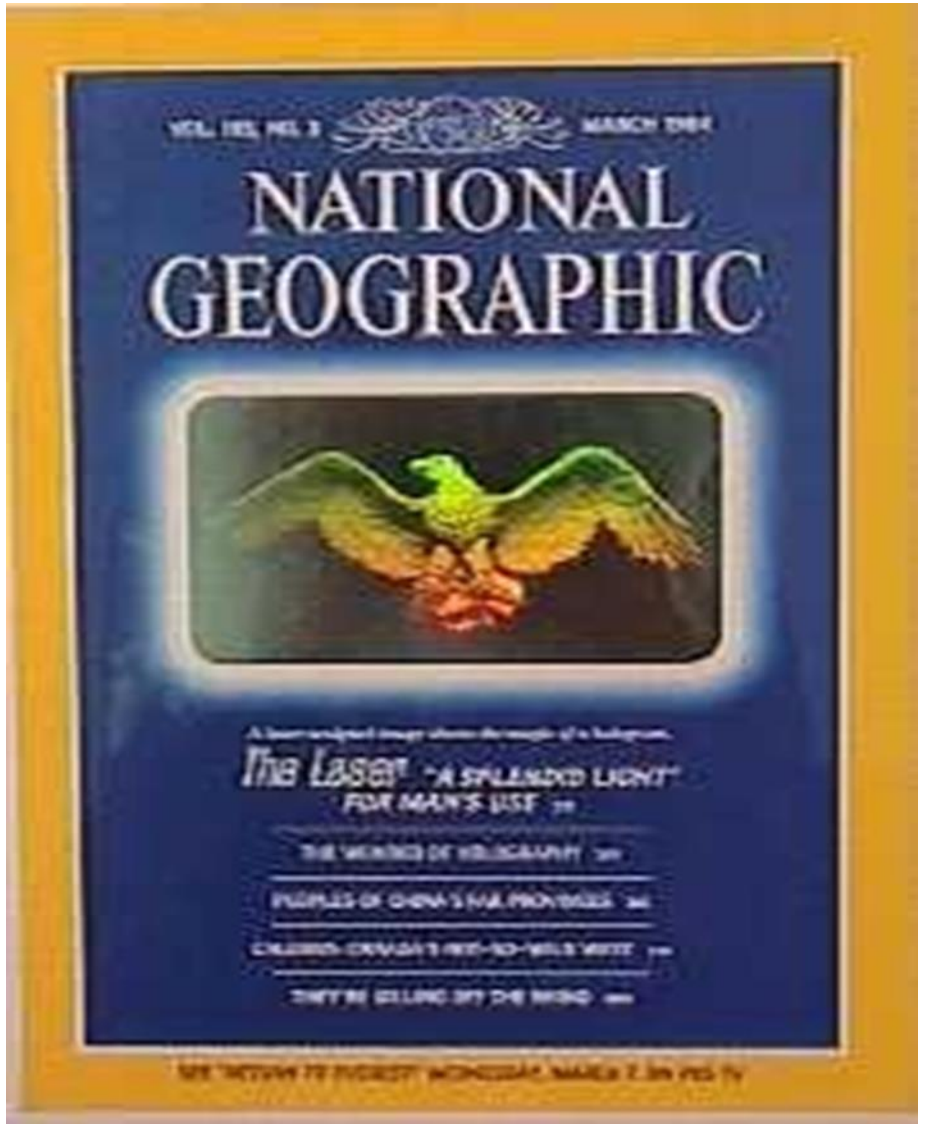
- ***Security***: security holograms are very difficult to forge because they are replicated by a master hologram, which requires very expensive, specialized and technologically advanced equipments. They are used in credit cards, bank cards etc.

- Determining cubic dimensions; ***holographic sensors*** used in post offices, larger shipping firms, automated conveyor systems to determine the three dimensional images/size of the packets.

- In movies etc.

National Geographic

- First major publication to put a hologram on its cover
- March 1984 issue carried nearly 11 million holograms around the world



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