Preface

Development of coherent radiation sources for a wavelength λ below 1 angstrom (i.e., in the hard X-ray and gamma ray ranges) is a challenging goal of modern physics. Sub-angstrom wavelength powerful spontaneous and, especially, coherent radiation will have many applications in basic science, technology and medicine. In particular, they may have a revolutionary impact on nuclear and solid-state physics as well as on life sciences.

The present state-of-the-art lasers are capable of emitting electromagnetic radiation from the infrared to ultraviolet range of the spectrum. Currently, there is one Free-Electron Laser (FEL) operating in the X-ray range ($\lambda \approx 1$ Å) [99]. Several other FEL X-ray facilities are either under construction or undergoing advanced technical design work. Moving further, i.e., into the hard X-ray or/and gamma ray band, is not possible without new approaches and technologies.

In this book we present and discuss one of such novel approaches. The main phenomenon addressed is the radiation formed in a *Crystalline Undulator*. In this device, the electromagnetic radiation is generated by a bunch of ultra-relativistic particles channeling through a periodically bent crystalline structure. Such a system becomes a source of intensive spontaneous monochromatic radiation and, under certain conditions, also a source of the laser light. A laser based on the crystalline undulator could produce photons with $\lambda = 0.01$–0.1 Å (the corresponding photon energy range is from tens to hundreds of keV up to MeV region). Thus, its photon energy range starts where conventional FEL devices tail-off.

The feasibility of constructing a crystalline undulator is a very recent concept. The aim of this book is to represent the underlying fundamental physical ideas as well as the theoretical, experimental and technological advances made during the last one and a half decades in exploring the various features of crystalline undulators and the radiation formed in them. The book is addressed to a wide audience of researches and students since the phenomenon of crystalline undulator entangles the concepts from various research fields, such as material science, beam physics, physics of radiation, solid-state physics, acoustics, etc., whereas its investigation implies the use and further elaboration of a variety of theoretical and computational methods, experimental techniques, and technological and engineering approaches.

We are grateful to Andriy Kostyuk, Wolfram Krause and Mehdi Tabrizi together with whom many of the presented theoretical results were obtained. We express our gratitude to Erik Uggerhøj and Simon Connell for helpful discussions. We are indebted to Hartmut Backe, Werner Lauth and Ulrik Uggerhøj for numerous stimulating and clarifying discussions as well as for their support of our theoretical activity in the field and eagerness to carry out experimental investigations.

Financial support from Deutsche Forschungsgemeinschaft (DFG), Alexander von Humboldt Foundation and European Commission, granted to us at various stages of the research, is gratefully acknowledged.

Frankfurt, Germany

Andrey V. Korol
Andrey V. Solov'yov
Walter Greiner

http://www.springer.com/978-3-642-54932-8

Channeling and Radiation in Periodically Bent Crystals
Korol, A.V.; Solov'yov, A.V.; Greiner, W.
2014, XI, 284 p. 122 illus., 96 illus. in color., Hardcover
ISBN: 978-3-642-54932-8