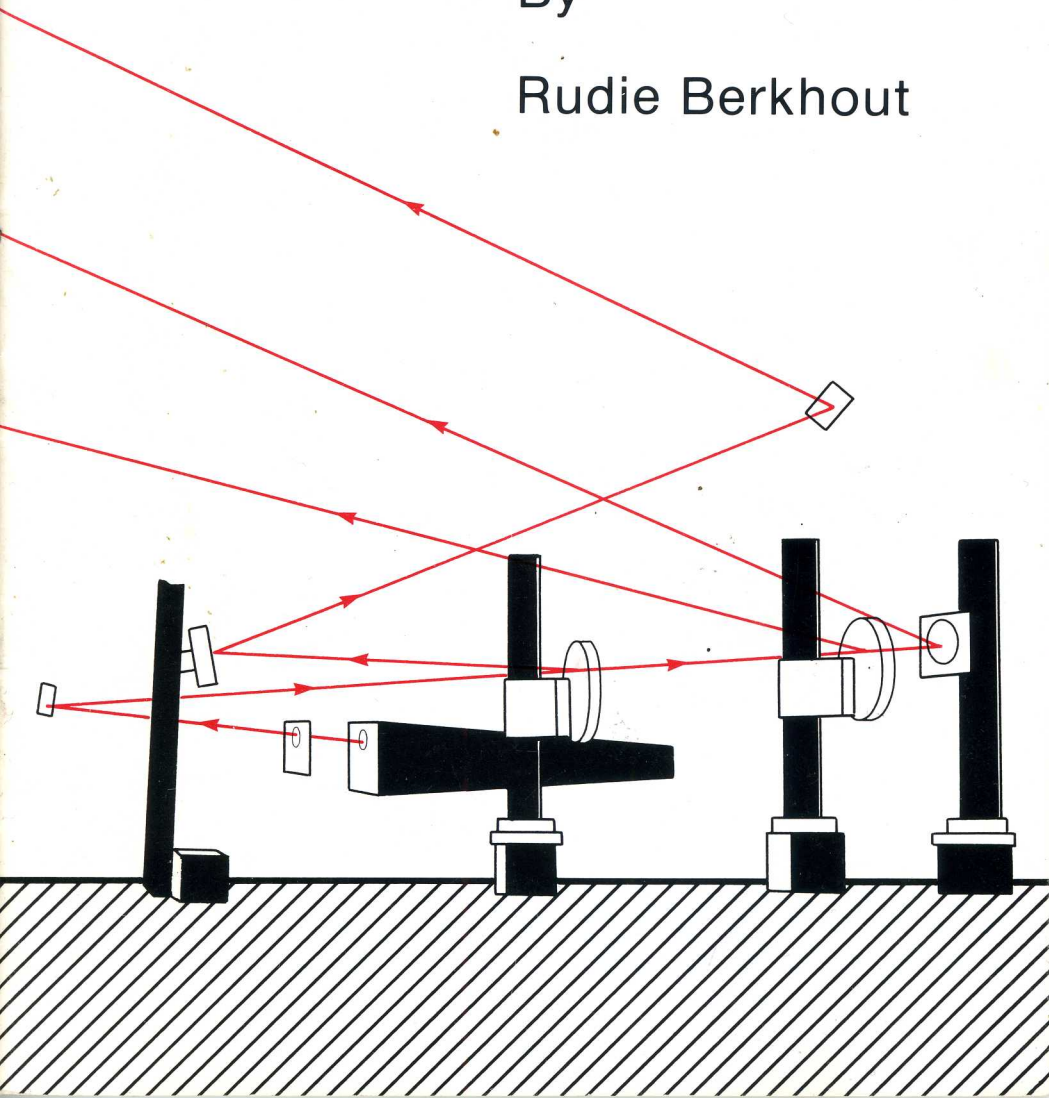


An
Explanation
Of
Holography
By
Rudie Berkhout



What is a hologram?

A hologram is a **three dimensional picture** made with laser light.

A hologram is a piece of **glass** or **plastic**, coated with a light-sensitive emulsion that has been exposed to laser light.

A hologram is like a **lens, bending the light** that shines through it, shaping the light so that the viewer can see an image in three dimensions.

A hologram is a **light record**.

When you play a **sound record** you use a needle to hear the song. When you play a **light record** you use your two eyes to see the image. If you move around and up and down in front of the hologram you can see different colors and the different sides of the image.

A hologram **transforms light**. The light coming from the little glowing wire in the light bulb is transformed into an image made of light.

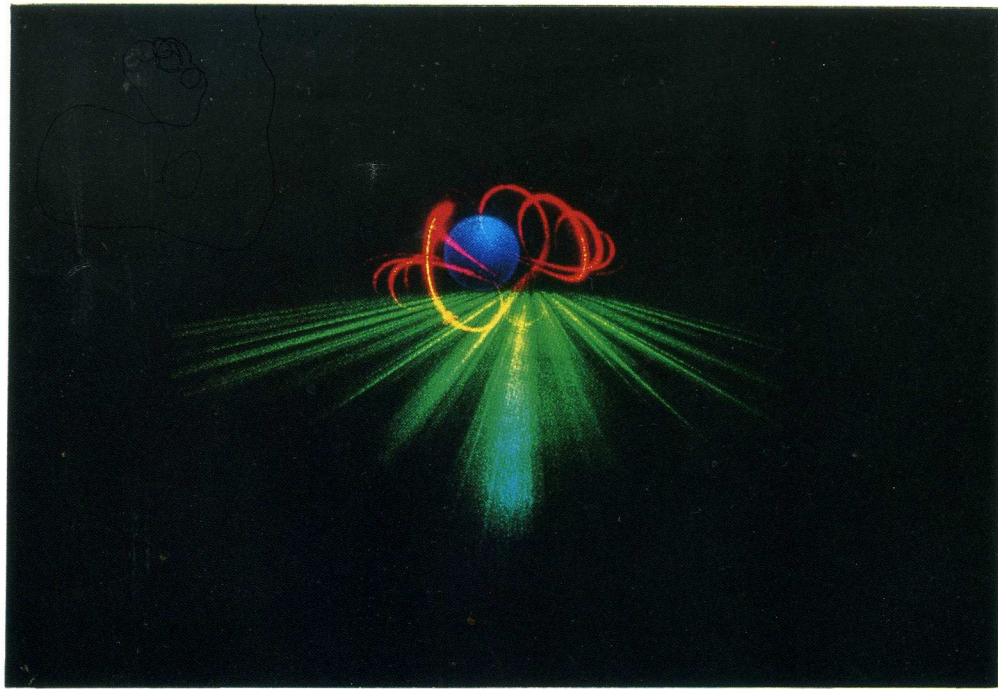
If you use a clear light bulb you will see an image.

If you use 2 clear light bulbs you will see 2 images.

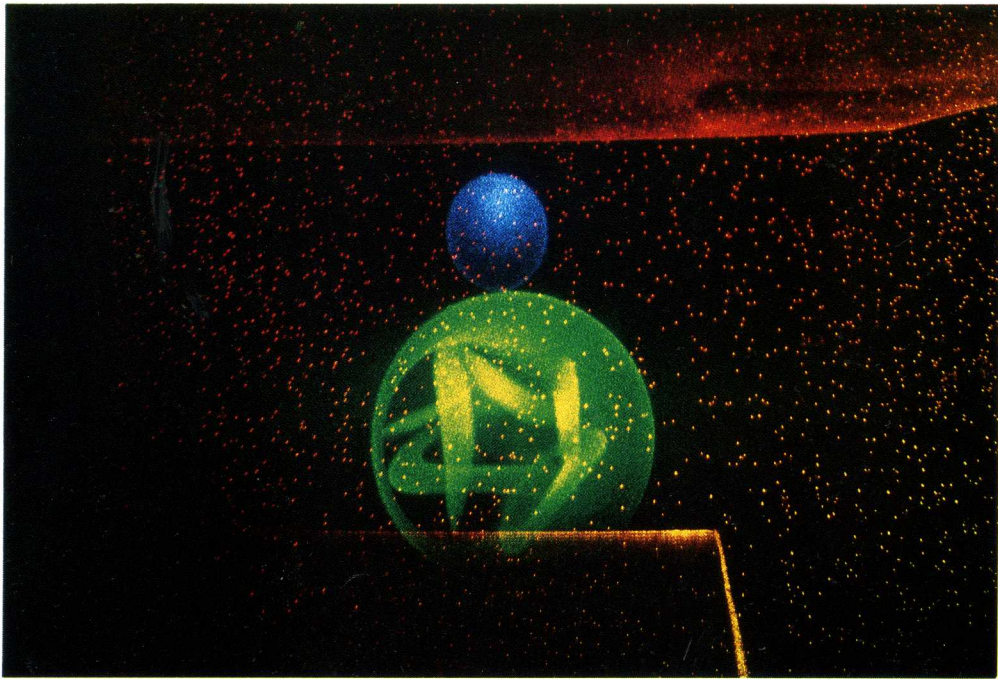
If you use a fuzzy light bulb, like a fluorescent tube, you will see a fuzzy image.

Holography is a very special imaging technique that can be used for making beautiful pictures and toys. It is also used as a tool by scientists and engineers.

Holography is a new technique that can be explored and developed further by everybody.



"Event Horizon"

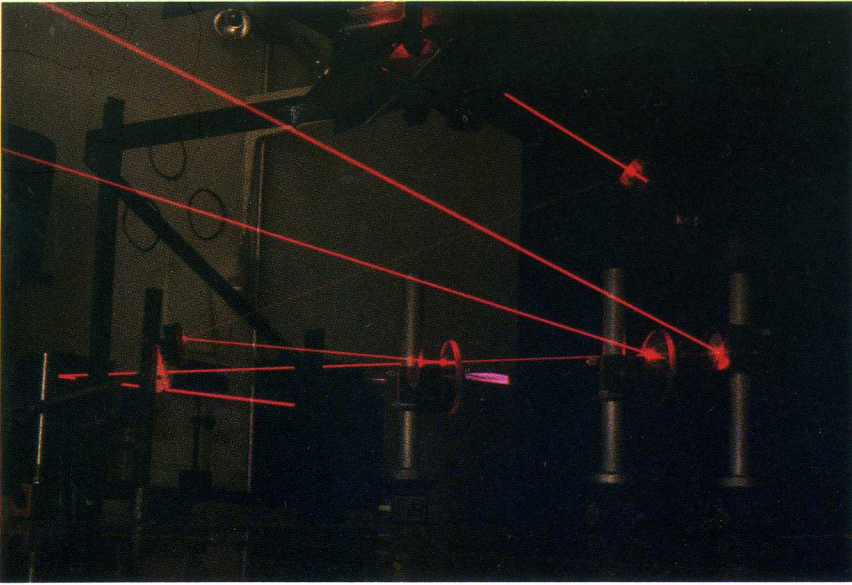


"Future Memories"

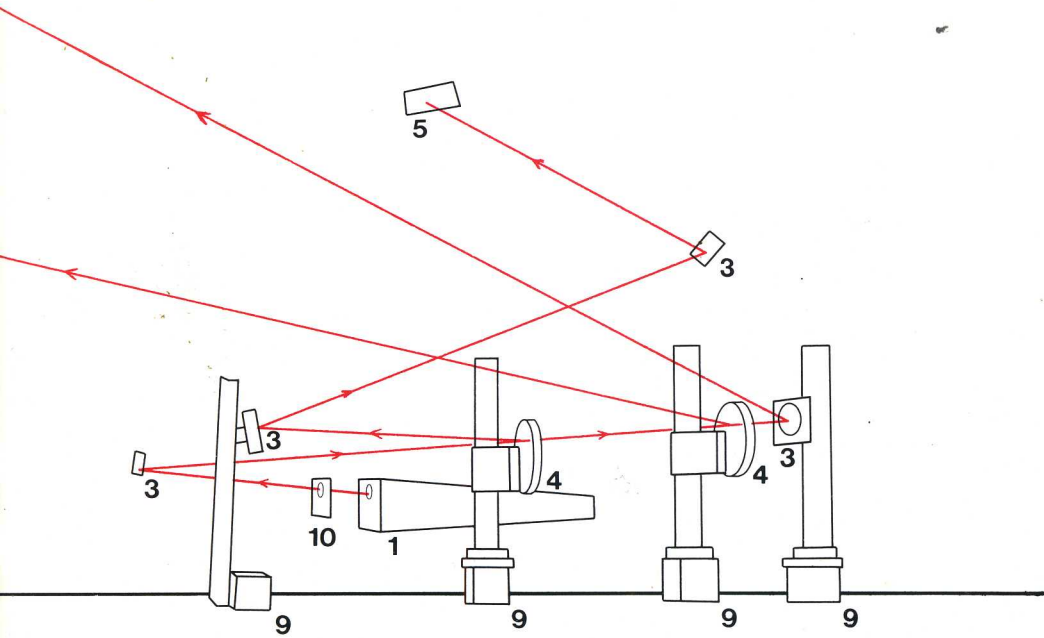
Tools for making a hologram:

- 1 Laser as the light source
- 2 Vibration Free Table to hold everything very still during the exposure
- 3 Mirrors to reflect the beams
- 4 Beamsplitters to split the laser beam into 2 beams
- 5 Lenses to spread out the light
- 6 Holographic Film or Plates on which to record the hologram
- 7 Film or Plate Holder to hold the plates or film very still on the table during the exposure
- 8 Chemicals to process the holographic emulsion after the exposure
- 9 Magnetic Holders and Optical Mounts to attach everything very tightly to the vibration free table
- 10 Shutter to turn the laser beam on and off without turning off the laser

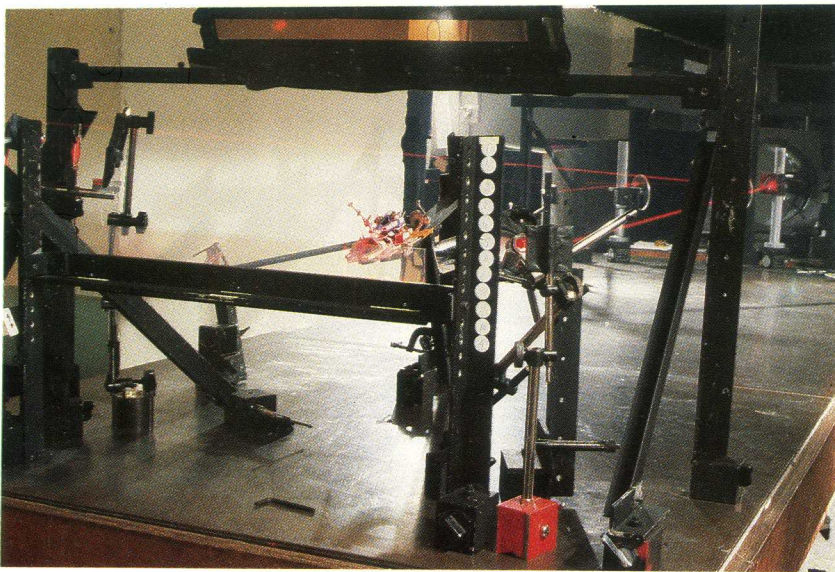
How is a hologram made?



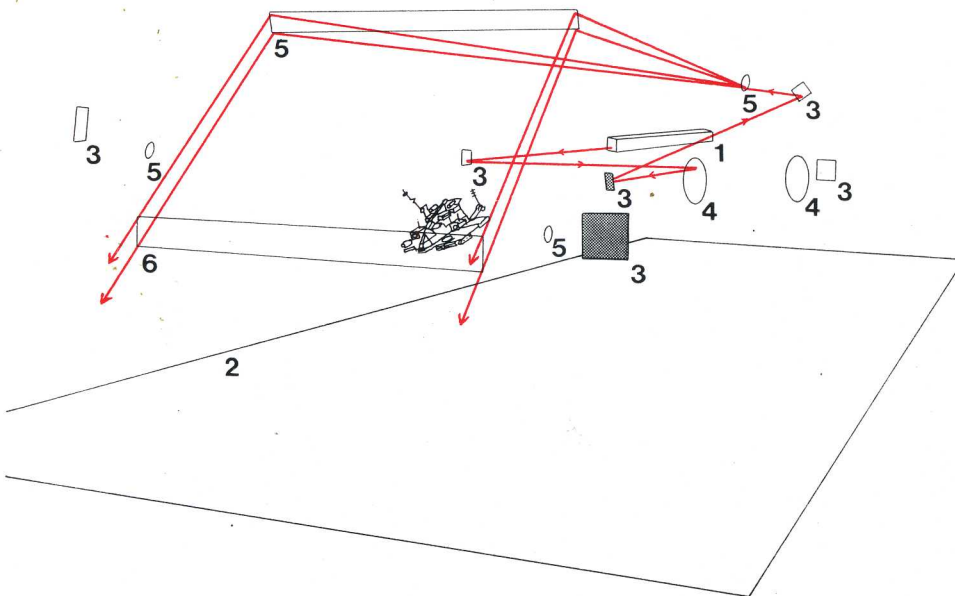
A hologram is made with the light from a laser.



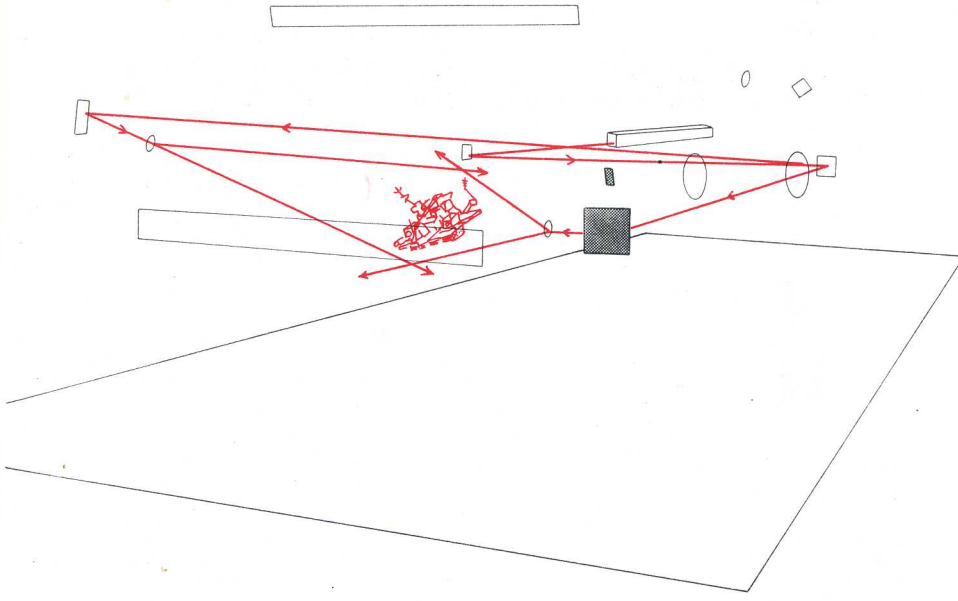
The laser beam is split into 3 beams by 2 beam splitters.



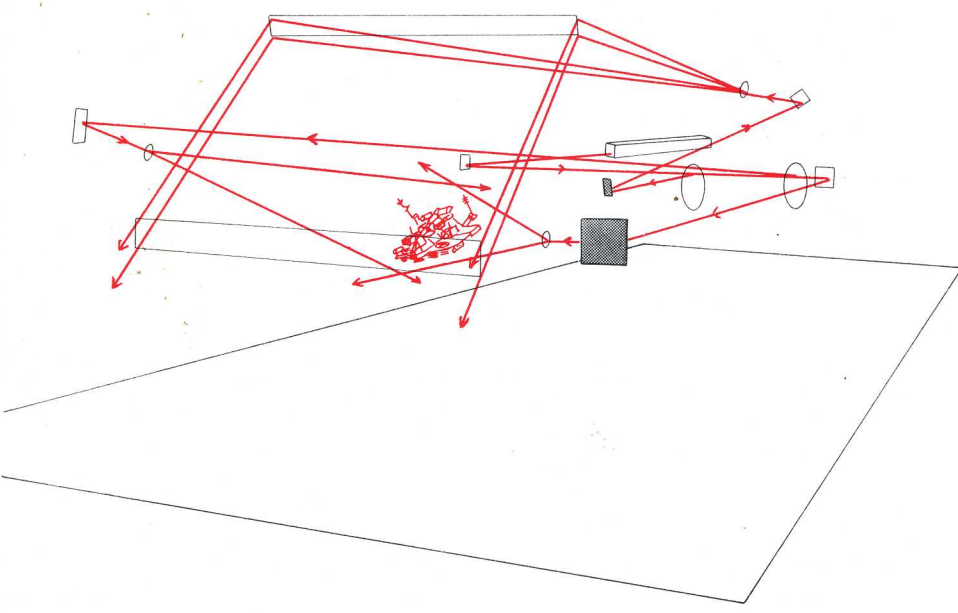
Optical set-up



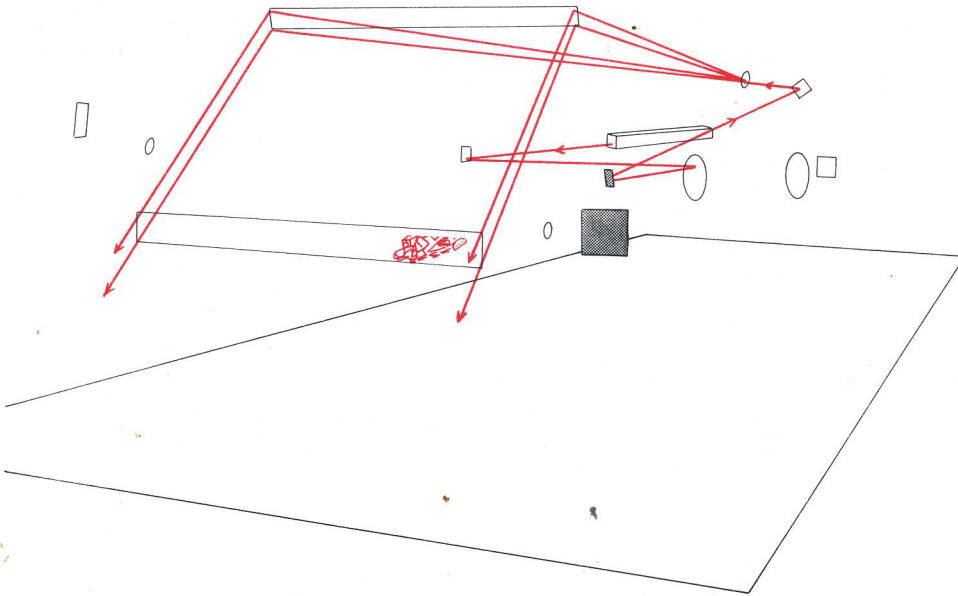
One beam (**the reference beam**) is aimed with 2 mirrors and is spread out with lenses, directly shining on the holographic plate.



The 2 other beams (**the object beams**) are also directed with mirrors and spread out with lenses illuminating the object.



When the reference light and the light coming from the object meet at the emulsion on the holographic plate they expose together a pattern of fine lines in the emulsion. The fine lines are made permanent with the help of chemistry.



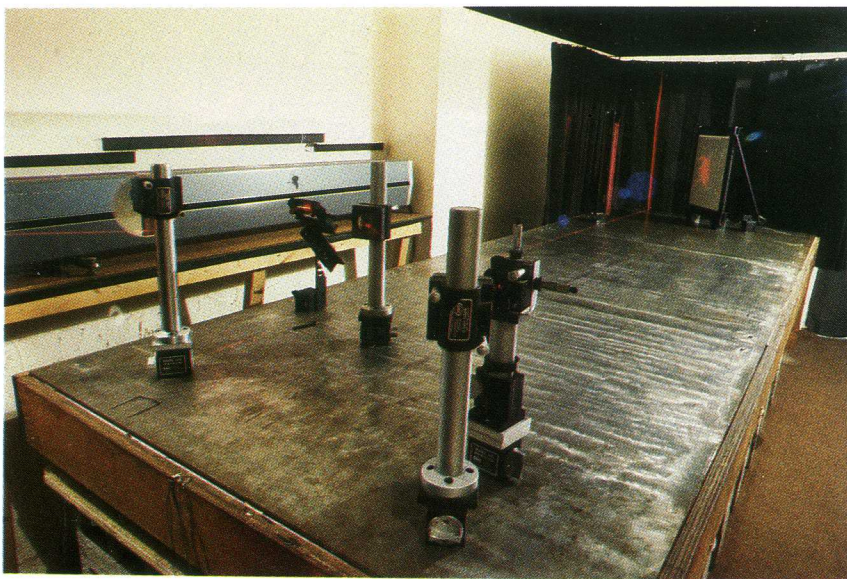
When the hologram is lit by **laser light** the **same direction** as it was lit by the reference beam during the exposure it will form a **virtual image**.

This hologram is called a **laser transmission hologram** or **master hologram** and can only be seen in laser light.

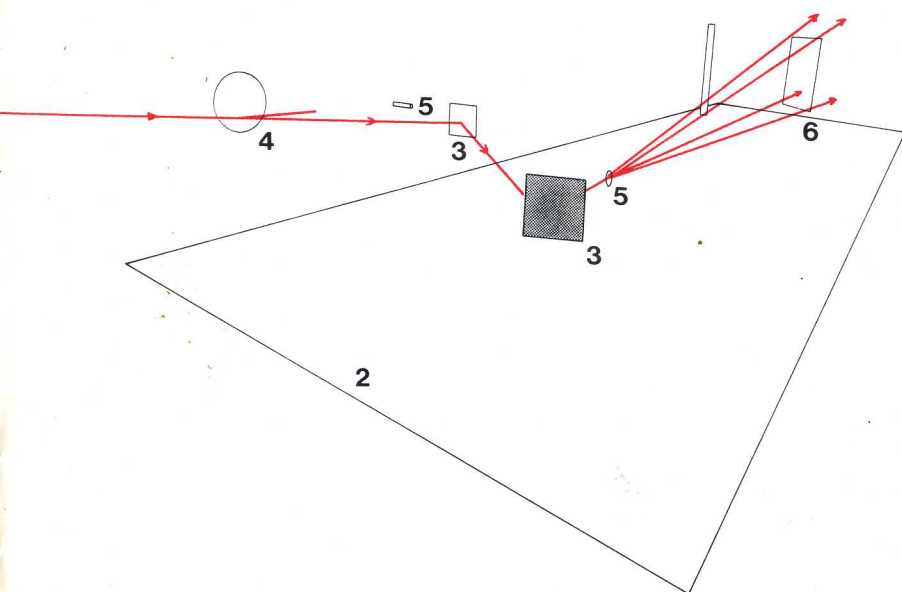
When the hologram is lit by **laser light** from the **exact opposite direction** as it was lit by the reference beam during the exposure it will form a **real image**.

A white light transmission hologram can be made from a **laser transmission** hologram (**master hologram**).

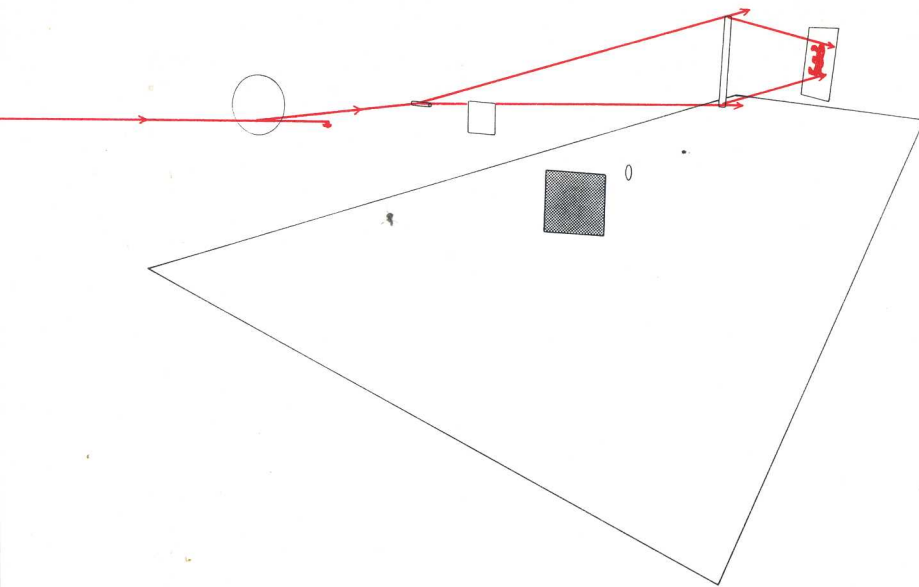
How is a hologram made that can be seen in white light?



Optical set-up

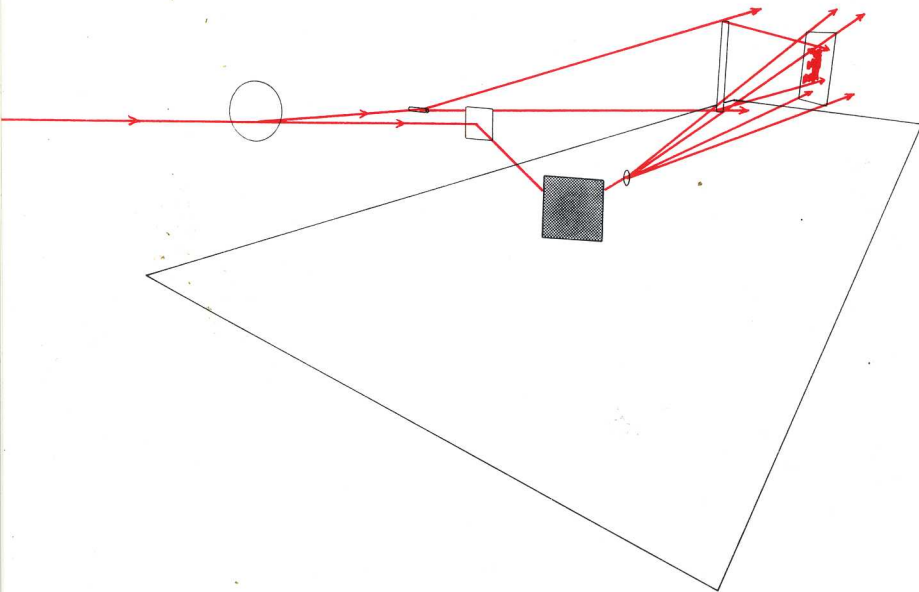


The laser beam is split in 2 beams by 1 beam splitter. One beam (**the reference beam**) is aimed with 2 mirrors and is spread out with a lens, directly shining on the holographic plate.

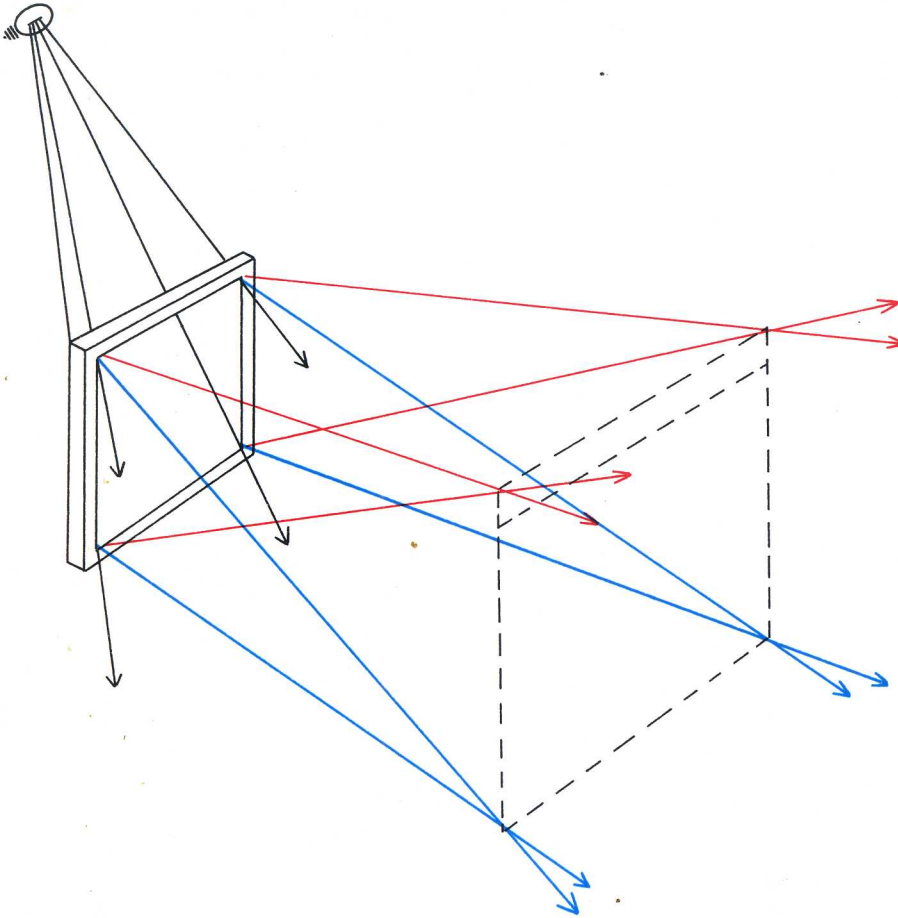


The other beam (**the object beam**) is spread out with a cylindrical lens illuminating a **horizontal** strip of the master hologram. The master hologram projects a **real image** of the object onto the holographic plate.

Notice that the holographic set-up on the vibration free table is laying on its side for the purpose of stability.



When the reference light and the image light from the master hologram meet at the emulsion on the holographic plate they expose together a pattern of fine lines in the emulsion. The fine lines are made permanent with the help of chemistry.



When this hologram is lit by white light from the **exact opposite direction** as it was lit by the reference beam during the exposure it will form its image.

The strip aperture (**master hologram**) opens up into a "**spectral window**" through which you can see the object in the different colors of the rainbow when you move up and down.

Recording several master holograms on one white light transmission hologram makes multiple color compositions possible.

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