6.1.1

September 13, 2022

1 Imports

[ ]:
```
import sdf_helper as sh
import matplotlib.pyplot as plt
import os
import sdf
from matplotlib import colors
plt.rcParams["font.size"]=13
```

[ ]:
```
EXTENT = [-10,10, -25, 25]
```

2 Parameters

- Simulation Box: $20\,\mu m \times 20\,\mu m \times 50\,\mu m$
- Number of Cells: $200 \times 200 \times 500$
- Plasma Density: $n_0 = 10^{25}\,m^{-3}$
- Laser Intensity: $I = 2 \times 10^{22}\,Wm^{-2}$
- Laser Wavelength: $\lambda = 10^{-6}\,m$
- Particle Per Cell: 0
- FWHM of the Laser: $1\,\mu m$
- Width of the Laser: $2.5\,\mu m$
- The laser propagates in z direction and is p-polarized, that is, the electric field vector of the laser oscillates along the y-axis.
- The laser starts at $(10\,\mu m \times 10\,\mu m \times -2\,\mu m)$ which is the center of the xy-plane $2\,\mu m$ in front of the simulation box.

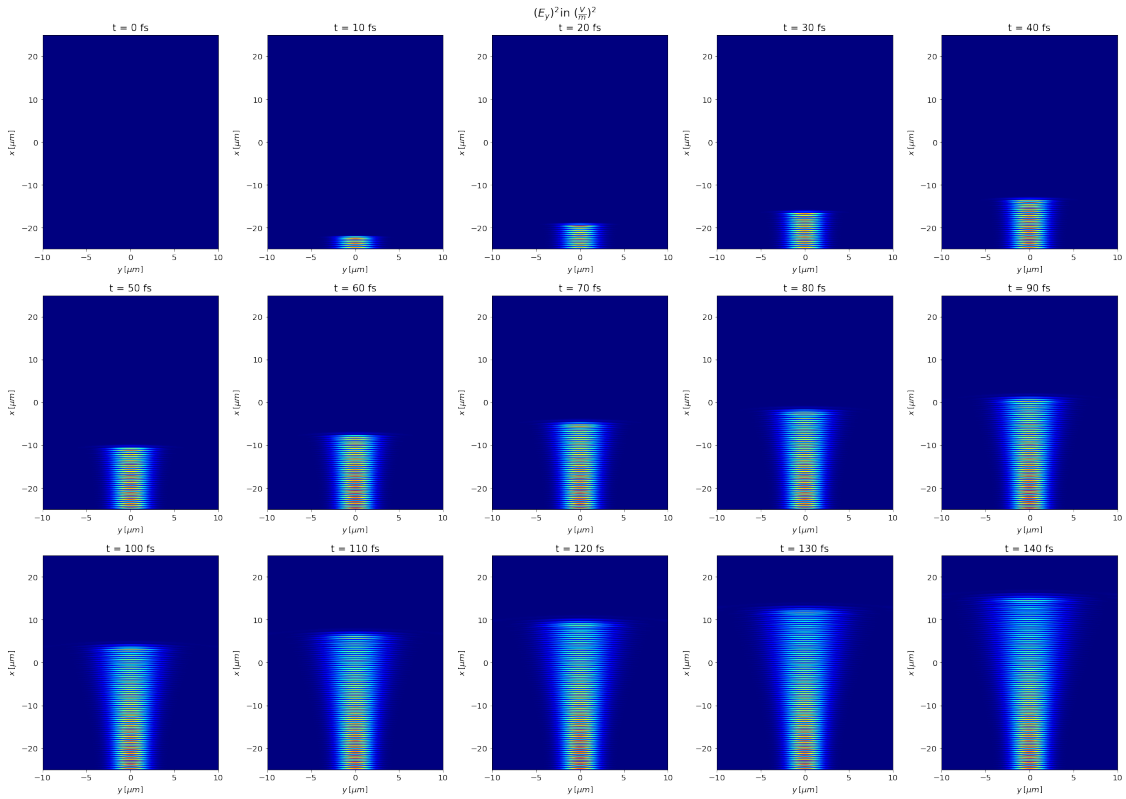
3 Fields With Time

[ ]:
```
def plot_field(data_dir, ax, component="y"):
    raw_data = sdf.read(data_dir)
    comp = {
        "x":raw_data.Electric_Field_Ex,
        "y":raw_data.Electric_Field_Ey,
        "z":raw_data.Electric_Field_Ez,
    }
    field = comp[component]
```

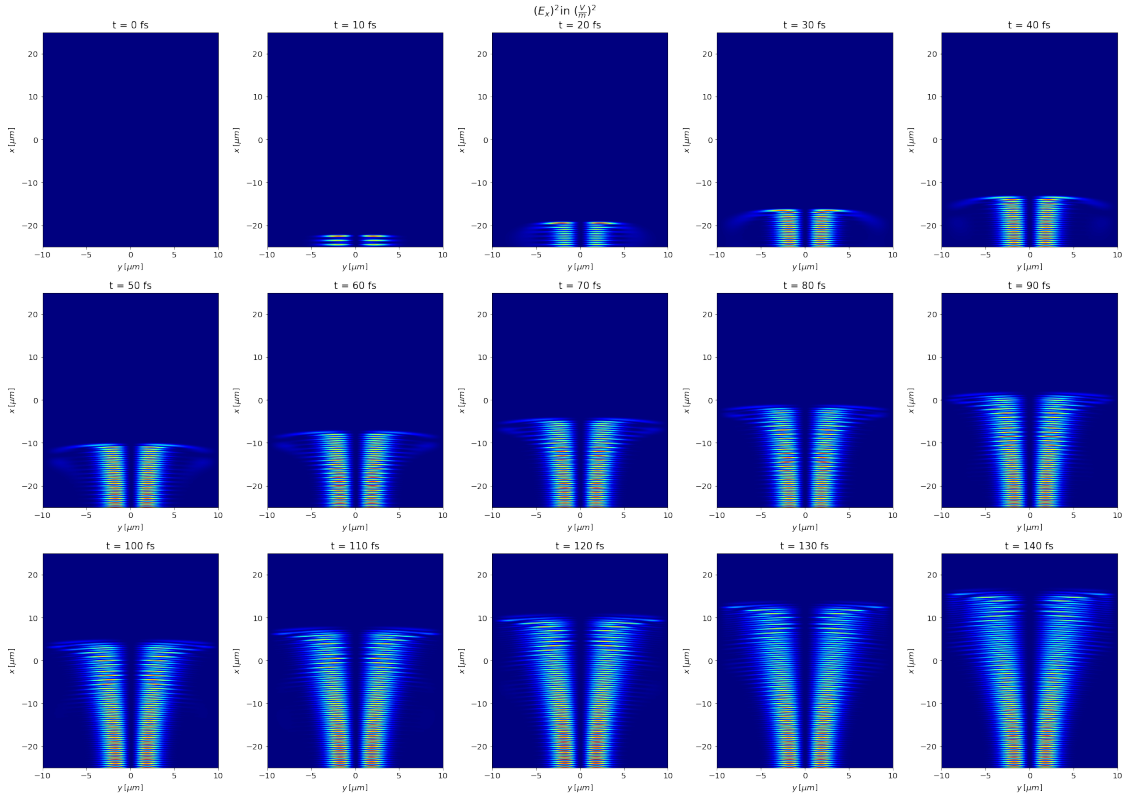
```
    t = raw_data.Header['time']*1e15

    ax.imshow(field.data**2, cmap='jet', origin='lower',
    extent=EXTENT,
    aspect='auto')
    ax.set_xlabel('$y \, [\mu m]$')
    ax.set_ylabel('$x \, [\mu m]$')
    ax.set_title(f't = {t:.0f} fs')
```

[ ]:
```
all_files = [f for f in os.listdir('.') if f.endswith('.sdf')]
```

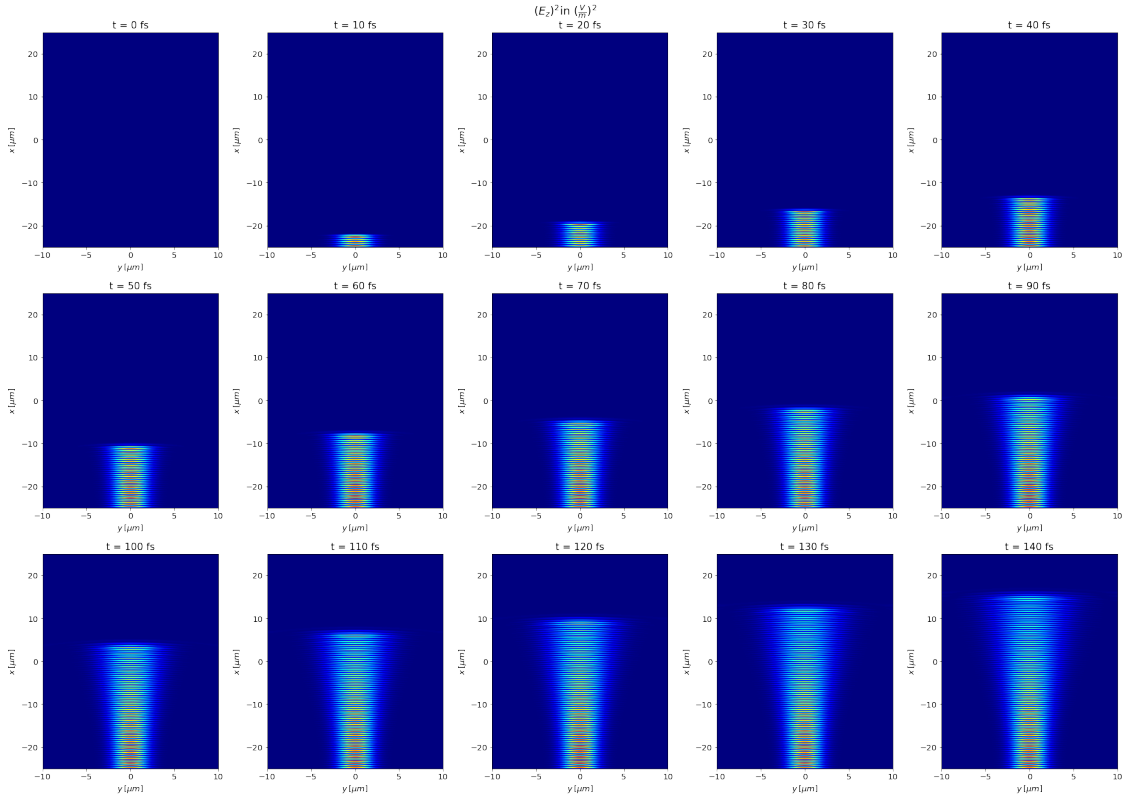
[ ]:
```
fig, ax = plt.subplots(3, 5, figsize=(25, 18))
component="y"
field = f"E_{component}"
fig.suptitle(rf"$({field})^2$" +r"in $({\frac{V}{m}})^2$", fontsize=18)
i=0
for data in all_files[:-1]:
    t = i*10
    plot_field(data, ax[i // 5, i % 5],component=component)
    i += 1
fig.tight_layout()
```



[ ]:
```
fig, ax = plt.subplots(3, 5, figsize=(25, 18))
component="x"
field = f"E_{component}"
fig.suptitle(rf"$({field})^2$" +r"in $({\frac{V}{m}})^2$", fontsize=18)
i=0
for data in all_files[:-1]:
    t = i*10
    plot_field(data, ax[i // 5, i % 5],component=component)
    i += 1
fig.tight_layout()
```



[ ]:
```
fig, ax = plt.subplots(3, 5, figsize=(25, 18))
component="z"
field = f"E_{component}"
fig.suptitle(rf"$({field})^2$" +r"in $({\frac{V}{m}})^2$", fontsize=18)
i=0
for data in all_files[:-1]:
    t = i*10
    plot_field(data, ax[i // 5, i % 5],component=component)
    i += 1
fig.tight_layout()
```

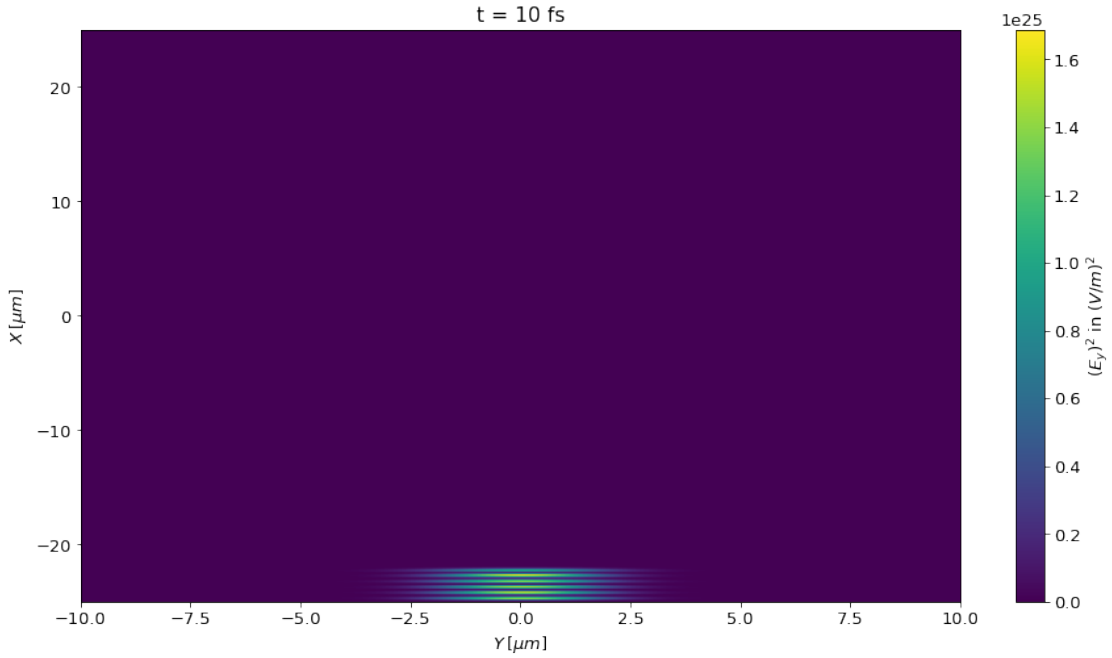


4 Fields With Scale

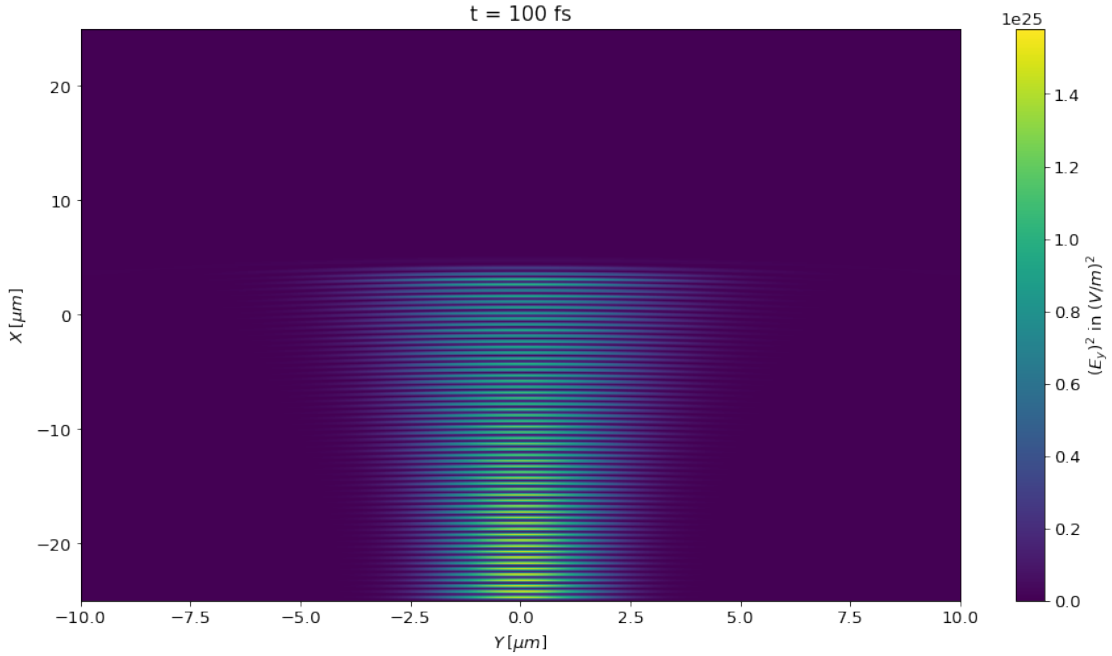
[ ]:
```
def plot_with_scale(data_dir, component="x"):
    raw_data = sdf.read(data_dir)
    comp = {
        "x":raw_data.Electric_Field_Ex,
        "y":raw_data.Electric_Field_Ey,
        "z":raw_data.Electric_Field_Ez,
    }
    field = comp[component]

    t = raw_data.Header['time']*1e15
    c_label = f"$(E_{component})^2$ in $({field.units})^2$"

    plt.figure(figsize=(15,8))
    plt.imshow(field.data**2, cmap='viridis', origin='lower',
    extent=EXTENT,
    aspect='auto',
    )
    plt.xlabel('$Y \, [\mu m]$')
    plt.ylabel('$X \, [\mu m]$')
```

```
    plt.title(f't = {t:.0f} fs')
    cbar = plt.colorbar()
    cbar.ax.set_ylabel(c_label)
```

[ ]:
```
plot_with_scale("0001.sdf", component="y")
```



[ ]:
```
plot_with_scale("0010.sdf", component="y")
```



[ ]:
```
plot_with_scale("0015.sdf", component="y")
```