This dissertation is an outcome of the continuation of the works originally undertaken by this laboratory under a research grant sponsored by the Department of Science and Technology, Govt. of India. The knowledge of angular distributions of number and energies of reflected photons from shield materials is useful in shield calculations in nuclear installations. The present dissertation deals with the development of a novel instrument 'proportional response photon counter' and its application in the measurement of energy albedo of reflected photons. The photon scattering theory has been used in the fundamental instrument design and it has been conclusively proved that the application of this instrument in the measurement of energy albedo has distinct advantages over the conventional method of measurement used so far. The measurement has been carried out for two different photon energies (662 keV and 1250 keV) and for five different scatterers. The present work has been organised into four chapters.

The first chapter presents the scope and objective of the present investigation.

The development of the detecting system constitutes one of the major portions of the thesis and therefore the
Chapter 2 begins with the discussion of basic mechanism of scintillation counter. Chapter 2 essentially presents the general theoretical development of the detecting system and its experimental realisation.

The third chapter presents a brief review of the backscatter phenomena of gamma rays. The concept of albedo, the present status of theoretical, approximate and experimental observations of angular distribution of reflected photons and energies have been presented. The advantage of using the proportional response photon counter developed in the second chapter over the conventional detecting system has been stressed.

The chapter four describes in detail the experimental arrangement, the method of measurement and analysis of the results.

The author apologises to the reader for some repetitions which is unavoidable to make each chapter self-content.

The references appeared in the text are presented alphabetically by author’s name at the end of the dissertation.

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