

1. Record Nr.	UNINA9910729894403321
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Titolo	The Nature of X-Rays and Their Interactions with Matter // by Joachim Stöhr
Pubbl/distr/stampa	Cham : , : Springer International Publishing : , : Imprint : Springer, , 2023
ISBN	3-031-20744-0
Edizione	[1st ed. 2023.]
Descrizione fisica	1 online resource (933 pages)
Collana	Springer Tracts in Modern Physics, , 1615-0430 ; ; 288
Disciplina	539.7222
Soggetti	Synchrotrons Optics X-ray spectroscopy Atoms Molecules Quantum optics Condensed matter Synchrotron Techniques Light-Matter Interaction X-Ray Spectroscopy Atomic, Molecular and Chemical Physics Quantum Optics Condensed Matter Physics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Introduction and Overview -- Production of X-Rays: From Virtual to Real Photons -- From Electromagnetic Waves to Photons -- Brightness and Coherence -- The Complete Description of Light: Higher Order Coherence -- Semi-Classical Response of Atoms to Electromagnetic Fields.
Sommario/riassunto	This book gives a comprehensive account of modern x-ray science, based on the use of synchrotron radiation and x-ray-free electron lasers (XFELs). It emphasizes the new capabilities of XFELs which extend the study of matter to the intrinsic timescales associated with the

motion of atoms and chemical transformations and give birth to the new field of non-linear x-ray science. Starting with the historical understanding of the puzzling nature of light, it covers the modern description of the creation, properties, and detection of x-rays within quantum optics. It then presents the formulation of the interactions of x-rays with atomic matter, both, from semi-classical and first-principles quantum points of view. The fundamental x-ray processes and techniques, absorption, emission, Thomson, and resonant scattering (REXS and RIXS) are reviewed with emphasis on simple intuitive pictures that are illustrated by experimental results. Concepts of x-ray imaging and diffractive imaging of atomic and nano structures are discussed, and the quantum optics formulation of diffraction is presented that reveals the remarkable quantum substructure of light. The unique power of x-rays in providing atom and chemical-bond specific information and separating charge and spin phenomena through x-ray polarization (dichroism) effects are highlighted. The book concludes with the discussion of many-photon or non-linear x-ray phenomena encountered with XFELs, such as stimulated emission and x-ray transparency.
