Grant Agreement No: 312453

EuCARD-2

Enhanced European Coordination for Accelerator Research & Development

Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures,
Combination of Collaborative Project and Coordination and Support Action

PROJECT FINAL REPORT

FINAL EUCARD-2 PROJECT REPORT

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For more information on EuCARD-2, its partners and contributors please see http://eucard2.web.cern.ch/.

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TABLE OF CONTENTS

I. PUBLISHABLE SUMMARY

EXECUTIVE SUMMARY

Particle accelerators are contributing to the advancement of physics and, through accelerator-based X-ray and neutron sources, to the progress of medicine, biology and material science. With more than 30,000 accelerators worldwide in the industrial and health sectors their use is rapidly spreading outside of the scientific environment, to address societal challenges and to generate economic growth. To deal with the increasing demands from basic science and to enhance the diffusion of accelerator technologies towards applied science and societal applications, future particle accelerators need to be more powerful but at the same time have smaller footprint, better energy efficiency, and higher reliability. A common development strategy to face these challenges was the subject of the EuCARD-2 (Enhanced European Coordination for Accelerator Research and Development) Integrating Activity Project. It brought together a consortium of 40 European universities, accelerator laboratories and technological institutes on a programme that, over 4 years, has mobilised a community of more than 350 researchers, organising more than 100 workshops and events and producing 62 high-level deliverable reports, 282 publications and dissemination activities and 4 applications for patents.

The EuCARD-2 Networks have generated a large amount of studies, initiatives and new ideas in a wide range of fields related to accelerator technologies. Activities were centred on future circular particle colliders, storage rings for intense beams, superconducting hadron linacs, and polarization challenges. Novel ideas included sequences of large circular colliders, new schemes for the production of cold muon beams, future acceleration concepts based on crystals or nanotubes, and new concepts and techniques for lattice optimisation in synchrotron light sources. The activities on Novel Acceleration techniques generated a new successful series of bi-annual international Workshops and a new Design Study supported under Horizon 2020. Other Networks covered subjects closely related to innovation, societal challenges and applications, organising three “EuCARD-2 meets industry” events on selected subjects from the project technology portfolio: medical isotope production with accelerators, new materials for extreme thermal management, and environmental applications of low-energy electron accelerators. Other activities covered the evaluation of conceptual aspects of the energy efficiency of particle accelerators, as well as the efficiency of typical component technology used in particle accelerators. The Network on Accelerator Applications has identified existing and new applications that could benefit from accelerator technology, documenting these in a comprehensive document, the “Applications of Particle Accelerators in Europe”.

Three accelerator test facilities provided Transnational Access for a total of 10,557 access units.

A Joint Research Activity (JRA) made remarkable progress in the application of High Temperature Superconductivity (HTS) to particle accelerators, selecting suitable superconductor, tape and cable design, and achieving the world record of 1.3 kA/mm^2 current and realising a coil tested in a magnet at 3.3 T field. Another JRA developed and improved novel composite materials for collimators exposed to high luminosity beams. A third JRA on innovative Radio-Frequency technologies has demonstrated new thin film deposition techniques to realise superconducting accelerating cavities at lower cost, and has contributed to the design manufacturing and testing of high gradient accelerating and deflecting structures to very high performance. The last JRA progressed in the field of plasma wakefield accelerator. Higher brightness beams, external injection, and feasibility of femtosecond-level synchronisation between lasers and beams have been demonstrated, together with the particular operating regime of a plasma excited by an intense proton beam.