Models

- Stage 0: Monochromatic rates (countable number of $\hbar\omega_0$ absorbed)
- Stage 1: LCFA rates (infinite number of photons absorbed) larger χ

basic quantities χ

let start with formula Nikishov&Ritus, 1964, see also [Elkina, 2011]

$$\chi = \frac{e\hbar}{m^3c^4}\sqrt{\left(\frac{\varepsilon\vec{E}}{c} + \vec{p}\times\vec{B}\right)^2 - (\vec{p}\cdot\vec{E})^2} \tag{1}$$

where $\varepsilon = \gamma m_e c^2$, $\vec{p} = \gamma m_e c\vec{\beta}$, $\vec{\beta} = \vec{v}/c$ fields $\vec{E}, \vec{B} = \{E', B'\}m_e c\omega_0/e = a_0(m_e c\omega_0/e)$. Inserting everything into χ definition, we get

$$\chi = \frac{\hbar\omega_0}{m_e c^2}\gamma\sqrt{(\vec{E'} + \vec{\beta}\times\vec{B})^2 - (\vec{\beta}\cdot\vec{B'})^2} \tag{2}$$

putting numbers, we get

$$\chi = \frac{\hbar\omega_0[eV]}{0.512\cdot 10^6 eV}\gamma\sqrt{(\vec{E'} + |\beta||\vec{B'}|\sin(\theta))^2 - (|\vec{\beta}||\vec{B'}|\cos(\theta))^2} = \frac{1}{0.512\cdot 10^6}\gamma\begin{cases} 2a_0 & \theta = -\pi \\ 0 & \theta = 0 \end{cases} \tag{3}$$

thus for $0.1 < a_0 < 10$ and $\varepsilon_p = 17.5\ GeV$, Ti:Sa laser $\lambda = 800nm$, frequency $\hbar\omega_0 = 1.55eV$

$$0.02 < \chi < 2$$

Laser parameters

Intensity can be estimated by

$$I \simeq= \frac{\text{energy}[J]}{\text{duration}[s] \cdot \text{focus}[cm^2]}$$

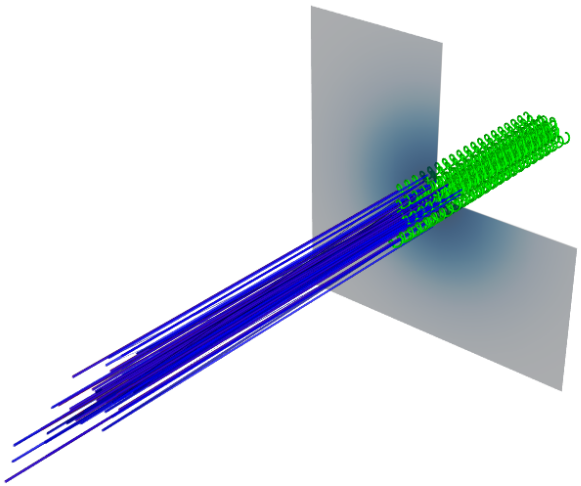
then stage 0 and stage 1

$$I_0 \simeq = \frac{0.35J}{35 \cdot 10^{-15}[s]\pi(5/2)^2 \cdot 10^{-8}[cm^2]} = 5 \cdot 10^{19} W/cm^2,$$
$$I_1 \simeq = \frac{7J}{35 \cdot 10^{-15}[s]\pi(5/2)^2 \cdot 10^{-8}[cm^2]} = 10^{21} W/cm^2$$

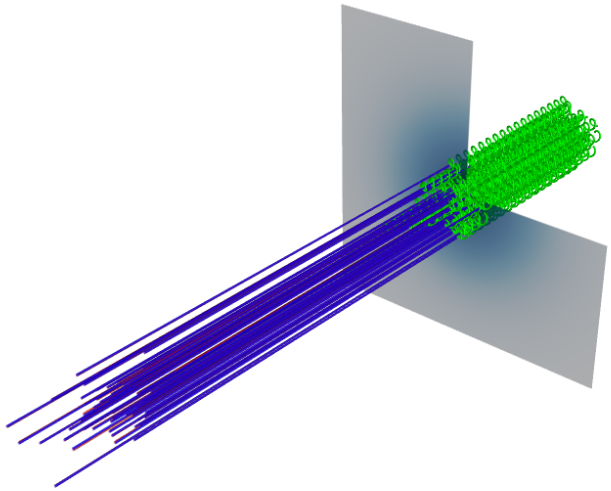
a_0 can be estimated

$$a_0 = 0.85 \left(\frac{I\lambda^2}{10^{18} W/cm^2 \cdot \mu m^2} \right)^{1/2} = \begin{matrix} 4.8 & \text{stage 0} \\ 21.5 & \text{stage 1} \end{matrix}$$

$a_0 = 10,\ N_\pm = 31$



$a_0 = 20,\ N_\pm = 222$



spectra for $a_0 = 20$