

PREFACE

Interaction of beams of charged and neutral particles with matter is one of the most widely used research methods in physics for studying the properties of various substances and processes. Prominent among these methods electromagnetic radiation is applied throughout its range of wavelengths: from hard γ - till soft X-ray and ultraviolet radiations. Therefore, since the discovery of radiation, intensive search for new sources of electromagnetic radiation of various frequency ranges has remained a topical concern. The main sources of radiation are the interaction of charged particles in solids as well as in various external fields. The processes of electromagnetic radiation, accompanying the motion of charged particles in various fields, so far are widely studied both theoretically and experimentally.

Relativistic electrons and positrons traversing various targets emit different types of radiation known as coherent bremsstrahlung, channeling radiation, transition radiation, parametric X-ray radiation, etc. The emitted radiation, electromagnetic radiation, represents in such a way variety of processes of atomic physics that has been described within both classical and quantum approaches of electrodynamics. Radiation sources of that origin can be considered as complementary to conventional radiation sources based on synchrotron and undulator radiations, Compton scattering sources and free electron lasers. However, due to the ability to deliver powerful coherent photon beams within the frame of low cost projects, the radiation of electrons and positrons in solids of various periodicities attracts attention of researchers from many laboratories throughout the world specializing in accelerator and radiation physics, nuclear physics, material science, biology and medicine, extending the landscape of radiation science and its applications.

Channeling of charged particles in crystals (monocrystals, complex crystals, nanostructures, etc.) is rather powerful instrument to trap the beams in a strong field of crystal planes or axis. Once the crystal channel is optimally bent, the trapped beam will be deflected following the channel profile. Hence, having the potential to handle the beams, bent crystal channeling may result in beam steering at accelerators. The latter provides the opportunity for beam extraction or collimation; first successful attempts to prove the phenomenon at JINR were followed by several series of brilliant experiments performed within international collaborations at FNAL and CERN. Moreover, channeling becomes very promising instrument for muons cooling and accelerating, for positron beams production, etc.

The use of various channeling approaches to handle the beams (by means of natural crystals as well as artificial structures) is not limited by charged particles.

Channeling also works as useful method to control X-ray and γ - radiations as well as thermal neutrons for efficient beams deflection over the large angles at very short distances allowing the radiation intensity of existing sources to be increased in orders of the value (X-ray and neutron capillary/polycapillary optics, waveguides). Propagation of charged particles in crystals and propagation of photons/neutrons in capillary systems, even if strongly different by nature, have much in common, as both can be described within the frame of channeling theory.

The "Channeling", International Conference on Charged and Neutral Particles Channeling Phenomena, series are the conferences devoted to new developments in the field of coherent and incoherent scattering of hadrons and leptons (protons, ions, electrons, muons and related antiparticles) in matter of various periodicity structures from the viewpoint of fundamental studies as well as applications. The organization of these conferences based on the traditions of the related successful meetings in Europe, America and Asia (including URSS and former URSS states' conferences) started more than 30 years ago. The conference represents a unique opportunity for the wide interdisciplinary community to gain information about current and future researches in the field of coherent/incoherent scattering of radiations in matter (crystals, nanoporous materials, capillaries), and in particular for young scientists who have interest in undertaking new investigations following the foreseen development of the next generation photon sources, as well as an important opportunity for exploring and discussing new international initiatives in radiation penetration science, such as channeling of charged and neutral particles and related studies.

The first meetings of new series, "Channeling 2004" and "Channeling 2006", were organized by the National Institute for Nuclear Physics (INFN) at the National Laboratories of Frascati (LNF). The proceedings of the conferences issued by SPIE - the International Society for Optical Engineering, Proc. of SPIE, Vols. 5974 (2005) and 6634 (2007), include manuscripts by the reports to the conferences.

This volume consists of the contributions prepared following the reports to the 3rd International Conference on Charged and Neutral Particles Channeling Phenomena – "Channeling 2008"¹, organized as the 51st Workshop of the INFN ELOISATRON Project² and hosted by the "Ettore Majorana" Foundation and Centre for Scientific Culture (Erice, October 25 - November 1, 2008). The "Channeling 2008" has collected 30 invited lectures and more than 100 reports.

¹ Details of the workshop, including pdf copies of the reports to the workshop, are available through the official web page <http://www.lnf.infn.it/conference/channeling2008>

² The ELOISATRON (ELN) Project aims at a future proton supercollider with 100-500 TeV energy per beam and 10^{34} - 10^{36} cm²s⁻¹ luminosity. While the Large Hadron Collider (LHC) is being implemented at CERN, it is in fact very timely to study the feasibility of the next generation of hadron colliders at the extreme limits of energy and luminosity.

The workshop has formed by the five main and two poster sessions devoted to the discussion of recent results on charged and neutral particles coherent phenomena of propagation in various structures and periodicities obtained by the leading researches at various world centres together with historical reviews on coherent bremsstrahlung, channeling radiation, crystal channeling and novel FEL and other powerful radiation source machines. The Crystal Channeling Collimation session, dedicated to the discussion of new achievements and ideas within the CERN and FNAL projects, was organized as a videoconference with the Fermi National Accelerator Laboratory (Batavia, USA). There were two special lectures, one devoted to the 100th anniversary of the birth of L. Landau, and another one to the great experience of one of the pioneer of coherent bremsstrahlung studies, H. Überall, unfortunately, unable to take part in the meeting due to the health problem.

We would like to thank the participants for their extremely high-level contributions, and the workshop committees together with the secretaries Mrs. Donatella Pierluigi and Dr. Francesca Casarin for their fruitful cooperation in organizing this meeting. Many thanks are also due to the administration of LNF (Prof. M. Calvetti) and the SPARC project team, whose interest in the subject made the task easier. We are particularly grateful to our sponsors: HADRON PHYSICS I3 - EU Project (Prof. C. Guaraldo) and CARE HHH - CERN (Dr. W. Scandale) - for their invaluable support that contributed to the success of the workshop. Finally, we sincerely appreciate the support of our initiatives by Prof. A. Zichichi and Prof. L. Cifarelli, as well as the effective collaboration of the personnel of the Erice Majorana Centre headed by Dr. F. Ruggiu.

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