③ Basic Amateur Holography Setup

See the section: Holographic Information Resources for alternatives – this is just one option.

(From: Brian Hogan (bhogan@bjgate.com)).

I haven't made holograms for a long time, but I started from the ground up. If you've got $3K to play with, you can really start off very well. But if you want to save money, you can build a complete setup for less than $1,000. It may be far more advanced than what you may to create pretty professional holograms.

The best bet is to get a 5–10 mW HeNe surplus laser for about $200 to $300 dollars. This type of laser should have a coherence length of at least 6″ or so. You'll also need some holographic film years ago –– don't know if they still make and easy to use). Next, you'll need to build a stable table. In a pinch, a heavy wooden plank, slab of marble, etc., laid on a few partially inflated inner tubes will probably be enough. I strongly recommend against a sandbox as it's more of a pain in the ass to keep things clean and to prevent optics from constantly shifting as you move things in the sand. Set the table up on the lowest floor, preferably on a concrete foundation, to minimize vibrations. Then you'll need to get some redirection mirrors and expanding lenses. Finally, you'll need the chemicals

From complete scratch, you are looking at an investment of about $350 to make a simple hologram.

Here are more detailed suggestions:

1. Ditch the sandbox idea. While it does work, it's a pain to keep sand from getting on all of the optics. Also, the light color of the sand means that you'll often have to mask out stray reflections. Lenses and mirrors have a tendency to shift when you move things around. I strongly recommend that you build a solid, rigid table and place it on inner tubes. For my setup, I made 6 columns out of cinder blocks about 3 ft columns a 2 inch thick pine plank measuring 4'x8'. I drilled six 4″ holes in the plank spaced evenly out and then placed 6 forklift inner tubes centered around these holes. (The holes in the plank allowed for inflating the inner tubes later on from the bottom to adjust the air cushioning.) On top of the inner tubes I built a box out of wood measuring 4'x8'x4″ inside dimensions. Into the box I poured about 11 cubic feet of Redimix concrete, using chicken wire and rebar for strengthening. The top was smoothed. After five days of curing, I glued a 1/16″ thick sheet of steel (4'x8') to the top of the concrete. I painted the steel and definitely a very heavy, solid table that (except with dynamite!) Anyway, this might be more than what you'd like, but the table performed exceptionally well. The height was such that it made for comfortable working. The size meant I could do many intricate setups with multiple beams. The steel top meant I could use magnetic mounts for the optics. Total cost was less than $200 bucks in 1986.
2. Get good optics. I got most of mine through Edmund Scientific. They're a bit expensive, though. All mirrors should front surface, not on the back). I recommend getting several mirrors of about 2″x2″. You'll also need to get two or three in the 4″x6″ range and higher. You can never have too many mirrors. The concave. Look for the largest diameter, shortest NEGATIVE focal lengths

you can find. These lenses will expand beams, doing in holography. I would try to get an assortment of −6 to −20 mm double concave lenses at least 10 mm in diameter. If you don't use plate film, get some clear glass plates about 4″x6″ to sandwich the film. I built a special jig that would clamp the film between the to make the clamp jig as small as possible −− you don't want it to interfere with any laser beams coming from behind the film to illuminate the object to be holographed. Also in the optics category, you'll need to get at least 1 variable beamsplitter mirror.

3. Make or buy good optics mounts. You can go out and purchase optics mounts, but talk about EXPENSIVE. My table had a steel top, so I built magnetic mounts. The base of the mount was nothing in diameter). I solidly epoxied 3/8″ steel rods to these magnets vertically. Most were about 18″ tall but some measured as much as 36″ tall for overhead illumination shots. The optics themselves were glued to masonite pieces (with holes for the lenses). I used laboratory stand clamps to hold the optics in place. They clamp to the optic mount rods and can swivel the optics 360 degrees. Everything was painted flat black to reduce reflections. I built about 16 mounts in all. Like mirrors, you can never have too many.
4. Get the most powerful laser you can afford. I did most of my holography with an 8 mW He−Ne laser that I purchased Instruments. The more power means shorter results. You must get a TEM00 mode, single wavelength laser. I never tried a diode laser, but I don't recommend them because the beam is not round like a TEM00 laser. A good surplus HeNe laser will cost at least $300, but it's the most important part.
5. Get the right film. Holography requires high resolution, special film for the purpose. I'm not sure Kodak is still in the holographic film business, but I had very good success with their film. I also used Agfa holographic film with pretty good results. Check around on other types of media (e.g., dichromatic emulsions), but try films first. For processing, I used Kodak D−19 developer and Kodak fixers. I used a bleach mixture I made myself out of sulfuric acid (look in plumbing section of home center for drain cleaner −− very dangerous stuff!) and potassium dichromate. There are many other formulas out there so check around on websites. Processing must be done under clean conditions in a dark room. You can use a dim green safelight so that it won't exposure the red light sensitive film. (Also see below. −−− Sam.)
6. Though this is a long description, it should give you some ideas. There are many books out there that should give setup I described will cost somewhere around $1000. Once you've had some success with making basic holograms, you'll probably invest in specialty optics and other stuff to make more advanced holograms. With my setup, I was able to do practically anything anybody else could do with equipment costing many times as much as what my stuff cost. with the actual holograms themselves but also with the equipment you use.

Good luck and have fun.

(From: Rick Poulin (rpoulin@rohcg.on.ca).)

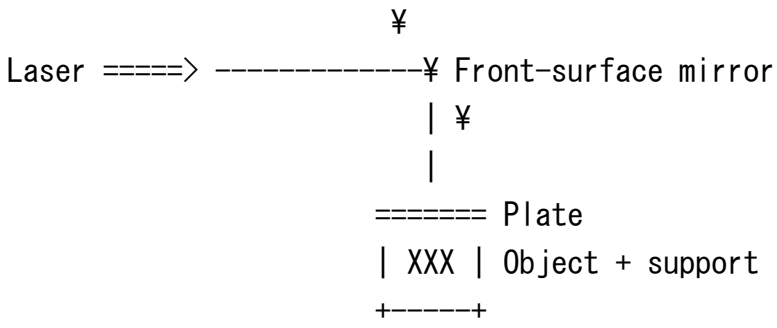
I used to be a holographic experimenter and got my supplies from Agfa but sadly they got out of the business and left many people scrambling for a new cheap source. If you want to pay through the nose, Edmund Scientific or MWK Laser Prodcuts are the high water marks for pricing.

If you want cheap film or glass plates there is a source in Russia called Red Star. Go to the Royal Holographic Art Gallery Film Page for the North American dealer in British Columbia, Canada.

(From: Jens Kilian (Jens_Kilian@agilent.com).)

The difficulty of making holograms is *much* overrated. If you're not going for commercial quality or for fancy stuff (image plane, rainbow etc.), a simple Denisyuk (reflection) hologram can be made with *very* little equipment (laser, lens, plate, chemicals).

With the right plate exposure time is in the seconds, not hours range; and the vibration problem can be reduced with a robust setup like this:



I've been to a workshop (see below) which was held in a public building next to one of the main thoroughfares in Stuttgart, where *everybody* produced near perfect holograms, even the guy, not me :-), who carried out a developed plate from the darkroom into near full sunlight.

The workshop was run by: Junker Holografie. We used HRT plates. Clickety click... *darn*, HRT has shut down (HRT Holographic Recording Technologies GmbH).

(From: Fleetie (fleetie@fleetie.demon.co.uk).)

Well, I ended up paying a lot of money for and an AR-coated beamsplitter, and such like when I briefly (!!!) took it up, but the plain fact is if you just want your first hologram, and you have the film and developing chemicals, you just need:

- Laser.
- Lens to diverge the beam.
- Object(s) to take hologram of.

Just put the lens right by the laser, get the beam nice and wide. Place the (ideally glassy or transparent or translucent) objects somewhere in the diverged beam. Put the film down-beam somewhere, so that the objects are between the laser and the film. You may find that the objects cast a shadow on the film; as long as a significant part of the film is not in shadow, it should be ok.

Unless something moves really grossly, or you severely under- or over- expose, you'll get at least some kind of a it. (It won't be optimally efficient, but you really should see SOMETHING.)

Even if something moves (but not TOO much), you'll often end up with a hologram that looks kind of stripy; the more movement, the more stripes.

To view the hologram, just leave everything set up the way it was, remove the object(s), put the hologram back in the film holder in the SAME orientation in which it was exposed, let the laser illuminate it, look THROUGH the hologram towards the laser at the place where the objects were. You should see a holographic to cut a little corner off the rectangle of film at the top right, to help get the film orientation the same when I wanted to view it. Then there are only 2 ways to orient the film, rather you had the emulsion side of the film facing towards or away from the laser. (Put a corner of the film between your lips; the emulsion side will feel sticky.))

(This is all in my limited experience; standard disclaimers apply.)

After that, you may want to try a 2-beam setup, with a reference beam shining directly onto the film, and another beam illuminating the object(s) but not the film. Then you can play with the relative brightnesses of the beams, and get better interference, and therefore a brighter hologram.

It gets harder when you want to produce reflection holograms, which can be viewed in white light. You need more power, really, to get your exposure times down.

Have fun anyway if you decide to go for it.