Music: Time and Frequency are Fourier-conjugate variables

“Sound wave”

\[ \Psi(t) = \int \Psi(t) e^{i\omega t} dt \]

“Sound spectrum”

\[ \Psi(\omega) = \frac{\omega_0 \tau_0}{\pi} \]

A sound oscillating with period \( \tau_0 \) (frequency \( \omega_0 \)) and duration \( \Delta t \) has a spectrum with a peak at frequency \( \omega_0 \), and a spread of frequencies \( \Delta \omega = 1/(2\Delta t) \).

Consider the case where \( \omega_0 = 0 \), just a single “pulse”:

The Gaussian is its own Fourier Transform!