Appendix V: The Omnichrome Air cooled Argon Laser

The argon laser has proved to be a very versatile laser for scientific applications. The laser utilizes pure argon with a longitudinal discharge to create excited argon neutrals as well as Ar ions in the ground state and in the excited states. In fact the lasing transitions occur in the excited states of the argon ion. This means that very high current densities are required since the excitation is a multi-step process with electron-atom collisions first exciting the atoms, then ionizing and maybe even a third collision to create the excited ion states. In order to further enhance the current density, for a given discharge current, a solenoidal magnetic field is used to squeeze the current to about 1 mm or so–considerable smaller than the diameter of the discharge tube. Furthermore there is a very high rate of heat transfer to the walls of the tube and high melting point materials are necessary. This air cooled argon laser uses tungsten discs, I believe. Other designs use BeO, or graphite.

This Omnichrome laser has a very simple operational sequence. Since it is basically designed for original equipment manufacturers (OEM) we need to supply a voltmeter to get a readout of the current. Although there is an optical feedback circuit, I strongly recommend always operating the laser in the constant current mode.

Caution!! The laser has sufficient output power easily to cause retinal damage if the direct beam or a strong reflection enters your pupil where it is then focused by the lens of your eye onto your retina!! Always wear the orange protective goggles when turning on the laser or adjusting the beam!! Always know where the beam is headed before you start the laser!! Usually you can see where the beam is by putting a piece of paper in the beam where it will fluoresce at wavelengths transmitted by the goggles.

Operation:

- attach the voltmeter probes to the little circuit board
- verify that the little switch on the pc board is in the **standby** position
- turn on the AC power at the rocker switch
- turn the key switch interlock to the "on" position
- after a minute or so, a high voltage spark will start the discharge
- allow a few minutes for warmup and then adjust the power–Verify that the power control knob is fully counterclockwise, switch to the **normal** position and use the knob to increase the power while observing the voltmeter readout. Note that the calibration is 0.1 V / Amp of discharge current.

Note that the operating lifetime (mean time before failure--MBTF) is strongly dependent on the current level as the table shows. Also, since the mirrors are physically sealed to the laser tube and chosen for high reflectivity over a rather broad spectrum, the laser will normally operate on at least three transitions simultaneously. Some transitions have higher gain than others so the number of lines and their power is a strong function of the driving current.

OMNICHROME SERIES 532 OUTPUT POWER AND LIFETIME

PLASMA TUBE	LASER OUTPUT POWER (mW)				LIFETIME
CURRENT	multi-	pure lines			MTBF
(amps)	mode	457.9 nm	488.0 nm	514.5 nm	(hours)
4	20	1	7	0	20000
6	50	2	17.6	7.6	12000
8	110	5.2	27	23	5000
10	220	10	44	42	1750
12	325	15	60	68	1250
14	430	22	81	98	750