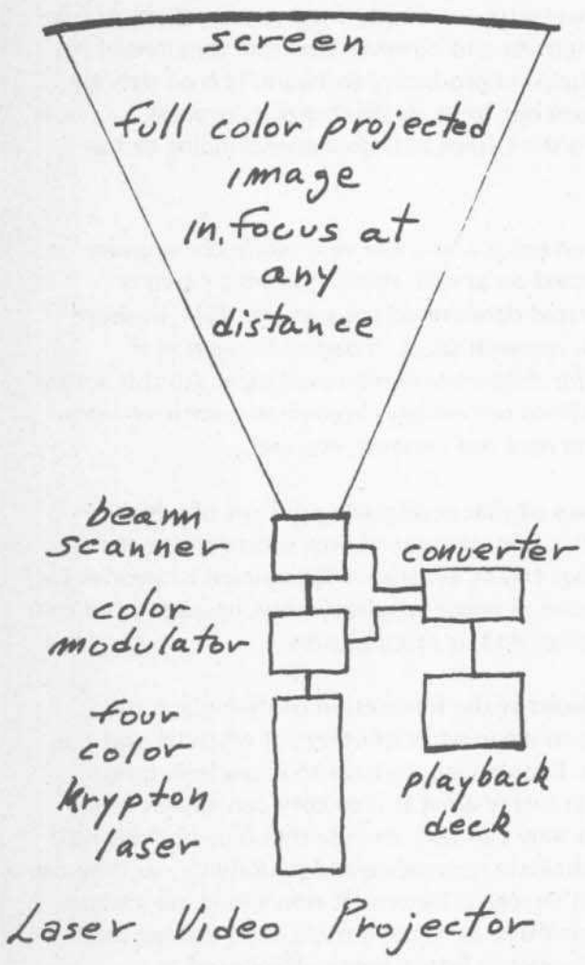
LASER

A SHORT HISTORY OF THE LASER®

by Lloyd Cross



On any Planet, proposing, conceiving, designing, building, demonstrating, using or "inventing", the laser is possible only after the discovery of the quantum theory. A laser could have been built on this planet by the scientists of the 18th century IF (and only IF) they had known the quantum theory. On this planet, a laser (or optical maser as it was called by pre-laser physicists) was built first and demonstrated by Ted Maiman at Hughes research laboratory in June of 1960, 30 years after the discovery of the quantum theory. It is interesting to note that a good percentage of the scientific community did not quite believe Ted Maiman's first report of his incredible results with a small cube of ruby crystal, highly polished, silvered and subjected to a high intensity electronic flash bulb, from Hughes Laboratory in June of 1960.

In the early 1950's, several scientists published the concept of amplification of high frequency electromagnetic energy by stimulated emission of radiation from atomic and/or molecular sites in a properly prepared material.

In 1954, Charles Townes, working at Columbia University in N.Y.C. demonstrated the application of this concept by designing and fabricating a microwave amplifier and oscillator (called a maser) using hot ammonia gas as the material.

Chihiro Kikuchi, working at the University of Michigan, first demonstrated maser action in a ruby crystal in December of 1957. (I was there the day it happened.) This was the first practical maser material and led to a tremendous influx of money and effort into the field.

It is not completely coincidental that Ted Maiman also used ruby (prepared in a much different way) to achieve laser action, since in the few years between 1957 and 1960, an incredible amount of information on the electromagnetic properties of ruby and associated materials was compiled and published by dozens of laboratories.

And here is one final piece of information concerning the history of the laser . . .

A United States Patent was issued to Townes and Schalow (subsequently purchased by A.T.&T.) in 1958! They did not demonstrate a working laser, but they received a patent by a neat legal process which is called constructive reduction to practice, which means that the fact of the U.S. Patent Office issuing a patent is equivalent to an actual demonstration of a conceived device. (U.S. patent law was written in the late 18th century and has undergone little or no revision, even after the quantum theory, the atomic bomb, microelectrons modern chemistry and the laser.)

The reader is left to his own devices to figure out who invented the laser and how he came about it. But one important fact is that each of these men had intimate working knowledge of the quantum theory, there was not a "crack pot inventor" among them. The most energetic and enthusiastic Rube Goldberg or Thomas Edison would not achieve laser action, without instruction, in a million years of intensive screwing around, given the best equipment in the world, if he didn't know the quantum theory.

The proper mathematical solutions to this equation describe the energy states and configurations of any atom or molecular system known (which includes a lot of material, including our entire physical being). Get to know it. Look into lasers, and beyond, into the infinite and completely comprehensible universe.

THE POTENTIAL IMPACT of the LASER on the VIDEO MEDIUM®

by Lloyd Cross

The laser is the highest frequency coherent source of electromagnetic radiation. Using laser radiation as an information carrier, 10% bandwidths of 10^{13} cycles per second (ten thousand, billion cycles per second or approximately ten billion telephone circuits or approximately one million video circuits or approximately one hundred thousand holographic video circuits) could be transmitted via optical transceiver stations, using a single laser beam.

In other words, since the discovery of the laser in 1960, the capability of virtually free information transmission is ours. The problems of designing, fabricating and operating the optical transceiver stations are large and require many years and considerable technical and financial investment to solve, but there are no basic problems remaining to essentially unlimited information transfer since the advent of the laser.

Prior to the laser, the highest frequency coherent oscillator had a capability of a 10^9 cps bandwidth, which reduces all the above numbers by a factor of ten thousand which brings information transmittal back into the problem area of carrier frequency assignments, interference, limited number of channels and all that bullshit we presently have to contend with. The existence of the laser at least lets us know that that particular bullshit will be gone forever, with the advent of the first economical optical transceiver equipment.

> Consider, for example, a possible future in which millions of low cost mass-produced optical transceivers are available operating on one optical laser wavelength which, when pointed to the sky, day or night, rain or shine, anywhere in the world, would pick up scattered optical carrier waves from a few syncronous satellites which could potentially contain the equivalent of one million continuous open video channels. (A tiny computer would be required for fine tuning.)

(Since there are extensive, but not insoluble, problems in the area of optical cabling and atmospheric optical transmission, there will probably be an intermediate period of microwave transceiver equipment in the near future.)

In terms of information transmitted by stored information, tapes, cassettes, holographic cassettes, etc., the laser will again supply the technology to reduce the cost and volume of storage equipment to a level such that those materials can be considered to be virtually free.

> Consider, for example, a possible future where in a small holographically coded plastic coin, say the size of a quarter, would be dropped in a slot in a small black box and play back video programs for one hundred .
>
> HOURS

The above examples are complete fiction, without laser technology. Of course, it goes without saying that the above linear projections will probably not evolve exactly as stated, but some equivalent thing can happen with the use of the laser. The laser comes from beyond the year 2000. We have the laser N O W.

But what can we do with it NOW?

Well, even if the problems of information transmission were solved today, via the laser, the equipment limitations of camera pickup, recording, editing, replaying and displaying video would still keep us oscillating around our various thresholds of frustration whenever we really tried to achieve mass information transmission, which is necessary to or equivalent to free or low cost information.

In fact, from a free information point of view, the video medium today, with the tape and cassettes now available, is primarily limited by the peripheral equipment (pickups, players and monitors) and not the information carrier or storage medium.

(I guess I should say a little bit about what I mean when I use the words free information. I mean very low cost, non-programmed no-hassle to get, keep or play back, information, whether live or stored.)

Concerning the problem of video display. There is no reason why (given, say six months and $100,000.) a prototype full color laser video projector couldn't be built and installed in a convenient central location in New York where anyone could go and see video tapes displayed in bright, high resolution format on a 6' x 8' screen along with hundreds of other people in a comfortably lighted environment. Similar units could be installed in other locations around the planet for a fraction of the cost of the first device ($15,000. Or $20,000. each). Whether or not such a financial investment would return a respectable percentage to the financier depends on the charge for and rate of attendance, but regardless of that consider the effect of that kind of facility on the video medium and community today.

That kind of facility would mean that (providing the charge for admission was really nominal, say $.25/hr.) hundreds or perhaps thousands of people per day could get access to the tapes now stored in Central Data Bank and other archives, as well as the tapes now being made or planned.

Further, that facility could provide funds for people making tapes on some kind of percentage basis from attendance receipts.

Now I should explain why I believe that a laser projector is the best way to go about this project (assuming it's a desirable thing to do in the sense that it would at least experiment with some kind of mass information transfer on a low cost, no hassle, non-programmed basis). A bright projected image, 6' x 8' in size in a room 50' x 100' (5,000 sq. ft.) in dimension would have the same aspect, angle of view and resolution for viewers located in the middle of the room as a normal 18" monitor would have for a viewer sitting six feet away from it. A viewer at the end of the room would have a totally equivalent view to someone twenty feet from a normal monitor.

A four color krypton laser would produce a bright, total color image in which line resolution could be reduced to that of the finest commercial monitor, if desired. Further, the direct laser beam could be scanned at lower rates to achieve visual effects completely impossible with a conventional video projector pack, as in the laser projection of sound currently being exhibited at the Laser Theater at 131 Prince Street, New York City. And still further, the krypton laser could run for thousands of hours, maintenance free, which is a problem for state of the art T.V. projectors. The problem of brightness is important since a comfortable lighted environment would permit reading and writing by the viewer as well eliminate hassle in coming and going. The advent of the four color krypton laser, the world's most fantastic light source, makes this possible, N O W, within the year. In fact, I'm going to do it, when I get the cash together, if someone else doesn't do it first.

There are a few other places in the video process where laser technology could eliminate or mutate present restrictions right now.

Consider for example:

A reasonably priced laser video camera which would be virtually independent of environmental lighting conditions. The Perkins-Elmer Corporation has built an experimental prototype of such a device which can record bright video in complete darkness, but it is far too expensive for the typical video artist. A development and design project could produce low cost laser camera within one or two years, again the questions of time, cash and return on investments need answers, but it could be done-----NOW.

Consider also:

Given stereo information from two conventional video cameras, it's possible that a laser projector in combination with a holographically etched screen could produce 3-D stereo projection video without the use of poloroid glasses or other physical encumbrances. This technique, again, is really feasible only with a laser projector and it is possible NOW.

And, consider still further:

Using a 360° pickup system with a conventional Vidicon camera system, and a 360° overhead laser projector scanning the recorded video onto a circular wall, viewers would receive a complete 360° view of the camera's environment over a vertical angle of 60°. The viewer would be standing or seated in a large circular room seeing in all directions and having difficulty determining the reality of their environment. Again, given a laser projector, this is possible N O W. Cost, may be one year and another $200,000. Why not, should video stay in the tube forever? I say, let's get it out of there, man, let's see what it can really do for us.

Considering such things as holographic television, mass transference via laser beam, projection in free space without screens and stuff like that, either forget it forever as a totally fucked up idea or maybe wait ten or fifteen years, if we last that long, for some kind of holographic 3-D video. That's all I've got to say about that, right now. I will be willing to discuss these or other applications of or questions about lasers with anyone. *Write Lloyd G. Cross, P.O. Box 60, Prince Station, New York City 10012.*