P R E F A C E

The present thesis is based on the work done in the field of photon scattering in matter and pertains mainly to coherent scattering of photons in the range 84 KeV - 2 MeV with emphasis on the following:

1. A critical analysis of the existing theories on coherent photon scattering has been made with a view to finding a correlation among these theories as a function of scattering variables.
2. An experiment was set up, carried out and new results on coherent photon scattering have been obtained for photon energies in the range 84 KeV to 2 MeV from bound atomic systems of low, medium and high and target atoms at scattering angles from 1^{0} to 150^{0}.
3. Reference to experimental results obtained by other researchers on coherent scattering made after 1965 have been made and the need for new measurements in the energy ranges where new theoretical results are available have been emphasized.
4. New results together with some other recent results have been used to test the recent theories on Rayleigh and Delbruck scattering of photons.

After careful study of the comparisons of different theoretical predictions with each other and with experimental data mentioned above the following facts were observed. The applicability of using form factors to predict Rayleigh scattering at low momentum transfer has been established. The usefulness of dispersion correction to form factors for photon energies near K-absorption edges of target atoms has been analysed. Recent calculation of Rayleigh scattering amplitudes from S-matrix formalism has been found to be in excellent agreement with experimental data. The need to calculate Rayleigh amplitudes based on S-matrix formalism at low momentum transfer (small angle scattering for low photon energies) has been pointed out. The same need to calculate higher shell Rayleigh amplitudes which are not available to-date for photon energies above 1 MeV has also been discussed. The status of all available theoretical predictions of Rayleigh scattering in relation to each other has been examined.

The recent calculation of Delbruck amplitudes has been found to be adequate for photon energies near threshold, for high -Z target atoms. The failure of this calculation based on Born Approximation for photon energies above 2 MeV has been established.

This present work was carried out under the Faculty Improvement Programme of University Grants Commission for college teachers during 1977-81. Most of the experimental results presented in the thesis have been published by the author in different journals during the period of work. The author had the privilege of presenting some of these results in three International Conferences held abroad. A list of publications by the author in collaboration with others is given in support of the candidature. Copies of some of the publications are also attached in the thesis.

New results, methodology of analysis of existing theories and the conclusions drawn about the present state of the theory are original and contribute to a better knowledge of the coherent scattering processes.