Universität Hamburg
Physics Department
Ultrafast Sources
SoSe 2021

Problem Set 0

Issued: April 8, 2021 Due: April 15, 2021

Instruction: This problemset will not be mandatory. It is meant to prepare you for the first and the following problemsets. We will be using numerical tools like Matlab in the problemset, so this problemset will give you instructions on where to get Matlab and how to use it. We will discuss any problems in the problemset class on the 15th of April.

Problem 1: Installing Matlab on your computer

The university of Hamburg has a pool of 301 floating Matlab licenses you can use, assuming you are a student or employee of UHH. If you are from DESY or Max-Planck, please contact your IT department.

To install and get the licenses please follow this link to the website of the *Rechen-Zentrum* *Link*.

Be aware that you will need a VPN access to UHH to run Matlab on your personal computer, here is the link provided by the RZ VPN.

Problem 2: Getting used to the fft() function in Matlab

When using **fft()** you should use our tutorial and also have a look at the Matlab documentation page. In the following we will give you a few examples for you to **fft()** and plot the spectrum of the waveform. Using what you have learned, start by choosing a reasonable sampling rate and time interval. What do you need to consider for the given waveform?

fft() the following waveforms:

1. $f(t) = e^{-2log(2)\left(\frac{t}{\tau}\right)^2},\ \tau = 100\ fs$
2. $f(t) = e^{j\omega_0 t},\ \omega_0 = 2\pi \cdot 300THz$
3. $f(t) = e^{2log(2)\left(\frac{t}{\tau}\right)^2} e^{j\omega_0 t}, \tau = 100\ fs, \omega_0 = 2\pi \cdot 300THz$
4. $f(t) = e^{2log(2)\left(\frac{t}{\tau}\right)^2} \cdot sin(\omega_0 t),\ \tau = 100\ fs, \omega_0 = 2\pi \cdot 300THz$
5. $f(t) = e^{2log(2)\left(\frac{t}{\tau}\right)^2} \cdot e^{j\omega_0 t},\ \tau = 10\ ps, \omega_0 = 2\pi \cdot 300THz$
6. $f(t) = \begin{cases} 1, & when\ t = 0 \\ 0, & else \end{cases}$
7. $f(t) = \begin{cases} 1, & when\ -1s < t < 1s \\ 0, & else \end{cases}$