Project Number: RISE 645479

Project Acronym: E-JADE

Project title: **E**urope-**J**apan **A**ccelerator **D**evelopment **E**xchange Programme

Periodic Technical Report

Part B

Period covered by the report: from 01/01/2015 to 31/12/2016

Periodic report: 1st

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

- Explain the work carried out during the reporting period in line with the Annex 1 to the Grant Agreement.
- Include an overview of the project results towards the objective of the action in line with the structure of the Annex 1 to the Grant Agreement including summary of deliverables and milestones, and a summary of exploitable results and an explanation about how they can/will be exploited.

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 so far two prominent Japanese partners, KEK and University of Tokyo 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. Key objectives beyond technical progress are related to sharing of technical knowledge, project organisation, etc. to significantly advance these projects.

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 and are by now implemented (new tasks, new beneficiaries and partners as of 1 January 2017, updated secondment plan). These will be described towards the end of this document.

The **overall progress of E-JADE towards its objectives** is good; all work packages have picked up speed and are progressing well. So far, all milestones (except one that was shifted) have been reached, albeit some with some delay, and secondments are executed according to the secondment plan. The perspectives for impact remain excellent. Details are described in the text below.

The impact of E-JADE, and the exploitation of its results, is already 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, one major area benefitting from E-JADE is the LHC and studies for its upgrade in Europe, where Japanese participation and contributions are very significant. The secondments from Japan to Europe are very important, and secondments from Europe to Japan to collaborate and provide support to the Japanese developments for future European accelerator facilities are crucial. E-JADE already has a major impact in positioning Europe to be a major player in the upcoming ILC project in Japan. This is underlined by the fact that E-JADE has been asked by CERN and KEK management to draft a study about a potential European involvement in the ILC. Given the scale of ILC project, major parts have to be produced in industry. Studies of the industrialisation of key components have already been performed, supported for example by the AAA (Advanced Accelerator Association Promoting Science and Technology) in Japan. As the European XFEL has just been completed and is technology-wise a 10% prototype for the ILC, European industry is already well positioned to mass-produce accelerator structures like the superconducting RF structures for the ILC once the machine has been approved in Japan. Finally, the European participation in the ATF2 studies in Japan provide not only access to a unique accelerator research facility in Japan, but also a unique training ground for young researches, and E-JADE has significantly strengthened the European exploitation of this facility.

1.1 Objectives

List the specific objectives for the project as described in section 1.1 of the DoA and describe the work carried out during the reporting period towards the achievement of each listed objective. Provide clear and measurable details.

In this section, 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.

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 in general 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 operation and other activities of the ATLAS experiment and the construction, test and re-assembly of the D1 short prototype beam separation dipole magnet. Some discrepancy between planned and actually executed secondments has, however, arisen during the first two E-JADE years, for reasons discussed in the progress report of May 2016. These issues are overcome with a new secondment plan that will be effective as of the following reporting period (see below under 4.).

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. In the course of the grant agreement amendment at the end of 2016, work package 2 took up additional activities that are described below.

Important achievements of WP 2 are the assessment of the role of higher-order aberrations for the beam size, a significant reduction of the number of wakefield sources at the ATF2, progress towards the realisation of a ground motion feed-forward system, simultaneous beam size and halo measurements, and an improved performance of the FONT intra-train beam-feedback system.

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 appropriate mitigation steps have been implemented, as will be detailed below.

Nevertheless, within WP 3, a number of significant results and progress steps could be realised, among them significant contributions to the adaption of the ILD and SiD designs and intended assembly procedures to the site-specific conditions in Kitakami, studies on ground motion and earth-quake stability, and first contacts with Japanese industry on the construction of large coils (e.g. for the ILD detector). Furthermore, E-JADE is managing the organisation of a European Action Plan, matching the KEK action plan and acting as a blue print for a potential European contribution to the project in case of "green light". Also work on superconducting RF cavities is progressing well in the collaboration between Europe, Japan, and the US, supported by E-JADE. Likewise, studies of high-gradient normal-conducting structures at KEK, built in Japan and by Asian partners for the CLIC project, have provided important results.

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, adaptive steps have been devised (see below under 1.2.4 and 1.2.5).

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. We will not distinguish the work carried out by each of the individuals as the work within each work package is achieved by teams working hand in hand in the spirit of an international physics collaboration. The list of institutes contributing to each work package will however be mentioned in the paragraphs below.

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

Explain the work carried out in WP1 during the reporting period giving details of the work carried out by each beneficiary involved.

The LHC accelerator is currently in full operation, and Japanese researchers participate in operation, analysis and upgrade projects for both the accelerator and the 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 (HL-LHC). 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.

In detail, and spelling out the high-level goals given in section 1.1 above, the objectives of WP 1 are the following:

- Execution of an intensified Japanese programme at LHC in preparation for future accelerator programmes;
- advancement of the preparation for and execution of the European-Japanese collaboration on the high-luminosity LHC upgrade and the associated R&D;
- strengthening of the R&D on high-field magnets and RF systems for future or upgraded energy- and/or intensity-frontier hadron machines.

There are three tasks in WP 1. **Task 1.1 "LHC operation and analysis"** (CERN, KEK & UoT) aims at supporting Japanese efforts in the operation of LHC machines and detectors at full energy; the task is expected to provide important guidance for future accelerator developments in Europe and Japan. **Task 1.2 "The HL-LHC project"** (CERN & KEK) focuses in particular on the engineering design and validation of two short prototype separation superconducting dipoles (D1) for the upgraded LHC insertion regions. Within **Task 1.3 "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 is performed. Other technologies of special interest for WP 1 are wideband cavities using magnetic alloy, solid-state amplifiers and low-level RF. Since most of the activities related to WP 1 take place in Europe, this work package is the one predominantly benefitting from secondments from Japan to Europe in the framework of E-JADE. Each task includes the goals of training and transfer of knowledge.

For Task 1.1, Japanese researchers take leading roles in the ATLAS experiment: operation, data analysis and physics studies. Long stays at CERN are essential for this work, and E-JADE secondments from Japan to CERN an important element of this activity.

In Task 1.2, the collaboration between CERN and KEK for the high-luminosity upgrade is concentrated around the beam separation dipole magnets D1. The efforts in the years 2015 and 2016 have focused on producing and testing a 2 m long model magnet. This prototyping study was regularly supported by visits from CERN to Japan, and the coordination of practical and technical issues has been consistently been arranged as E-JADE secondments. An important milestone was reached with the construction of a mechanical short model of the magnet (see figure 1). This D1 prototype showed instabilities at the highest currents and has recently been re-assembled at increased pre-stress levels, preparing for colds tests in 2017.

Figure 1: D1 test magnet being assembled.

For Task 1.3, three activities are supported by E-JADE. One key activity at KEK, with support from CERN, is the consolidation and upgrade of the CERN PSB RF systems, with the aim of using wideband multi-harmonic solid-state-driven magnetic alloy loaded cavities, and the development and installation of a longitudinal damper in the CERN PS. Secondly, based on research and development on crab cavities for the LHC high-luminosity upgrade, cooperative work between KEK and CERN aims to develop state-of-the-art surface treatment techniques for high-field superconducting crab cavities that deflect beam bunches in order to realize the crab crossing for the LHC accelerator high-luminosity upgrade. Finally, in the context of the CERN-lead FCC study, E-JADE secondments have been used to initiate studies on Nb_3Sn magnets and on HTS magnet R&D for extreme fields, carried out between CERN, KEK, and Japanese university and industry partners.

Status reports on WP 1 tasks (December 2016):

- Task 1.1, ATLAS upgrade:
    - https://indico.cern.ch/event/579735/contributions/2349639/attachments/1387508/2112135/CERN-KEK_hanagaki.pdf
- Task 1.2, HiLumi project:
    - https://indico.cern.ch/event/579735/contributions/2349631/attachments/1387590/2112316/20161213D1_NakamotoCERNKEKfinal.pdf
- Task 1.3 LiU and general magnet R&D:
    - https://indico.cern.ch/event/579735/contributions/2349641/attachments/1387593/2114129/2016KEK_Participation_in_LIU_V3.pdf
    - https://indico.cern.ch/event/579735/contributions/2349636/attachments/1387535/2112190/FACSCM_Dev_In_Japan20161213.pdf

- o https://indico.cern.ch/event/579735/contributions/2349640/attachments/1386542/2110210/CERN-KEK_Yamaguchi.pdf

Publications in the context of WP 1 during the report period

- G. Aad, M. Aoki, K. Nagano, K. Nakamura,, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *Combined Measurement of the Higgs Boson Mass in pp Collisions at √s = 7 and 8 TeV with the ATLAS and CMS Experiments*, Phys. Rev. Lett. 114 (2015) 191803.
- G. Aad, M. Aoki, K. Nagano, K. Nakamura,, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *Evidence for the Higgs-boson Yukawa coupling to tau leptons with the ATLAS detector*, JHEP 10.1007 (2015) 117.
- G. Aad, M. Aoki, K. Nagano, K. Nakamura,, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *Observation and measurement of Higgs boson decays to WW* with the ATLAS detector*, Phys. Rev. D 92 (2015) 012006.
- G. Aad, M. Aoki, K. Nagano, K. Nakamura,, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *Performance of the ATLAS muon trigger in pp collisions at sqrt(s) = 8 TeV*, Eur. Phys. J. C 75 (2015) 120.
- G. Aad, M. Aoki, K.Nagano, K. Nakamura,, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *Identification and energy calibration of hadronically decaying tau leptons with the ATLAS experiment in pp collisions at √s = 8 TeV*, Eur. Phys. J. C75 (2015) 7, 303.
- K. Nakamura, Y. Takubo and Y. Unno et al., Irradiation and Testbeam of KEK/HPK Planar p-type Pixel Modules for HL-LHC, Journal of Instrumentation 10 06 (2015) C06008.
- Y Yang, M Yoshida, T Ogitsu, Y Makida, T Nakamoto, T Okamura, K Sasaki and M Sugano, *Influence of neutron irradiation on conduction cooling superconducting magnets*, IOP Conf. Series: Materials Science and Engineering 101 (2015).
- T. Nakamoto, M. Sugano, Q. Xu, H. Kawamata, S. Enomoto, N. Higashi, A. Idesaki, M. Iio, Y. Ikemoto, R. Iwasaki, N. Kimura, T. Ogitsu, N. Okada, K. Sasaki, M. Yoshida, E. Todesco, *Model Magnet Development of D1 Beam Separation Dipole for the HL-LHC Upgrade*, IEEE Transactions on Applied Superconductivity, Volume 25, Issue 3, 2015, 4000505.
- M. Sugano et al., *Field Quality and Mechanical Analysis of the Beam Separation Dipole for HL-LHC Upgrade*, IEEE Transactions on Applied Superconductivity, Volume 25, Issue 3, 4001105, 2015.
- 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, 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.
- C. Ohmori et al., *Development of a high gradient rf system using a nanocrystalline soft magnetic alloy*, Phys. Rev. ST Accel. Beams 16, 112002.
- T. Mitsuhashi et al., *Design of coronagraph for the observation of beam halo at LHC*, Proc. IBIC2015, p288-292, 2015.
- M. Ady, P. Chiggiato, R. Kersevan, Y. Tanimoto, and T. Honda, *Photodesorption and Electron Yield Measurements of Thin Film Coatings for Future Accelerators*, in Proceedings of the 6th International Particle Accelerator Conference, Richmond, VA, USA, 2015, pp. 3123-3126.

- T. Mitsuhashi, *Recent trends in beam size measurements using the spatial coherence of visible synchrotron radiation*, Proc.IPAC2015, p3662-3667.
- G. Aad, M. Aoki, K. Nagano, K. Nakamura, Y. Takubo, K. Tokushuku, S. Tsuno, Y. Unno et al. [ATLAS Collaboration], *ATLAS Phase-II Upgrade Scoping Document*, CERN-LHCC-2015-020.

WP 1 Deliverables in the report period

There were no deliverables for WP 1 in the reporting period.

WP 1 secondments per task

- Task 1.1: S. Stapnes
- Task 1.2: A. Musso
- Task 1.3: F. Zimmermann, J. Charles, A. Marton, M. Benedikt, S. Mattei

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

WP 2 covers the programme at the Accelerator Test Facility (ATF2) at KEK operating an electron damping ring with ultra-low transverse emittance. ATF2 is a low-energy scaled version of a future linear collider (ILC, CLIC) final focus beam line where the ATF2 beam is extracted to test the complex beam handling techniques planned at the IP. The main objective of this work package is to demonstrate solutions and methods for final focus systems for future linear colliders so as to meet their performance goals. The operation and R&D program are managed by an international team involving all the E-JADE partners.

There are **six main tasks** in this work package: **Task 2.1 "Beam size minimization"** (CERN, CNRS, KEK & UoT) is responsible for evaluating and implementing optical tuning to produce the smallest possible beam size at the IP. **Task 2.2 "Wake field"** (CERN, CSIC, KEK & RHUL) studies beam size enhancements from EM wake field sources, theoretically and experimentally, as well as mitigation techniques. **Task 2.3 "Ground motion"** (CERN, CNRS & KEK) measures ground motion and mitigation techniques thereof, including feed-forward procedures. **Task 2.4 "Halo collimation and backgrounds"** (CNRS, CSIC, KEK & RHUL) is in charge of evaluating and controlling beam halo, in view of mitigating backgrounds. **Task 2.5 "Beam instrumentation and control"** (CNRS, KEK, RHUL, UOXF & UoT) is responsible for the operation and improvements of the instrumentation used to measure beam parameters. **Task 2.6 "Beam Position Feedback"** (KEK & UOXF) is in charge of designing, implementing and optimizing fast intra-train feedback at the interaction point. Each task includes the goals of training and transfer of knowledge.

All ATF2 teams have been very active in 2015-2016, in spite of a reduction in number of beam operation weeks caused by budgetary constraints at KEK (11 in 2015 and 17 in 2016, instead of the usual 20-21 weeks/year), which resulted in fewer than expected visits to KEK by European scientists. The work is reviewed on a regular basis, in weekly operation and planning meetings, chaired by a KEK staff, and attended both locally and remotely (via web-conference tools). More in-depth reviews also took place at our annual project meeting, which were hosted in February 2015 by LAPP-Annecy and in January 2016 by LAL-Orsay, at the premises of the two teams of the CNRS partner. At international conferences or workshops dedicated to linear colliders, a session of half a day to one day is usually also dedicated to ATF2. This was the case both in 2015 and 2016, at the International Workshops on Future Linear Colliders, at Whistler, BC, Canada (LCWS15) and at Morioka, Japan (LSWS16), as well as at the CLIC annual workshops, at CERN, Switzerland. In 2016, a session was also dedicated to ATF2 at the ECFA Linear Collider Workshop in Santander, Spain.

For Task 2.1, while vertical beam sizes close to 40 nm are routinely achieved at low intensity, demonstrating suitable correction of ILC-like chromaticity, further beam size reduction is limited by wake fields, beam jitter and residual optical non-linearity. There was significant progress in 2015 and 2016 assessing the role of higher-order aberrations, through experiments with different β parameters at the IP, both horizontally and vertically, including with reduced values to represent the more ambitious CLIC-like chromaticity. Moreover, improved techniques to experimentally evaluate and correct IP β parameters were developed, based on optimized waist-scanning and measuring the effects of propagating artificially generated beam jitter. Mechanisms enhancing growth in effective beam size from jitter in the presence of wake fields were also explored. A significant reduction in the number of wake field sources was achieved in 2016 by removing many non-essential beam position monitors and by implementing RF-shielding on bellows. Prospects for the coming year are more complete evaluation of performances with a reduced IP vertical β parameter, in particular using a set of new octupole magnets that were just installed at the end of 2016 to correct aberrations, and investigation of improved beam sizes with higher intensities, profiting from the reduced number of wake field sources (Task 2.2) as well as by suppressing jitter with feedback techniques (Task 2.6). The delivery report "BeamSize-1", due in December 2016, was postponed to March 15, 2017 to enable including experimental results with the two installed octupoles. In 2015-2016, two Early Stage Researchers have been seconded from CERN to KEK in the context of Task 2.1: Marcin Patecki and Fabien Plassard.

For Task 2.2, intensity-dependent effects on the beam size across the ATF2 line, as well as at the IP, observed consistently since ATF2 started operation and limiting the achievement of 40 nm beam sizes to low beam intensities, have been studied using beam-based alignment techniques already successfully tested elsewhere (e.g. Wakefield-Free Steering, WFS, tests at SLAC). Preliminary tests were performed in 2015 in the extraction line of ATF2, where the lattice is linear, showing the expected behavior. The non-linear parts of the ATF2 lattice, especially the final focus system (FFS), have also been analyzed. In 2016, a comprehensive review of all wake field related effects and their impact on the beam transport, including enhancement through beam jitter, was pursued. It was found that a significant reduction in the number of wake field sources could be achieved by removing many non-essential beam position monitors and by implementing RF-shielding on bellows. This led to the observation of a reduced IP beam size intensity dependence of about a factor 0.3-0.5 in comparison with the factor 0.5 which was expected from calculations. In addition, a campaign of wake field measurements dedicated to evaluating the impact on the orbit of the newly installed vertical collimation system (designed and constructed in 2015 by CNRS and CSIC, and installed at the beginning of 2016, see Task 2.4) was successfully conducted. Good consistency with simulations based on the 3D EM solver CST PS and the tracking code PLACET was found. In 2015-2016, one Early Stage Researcher and two Experienced Researchers have been seconded from CSIC and RHUL to KEK in the context of Task 2.2: Nuria Fuster-Martinez, Angeles Faus-Golfe and Jochem Snuverink.

For Task 2.3, using two of the 14 ground motion (GM) sensors installed along the extraction line and final focus, the vibration of one of the final-doublet quadrupoles was studied, showing clear evidence for detrimental mechanical resonances. After careful evaluation, an improved mechanical support was designed, built and sent to Japan for installation under the quadrupole. This new support has less sensitivity to vibration sources and reduces displacement amplitudes by factors of 4 and 6 in the vertical and horizontal direction, respectively. While several other vibration effects were also successfully dealt with in the rest of the beam line, an intermittent source sometimes appears at 16.5Hz, affecting critical elements. Identification of this source will have to be addressed in the coming year. In parallel, significant progress was also made towards realizing a GM feed-forward system. The potential performance of the system in terms of jitter reduction was greatly improved through the discovery that the quality of the fit between the beam position reported by the BPMs and that predicted from the ground motion sensors is greatly enhanced if the GM sensors are placed directly on top of the quadrupoles during data acquisition. The quality of this fit was further increased by optimizing the characteristics of the digital filter to be applied in real-time to the GM data. In addition, the new hardware required for use as the processor for the feed-forward system was acquired and has been installed and tested successfully at ATF2. Extensive studies for optimal control parameters have been done, in particular an optimization of the band pass filter parameters. A 0.2 Hz high-pass filter gave a beam jitter reduction of 15% compared to when the feedforward is off, corresponding to several micrometres. Feasibility has thus been demonstrated.

For Task 2.4, simultaneous beam size and halo measurements were performed in 2015-2016, using a set of new large dynamic range single crystal CVD diamond sensor scanners designed and installed a few meters after the IP. Measurement data were collected and analyzed for different optical demagnifications and vacuum pressures in the ATF2 damping ring. By modelling the beam halo and its propagation along the beam line, the influence of the optical demagnification was confirmed. Beam halo levels recorded for different vacuum pressures also showed a clear dependence, confirming beam-gas scattering as the dominant beam halo generating mechanism. Explicit tracking of elastic and inelastic scattering of beam electrons off residual gas molecules in the presence of synchrotron radiation damping and quantum excitation provided consistent estimates of beam tail formation in the damping ring, which compare well with predictions from an analytical model, reproducing in particular the inverse cubic dependence of the halo distribution with respect to the transverse phase space coordinates obtained when integrating the differential cross section of the Coulomb scattering process. Good agreement with the experimental data was also obtained after implementing a calibration procedure to overcome known saturation effects in the diamond sensor. In parallel, a retractable vertical beam halo collimation system was designed and constructed for the FFS of ATF2, to control the vertical beam halo near the interaction point of ATF2, and thereby reduce the rate of bremsstrahlung photons in the instrumentation used to measure the nanometre beam size. Simulations based on MADX and PLACET enabled us to optimize the system's location in the final focus and to study its performance as collimator. The installed device was shown to be efficient to collimate the vertical beam halo. Moreover, the beam line and interaction region were modelled with the GEANT4-based BDSIM toolkit. The relative reduction with respect to collimator aperture in the rate of simulated bremsstrahlung photons at the photon collimator used to control the background in the beam size measurement showed very good consistency with the actually measured background reduction. In 2015-2016, one Early Stage Researcher, three Experienced Researchers and three Technical Staff have been seconded from CSIC and CNRS to KEK in the context of Task 2.4: Nuria Fuster-Martinez, Viacheslav Kubytskyi, Hayg Guler, Philip Bambade, Frédéric Bogard, Patrick Cornebise and Sandry Wallon.

For Task 2.5, two of the main instruments used to measure beam parameters, the C-band Beam Position Monitors (CBPM) and Interaction Point Beam Size Monitor (IP-BSM), were successfully upgraded in 2015 to enable separately measuring subsequent bunches extracted from the ATF2 damping ring with separations of 180-200 ns. These improvements have allowed using feedback to reduce position jitter at the IP (Task 2.6), which is important for beam size minimization (Task 2.1). In the coming years, this new capability may enable measuring small beam sizes with larger bunch populations than presently achieved. Improvements to other instruments have also been pursued, e.g. for the diamond sensor scanners used for halo measurements after the IP (Task 2.4), several calibration schemes were implemented and compared in 2016, to take into account saturation effects affecting the signal collection, which depress the beam core and strongly bias the determination of its standard deviation later used as normalization for the transverse coordinate. Thanks to such improved calibrations, the full dynamic range of 10^6 could be exploited for the first time without biasing the profiles. This was important to obtain agreement between the measurements and theoretical modelling. A new optical diffraction + transition radiation combined measurement station was also installed, commissioned and tested in 2016. These two new instruments are designed to allow non-invasive beam size measurements down to tens of microns and high-resolution measurements for sub-micron beam sizes, analysing the collected diffraction and transition radiation, respectively. First results with the diffraction radiation show that it is possible to see 2D images of the angular patterns for different beam sizes. Sensitivity down to 20-30 micrometres using the diffraction radiation was demonstrated. The transition radiation was used to evaluate beam emittances using the quadrupole scanning technique, with minimum beam sizes of 600 nanometres. More detailed studies to improve the performance of both the diffraction and transition radiation monitors are foreseen for the next operational year. For the latter, a new grated target will be used. In 2015-2016, five Experienced Researchers and two Early Stage Researchers have been seconded from CERN and RHUL to KEK in the context of Task 2.5: Pavel Karataev, Emi Yamakawa, Konstantin Kruchinin, Lawrence Nevay, Stefano Mazzoni, Michele Bergamaschi and Tom Vaughan.

For Task 2.6, significant progress has been made in the performance of the FONT ATF2 'upstream' intra-train beam-feedback system. This system comprises two coupled feedback loops incorporating two pairs of stripline BPMs and stripline kickers. In 2015 a paper was published reporting on the achievement of real-time, single-shot BPM resolution of less than 300 nm for a bunch charge of 1 nC.

Such a performance is unprecedented for stripline BPMs operating in this mode and meets the BPM resolution requirement for the ILC IP feedback system. The total signal processor latency (140 ns) moreover meets the ILC latency requirement for all currently-envisaged ILC bunch spacings. The upstream feedback system has been used to stabilise the ATF2 beam in the y,y' phase space, and the feedback performance has been verified in terms of the beam jitter measured in a stripline BPM about 30 m downstream of the feedback. The jitter correction ratio of about a factor of 3 in-loop, down to the BPM resolution limit, is preserved downstream, which confirms the understanding of the beam transport in this part of the ATF2 lattice. Additional vertical beam jitter was deliberately introduced upstream and the FONT system was activated to remove the jitter, while monitoring the corresponding apparent beam size measured at the ATF2 IP using the Shintake monitor. The FONT system was able to reduce the apparent measured IP beam size down to a value limited by the corresponding FONT BPM resolution. These measurements are significant in demonstrating unambiguously the potential influence of upstream beam jitter on the measured IP beam size, and they allow upper limits to be set on the contribution of beam jitter to the apparent IP beam size. In 2016, a feedback loop was also implemented directly at the IP, using a set of three C-band cavity BPMs and a kicker located immediately upstream of the final doublet. First tests with this dedicated IP feedback enabled reducing the vertical beam jitter from an r.m.s. deviation of 420 nm to 74 nm. This compared well with the estimation of what could be reached with feedback, based on the uncorrected jitter levels and correlations between bunches, which gave 79 nm with an average individual BPM position resolution of 50 nm. Further measurements and optimization are planned to improve the performances and fully characterize the IP feedback in next two years. In 2015-2016, two Early Stage Researchers and four Experienced Researchers have been seconded from UOXF to KEK in the context of Task 2.6: Talitha Bromwich, Rebecca Ramjiawan, Ryan Bodenstein, Philip Burrows, Glenn Christian, Neven Blaskovic Kraljevic.

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

- Neven Blaskovic Kraljevic, Oxford University, June 2015
- Shan Liu, Université Paris Sud – Orsay, July 2015
- Oscar Blanco, Université Paris Sud – Orsay, July 2015
- Lorraine Bobb, Royal Holloway University London, May 2016

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

- R.J. Apsimon et al., *Performance of a high resolution, low latency stripline beam position monitor system*, Phys. Rev. ST Accel. Beams 18 (2015) 032803.
- S. Liu et al., *In vacuum diamond sensor scanner for beam halo measurements in the beam line at the KEK Accelerator Test Facility*, Nucl.Instrum.Meth. A832 (2016) 231-242.
- M. Patecki et al., *Probing half β_y* optics in the Accelerator Test Facility 2*, Phys. Rev. Accel. Beams 19 (2016) 101001.

- A. Faus-Golfe et al., *Emittance reconstruction from measured beam sizes in ATF2 and perspectives for ILC*, Nucl. Instrum. Meth. A819 (2016) 122-138.
- J. Snuverink et al., *Measurements and simulations of wakefields at the Accelerator Test Facility 2*, Phys. Rev. ST Accel. Beams 19 (2016) 091002.
- T. Aumeyr et al., "Advanced simulations of optical transition and diffraction radiation", Phys. Rev. ST Accel. Beams 18 (2015) 042801.
- B. Bolzon et al., *Very high resolution optical transition radiation imaging system: Comparison between simulation and experiment*, Phys. Rev. ST Accel. Beams 18 (2015) 082803.
- A. Aryshev et al., *Monochromaticity of coherent Smith-Purcell radiation from finite size grating*, Phys. Rev. Accel. Beams 20 (2017) 024071.

WP 2 Deliverables in the report period

- Month 12 – HaloCollBgds-1
- Month 12 – Instr-1
- Month 18 – GM-1
- Month 24 – Instr-2
- Month 24 – Wakefield-1
- Month 24 – Feedback-1
- Month 24 – BeamSize-1 (postponed to March 15, 2017)
- Month 24 – HaloCollBgds-2

WP 2 secondments per task

- Task 2.1: M. Patecki, F. Plassard
- Task 2.2: N. Fuster-Martinez, A. Faus-Golfe, J. Snuverik
- Task 2.4: N. Fuster-Martinez, V. Kubytskyi, H. Guler, P. Bambade, F. Bogard, P. Cornebise, S. Wallon
- Task 2.5: P. Karataev, E. Yamakawa, K. Kruchinin, L. Nevay, S. Mazzoni, M. Gergamaschi, T. Vaughan
- Task 2.6: T. Bromwich, R. Ramjiawan, R. Bodenstein, P. Burrows, G. Christian, N. Blaskovic Kraljevic

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.).

WP 3 members participated strongly in the last E-JADE meeting, which was held in conjunction with the LCWS 2016, a working meeting for Linear Colliders hosted by KEK in Morioka, Japan. The WP 3 members are also driving the "European Action Plan for the ILC", which is a blue print for a European engagement in the ILC, once Japan gives a green light.

Task 3.1 "EDMS" is the one most affected by the ILC delay (see **deliverable report 17 "EDMSReqUser"**). However, as envisaged, there have been low-level discussions between E-JADE members and experts in Japan, supported by secondments from DESY (B. List).

For **Task 3.2 "Machine and detector integration",** E-JADE enabled sizable European participation in the bi-annual series of MDI/CFS workshops that covered a lot of site-specific aspects of the ILC. They provided a great forum to exchange information with local Japanese experts (the workshops took place in August 2015, March 2016 and September 2016; the next one is planned for May 2017). The support from E-JADE was essential for these workshops.

A first key subject was the location of the interaction region and he geological and practical implications ranging from available hall space to transport issues. Both SiD and ILD have adapted their designs to meet the realities of transporting large and/or heavy pieces of detectors in the Kitakami mountain range. Assembly scenarios play an important role for the final layout of the IP surface area (hall space / crane capacities). Both SiD and ILD have presented detailed scenarios for the detector assembly at the Kitakami site. This is embedded within the Japanese effort to choose an optimal layout for the entire ILC site. This includes detailed studies of calorimeter assembly, overall studies of the assembly strategies, where SiD and ILD have presented quite different approaches down to detailed studies of the gantry cranes being required to lower the detectors. There have also been studies on the impact of earthquakes on the detector structures, detailed reports on the available cryogenic infrastructures and also first interactions with the Japanese industry on making large coils or steel structures. The final focus magnets and their integration into the detectors was another import point that has been discussed. Thanks to the close integration with our Japanese partners, also several visits were possible including the detector IP and also the Horonobe Underground Research Center, which studies deep underground installations e.g. for long-term storage of nuclear waste.

Finally, E-JADE participated in the studies defining the needs for the ILC Campus/Main lab, in terms of services needed, the infrastructures required using the experience from European Labs like CERN or DESY. All activities have been supported by E-JADE secondments.

With the ongoing cavity assembly and testing at DESY and CEA for the European XFEL, the activities of **Task 3.3 "SRF"** had previously focused on extracting the "lessons learned" from this exercise. The XFEL represents roughly a tenth of the ILC, and cavity production is happening in industry. There have been frequent visits of KEK experts, while we expect that visits to Japan will significantly ramp-up once the ILC project moves ahead.

Within E-JADE there is now a growing collaboration with KEKs concerning R&D on superconducting RF cavities. The discovery of the reduction of the surface resistance in the cavities after a specific nitrogen treatment has raised many questions. Since DESY, as well as KEK, try to reproduce this experiment, a joint effort (supported by E-JADE secondments) will lead to a better understanding of this process and to the identification of key parameters of the experimental set ups in the two labs. In addition, a technology transfer on cavity testing started between DESY and KEK, which was coordinated by E-JADE. The secondments helped to improve the experimental stability, deepened the understanding and fostered the collaboration between DESY and KEK. The upcoming secondments are devoted to improve the repeatability and stability of the process, which would allow a transfer to industry.

In **Task 3.4 "LC optimization"** there has been a growing collaboration between positron source experts in Europe and Japan who are currently defining common projects with extended periods of work in Japan. With the stress of the Nomura report, which was published in 2016, on the reliability of the positron source there has been an increasing activity between European groups and Japan, with secondments being planned for 2017.

There is a long-standing collaboration between Europe and KEK on the development and testing of 12 GHz copper RF structures for use at a CLIC-based linear collider. These structures are manufactured in Japan, China and Europe and tested both at KEK and CERN. During 2015-16, the two test stands have been used to characterise travelling wave CLIC accelerating structures (of the T24 and TD24 series) and an X-Band deflector produced by SINAP (Shanghai), as well as standing wave cavities for more specific structure studies, produced both in Japan and at Tsinghua University (Beijing). Travels from KEK to CERN and vice versa for coordination and scientific discussions of results and future plans are all supported by E-JADE funds, which have proven essential for carrying out a well-coordinated programme.

In the new **Task 3.5 "Detector-related R&D and physics studies for the ILC**" (see below) the activity has been ramping up, especially in the area of physics studies supporting the detector design. E-JADE participants strongly contributed to the workshop on top-quark physics at the LC 2016, to give an example. Also there was an ongoing activity to study in particular the implications of beam-beam interactions and polarization on both ILC detectors and physics impact. One of the questions being raised during ILC reviews was the impact of ILC machine and detector design on the discovery potential of the ILC, and there has been an ongoing collaboration on this subject funded by E-JADE.

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

- Oskar Hartbrich, Bergische Universität Wuppertal, July 2016.

Publications in the context of WP 3 during the report period

- T. Barklow et al., *A Study of the Impact of High Cross Section ILC Processes on the SiD Detector Design*, arXiv:1609.07816v1.
- A. Schütz, *Pair Background Envelopes in the SiD Detector*, Proceedings of LCWS16 Morioka 2016 (in preparation)
- A. Schütz, L. Keller and G. White, *A Study of the Impact of Muons from the Beam Delivery System on the SiD Performance*, Proceedings of LCWS16 Morioka 2016 (in preparation)
- K. Büsser et al., *Towards a site-specific ILC design*, PARTICLE PHYSICS 2014 Highlights and Annual Report DESY, Apr 2015, ISBN: 978-3-935702-97-3 doi: 10.3204/DESY_AR_ET2014
- X. Wu et al., *High-gradient breakdown studies of an X-band Compact Linear Collider prototype structure*, submitted to Phys.Rev.ST-AB, 2016.

- T. Abe et al., *High-Gradient Testing of Single-Cell Test Cavities at KEK/Nextef*, 13th Annual meeting of Particle Accelerator Society of Japan, MOP015, p.348, Japan, 2016, http://www.pasj.jp/web_publish/pasj2016/proceedings/PDF/MOP0/MOP015.pdf.
- X.W. Wu et al., *High-Gradient Properties of A CLIC Prototype Accelerating Structure Made by Tsinghua University*, Proceedings of IPAC2016, THPOR041, Busan, Korea, 2016, http://accelconf.web.cern.ch/AccelConf/ipac2016/papers/thpor041.pdf.
- X.W. Wu et al., *High-Power Test of X-Band Single Cell HOM-Free Choke-Mode Damped Accelerating Structure Made by Tsinghua University*, Proceedings of IPAC2016, THPOR043, Busan, Korea, 2016, http://accelconf.web.cern.ch/AccelConf/ipac2016/papers/thpor043.pdf.
- T. Higo et al., *High-gradient performance of travelling-wave accelerator structures targeting 100MV/m*, 12th Annual meeting of Particle Accelerator Society of Japan, WEP047, p.553, Tsuruga, Japan, 2015, http://www.pasj.jp/web_publish/pasj2015/proceedings/PDF/WEP0/WEP047.pdf.
- T. Abe et al., *Basic Study on High-Gradient Accelerating Structures at KEK/Nextef*, 12th Annual meeting of Particle Accelerator Society of Japan, WEP060, p.607, Tsuruga, Japan, 2015, http://www.pasj.jp/web_publish/pasj2015/proceedings/PDF/WEP0/WEP060.pdf.

WP 3 Deliverables in the report period

- Month 6 – EDMSReqUser
- Month 18 – ILCRep

WP 3 secondments per task

- Task 3.1: B. List
- Task 3.2: K. Buesser, U. Schneekloth, T. Schörner-Sadenius, A. Schuetz, K. Sinram, F. Sefkow, M. Stanitzki, R. Stromhagen, R. Poeschl, S. Wallon, H. Guler, I. Chaikovska, , P. Burrows, R. Bodenstein,
- Task 3.3: M. Wenskat
- Task 3.4: P. Gomis Lopez, M. Perello Resello, M. Vos
- Task 3.5: M. Titov, P. Colas, M. Berggren, S. Lehtinen, S. Ganjour

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.

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 seconded related to integration locally, administrative and practical questions and 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 and dissemination event in Morioka, both discussed below, were 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”).

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.

As examples of communication and dissemination actions, three examples can be mentioned.

At the Japan Science Agora in November 2015, E-JADE featured on a stand planned with KEK together with the EU delegation in Tokyo (figure 2).

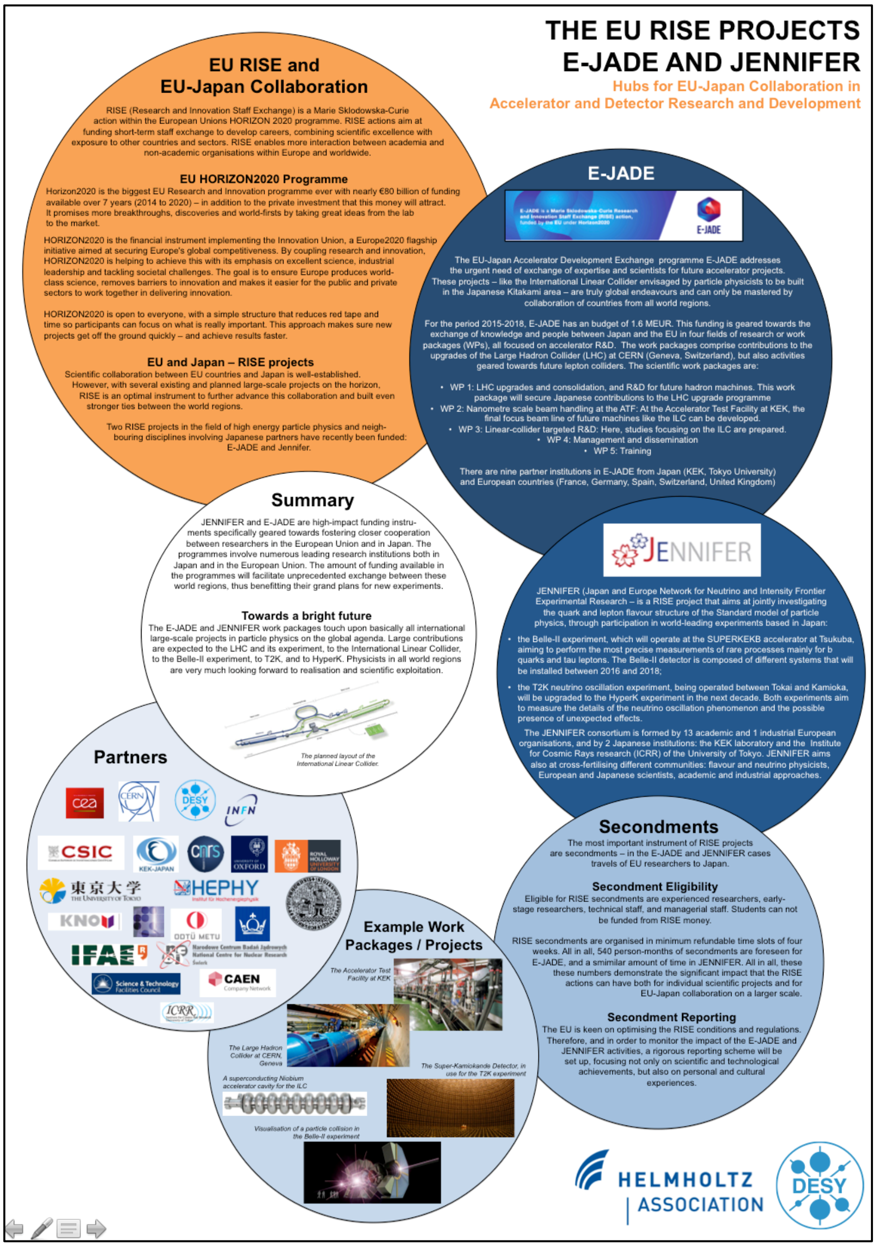

Figure 2: Presentation of EU RISE projects within particle physics (E-JADE and JENNIFER) in Tokyo, November 2015.

E-JADE supported and participated in the Industrial Session at the IEEE NSS/MIC Conference, from 29 October to 5 November 2016, in Strasbourg, France. The IEEE Conference is a well-established meeting that has continuously provided an exceptional venue to showcase outstanding developments and contributions across the nuclear and medical instrumentation fields. E-JADE was presented and showcased with a poster, a miniature of which is shown in figure 3. E-JADE supported the industry session of this conference in fulfilment of the goal of arranging an industry workshop at month 20. Figure 4 shows the collection of sponsor logos printed on IEEE give-aways and the conference bag; E-JADE can be seen to figure prominently.

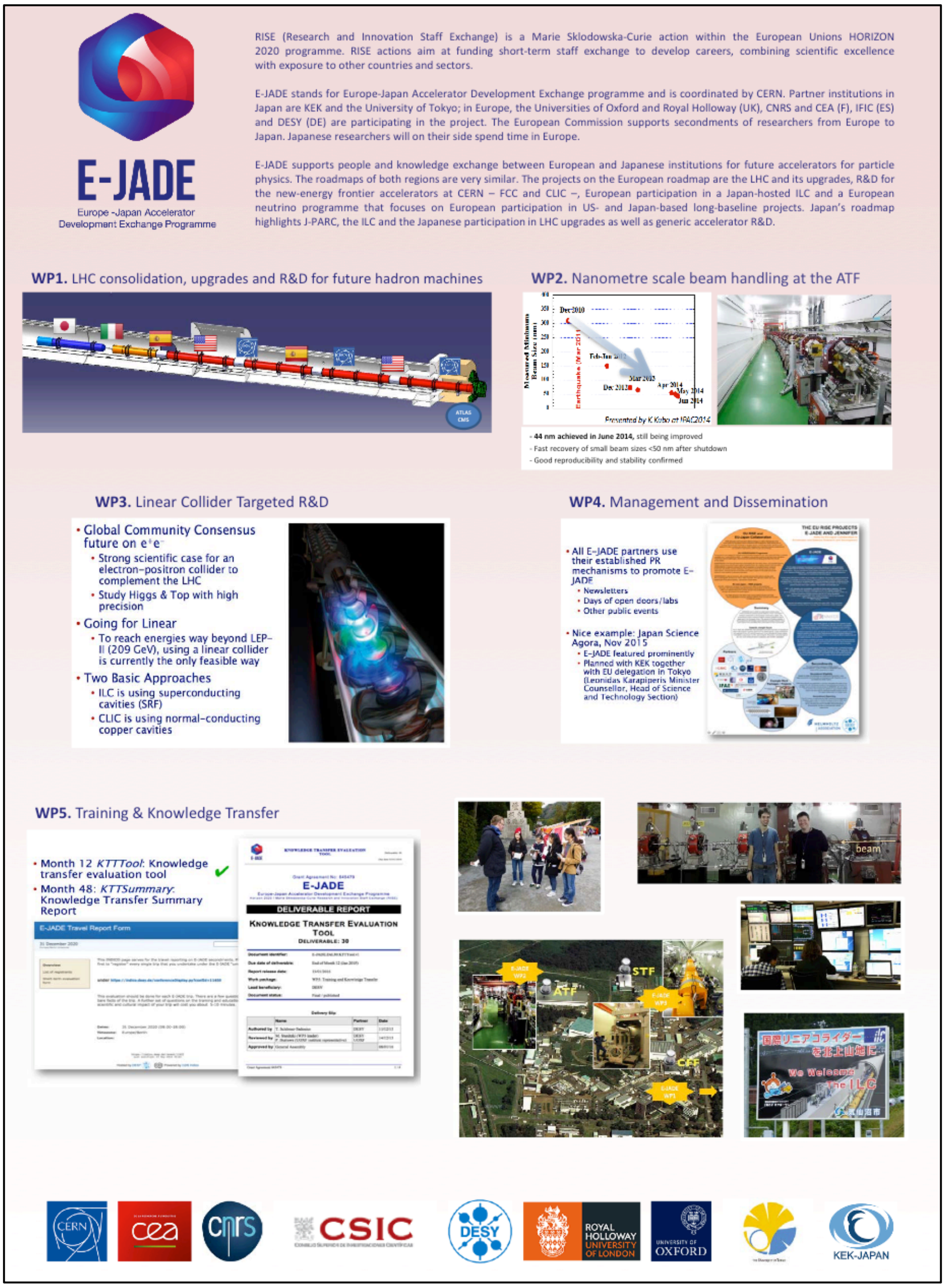

Figure 3: This E-JADE poster was shown at the IEEE Conference in November 2016 in Strasbourg, France.

On the occasion of the International Linear Collider Workshop 2016, which took place in Morioka, Japan, in December 2016, the E-JADE consortium gathered and presented the project in an "E-JADE ILC Event", open to the public. During this event, classes of Japanese high-school students met some E-JADE scientists and Ph.D. students making a significant part of their thesis work at ATF2 at KEK, in an encounter where the benefits of the E-JADE secondment scheme supporting these extended stays were highlighted. See pictures from the event in figure 5 below.

Figure 4: The IEEE sponsor collection, featuring a prominent entry for E-JADE.

Figure 5: E-JADE members during the E-JADE dissemination event in Morioka.

WP 4 deliverables in the report period

- Month 2 – Kickoff

- Month 3 – PubWWW
- Month 7 – CERNKEKOffices
- Month 12 – E-JADE-Report
- Month 12 – CommStrgy
- Month 20 – IndustryWS

WP 4 secondments

- Task 4.1 - 4.4: S. Stapnes, A.Augier

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**).

Concerning **Task 5.1**, as already stated in the progress report of May 2016, all partners started to provide a schedule of training courses, of coaching opportunities, and of relevant research experience periods. Due to the very diverse nature of the numerous E-JADE objectives and tasks, each secondee's individual needs are analysed on a 1-to-1 basis, and training activities are then tailored specifically for these needs and the potential of the secondee.

However, central **training events** for the LC community are also supported by E-JADE, and by WP 5 in particular. An important event was the Linear Collider School 2016, held in conjunction with the already mentioned LCWS16 conference in Morioka, Japan, in December 2016 (http://www.linearcollider.org/school/2016). Of the 50 participant students, 27 were affiliated with E-JADE institutes, demonstrating the high impact that E-JADE has in the education of staff in this dynamic field. Several E-JADE ERs were among the teachers at the school, and some of these were supported by E-JADE (e.g. H. Schmickler).

As previously reported, **Task 5.2 ("setting up of an evaluation framework")** has been tackled by implementing an INDICO-based secondment evaluation questionnaire to be filled out by all secondees upon their return. The questionnaire inquires into the success of the secondment in terms of experience, scientific output, and new collaborations, and of the cultural impact of the secondment. The questionnaire is described in **deliverable report 30 "KTTTool"**. The questionnaire will be evaluated towards the end of E-JADE to ensure a global view and analysis of all secondments. However, impressions and feedback received from "sneak previews" of the data show convincingly that, for younger researchers, E-JADE is considered a very interesting project and tool to broaden horizons and knowledge, make new contacts and form new collaborations (in the sense of career networking), which could have a positive impact on their future career, while more senior scientists appreciate the possibility to more easily combine their activities in Europe and in Japan using the E-JADE funds, developing fruitful contacts and synergies between Japan and Europe. They can, e.g., more easily supervise theses together with Japanese colleagues, and they get access to new students and facilities. Defining common goals and providing common reports with Japanese colleagues increase the collaboration and coordination of future actions on both sides.

WP 5 deliverables in the report period

- Month 12 - KTTTool

WP 5 secondments in the report period

- H.Schmickler

1.3 Impact

Include in this section whether the information on section 2.1 of the DoA (how your project will contribute to the expected impacts) is still relevant or needs to be updated. Include further details in the latter case.

The contribution of E-JADE to enhancing research- and innovation elated 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)

Include in this section whether the plan for exploitation and dissemination of results as described in the DoA needs to be updated and give details.

(Not applicable)

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

Include in this section whether the data management plan as described in the DoA needs to be updated and give details.

(Not applicable)

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

Include in this section the list of recommendations and comments from previous reviews and give information on how they have been followed up.

In May 2016, the E-JADE mid-term review took place in Santander, Spain, during the ECFA Linear Collider Workshop 2016. Delays in the execution of the secondment plan were brought to the attention of the project officer, and the reasons explained:

- The ILC schedule has shifted significantly with respect to the E-JADE planning from 2014, leading to a significantly reduced number of secondments specifically for WP 3.
- The ATF2 facility offered only significantly reduced beam time – in fact, beam operation was reduced by almost a factor 2 with respect to the initial planning. This hampered the execution of secondments for WP 2.
- In addition, some activities had a slower than expected start, and the swift implementation of secondments was sometimes cumbersome.
- Eligibility issues for administrative personnel in short-term positions made it difficult to staff CERN office at KEK.

In Santander, the following recommendations were made orally by the project officer:

- **Efforts towards integrating industry into E-JADE**: This idea was pursued for a substantial part of 2016, and several companies were approached by key persons in E-JADE. However, unfortunately, no new industrial partner could be identified where significant secondments could be arranged in the 2017-18 timeframe to benefit the accelerator projects pursued by E-JADE. None of the projects pursued are currently in full construction, which is the period where industry secondments are most relevant.
- A **widening of WP 2** in the sense that **final-focus activities at the SuperKEKB** electron-positron collider (which is currently being commissioned) were now included to complement those at the ATF2 (in a sense, SuperKEKB is the next logical step when aiming from the ATF2 towards the ILC). In fact, since summer 2016 several related secondments have been executed, and they bring significant scientific added value and help the execution of the newly updated secondment plan.
- Introduction of a **new task 3.5 on ILC-related detector activities** (see above under 1.2.3) in **WP 3**: There is a very strong interplay between the layout of detectors for the ILC and the machine design. These ideas are now – after the intended location of the ILC IP has been announced – being pursued more consequently, taking into account the relevant site-specific information. Numerous WP 3 secondments have been undertaken for this task in the second half of 2016, and more will come in 2017 and 2018.
- The introduction of **new beneficiaries and partners into the E-JADE** consortium: Further European and Japanese institutions were identified to complement the existing E-JADE expertise and help to fulfill all (including the new) 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.

The introduction of new partners and beneficiaries as well as the new secondment plan **required an amendment to the grant agreement**, which is currently being finalised. The changes will take effect as of 1 January 2017. At the time of writing this report, the new partners have started to execute their newly planned secondments.

With the changes sketched above implemented, we believe E-JADE to be on a good track concerning the fulfilment of all tasks and deliverables for the future two years of the project.

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

Explain the reasons for deviations from the DoA, the consequences and the proposed corrective actions.

Deviations have been detailed under 4.

5.1 Tasks (and deliverables)

Include explanations for tasks not fully implemented, critical objectives not fully achieved and/or not being on schedule. Explain also the impact on other tasks on the available resources and the planning.

In the past two years, almost all E-JADE tasks have been addressed according to plan, and the reasons for delays and resulting mitigation measures have been discussed above. Currently only one deliverable (D9 – BeamSize-1 in WP 2) from the reporting period is not completed due to the delivery date of two magnets from CERN to KEK. Being installed in November

2016, the magnets were not in place during the last ATF2 2016 beam period so that no relevant measurements for this deliverable could be carried out. The new beam period will allow the deliverable to be reported in March 2017.

All other future deliverables are currently on track, and no major risks have been identified that might pose serious challenges to our planning.

5.2 Secondments

In May 2016, the status of secondments has been noticed to be critical for reasons mentioned under 4. Since then, secondment activity has increased and – more importantly – in the meantime a reduced and reworked secondment plan has been designed and submitted to the project officer, including the new E-JADE project partners fully for the coming two years. This new plan foresees a reduction in the number of European secondment months to Japan to 262 (compared to 367 before).

We expect to fulfil this new plan and currently have not identified significant further risks.