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Edited by
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Dedicated to HERBERT WALTHER

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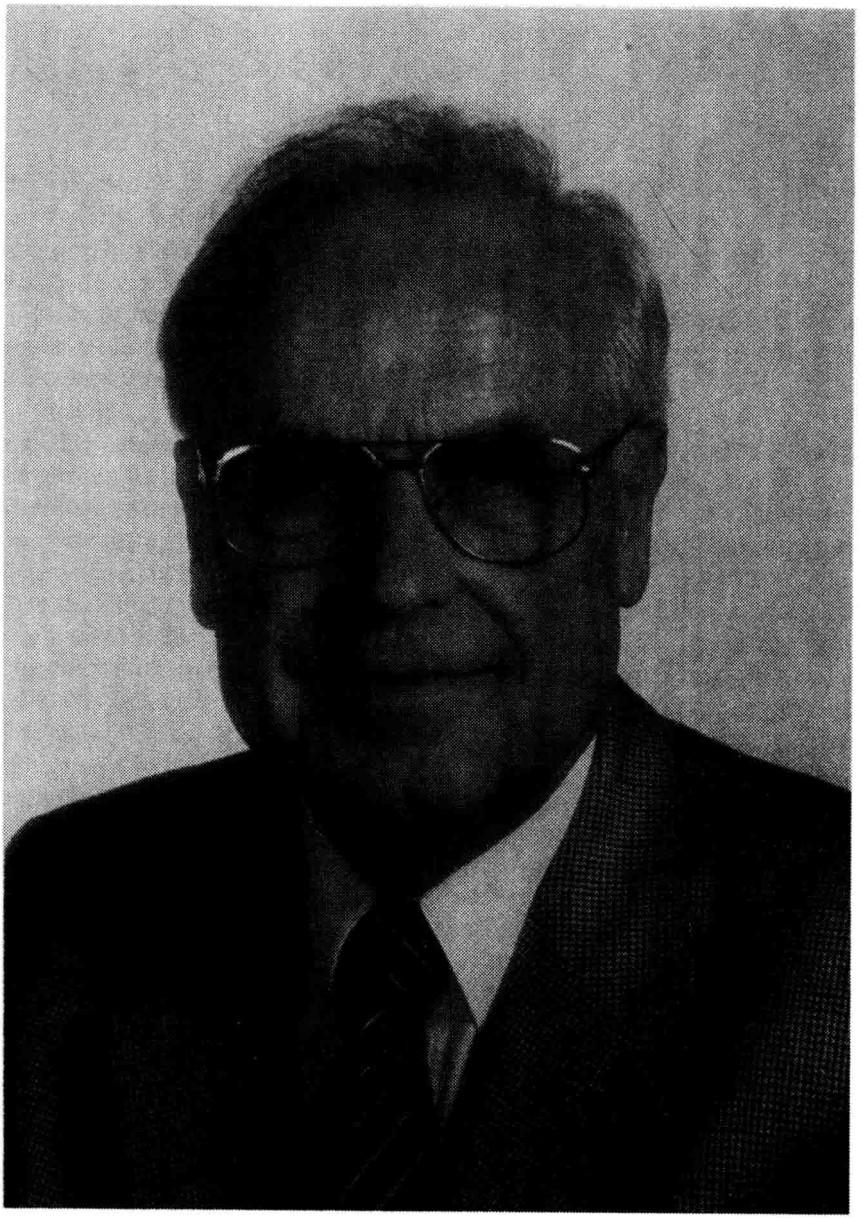

HERBERT WALTHER

PREFACE

Prof. Herbert Walther is a quantum optics star of galactic magnitude! Experimental physicists admire his ability to conduct experiments previously considered impossible. Theoretical physicists eagerly look forward to the stunning results that come out of his laboratory. His discoveries have brought increasingly new life to both the theoretical and experimental quantum optical physicists. The scientific methods developed in his laboratory have become a mainstay to quantum optics laboratories all over the world.

Three qualities of Herbert Walther stand out most clearly: His enormous energy, his unique dedication to science and his special eye for scientific quality. He obviously must subscribe to the German motto: "Die Probleme existieren, um überwunden zu werden" (problems exist to be overcome). This statement holds true not only for scientific matters but also for science policy. Three examples illustrating his qualities offer themselves:

In the early 1980s the Max-Planck-Society inherited the Ringberg castle located in the picturesque Bavarian mountains next to Lake Tegernsee. The Max-Planck Institute for Quantum Optics was one of the first institutes that started using this facility as a retreat to review its progress in the various groups and initiate novel research directions. It was during one of these early meetings when Herbert Walther's group was discussing the new possibilities in cavity quantum electrodynamics offered by the unique combination of Rydberg atoms and high-Q microwave resonators. Herbert Walther proposed to build a new type of maser driven by a single atom. However, fresh ideas are rarely received with enthusiasm, especially by those who have to transfer the Gedanken experiments into real experiments. It was argued that too many novel techniques, such as, atomic beams and cryogenic equipment, which had only worked separately before, now had to be combined into one single experiment: it was considered impossible to make all these experimental tricks work at the same time. Herbert Walther tried to convince the nay sayers about the feasibility of the experiment—without success. Finally he decided to follow a different route and attract students to do the work. Indeed, several students, starting with Dieter Meschede, Gerhard Rempe, Ferdinand Schmidt-Kaler, Georg Raithel, Oliver Benson, and Ben Varcoe, now all faculty members at different scientific institutions, together with other students, postdocs and visitors, planned and implemented today's famous research line of the micromaser.

Second, Herbert Walther is a great institution builder. He was a main driving force responsible for building up the Max-Planck Institute for Quantum Optics to

one of the top institutions in the field worldwide and in fact a Mecca for many international scientists visiting it religiously. Today it is hard to believe that in the late 1970s the Institute was an institute on probation: The Max-Planck Society had installed a research group in the newly emerged field of laser physics, the so called "Projektgruppe für Laserforschung" (project group for laser research). Herbert Walther was hired as one of the directors. In no time he was able to attract many bright students to his group and bring the high society of laser physics to the project group. Clearly enough, the Max-Planck Society then was given little choice but to found a full fledged Max-Planck Institute. Many years later, Herbert Walther had the unique opportunity to repeat this story of success on a much larger scale: As Vice President of the Max-Planck Society, he was a leading authority while setting up the new institutes in East Germany after reunification.

A third example illustrating Herbert Walther's lack of fear was the hiring of Prof. Theodor Hänsch who had previously turned down several offers from German universities. It seemed to be a hopeless task to lure Hänsch away from Stanford. Nevertheless, Herbert Walther was not afraid to compete. He first arranged a Humboldt prize for Hänsch to get him used again to German life. He then managed to arrange an offer which could not be refused—a chair at the University of Munich together with a directorship at the MPQ. In this way, Herbert Walther achieved the impossible.

It is difficult to describe the impact of his works in just a few words. Those of us who have been associated with him consider ourselves very fortunate, having benefited from the relationship in many different ways. Needless to say, Herbert Walther has trained a large number of students and other researchers, many of whom have become authorities in the field. His students and colleagues have won Nobel prizes; few are able to boast this line. But his humbleness and generosity have no bounds and the optical community knows and appreciates all that he has done for it.

We hope that some of the many shining aspects of his scientific life are reflected in the present volume. All articles have been written by Herbert Walther's former students and collaborators, now grown up and dedicated to their own research. But clearly enough, the nucleus of their work lies in Herbert Walther's laboratory. To our minds, when history is written, then one would find that many of the discoveries made in Herbert Walther's laboratory will stand out as some of the most fundamental discoveries in the discipline of quantum optics.

So with the preceding in mind, appreciation and admiration in our hearts, and a special applause to his endearing spouse Margot, we dedicate this volume to you Herbert. Vielen Dank!

Girish Agarwal
Gerhard Rempe
Wolfgang Schleich
Marlan Scully

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*NON-CLASSICAL LIGHT FROM ARTIFICIAL ATOMS**

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1. Introduction

A photon is the fundamental excitation of the quantized electro-magnetic field. Its introduction helped to get a deeper, yet more intuitive understanding of the phenomenon *light*. The year 2005 celebrates the 100th anniversary of Einstein's ingenious explanation of the photoelectric effect using the concept of the photon. Until today, the photon is a workhorse to test the foundation of quantum physics against recurring efforts of a purely classical interpretation of nature [1,2]. More

* We would like to dedicate this article to Prof. Herbert Walther on behalf of his 70th birthday. He pioneered quantum optics with single quantum systems and drew our attention to the beauty of the single photon. The experiment we report in Section 4 of our article was motivated by his wonderful experiments with single ions.

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