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Annual Report 2017

Period covered by the report: from 01/01/2017 to 31/12/2017

1. Explanation of the work carried out by the beneficiaries and Overview of the progress

1.0 Introduction and overview

The **Europe-Japan Accelerator Development Exchange Programme (E-JADE)** addresses the urgent need of exchange of ideas on R&D and implementation of future accelerators for particle physics. It does so by exchanging accelerator scientists and experts between Europe and Japan. The on-going exchange of staff of leading European laboratories and universities with prominent Japanese partners focuses on the most critical and rewarding issues – namely on the design, R&D and prototyping of large international future accelerator facilities for particle physics research.

E-JADE is active since 1 January 2015. At a **midterm review in May 2016 in Santander**, Spain, issues concerning the timely execution of secondments and the overall deliverable situation were identified, and mitigation measures have been developed (new tasks, new beneficiaries and partners as of 1 January 2017, **updated secondment plan**). A large fraction of 2017 was devoted to implementing these updates, and today E-JADE (with new beneficiaries and partners on board, with new tasks, and with a reduced and realistic secondment plan in place) is well on track to achieve all of its objectives. This is demonstrated by the satisfactory achievement of defined milestones and deliverables (see below).

The impact of E-JADE, and the exploitation of its results, is significant. E-JADE is training the next generation of accelerator experts using worldwide unique facilities like, for example, the ATF2 in Japan and are educated in leading technologies like high-field magnets and high-gradient RF structures. Given the continuing spread of accelerators in science, technology and society (i.e. for medical applications, material research, life sciences etc.), these students and postdocs will be highly sought after by industry.

Scientifically, **major areas benefitting from E-JADE** are the LHC and its upgrade in Europe (where Japanese contributions are significant), the upcoming ILC project in Japan (see the remark on the ILC European Action Plan below), and the ATF2 and SuperKEKB facilities in Japan. All of these areas provide unique training grounds for young researches, and E-JADE has significantly strengthened the full scientific exploitation of this facility.

1.1 Objectives

In this section[1], we will briefly summarise and **discuss the high-level objectives and goals** specific for the European-Japanese collaboration of E-JADE as described in section 2.1 of the DoA ("Quality, innovative aspects and credibility of the research"), and summarise the respective work and progress that will be explained, in greater detail, in section 1.2 of this document.

[1] Note that the objectives of E-JADE have not changed since the last periodic report, which is why we took the liberty to copy this section to a large extent from it.

The **main objective for WP 1 "LHC consolidation, upgrades and R&D for future hadron machines"** is the integration of the European and Japanese efforts (involving also other regions) on the LHC high luminosity upgrade into a construction project for the upgrade hardware. This covers aspects of high-field magnet development and wide-band RF systems (also in view of J-PARC upgrades and FCC). **Goals for E-JADE** are

- to prepare the move from R&D to construction for the HL-LHC and to clearly define the Japanese contributions to it,
- to help complete the LHC injector upgrades and the necessary R&D work with Japanese contributions (serving also needs of the neutrino programme at J-PARC), and
- to perform injector studies for FCC (linking to the LIU programme) and to have a complete FCC conceptual design report around 2018 that includes Japanese contributions to high-field magnets and high-gradient structures.

Work in WP 1 has progressed on all fronts, with numerous E-JADE-supported secondments in both directions; the maybe most important achievement being the large Japanese contributions to the continued operation of and physics studies in the ATLAS experiment, as well as the construction and successful testing of the D1 short prototype beam separation dipole magnet. Additionally, the ATLAS detector upgrade contributions and R&D results for high-gradient magnets with new materials and processes are important achievements and expected to increase further in 2018.

The **main objective of work package 2 "Nanometre-scale beam handling at the ATF2"** is to demonstrate solutions and methods for final focus systems for future linear colliders so as to meet their performance goals. **E-JADE specifically aims** at exploiting the potential of the ATF2 facility at KEK for these and other studies (e.g. those related to general linear collider performance issues).

Work package 2 is making excellent progress, commanding by far the highest number of E-JADE secondments.

Important achievements of WP 2 are the assessment of the role of higher-order aberrations for the beam size, better understanding of wakefield sources at the ATF2, a full proof-of-principle demonstration of an orbit feed-forward scheme based on ground motion sensors placed on top of quadrupoles, a full characterisation of the vertical beam halo distribution, including reliable theoretical modelling, as well as first time measurements of the momentum distribution with a newly developed combined YAG/OTR monitor, using a new experimental technique, first-time non-invasive beam size measurements with the newly developed ODR/OTR monitor and substantial improvements in the achieved stabilisation of the beam at the interaction point using the IP-BPM and FONT intra-train beam-feedback systems.

Work package 3 "Linear collider-targeted R&D" has as its main objectives the development of the site-specific design for the International Linear Collider (ILC) in Japan and a project implementation plan involving European participation at an appropriate level. Concretely, a completed preparation phase with a site-specific design and the preparation of the construction were envisaged during the E-JADE project duration.

However, WP 3 has suffered from the unforeseen delay of the ILC project, as outlined in the May 2016 progress report. These complications were addressed, and the mitigation steps introduced in the last periodic report have started to show effect.

Work packages 4 and 5 – "Management and dissemination" and "Training and knowledge transfer" – have both progressed according to plan, with some difficulties to execute the related secondments to the full extent that was foreseen. Also here, corrective actions have been devised.

1.2 Explanation of the work carried out per WP

In this section, we will describe, separately for each of our five work packages, the work carried out and the main results achieved, together with a list of significant publications, the Ph.D. theses defended and the milestones.

1.2.1 Work Package 1 "LHC consolidation, upgrades and R&D for future hadron machines

The LHC accelerator is currently in full operation, and Japanese researchers participate in operation, analysis and upgrade projects for both accelerator and detectors. R&D on high-field magnets and wideband magnetic alloy RF systems is a key ingredient for upgrading the LHC, and its injectors through the LIU project, and for reaching the goals of the High Luminosity LHC project. These studies are also relevant for the J-PARC accelerators and for a potential very large collider as studied in the context of the FCC study. The objectives of WP1 are the following have been sketched above.

There are three tasks in WP1. Task 1.1 covers LHC operation and analysis (CERN, KEK & UoT) and aims at supporting Japanese efforts in operation of LHC machines and detectors at full energy; expected to provide important guidance for future accelerator developments in Europe and Japan. Task 1.2 focuses on the HL-LHC project (CERN & KEK) and in particular the engineering design and validation of two short prototype separation superconducting dipoles (D1) for the upgraded LHC insertion regions. Task 1.3 covers studies of high field magnet R&D and preparation of future hadron injectors and colliders (CERN & KEK). R&D on the viability of HTS magnets of accelerator/collider quality. Other technologies of special interest are Wideband Cavities using Magnetic Alloy, Solid State Amplifiers and Low Level RF.

For task 1.1 Japanese researchers take leading rules in the ATLAS experiment; operation, data-analysis and physics studies. Long stays at CERN are essential for this and EJADE secondments from Japan to CERN important. 2017 was a very successful year for LHC with record delivered luminosities. Another key achievement was the submission of the Technical Design Report for the upgrade of the ATLAS inner detector with strong Japanese participation.

For task 1.2 Specifically, the development of the beam separation dipole magnet D1 was pushed with the focus on the 2 m long model magnet. This effort was much supported by visits from CERN to Japan; the coordination of practical and technical issues continues to profit strongly from the E-JADE secondments. The D1-MBXFS1b tested in 2017 successfully demonstrated improved training performance reaching both nominal and ultimate current level. Development of a 2nd model magnet (D1-

MBXFS2) has been carried out. It includes several design updates (enhanced coil pre-stress, 4 HX holes, improved coil end shape & wet-winding, new QPH, etc.) and these are being implemented.

For task 1.3 "High-field magnet R&D and preparation of future hadron injectors and colliders", the involvement of KEK in the LHC injector upgrade continued at full strength but also the R&D for high-field magnets with new materials and processes gained momentum. The most prominent such programmes are related to Nb3Sn developments as a joint R&D activity between CERN, KEK and Tohoku & Tokai Universities with Japanese companies, as well as R&D on radiation resistant HTS magnets.

Publications in the context of WP 1 during the report period

- M. Aaboud, M. Aoki, K. Nagano, Y. Takubo, K. Tokushuku, S. Tsuno et al. [ATLAS Collaboration], "Evidence for light-by-light scattering in heavy-ion collisions with the ATLAS detector at the LHC", Nature Phys. 13, no.9, 852-858 (2017).
- M. Aaboud, M. Aoki, K. Nagano, Y. Takubo, K. Tokushuku, S. Tsuno et al. [ATLAS Collaboration], "Evidence for the H→bb decay with the ATLAS detector", JHEP 1712 (2017)
- M. Aaboud, M. Aoki, K. Nagano, Y. Takubo, K. Tokushuku, S. Tsuno et al. [ATLAS Collaboration], "Search for supersymmetry in final states with two same-sign or three leptons and jets using 36 fb- 1 of √s = 13 TeV pp collision data with the ATLAS detector", JHEP 1709 (2017) 084.
- M. Aaboud, M. Aoki, K. Nagano, Y. Takubo, K. Tokushuku, S. Tsuno et al. [ATLAS Collaboration], "Search for high-mass new phenomena in the dilepton final state using proton-proton collisions at √s=13 TeV with the ATLAS detector", Phys. Lett. B 761, 372-392 (2016).
- M. Aaboud, M. Aoki, K. Nagano, Y. Takubo, K. Tokushuku, S. Tsuno et al. [ATLAS Collaboration], "Search for squarks and gluinos in final states with jets and missing transverse momentum at √s = 13 TeV with the ATLAS detector", Eur. Phys. J. C76, no.7, 392 (2016)
- Y. Unno, K. Hanagaki, Y. Ikegami, K. Nakamura et al., "Development of n^+-in-p planar pixel sensors for extremely high radiation environments, designed to retain high efficiency after irradiation", Nucl. Instrum. Meth. A 831, 122-132 (2016).
- Y. Unno, K. Hanagaki, Y. Ikegami, K. Nakamura, K. Tokushuku et al. [ATLAS Collaboration], "Technical Design Report for the ATLAS Inner Tracker Strip Detector", CERN-LHCC-2017-005, ATLAS-TDR-025.
- G. Trad, E. Bravin, S. Mazzoni, F. Roncarolo and T. Mitsuhashi , "Performance of the Upgraded Synchrotron Radiation Diagnostics at the LHC", Proc. of IPAC 2016, 306 (2016) Busan.
- G. Trad, E. Bravin, A. Goldblatt, S. Mazzoni, F. Roncarolo and T. Mitsuhashi , "Beam Size Measurements Using Interferometry at LHC", Proc. of IBIC2016, 583 (2016) Barcelona.
- A. Goldblatt, E. Bravin , F. Roncarolo, G. Trad, and T. Mitsuhashi , "Design amd Performance of Coronagraph for Beam Halo Measurements in the LHC", Proc. of IBIC2016, 253 (2016) Barcelona.
- G. Trad, E. Bravin, F. Roncarolo and T. Mitsuhashi , "First Observation of the LHC Beam Halo Using a Synchrotron Radiation Coronagraph", Proc. of IPAC2017 (2017) Copenhagen.
- Chihiro Ohmori, Mauro Poluzzi, Fumihiko Tamura, Katsushi Hasegawa, Yasuyuki Sugiyama, Masahito Yoshii, "LIU (LHC 入射器アップグレード)-RF の現状とCERN メイラン地区加速器の広帯域化 STATUS OF LIU (LHC INJECTOR UPGRADE) RF COLLABORATION AND WIDEBAND

CAVITIES IN CERN MEYLAN CAMPUS ACCELERATORS", Proceedings of the 14th Annual Meeting of Particle Accelerator Society of Japan August 1-3, 2017, Sapporo, Japan.

- "LHC luminosity upgrade accelerates ",CERN COURIER Vol 57 Number 6 (http://cerncourier.com/cws/article/cern/69321)
- "A new acceleration system for the PS Booster", CERN Bulletin Issue No.29-30/2017（ http://bulletinserv.cern.ch/emails/archive/364/
- M. Sugano, S. Enomoto, T. Nakamoto, H. Kawamata, N. Okada, R. Okada, N. Higashi, T. Ogitsu, K. Sasaki, N. Kimura, Y. Ikemoto, N. Takahashi, A. Musso, Q. Xu, and E. Todesco, "Development Status of a 2-m Model Magnet of Beam Separation Dipole for the HL-LHC Upgrade", IEEE Transactions on Applied Superconductivity, Vol. 26, No.4, 2016, 4002606.
- S. Enomoto, M. Sugano, T. Nakamoto, H. Kawamata, R. Okada, N. Okada, N. Higashi, T. Ogitsu, K. Sasaki, N. Kimura, Y. Ikemoto, A. Musso, Q. Xu, and E. Todesco, "Development of a 200-mm Short Model of Beam Separation Dipole for HL-LHC Upgrade", IEEE Transactions on Applied Superconductivity, Vol. 26, No.4, 2016, 4001905.
- Akira Idesaki, Tatsushi Nakamoto, Makoto Yoshida, Akihiko Shimada, Masami Iio, Kenichi Sasaki, Michinaka Sugano, Yasuhiro Makida, Toru Ogitsu, "Development of high radiation-resistant glass fiber reinforced plasticswith cyanate-based resin for superconducting magnet systems", Fusion Engineering and Design, Vol. 112, 2016, 418-424.
- Michinaka Sugano, Tatsushi Nakamoto, Shun Enomoto, Hiroshi Kawamata, Naoki Okada, Ryutaro Okada, Ken-ichi Sasaki, Toru Ogitsu, Nobuhiro Kimura, Kenichi Tanaka, Hirokatsu Ohata, Masahisa Iida, Norio Higashi, Naoto Takahashi, Sigekatu Sugawara, Andrea Musso, Ezio Todesco, "Fabrication and Test Results of the First 2 m Model Magnet of Beam Separation Dipole for the HL-LHC Upgrade", IEEE Transactions on Applied Superconductivity, Vol. 27, No. 4, 2017, 4002409.
- Shun Enomoto, Michinaka Sugano, Tatsushi Nakamoto, Naoki Okada, Hiroshi Kawamata, Ken-ichi Sasaki, Kenichi Tanaka, Hirokatsu Ohhata, Masahisa Iida, Ryutaro Okada, Naoto Takahashi, Shigekatu Sugawara, Norio Higashi, Toru Ogitsu, Nobuhiro Kimura, Andrea Musso, Ezio Todesco, "Magnetic Field Measurement of 2-m-Long Model of Beam Separation Dipole for the HL-LHC Upgrade", IEEE Transactions on Applied Superconductivity, Vol. 27, No. 4, 2017, 0600705.
- M. Sugano, S. Enomoto, N. Higashi, M. Iida, Y. Ikemoto, H. Kawamata, N. Kimura, T. Nakamoto, T. Ogitsu, H. Ohata, N. Okada, R. Okada, K. Sasaki, K. Suzuki, N. Takahashi, K. Tanaka, A. Musso and E. Todesco, "Training Performance with Increased Coil Pre-stress of the 2-m Model Magnet of Beam Separation Dipole for the HL-LHC Upgrade", IEEE Transactions on Applied Superconductivity, Vol. 28, No.3, 2018, 4000805.
- J.W. Storey, D. Bodart, B. Dehning, G. Schneider, R. Veness, W. Bertsche, H. Sandberg, S. Gibson, S. Levasseur, M. Sapinski, K. Satou, "First Results From the Operation of a Rest Gas Ionisation Profile Monitor Based on a Hybrid Pixel Detector", Proc. of IBIC17, WE2AB5(2017) Grand Rapids.
- M. Sapinski, P. Forck, T. Giacomini, R. Singh, S. Udrea, D.M. Vilsmeier, F. Belloni, J. Marroncle, B. Dehning, J.W. Storey, K. Satou, C.A. Thomas, R.M. Thurman-Keup, C.C. Wilcox and R.E. Williamson, "Ionization Profile Monitor Simulations - Status and Future Plans", Proc. of IBIC2016, 520(2016) Barcelona.
- D. Bodart, B. Dehning, S. Levasseur, P. Pacholek, A. Rakai, M. Sapinski, K. Satou, G. Schneider, D. Steyart, and J.W. Storey, "Development of an Ionization Profile Monitor Based on a Pixel

Detector for the CERN Proton Synchrotron", Proc. of IBIC2015, 470(2015) Melbourne.

WP 1 Deliverables in the report period

- Month 25: D1.1 Magnets and Gradients: released in February 2018
- Month 25: D1.2 Hadrons at high intensity and energy: postponed to 2018 .
  This report is in progress of being written up, based on new reports presented in the recent CERN-KEK coordination meeting.

Events (co)organised by WP 1 in the report period

- CERN-KEK coordination meeting, KEK, 31 October – 1 November 2017

1.2.2 Work package 2 "Nanometre-scale beam handling at the ATF2"

A detailed progress report was submitted in the mid-term review report, covering the period 2015-2016. In this report, only recent progress achieved during 2017 is included. A new activity started in 2017 in the context of WP2, related to preparations for planned experimentation with the "nanobeam" collision scheme of the SuperKEKB collider, is also included.

For Task 2.1, time has been invested to identify sources of beam size blow-up versus intensity. The most important sources were identified as the cavity BPMs. After removal of these BPMs ATF2 has proceeded with nominal operation to decrease beam size towards the goal of 37nm, achieving about 60nm in 2017. First attempts were performed at the end of 2017 with a pushed optics design aided by octupole magnets. Key required improvements were identified for future attempts. The delivery report "BeamSize-1", due in December 2016, was submitted in April 2017. In 2017, one Early Stage Researchers was seconded from CERN to KEK in the context of Task 2.1: Fabien Plassard.

For Task 2.2, a new PhD student, Pierre Korysko, who started in November 2016 at CERN and Oxford University, started a thorough investigation of the impact of beam current variations as direct measurement on the beam orbit. After preliminary simulation studies with the tracking code PLACET, he visited ATF2 at KEK in May / June and then in December 2017 to perform experimental verification of the predictions. His measurements revealed that some BPMs manifest charge-dependent orbit deflections of order 100 µm per charge variations of 1 nC. Investigations are continuing to determine the reason for such a large effect. The Early-Stage Researcher was seconded from CERN to KEK for a total of about 5 weeks in the context of Task 2.2.

For Task 2.3, a proof-of-principle orbit feed-forward based on ground motion sensors placed on top of quadrupoles has been fully demonstrated in ATF2, showing a significant reduction in orbit jitter, close to the expected performance. Further studies will probe the use of more kickers to enhance the performance. The ground motion sensors moreover allow regular assessments of the sources of orbit jitter throughout the ATF2 line, especially near the IP. A recent campaign successfully narrowed down the identification of the possible sources of a previously measured 16.5Hz vibration peak by actively excluding effects from nearby cooling systems and power

supplies. The delivery report "GM-2", due in December 2017, was postponed to March 31, 2017, to a necessary knowledge transfer to a newly recruited postdoctoral researcher. In 2017, two Experienced Researchers were seconded from LAPP to KEK in the context of Task 2.1: Andrea Jérémie and Gaël Balik.

For Task 2.4, work has focused on charactering the physical mechanisms explaining the halo observed in ATF2. Thanks to a new data-driven calibration method to correct saturation effects in the diamond sensor scanners used at the end of the beam line, excellent agreement could be obtained in the vertical plane with a detailed Monte Carlo simulation of the scattering of beam particles on residual gas molecules in the ATF ring. Uncertainties related to measuring the vacuum pressure were also studied. In the horizontal plane, a newly upgraded combined 2D YAG/OTR monitor has allowed some initial complementary measurements, which confirm the sizeable excess previously observed with the diamond sensors with respect to the beam gas scattering simulation. Quality measurements of the momentum halo distribution were also obtained by appropriately controlling the optical dispersion function in the extraction line. Current studies focus on estimating effects from intra-beam scattering as well as from the shape of the potential well in the RF accelerating cavity, which, through the optical dispersion, may explain the magnitude of the horizontal halo. In 2017, one Early Stage Researcher and one Experienced Researcher were seconded from Université Paris Sud and CNRS to KEK in the context of Task 2.4: Renjun Yang and Philip Bambade.

For Task 2.5, an important milestone was achieved in 2017 on the ODR/OTR beam size monitoring system installed in the extraction line of ATF2.

The system was upgraded with new optical components and a new intensified camera working in the UV range down to 232nm wavelength. Initial tests were performed in May and June to assess the performance of the new hardware, leading to several improvements which were successfully validated with beam in October and November 2017. For the first time, non-invasive beam size measurements were achieved using UV diffraction radiation with a resolution below 10microns. The data are still being processed to determine the final resolution. Overall, the initial goal is close to being met. In 2017, one Experienced Researchers and one Early Stage Researchers were seconded from CERN to KEK in the context of Task 2.5: Stefano Mazzoni et Michele Bergamaschi.

For Task 2.6, in 2017 substantial progress was made on the stabilization of the ATF beam in the final-focus region. Modifications were made to the IP cavity BPMs and associated signal-processing electronics, and in addition the feedback control firmware was substantially upgraded. In particular the firmware modifications enable the integration of multiple samples in the digitized BPM output waveforms so as to improve the signal-to-noise ratio in real-time operation. This allows for an improvement in both the real-time resolution performance of the IP BPMs and their use in closed-loop beam position stabilization. Real-time resolution of 20nm was demonstrated and beam position stabilization to about 40nm was achieved, representing a significant improvement on previous performance. During the year, some technical maintenance of the mechanical setup supporting the BPMs with piezo-movers in the vacuum chamber, including alignment and calibration, was also performed. Two Early Stage

Researchers and one Experienced Researcher were seconded from UOXF to KEK in the context of Task 2.6, as well as one Technical Staff from CNRS: Rebecca Ramjiawan, Talitha Bromwich, Neven Blaskovic Kraljevic and Sandry Wallon.

For the new SuperKEKB "nano-beam" experimentation activity, added to the scientific scope of WP2 from 2017 as part of an amendment to the E-JADE contract, significant work took place in 2017, in preparation for the first SuperKEKB collider operation planned in 2018. In particular, teams from the CNRS/IPHC and from the University of Strasbourg installed a set of CMOS pixel sensors very near the interaction point, along with associated readout electronics, to enable characterizing the machine backgrounds induced by the "nano-beam" collision scheme. Moreover, meetings to prepare the mechanical supports and DAQ scheme for the fast luminosity monitoring designed by the CNRS/LAL for the purpose of tuning the collider beams at the interaction point were attended. One Early Stage Researcher, three Experienced Researchers and four Technical Staff were seconded from the CNRS and University of Strasbourg to KEK in the context of this new activity: Daniel Cuesta, Isabelle Ripp-Baudot, Jérôme Baudot, Philip Bambade, Gilles Claus, Mathieu Goffe, Michel Szelezniak and Didier Jehanno.

Ph.D. theses defended in the context of WP 2 during the report period

- Nuria Fuster-Martinez, University of Valencia, July 2017

Refereed publications in the context of WP 2 during the report period

- R. Kieffer et al., "Optical Diffraction radiation for position monitoring of charged particle beams", NIM A 402, 88 2017
- R. Yang et al., "Numerical Investigation of Beam Halo From Beam Gas Scattering in KEK-ATF", J.Phys.Conf.Ser. 874 (2017) no.1, 012063
- R. J. Apsimon et al., "Design and operation of a prototype interaction point beam collision feedback system for the International Linear Collider", submitted to PRAB (December 13, 2017)

WP 2 Deliverables in the report period

- Month 24: D2.5 BeamSize-1 (submitted in April 2017)
- Month 36: D2.9 Wakefield-2 (submitted in January 2018)
- Month 36: D2.10 GM-2 (postponed to May 2018)
  The work on GM Feedforward on ATF2 has made progress since last GM-1 deliverable, in particular with good beam jitter reduction. This will be reported in the next GM-2 deliverable report. However, it will be delivered with three months delay, March 2018 (instead of December 2017). This is due to the recent change in collaborator. There was a need for transfer of experience to the new E-JADE participants because the previous collaborator's contract expired. The last 3 to 4 ATF2 beam time shifts dedicated to GM were used for training the newly hired personnel and contributors from CERN and from LAPP. In addition, these shifts were done in November and December (still ongoing) and there will be a little time needed to analyze the new data. A report in December is thus very difficult to write. Therefore, we would like to ask for additional time to write the GM-2 deliverable report.

WP 2 organised workshops

- ATF2 annual project meeting, CERN 14-15 March 2017
- ATF2 dedicated session at LCWS17, Strasbourg, 24 October 2017

1.2.3 Work package 3 "Linear collider targeted R&D"

WP 3 "Linear collider-targeted R&D" mainly addresses the site-specific optimisation of the ILC design and implementation. The work package has suffered significantly from a slower than expected ILC approval process in Japan since the beginning of E-JADE. Within WP 3 a fifth task called "Detector-related R&D and physics studies for the ILC" was implemented in Summer 2016 as an outcome of the midterm review in Santander (see below under 4).

The ILC development in general is urgently waiting for a "green light "from Japan. It was stated in various meetings that a statement from Japan is needed by the end of 2018, if the ILC is to be discussed in 2019 for the Update on the European Strategy for Particle Physics. In 2017, the staging discussion was dominating the overall ILC discussions, and it was proposed to start the ILC project with a scaled-down version of the accelerator with 250 GeV collision energy only and to extend it later to higher energies. The physics impact was studied thoroughly and several E-JADE members were part of the discussions and the final report. While the physics case is not as broad as the 500 GeV programme, the programme at 250 GeV is very competitive and strong and will provide e.g. unique measurements of the recently discovered Higgs boson. Overall the cost saving is about 30-40% compared to starting right away with a 500 GeV machine.

The Machine-Detector Interface (MDI) activities continue having their dedicated Mini workshops in Japan, where European and Japanese experts discuss many aspects of realizing the ILC detector halls in Japan. In 2017, these took place in May and September with on average 15 participants

The Experiments have started to further detail their requirements for the experimental halls and E-JADE was very instrumental in studying the impact of the recent parameter changes of the ILC accelerator which will increase the luminosity by 65 % but comes with the price of significantly higher machine backgrounds.

The collaboration – facilitated through EJADE – between KEK and DESY with respect to SRF R&D allowed a deeper understanding on the process of the so-called Nitrogen Infusion. A cost saving potential for future accelerators like the ILC is attributed to this process, as well as a fundamental new understanding of the relevant surface properties leading to high accelerating fields and low surface losses. This collaboration will be improved in the next year, after extensive preparations of the experiments, with an exchange of cavities between the institutes for a treatment. KEK just achieved the first infused cavity in Asia also based on the gained knowledge from this collaboration, and DESY will hopefully follow up next year.

For the development of a TPC for a linear collider, there is a growing exchange between the European experts especially at Saclay and DESY and KEK and there is an increasing activity also foreseen in 2018.

The European E-JADE groups are in regular exchange on physics studies for the ILC. European and Japanese groups delivered major inputs to the review of the physics potential of the 250 GeV initial stage of the ILC that was piloted by Michael Peskin of SLAC.

To further strengthen the physics case of the ILC and CLIC, the experts for top-quark physics from Europe and Japan continue having their dedicated workshops, the last workshop happened in Europe at CERN and the next one will be in Japan.

Finally, E-JADE has been instrumental in a study, that is producing an European Action Plan for the ILC, once there is a positive signal from Japan. There is a final draft, which has already been presented to CERN Council this September and will be used as an input for the upcoming European Strategy for Particle Physics, which will start in 2018.

Ph.D. theses defended in the context of WP 3 during the report period

- None

Publications in the context of WP 3 during the report period

- M. Wenskat et al., "Nitrogen Infusion R&D on Single Cells at DESY", proceedings of the 18th International Conference on RF Superconductivity, Lanzhou, China.
- M. Wenskat, "N-Infusion study at DESY", talk at the International Workshop on Future Linear Colliders (LCWS2017), Strasbourg, France, 23-27 October 2017.
- R. Poeschl, “Plans for ECAL at LCL”, talk at CALICE Meeting 25/9/17 - 27/9/17, University of Tokyo (supported by KEK)
- A.Schuetz, “Impact of the new ILC250 Parameter Sets on the SiD Vertex Detector Occupancy arising from e+ e- Pair Background”, talk at the International Workshop on Future Linear Colliders (LCWS2017), Strasbourg, France, 23-27 October 2017
- K. Fuji et al., “Physics Case for the 250 GeV Stage of the International Linear Collider”, DESY-17-155, KEK-PREPRINT-2017-31, LAL-17-059, SLAC-PUB-17161.
- K. Fuji et al., “The Potential of the ILC for Discovering New Particles”, DESY-17-012, KEK-PREPRINT-2016-60, SLAC-PUB-16916, LAL-17-017, MPP-2017-5, IFT-UAM-CSIC-17-008.
- Altogether 24 presentations in the two “Mini-Workshops on ILC Infrastructure …” listed below.

WP 3 Deliverables in the report period

- No deliverable was foreseen for this work package for this reporting period in the Grant Agreement.

WP 3 Supported workshops and conferences in reporting period

- International Workshop on Future Linear Colliders (LCWS2017), Strasbourg, 23-27 October 2017 (https://agenda.linearcollider.org/event/7645/overview).
- Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors, KEK/Tsukuba, 16 May 2017 (https://agenda.linearcollider.org/event/7611/).
- Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors, KEK/Tsukuba, 28/29 Sep 2017 (https://agenda.linearcollider.org/event/7665/).
- Further informal meetings with Japanese bodies and interested parties (Tohoku University, ILC Promotion Council of Ichinoseki, Association for Advanced Accelerators, Tohoku Chamber of Commerce, etc.)

1.2.4 Work package 4 "Management and dissemination"

This work-package covers **Task 4.1,** which is the **"Scientific and Financial Management"** (CERN & KEK) of the project. The management of the programme involves the organisation of programme events, managing the secondments of researchers and the financial planning, and execution and reporting to the EU. **Task 4.2** covers setting up "**CERN & KEK Offices"** (CERN & KEK). These are permanent offices at CERN and KEK, which support the researchers during the duration of their secondments. **Task 4.3** (CERN & KEK) covers the **"Communication"** of E-JADE achievements, experiences and results within the E-JADE programme and will ensure the most efficient sharing of knowledge and expertise of the seconded researchers. Finally, **Task 4.4** covers **"Dissemination"** (CERN & KEK). This involves setting up the public web pages and social media accounts as well as providing information for media and general public. The publication of results in scientific journal articles is also monitored.

For **Task 4.1** a key initial effort was the establishment of all workflows necessary for task 4.1 "Scientific and financial management" (including the deliverable 23 "Kickoff"). The E-JADE reports are also coordinated and executed based on the work within this task, likewise central E-JADE meetings and project follow-up. During the first part of 2017 the work to integrate new project members and initiate their secondments within the amended project plan from 2016 was a priority. During the second half of the year the LCWS 2017 in Strasbourg was a focusing point for the E-JADE project members.

For **Task 4.2** the CERN&KEK offices were established and started to execute their function (deliverable report 25 "CERNKEKOffices"). The initial plans of staffing the KEK office with E-JADE-seconded personnel could not be implemented due to administrative and eligibility constraints but solutions have been found using local staff funded outside E-JADE. The office supports the E-JADE secondees in matters related to integration locally, administrative and practical questions, and it also provides temporary desk space if needed.

For **Task 4.3** (CERN & KEK) the communication strategy of E-JADE is based almost entirely on the communication strategies and tools of the individual E-JADE partners (and their respective PR and communication departments), and the deliverable 28 "CommStrgy" outlines

the actions. The recent industry workshop in Strasbourg discussed below and the 2016 dissemination event in Morioka were both elements of the "CommStrgy". The public web pages for dissemination to the public and to all E-JADE colleagues were set up by month 3 of the project (deliverable 24 "PubWWW"). During 2017 the international web pages for the Linear Collider Collaboration were moved from Fermilab-US to CERN, increasing the collaborative efforts between Europe and Japan also in the communication and dissemination area. We expect that this will bring further results in 2018 related to the E-JADE communication efficiency and output as we have much easier access to news and information in particular for this area (WP3 and partly WP2).

The **Task 4.4** "Dissemination" comprises, among other things, the collection (on the E-JADE web pages) of E-JADE results and publications, of E-JADE contributions to conferences etc. These are being monitored and some of them appear as references in this report. During LCWS 2017 in Strasbourg an industry session with the title "Japanese-European Industrial Forum on Accelerator Technologies and Advanced Instrumentation for the Future Large-Scale Facilities (ILC/CLIC)" was especially important as it directly addresses industrial contributions to potential future projects in Japan and Europe, involving key industrial partners from both sides (agenda).

WP 4 deliverables in the report period

- Month 36: E-JADE-Report (this report)
- Month 36: E-JADESummary (postponed to July 2018)

WP 4 (co)organised events in the report period

- International Workshop for Future Linear Colliders (LCWS2018), Strasbourg, 23-27 October 2017 (industry session).

1.2.5 Work package 5 "Training and knowledge transfer"

Tasks in **WP 5 "Training and knowledge transfer"** are the setting up of a training programme for E-JADE secondments (**Task 5.1**), and the tools necessary for evaluation of the E-JADE impact (**Task 5.2**).

In 2017, there was not much central activity in WP5, besides the collection of information from the secondees, waiting to be evaluated for the final secondment report (deliverable KTTSummary).

WP 5 deliverables in the report period

- No deliverable was foreseen for this work package for this reporting period in the Grant Agreement.

1.3 Impact

The contribution of E-JADE to enhancing research- and innovation related human resources, skills and working conditions to realise the full potential of individuals travelling under the E-JADE scheme, and to provide them with new career perspectives, remains identical to the previous period. E-Jade contributes to enhance skills and working conditions to realise the full potential of individuals travelling under the E-JADE scheme, and to provide them with new career perspectives and networks, in a research and innovation domain.

2. Update of the plan for exploitation and dissemination of result (if applicable)

(Not applicable)

3. Update of the data management plan (if applicable)

(Not applicable)

4. Follow-up of recommendations and comments from previous review(s) (if applicable)

As alluded to above, under WP 4, the 2016 Santander midterm review lead to a number of recommendations concerning an update of the E-JADE secondment plans, tasks and objectives. Details can be found in the 2016 periodic report. 2017 was to a large extent devoted to implementing these changes in the project and to getting E-JADE back on track. In the following list we briefly describe the actions and the effects they so far had. The changes were defined in an amendment to the E-JADE grant agreement that took effect in early 2017.

- The suggestions for an **integration of industries into E-JADE** did not bear fruit, mainly because none of the projects pursued in E-JADE are currently in construction mode, which is the period where industry secondments are most relevant.
- A **widening of WP 2** by including **SuperKEKB final-focus activities** was very successful, both secondment-wise and concerning the scientific output.
- The newly introduced **task 3.5 on ILC-related detector activities** has already seen numerous WP 3 secondments, and more will come in 2018.
- Several new beneficiaries and partners were introduced into the consortium in order to complement the existing E-JADE expertise and help to fulfil all tasks. These partners are VINCA (Serbia), AGH-Cracow (Poland), Tel Aviv University (Israel), Liverpool University (UK), Université de Strasbourg (France), Université Paris-Sud (France) in Europe, and Tohoku University and Kyushu University (both Japan).

- A **re-working of the secondment plan**, taking into account the discovered problems, the new tasks and activities, and the new partners and beneficiaries.

As of March 2018, the secondment plan is found to be well on track. Depending on partners and work packages, up to 80% of planned secondments are already spent (some partners, however, will do most of their secondments only in 2018). So far, European E-JADE researchers have spent close to 4500 days in Japan!

5. Deviations from Annex 1 and Annex 2 (if applicable)

Minor changes to the grant agreement amendment dating from early 2017 are currently being collected. They include the suppression and new inclusion of a few researchers as secondees (mainly because of people leaving the E-JADE partners in the framework of normal career development steps) and a slight re-shuffling of secondment months between different partners and different work packages. Details will be discussed with the project officer once the plan is finalised.