# Diffraction spectrometry of X-ray laser beams

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## Thesis Abstract

The new method of spectrometry, which allows to measure spatial-spectrum profile of X-ray laser sources, is developed in this work. This method, which was called diffraction spectrometry, is based on solving an inverse problem of diffraction on periodical object inserted into the laser beam. The new method allows to obtain spectrum of the source in different places of beam spatial profile and it allows to reconstruct not only spectral amplitudes, but also spectral profile of each harmonic. This is achieved by special analysis of experimental diffraction patterns, that are obtained from different grid cells. In the present work the algorithm of calculation diffraction pattern from a source with known spectrum and the algorithm of solving inverse problem of diffraction are developed. These algorithms carry out the diffraction spectrometry and allow to automatically measure spatial-spectrum profile from a diffraction pattern of known periodical object. The data from three experimental set-ups has been used to create and test algorithms: the diffraction experiment of optical femtosecond laser impulse of Ti:Sa laser on a wire, the diffraction experiment of high-order harmonic generation source emission, obtained during powerful femtosecond laser impulse passes through non-linearity medium, and the diffraction experiment of free electron laser (FEL) emission on periodical grid with square cell. The special methods for processing of experimental data are developed to minimise noise level. As a result, for the first time ever the spatial-spectrum profile of FEL impulse is measured.