

Physics 7810 Ultrafast Optics

Homework Set #1

- 1) Chirped Gaussian Pulses. Gaussian pulses have the interesting property that they remain Gaussian even when chirped by passage through a dispersive material. Show analytically that this is the case. How does the temporal pulse width depend on the net chirp created by material dispersion? Assume that there is only quadratic dispersion (no cubic or higher order).
- 2) Chirped Hyperbolic Secant Pulses. $\text{sech}(t)$ pulses do not remain the same shape when chirped by passage through a dispersive material, although this cannot be shown analytically. Use your favorite numerical software to show how the shape changes as a function of chirp. Plot how the temporal pulse width depends on chirp. Compare to a Gaussian.
- 3) Prism Pair Design. Calculate the optimum prism pair to be inserted into the cavity of a femtosecond laser at 620 nm. The design criteria are that the prisms should provide 20% GVD tenability around -800 fs² and the next higher order dispersion should be as small as possible. With the help of the attached table choose an appropriate prism material, calculate the apex angle of the prisms for the Brewster condition at minimum deviation and determine the prisms separation. If needed, assume a beam diameter of 2 mm to estimate the minimum possible glass path between the prisms.