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# Femtosecond Laser Pulses: Principles and Experiments Edited by C. Rulliere. Springer-Verlag: New York. 1998. \$59.95. 305 pp. ISBN 3-540-63663-3

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Femtosecond Laser Pulses: Principles and Experiments, edited by C. Rulliere, Springer-Verlag, New York, 1998, \$59.95, 305 pp., ISBN 3-540-63663-3

Not long ago, research groups using the first homemade femtosecond lasers relied on ‘laser jocks’ to advance their research. The training of a laser jock depended on the transfer of information from one laser jock to the next, primarily teaching what works and what does not. In those days, advances published in the literature about these laser sources contained more empirical observations than hard core principles that one could assimilate and use to improve a laser system. Today, the commercial availability of relatively affordable ‘turn key’ femtosecond lasers and their wide range of application are resulting in increases in the number of users. The extremely wide bandwidth of femtosecond pulses makes it non-trivial to maintain the ultrashort pulse duration from the output of the laser to where the experiment occurs. This creates the need for a textbook that serves as a teaching, learning and reference tool for femtosecond laser research. This book evolved from a series of lectures beginning in 1992 at the Bordeaux University. It was intended as a pedagogical guide to train scientists in the use of femtosecond lasers. Personally, I find it a wonderful resource for any laboratory where femtosecond lasers are used in that it provides the type of information required for understanding their operation and application.

The book begins with a short chapter on the principles of lasers followed by four chapters on pulsed laser sources, including one exclusively dedicated to semiconductor lasers. The chapters are well written, relatively short, and include a fair amount of useful charts, formulae, and tables. At the end of some of these chapters, the reader can find some practical questions.

Answers are provided in most cases so that the reader can understand how to use the information in a practical way. This makes the text ideal for beginning experimenters. More advanced scientists can use the text as a reference that compiles many of the formulas required in the design of new methods and references to their original sources. However, there is some repetition in the three chapters covering the generation of femtosecond laser pulses that could have been avoided.

The chapter dealing with compression, amplification, and tunability introduces these topics but fails to connect them with the formulae given in the previous chapters. Also, this section does not give the user the same level of practical formulas and quantitative information as the other chapters do. Readers will find the chapter on measurement and characterization to be quite useful. It contains tables, formulae, and diagrams that illustrate most of the methods being used to characterize femtosecond laser pulses. Readers may find this chapter to be one of the most useful in the book.

The last three chapters of the book are dedicated to applications. Given the tremendous proliferation of femtosecond lasers in diverse areas of research, it is impossible to review each of the applications individually. Instead, the book covers some of the more conventional methods such as pump-probe and transient grating. The strength of this chapter is that it provides the basic principle of operation and diagrammatic setup of many of these methods. Additional information is given as useful tricks; valuable experimental parameters that the user will want to know when setting up these measurement techniques in their laboratory. The chapter includes four 'how to' sections where the reader is given precise instruction on specific setups.

The chapter on coherent effects in femtosecond spectroscopy gives a very useful introduction based on perturbation theory and Bloch equations. This formulation gives the foundation of many nonlinear optical techniques. Readers should be warned that most femtosecond lasers achieve peak intensities that typically exceed the perturbation limit. This section introduces the excitation of wave packets (coherent superpositions of quantum states). An example is given for an asymmetric semiconductor as well. However, the presentation seems to overlook a very large volume of research on the observation of rotational and vibrational wave packets in molecules in the gas and condensed phases. The final chapter introduces terahertz femtosecond pulses, their generation and applications.

In summary, this is a valuable text on the principles and applications of femtosecond laser pulses. In this quickly evolving field, there have been many very useful texts but progress seems to outpace the rate at which books are published. The book contains few publications after 1996; nevertheless, it is much more readable than a proceedings type of book. Users interested in the very latest technologies will have to rely on scientific literature until the next technical book is written. Readers interested in chemical and biological applications of femtosecond lasers will find the proceedings of the Femtochemistry conferences useful. A good source of articles on the latest femtosecond laser techniques is the proceedings of the Ultrafast Phenomena conferences.

Professor Marcos Dantus, Department of Chemistry, Michigan State University, East Lansing,  
MI 48824