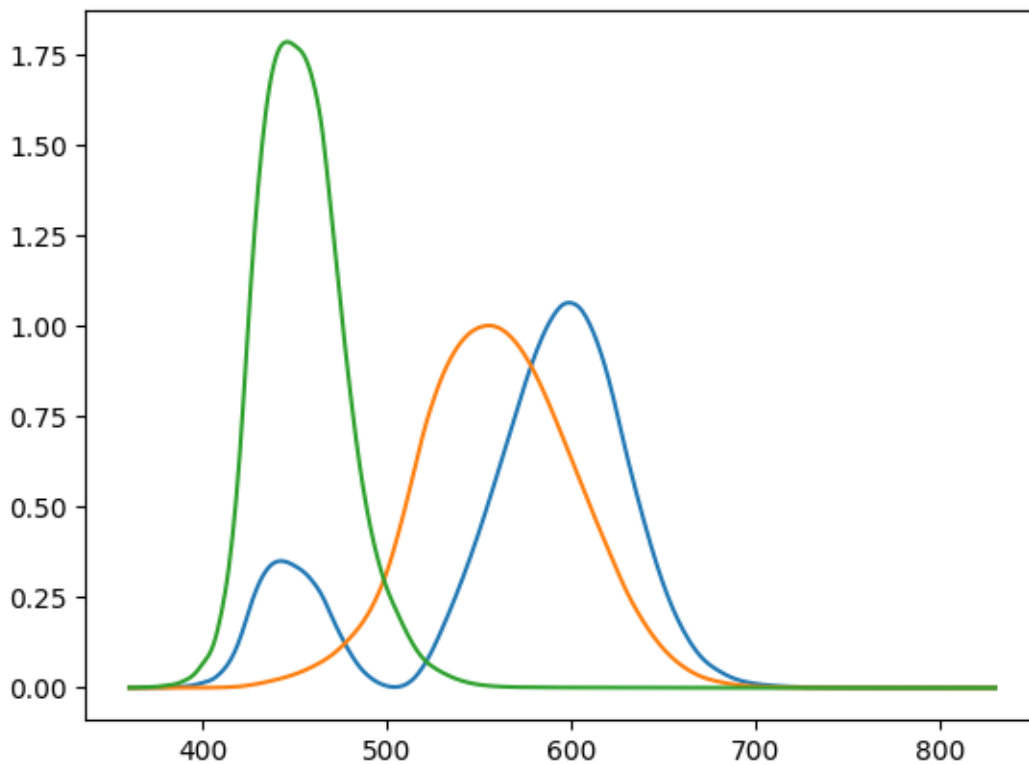# fundamentals

January 13, 2025

```
[15]: import colour
      import matplotlib.pyplot as plt
      import numpy as np
```

```
[18]: xyz_cmfs = colour.colorimetry.MSDS_CMFS_STANDARD_OBSERVER["CIE 1931 2 Degree␣
      ↪Standard Observer"]

      print(xyz_cmfs.values.shape, xyz_cmfs.wavelengths.shape)
      plt.plot(xyz_cmfs.wavelengths, xyz_cmfs.values)
```

```
(471, 3) (471,)
```

```
[18]: [<matplotlib.lines.Line2D at 0x3014b9b90>,
       <matplotlib.lines.Line2D at 0x1752f3850>,
       <matplotlib.lines.Line2D at 0x30149a010>]
```
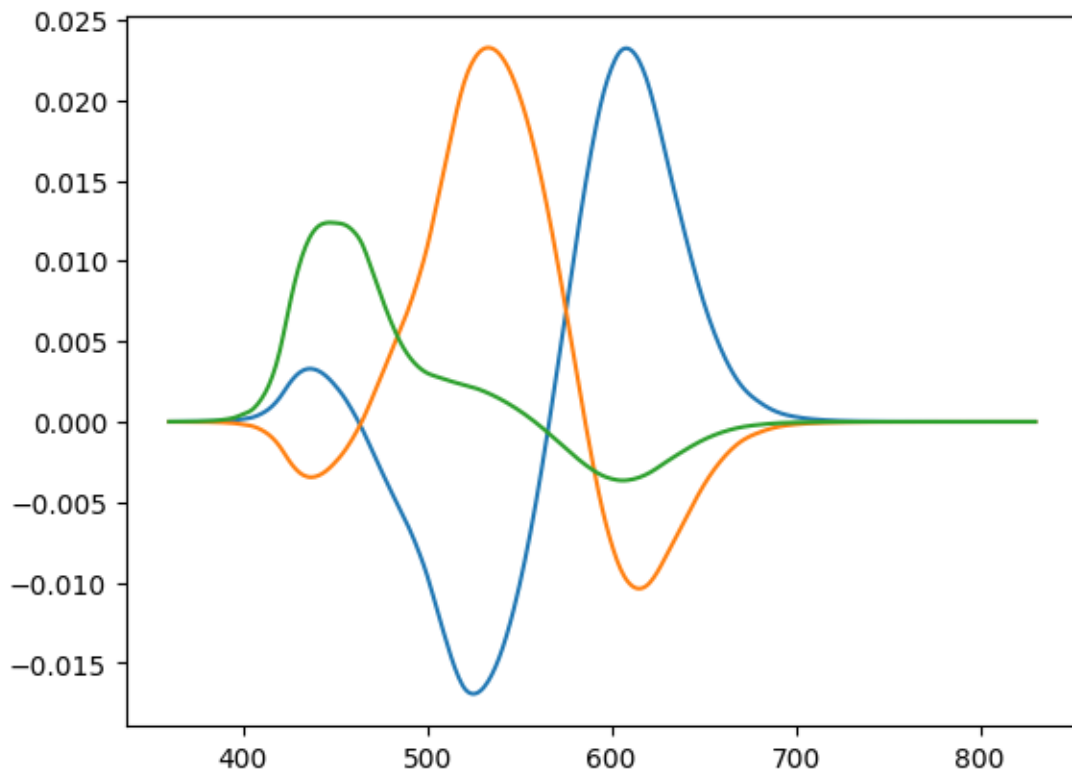
```
[23]: A = xyz_cmfs.values # Color matching functions
      E = A @ np.linalg.inv(A.T @ A) # represents the primaries
      R = E @ A.T # Maps from SPD to fundamental.
```

```
[24]: plt.plot(xyz_cmfs.wavelengths, E)
```
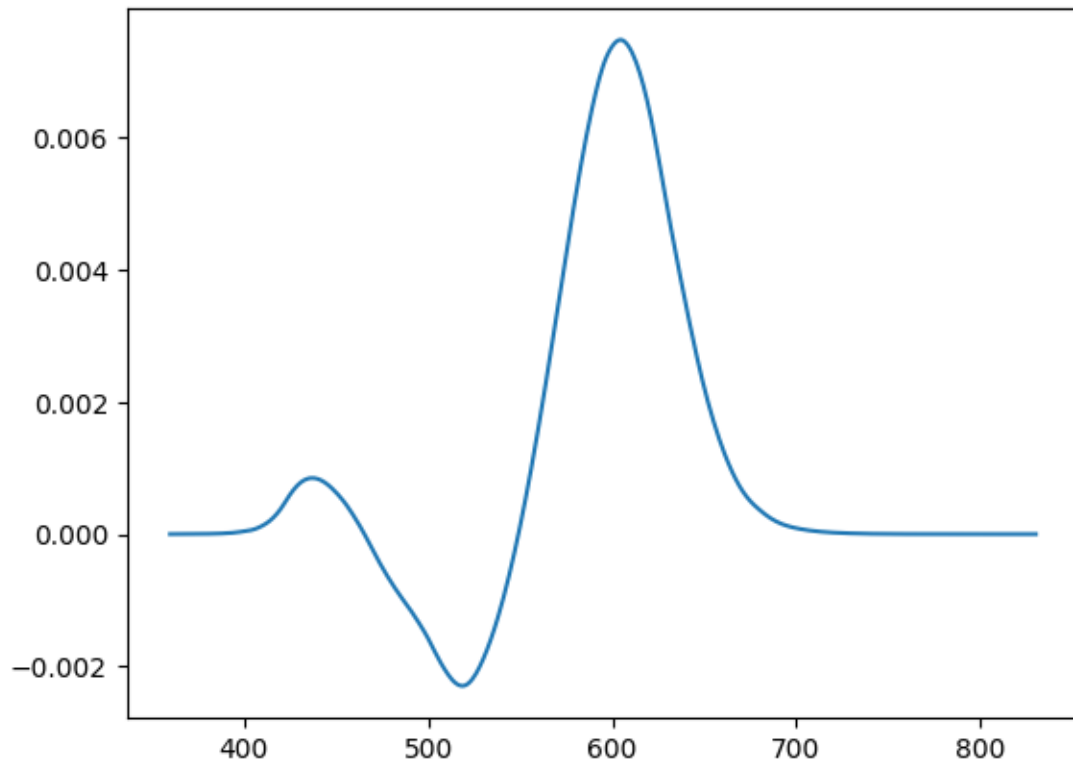
```
[24]: [<matplotlib.lines.Line2D at 0x301429610>,
       <matplotlib.lines.Line2D at 0x300777d10>,
       <matplotlib.lines.Line2D at 0x30098ff50>]
```

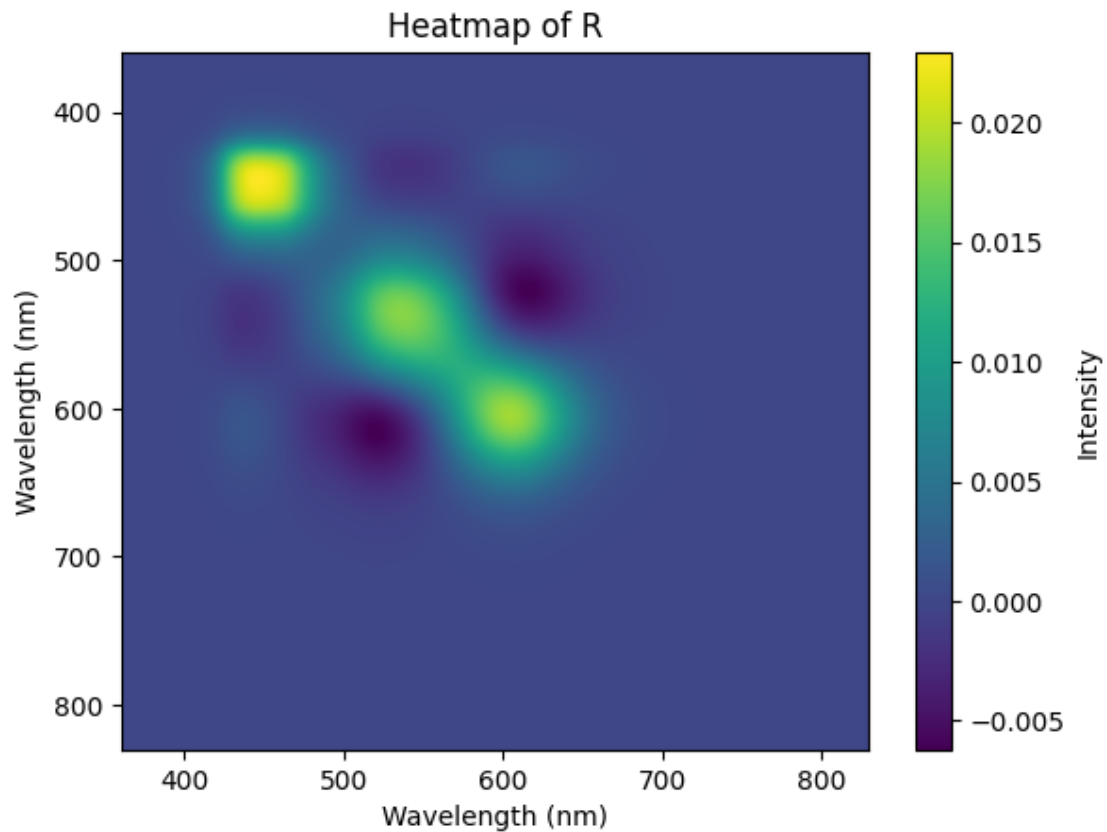

```
[25]: spd = E @ np.array([0.41239, 0.21264, 0.01933]) # rec709 red
      plt.plot(xyz_cmfs.wavelengths, spd)
```
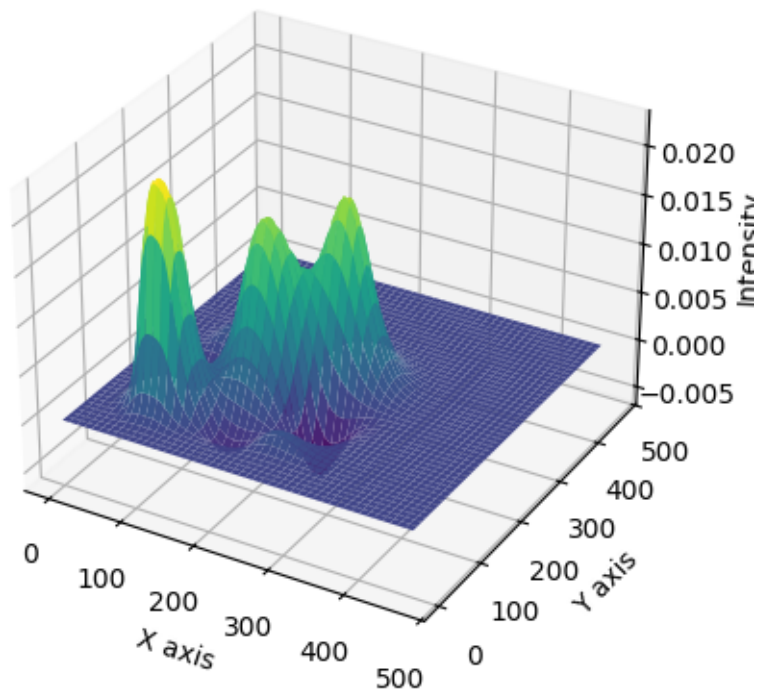
```
[25]: [<matplotlib.lines.Line2D at 0x300c0a3d0>]
```

```
[28]: plt.imshow(R, aspect='auto', cmap='viridis', extent=[xyz_cmfs.wavelengths[0],␣
      ↪xyz_cmfs.wavelengths[-1], xyz_cmfs.wavelengths[-1], xyz_cmfs.wavelengths[0]])
      plt.colorbar(label='Intensity')
      plt.title('Heatmap of R')
      plt.xlabel('Wavelength (nm)')
      plt.ylabel('Wavelength (nm)')
      plt.show()
```

## Heatmap of R



[29]:
```python
from mpl_toolkits.mplot3d import Axes3D

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
X, Y = np.meshgrid(np.arange(R.shape[1]), np.arange(R.shape[0]))
ax.plot_surface(X, Y, R, cmap='viridis')
ax.set_xlabel('X axis')
ax.set_ylabel('Y axis')
ax.set_zlabel('Intensity')
plt.show()
```

[ ]: