Preface

This book has its roots in a course that was taught at Lawrence Livermore National Laboratory in the summer of 2005 entitled “Analytic Methods for Nonproliferation.” This course was an intensive two-week experience for 22 graduate students from around the United States, with two foreign nationals included. The instruction was shared among 36 people, with three Berkeley faculty (Michael Nacht, Stan Prussin, and me), and 33 LLNL scientists. It was an impressive tour de force of scientific knowledge and technical capability in the area of nonproliferation and arms control. The Berkeley students followed up with another week on the Berkeley campus (a required element for them to get course credit through the university), which allowed a more “hands-on” approach to detection experiments, but without large quantities of weapons-grade material available. While at first it was thought that we would hold this class at Livermore in subsequent summer sessions, the tremendous amount of time, effort, and money required resulted in this being a one-off experience. It became clear that there was a need for this type of education on the Berkeley campus in a regular semester-long course. This resulted in a course at Berkeley with the same title as this book, which has now been taught in each of the 10 years since the 2005 course at Livermore. It became clear that the course needed a textbook, and this book is the result.

The level of this book assumes knowledge of some concepts of basic nuclear engineering, such as the cross-section concept and alpha, beta, and gamma decay. While some background on gamma and neutron transport is provided here, it is done so only to show some of the simplified forms of these mathematically rich subjects, which can lead to approximations that can be used to evaluate detection schemes in applications relevant to nonproliferation, arms control, and treaty verification. Thus the book is not intended as a replacement for standard textbooks such as Lamarsh (for neutron transport and reactor theory) and Knoll (for detector physics). The exercises in the book are best carried out with a mathematical processing language such as Mathematica or Matlab.

This book should be accessible to advanced undergraduates as well as graduate students in nuclear engineering or applied physics. There is a good bit of material outside the normal exposure that students in these disciplines have, such as seismology, chemical engineering, and materials processing techniques. Again, this book is not intended to be a substitute for stand-alone courses in these areas. Also, the chapter on public policy is not a replacement for a well-rounded education in this field, but rather to help a reader with an engineering or science background understand how the organizations responsible for global nuclear security fit together, and perhaps help potential job seekers understand what is out there.

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