INTRODUCTION

Solving problems in school work is exercise of the mind and enhances understanding of the principles. In general examination questions usually parallel such problems. Thus working out problems forms an essential and important part of the study of physics.

Major American University Ph.D. Qualifying Questions and Solutions is a series of seven volumes. The subjects of each volume and the respective referees (in parentheses) are as follows:

1. Mechanics (Qiang Yuan-qi, Gu En-pu, Cheng Jia-fu, Li Ze-hua, Yang De-tian)
2. Electromagnetism (Zhao Shu-ping, You Jun-han, Zhu Jun-jie)
3. Optics (Bai Gui-ru, Guo Guang-can)
4. Atomic, Nuclear and Particle Physics (Jin Huai-cheng, Yang Bao-zhong, Fan Yang-mei)
5. Thermodynamics and Statistical Physics (Zheng Jiu-ren)
6. Quantum Mechanics (Zhang Yong-de, Zhu Dong-pei, Fan Hong-yi)
7. Solid State Physics, Relativity and Miscellaneous Topics (Zhang Jia-lu, Zhou You-yuan, Zhang Shi-ling)

This series covers almost all aspects of University Physics and contains 2550 problems, most of which are solved in detail.

The problems have been carefully chosen from a collection of 3100 problems, of which some came from the China–U.S.A. Physics Examination and Application (CUSPEA) Program, some were selected from the Ph.D. Qualifying Examination on Experimental High Energy Physics sponsored by Chao Chong Ting. The rest came from the graduate preliminary or qualifying examination questions of seven world-renowned American universities: Columbia University, University of California at Berkeley, Massachusetts Institute of Technology, University of Wisconsin, University of Chicago, Princeton University and State University of New York, Buffalo.

Generally speaking, examination problems in physics in American universities do not involve too much mathematics. Rather, they are to a large extent characterized by the following three aspects. Some problems involving various frontier subjects and overlapping domains of science are selected by professors directly from their own research work and thus have an "up-to-date" flavor. Some problems involve broad fields and require a quick

mind to analyse, while the methods needed for solving the other problems are simple and practical but requires a full "touch of physics". Indeed, we venture to opine that the problems, as a whole, embody to some extent the characteristics of American science and culture, as well as the philosophy underlying American education.

Therefore, we considered it worthwhile to collect and solve these problems and introduce them to students and teachers, even though the effort involved was formidable. As many as a hundred teachers and graduate students took part in this time-consuming task.

A total of 380 problems make up this volume of eight parts: basic principles and one-dimensional motions (72), central potentials (27), spin and angular momentum (48), motion in electromagnetic field (16), perturbation theory (83), scattering theory and quantum transitions (61), many-particle systems (37), and miscellaneous topics (40).

In scope and depth, most of the problems conform to undergraduate physics syllabi for quantum mechanics in most universities, while many are rather profound and sophisticated or broad-based. A remarkable fact is that the problems from American universities often combine fundamental principles and latest research activities. Thus the problems may help the reader not only to enhance understanding of basic principles, but also to cultivate the ability of solving practical problems in a realistic environment.

This volume is the result of the collective effort of 19 physicists who worked out and checked the solutions, notably Zhang Yong-de, Zhu Dong-pei, Fan Hong-yi, Ren Yong, Dai Tie-sheng, Ning Bo. The original translation was carried out by professors Zheng Jiu-ren and Qi Bo-yun.