```
μm = 10^-6;
c = 299 792 458;
fs = 10^-15;
mm = 10^-3;
nm = 10^-9;
```

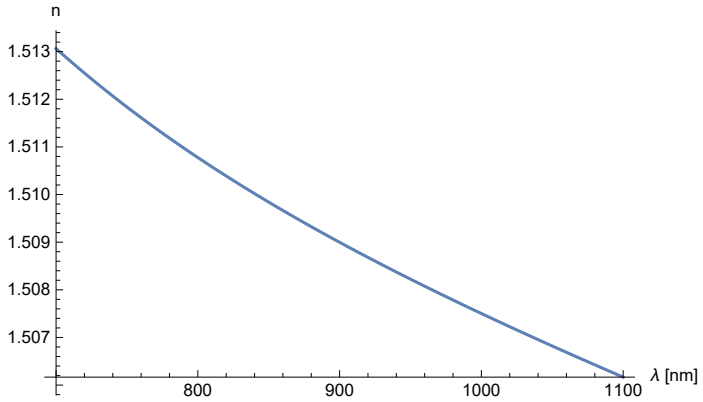
Refractive index. Ref: refractiveindex.info

$$\text{nsi}[\lambda\_] := \left(1 + \frac{0.6961663\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 0.0684043^2} + \frac{0.4079426\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 0.1162414^2} + \frac{0.8974794\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 9.896161^2}\right)^{1/2}$$

```
(*fused silica*)
```

$$\text{nBK7}[\lambda\_] := \left(1 + \frac{1.03961212\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 0.00600069867} + \frac{0.231792344\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 0.0200179144} + \frac{1.01046945\ (\lambda/\mu m)^2}{(\lambda/\mu m)^2 - 103.560653}\right)^{1/2}$$

```
(*N-BK7*)
Plot[nBK7[λ nm], {λ, 700, 1100}, AxesLabel → {"λ [nm]", "n"}]
```



Group velocity dispersion (GVD). Ref: Young 2015 and Newport website

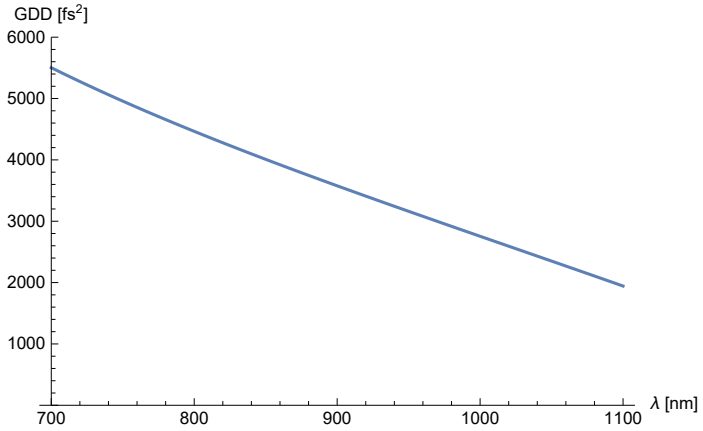
$$\text{GVDBK7}[\lambda\_] := \frac{\lambda^3\ \text{nBK7}''[\lambda]}{2\pi c^2}$$

$$\text{GVDsi}[\lambda\_] := \frac{\lambda^3\ \text{nsi}''[\lambda]}{2\pi c^2}$$

```
GDD[L_, f_] :=
 L * f(*Group delay dispersion GDD = GVD*L, where L is the material thickness*)
```

Group delay dispersion GDD vs wavelength

```
Plot[GDD[100 mm, GVDBK7[λ nm]] / fs^2, {λ, 700, 1100},
 PlotRange → {0, 6000}, AxesLabel → {"λ [nm]", "GDD [fs^2]"}]
```



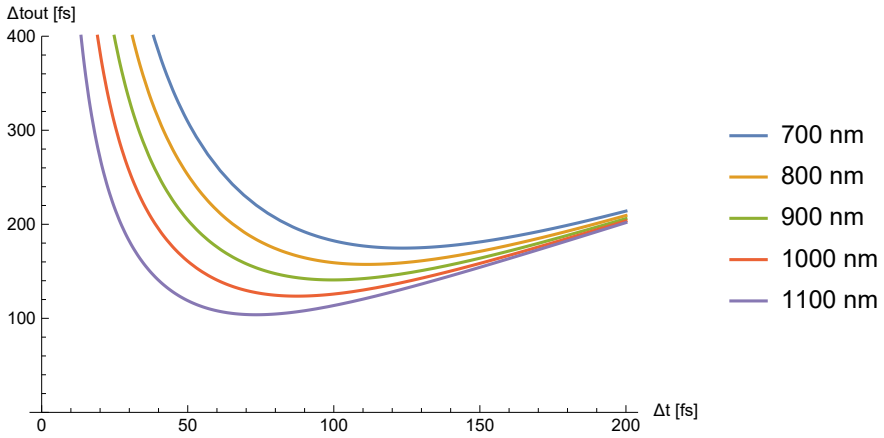
Gaussian pulse broadening

Ref: Eq8 in http://www.newport.com/The-Effect-of-Dispersion-on-Ultrashort-Pulses/602091/1033/content.aspx

$$\Delta\text{tout}[\Delta t\_, \text{GDD}\_] := \frac{\sqrt{\Delta t^4 + 16\,\text{Log}[2]^2\,\text{GDD}^2}}{\Delta t}$$

Output vs input pulse width (gaussian pulse)

```
Plot[Evaluate[Table[Δtout[Δt fs, GDD[100 mm, GVDBK7[λ nm]]] / fs, {λ, 700, 1100, 100}]],
 {Δt, 0, 200}, PlotRange → {0, 400}, AxesLabel → {"Δt [fs]", "Δtout [fs]"},
 PlotLegends → {"700 nm", "800 nm", "900 nm", "1000 nm", "1100 nm"}]
```



Output pulse width vs material thickness

```
Plot[Evaluate[Δtout[140 fs, GDD[L mm, GVDBK7[750 nm]]] / fs],
 {L, 0, 100}, PlotRange → {0, 300}, AxesLabel → {"L [mm]", "Δtout [fs]"}]
```