We already know that wave number can be expressed as:
\[ k = \frac{\omega}{c} \]
We know that:
\[ \sqrt{\varepsilon n} = \beta - i \gamma \]
in other words, we determined what is \( \varepsilon \) refractive index.
but as you know:
\[ \frac{c}{\varepsilon n} = \frac{c}{\varepsilon_n} = \frac{c}{\varepsilon n} \]
\[ \frac{c}{\varepsilon n} = \beta - i \gamma \]
it appears to be complex number.
What is the physical meaning of \( k \) being complex number?
Let's assume that plane wave is propagating in the medium:
\[ E = E_0 e^{i(kz - \omega t)} \]
The surface of equal phase will move with speed:
\[ \frac{c}{\varepsilon n} = \beta - i \gamma \]
Now, what about the amplitude?
Amplitude depends on \( \varepsilon \) and decreases with \( \beta \).
\[ E = E_0 \]
Hence, intensity decreases on light propagation:
\[ I = I_0 e^{-2\beta \varepsilon n z} \]
It decreases, as it depends on \( \varepsilon n \), i.e.
decaying of oscillator.

This law was discovered by Bouguer in 1729, later it was confirmed by Beer and Lambert. Beer 1852, Lambert 1910.
Lambert noticed dependence on path length.
Beer established constancy dependence.
Of course, there were me also Henry 1823.
Thus, Bouguer had the following logic:
\[ \frac{I_0}{I} = \frac{I_0 e^{-2\beta \varepsilon n dz}}{I_0} \]
In case of solutions:
\[ I = I_0 e^{-2\beta \varepsilon n d} \]
- constant on