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Construction Projects and Upgrades of Particle Accelrators – Information for Industry Collaboration in the Framework of IPAC'18, Vancouver, Canada

Compiled by Robert Laxdal and Oliver Kester (TRIUMF)

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10th Edition

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Introduction

IPAC'18 LOC followed the example of past year and provides information on future accelerator projects around the world to industry for future collaboration. The European Physical Society Accelerator Group (EPS-AG), organizer of the IPAC series in Europe, has for many years contacted major laboratories around the world inviting them to provide according information on future accelerator projects and upgrades, to be made available to exhibitors present at IPAC commercial exhibitions.

We would like to acknowledge the former EPS-AG Executive Secretary and IPAC Conference Organizer for Europe, Christine Petit-Jean-Genaz, who has played a leading role in setting up this initiative and in pursuing it over more than two decades. We used this amazing piece of work that went into this compilation and organized and update for this year's IPAC in Vancouver.

The laboratories and project leaders having contributed to the preparation of this 10th printed edition, prepared in connection with IPAC'18, in Vancouver, are warmly thanked for their collaboration and input to the booklet.

All of the information contained in this booklet is subject to confirmation by the laboratory and/or contact persons whose name is entered for each project.

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Advanced Rare Isotope Facility - ARIEL-II

Project Location:	Canada
Project Type:	Project Upgrade
Project Description:	ARIEL was conceived as a two-stage rare isotope beam (RIB) project. The first stage, ARIEL-I, funded in 2010 included the ARIEL building and a super-conducting cw-electron linear accelerator, designed to deliver 10mA electron beams at 50MeV. An initial stage is in place to deliver 3mA beams at 30MeV. The second stage, ARIEL-II, will increase the scientific productivity by exploiting the new electron accelerator to produce a wider variety of exotic isotope species at higher intensities and to deliver multiple beams in parallel. The project comprises a new proton beam line for a 100 μA proton beam from the existing cyclotron to the new isotope production facility in the ARIEL building, the ARIEL-I SRF e-linac completion to its design specifications, the new high power target stations for the electron and proton beams and the beam transport systems to deliver the radioactive ion beams from the

	two new target stations to the existing experimental stations.
Requirements List Available:	Yes
Approval Date:	6-Oct-16
Status of Contracting:	25% of the items are contracted
Construction scheduled to start:	1-Oct-17
Estimated Project Cost:	45 M CAD
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Target ion sources, target hall infrastructure (hot cells, shielding etc.), vacuum components, RF-equipment, beam diagnostics, beamline magnets

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Project Region: Americas

Advanced Photon Source Upgrade

Project Location:	United States of America
Project Type:	Project Upgrade
Project Description:	The Upgrade replaces the existing APS storage ring with a multi-bend achromat lattice including reverse bends. In addition, insertion devices and beamlines are upgraded to take advantage of the new source properties
Requirements List Available:	Yes
Approval Date:	4-Feb-2016
Status of Contracting:	The project is completing a preliminary design report and developments tests now, to be followed by initial procurements
Construction scheduled to start:	FY2019
Estimated Project Cost:	Not yet final; approx. 770 M USD
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Storage ring components and systems including for example vacuum, magnets, and power supplies; insertion devices, and components for new beamlines

Project Leader(s):	Mr. Jim Kerby
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Contact Person(s):	Same as Project Leader

Project Region: Americas

CBETA

Project Location:	United States of America
Project Type:	New Project
Project Description:	The Cornell-BNL ERL Test Accelerator (CBETA) is a four-turn Energy Recovery Linac (ERL) with a single return loop of Fixed-Field Alternating Gradient optics, using superconducting RF technology and permanent magnets. It is constructed at Cornell University in collaboration with BNL.
Requirements List Available:	Yes
Approval Date:	31-Oct-16
Status of Contracting:	Construction and procurement has begun.
Construction scheduled to start:	1-Jan-17
Estimated Project Cost:	25 M USD
Estimated Construction Duration:	3.5 years
Type of Equipment to be Purchased:	Permanent combined-function Halbach magnets, electromagnets, vacuum system, power supplies, RF power amplifiers, beam diagnostics.

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Contact Person(s):	Same as Project Leader

Project Region: Americas

eRHIC

Project Location:	United States of America
Project Type:	New Project
Project Description:	Electron-Ion Collider for luminosities of L = 10^{34} $cm^{-2}s^{-1}$, with electrons up to 18 GeV and ions up to 100 GeV/nucleon or 275 GEV protons using the RHIC accelerator complex.
Requirements List Available:	No
Approval Date:	TBD
Status of Contracting:	not ready for procurement
Construction scheduled to start:	TBD
Estimated Project Cost:	TBD
Estimated Construction Duration:	TBD
Type of Equipment to be Purchased:	super conducting RF equipment, cryogenic equipment, magnets, vacuum components

Project Leader(s):	Ferdinand Willeke (BNL)
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Project Region: Americas

Electron-Ion Collider/JLEIC

Project Location:	United States of America
Project Type:	New Project
Project Description:	Electron-ion collider with wide array of ion species (p to Pb), variable center of mass energy (20-140 GeV), high luminosity (1e33-1e34) and high polarization (>70%)
Requirements List Available:	Yes
Approval Date:	DOE CD0 estimate: late 2018
Status of Contracting:	First priority for new construction in US DOE Nuclear Physics Long Range Plan
Construction scheduled to start:	01-Oct-2022 (estimated)
Estimated Project Cost:	1.5-2.0 B USD (estimated)
Estimated Construction Duration:	7+ years
Type of Equipment to be Purchased:	JLab: new ion complex (polarized sources, ion booster, variable bunch length ion diagnostics), electron collider ring, high-performance feedback systems

Project Leader(s):	Yuhong Zhang, Todd Satogata
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Project Region: Americas

Facility for Advanced Accelerator Experimental Tests II (FACET-II)

Project Location:	United States of America
Project Type:	
Project Description:	The National User Facility for Advanced Acceleration Research will be an experimental user facility with the electron and positron beams required to advance the development of plasma wakefield acceleration and support a broad range of other experiments requiring high-energy, high density beams. It will provide short, intense pulses of electrons or laser radiation to excite plasma wakefields with sufficient amplitude to accelerate electrons by 10 GeV or more in approximately one meter of plasma. The plasma program has been designed to address critical technical issues for very compact, multi-TeV, plasma-based accelerators. Among these issues are: high accelerating gradients, electrical efficiency, operating plasma accelerating modules in series to achieve high beam energies and quality of the accelerated beam.
Requirements List Available:	Yes

Approval Date:	
Status of Contracting:	
Construction scheduled to start:	1-Oct-17
Estimated Project Cost:	46.6 M USD
Estimated Construction Duration:	3 years
Type of Equipment to be Purchased:	Magnets, vacuum components, various diagnostics

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Contact Person(s):	Same as Project Leader

Project Region: Americas

Facility for Rare Isotope Beams (FRIB)

Project Location:	United States of America
Project Type:	New Project
Project Description:	Rare isotope research project based upon a heavy ion driver linac to accelerate all stable isotope beams to a beam power of 400 kW, a beam energy over 200 MeV/nucleon
Requirements List Available:	Yes
Approval Date:	1-Aug-14
Status of Contracting:	80 % completed
Construction scheduled to start:	1-Mar-14
Estimated Project Cost:	730 M USD
Estimated Construction Duration:	7 years
Type of Equipment to be Purchased:	Cryoplant components, cryostat components, target and preseparator subcomponents, RF components, magnets, power suppliers, vacuum, controls, instrumentation equipments.

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Project Region: Americas

IOTA/FAST facility

Project Location:	United States of America
Project Type:	New Project
Project Description:	Construction of accelerator R&D facility consisting of 40-m long e-/p+ storage IOTA ring and its 150-300 MeV/c e- injector based on ILC-type SRF cryomodule and 70 MeV/c RFQ based proton injector at Fermilab Accelerator Science and Technology (FAST) facility.
Requirements List Available:	Yes
Approval Date:	1-Mar-14
Status of Contracting:	Ongoing
Construction scheduled to start:	1-Mar-14
Estimated Project Cost:	20 M USD (last stage)
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Magnets (incl. nonlinear) Power supplies Vacuum equipment Advanced beam instrumentation

Project Leader(s):	Vladimir Shiltsev
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Project Region: Americas

Linac Coherent Light Source II

Project Location:	United States of America
Project Type:	New Project
Project Description:	Construction of a 4 GeV CW superconducting linac and two new x-ray FEL undulator sources in the existing LCLS tunnels. Both the new SCRF linac and the original copper linac will continue to operate. Using both linacs, the new undulators will produce x-rays in the range 200-25,000 eV
Requirements List Available:	Yes
Approval Date:	14-Aug-14
Status of Contracting:	the Project is 50% complete
Construction scheduled to start:	21-Mar-16
Estimated Project Cost:	1.045 B USD
Estimated Construction Duration:	4 years
Type of Equipment to be Purchased:	niobium cavities, all hardware for XFEL-type cryomodules, helium transfer lines, helium refrigeration system, undulators, x-ray optics, high-power solid state amplifier sources, lasers, iron/copper magnets

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Project Region: Americas

Long Baseline Neutrino Facility (LBNF) Beamline

Project Location:	United States of America
Project Type:	New Project
Project Description:	The LBNF Beamline located at Fermilab will provide and aim a neutrino beam of sufficient intensity and appropriate energy range toward DUNE detectors, placed deep underground at the Sanford Underground Research Facility (SURF) in South Dakota.
Requirements List Available:	Yes
Approval Date:	05-Nov-15
Construction scheduled to start:	1-Oct-20
Estimated Project Cost:	200MUS$
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Magnet power supplies, beam instrumentation, vacuum equipment an instrumentation, fluids equipment and instrumentation, capacitor banks, fabrication of beam windows, aluminum blocks and plates, steel blocks and plates, borated polyethylane for neutron shielding, marble shielding, controls

Project Leader(s):	Christopher J. Mossey <cmossey@fnal.gov>
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Project Region: Americas

Proton Improvement Plan (PIP)

Project Location:	United States of America
Project Type:	Project Upgrade
Project Description:	PIP is a series of upgrades to the Fermilab linac and Booster synchrotron to support the laboratory's mid-term program. It involves a doubling of flux from the Booster, reduction of beam losses, improvement in reliability, and modernization of obsolete equipment.
Requirements List Available:	No
Approval Date:	1-Oct-11
Status of Contracting:	About 90% of equipment has been purchased.
Construction scheduled to start:	1-Oct-11
Estimated Project Cost:	78 M USD
Estimated Construction Duration:	2011 to 2019
Type of Equipment to be Purchased:	RF devices and equipment, power supplies (magnet, HVDC for RF), magnets, controls (beam instrumentation and device control).

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Project Region: Americas

Proton Improvement Plan-II (PIP-II)

Project Location:	United States of America
Project Type:	New Project
Project Description:	Replacement of the existing 400-MeV linac at Fermilab with a CW-capable 800-MeV superconducting linac, accompanied by upgrades to the existing circular accelerators to support higher beam powers. This project will support long-term research goals in accelerator based neutrino and muon physics at Fermilab.
Requirements List Available:	Yes
Approval Date:	1-Nov-15
Status of Contracting:	R&D Phase
Construction scheduled to start:	1-Mar-19
Estimated Project Cost:	650 M USD
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Superconducting RF acceleration modules RF sources Magnets (normal- and superconducting) Power supplies Vacuum equipment Cryogenic equipment Instrumentation

Project Leader(s):	Lia Merminga
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Project Region: Americas

Sirius

Project Location:	Brazil
Project Type:	New Project
Project Description:	3GeV synchrotron radiation source and injection system
Requirements List Available:	
Approval Date:	1-Jan-12
Status of Contracting:	most of the components and sub-systems have been contracted.
Construction scheduled to start:	1-Jul-12
Estimated Project Cost:	100 M USD (electron accelerator only)
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Commissioning of electron accelerators in progress. Future purchasing process will be more related to the second phase beamlines.

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Project Region: Asia

Australian Synchrotron Maintenance

Project Location:	Australia
Project Type:	Project Upgrade
Project Description:	In addition to the normal operations funding, this project is to maintain and upgrade many accelerator and beamline components at the Australian Synchrotron.
Requirements List Available:	No
Approval Date:	1-Jul-16
Status of Contracting:	Ongoing as needs arise
Construction scheduled to start:	1-Oct-16
Estimated Project Cost:	50 M AUD
Estimated Construction Duration:	10 years
Type of Equipment to be Purchased:	RF hardware systems including klystrons and low level RF electronics, beam diagnostics for linac, transfer lines, booster synchrotron and storage ring, BPM electronics, power amplifiers, feedback systems, power supplies, computer and FPGA hardware and services.

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Project Region: Asia

iBNCT Project

Project Location:	Japan
Project Type:	Project Upgrade
Project Description:	Development for the compact linac-based neutron source for boron neutron capture therapy (BNCT). Proton energy: 8 MeV, Average current: > 5 mA
Requirements List Available:	Yes
Approval Date:	24-Mar-11
Status of Contracting:	Completed construction, conditioning and improvement
Construction scheduled to start:	24-Mar-11
Estimated Project Cost:	Approx. 25 M USD
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	Competitive funds

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Project Region: Asia

China Spallation Neutron Source

Project Location:	People's Republic of China
Project Type:	New Project
Project Description:	The CSNS facility is designed to provide multidisciplinary research
Requirements List Available:	No
Approval Date:	28-Sep-08
Status of Contracting:	Under progress
Construction scheduled to start:	3-Sep-11
Estimated Project Cost:	1.8863 B CNY supported
Estimated Construction Duration:	6.5 years
Type of Equipment to be Purchased:	a 80-MeV H¬Ø linac, a 1.6-GeV proton rapid cycling synchrotron (RCS),beam transport lines, a solid tungsten target station, and 3 initial instruments for the pulsed spallation

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Project Region: Asia

High Intensity Heavy Ion Accelerator Facility (HIAF) in China

Project Location:	People's Republic of China
Project Type:	New Project
Project Description:	HIAF (High Intensity heavy ion Accelerator Facility) is a proposed new accelerator facility in China. The HIAF facility will be built on the experience and technological developments already achieved at the existing HIRFL facility and also be incorporated new technological concepts. The facility is being designed to provide intense beams of primary and radioactive ions for a wide range of research fields. High energetic highly bunched heavy ion beams are used to interact with dense plasma to probe the physics of nuclear fusion. Radioactive ion beams are used to investigate the structure of exotic nuclei, to learn more about nuclear reactions of astrophysics and to measure the mass of nuclei with high precision. Highly charged ions are used for atomic physics and a series of applied science. The unique features of the first phase of HIAF are high current pulsed beams from the iLinac

	and high intensity heavy ion beams with ultra-short bunch from the BRing. The cooled rare isotope beams also will be prepared through projectile-fragmentation (PF) method. The HIAF facility plan was approved in principle by central government of China in December 2012. The final approval of central government was in December 2015. Projected funding for HIAF is estimated to be up to $500 million and the approximately 8-year period is expected to design and construct the facility.
Requirements List Available:	Yes
Approval Date:	31-Dec-15
Status of Contracting:	
Construction scheduled to start:	1-Jun-17
Estimated Project Cost:	2.0 B CNY
Estimated Construction Duration:	From 01-06-2017 to 01-06-2024
Type of Equipment to be Purchased:	Irradiation protection magnet,Power supply for fast ramping rate magnets,magnetic alloy loaded cavity,High intensity beam diagnosis devices,Vacuum system devices,Superconducting RF cavity,Electric device and control card

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Project Region: Asia

IFMIF-A-FNS

Project Location:	Japan
Project Type:	New Project
Project Description:	14 MeV neutron source for Nuclear Fusion materials research
Requirements List Available:	No
Approval Date:	
Status of Contracting:	Not ready for procurement
Construction scheduled to start:	
Estimated Project Cost:	
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	The accelerator will be a 125 mA CW 40 MeV deuterons superconducting Linac

Project Leader(s):	Keishi Sakamoto
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Contact Person(s):	Same as Project Leader

Project Region: Asia

Korea Heavy-Ion Medical Accelerator (KHIMA) project

Project Location:	Republic of Korea
Project Type:	New Project
Project Description:	KHIMA project will be used for heavy-ion cancer therapy and academic R&D purpose with proton, helium, and carbon beam
Requirements List Available:	Yes
Approval Date:	1-Apr-10
Status of Contracting:	Contraction will be made by the end of Jul, 2017 for the equipments. Site construction is done.
Construction scheduled to start:	1-Aug-10
Estimated Project Cost:	195 M USD
Estimated Construction Duration:	10 years
Type of Equipment to be Purchased:	ECRIS, RFQ+DTL, HI synchrotron, HEBT, scanning irradiation system, accelerator control system, and other treatment equipments

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Project Region: Asia

RAON

Project Location:	Republic of Korea
Project Type:	New Project
Project Description:	Rare isotope and stable ion beam facility with 400-kW, 200-MeV/u (for uranium beam) driver linac that can accelerate from uranium to proton, and 70-MeV, 1-mA proton cyclotron as ISOL driver.
Requirements List Available:	Yes
Approval Date:	20-Dec-11
Status of Contracting:	contracting
Construction scheduled to start:	20-Dec-11
Estimated Project Cost:	946 M USD (excluding site cost)
Estimated Construction Duration:	Ten years
Type of Equipment to be Purchased:	SC cavities, cryomodules, SC magnets (HTS, LTS), 28 GHz ECR ion source, RFQ, solid state rf amplifiers, vacuum systems, control system

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Project Region: Asia

RIBF upgrade project

Project Location:	Japan
Project Type:	Project Upgrade
Project Description:	This project aims at increasing the intensity of the radioactive-isotope beams by 30 times more than what is available at present. It also upgrades the heavy-ion linac injector for superheavy element research.
Requirements List Available:	No
Approval Date:	
Status of Contracting:	Partially in procurement
Construction scheduled to start:	
Estimated Project Cost:	
Estimated Construction Duration:	
Type of Equipment to be Purchased:	A ring cyclotron, superconducting rf linacs and related subsystems.

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Project Region: Asia

R&D on High Energy Photon Source (HEPS-TF)

Project Location:	People's Republic of China
Project Type:	New Project
Project Description:	In construction
Requirements List Available:	No
Approval Date:	12-Feb-15
Status of Contracting:	
Construction scheduled to start:	11-Apr-16
Estimated Project Cost:	50 M USD
Estimated Construction Duration:	3 years
Type of Equipment to be Purchased:	Magnets, power supplies, kicker, BPM, KB mirror, insertion device, beam line optics, etc.

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Project Region: Asia

SPring-8 Upgrade (SPring-8-II)

Project Location:	Japan
Project Type:	Project Upgrade
Project Description:	The project aims at upgrading the current SPring-8 to a stable highly coherence ring-based source with an emittance of ~100 pm.rad, a stored current of 100~200 mA, and a beam lifetime of around 10 hours by timeshare use of the SACLA linac as the ring injector.
Requirements List Available:	No
Approval Date:	
Status of Contracting:	Not ready for procurement
Construction scheduled to start:	
Estimated Project Cost:	
Estimated Construction Duration:	5 years
Type of Equipment to be Purchased:	magnet system vacuum system beam diagnostic system LLRF and timing system control system

Project Leader(s):	Hitoshi Tanaka
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Project Region: Asia

The Development of Fully Solid-state 60 kW RF Transmitter

Project Location:	Taiwan
Project Type:	New Project
Project Description:	Build a RF transmitter constructed fully by solid-state power amplifiers
Requirements List Available:	No
Approval Date:	1-Jan-2014
Status of Contracting:	In prototyping
Construction scheduled to start:	1-Jan-2014
Estimated Project Cost:	360 K USD
Estimated Construction Duration:	Five years
Type of Equipment to be Purchased:	2kW power supply module, 1kW RF circulator, 1.2kW RF microstrip load, high power directional coupler, RF power combiner/divider

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Project Region: Europe

AWAKE

Project Location:	Switzerland
Project Type:	New Project
Project Description:	Proton Driven Plasma Wakefield Experiment at CERN In Run 1, Phase 1 of AWAKE was dedicated to the study of the seeded self-modulation (SSM) that makes the long proton bunch suitable to drive large amplitude wakefields. The current Phase 2 is dedicated to acceleration of externally injected electrons. At the same time, we are developing plans for Run 2, scheduled to start in 2021. Run 2 will be dedicated to accelerating an externally injected bunch of electron and to the preservation of its quality: low relative energy spread and low emittance. These experiments will require a new plasma source and electron injector. We are also developing plans for the mid-term with applications to beam dump experiments at the ~100GeV level. Long term plans include very high energy collisions between TeV electrons and LHC protons. These applications will require very long plasma sources (50m to a few kilometers), with

	very uniform densities, These are both scientific and technical challenges.
Requirements List Available:	No
Approval Date:	28-Aug-13
Status of Contracting:	
Construction scheduled to start:	1-Sep-13
Estimated Project Cost:	20 M CHF (material)
Estimated Construction Duration:	4 years
Type of Equipment to be Purchased:	Equipment that was purchased includes, TW laser system, alkali metal vapor source, streak camera, instrumentation (computers, oscilloscopes, microwave equipment, etc.), magnets, power converters, etc.

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Project Region: Europe

bERLinPro

Project Location:	Germany
Project Type:	Upgrade
Project Description:	The Helmholtz-Zentrum Berlin (HZB) is realizing an innovative upgrade scheme for BESSY II to generate simultaneously 15 ps and 1.7 ps (rms) long electron bunches, the Variable pulse length Storage Ring BESSY VSR. Light pulses of both the short and long pulses are supplied to all beam ports and can be separated by pulse picking methods. With picosecond X-ray pulses of 1.25 MHz to 250 MHz repetition rate BESSY VSR covers the gap in pulse length between extreme brilliant pulses of diffraction limited storage rings and ultrashort pulses of Free Electron Lasers. The basic idea behind this scheme is to apply a beating of an enhanced longitudinal focusing - approximately 80 times more than the present configuration. This is achieved by superconducting (SC) four-cell cavities of harmonic and sub-harmonic radio frequencies (RF) of 1.5 GHz and 1.75 GHz, and the existing, normal conducting (NC) 0.5 GHz RF system. The

	beating creates alternating buckets for 200 long and 200 short bunches. The current in these buckets is defined by machine requirements and user demands.
Requirements List Available:	
Approval Date:	01.06.2017
Status of Contracting:	Procurement ongoing
Construction scheduled to start:	Summer 2019
Estimated Project Cost:	30 M EUR
Estimated Construction Duration:	4 years
Type of Equipment to be Purchased:	solid state cw 15 kW transmitters @ 1.5 GHz and 1.75 GHz, HOM damped high voltage cw SRF cavities @ 1.5 GHz and 1.75 GHz, resp. cryo-modules, particle free vacuum components

Project Leader(s):	Pierre Schnizer Andreas Jankowiak Jens Knobloch
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Contact Person(s):	Same as Project Leaders

Project Region: Europe

CLARA

Project Location:	United Kingdom
Project Type:	New Project
Project Description:	Single pass FEL, 250MeV, 100nm, test facility
Requirements List Available:	No
Approval Date:	1-Sep-14
Status of Contracting:	In Progress
Construction scheduled to start:	1-Apr-15
Estimated Project Cost:	35 M GBP
Estimated Construction Duration:	5 years
Type of Equipment to be Purchased:	RF, vacuum, magnets, undulators, lasers, diagnostics, power supplies, controls

Project Leader(s):	Jim Clarke
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Contact Person(s):	Same as Project Leader

ELENA

Project Location:	Switzerland
Project Type:	New Project
Project Description:	ELENA, a small 30.4 m circumference synchrotron installed recently at CERN, will decelerate antiprotons from 5.3 MeV down to 100 keV and reduce the beam emittances using an electron cooler. At present, experiments receive antiprotons from the Antiproton Decelerator AD at 5.3 MeV, the lowest energy which can be reached under good conditions in this longer machine. In the future, the antiprotons will be transferred from the AD to ELENA, where they will be further decelerated and cooled and sent to the experiments with a kinetic energy of 100 keV. The lower energy will improve the efficiency of the experiments and make new types of experiments possible.
Requirements List Available:	No
Approval Date:	
Status of Contracting:	Almost all equipment has been purchased and delivered.
Construction scheduled to start:	
Estimated Project Cost:	25 M CHF

Estimated Construction Duration:	The installation of the ELENA ring and a few lines required for ring commissioning has been completed in autumn 2016. Lines to a new and the old experimental area in 2017 and 2019.
Type of Equipment to be Purchased:	Almost all equipment required has already been purchased and delivered. Only few items as for example simple vacuum chambers for transfer lines to experiments still have to be purchased.

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Contact Person(s):	Same as Project Leader

Project Region: Europe

ELIMED

Project Location:	Italy
Project Type:	New Project
Project Description:	Realization of a transport beamline for laser-driven ions for multidisciplinary applications
Requirements List Available:	
Approval Date:	4-Dec-14
Status of Contracting:	on-time
Construction scheduled to start:	4-Dec-14
Estimated Project Cost:	2.5 M EUR
Estimated Construction Duration:	three years
Type of Equipment to be Purchased:	Conventional and non-conventional beam transport elements

Project Leader(s):	G A Pablo Cirrone
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Contact Person(s):	Same as Project Leader

Project Region: Europe

ELI-NP Gamma Beam System

Project Location:	Romania
Project Type:	New Project
Project Description:	The system is dedicated to the development and operation of a high flux, high brilliance, monochromatic (bandwidth less than 0.5%), energy tuneable (continuously in the range of 0.2 - 19.5 MeV), linearly polarized (to more than 95%) gamma beam based on laser inverse Compton scattering off relativistic electron bunches.
Requirements List Available:	Yes
Approval Date:	18-Sep-12
Status of Contracting:	Completed Stage I of the contract consisting of the delivery of system components corresponding to a gamma beam energy of minimum 1 MeV
Construction scheduled to start:	19-Mar-14
Estimated Project Cost:	66.8 M EUR
Estimated Construction Duration:	54 months
Type of Equipment to be Purchased:	Electron RF Linac 720 MeV, 1 Photoinjector laser, 2 Lasers of 200 mJ for inverse Compton scattering, interaction chambers with laser pulse circulators, electron and gamma beam diagnostics, control system

Project Leader(s):	Nicolae Victor Zamfir
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Project Region: Europe

ESS Bilbao

Project Location:	Spain
Project Type:	New Project
Project Description:	Partner (5%) of European Spallation Source ERIC (Lund, Sweden). Scientific and technical research for development, manufacturing, delivery and installation of the subsystems led by ESS-Bilbao in the ESS project.
Requirements List Available:	Yes
Approval Date:	01-Jun-14
Status of Contracting:	Subsystems: prototyping, and tendering, and some, awarded
Construction scheduled to start:	01-Jun-14
Estimated Project Cost:	92.1 M EUR: 73.7 M EUR In-Kind, 18.4 M EUR Cash
Estimated Construction Duration:	Construction Phase: 2014-2020; Commissioning & Completion Phase: 2019-2025
Type of Equipment to be Purchased:	Equipment to manufacture: MEBT (Beam Instrumentation, Control Systems, Interlocks, Scrapers, Quadrupoles, Power supplies, Bunchers, RF power amplifiers, distribution, LLRF, Coupler, Fast Chopper); RF Systems (HPVC, HPA, distribution, Control and Interlocks, LLRF); Target Wheel, Monolith Vessel, Tuning Beam Dump, Proton Beam Window,

	Proton Beam Instrumentation Plug; Backscattering

Project Leader(s):	José L. Martinez
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Contact Person(s):	Same as Project Leader

Project Region: Europe

European Spallation Source (ESS)

Project Location:	Sweden
Project Type:	New Project
Project Description:	The European Spallation Source (ESS) is a multi-disciplinary research facility based on the world's most powerful neutron source. The unique capabilities of this new facility will both greatly exceed and complement those of today's leading neutron sources, enabling new opportunities for researchers across the spectrum of scientific discovery, including life sciences, energy, environmental technology, cultural heritage and fundamental physics.
Requirements List Available:	Yes
Approval Date:	1-Jun-14
Status of Contracting:	On-going by ESS (Lund) and in-kind partners
Construction scheduled to start:	1-Jun-14
Estimated Project Cost:	1.84 B EUR (2013)
Estimated Construction Duration:	Construction phase 2013-2025, Initial Operations phase 2019-2025, Steady State Operations phase 2026-2065, Decommissioning 2066
Type of Equipment to be Purchased:	RF modulators, RF power sources, RF accelerating cavities (normal and super-conducting), cryogenics and cryodistribution systems, vacuum equipment,

	magnets, power supplies, beam diagnostics, other accelerator related hardware equipment, detectors, motion controls, various services related to installation, tooling, lifting, workshops

Project Leader(s):	John Womersley (Director General), John Haines (Project Manager), Meredith Shirey (Head of Supply, Procurement and Logistics Division)
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Contact Person(s):	Same as Project Leader

Project Region: Europe

Facility for Antiproton and Ion Research (FAIR)

Project Location:	Germany
Project Type:	New Project
Project Description:	The Facility for Antiproton and Ion Research (FAIR) is an international accelerator facility under construction which will use antiprotons and ions to perform research in the fields of: nuclear, hadron and particle physics, atomic and anti-matter physics, high density plasma physics, and applications in condensed matter physics, biology and the bio-medical sciences
Requirements List Available:	
Approval Date:	
Status of Contracting:	
Construction scheduled to start:	2017
Estimated Project Cost:	
Estimated Construction Duration:	2015
Type of Equipment to be Purchased:	fast ramping superconducting magnets for SIS100 synchrotron large aperture superconducting magnets for Super-FRS fragment separator

Project Leader(s):	Jörg Blaurock
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Contact Person(s):	Ingo Peter
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Project Region: Europe

Future Circular Collider (FCC) study

Project Location:	Switzerland
Project Type:	New Project
Project Description:	Design study of a future large-scale research infrastructure centred on a new-generation circular hadron collider with a circumference of about 100 kilometre, able to reach proton-proton collision energies of 100 TeV and a corresponding energy in heavy-ion collisions. A future high-luminosity electron-positron collider, which could be housed in the same tunnel and reach centre-of-mass energies up to 350 GeV, is also considered as a possible first step. A lepton-hadron collider is another option. In addition, the FCC study develops an energy upgrade of the LHC (HE-LHC) based on FCC-hh magnet technology.
Requirements List Available:	No
Approval Date:	1-Mar-25 (expected)
Status of Contracting:	R&D phase
Construction scheduled to start:	1-Mar-27 (expected)
Estimated Project Cost:	not yet available
Estimated Construction Duration:	10-15 years
Type of Equipment to be Purchased:	Nb3Sn accelerator magnets with a field of about 16 T, SRF cavities at 400 and 800 MHz,

	efficient RF power sources, vacuum chambers appropriate for high synchrotron radiation, advanced cryogenics, novel manufacturing techniques, warm accelerator magnets, collimation system, etc.

Project Leader(s):	Michael Benedikt
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Contact Person(s):	Same as Project Leader

Project Region: Europe

FLUTE

Project Location:	Germany
Project Type:	New Project
Project Description:	FLUTE (Ferninfrarot Linac Und Test Experiment) is a compact versatile linear accelerator R&D facility currently under construction at KIT. FLUTE allows conducting a variety of accelerator physics studies and it will be used to generate intense, ultra-short THz pulses for photon science experiments. FLUTE consists of a ~ 7 MeV photo-injector gun, a ~ 41 MeV S-band linac and a D-shaped chicane to compress bunches to a few femto-seconds and will provide a THz beamline for different applications. In addition access to FLUTE experiments at 7 and 41 MeV will be possible via the ARIES transnational access program.
Requirements List Available:	
Approval Date:	
Status of Contracting:	50% ongoing, 50% planned for tendering
Construction scheduled to start:	started
Estimated Project Cost:	4 M EUR investment plus costs for personal, building, expendables, operation
Estimated Construction Duration:	2019

Type of Equipment to be Purchased:	High stability power supplies, magnets, electron and photon diagnostics, vacuum components in 316 LN, OFHC copper, Modulator for 45MW klystron, Solid State Amplifier, MTCA timing system components

Project Leader(s):	Dr.-Ing. R. Ruprecht
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Project Region: Europe

High Luminosity LHC (also: HiLumi LHC, HL-LHC)

Project Location:	Switzerland
Project Type:	Project Upgrade
Project Description:	https://edms.cern.ch/ui/file/1723389/1/HL-LHC_in_a_nutshell.pdf https://project-hl-lhc-industry.web.cern.ch/
Requirements List Available:	Yes
Approval Date:	1-Nov-13
Status of Contracting:	Tendering components
Construction scheduled to start:	1-Jan-16
Estimated Project Cost:	950 M CHF (material cost) including R&D and in-kind contribution; Industrial contracts are about 500 M CHF
Estimated Construction Duration:	Up to mid 2026
Type of Equipment to be Purchased:	SC Magnets & components; SC RF cavities & components; Powering and controls devices for Magnets and Cavities; Collimators & precision mechanics special equipment; Vacuum equipment and beam diagnostics; Cryogenic plants and cryogenic equipment; SC links in MgB2 or High temperature superconductors; Large & precision mechanical tools; technical infrastructures, manufacturing services

Project Leader(s):	Lucio Rossi
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Project Region: Europe

IFMIF-DONES

Project Location:	Europe – Granada Spain
Project Type:	New Project
Project Description:	14 MeV neutron source for Nuclear Fusion materials research
Requirements List Available:	Engineering design to be available end of 2017 (based in IFMIF project one)
Approval Date:	2020
Status of Contracting:	Not yet started. Only engineering work under development
Construction scheduled to start:	2020
Estimated Project Cost:	500 M EUR
Estimated Construction Duration:	8 years
Type of Equipment to be Purchased:	The accelerator will be a 125 mA CW 40 MeV deuterons superconducting Linac

Project Leader(s):	Angel Ibarra (for engineering work up to 2020)
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Contact Person(s):	Same as Project Leader

Project Region: Europe

Iranian Light Source Facility, ILSF

Project Location:	Iran
Project Type:	New Project
Project Description:	The Iranian Light Source Facility Project (ILSF) is a 3rd generation light source with energy of 3 GeV, a full energy injector and a 150 MeV linac as pre-injector. The stored beam current in top up mode is 400 mA, the beam lifetime is about 7 h, and the average pressure of vacuum chamber is approximately 1 nTorr.
Requirements List Available:	No
Approval Date:	1-Oct-10
Status of Contracting:	
Construction scheduled to start:	10-Sep-15
Estimated Project Cost:	300 M USD
Estimated Construction Duration:	10 years (2015-2025)
Type of Equipment to be Purchased:	Power suppliers, Vacuums systems, RF systems, Control systems, Optics, Cavities, Electronics and Mechanics

Project Leader(s):	Javad Rahighi
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Contact Person(s):	Same as Project Leader

Project Region: Europe

LHC Injectors Upgrade (LIU)

Project Location:	Switzerland
Project Type:	Project Upgrade
Project Description:	LHC Injectors Upgrade
Requirements List Available:	Yes
Approval Date:	1-Oct-10
Status of Contracting:	
Construction scheduled to start:	
Estimated Project Cost:	200 M CHF
Estimated Construction Duration:	11 years
Type of Equipment to be Purchased:	Many accelerator equipment

Project Leader(s):	Malika Meddahi
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Contact Person(s):	Same as Project Leader

Project Region: Europe

MESA - Mainz Energy-recovering Superconducting Accelerator

Project Location:	Germany
Project Type:	New Project
Project Description:	Recirculating superconducting linear accelerator with option for external beam and for energy recovery operation
Requirements List Available:	No
Approval Date:	01-NOV-2012
Status of Contracting:	cryomodules ordered, RF system under contracting, magnets, subsystems: purchase not started
Construction scheduled to start:	01-JUN-2015
Estimated Project Cost:	15 M EUR
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	superconducting RF system, recirculators, normal conducting injector, infrastructure: vacuum powersupllies, shelding

Project Leader(s):	Kurt Aulenbacher
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Contact Person(s):	Same as Project Leader

MYRRHA_100MeV

Project Location:	Belgium
Project Type:	New Project
Project Description:	First phase of the full-size MYRRHA project, an Accelerator Driven System fed by a 600 MeV 4 mA CW proton linac.
Requirements List Available:	No
Approval Date:	1-Jan-18
Status of Contracting:	Present phase is prototyping. Contracting status is "prospecting".
Construction scheduled to start:	1-Jan-18
Estimated Project Cost:	320 M EUR
Estimated Construction Duration:	6 years
Type of Equipment to be Purchased:	100 MeV proton linac consisting of a 17 MeV injector with 15 copper CH-cavities followed by a superconducting spoke linac with 48 single spoke cavities. A target station is foreseen.

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Project Region: Europe

National Electromagnetic Radiation Research Centre at the Jagiellonian University stage I

Project Location:	Poland
Project Type:	New Project
Project Description:	The project includes construction of a third generation light source at the Jagiellonian University in Krakow, Poland. It is funded from the EU Structural Funds and covers: people/services, buildings and laboratorium, 600 MeV linear injector with a thermionic RF gun and a vertical transfer line, storage ring and two experimental beamlines with 3 experimental stations. The project is accomplished through very tight cooperation with the MAX IV team in Lund, Sweden. The Solaris storage ring is a replica of MAX IV 1.5 GeV storage ring, composed of 12 integrated magnet cells with 96m circumference. It has been designed to have an emittance of 6 nm-rad and operate with 500 mA stored current. Solaris will deliver radiation from the bending magnets and insertion devices in the range from IR to

	hard X-rays offering research opportunities in diverse fields of research.
Requirements List Available:	No
Approval Date:	9-Apr-10
Status of Contracting:	The project was finished in December 2015 but procurement for the Beam Line is ongoing.
Construction scheduled to start:	24-Mar-11
Estimated Project Cost:	50 M EUR
Estimated Construction Duration:	5 years
Type of Equipment to be Purchased:	Linac structures, RF Units (Klystrons&Modulators), RF Gun, Magnets: Quadrupoles, Correctors, Speta, Integrated Double Bend Achromats, Undulator, Power Supplies, Vacuum chambers,RF Cavities, RF Transmitters, front ends, beamline components: mirrors, monochromators, slits, end stations, safety hutches, beam diagnostics & instrumentation: Scopes, BPMs (heads & electronics), YAG screens, DCCT, striplines, etc)

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Project Region: Europe

Nuclotron-based Ion Collider fAcility (NICA)

Project Location:	Russia
Project Type:	New Project
Project Description:	NICA heavy ion collider has the aim to create a special state of matter in which our Universe stayed shortly after the Big Bang - the Quark-Gluon Plasma (QGP).
Requirements List Available:	No
Approval Date:	11-Jan-11
Status of Contracting:	collider building construction, superconducting magnets production
Construction scheduled to start:	1-Sep-15
Estimated Project Cost:	500 M USD
Estimated Construction Duration:	5 years
Type of Equipment to be Purchased:	Heavy ion linear accelerator, booster synchrotron, collider rings, multi-purpose detector, high energy electron cooling system.

Project Leader(s):	Grigory Trubnikov, Igor Meshkov
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Contact Person(s):	Same as Project Leader

Project Region: Europe

SINBAD

Project Location:	Germany
Project Type:	New Project
Project Description:	The SINBAD facility is a dedicated accelerator R&D facility currently under construction at DESY Hamburg. Located in the former DORIS accelerator tunnel (plus associated halls), it features sufficient space to host multiple independent experiments. In the initial stage, two experiments, AXSIS and ARES, will be implemented. The AXSIS - collaboration aims for acceleration of electrons to 10MeV in THz-laser driven dielectric loaded waveguides. At ARES a normal conducting S-band linac will accelerate ultra-short electron bunches (single/sub fs) to 100MeV with excellent beam arrival time stability. Once operational, the linac will be used to a) compare various bunch compression methods and b) to inject into advanced acceleration schemes like dielectric structures (e.g. ACHIP collaboration experiments). Future upgrade plans include e.g. laser driven

	plasma wakefield experiments with external injection. In addition access to the SINBAD-ARES-linac beams will be possible via the ARIES transnational access program.
Requirements List Available:	Yes
Approval Date:	20-Sep-16
Status of Contracting:	Procurement ongoing
Construction scheduled to start:	1-Jan-17
Estimated Project Cost:	20 M Euro
Estimated Construction Duration:	Staged construction, Beam from linac available 2019
Type of Equipment to be Purchased:	S-band RF-linac

Project Leader(s):	Ulrich Dorda
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Contact Person(s):	Same as Project Leader

Project Region: Europe

SPARC_LAB

Project Location:	Italy
Project Type:	Project Upgrade
Project Description:	The SPARC_LAB test facility at LNF is an inter-disciplinary laboratory with unique features in the world. Born from the integration of a last generation photo-injector, able to produce electron beams up to 200 MeV energy with high peak current (> 1 kA) and low emittance (<2 mm-mrad), and of a high power laser (> 200 TW), able to produce ultra-short pulses (<30 fs), SPARC_LAB has already enabled the development of innovative radiation sources and the test of new techniques for particle acceleration using lasers. In particular a Free Electron Laser has been commissioned (coherent radiation tunable from 500 nm down to 40 nm in new regimes of operation has been observed), a source of both broad band and narrow band (<30%) and high energy (> 10 μJ) THz radiation has been tested and electrons have been accelerated up to 100 MeV in 4 mm long plasma wave excited by the high power laser FLAME. Beam driven plasma acceleration

	experiments are also foreseen and the beam line is under commissioning. An experiment of light ions acceleration through laser interaction with thin metal targets is also underway. SPARC_LAB is also an accelerator test facility in the framework of the European collaborations ELI, EUROFEL and EUPRAXIA.
Requirements List Available:	No
Approval Date:	11-Feb-12
Status of Contracting:	In progress for upgrades
Upgrade scheduled to start:	1-Jan-17
Estimated Project Cost:	3 M EUR
Estimated Construction Duration:	3 years
Type of Equipment to be Purchased:	Accelerating structures, RF components, Undulators, Quadrupole Magnets, Vacuum components, Control system, Lasers, Optics components, UV and X ray detector.

Project Leader(s):	Massimo Ferrario
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Contact Person(s):	Same as Project Leader

Project Region: Europe

SPES

Project Location:	Italy
Project Type:	New Project
Project Description:	ISOL type facility for the acceleration of exotic beams. A primary p-beam is accelerated to 40 MeV by a commercial cyclotron onto a Target-Ion-Source system. Emitted charged ions are mass-selected with high-resolution, sent to an ECR-ype charge breeder and reaccelerated through the existing SC linac ALPI. The cyclotron will be used also for production and research in the field of radioisotopes for medicine.
Requirements List Available:	No
Approval Date:	15-Dec-12
Status of Contracting:	
Construction scheduled to start:	15-Dec-12
Estimated Project Cost:	53 M EUR
Estimated Construction Duration:	First accelerated beams in 2021
Type of Equipment to be Purchased:	Beam Dipoles and lenses. Vacuum components, pumps and gauges. Beam Instrumentation devices. Control systems. Cryomodules. RF components and instruments. HV platform. Mechanical components on design specs.

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Project Region: Europe

Superconducting Cyclotron for Intense Light Ion Beams

Project Location:	Italy
Project Type:	Project Upgrade
Project Description:	The proposed upgrade of the LNS Superconducting Cyclotron aims at increasing the intensity of ion beams with mass lower than 40 amu. A beam power of 10 kW will be reached by means of extraction by stripping, so as to fulfil the demand of users willing to study rare processes in Nuclear Physics
Requirements List Available:	Yes
Approval Date:	TBD expected 1-Dec-18
Status of Contracting:	under evaluation
Construction scheduled to start:	1-Dec-18
Estimated Project Cost:	11.4 M EUR
Estimated Construction Duration:	3.5 years
Type of Equipment to be Purchased:	Superconducting Magnet (cryostat, s.c. coils, thermal shield), Normal conducting trim coils, Magnetic channels, RF liner, Stripper system, Helium liquefier, Power supplies, Beam line magnetic elements

Project Leader(s):	Danilo Rifuggiato
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Contact Person(s):	Same as Project Leader

Project Region: Europe

Super Charm-Tau Factory

Project Location:	Russia
Project Type:	New Project
Project Description:	e+e- collider with the beam energy from 1 GeV to 2.5 GeV and with Crab Waist collision scheme providing 1e35 cm-2s-1 maximum luminosity.
Requirements List Available:	No
Approval Date:	
Status of Contracting:	
Construction scheduled to start:	
Estimated Project Cost:	450 M EUR
Estimated Construction Duration:	5 years
Type of Equipment to be Purchased:	Detector systems, electronics, beam diagnostics, feedback systems, vacuum equipment, control system.

Project Leader(s):	Eugene Levichev
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Contact Person(s):	Same as Project Leader

Project Region: Europe

ThomX

Project Location:	France
Project Type:	New Project
Project Description:	Compact X-ray source based on Compton back-scattering. ThomX is designed to maximize the average X-ray flux and be a compact, tunable and reliable source which can be operated in hospitals or museums in a user-friendly way.
Requirements List Available:	No
Approval Date:	20-Jan-12
Status of Contracting:	Done
Construction scheduled to start:	1-Jan-14
Estimated Project Cost:	10 M EURO
Estimated Construction Duration:	4 years
Type of Equipment to be Purchased:	All the components of the accelerator complex (e- gun, Linac, transfer line, ring, Fabry-Perot optical cavity, laser system), that is magnets, klystrons, modulators, RF cavity, diagnostics, as well as lasers for the photo-gun and the optical cavity

Project Leader(s):	Hugues Monard
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