Galilean Relativity

$$x = x' + vt, y = y', z = z'$$

Time dilation and length contraction

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad t = \gamma t_0 \qquad \ell = \frac{\ell_0}{\gamma} \qquad v = c\sqrt{1 - (\frac{\ell}{\ell_0})^2} \qquad v = c\sqrt{1 - (\frac{t_0}{t})^2}$$

Lorentz transform

$$x' = \gamma(x - vt) \qquad t' = \gamma(t - \frac{vx}{c^2}) \qquad v'_x = \frac{v_x - u}{1 - \frac{uv_x}{c^2}}$$

$$x = \gamma(x' + vt) \qquad t = \gamma(t' + \frac{vx'}{c^2}) \qquad v_x = \frac{v'_x + u}{1 + \frac{uv'_x}{c^2}}$$

Doppler effect, f: f of observer, f_0: f of rest frame of source

$$f_{towards} = \sqrt{\frac{c+v}{c-v}} f_o \qquad f_{away} = \sqrt{\frac{c-v}{c+v}} f_o$$

Relativistic momentum

$$\vec{p} = \gamma m \vec{v} \quad m_{rel} = \gamma m_{rest} \quad p_{photon} = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$$

Relativistic Energy

$$E^2 = (pc)^2 + (mc^2)^2 \quad E = hf = \frac{hc}{\lambda} \quad E = K + mc^2 \quad K = (\gamma - 1)mc^2 \quad E = \frac{p^2}{2m} \quad E_{tot} = \gamma mc^2$$

Speed of light

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = \lambda f = \frac{d}{t}$$

Black Body Law I: Intensity, σ: constant, T: Absolute temperature

$$I = \sigma T^4$$

Einstein's Photoelectric Effect Work Function

$$K = hf - \phi \rightarrow K_{max} = \frac{1}{2} m v_{max}^2 \quad \boldsymbol{eV_0} = hf - \phi,$$

Bremsstrahlung, only for x-ray production, V_AC: Accelerating voltage.

$$eV_{AC} = hf_{max} = \frac{hc}{\lambda_{min}}$$

Compton Scattering

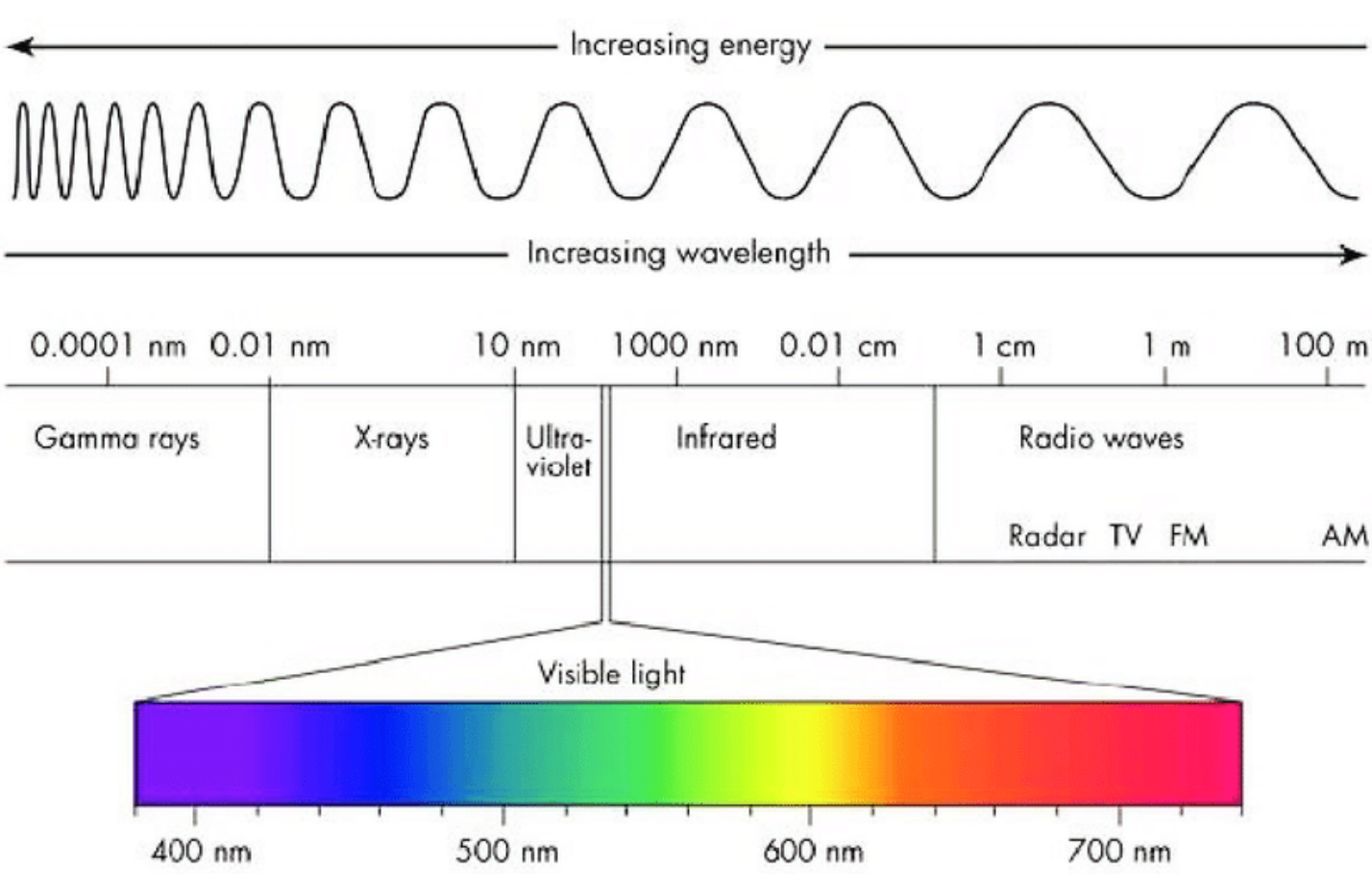
$$\lambda' - \lambda = \frac{h}{mc}(1 - cos(\phi)) \rightarrow \lambda'_{max} = \lambda + 2\frac{h}{mc}$$

Heisenberg Uncertainty Principle

$$\Delta x \Delta p_x \geq \frac{\hbar}{2} \qquad \Delta t \Delta E \geq \frac{\hbar}{2}$$

$$p_x = \frac{h}{\lambda} = \frac{h}{2\pi}\frac{2\pi}{\lambda} = \hbar k$$

$$E = hf = \frac{h}{2\pi} 2\pi f = \hbar\omega$$



10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{-1}	deci	d
10^{0}	Liter, meter, gram	Basic unit
10^{1}	deka	da
10^{2}	hecto	h
10^{3}	kilo	k
10^{4}	mega	M
10^{9}	giga	G
10^{12}	tera	T
10^{15}	peta	P
10^{18}	exa	E

Constants

$$h = 6.626 \times 10^{-34} J \cdot s, \hbar = \frac{h}{2\pi}$$

$$\epsilon_0 = 8.854 \times 10^{-12} F \cdot m^{-1}$$

$$\mu_0 = 1.256 \times 10^{-6} N \cdot A^{-2}$$

$$\sigma = 5.670 \times 10^{-8} W \cdot m^{-2} \cdot K^{-4}$$

$$m_p = 1.672 \times 10^{-27} kg$$

$$m_e = 9.109 \times 10^{-31} kg$$

$$eV = 1.602 \times 10^{-19} C$$

$$c = 3.00 \times 10^{8} \frac{m}{s}$$