Laser Experiment Notes

Laser Setup:

Adjust laser tube so that mirror (output coupler) is centered in the beam horizontally and vertically; the beam when not lasing can be seen as a large spot with concentric circles of light. Then, look for the back reflection around the sides of the Brewster window. Alignment is accomplished by two fine adjustments on output coupler. Adjust the tilt of the output coupler window to put the reflected beam in the center of the Brewster window.

Transverse Modes:

Use mirror at 45 degrees to direct beam through magnifying lens and observe transverse modes. Vary alignment of output coupler slightly for different modes.

Fabry-Perot Setup

Will observe longitudinal modes of the laser. Only 2 or 3 modes of the cavity fall within the line width of the He-Ne transition. A piezoelectric crystal moves one of the mirrors of the Fabry-Perot. Distance is linear with voltage.

Wavetek signal generator (lo 50 ohm output) goes to Burleigh high voltage op amp input (voltage range 0-1000v); sync out feeds external trigger of scope.
Set for triangle wave, frequency multiplier=10 Hz

Burleigh high voltage output goes to Fabry Perot (connector on side of detector). A red light on Burleigh unit indicates overvoltage requiring reset.
Burleigh “voltage divided by 100” goes to ch 1 of scope.
FP output goes to ch 2.

On scope, triangle wave amplitude peak to peak ~1 v (--> 100v applied to FP)
For 50 ms period (20 Hz) peaks will be seen in FP output separated by ~4 ms.

Align laser for Gausian beam.

Center laser beam on FP:

Align so that incoming beam is reflected back on itself by interferometer mirror. Incoming and reflected beam observed as two spots on face of FP. Vertical adjustment requires slightly loosening lock screw and pivoting by hand.

Longitudinal modes of laser shift back and forth in frequency as length of cavity changes due to vibrations and thermal effects. Capture single traces using the digital camera. Measure the position difference between longitudinal modes on in the photographs. The pattern is repeated (different orders in the FP). Use the known spacing between orders (free spectral range) to calibrate and calculate the frequency difference of the longitudinal modes. Compare with what is expected based the cavity length and the laser wavelength. Repeat for several cavity lengths.