Rachel:
Write an analytic expression for the pulse duration of a chirped Gaussian vs distance propagating in a material with a value of k2 that is constant in ω. Use this to calculate the B-integral during compression in material, and put in some numbers to estimate the beam size required to limit the B to less than 1.

Dan:
Calculate the beam crossing angle to get a delay range of +/- 200fs in the single-shot configuration. Using the phase-matching relations, calculate the spectral peak of the phase-matching curve vs angle of incidence. From this you can estimate the range of angles (focal length of the cylindrical lens) required for a wavelength range of 100nm.

Eric:
Determine the connection of the shape of the nanoparticle to the symmetry properties of the χ2 and χ3 for different polarization properties.

Alex:
Derive the connection between the shape of a particle and the value of the plasmon resonance. Also look at the effect of the particle size on the width of the resonance (see the paper I sent you for references).

Lisa:
Write down equations that connect the acoustic wave equation to the refractive index (in both directions) of the material used in the photoelastic modulator. Plot $\Delta n(x) = n_x(x) - n_y(x)$ for a simple 1D standing wave. (I'm assuming the modulator is driven on the side, setting up a standing wave along the x-direction).

Nick:
Calculate the THG yield vs z for a double interface, as a function of the separation of the interfaces in z. Use your best estimate for the indices as they should apply in your problem.

Matt:
Work through the calculations in Boyd for refractive bistability to generate the plots like figure 7.3.5 showing intensity-dependent resonances for the nonlinear Fabry-Perot. See if you can find a way to calculate the resulting intensity-dependent transmission.

David W:
Determine the crystal incident angle required to get some angular separation for degenerate downconversion. Compare this to the optimum angle for doubling. For this crystal angle, calculate the emission angle vs wavelength in parametric downconversion.

David M:
Find the parameters for a typical saturable absorber used in passive modelocking. Look at the equations for modelocking (one early reference that might help is H. Haus, IEEE JQE

v11, p736 (1975)), and work through the math to show that the steady-state solution for a mode-locked laser is a sech(t/T) pulse.

Colby:
Assuming an initial sinusoidal electron density distribution in 1D ne(x,0), calculate the ne(x,t) assuming it follows the diffusion equation. Compare this to the heat equation (which is also a diffusion equation).

Jody:
Calculate the phase matching requirements vs angle in the BOX-CARS geometry. (See Muller/Squier paper). An additional idea is to show that broadband chirped pulses can be used for the input (see me to discuss this).

Chase:
In the book's treatment of SBS, the key step in developing the nonlinear equations is the effect of the EM intensity on the density of the material through electrostriction. In a plasma, this effect takes the form of the ponderomotive potential on the electrons, which, through the electrostatic potential, is relayed to the ions. Derive or find an expression for the ion acoustic wave equation and the term that couple the EM wave to the ion density.

Jeff:
For a surface plasmon on a single-interface between a metal and a nonlinear dielectric, calculate a value of the nonlinear parameter γ that accounts for the effective area of the mode. Determine a connection between the plasmon losses (which affects the range of the mode into the dielectric) and the strength of the nonlinearity.

Brooke:
Derive the nonlinear equation that describes polarization gating for two beams crossed at a small angle. Describe how the time response of the nonlinearity can be included in the equations.