Coherence measurements with double pinholes at FLASH2

Thomas Wodzinski[1,2,*], Mabel Ruiz-Lopez[2], Masoud Mehrjoo[2], Barbara Keitel[2], Marion Kuhlmann[2], Maciej Brachmanski[2], Swen Künzel[1], Marta Fajardo[1], and Elke Plönjes-Palm[2]

[1] *GoLP/Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, 1049-001 Lisboa, Portugal*
[2] *Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, 22607 Hamburg, Germany*
[*] *thomas.wodzinski@tecnico.ulisboa.pt*

Abstract:
Since 2016 FLASH at DESY in Hamburg operates the variable-gap undulator beamline FLASH2 as a user facility. Young's double pinhole measurements were performed at photon beamline FL24 downstream of the Kirkpatrick-Baez focusing optics, which were installed in 2017. FLASH2 was characterized at wavelengths of 8, 13.5 and 18 nm and under different machine settings. The coherence length was determined from the interference pattern of several pinhole pair separationscovering the width of the beam. A blind deconvolution algorithm was implemented to determine the coherence function from the partially coherent interference pattern. Simulations of the patterns including the Kirkpatrick-Baez focusing optics were implemented with WavePropaGator (WPG), a software for X-ray wavefront propagation simulations developed at the European XFEL. We present first results of these coherence measurements and simulations.

1. Introduction

1.1. Blind-deconvolution to recover the partially coherent intensity

The measured intensity can be expressed as a convolution (see [**?**, (eq.33)] [**?**, (eq.23)] (citing [**?**] (citing [**?**])), [**?**, (eq.1)] and [**?**, (eq.5)]):

$$I_{\mathrm{pc}} = I_{\mathrm{c}} * \mathcal{F}(\gamma)$$

where I_{pc} and I_c are the partially coherent intensity and the coherent intensity, respectively, and $\mathcal{F}$ represents the Fourier transformation. γ is termed as the normalized spatial coherence function, transverse (r) to the direction of the wave field propagation.

The transverse coherence length ξ_{T} can be measured as the FWHM of the $\mathcal{F}(\gamma)$ at the detector plane. (reference?)

$$\gamma \propto \exp\left[-\frac{r}{2\sigma}\right]$$

$$\left(I_{\mathrm{pc}}, \mathcal{F}(\gamma)_{\mathrm{est}}\right) \longrightarrow \left(I_{\mathrm{c}}, \mathcal{F}(\gamma)_{\mathrm{rec}}\right)$$