



# **Ultraviolet and Soft X-Ray Free-Electron Lasers: Introduction to Physical Principles, Experimental Results, Technological Challenges (Springer Tracts in Modern Physics)**

*Peter Schmüser, Martin Dohlus, Jörg Rossbach*

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The main goal of the book is to provide a systematic and didactic approach to the physics and technology of free-electron lasers. Numerous figures are used for illustrating the underlying ideas and concepts, and many links to other fields of physics are provided. After an introduction to undulator radiation and the low-gain FEL, the one-dimensional theory of the high-gain FEL is developed in a systematic way. Particular emphasis is put on explaining and justifying the various assumptions and approximations that are needed to obtain the differential equations governing the FEL dynamics. The predictive power of the 1D FEL theory is demonstrated with numerous examples and figures, including exponential gain, saturation and FEL bandwidth. One of the most important features of a high-gain FEL, the formation of microbunches, is studied at length and illustrated with several figures. 3D corrections to the 1D theory are discussed. The process of self amplified spontaneous emission (SASE) is explained mathematically, and many experimental results are shown. The layout of the world's first SASE FEL in the soft X-ray regime, FLASH, is described in some detail and the technological challenges of X-ray FELs are outlined. Important concepts of accelerator physics are explained while some of the more involved mathematical computations are put into the appendices.

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