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The Beam-Based Alignment for Soft X-Ray Free-Electron Lasers via Genetic Algorithm[☆]

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Abstract

The overlap between the electron beam and the radiation field is one of the most important characteristics during the free-electron laser (FEL) amplification processes, which will dramatically influence the quality of the FEL radiation. The beam-based alignment (BBA), first proposed in 1980s, has achieved great success in both theoretical and experimental studies on hard X-ray FELs. This paper gives a brief analysis on the undulator misalignment, which has been ignored in the original BBA algorithm. These misalignments, as revealed by the calculation and simulation, tend to have significant impacts on the soft X-ray FELs which are driven by the low energy accelerators. Furthermore, we demonstrate a method that can probably solve this dilemma using a searching algorithm - genetic algorithm.

Keywords: Beam-Based Alignment, Modified Genetic Algorithm, Soft X-ray

1. INTRODUCTION

As a feasible technical approach to the fourth generation light source, the X-ray free-electron lasers (XFELs) have been playing an irreplaceable role in the field of physics[1], chemistry[2], biology science and material science[3] due to its remarkable characteristics of continuously tunable wavelength, high brightness, high spatial coherence and

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