LhARA Capture Meeting

Hin Tung Lau

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Smilei Simulations Ex and Ey field

Simulate laser incident at 45°on a thin foil.

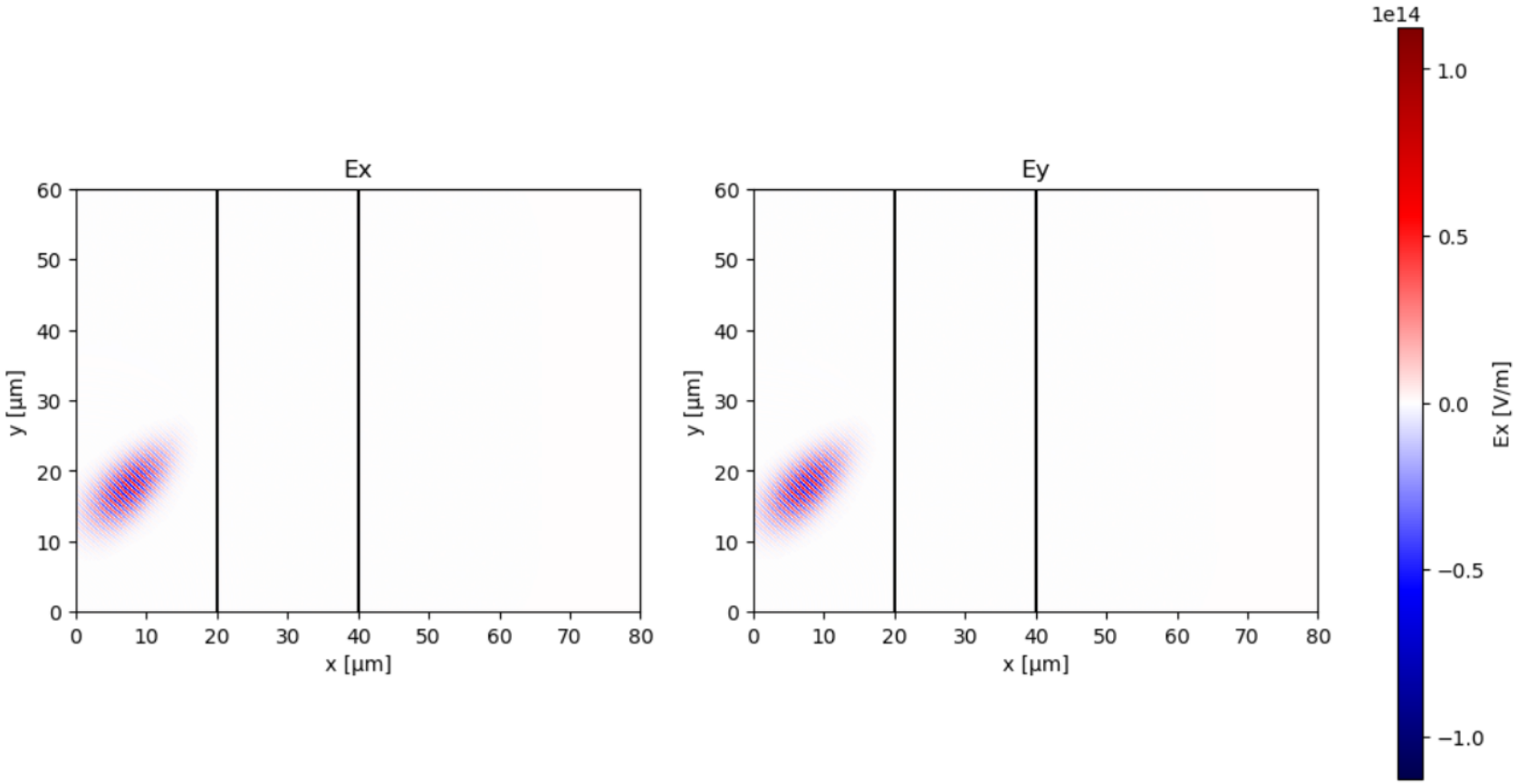

Figure: A single timestep of E_x and E_y.

Consistency

Find a relation between laser strength parameter/intensity to electric field for consistency check.

Intensity, I is the time averaged value of the Poynting vector, $\mathbf{S}$.

$$I = \langle \mathbf{S} \rangle = \langle \mathbf{E} \times \mathbf{H} \rangle = \frac{\epsilon_0 c}{2} E_{\text{max}}^2$$

where $\mathbf{E}$ is the electric field, $\mathbf{H}$ is the magnetic field strength, c is speed of light in vacuum and E_{max} is maximum amplitude of the electric field.

Laser strength parameter, a_0 defined as:

$$a_0 = \left(\frac{e}{m_e c^2} \frac{\lambda}{2\pi} \right) \sqrt{\frac{2I}{\epsilon_0 c}} = \left(\frac{e}{m_e c^2} \frac{\lambda}{2\pi} \right) E_{\text{max}}$$

$$\Rightarrow E_{\text{max}} = \frac{a_0}{\left(\frac{e}{m_e c^2} \frac{\lambda}{2\pi} \right)}$$

where e is electron charge, m_e is mass of electron, λ is laser wavelength.

Consistency

Calculated maximum transverse electric field magnitude:

$$
\begin{aligned}
E_{\text{max}} &= \frac{a_0}{\left(\frac{e}{m_e c^2}\frac{\lambda}{2\pi}\right)} \\
&= \frac{20.75}{\left(\frac{e}{m_e c^2}\frac{0.8\times 10^{-6}}{2\pi}\right)} \\
&\simeq \mathbf{8.33 \times 10^{13}}\ [\text{V/m}]
\end{aligned}
$$

Transverse field is component of E_x and E_y perpendicular to incident angle.

$$
E_{\text{transverse}} = E_x \cos\left(\frac{\pi}{4}\right) - E_y \cos\left(\frac{\pi}{4}\right)
$$

finding the maximum transverse electric field in a cell from the simulation is $\simeq \mathbf{8.81 \times 10^{13}}$ [V/m].

To Do

Benchmark simulation for 2D results.