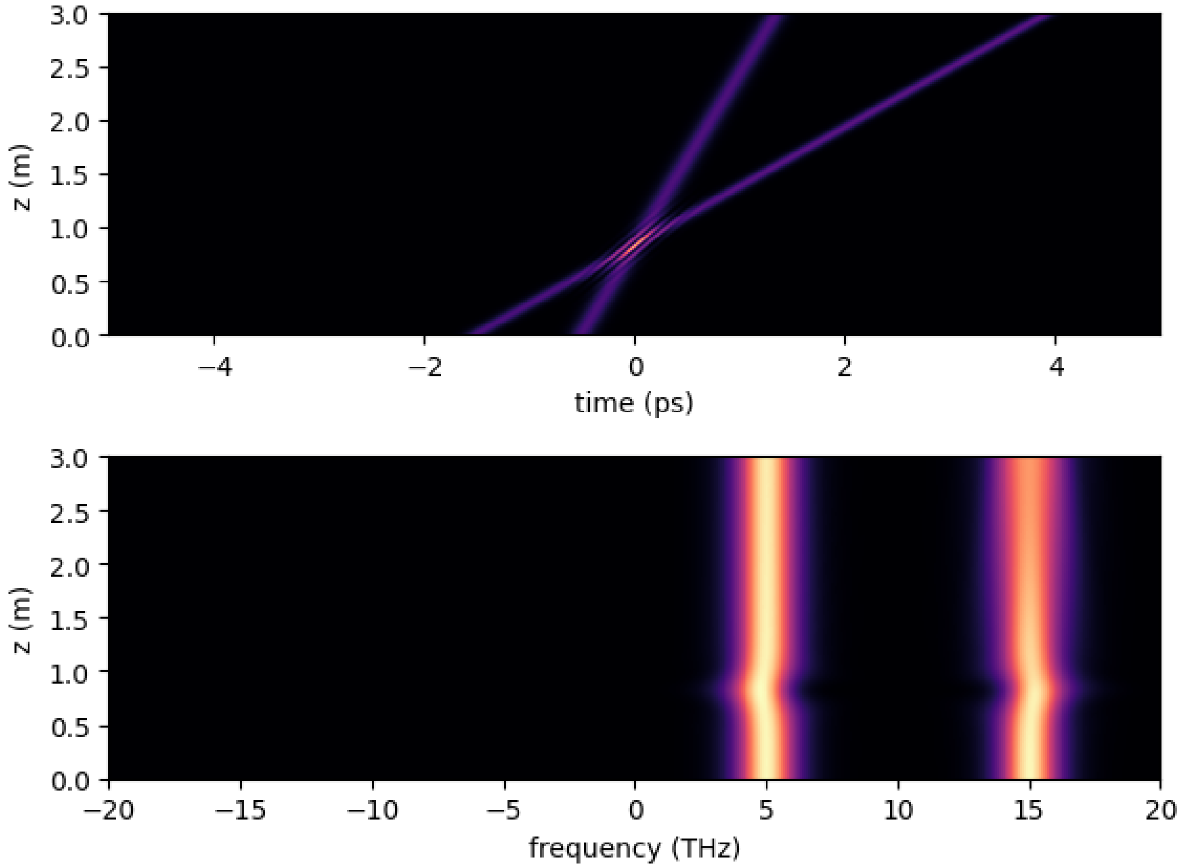
Exercise 9 **Joshua Igbonukere 6805993**

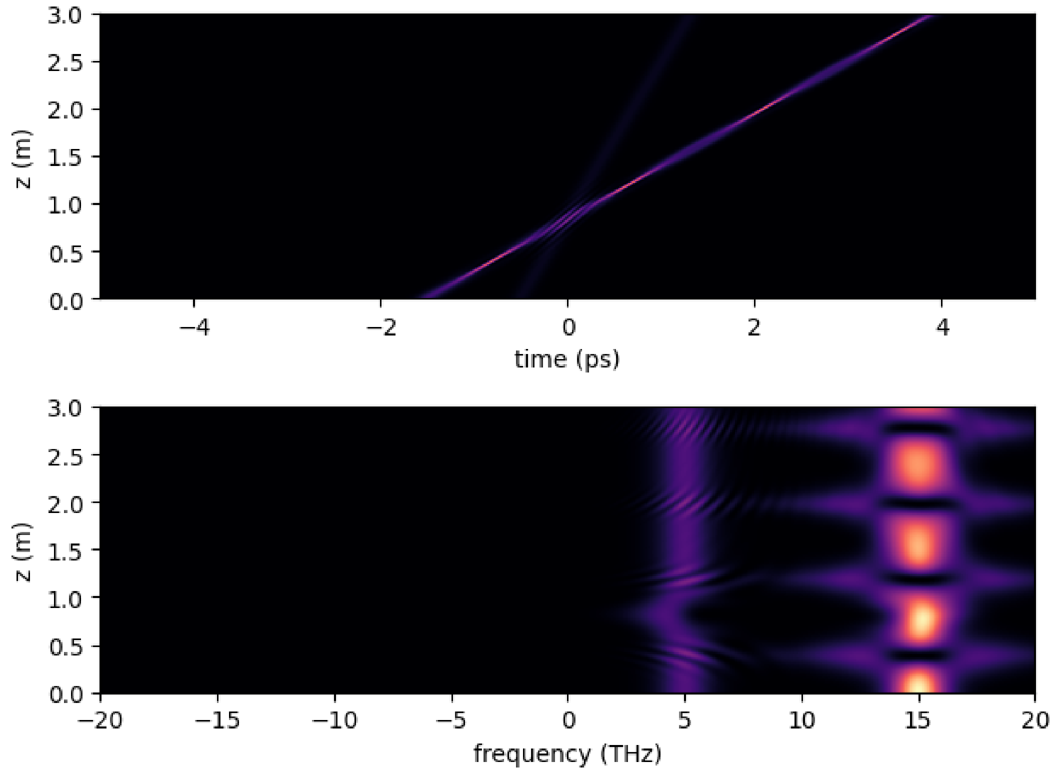
By modifying the provided python code, we can simulate two Solitions. One is faster than the other.

```
###########################################
# Initial field envelope
###########################################

#pulse 1
tau0 = 0.1e-12
freq_offset = -np.pi*10e12 #2*np.pi*10e12
tau_offset = -0.5e-12
a0 = np.sqrt(-k2/gamma/tau0**2)
a_init = a0/np.cosh((tau-tau_offset)/tau0) * np.exp(-1j*freq_offset*tau)

#pulse 2
tau0 = 0.1e-12
freq_offset = -3*np.pi*10e12
tau_offset = -1.5e-12
a0 = np.sqrt(-k2/gamma/tau0**2)

a_init += a0/np.cosh((tau-tau_offset)/tau0) * np.exp(-1j*freq_offset*tau)
```

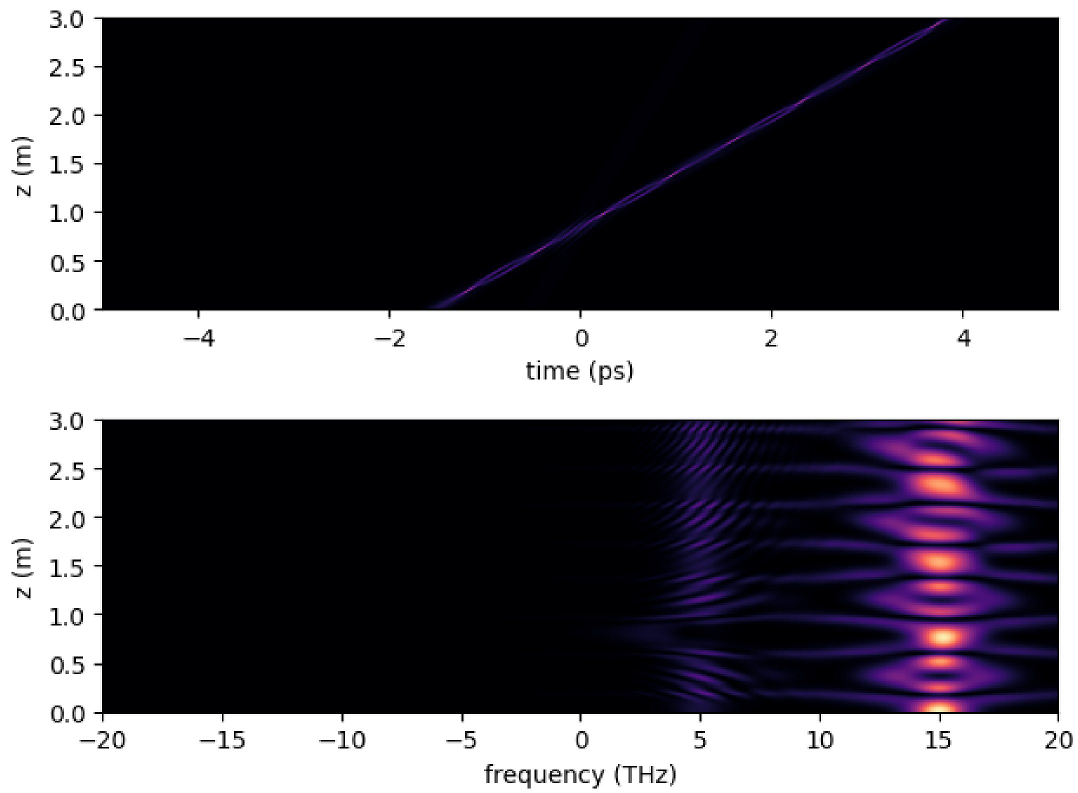


In the output, we can see that if both solutions are propagating in the first order, both shapes are conserved after the collision.

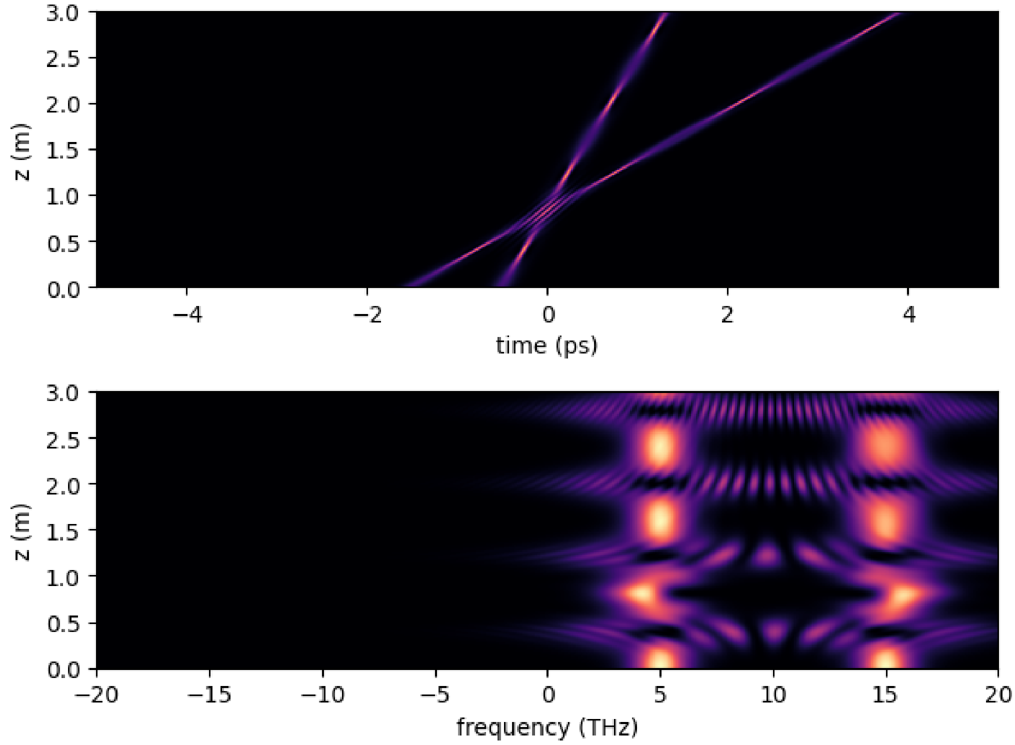
When we change the energy of the pulses, the higher order Solitions are not necessarily preserved.



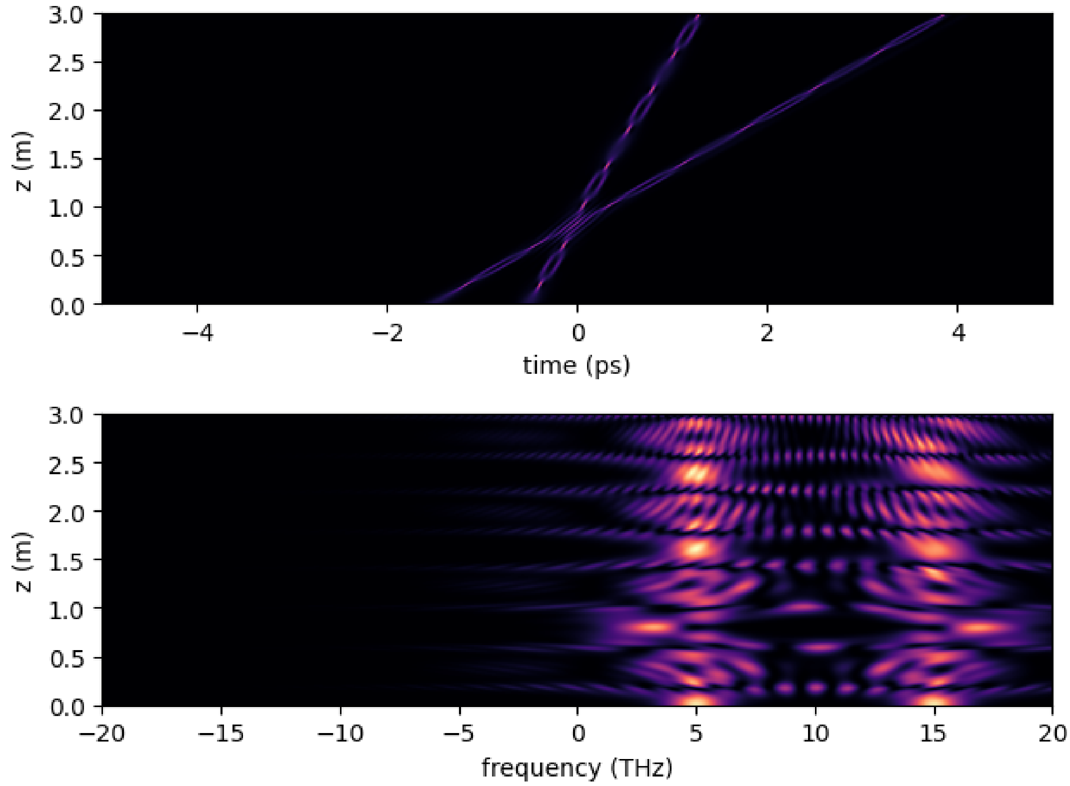
Colliding a second order pulse with a first order pulse, the perturbation is minimal.



Colliding a third order pulse with a first order pulse, we can see some change in the 3rd order pulse.



For two second order Solitions its again hard to tell if they are conserved. We would need to further extend the propagation distance.



For two 3rd order Solitions we can see stronger effects on the frequencies.