More than **400 B€** of end products are produced, sterilized, or examined using industrial accelerators annually worldwide.

More than **24 000** particle accelerators have been built globally over the past **60 years** to produce charged particle beams for use in industrial processes. This number does not include the more than **11 000** particle accelerators that have been produced exclusively for medical therapy with electrons, ions, neutrons, or X-rays.

More than **24 000** patients have been treated by hadron therapy in Europe.

More than **75 000** patients have been treated by hadron therapy in the world.

Around **200** accelerators are used for research worldwide, with an estimated yearly consolidated cost of **1 B€**.

The world's largest particle accelerator, the Large Hadron Collider (LHC), is installed in a tunnel **27 km** in circumference, buried 50-175 m below ground.

The temperature of the superconducting magnets in the LHC reaches **– 271 °C.** In contrast, the temperature at collision point is 1000 million times hotter than that of the Sun's core.

References
Numbers related to industrial accelerators
Robert W. Hamm and Marianne E. Hamm, Eds., "Introduction to the Beam Business" in Industrial Accelerators and their Applications (World Scientific, Singapore, 2012), ISBN-13 978-981-4307-04-8, pp.1–8.
Numbers related to LHC
CERN (European Organization for Nuclear Research) website
http://home.web.cern.ch

The main objective of TIARA is the integration of national and international accelerator R&D infrastructures into **a single distributed European accelerator R&D facility with the goal of developing and strengthening state-of-the-art research, competitiveness and innovation in a sustainable way** in the field of accelerator Science and Technology in Europe.

Besides maximizing the benefits for the owners of the infrastructures and their users, TIARA aims to establish a framework **for developing and supporting strong joint European programmes:**

- for accelerator Research and Development
- for education and training
- for enhancing innovation in collaboration with industry.

The means and structures required to bring about the objectives of TIARA are being developed through the TIARA Preparatory Phase project, which started in January 2011 and will run for 3 years. This project involves 11 partners from 8 countries.

Member institutes of the TIARA preparatory phase:
CEA, France
CERN, Switzerland
CIEMAT, Spain
CNRS, France
DESY, Germany
GSI, Germany
IFJ PAN, representing the Polish consortium
INFN, Italy
PSI, Switzerland
STFC, United Kingdom
Uppsala U., representing the Nordic consortium (Denmark, Finland, Norway, Sweden)

More information on
www.accelerators-for-society.org

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2- Voss et al. Nature (2010) 468, 709 (via Synchrotron Soleil, France)
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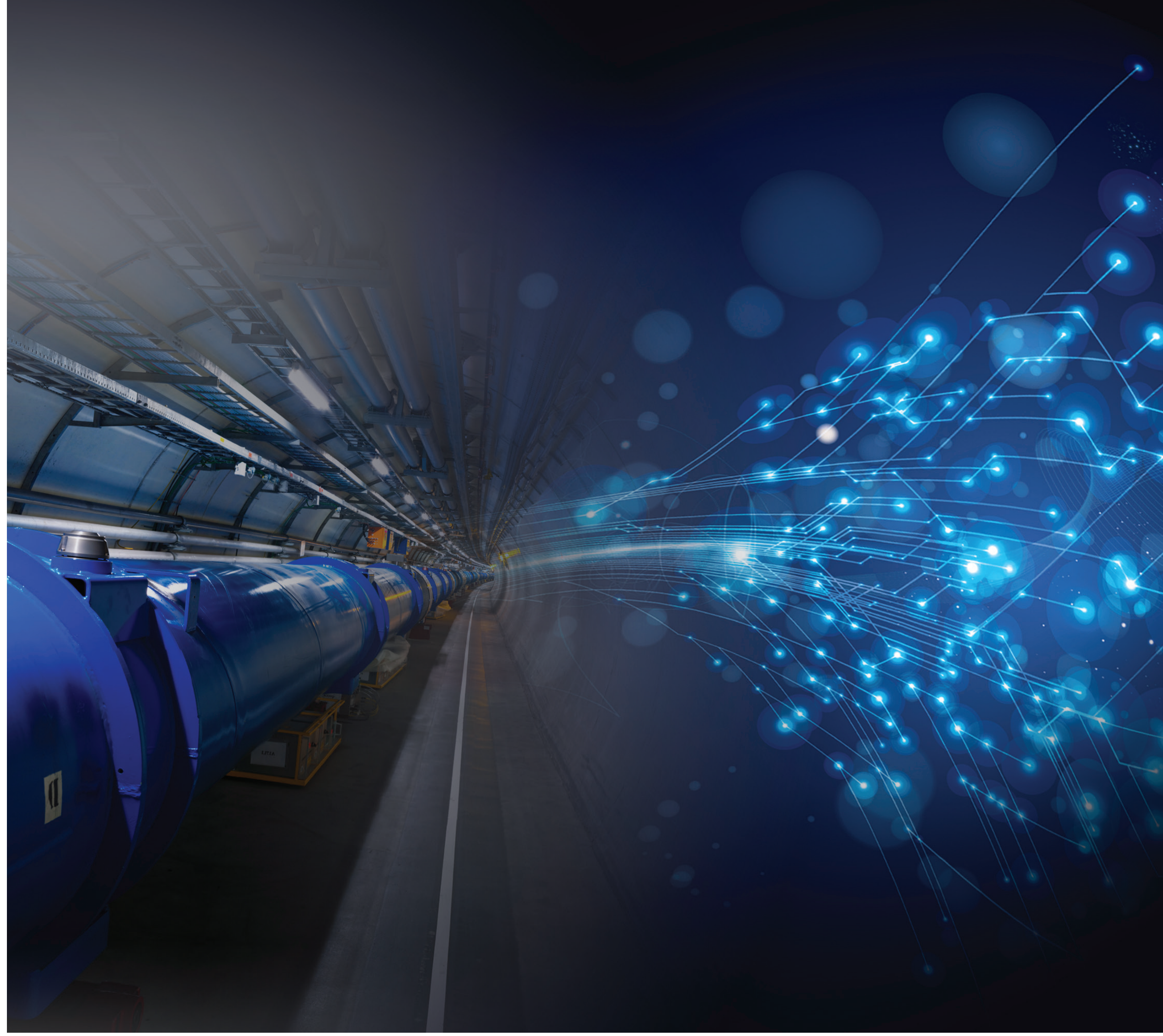
TIARA
ACCELERATING KNOWLEDGE AND INNOVATION

SEVENTH FRAMEWORK PROGRAMME



Accelerators for Society

Particle accelerators are being applied throughout society. Originally developed for fundamental research, today they are used for a range of applications, from healthcare to manufacturing silicon chips to reducing pollution.

TIARA
ACCELERATING KNOWLEDGE AND INNOVATION

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The impact of accelerators on Society

Particle accelerators were originally developed for investigating the fundamental laws of nature. These machines would do this by accelerating and colliding charged particles at extremely high energies. The resulting particles produced in these collisions would then be detected and analysed to reveal the structure of matter. However, today, accelerators also play an increasingly significant role in society and industry with an extremely important, but often unseen, impact on our everyday life.

Nowadays the vast majority of accelerators are not used for fundamental science but for industrial processes and for applications relevant to society. Among these, the most noteworthy applications include electronics, electron beam cutting and welding, hardening materials, medical diagnosis, the treatment of cancer, monitoring air pollution and climate change, the examination and dating of works of art and ancient objects, sterilising food and medical goods and cargo scanning. Possible future applications towards alternative energy sources are also being developed.

To ensure that the technological benefits of science can be exploited for more efficient and effective applications that impact on the way we all live and work as a society, it is essential to provide on-going support for accelerator research and development.

Research

Fundamental physics
Materials science
Solid state and condensed matter physics
Biological and chemical science

Energy & Environment

Cleaning flue gases of thermal power plants

Health & Medicine

Treating cancer
Medical imaging

Industrial applications

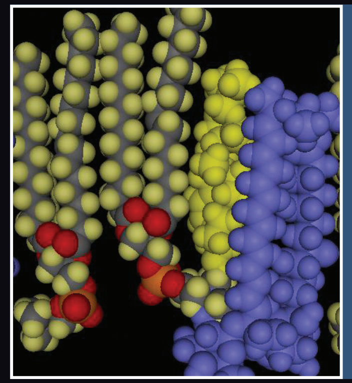
Ion implantation for electronics
Hardening surfaces & materials
Welding and cutting
Treating waste & medical material
Food preservation

Material characterisation

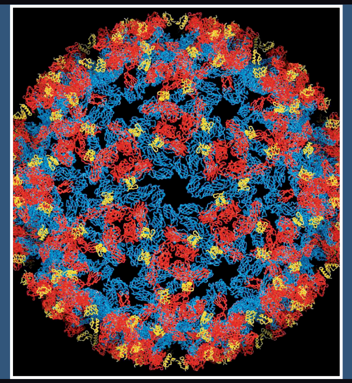
Cultural heritage
Authentication
Cargo scanning and security

Prospects

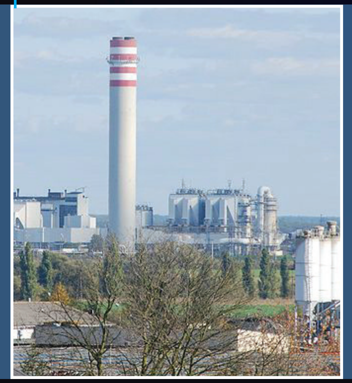
Cleaner and safer nuclear power
Technologies for fusion
Replacing ageing research reactors



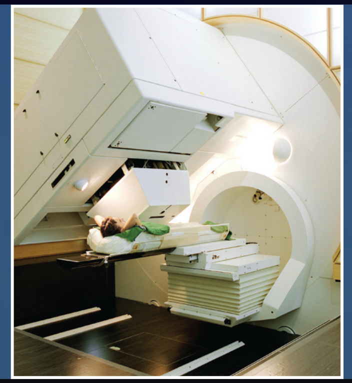
Materials research
Beams of photons, neutrons and muons are essential tools to study materials at the atomic level.



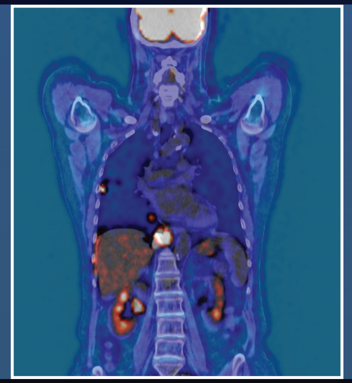
Protein modelling
Synchrotron light allows scientists to solve the 3D structure of proteins e.g. the Chikungunya virus.



Controlling power plant gas emission
In some pilot plants, electron beams are used to control emission of sulphur and nitrogen oxides.



Hadron therapy
Proton and ion beams are well suited for the treatment of deep seated tumours.



Positron Emission Tomography (PET)
Radioisotopes used in PET-CT scanning are produced with accelerators.

Ion implantation for electronics
Many digital electronics rely on ion implanters to build fast transistors and chips.

Hardening materials
Replacing steel with X-ray cured carbon composites can reduce car energy consumption by 50%.

Cultural heritage
Particle beams are used for non-destructive analysis of works of art and ancient relics.

Energy
Accelerator technologies may bring the power of the sun “down to earth”, treat nuclear waste and allow for safer operation of reactors.