→ Split-step Fourier

Divide in $\hat{D}$ & $\hat{N}$ $\hat{D} \to$ edp : $\to \hat{P} \xrightarrow{F^{-1}} F$ | step h $F(z+h,t) \approx e^{h\hat{D}} e^{h\hat{N}} F(z,t)$

$\hat{N} \to$ edp $\to F$

→ GVD

Phenomenom that group vel. depends on freq. It affects every freq comp.

→ Chirp | Dispersion compensation $D_1L_1 + D_2L_2 = 0$

change in center wavelength depends on sign β_2

Freq variation

→ Gaussian with GVD

causes broadening bc freq comps. travel @ dif. speed

→ Normal dispersion

$\beta_2 > 0$ red faster than blue

→ Anomalous disp.

$\beta_2 < 0$ red slower than blue

→ Chirp / unchirp gaussian

unchirp → broadening no depends sign (β_2)

chirped → yes $\delta\omega \uparrow$ β_2 from when $C > 0$

$\delta\omega \downarrow$ when $C < 0$

chirp & unchirp maintain gaussian shape

chirped → broadens → $\beta_2 C > 0$

narrows → $\beta_2 C < 0$

→ Super Gaussian

steeper lead & trail edges broadens more rapidly bc wider spectrum start

Always chirped, broadens faster, distorts shape

→ SPM

Non lin effect : ultrashort pulse $\xrightarrow{\text{induc}}$ varying n due to Kerr $\xrightarrow{\text{produc}}$ phase shift ⟶ change its pulse's freq spectrum

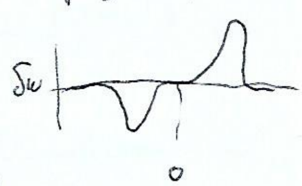
Depends on intensity ($\chi^{(3)}$)

Induces a chirp

<u>Spectral broadening</u> (in temporal unafected)

a temporary varying phase implies instant opt. freq differs across the pulse ↘ new freq. compo generated continuosly

→ Super gaussian



<u>Super gaussian</u>

Spectra broadening with oscilatory structure

broadens depends on
→ pulse shape
→ initial chirp

→ <u>Competition</u>

when both GVD & SPM

↳ Normal (β_2) ⇒ Broadens more rapidly (SPM generates new freqs)
spectra broadens (less)

↳ Anomalous (β_2) ⇒ Broadens rate lower → almost stationary
spectrum narrows (SPM $C>0$, GVD $C<0$)