Grant Agreement No: 645479

E-JADE

Europe-Japan Accelerator Development Exchange Programme

Horizon 2020 / Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE)

PROGRESS REPORT

ACTIVITY REPORT FOR THE FIRST YEAR

DELIVERABLE: 26

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Abstract:

This report summarises the status of the E-JADE project 15 months after its beginning.

1. General Progress of the action

1.1 Please indicate the progress of the action during the period covered by this report:

- ○ The action has fully achieved its objectives for the period.
- ☒ The action has achieved most of its objectives for the period with relatively minor deviations.
- ○ The action has achieved some of its objectives but corrective action is required.
- ○ The action has failed to achieve critical objectives and/or is severely delayed.

1.2 Please describe the general scientific progress of the action during the period covered by this report (including by giving qualitative indicators and by describing deliverables and milestones achieved):

The E-JADE project has progressed well, with some delay mainly in the execution of secondments and in the ILC-related activities in work package (WP) 3 "Linear collider targeted R&D". More details are given below.

In WP 1 "LHC consolidation" one focus was on the R&D on high-field magnets for the HL-LHC and future hadron colliders and on wideband magnetic alloy RF systems (**task 1.2 "The HL-LHC project"**). 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 profited enormously from the E-JADE secondments. An important **milestone** was reached with the recent construction of a mechanical short model of the magnet.

In **task 1.3 "High-field magnet R&D and preparation of future hadron injectors and colliders"**, much effort at KEK with support from CERN was spent on the consolidation and upgrade of the CERN PSB RF systems (with the aim of potentially using wideband multi-harmonic solid-state-driven magnetic alloy loaded cavities) and the development and installation of a longitudinal damper in the CERN PS.

WP 2 "Nanometre-scale beam handling at the ATF" has been the most active work package, in spite of a budget-induced reduction of ATF2 beam operation time by about 50%, which resulted in fewer than expected secondments.

For **task 2.1 ("Beam Size Minimisation")**, a reduction of vertical beam size beyond 40-50 nm is limited by wake fields, beam jitter and residual optical non-linearity. There was significant progress assessing the role of higher-order aberrations. Improved techniques to experimentally evaluate and correct IP β parameters were developed. Mechanisms enhancing growth in effective beam size from jitter in the presence of wake fields were also explored.
For **task 2.2 ("Wake field")**, intensity-dependent effects on the beam size across the ATF2 line, as well as at the IP have been studied using beam-based alignment techniques. Preliminary tests were performed in the extraction line of ATF2, showing the expected behaviour.
For **task 2.3 ("Ground motion")**, the vibration of one of the final doublet quadrupoles was studied, showing clear evidence for detrimental mechanical resonances. An improved mechanical support was designed, built and sent to Japan for installation under the quadrupole; it was shown to reduce displacement amplitudes by factors 4 to 6. Significant progress was made towards realising a GM feed-forward system; the new hardware required for use as the processor for the system has been acquired, installed and tested successfully at ATF2.
For **task 2.4 ("Halo collimation and backgrounds")**, a set of simultaneous beam size and halo measurements were performed, using new single crystal CVD diamond sensor scanners (**deliverable 5 "HaloCollBgds-1"**). In parallel, a vertical beam halo collimation system was designed and constructed for dedicated beam halo control in the ATF2 post-IP region. Simulations allowed an optimisation of the system in the final focus and studies of its performance. The device was installed at the beginning of 2016.

For **task 2.5 ("Beam instrumentation and control")**, 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 to enable separately measuring subsequent bunches extracted from the ATF damping ring with separations of 180-200 ns (**deliverable 6 "Instr-1"**). These improvements allow using feedback to reduce position jitter at the IP (task 2.6), which is important for beam size minimization (tasks 2.1).

For **task 2.6 ("Beam position feedback")**, significant progress has been made in the performance of the FONT ATF2 'upstream' intra-train beam-feedback system. In 2015 a paper was published reporting on the achievement of an unprecedented real-time, single-shot BPM resolution of less than 300 nm for a bunch charge of 1 nC. 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 (**deliverable 6 "Instr-1"**).

WP 3 "Linear collider-targeted R&D" mainly addresses the site-specific optimisation of the ILC design and implementation. The work package suffers from a slower than expected ILC approval process in Japan.

We will comment on **task 3.1 "EDMS"**, which is the most affected one, in detail below (see also **deliverable report 17 "EDMSReqUser"**).

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. The final focus region of the ILC has already seen several adaptations, and ILD and SiD started to adapt their detectors accordingly. 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 transport of detector components to the IP and the detector assembly at the Kitakami site. This is embedded within the Japanese effort to choose an optimal layout for the entire ILC site. Furthermore, there have been studies on the impact of earthquakes on the detector structures. 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"** have 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.

In **task 3.4 "LC optimisation"** 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. There is a long-standing collaboration between Europe and KEK on development and testing of 12 GHz copper RF structures for use at a CLIC-based LC. These structures are manufactured in Japan and Europe and tested at KEK and CERN.

An important **milestone** in **WP 4 "Management and dissemination"** was the establishment of all workflows necessary for **task 4.1 "Scientific and financial management"** (including the **deliverables 23 and 24 "Kickoff" and "PubWWW**). The CERN&KEK offices (**task 4.2**) were established and started to execute their function (**deliverable report 25**

"CERNKEKOffices").
The communication strategy of E-JADE will be based almost entirely on the communication strategies and tools of the E-JADE partners (and their respective PR and communication departments); so far no overall strategy has been developed, and the **deliverable 28 "CommStrgy" is late** (see below).
The **task 4.4 "Dissemination"** will comprise, among other things, the collection (on the E-JADE web pages) of E-JADE results and publications, of E-JADE contributions to conferences etc. (this objective will be realised after the midterm review).
The public web pages for dissemination to the public and to all E-JADE colleagues have been set up (**deliverable 24 "PubWWW"**), and a social media account for E-JADE will be discussed in Santander.

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**). All partners started to provide a schedule of training courses, of coaching opportunities, and of relevant research experience periods. Training in the E-JADE sense is hands-on experience at the host institution, the corresponding exchange of the results via seminars and publications, and the exchange of expertise in the framework of future projects. Most of these activities are tailored specifically for the needs and potential of the secondee in question. However, the training typically comprises the teaching of new technical skills (typically but not only introduced by host-lab representatives to the secondee), the introduction to new areas of research, and an overview of the organisation of research at the host institution.
Current experience shows that secondments of European scientists and engineers to Japan are typically very intense periods of work and exchange, which bring large benefits for the secondees and for the receiving and sending institutions.
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"**. Considering the currently still low number of secondments, the questionnaire has not yet been evaluated – this will be reserved for the two-year report to be delivered at the beginning of 2017.
This report – which is part of the **deliverable 26 "E-JADE-Report" is in itself late**, for reasons that will be explained below.

Status of secondments

So far, more than 30 physicists from all European E-JADE partner institutions have travelled on E-JADE funding, spending close to 1000 days in Japan, or about 30 months. Of these, roughly 60% (16%) are experienced researchers with more (less) than 10 years of experience, and about 16% are early-stage researchers doing their Ph.D. Administrative, managerial and technical staff was seconded as well. About 1 out of six seconded E-JADE members is female.

Compared to the total of 367 months initially pledged, and considering that of 4 years of the project already 1.25 have passed, the 30 or so months are insufficient. We address this matter below under "2. Corrective Measures".

2. Corrective Measures

2.1 Please explain any delays accumulated in the secondments / activities / deliverables foreseen in the Grant Agreement and the measures taken to oversee them.

Delays in activities:

Despite the rather severe delays in secondments, there are only moderate delays in activities in the various WPs, the most significant probably being for the ILC-related work in WP 3.

Compared to the planning assumptions during the writing and evaluation of the E-JADE proposal, the ILC schedule has significantly shifted in time; we now do not expect a positive decision about the construction of the machine before 2018. This unclear overall situation of the ILC is showing first detrimental side effects: It is getting more and more difficult for non-Japanese institutions to provide funding for ILC-related tasks. For this reason, also some activities that do not touch upon the necessary technical R&D are postponed, and a significant shift of timescales has to be taken into account.

This is particularly true for **task 3.1 "EDMS"**, for which the original work plan had to be de-scoped. This is due to the fact that a complex system like the EDMS cannot be tackled in a meaningful way without the overall definition of an international ILC project. While there have been a series of preparatory discussions preparing a EDMS solution, it is obvious that without well-defined key stakeholders both on the Japanese and the international side, any detailed list of EDMS user requirements would be in fact premature (as stated in **deliverable report 17 "EDMSReqUser"**).

However, also the other tasks in WP 3 are affected by the slower-than-expected progress of the ILC project. The consequences are discussed in the next paragraphs.

Delays in deliverables:

This report, which is part of **deliverable 26 "E-JADE-Report"**, is late by about 3 months. This delay can be explained by factors relating to the ILC that are beyond our control, the reduced beamtime operation at ATF2, and the unforeseen and unavoidable absence of two key figures of the project (the scientific coordinator and the previous WP 3 leader) in September 2015. Their responsibilities were taken over by other colleagues in the consortium as best possible. We are confident that we have by now tackled the related problems successfully.

As indicated above, **deliverable 28 "CommStrgy"** is late. This will be remedied directly after the midterm review, when also all partner institutes took another term to discuss a strategy and to collect their information.

Delays in secondments:

The most significant deviation from the planning in E-JADE is not in terms of activities or deliverables, but of secondments. The status of secondments has been discussed above – after about 30% of the project's time only less than 10% of the pledged secondments have taken place. There are several reasons for this, which partly have been touched upon already:

- There is significant lack of progress in the ILC project which is beyond E-JADE's control;
- In the Japanese fiscal year 2015/16 (that ended in March 2016) there was, at KEK, a severe and unexpected reduction (by almost a factor of 2) of funding for beam operations that also affected ATF2 and thus WP 2;
- E-JADE suffered from the absence of key persons in the E-JADE project: the WP 3 leader was appointed CERN Research Director and could not fulfil his function anymore, and it took time to identify a well-suited successor; also WP 1 and the overall E-JADE project suffered from the absence of the Scientist in Charge);
- The start-up of some activities and specifically of the building of scientific collaborations and intensive exchange with Japanese colleagues was significantly slower than expected;
- We encountered numerous problems with eligibility criteria, especially for Ph.D. students (who are often not employed by the E-JADE partner institutions but by centrally managed stipends); there were also larger-than-expected problems for more senior researchers to realise long-term absences from their home institutions;
- The initial planning of secondments was rather aggressive.

Some of the above problems can be dealt with or will be alleviated or solved in due time:

- In WP 1, the injector-related activities are ramping up more and more, and there is increased effort to fill the FCC-related activities with more life. Both these measures will lead to a more intense exchange with Japan and to an increase of secondments.
- In WP 2, there are hopes that in the newly started Japanese fiscal year 2016/17, the budget situation for ATF2 operation at KEK will be much improved so that it makes more sense for European researchers to spend time at KEK; furthermore, CERN is considering to considerably strengthen its involvement in the ATF2.
- In WP 3, the DESY activities (at the lab's Zeuthen site) on positron injection and beam polarisation are ramping up, leading to well-founded expectations for an increased related travel activity.
- Also in WP 4, there are plans to increase the European engagement significantly, with current ideas focusing on the ILC project management being supported by CERN.
- The loss of key persons has by now been compensated with new expert staff (e.g., the new WP 3 leader Marcel Stanitzki from DESY has taken over and is monitoring WP 3 closely).

- More and more foreseen collaborations between Europe and Japan are taking up speed, with ensuing (also longer-term) secondments, and also more and more new collaborations and threads of scientific exchange are being established.

We are therefore confident that some of the delay can be compensated in the coming reporting periods. However, the facts remain that the ILC – which clearly was very much in the focus of the E-JADE project – is late compared to our initial planning and that this initial planning now seems optimistic. We would like to discuss this situation during the imminent E-JADE midterm review (scheduled for 31 May 2016 in Santander).

- The severe delay of the ILC project and the reduction of beamtime operation at the ATF2 introduced an effective delay in the execution of at least WPs 2 and 3, but also of the overall project (as, to a much lesser extent, did the loss of a key person and the temporary absence of another). For the extreme case that we can not at all compensate the delays in the future, one might consider a zero-cost prolongation of the E-JADE project by an appropriate amount of time.

- An additional mitigation measure would be to moderately re-scoping of the E-JADE project. In particular, we propose a WP 2 work programme modification in 2017-2018 to include some tests of optical tuning methods and luminosity optimisations with the nano-beams of SuperKEKB at KEK, Japan. These efforts, which are anyhow pursued at some E-JADE partner institutions, have only recently become possible, with the successful startup of the SuperKEKB electron-positron collider; they do however fit extremely nicely into the necessary steps towards achieving the overall goals of WP 2, and therefore a corresponding change of the scope of the work package seems perfectly justified. Additionally, a re-scoping might also be beneficial for the success of WP 3, were the focus could be slightly shifted from the EMDS aspect to R&D and MDI issues.

We are very much looking forward to a productive discussion on these matters in the midterm review in Santander.

2.2 Please indicate any potential risks identified and suggested approaches to mitigate them.

In this section, we will briefly discuss a few risks for the planned progress of E-JADE.

- **Further delays in future secondments (all WPs)**: This risk and possible mitigation strategies have been discussed above.

- **Risk WP 2 (WP 2)**: The dominating risk in this work package is the loss of significant amounts of beam operation time at the ATF 2 at KEK, Japan. In the past fiscal year 2015/16, budgetary constraints at KEK lead to a reduction from 20-21 weeks of planned beam time to only about 11 weeks – a reduction by roughly of a factor 2 that in consequence probably led to an even stronger reduction in travels by experts to

Japan. Since the ATF 2 is a unique facility, the resulting delay in the execution of tasks could not be counterbalanced.

- **Further delay in the ILC project (WP 3)**: A further delay of the ILC project, and a future lack of positive signals from Japan, would cause further delay in the execution especially of the EDMS task. There is no way to counterbalance this delay as this is impossible to achieve in the absence of a clearly established project.
- **Lack of significance of secondment feedback (WP 5)**: An in-depth evaluation of the feedback delivered (planned for the end of 2016) could show a lack of impact of the E-JADE measures (specifically of the secondments). One mitigation measure might consist in an even better and more detailed planning of secondments and of the work foreseen during it. Furthermore, the bonds between Europe and Japan will certainly tighten with every single secondment and every personal contact established or deepened, and even more productive secondments and more fruitful experiences for the secondees will be the consequence.

3. Ethical Issues

Please indicate how the ethical issues have been addressed during the period covered by this report and mention all the approvals/authorisations already provided to the REA (if applicable).

Not applicable.

4. Additional information

Please indicate any additional information that you may consider useful to assess the project implementation during the period covered by this report, including management issues.

None