1. Preface
    (a) Quantum materials are really cool
    (b) Correlated systems are really cool
    (c) Probably the most exciting systems right now
    (d) What are the major questions?
    (e) Description of the book - dissemination of results, and instruction manual
2. Introduction to ultrafast optics in correlated electron systems
    (a) Interactions: the weak limit
        i. Fermi liquid
        ii. CDW / SDW
    (b) The strong limit
        i. Mott insulator
        ii. Cuprates
    (c) Spectroscopy
        i. Comparison of nonequil. vs equil. spectroscopy
        ii. Excitation of coherent collective modes
            A. In correlated materials
            B. In multiferroics
    (d) Control
        i. Dynamical phase transitions
        ii. TDGL theory
        iii. Incoherent versus incoherent control
            A. In correlated systems
            B. In CDWs
            C. In magnets
3. SHG theory
    (a) Space groups and point groups
    (b) Response tensors
        i. Multiple contributions to SHG
    (c) Symmetry of tensors - the free energy
        i. SHG does not mean inversion broken
        ii. Presence of absorption
    (d) Bond model
    (e) Phenomenological GL model of SHG

i. Free energy is p dot e
ii. Free energy for SHG can be written like ...
iii. $\chi_{ijk} = \chi_{ijkl} O_l$ (but fully general) is a valid expression for the free energy
iv. Free energy needs to be a real and totally symmetric scalar
v. This gives us constraints on χ_{ijk}.
vi. Time reversal affects SHG
vii. SHG also measures domains

(f) Quantum model
i. Wavelength dependence of SHG

4. SHG practical

(a) Basic idea
i. Connection to last chapter - want to probe as many elements as possible
ii. We have control over the fields and the outgoing polarization
iii. Our choices: oblique incidence, large spot size, single color, PMT detector
iv. Schematic description of the setup

(b) Before you build the setup
i. Choice of oblique vs. normal incidence - which tensor elements do you want to probe?
ii. Scaling of SHG signal with volume, pulse width - microscopy or not? Domain size?

(c) Construction of the setup
i. Description of the setup that we built
ii. Automated polarization rotators
iii. Better to use hollow bore stepper motors
iv. Choice of detector
v. Alignment
A. Aligning the circles
B. Checking that the symmetry looks good
C. Waveplates

(d) Considerations for time-resolved
i. Location of pump mirror
ii. Alignment of normal incidence
iii. Choice of pump wavelength (OPA)
iv. Polarization rotation (why do it?)
v. Pump scatter

(e) Data analysis (static)
(f) Data analysis (time-resolved)

5. Appendix A: Failed experiments