**Exercise 1:**

The goal of this exercise is that you become familiar with Coherent Diffraction Imaging a far-field imaging technique commonly used in X-ray imaging, and you implement a phase-retrieval algorithm capable of retrieving the sample in a real experiment. For that, I have attached the original paper, (miao1999.pdf) where the technique is explained.

Once you have read and understood the paper, you will have to implement a reconstruction algorithm, also known as phase retrieval. For that I have provided you a h5 file (CDI_exercise.h5) which contains the real space support to constraint the sample (/data/RealSpaceSupport), the amplitude modulus in the detector space (/data/FourierAmplitudeConstraint) and a convergent complex initial object guess, split in the real part (/data/InitialGuesReal) and the imaginary part (/data/InitialGuessImaginary).

The tested algorithm converges after 20 to 100 iterations. Each iteration is a combination of

1. 45 times: Hybrid-Input-Output algorithms with β=0.7 (https://en.wikipedia.org/wiki/Phase_retrieval and the attached article: fienup1978.pdf)
2. 5 times: error reduction (https://en.wikipedia.org/wiki/Phase_retrieval)

**Exercise 2:**

In this exercise, you will work with another of the most common X-ray imaging techniques: in-line holography. In contrast with Coherent Diffraction Imaging, this exercise explores a near-field technique. The goal of this exercise is to implement TIE phase retrieval Eq. (10) of the attached article: paganin2002.pdf. For that purpose, a simulation of a representative image is provided in the file (TIE_exercise.h5). This simulation has been obtained with the following parameters:

1. R2 = 0.2 m
2. δ = 1.5e-06 (dimensionless)
3. μ = 264 $m^{-1}$
4. Iin = 1
5. pixel size=1 μm (The pixel size is required to compute the transverse momentum k)