EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION
Research infrastructure

AMICI Kick-off Meeting
WP2: Strategy

W. Kaabi- CNRS/LAL

Paris, January 18th 2017

Objectives of the WP2:

- Identify the strategic elements necessary for a successful implementation of a viable and sustainable cluster of Technological Infrastructures (TIs) in partnership with industry.
- Create an ecosystem helping to enhance basic research and applications with high societal impact through laboratories and industries (large or SME).

Methodology:

To set up an efficient strategic analysis, the WP2 have to:

- Identify the Key Technological Areas (KTAs) essential for the sustainability of the Technological Infrastructures in which the most progress and innovation are expected.
- Study the scientific roadmaps of the different scientific domains and their agendas.

→ The cross-reference of both analyses will allow to define the technological roadmap for the different identified KTAs.

Organization of WP2:

The WP2 will be subdivided in 3 sub-tasks:

- WP2.1: Key Technological Area (**CNRS**, IFJ PAN, CEA, STFC)
- WP2.2: Global Landscape (**CEA**, CERN, INFN, CNRS)
- WP2.3: Accelerator and SC Magnet Technological Infrastructures Sustainability (**UU**, DESY, CEA, CNRS, CERN)

	WP Leader	WP.1 Leader	WP.2 Leader	WP.3 Leader
WP2: Strategy	W. Kaabi	W. Kaabi	O. Napoly	T. Ekelöf

Milestones and deliverables:

Deliverables:

- D2.1: Report on Key Technological Areas (KTA) and prospective outlook (M24).
- D2.2: Report on the Technological Roadmaps for the different KTA (M24).
- D2.3: Report on propositions to guarantee the long term sustainability of TIs (M30).

Milestones:

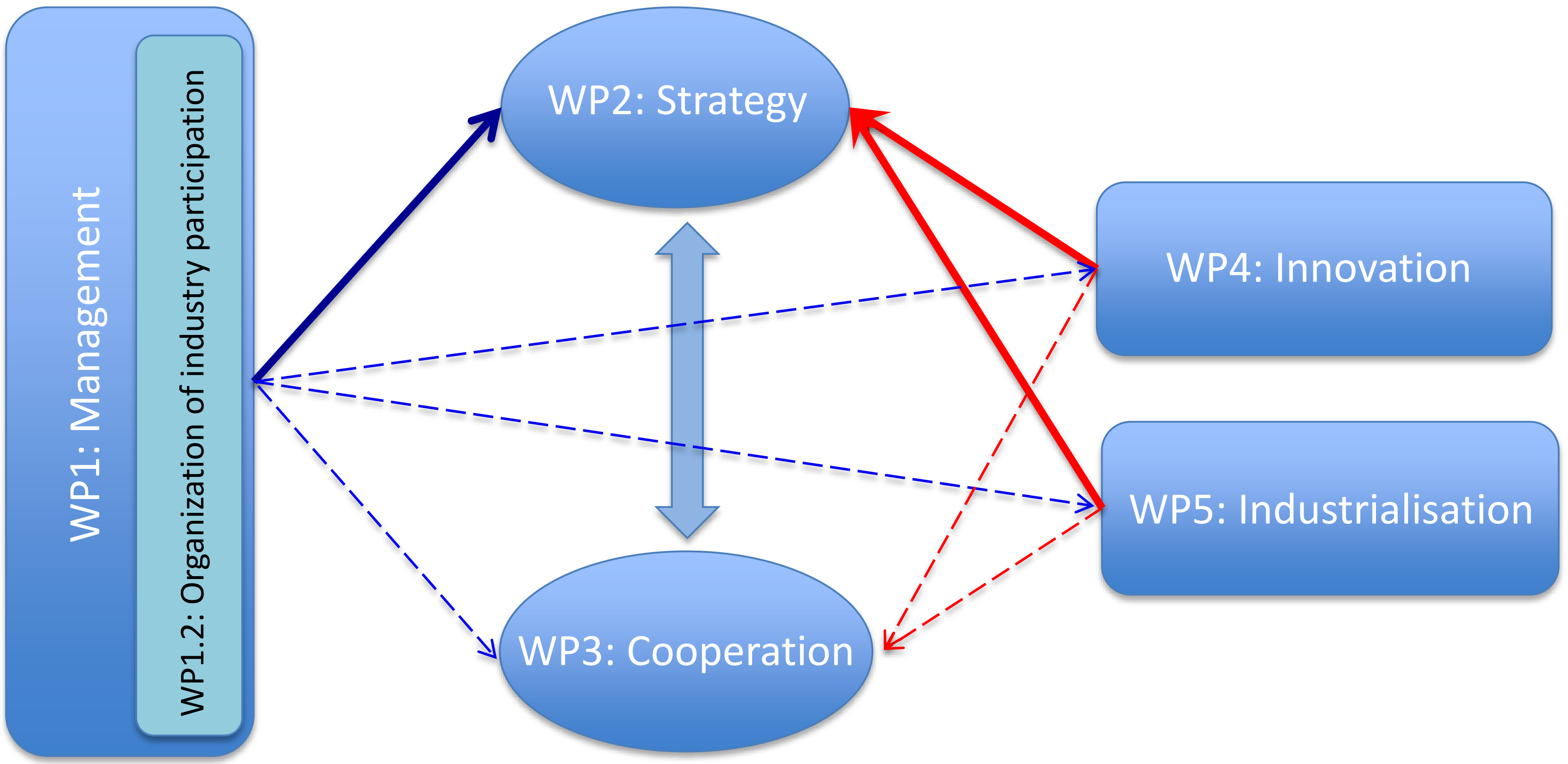
- M2.1: Updating of the Key Technological Areas (M9).
- M2.2: Collection of the scientific Roadmaps (M12).
- M2.3: Intermediate report on sustainability (M18).

Milestones and deliverables:

	YEAR 1												YEAR 2												YEAR 3					
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30
Work Package 1 : Management, coordination and dissemination (CEA)																														
WP1.1 Project management (CEA)	M1.1	D1.1									M1.5	D1.4											M1.5	D1.4					M1.5	D1.4
WP1.2 Organization of the participation of industry (INFN)			M1.3	D1.2																				D1.6						
WP1.3 Administrative and financial project management (CEA)												D1.5												D1.5						D1.5
WP1.4 Communication and outreach activities (IFJ-PAN)		M1.2			M1.4						D1.3																			D1.7
Work Package 2 : Strategy (CNRS)																														
WP2.1 Key technological areas (CNRS)									M2.1															D2.1						
WP2.2 Global landscape (CEA)												M2.2												D2,2						
WP2.3 Accelerator and SC magnet TI sustainability (UU)																		M2.3												D2.3
Work Package 3 : Cooperation (DESY)																														
WP3.1 Definition of eligibility criteria (CEA)									M3.1									D3.1												
WP3.2 Networking and coordination model (IFJ-PAN)												M3.2																		D3.2
WP3.3 From cooperation to collaboration (DESY)																		M3.3												D3.3
Work Package 4 : Innovation (STFC)																														
WP4.1 Industry survey - accelerator technologies (STFC)															M4.1												M4.4			D4.1
WP4.2 Industry survey - magnet technologies (CEA)															M4.2															D4.2
WP4.3 Good practices and barriers to engagement between industry and TIs (INFN)																										M4.3				D4.3
Work Package 5 : Industrialization (INFN)																														
WP5.1 Professional training and apprenticeship (CEA)																M5.2		M5.3										D5.2		D5.4
WP5.2 Harmonisation - Material and components reference (CNRS)																										D5.1				
WP5.3 Harmonisation - Cryogenic safety procedures (KIT)												M5.1																D5.3		
WP5.4 Developing prototyping in industry (INFN)																								M5.4						D5.5

Figure 3: Gant chart of the project

Link with other WPs:



WP2.1: Key Technological Areas

A prospective analysis of future trends in Key Technological Areas will be performed taking into account:

- The existing basic research activity,
- The new industrial needs (output from WP5),
- The applications with high societal impact,
- The emerging technologies (output from WP4).

WP2.1: Key Technological Areas

The inputs for this prospective survey will be:

- The census of key technologies performed by TIARA for Accelerator R&D.
- The work done in EUCARD2.

In addition, a close link will be maintained with the networking program currently running, aiming to improve the performances of Accelerators (ARIES) or to promote the societal applications of nuclear physics accelerators, in particular in medical applications (ENSAR2).

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WP2.2: Global Landscape

- Identify the future trends and need of the scientific or applied domains using accelerators and SC magnets by collecting and analyzing the existing strategic roadmaps, at the national, European and world levels.

- Additional input from the innovation market survey from WP4, will allow to identify the synergies, possible mismatches and potential for innovation.

All this will be used to assess the workload, the capabilities and, whenever possible the priorities of the European Technological Infrastructures, constituting Technological Roadmaps, in the different Key Technological Areas identified in WP2.1.

WP2.2: Global Landscape

Some relevant documents:

WP2.2: Global Landscape

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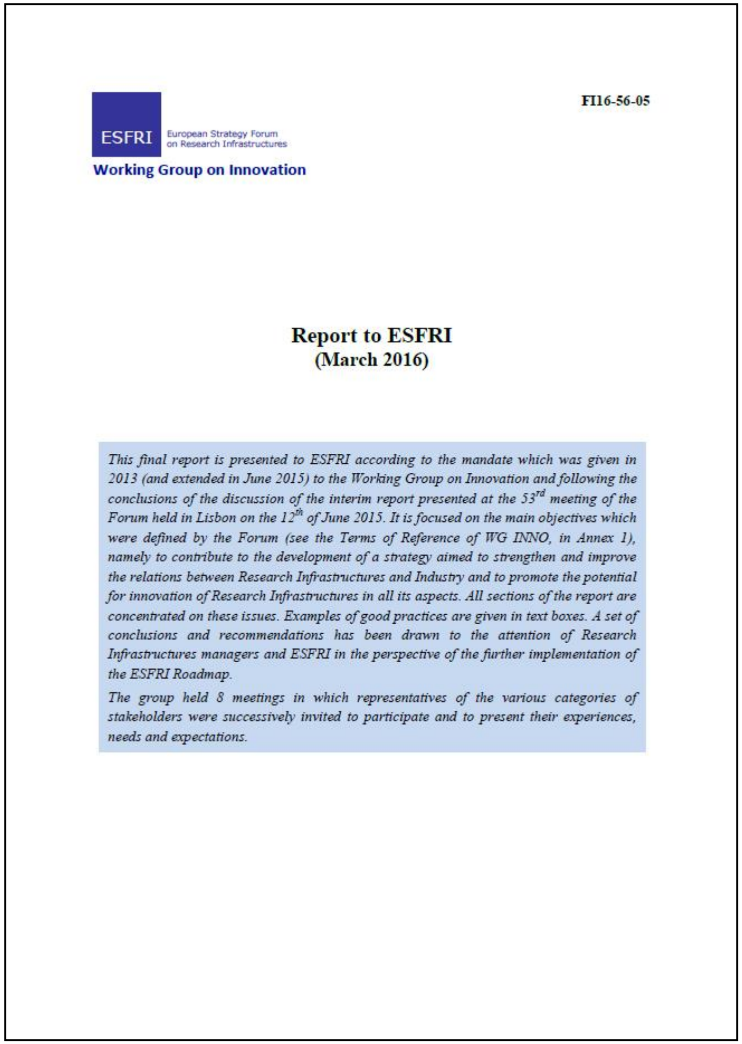

ESFRI European Strategy Forum on Research Infrastructures

Working Group on Innovation

FI16-56-05

Report to ESFRI
(March 2016)

This final report is presented to ESFRI according to the mandate which was given in 2013 (and extended in June 2015) to the Working Group on Innovation and following the conclusions of the discussion of the interim report presented at the 53rd meeting of the Forum held in Lisbon on the 12th of June 2015. It is focused on the main objectives which were defined by the Forum (see the Terms of Reference of WG INNO, in Annex 1), namely to contribute to the development of a strategy aimed to strengthen and improve the relations between Research Infrastructures and Industry and to promote the potential for innovation of Research Infrastructures in all its aspects. All sections of the report are concentrated on these issues. Examples of good practices are given in text boxes. A set of conclusions and recommendations has been drawn to the attention of Research Infrastructures managers and ESFRI in the perspective of the further implementation of the ESFRI Roadmap.

The group held 8 meetings in which representatives of the various categories of stakeholders were successively invited to participate and to present their experiences, needs and expectations.

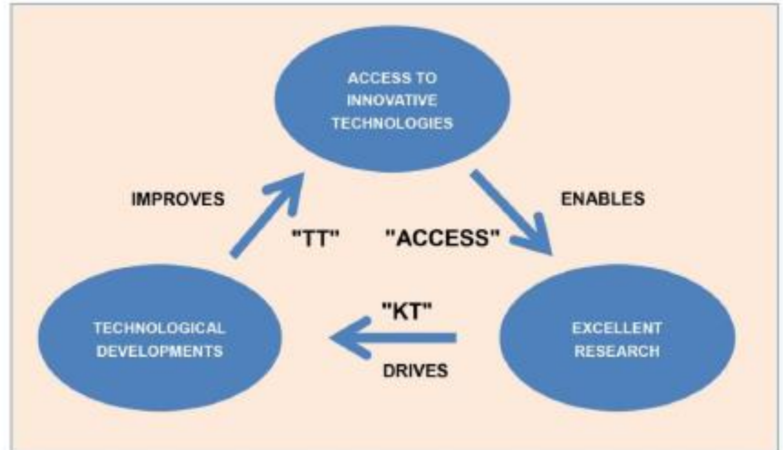

Figure 1. The virtuous circle of innovation

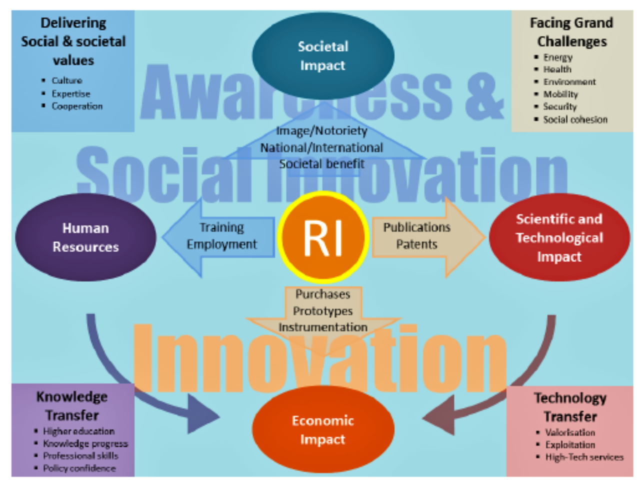

Figure 2. Interactions between RIs and their surrounding techno-scientific, socio-economic and societal environment

WP2.2: Global Landscape

Some relevant documents:

NUCLEAR AND HIGH-ENERGY PHYSICS

LIST OF RESEARCH INFRASTRUCTURES
NUCLEAR AND HIGH-ENERGY PHYSICS

TYPE	NAME	FULL NAME	ESFRI
IO	CERN-LHC	European Organization for Nuclear Research - Large Hadron Collider	
VLRI	EGO-VIRGO	European Gravitational Observatory - VIRGO	
VLRI	FAIR	Facility for Antiproton and Ion Research	FAIR (2006)
VLRI	GANIL-Spiral2	Grand National Heavy Ion Accelerator (GANIL), Radioactive Ion Production System in Line of 2nd generation (SPIRAL2)	Spiral2 (2006)
RI	*HESS*[1]	*High Energy Stereoscopic System*	
RI	KM3NeT	Kilometre Cube Neutrino Telescope	KM3NET (2006, 2016)
RI	LSST	Large Synoptic Survey Telescope	
Project	*CTA*[2]	*Cherenkov Telescope Array*	*CTA (2008)*

1 RI at the interface with the sector "Astronomy and Astrophysics". RI description can be found in the sector "Astronomy and Astrophysics".
2 RI at the interface with the sector "Astronomy and Astrophysics". RI description can be found in the sector "Astronomy and Astrophysics".

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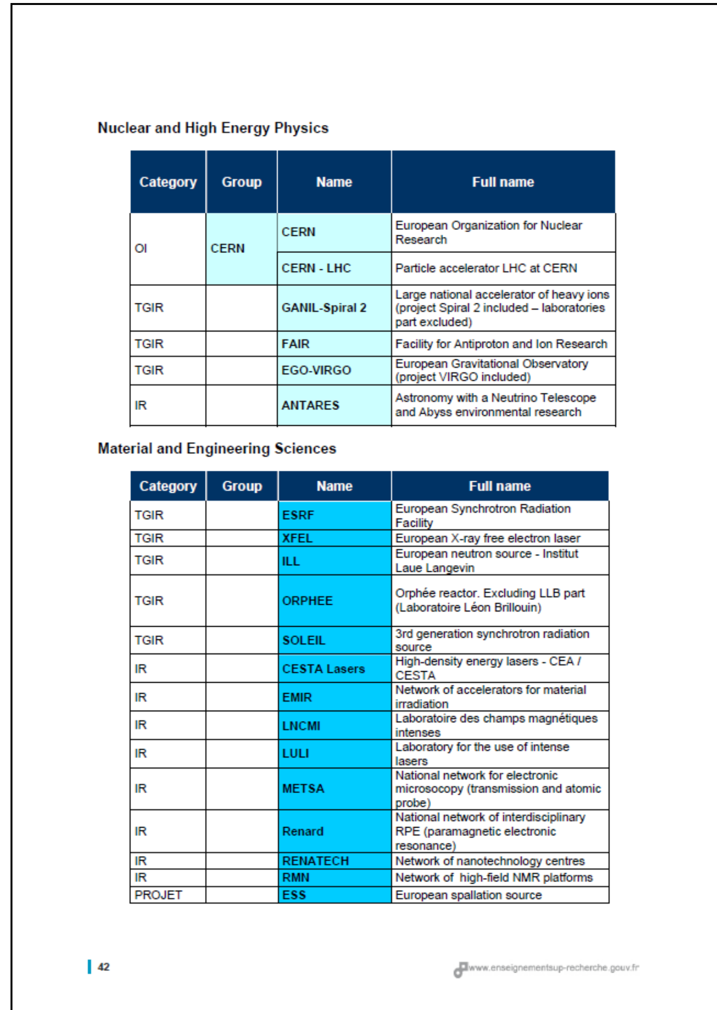
WP2.2: Global Landscape

Some relevant documents:



Nuclear and High Energy Physics

Category	Group	Name	Full name
OI	CERN	CERN	European Organization for Nuclear Research
		CERN - LHC	Particle accelerator LHC at CERN
TGIR		GANIL-Spiral 2	Large national accelerator of heavy ions (project Spiral 2 included – laboratories part excluded)
TGIR		FAIR	Facility for Antiproton and Ion Research
TGIR		EGO-VIRGO	European Gravitational Observatory (project VIRGO included)
IR		ANTARES	Astronomy with a Neutrino Telescope and Abyss environmental research

Material and Engineering Sciences

Category	Group	Name	Full name
TGIR		ESRF	European Synchrotron Radiation Facility
TGIR		XFEL	European X-ray free electron laser
TGIR		ILL	European neutron source - Institut Laue Langevin
TGIR		ORPHEE	Orphée reactor. Excluding LLB part (Laboratoire Léon Brillouin)
TGIR		SOLEIL	3rd generation synchrotron radiation source
IR		CESTA Lasers	High-density energy lasers - CEA / CESTA
IR		EMIR	Network of accelerators for material irradiation
IR		LNCMI	Laboratoire des champs magnétiques intenses
IR		LULI	Laboratory for the use of intense lasers
IR		METSA	National network for electronic microscocopy (transmission and atomic probe)
IR		Renard	National network of interdisciplinary RPE (paramagnetic electronic resonance)
IR		RENATECH	Network of nanotechnology centres
IR		RMN	Network of high-field NMR platforms
PROJET		ESS	European spallation source

42 www.enseignementsup-recherche.gouv.fr

WP2.2: Global Landscape

Some relevant documents:

Technology Infrastructures

- The European network of capabilities in this area is a key to implementing new RI projects
- Enabling technologies include
  - Particle accelerators
  - Imaging detectors
  - Electronics
  - Magnets
  - Cryogenics
  - Lasers
  - Computing and data-intensive science

WP2.2: Global Landscape

Some relevant documents:

IPAC15

Richmond Conference Center
Richmond, Virginia, USA
3-8 May, 2015

Construction Projects and Upgrades
of Particle Accelerators

8th Edition

Information for Industry
Collaborating in the Field of Particle Accelerators

Compiled by Christine Petit-Jean-Genaz
IPAC Conferences Coordinator for Europe

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Accelerators for Security and Defense

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Accelerators are central to a number of current proposals to develop cargo-inspection techniques.

now ubiquitous in the accelerator world. The current need is for development of a fieldable device for testing with defense and security partners.

Relativistic electron beams can generate high-power electromagnetic radiation at various frequencies for directed-energy-specific missions. Examples include free electron lasers, highly directional gamma-ray beams through Compton scattering, and millimeter-wave to terahertz radiation.

Free electron lasers can in principle achieve megawatt average power levels and optical beam quality and wavelengths required for security and defense purposes. In the mid-1990s, the highest average-power FEL had achieved only 11 watts. The Navy, as a user of the FEL at DOE's Thomas Jefferson National Accelerator Facility achieved 2.2 kW, and a subsequent upgrade in 2006 demonstrated 14kW at 1.6microns, a wavelength of particular interest to the Navy.

Free electron laser-based directed energy can expand to a wide range of missions. With increased efficiency and decreased weight, for example, FELs might serve as airborne platforms. With appropriate R&D, such goals appear achievable. Most such improvements would feed back to the basic science programs, potentially leading to lower-cost FEL systems and associated energy-recovery-linac light sources.

A megawatt-class FEL will require several critical accelerator R&D developments. Credible designs exist for two of these: a high-quality ampere-class electron gun and continuous wave injector that can operate for weeks, and ampere-class SRF cavities with higher-mode suppression using high-temperature superconductors. However, demonstration of these designs requires funding. At the conceptual level with simulations, researchers are currently exploring a third critical element, megawatt-level RF couplers. Complete system modeling is underway; but bringing these efforts to the point of comparison to the actual performance of, for example, future 100-kW prototypes, will require major efforts.

Computer animation of the field inside a superconducting accelerator resonator *Image courtesy of DESY*

Cargo Inspection and Interrogation

Security priorities of the last decade have turned to deterring the threat from subnational organizations. Some of these deterrents rely on identifying small quantities of special nuclear material in shipping containers through a signature reaction induced by radiation. Accelerators are a natural choice for producing well-characterized beams of radiation and are central to a number of current proposals to develop active interrogation techniques.

"Standing off" at a distance from the object under inspection by using electromagnetic radiation, including that from accelerators, is of significant interest in security and defense. The recent developments in terahertz radiation at FELs show potential for active interrogation with desirable standoff distances for cargo, improvised explosive devices and biological investigations.

Other interrogation techniques use neutron and proton beams ranging from tens of keV to tens of GeV with radiographic sensitivity to a variety of materials. Standoff with GeV protons to induce fission will require milliampere beam currents, high gradient and high temperature superconducting technologies, as well as compact devices that laser-driven accelerator technology may make possible.

Researchers have proposed more exotic radiography using the low interaction rates of muons to achieve significant standoff. Such proposals would build on developments for muon colliders and neutrino factories, the subject of R&D for possible future basic-science facilities.

Replacement of radioactive sources and materials

In the 1970s, accelerator-based gamma-ray radiation therapy replaced radioisotope-based devices in the United States and Western Europe. However, in much of the rest of the world, ^{60}Co-based teletherapy units are still very common, with over 10,000 in service, according to the International Atomic Energy Agency.

62 *Accelerators for America's Future*

WP2.2: Global Landscape

Some relevant documents:

ACCELERATORS FOR AMERICA'S FUTURE

THE BENEFITS OF PARTICLE ACCELERATORS FOR SOCIETY

Physicists have been inventing new types of accelerators to propel charged particles to higher and higher energies for more than 80 years. Today, scientists estimate that more than 30,000 accelerators are in operation around the world—in industry, in hospitals and at research institutions. The following benefits are just a few examples on a growing list of practical applications.

Top: Electron beams make shrink wrap tougher and better for storing food and protecting other products. Photo courtesy of Fermilab.

Bottom: The semiconductor industry relies on accelerator technology to implant ions in silicon chips. Photo courtesy of Fermilab.

Left: Superconducting wire designed for particle accelerators enabled the creation of powerful magnets for MRI scanners. Photo courtesy of Fermilab.

Semi-conductors: The semi-conductor industry relies on accelerator technology to implant ions in silicon chips, making them more effective in consumer electronic products such as computers, smart phones and MP3 players.

Clean air and water: Studies show that blasts of electrons from a particle accelerator are an effective way to clean up dirty water, sewage sludge and polluted gases from smokestacks.

Medical diagnostics: Accelerators are needed to produce a range of radioisotopes for medical diagnostics and treatments that are routinely applied at hospitals worldwide in millions of procedures annually.

Pharmaceutical research: Powerful X-ray beams from synchrotron light sources allow scientists to analyze protein structures quickly and accurately, leading to the development of new drugs to treat major diseases such as cancer, diabetes, malaria and AIDS.

Nuclear energy: Particle accelerators have the potential to treat nuclear waste and enable the use of an alternative fuel, thorium, for the production of nuclear energy.

Shrink wrap: Industry uses particle accelerators to produce the sturdy, heat-shrinkable film that keeps such items as turkeys, produce and baked goods fresh and protects board games, DVDs, and CDs.

DNA research: Synchrotron light sources allowed scientists to analyze and define how the ribosome translates DNA information into life, earning them the 2009 Nobel Prize in Chemistry. Their research could lead to the development of new antibiotics.

Cancer therapy: When it comes to treating certain kinds of cancer, the best tool may be a particle beam. Hospitals use particle accelerator technology to treat thousands of patients per year, with fewer side effects than traditional treatments.

www.acceleratorsamerica.org

U.S. DEPARTMENT OF ENERGY

WP2.2: Global Landscape

Some relevant links:

- APAE: Applications of Particle Accelerators in Europe:

https://indico.cern.ch/event/377384/

- ACFA view and Asian activities on future colliders:

https://indico.cern.ch/event/438866/contributions/1084956/

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