

Re: Lena's Birthday Question: Neatest Optical Hacks

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What a great list!

AES wrote:

- * Student in my lab who got the CO₂ gas supply he needed for an early home-brew CO₂ laser by squirting it from the hallway fire extinguisher into a plastic laundry bag. (Fire marshall was not happy at next safety inspection.)

Man after my own heart. Of course, if you weren't so cheap he could have asked for \$10 to buy a little one at the hardware store. ;) Fire extinguishers are a useful source of dry ice in emergencies.

- * Student in my lab who triggered the spiral flashlamp in his very early home-brew ruby laser using a Ford Falcon spark coil.

I'd definitely hire that guy too. People like that get things done.

- * CO₂ lasers using water-cooled distillation columns bought from chemistry supply houses as the laser tubes — and evaporated-gold-coated eyeglass lenses for the mirrors.

The condenser tube is an excellent idea, although you'd really want something a bit better than glass.

There was an outfit in my hometown, Vancouver, calle Vortek. They made incredibly powerful arc lamps by running a huge flow of water helically down the *inside* of the tube, held there by the centrifugal force. You could melt 1/2 inch steel by holding it next to one of those lamps.

- * Revitalizing early Spectra Physics and other He-Ne lasers that had lost their He due to out-diffusion through the glass envelope by putting 'em in a plastic bag filled with 1 atm of He overnight.

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Soda-lime glass, I gather. You can kill a soda-lime glass envelope PMT in a few hours the same way. An orchid to you folks and an onion for Spectra.

* The very early low-cost internal-mirror He-Ne lasers made by University Labs in Berkeley using chem lab beakers (with the "100 ml, 200 ml" markings still visible on them) as the bells for the laser structure. (Marketing manager -- or one of the management positions -- for the firm was Tom Perkins, later co-founder of mega-billion venture capital firm Kleiner Perkins.)

Brr. I bet that wasn't annealed too well. Don't bump it!

* Art Schawlow and Ted Haensch's edible dye laser: ". . . The laser material was colored Knox gelatine, prepared according to the directions on the package . . . as such, the material was a bit soft for optical work."

Ted's other two brilliant hacks were the model train interferometer, which used a corner cube, and of course the aforementioned holey fibre comb generator. A very smart guy.

* Gouy demonstrating the 180 degree Gouy phase shift through a focus experimentally in 1890, at a time when knowledge of wave propagation was still in very early stages.

How did he do that? Fringe counting with a mirror on a lever?

* Israeli CO₂ gasdynamic laser made by igniting a gasoline mixture inside a heavy-walled tank (using an ordinary spark plug to do so); blowing open a heavy spring-loaded exit door; and letting the gas exit through a supersonic nozzle.

Wow, just like a V1 rocket. It's good that CO₂ lasers have lots of gain.

* Russian very high power quasi cw CO₂ gasdynamic laser, apparently used for heat treatment of steel, made by filling an ring of big (house-sized) heavy-walled tanks with CO₂; heating them up to just under bursting pressure using gas flames (huge Bunsen burners!); and sequentially valving them, one after another, into a supersonic gasdynamic laser, while previously used tanks are refilled and re-heated.

Now *THAT's* perverse. And very Soviet. It was somebody like Illyushin the aircraft designer who said, "You Americans make airplanes like a fine watch, whereas we make ours like a cheap alarm clock. But when you knock it off the night table, the alarm clock keeps working."

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* As a follow-on to rotating mercury mirrors (which I would have cited also), Roger Angel at UoA making deeply curved, near optically perfect, 3 or 4 meter diameter mirrors by electrically melting several tons of glass in a backyard swimming pool sized tank supported 8 feet up in the air on huge rotating megawatt-capacity electrical contact bearings; then rotating the tank for days on end while the glass cooled.

* And, in same project, making the mirror lightweight by having sandstone posts which don't melt forming a honeycomb structure inside the meter-thick (or thereabouts) mirror blank after the glass melts; then blasting these out with high-pressure water after the mirror cools.

It's amazing what you can get done by really believing in Newton's Laws. My friend Ed Yarmchuk, who invented the self-servowriting hard disk, did away with interferometrically-controlled spin stands in disk manufacturing, basically by believing Newton. Accuracy improved by about 10x and throughput by much larger factors. It happened in the lab next door to me and I didn't find out till afterwards. :(

* Using ink-jet printing technology to fabricate nanotech parts or printed circuits.

* The guy at Berkeley (??) who floats tiny GaAs tetrahedrons into pre-etched, properly shaped pits on silicon wafers using water, then makes 'em operate as EO devices.

Self-assembly is pretty cool, but definitely counts as a hack because it only works statistically.

* The early fiber optics guy described in Jeff Hecht's excellent book "City of Light: The Story of Fiber Optics" who drew glass fibers many tens of meters long by attaching the tip of a softened glass rod to a metal bolt and firing it down the length of a hallway using a cross bow.

A crossbow. Nice—I hope there was nobody in the way. Dropping it down the stairwell I'd believe. When I was an undergraduate at UBC, we had an annual egg-dropping contest in the glass-enclosed stairwell of the physics lab building (four stories tall, and originally intended for a Foucault pendulum). The winner was the one whose egg got there fastest while remaining intact upon hitting the solid granite floor. They had a nice setup with crisscross laser beams at the top and bottom of the shaft, so they got good timing.

People did things like aerodynamically shaped styrofoam nosecones with drinking-straw fletching, and it was all very fun. Then some bright soul wrapped the egg in bubble wrap in a foam Big Mac container, duct-taped it to a nylon rucksack full of rocks, and heaved it over the fourth-story railing.

Result:

Bright soul: 1

Glass stairwell: 0.

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* British researchers described in same book who demonstrated how to fabricate clad fibers using a central nozzle connected to one crucible and a concentric nozzle connected to another — with colored and clear molten sugars as the (much more easily melted) core and cladding materials.

Optical cotton candy. Nice.

* Early Bell Labs White cell experiment where they broke the x,y symmetry of the cell, and thus were able to get many more bounces stuffed into the cell, by mechanically bending one of the end mirrors.

Could you say more about that? What's a White cell?

* Allied Chemical, who found it very difficult to separate the mixture of rare earths used to add luminosity to Coleman lantern mantels, so just packaged them all in one powder and marketed it as previously unknown rare earth "didymium".

Hmm. Didymium is a kind of filter glass used for torch welding glasses—praseodymium and neodymium, I think. I wonder which came first?

* The old idea of compensating thermal expansion by using a differential structure where short section of high-expansion material compensates longer section of lower-expansion material.

That's the Huyghens pendulum (or was it Hooke?). The transient response is sufficiently horrible that this definitely qualifies as a hack, though we have to cut the guy some slack, considering he improved timekeeping by something like two orders of magnitude, and was working in the 17th century! (Another very smart guy.)

* Which leads to whole idea of precision differential screw techniques using slightly different threads per inch.

Differential screws are especially nice because they're pretty solid mechanically, if you get the keyways really snug. Victorian mechanical engineers really were pretty amazing. Mechanics was where the action was, of course, so you got the very best people, and that's enough to make any field exciting.

Thanks again for a great list!

Re: Lena's Birthday Question: Neatest Optical Hacks

Cheers,

Phil Hobbs

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