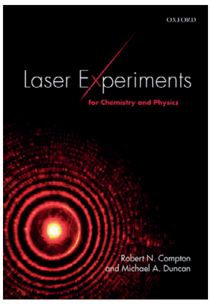
Laser Experiments for Chemistry and Physics

Since the invention of the laser by Theodore Maiman, more than 55 years ago, this extraordinary light source has had a breath-taking career, both in science and commercial applications. In physics and chemistry laboratories, lasers are used not only because of their unique properties in a variety of experiments for basic research, but also for standard analytical purposes. Due to their importance, there are many excellent books that deal with the physical principles of lasers and with all kinds of advanced applications. The new book *Laser Experiments for Chemistry and Physics*, by Robert N. Compton and Michael A. Duncan, introduces lasers in an unusual way, by describing laser experiments on a variety of topics, all of which are suitable to be performed as part of undergraduate and graduate courses in physics or physical chemistry. For each experiment, the book not only describes the physical and chemical effects, but also explains in detail how to conduct the experiment, and gives suggestions for follow-up experiments.

The authors, who can draw on many years of experience in research and teaching in physical chemistry, have introduced here many newly developed and successfully tested experiments at the University of Tennessee. Many of these experiments have been published in appropriate scientific journals.

The book is divided into five sections. The first describes the necessary physics for the experiments, then the other four deal with different topic areas in which lasers are applied. This group of chapters begins with experiments where lasers are used to study thermodynamic parameters; that is followed by experiments on chemical analysis, quantum chemistry, and spectroscopy, ending with applications in the field of kinetics. The introductory section is easy to read, and even a scientist already familiar with the field can gain some new insights. Nevertheless, it is more a revision course than an introductory textbook for students, and as such, students will probably prefer to stay with more classical textbooks on optics. I particularly like the chapter about laser safety, since this subject is hardly covered at all in scientific books, but is highly relevant for practical work, and also the more popular books seldom give it sufficient attention.



Laser Experiments for Chemistry and Physics
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The chapters on individual experiments with lasers form the bulk of the book. As a representative example, an experiment for the determination of heat capacity by using lasers to generate thermal lenses is described. Another chapter describes laser desorption mass spectrometry for chemical analysis, and a setup for the generation and use of the third harmonic in vacuum ultraviolet spectroscopy is explained. The authors not only explain the physical effects but also describe the detailed procedure for carrying out the experiment. In choosing experiments for inclusion in the book, the authors have always taken into account their feasibility for a university laboratory class at the undergraduate or graduate level. This makes the book rather unique and it is the strength of the authors' approach. These chapters immediately stimulate new thoughts about how such experiments can be realized within the framework of existing laboratories and limited budgets.

The description and level of detail of the specific experiments depends on the subject in question. Experiments such as that on time-of-flight mass spectrometry are described in great detail with photographs of actual setups, whereas others are only presented with a schematic sketch. All chapters end with a list of references for further reading, but I would have liked these to include some more recent publications showing the link to the latest research. I was disappointed to find no experiment using lasers that generate ultrashort pulses, which have become extremely important in physics and physical chemistry laboratories during the last 20 years. Of course, such laser systems are still quite expensive, and therefore less possible for a practical laboratory course.

In summary, it makes a lot of sense if this book is used as an accompaniment to a practical laboratory course. As an introductory student textbook on laser physics and laser chemistry, it seems to be less suitable. The chapters are too narrowly focused on the individual experiments, leading to discontinuous jumps between topics and to numerous repetitions. However, the greatest appeal of the new book, in my mind, is for university teachers who design laboratory courses and are considering a redirection of old courses or who want to revise existing experiments.

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