PHTN1306 Lasers III

Assignment (2017F 2017/12/19)

DPSS Model Review

The following assignment is to be word processed (not handwritten) and following the usual simple format: include a title page with the assignment title and student name, and submit the entire assignment in a bound folder (not a pile of loose papers or a binder).

Due Tuesday, Jan 2, 2018, in the lecture.

Following the lectures on 2017/12/12 and 2017/12/14, develop a complete model for a DPSS laser.

The target laser uses a single TEC cooler for both the laser diode and Nd:YAG amplifier.

Specs on the pump diode (AL0808F2000 laser diode):
Threshold current = 500mA (at 25C)
Wavelength coefficient of temperature 0.3nm/C
Slope efficiency 1W/A
Characteristic Temperature 157K
Center wavelength 808nm at 25C
Assume a Gaussian output curve with a FWHM of 5nm

Specs on the DPSS amplifier:
Wavelength 946nm
ROC = 99%
RHR=100%
Beam diameter 0.5mm
Amplifier length 1mm

The model must be done on a spreadsheet with columns (at a minimum) as follows:
Column A = Temperature (at least every degree C)
Pump diode wavelength (nm)
- Calculate this from the parameters given

Pump absorption (amplifier gain) (m^{-1}) from a convolution
- This must be scaled so the maximum gain is that determined in the re-absorption loss lab (#3) which was an identical laser. A separate spreadsheet may be used to calculate these values and the numerical values simply pasted into the main sheet

Diode output power as function of temperature
- Calculate this from the parameters given for the diode

Re-absorption loss (m^{-1}) from a calculation using Stark splitting
- A separate spreadsheet may be used to calculate these values and the numerical values simply pasted into the main sheet

DPSS Output power at 946nm for each temperature (relative)

Taking into account pump absorption, re-absorption loss, and diode output power

Ultimately, show a graph of DPSS output power (y) vs. temperature (x) showing the temperature where peak laser output occurs. Graph temperatures from at least 10C to 40C.

Submission:

a. Hand-in a screen shot of the spreadsheet model showing the numerical results for at least the range 15C to 35C temperatures as well as any anchored parameters at the top (such as saturation power, etc). All columns must be shown (this may require more than one screen-shot) and cell references ("ABC" columns and "123" rows) must be visible. Columns require a visible title as well. See the returned assignment #1 for notes on how this will look.
b. A summary of the formulae used: simply CUT and PASTE the formula used for the first two row cells (which will contain cell references) or present a spreadsheet printout with all formulae shown instead of values (FORMULA menu, SHOW FORMULAS option). Ensure formulae are readable and in a large enough font to be legible. Again, see the returned assignment #1 for details.
c. Submit a graph showing DPSS output power vs. temperature (i.e. the output of the model).
d. Presumably, a separate spreadsheet was used to calculate re-absorption loss. Include both a numerical screen-shot and a formula summary sheet of this spreadsheet as well (two pages minimum).
e. Presumably, a separate spreadsheet was used to calculate absorption/gain. Include both a numerical screen-shot and a formula summary sheet of this spreadsheet as well (two pages minimum).
f. Include a separate page showing the calculation of $P_{saturation}$ as well as any other parameters used in the model.

Be sure you understand the methodology of this model as it will be on the second test.