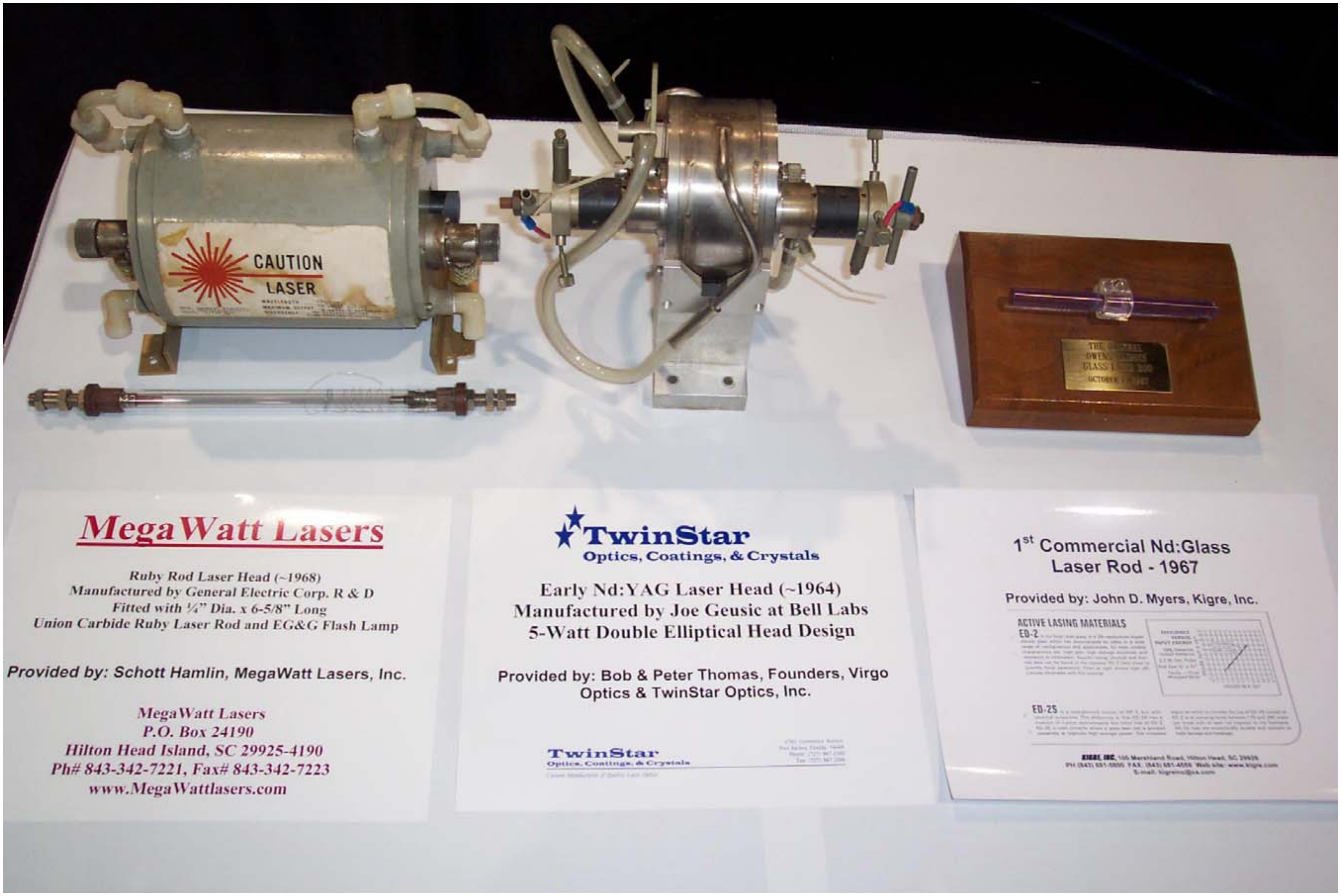

CAUTION
LASER
MegaWatt Lasers
Ruby Rod Laser Head (~1968)
Manufactured by General Electric Corp. R & D
Fitted with ¼" Dia. x 6-5/8" Long
Union Carbide Ruby Laser Rod and EG&G Flash Lamp
Provided by: Schott Hamlin, MegaWatt Lasers, Inc.
MegaWatt Lasers
P.O. Box 24190
Hilton Head Island, SC 29925-4190
Ph# 843-342-7221, Fax# 843-342-7223
www.MegaWattlasers.com
TwinStar
Optics, Coatings, & Crystals
Early Nd:YAG Laser Head (~1964)
Manufactured by Joe Geusic at Bell Labs
5-Watt Double Elliptical Head Design
Provided by: Bob & Peter Thomas, Founders, Virgo Optics & TwinStar Optics, Inc.
TwinStar
Optics, Coatings, & Crystals
1st Commercial Nd:Glass Laser Rod - 1967
Provided by: John D. Myers, Kigre, Inc.
ACTIVE LASING MATERIALS
ED-2
ED-2S

From Left to Right:

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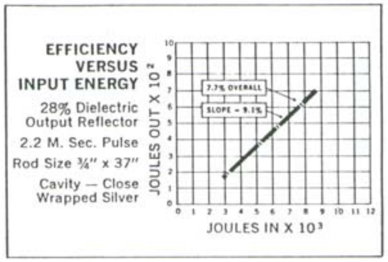
1st Commercial Nd:Glass
Laser Rod - 1967
Provided by: John D. Myers, Kigre, Inc.

ACTIVE LASING MATERIALS

ED-2 is our basic laser glass. It is 3% neodymium-doped silicate glass which has demonstrated its utility in a wide range of configurations and applications. Its most notable characteristics are: high gain, high damage threshold, and resistance to solarization. Specific lasing, physical and thermal data can be found in the separate ED-2 data sheet to quantify these parameters. Chart at right shows high efficiencies obtainable with this material.



ED-2S is a strengthened version of ED-2, but with identical properties. The difference is that ED-2S has a modulus of rupture approximately five times that of ED-2. ED-2S is used primarily where a glass laser rod is pumped repeatedly at relatively high *average* power. The crossover region at which to consider the use of ED-2S instead of ED-2 is at pumping levels between 175 and 200 watts per linear inch of laser rod exposed to the flashlamp. ED-2S rods are exceptionally durable and resistant to field damage and breakage.

A Blast from the Past: Highlights of a Vintage Laser Collection

Robert A. Hess

Immediately after Hughes Research Laboratory announced the first laser in July 1960, many working in research labs began building them for their own use. The second half of 1960 certainly saw the first do-it-yourself frenzy around lasers. By the end of that year, however, it was clear that somebody needed to start making and selling lasers commercially, and soon! Raytheon met the challenge by making the first sales of commercial ruby lasers in March 1961.

During the first few years of production, lasers went to researchers studying new applications for this radically new light source. Rods and coatings on solid-state lasers were destroyed. Air leaked past Brewster windows into early gas lasers. Imagine how delicate early ion lasers were. By the end of the ’60s, all those first lasers had been long replaced by something much more stable, with much higher output power and greatly improved beam quality. Nobody knows how many lasers from the first few years of production were scrapped, but the rest have been sitting quietly for the past 40 years in cabinets, basements or garages, never to run again.

I’ve collected a few of those old “cabinet grannies” over the past 25 years and have displayed them throughout this year as part of the Laserfest exhibit at West Coast conferences. Those from the early ’60s are wonderful souvenirs of the “Camelot” days of “the right stuff” – ruby lasers without Q-switches, radio-frequency-excited helium-neon lasers with start buttons and current control. Lasers from later in that decade featured a wide variety of plasma tube architectures and creative package designs, as well as vastly improved optical performance. My collection was very well received at those exhibits, and I’d like to share a few details about some of them.

Camelot lasers

I refer to lasers built during the Kennedy administration as Camelot lasers. They represent the very first round of production lasers offered for sale to the general public, and they were generally the first lasers used to explore many applications. There were only a handful of companies making lasers before 1964, but by 1965 there was a need for a dedicated magazine (*Laser Focus*) to organize the industry that formed around them. Camelot lasers are very rare indeed.

I’ll start with the oldest laser

I’ve found to date, a “proof of concept” prototype for the elliptical cavity ruby laser announced by M. Ciftan, C. Luck, C. Shafer and H. Statz of the Raytheon Research Div. in December 1960 and described at an Institute of Radio Engineers meeting the following May[1,2] (Figure 1).

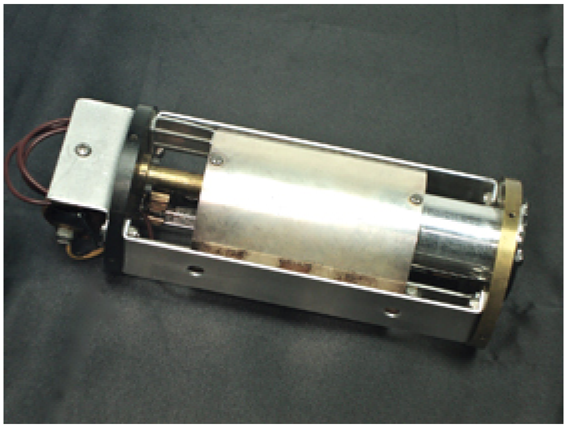


Figure 1. *This 1960 Raytheon prototype ruby laser head is a proof-of-concept prototype for the first commercial laser.*

Raytheon physicists were very quick to repeat Maiman's design and the results with it, and the elliptical cavity prototype was next in line. Since then, this head had been kept mostly by a lifetime-career employee of Raytheon, then bought from his estate by a surplus electronics dealer, then bought by a student who threw away the cover and never got around to making it work, then bought off eBay by Ben Steigerwald, a young laser enthusiast who finally sold it to me.

The cavity reflector is a piece of chrome-plated brass sheet metal, wrapped around chrome-plated brass elliptical end plates. The rod is 0.25 in. in diameter and 3 in. long and has dielectric reflective coatings on its ends. It's held against the front rod mount by a spring. The linear flashlamp is wrapped with a trigger wire, and a transformer is attached to the rear bulkhead. A few other electrical components were attached inside the cover that was lost. The front rod holder on this laser is cylindrical instead of conical as in pictures of these prototypes seen in books of the time,[3,4] and the joint of the cavity reflector is on the opposite side of the cavity compared with that shown in those books.

Next is the 1962 Hughes Aircraft Company Model 200 ruby laser system, the world's oldest operational commercial laser (Figure 2). This was the first laser model built for sale by the company that started it all, although Hughes Aircraft's incorporation of lasers into other systems predates the Model 200 by a year and a half.[5,6] It's all-original and fully operational, and it includes all of its original parts, except for the mounting interface piece. It's matched with a Model 250 power supply and produces a maximum of 1.5-J pulses at 694.3 nm.

Figure 2. *Built in 1962, the Model 200 ruby laser system was the first commercial laser product built by Hughes Aircraft Company. It was part of the Laserfest exhibit at Photonics West in 2010.*

After Maiman built the first laser in the middle of 1960, Hughes immediately applied pulsed ruby lasers to radar. In 1961, Douglas Buddenhagen, a member of the radar group, formed a new group at Hughes Aircraft Company to commercialize it. The group grew to about a dozen people making three or four models, this being the smallest and first out after a few for lab and demo use and one for Wright-Patterson Air Force Base. This particular laser was originally bought by Texas Instruments and used for trimming resistors. It was then bought at a surplus sale in the mid-1970s by a laser engineer who just wanted to have a ruby laser; he kept it on his shelf until 2006.

The HAC Model 200 is essentially the first laser design, and as basic as it gets. The ruby in this one is 1.5 in. long and 0.375 in. in diameter, with multilayer dielectric reflectors on its ends. The flashlamp is a xenon-filled quartz helix that takes a maximum input energy of 780 J at 1350 V. There is a purge tube to allow passing cool air or nitrogen through the flashlamp cavity for repetitive pulsing. The Model 250 power supply has a capacitance of 875 μF, adjustable in 175-μF increments by the scissor switches located under the top of the cabinet, which lifts up like the hood of a car.

Finishing the early ruby lasers here is a 1962 Optics Technology Inc. (OTI) Model 120 (Figure 3). OTI was started in 1960 by Narinder Kapany to make laser photocoagulators. The Belmont, Calif.-based company also included Art Schawlow. Early on, they decided to also produce lasers for the commercial market and, by January 1962, they were advertising their Model 100 pulsed ruby laser. The following year, they began production of the smaller Model 120.[7]

__Figure 3.__ Pictured are the 1962 Optics Technology Model 120 ruby laser system (below) and the 1962 PerkinElmer/Spectra-Physics Model 110 HeNe laser head (above). The OTI-120 featured space in the head for "modulation and Fabry-Perot accessories." The Model 110, displayed at SPIE's Optics & Photonics 2010, is owned by Spectra-Physics and includes its end covers.

The OTI 120 featured an easily accessible pump cavity, a 3 x 1/4-in. rod, 0.5-J output energy, an iris diaphragm on the output bezel and threads on the front end for a microscope objective. The rod holder in this laser, however, is made for a rod of smaller diameter, which I don't have. There is a bump in the glass rod positioner, which also indicates the use of a smaller-diameter rod.

The elliptical pump cavity is polished aluminum and comes apart with four screws. The lamp is linear and held by ceramic holders. There is plenty of room inside the head for mirror mounts, but this laser apparently had its reflectors on the rod ends. I love the vintage trigger that's permanently attached! The face of the power supply has taken a beating sometime in its past and looks like it's been hammered back into place. Otherwise, the components inside look good and clean.

The continuous wave

The first commercial CW laser was the PerkinElmer/Spectra-Physics Model 100 HeNe laser. It was first offered in March 1962 and had an IR output wavelength. Spectra-Physics had been formed to produce lasers seven months earlier; its first 75 sold (ending in June 1963) also carried the PerkinElmer name on the badge.[8]

The first commercial CW laser with a visible output was the PerkinElmer/Spectra-Physics Model 110 HeNe, one of which is shown in Figure 4, as displayed in the Laserfest exhibit at Photonics West earlier this year. This one is missing its cylindrical end covers and rubber boots. The Brewster windows are big compared with the tube diameter, making them look like puppies' feet. It was radio-frequency-excited, so there are antenna wires along the tube, and it has an in-line start button and a radio-frequency-level knob.

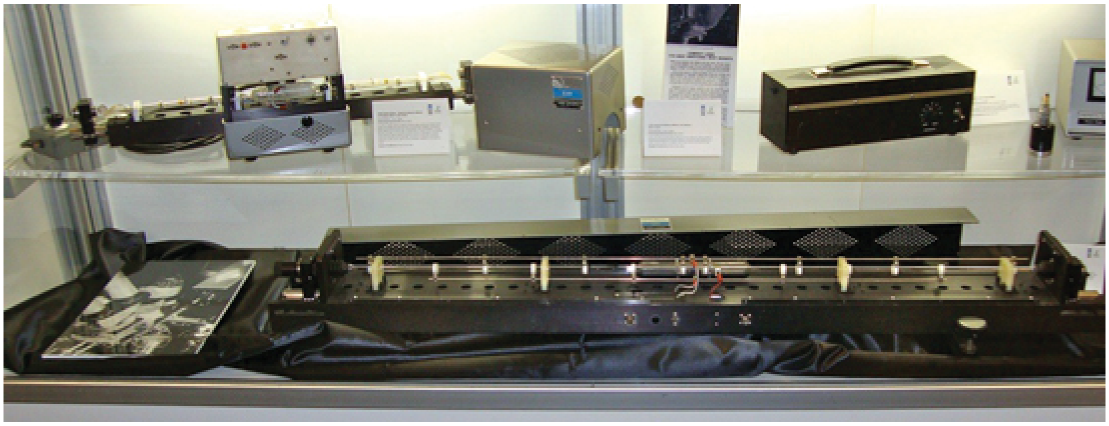


Figure 4. *The 1963 PerkinElmer/Spectra-Physics Model 111 HeNe laser head was one of the first 75 commercial CW lasers sold.*

The gentleman I bought it from a few years ago got it from his friend around 1970; the friend got it in a surplus sale from the University of Houston. It had long ago lost its gas, so he installed a gas fill valve onto the ballast tank. The valve extended to the right of the tank from the tip-off and curved forward to a valve mounted on the base of the head. This required moving the right side support for the head covers to the outside of the center section and drilling a hole in the face of the central cover. I've had the gas fill valve removed and put the cover hardware back to its original configuration.

It was the 3-mW beam from a Model 110 that Leith and Upatnieks borrowed from Vander Lugt on Christmas Eve in 1962 to make the first hologram ever with laser light, of 2-D imagery. In March 1963, they bought a laser for their own lab: the larger PerkinElmer/Spectra-Physics Model 111 (also seen in Figure 4).[9] This laser had a 10-mW output, giving the team the power necessary to eventually make the first holograms of 3-D imagery with diffuse illumination near the end of that year.

I got the Model 111 laser head in the early 1980s from a Silicon Valley Dumpster diver who needed cash to get out of jail. I knew it was old and loved the fact that the cover and badge were so clean and the number was 111. The getter is gone, the high reflector is missing, and I don't have the power supply, but the tube is intact.

The only reference to this laser I've found is the cover picture on "The Story of the Laser" by John Carroll. After the deal with PerkinElmer ended, Spectra-Physics introduced the Model 112, which the company made through the 1960s. It had a different resonator and much more complex mirror mounts featuring micrometer handles, but the tube was the same as in the Model 111.

Figure 5. *The 1966 PerkinElmer Model 5200 HeNe laser system, originally offered in 1963, was also used in the company's laser Raman spectrometer, first offered in July 1964. A very " '60s looking" laser!*

The first laser built in 1963 for sale by PerkinElmer alone was the Model 5200 (Figure 5). The first HeNe with the now-classic cylindrical head, it was touted as a "practical laser" for use on production equipment in demanding environments. The head's outer structure also was the resonator structure (which I call an exoresonator). It had an output power of 1.3 mW, a hot cathode and current control on the power supply. I bought this and a few other lasers in my collection from Sam Goldwasser, a well-known laser enthusiast.

The first laser designed to be used as a "laser pointer" was the Spectra-Physics Model 130, also introduced in 1963 (Figure 6). It weighed 10 lb and was 13 in. long. It featured an integrated DC power supply, an exoresonator, 0.3-mW output in a single mode and a price of $1,525 new. Compare that with today's laser pointers, which can produce >1 W of blue light in a battery-operated flashlight-size device costing less than $200!

Figure 6. With an integrated DC power supply and a handle, the 1964 Spectra-Physics Model 130B HeNe laser was the first "laser pointer."

Other producers of Camelot lasers were Raytheon, Maser Optics and Trion Instruments (which became Lear Siegler in 1962). Raytheon also sold the first ion laser in November 1964,[1] then went on to become the military industrial giant it is today. Maser Optics built many solid-state and a few gas laser systems before dissolving in the late '60s. Trion was formed by famous holographer Lloyd G. Cross early in 1961 to produce ruby lasers and was probably the first company formed specifically to build lasers commercially.

Lasers from the later '60s

The number of laser manufacturers grew steadily through the rest of the 1960s, with many large industrial lasers brought into the market along with the small lab devices. Large ruby, Nd:YAG, ion and CO_2 lasers all became available. These can be difficult to collect, however, because of their size and weight. I'd like to mention a few of the HeNe lasers I've found from that time, however, as good examples of what might be lurking under layers of dust on storage room shelves.

***Figure 7.** The 1965 Electro Optics Associates model LAS-101 HeNe laser head included a booklet called Laboratory Experiments with Coherent Light to help science educators explain the new technology to students.*

The 1965 Electro Optics Associates (EOA) Model LAS-101 was intended for the educational market (Figure 7). It was a portable laser designed for use with a user-provided power supply, and it featured a double-walled plasma tube for extended lifetime, an internal resonator structure and a stylish green Plexiglas cover. EOA was a Palo Alto, Calif.-based company that dissolved in the mid-1970s.

The 1967 Scientifica & Cook Model B-17/S is a very early laser from the London-based company founded in 1962 by Dr. Paul Cook (Figure 8). The mirrors were produced with hard-oxide materials by Angus Macleod at Grubb-Parsons. The output power was 0.5-mW single-mode, and it cost $728 during the “Summer of Love.” I bought this laser and the EOA LAS-101 from another collector of vintage lasers, Piotr Kucharski of Poland. It features an integrated DC power supply, an aluminum case where the corner posts serve as the resonator structure, large-diameter interchangeable mirrors (like the EOA LAS-101), three leveling feet, a very interesting plasma tube design and a striking red paint job. Very mod!

Figure 8. *The 1967 Scientifica & Cook Model B17/S HeNe laser, an early British laser from the “Summer of Love,” shows a classic ’60s design.*

The 1968 Hughes Aircraft Company Model 3052 argon-ion laser system is the oldest ion laser I’ve found (Figure 9). After the ion laser was invented at Hughes, a few models for airborne applications and other general uses were built. The technology was eventually transferred to the Electron Dynamics Div. to manufacture a line of militarized lasers,[10] and this is an example of what was eventually produced. It shares the head case design, adjustment knobs and prism tilter with the Model 3040H pulsed argon-ion laser Hughes built in 1966. This is a water-cooled CW version of that laser.

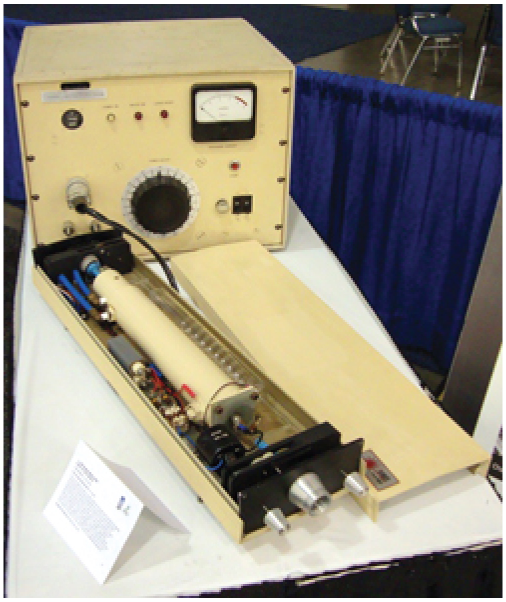


Figure 9. *The 1968 Hughes Aircraft Company Model 3052 argon-ion laser system was bought as surplus from Rutgers University and sold via Craigslist to a college student, who subsequently sold it to the author because it was just too old and heavy to deal with.*

The head (Serial No. C002) is 30 in. long and features a beautiful glass spiral gas return line inside the ballast tube, a heavy aluminum exoresonator, and "Jetsons"-style mirror adjustment knobs. The power supply is comically heavy, like a safe, and has vacuum tubes inside. Any laser with vacuum tubes inside the power supply is a "vintage" laser! I love the feel of that big old 5-in. knob, and I'm not the only one. When it was displayed at Photonics West last January, the knob was in a different position every time I looked at it.

Finally, there is the 1969 Edmund Scientific Model 79006, which was actually manufactured by Metrologic (Figure 10). It had an output power of 1 mW and featured a double-walled plasma tube providing a lifetime quoted to be up to 3000 hours. The tube was designed to be easily removed from the head and mounted on top with optional clips and extension leads for classroom demonstrations. The price of this laser was only $150 when new! I remember thinking how very expensive that laser was, as I drooled over the Edmund catalog as a 12-year-old in 1969. Forty years later, and it's mine! I didn't realize then that it was also a "time machine."

Figure 10. *This 1969 Edmund Scientific model 79006 HeNe laser was intended for educational applications and features an easily removable plasma tube for easy experimentation.*

Save the lasers!

Lasers with rubies and plasma tubes are drifting away. They are so easily separated from their power supplies, and it's often difficult even to identify them as lasers. Those who have them increasingly are not those who saved them all these years. Plasma tubes are delicate and easily broken in shipment. I would like to save as many of these wonderful old instruments from the dump as possible. Please contact me if you have an old laser you'd like to sell or see preserved. I'm also looking for old laser publications, old support equipment like Ealing rails and their associated carriers and components, and any other laser-related devices from the 1960s.

Here are a few tips to remember when encountering vintage "cabinet granny" lasers. Keep laser heads horizontal. Plasma tubes were generally not mounted to prevent movement along their axis. Don't trust handles on power supplies to take the weight originally entrusted to them. Don't stick adhesive tape on old paint or cables. Don't clean old lasers. Keep all parts of systems and cables together and identified. And finally, use at least 4 in. of insulation on all sides of laser components when shipping them, and mark boxes for heads to be kept horizontal.

Meet the author

Robert A. Hess is a holographer and laser enthusiast in San Jose, Calif. He currently works for SBG Labs in Sunnyvale, making electrically switchable hologram optical elements in proprietary holographic polymer dispersed liquid crystal materials. He may be contacted at bobhess57@comcast.net.

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