

# Lawrence Berkeley National Laboratory

## Recent Work

### Title

Formation of electron bunches for harmonic cascade x-ray free electron lasers

### Permalink

<https://escholarship.org/uc/item/64q7k5p9>

### Authors

Cornacchia, M.

Mitri, S. Di

Emma, P.J.

et al.

### Publication Date

2006-01-15

## **FORMATION OF ELECTRON BUNCHES FOR HARMONIC CASCADE X-RAY FREE ELECTRON LASERS**

M. Cornacchia, S. Di Mitri, P.J. Emma, G. Penco; G.V. Stupakov, A.A. Zholents

A relatively long electron bunch is required for an operation of harmonic cascade free electron lasers (FELs). This is because they repeatedly employ a principle when the radiation produced in one cascade by one group of electrons proceeds ahead and interacts with other electrons from the same electron bunch in the next cascade. An optical laser is used to seed the radiation in the first cascade. Understandably the length of the electron bunch in this situation must accommodate not only the length of the x-ray pulse, but at least this length multiplied by a number of cascades plus a possible time jitter between arrival time of the electron bunch and a seed laser pulse. Under these conditions a variation of the peak current along the electron bunch as well as other local characteristics of electrons may significantly affect performance of the FEL. For example a flat-top distribution in the peak current or a distribution where peak current is increased toward the head of the electron bunch responsible for the radiation at a shortest wavelength may be at a premium. In this paper we analyze all possible sources affecting the distributions and interplay between them and show how desirable distributions can be produced. Results are illustrated with simulations using particle tracking codes.

This work was supported by the U.S. Department of Energy under Contract No. DE-AC03-76SF00098