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PROJECT PERIODIC REPORT

Grant Agreement number: 206711

Project acronym: ILC-HIGRADE

Project title: International Linear Collider and High Gradient Superconducting RF-Cavities

Funding Scheme: Combination of CP & CSA

Date of latest version of Annex I against which the assessment will be made:

Periodic report: 1st ☐ 2nd ☒ 3rd ☐ 4th ☐

Period covered: from 1.2.2009 to 31.1.2010

Name, title and organisation of the scientific representative of the project's coordinator:

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Declaration by the scientific representative of the project coordinator[1]

I, as scientific representative of the coordinator[1] of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):
  - ☒ has fully achieved its objectives and technical goals for the period;
  - ☐ has achieved most of its objectives and technical goals for the period with relatively minor deviations[1];
  - ☐ has failed to achieve critical objectives and/or is not at all on schedule[2].
- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator[1]: Dr. Eckhard Elsen

Date: ....31/ 8 / 2010

Signature of scientific representative of the Coordinator[1]: ....

[1] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

[2] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

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1 Publishable summary

1.1 Project logo:

1.2 Project Summary and Context

A linear e^+e^- collider continues to be the next major project in High Energy Physics following the commissioning of the Large Hadron Collider (LHC). It has been prominently positioned in the European Strategy for Particle Physics agreed by CERN Council, which serves as the basis for ESFRI recommendations for High Energy Physics (HEP). As the first data of the LHC are being recorded and physics results extracted one can hope to get more guidance from the LHC physics results on the detailed design decisions for such a linear collider, in particular the energy reach of such a facility. The European Strategy will hence be updated over the next couple of years.

In the energy range from 500 to 1000 GeV a design for such a machine exists: the e^+e^- International Linear Collider (ILC). It is well understood today that the ILC will constitute the precision tool for the Terascale, the scale of electroweak symmetry breaking. The ILC complements the potential of the LHC, which will initially chart this unknown territory. – If a much farther leap into the Terascale is suggested by the physics results one will have to revisit the optimisation of the layout and time scales. Today a proven technology for the multi-TeV energy region does not exist. For this reason the R&D on the Compact Linear Collider (CLIC) technology has been identified as a field of intense research in the recommendations of the European Strategy for Particle Physics.

The ILC-HiGrade consortium concentrates on the rapid realisation of the International Linear Collider ILC and brings together the key players in Europe. They constitute a large fraction of the European element of the Global Design Effort (GDE) that has led to the publication of the Reference Design Report (RDR) in 2007. The report forms the basis for the Technical Design Phases I and II of the ILC, which the GDE will complete by mid-2012. The proposal for the ILC will then be presented to the global stakeholders, i.e. governments and funding agencies to seek approval. The technically driven schedule envisages start of construction as early as 2012. Project approval and start of construction is a two-stage process.

Starting in 2008, the ILC-HiGrade Consortium began to address important elements in this two-stage process with siting of the facility as one major ingredient. Currently site proposals for all three regions Japan, US and in Europe exist. Their benefits are being evaluated and the international framework in which the project will be realised will be developed. ILC-HiGrade encompasses the European side in this global endeavour. The participating laboratories and universities contribute their long-standing experience in conceiving large-scale experiments and the organisation of large collaborations to a process that establishes the global framework for an organisation that will support start of construction matching the technical timelines.

The linear accelerator sections of the ILC constitute a major cost-driver. Their design and their cost depend on the achievable accelerating gradient for the ILC. The global gradient development programme of the GDE will establish a realistic operational gradient for the ILC by employing proven preparation techniques, with European laboratories leading the effort. In the course of ILC-HiGrade, the partners are preparing at least 24 fully dressed cavities, which will initially serve as a technical reference for the decision on the choice of gradient and eventually as the industrialisation of the high-gradient process. While their delivery is pending till 2011 important steps have been made to prepare the facilities and the instrumentation for analysis and full diagnostics. Particular achievements have been made in the reporting period as detailed below.

The timelines of this 4-year project are well aligned with those of the Global Design Effort, aimed at establishing the technical basis for proposing the ILC by mid-2012. It thus matches the timelines of the iteration on the European Strategy for the High Energy Physics. If chosen, the ILC construction could commence soon after.

From a European perspective, all crucial elements necessary to produce this outcome, both technical and political are reinforced and explicitly supported in the ILC-HiGrade project.

1.3 Project webpage

The webpage of the project is hosted at http://www.ilc-higrade.eu.

2 Project objectives for the period

There are two main objectives of the preparatory phase of ILC-HiGrade: firstly, to ensure that the crucial R&D has been carried out to allow the project to be constructed within the internationally agreed cost envelope; secondly, to establish all necessary structures and technical capabilities to ensure that the ILC can be brought to governments for submission for approval in 2012 and that the site choice has been technically prepared.

The activities of the reporting institutes represent significant progress in all these areas.

On the technical side a key issue is the delivery of the Superconducting RF cavities and establishment of the good performance. The delivery times of the cavities are long; the delivery is currently foreseen for the second half of 2011. In the meantime the consortium has used other cavities to practise the diagnostics tools and to prepare for the rapid and comprehensive analysis of the cavities once they are delivered. The description of this preparatory work constitutes the major body of this work.

Concerning the advancement of the governance plans for the ILC again considerable progress has been made. Effectively Europe is currently leading this effort. The success here is based on the experience in collaborating at large scale (CERN, ITER, etc.) and the experience of collaborations on the European scale.

Specifically, ILC-HiGrade addresses the following objectives in its work packages:

WP1: Management of the Consortium

WP2: Integration and optimisation of the European contribution within the global GDE organisation as the ILC project moves through the GDE Technical Design Phases

WP3: Ensure that the characteristics and importance of the ILC, and its place within the world of science and research, is widely disseminated to the peoples of the European Union, and their governments

WP4: Investigate features and develop possible schemes of governance for the ILC, exploiting expertise of CERN (LHC) and DESY (HERA) in international projects

WP5: Prepare and investigate possible European sites for ILC construction

WP6: Investigate and monitor the production process that yields high-gradient cavities with high yield. Establish the process in industry

WP7: Optimisation of the coupler conditioning at reduced cost

WP8: Demonstrate suitability of tuner design in tests. Establish a cost-effective tuner production

3 Work progress and achievements during the period

3.1 WP2 – Coordination of European GDE Activity

Work package number	WP2	**Start date or starting event:**				1
Work package title	Coordination of European GDE Activity					
Activity type	COORD					
Participant id	1	3	6			
Person-months per beneficiary	6	-	4.04			

The European Global Design Effort (GDE) coordination continues to be primarily served via the strong overlap of senior management in both ILC-HiGrade and the GDE itself. Specifically the European Regional Director (B. Foster, UXOF.DL) and the European Project Manager (N. Walker, DESY), who both continue to serve on the GDE Executive Committee under the GDE Director B. Barish (CALTECH, USA). The organisation and function remain largely as outlined in the previous Annual Report, and continues to work well.

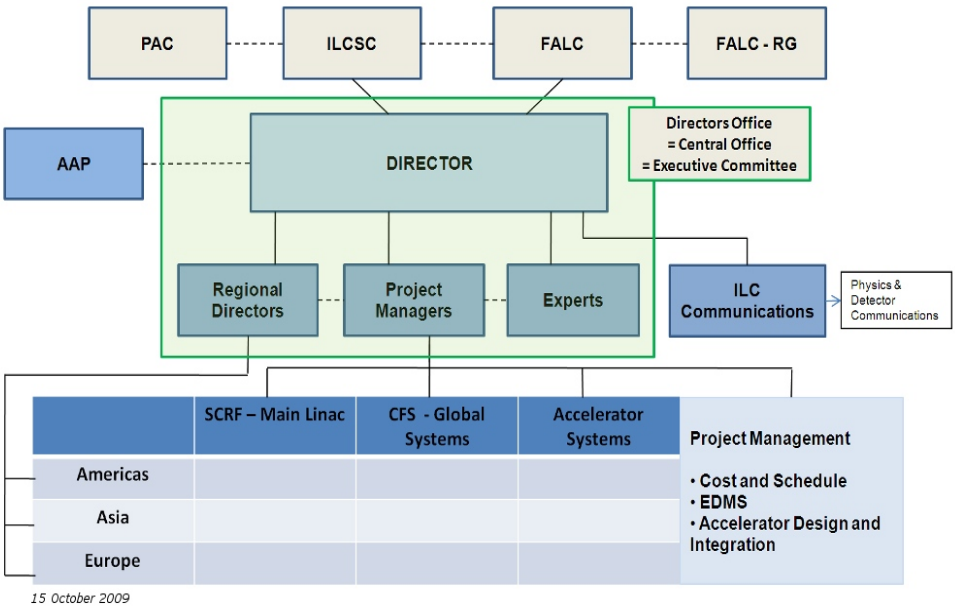


Figure 1 Structure of the GDE management. The boxes at the top correspond to bodies to whom the GDE in one sense or another reports. The blue box defines the Director's office, which in equivalent to the EC defined in the text. The AAP is the Accelerator Advisor Panel, a body that reports to the EC and which can be charged to carry out specific reviews of any area of GDE activity. The ILC communicators contain representative of each from each region and are responsible for public outreach. The Project Managers' Office is responsible for delivering the R&D programme defined by the EC.

One notable change during the current reporting period is the closer consolidation of ties between the CLIC collaboration (based at CERN) and the ILC. J.-P. Delahaye (European GDE deputy director and CLIC project leader) has formally joined the GDE EC, while B. Foster has become a member of the CLIC Steering Committee. From the GDE perspective this facilitates stronger technical collaboration on common fronts between the ILC and CLIC designs, while also improving access to other key CERN resources for ILC work such as civil engineering, cryogenics etc. The stronger ties are also aimed at supporting CERN's bid-to-host for a future Linear Collider, which naturally includes the possibility of hosting the ILC as a global project.

B. Foster (in his role as European Regional Director) continues to play a pivotal coordination role in Europe. During 2009 he visited R. Heuer (CERN Director General), M. Spiro (head of CERN council), G. Wormser (Director LAL, Orsay, France), B. Vierkorn-Rudolph (German BMBF ministry, Germany), R. Petronzio (president INFN, Italy), the late J.-A. Rubio, Director-General of CIEMAT, Spain and many key UK government representatives. B. Foster also continues to make regular presentations on ILC plans to plenary meetings of the European Committee for Future Accelerators (ECFA), and other European bodies, for example the symposium Realising and Managing International Research Infrastructures (RAMIRI). This programme of visits will continue, with the aim of visiting the major European funding authorities on average once per year.

The overall coordination of European GDE technical activities continues within the more globally orchestrated work, primarily via weekly teleconferences of the various technical groups. Two workshops with a special focus were held in Europe in 2009 (organised by project manager N. Walker and both held at DESY) on the technical design for the ILC that will be used as the baseline for the engineering and costs activities foreseen for 2011/12, in preparation for the publication of the ILC Technical Design Report at the end of 2012.

Meeting	Venue and Date	Purpose and Programme
1st GDE Accelerator Design & Integration Workshop	DESY, Hamburg, Germany 28.-29.05.2009	Technical planning for re-baseline proposal for the ILC. http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=3526
2nd GDE Accelerator Design & Integration Workshop	DESY, Hamburg, Germany 2.-3.12.2009	Consolidation of re-baseline proposal (SB2009) for the ILC. http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=4255

The next major GDE meeting will be a joint meeting with CLIC to be held at CERN in October 2010. B. Foster is a member of the organising committee and the scientific and logistical definition of the meeting are already well under way. This European-based but fully international meeting will be an important event for the coordination of the European effort on the ILC within the context of the ILC-HiGrade project.

3.2 WP3 – Dissemination and Outreach

Work package number	WP3	**Start date or starting event:**				1	
Work package title	Dissemination and Outreach						
Activity type	COORD						
Participant id	1	4	5	6			
Person-months per beneficiary	9.72	5.60	4.20	0.68			

A summary of the dissemination and outreach activities and links can be found at the ILC-HiGrade webpage http://www.ilc-higrade.eu/e10/e38725/.

3.2.1 Introduction

The core of European ILC communication is a team of two communication specialists with combined physics and journalistic backgrounds, who work in close collaboration with an Asian colleague, the scientific ILC community and a wider network of particle physics communication specialists from around the world. Ever since its formation five years ago, the international ILC communications team has had very active communication and outreach activities, producing publications and brochures aimed at an international audience. These publications were mainly produced in English. To improve awareness for the ILC, the European team considers it essential to develop European-specific communications tools and translate the existing ones, into the main languages of the member states of the EU.

Although the ILC is a global project and should be promoted as one further specific messages should be delivered to selected audiences in Europe. The work is based on a strategic ILC European communication plan for the fours years of the ILC-HiGrade project, which was approved by the ILC European Outreach Advisory Subgroup (chaired by B. Foster). The strategies are both internal in that the activities aim to strengthen the ILC collaboration as an international endeavour, and external, by developing tools to present the ILC to European governments and funding agencies and reaching out to the larger scientific community and key political representatives, always following the ultimate goal of building the ILC. This is illustrated by a number of concrete actions taken this past year.

3.2.2 ILC-HiGrade poster

This A0-format poster was originally presented at Versailles, France for the Fifth European Conference on Research Infrastructures (ECRI08). Written in simple and non-technical language, this poster comprises a short introduction to the ILC project in general, a schematic view of the accelerator and a description of its main components. It also summarises the goals and challenges of ILC-HiGrade and lists the participating institutes.

Link to the poster: http://www.ilc-higrade.eu/e10/e38725/

3.2.3 Press

The ILC communicators continue to handle incoming press requests and promote the ILC when talking to journalists even in contexts other than the ILC. Particle and accelerator physics are enjoying a raised profile thanks to the news from the Large Hadron Collider (LHC) at CERN. The focus lies very much on the LHC.

3.2.4 *Translation of the main ILC publications*

A companion document, a glossy 40-page brochure 'The International Linear Collider – Gateway to the Quantum Universe', to the rather technical four-volume ILC Reference Design Report, was produced by the ILC communicators as core part of a committee representing the whole ILC community. The final document was released in print and on a dedicated website in October 2007 and distributed widely to the key audiences of policy makers and the wider scientific community. In 2008 the WP3 coordinators coordinated and edited the French, German, Italian, Russian and Spanish versions of this document. These documents are now available on the ILC website and some of the versions have been printed and distributed widely.

Related ILC webpage: http://www.linearcollider.org/cms/?pid=1000446

3.2.5 *ILC Weekly Newsletter NewsLine*

Since August 2005, the birth of the Global Design Effort (GDE), the ILC communicators have published the electronic newsletter ILC NewsLine every week, including its 200th issue on 30 July 2009. The communicators are responsible for the content of the ILC website's public face, and tasks include updating it regularly with new news clippings, current and attractive images of R&D and other milestones. ILC NewsLine presently counts 2188 subscribers and the number of its readers is continuously increasing (+4% in 2009, + 13% in 2008). We estimate the number of European subscribers to be 590 this year, which represents about 28% of the total. This year, 150 articles were published in ILC NewsLine, 31 of those were written by members of WP3. Thirty-three articles on European R&D, milestones and scientific milestones were published, mainly on the ILC, but also some about related projects. Indeed, in Europe, it is particularly important to connect the ILC to other projects in particle physics, like the Large Hadron Collider at CERN, the European X-Ray Free Electron Laser Project (XFEL) at DESY or the Compact Linear Collider (CLIC) study. In particular, the relaunch of the LHC on 20 November 2009 and the series of LHC performance records, e.g. LHC ends 2009 run on a high note was a huge opportunity to tap the public and media interest in particle physics at an unprecedentedly high level. In ILC NewsLine, six articles and photos related to LHC were published in 2009. Altogether 23 articles and photos were devoted to European XFEL and CLIC projects.

This year a new feature "ILC blogs" has been added. Two ILC bloggers from Europe contribute and are presently writing in Quantum Diaries (http://www.quantumdiaries.org/).

The release of *thematic* issues in ILC NewsLine, with three of this kind in 2009, began in the reporting period. These issues are aimed to explain ILC key challenges such as the electron cloud in its special, to explain the assets of the ILC to the-man in the street with the technology benefits special or to review the different protagonists taking part in an ILC milestone with the detector special.

Links:

ILC NewsLine current issue: http://www.linearcollider.org/newsline

ILC NewsLine archive: http://www.linearcollider.org/newsline/archive/index.html

ILC NewsLine special issues archive: http://www.linearcollider.org/about/Publications/ILC-NewsLine

3.2.6 *ILC Technology transfer brochure*

Commissioned by the Funding Agencies for Large Colliders (FALC), "The International Linear Collider – Gateway to Technology" is a four-page outreach brochure that aims to describe possible industrial, socio-economic transfers and the wider societal implications of the ILC project. It is based on a FALC report entitled "Technology Benefits Deriving from the International Linear Collider". The European communicators worked with their Asian colleagues to write and realise this document, in close collaboration with, for the European aspects, the European Industry Forum for Accelerators with SCRF Technology (EIFast). Three translations are available already; European languages will follow on demand.

Technology transfer brochure website: http://www.linearcollider.org/cms/?pid=1000623.

3.2.7 New linearcollider.org website

The central communication tool for the ILC, its website http://www.linearcollider.org, was almost completely rewritten and restructured during the year 2009, with a launch date in early 2010. It now has a much more extensive section with general information about the ILC, clearly marked section for collaborators on the GDE, on the detectors and for the general public. Its news content is much higher with frequently changing features highlighting various aspects of ILC progress, including European projects and milestones like those of ILC-HiGrade.

3.2.8 Communications tools

ILC-HiGrade website update: Delivered on August 2009, http://ilc-higrade.eu is a concise and illustrated website which gives an overview of ILC-HiGrade project. A section called "general information" presents in short and simple terms the goals and challenges of the ILC project and machine. The site is updated regularly and contains contact information for each work package.

3.3 WP4 – Governance

Work package number	WP4	**Start date or starting event:**				1	
Work package title	Governance						
Activity type	SUPP						
Participant id	1	3	4	5	6		
Person-months per beneficiary	-	2.26	-	-	2.20		

There has been substantial progress to report in the work of WP4 in the past year. The members of the Working Group held several meetings (see Table 1) and have compiled information on "cognate" projects throughout the world that are facing or have recently faced the challenges of planning a new large international infrastructure. Using these examples proposals for the funding and governance of the International Linear Collider are being drawn together, which will be presented to funding agencies and the community in the summer of 2010. This progress is summarised in the report below, which summarizes the developments towards the Global Governance structure as specified for ILC-HiGrade milestone 5.

Because the ILC is a truly international project, its structure must reflect its nature. Thus input to the question of governance is necessary from all three major participating continents: Asia, the Americas, and Europe. This requirement is recognized in the structure set up to study the governance question and illustrated in Figure 2.

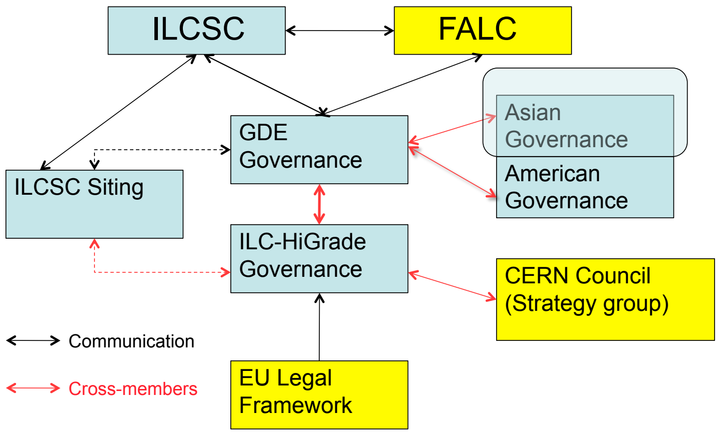


Figure 2 Structure of the governance activity in the ILC. The blue-shaded boxes represent committees set up inside the high-energy physics community. Those surrounded by the light-blue shaded box are currently not active. Note that since the last Annual Report, the American Governance group has constituted itself and has become active. Yellow boxes represent committees external to the particle physic community. Back arrows represent communication paths, while red arrows represent cross-membership between committees.

In Figure 2, FALC is the acronym for Funding Agencies for Large Colliders, a body which meets typically twice per year and contains representatives from most major funding authorities with an interest in particle physics. CERN Council represents the smaller European countries, while France, Germany, Italy and the UK have their own representatives. This body is currently chaired by P. Coulomb, former head of the Canadian Research Council, although his continued chairmanship is under discussion. The CERN Council is custodian not only of the affairs of the European Laboratory for Particle Physics, CERN, but also sets the European

Strategy for particle physics, which, after wide consultation among the European particle physics community, feeds directly into the ESFRI roadmap. The ILC project is the next major priority for a new world facility in particle physics.

The internal particle physics structures are controlled directly or indirectly by the International Committee for Future Accelerators (ICFA), which is an organ of the C11 Commission for Particles and Fields of the International Union of Pure and Applied Physics, IUPAP, itself an organ of UNESCO. ICFA is currently chaired by A. Suzuki, Director-General of KEK, the Japanese National Laboratory for Particle Physics. It contains representatives of each of the three regions as well as the heads of the major international laboratories, for example the Director-General of CERN is an ex-officio member. It meets twice yearly and sets overall policy for the world particle physics community. Although it has no executive authority, its influence is large.

The International Linear Collider Steering Committee, ILCSC, is charged by ICFA with overseeing the activity towards realising the International Linear Collider. The current chair is J. Bagger, a distinguished theoretician from Johns Hopkins University in the USA. Each of the three regions has ex-officio representation. From Europe this includes the Chair of the ELCSC, the European Linear Collider Steering Committee. The current chair, Tatsuya Nakada, is the Chair of the European Committee for Future Accelerators, ECFA, which is an organ of CERN Council. The ELCSC typically meets twice per year, just before the meetings of ILCSC.

The ILCSC siting group is a subgroup of the ILCSC and is discussing mechanisms and procedures to establish the preferred site for the ILC. Its composition is currently under discussion; the chair is A. Suzuki.

The other two bodies in Figure 2 are both chaired by the European Director of the Global Design Effort for the ILC, B. Foster. They maintain close contact with each other and will hold some common meetings in future. The GDE Governance group contains representatives of all three regions and is a subset of the Executive Committee of the GDE. Membership of this Governance groups is: B. Foster (chair), B. Barish (Director, GDE), M. Harrison (Americas Regional Director, GDE), E. Paterson (Integration Scientist, GDE) and S. Yamada, (ILC Research Director).

The ILC-HiGrade working group is the main organ to produce the deliverables of the WP4 work package. It is chaired by B. Foster, European Director of the Global Design Effort, and consists of the following members: J.-P. Delahaye, Deputy European Director, GDE; U. Dosselli, Deputy Director, INFN; E. Elsen, Scientific Coordinator of ILC-HiGrade; F. Richard, former director of LAL, Orsay, France and a member of the Steering Committee for the World-wide Study for the Physics of the Linear Collider; S. Stapnes, Secretary of the Strategy Group of the CERN Council; A. Wagner, Chairman of the DESY Directorate Emeritus, has now been replaced on the committee by J. Mnich, DESY Director for High-Energy Physics; and G. Wormser, Director of LAL, Orsay.

The GDE and ILC-HiGrade working groups are well coordinated by virtue of their common chair and their minutes are commonly available through the ILC-HiGrade website. Joint meetings will be held in the course of the process.

The ILC-HiGrade Governance Committee has met five times, mostly by teleconference, but sometimes “in person”, since the last annual report. The working documents of both the GDE and the ILC-HiGrade Governance Committees are posted in a password-protected are on the ILC-HiGrade web site, http://www.ilc-higrade.eu/.

This year has seen the production of "1-page summaries" of the cognate projects that have been studied, which include ALMA, ESS, FAIR, ITER, SKA, and European XFEL. These summaries gather together the important facts and the open questions or issues that each project has raised in the area of governance. The next step was to summarise the additional information gathered for a representative subset of projects into a common format that facilitates comparison and deduction, denoted as "pro-formas". The headings under which the pro-formas are organised are:

1) legal status of the project;

2) management structure;

3) representation and voting structure in governing body;

4) duration of agreement;

5) attribution of in-kind contributions, value engineering etc.;

6) calculation and attribution of running costs;

7) methods of budgetary control;

This process has greatly facilitated the ability to draw conclusions based on the experience of other projects. The first item on the list of milestones was to make a preliminary proposal for funding mechanisms for an ILC laboratory by January 2010. Use of the pro-formas has allowed us to deduce the following threads from other projects:

a) there are no currently existing models of funding in which a region, e.g. Asia, provides funding as an entity;

b) all models where the host state has a substantial scientific input have host state premiums exceeding ~ 50%. Practice on how the host-state contribution is calculated varies; however the cost of land for the laboratory should not be included;

c) no currently proposed new project calculates contributions explicitly related to the GDP, or alternative measures of national wealth;

d) the balance between in-kind and cash contributions is an issue. Detector collaborations in particle physics succeeded by having a substantial common fund and an ethos of sharing & support. Experience from the monitored projects implies that it is often the case that the common fund is insufficient for effective project management;

e) "value estimate" methodology is generally accepted as the basis for costing;

f) contingency is not explicitly included in the baseline cost and is an internal matter for each of the partners to safeguard being able to provide the deliverables to which they are committed.

These general conclusions will form the basis for the report, as specified in the ILC-HiGrade project milestones, by the summer of 2010.

The recently proposed ERIC legal framework is a very important development for research infrastructure development in the EU. However, it cannot be applied wholesale to ILC as it is understandably Eurocentric – e.g. EU countries have to be in a majority in the governing organs. The exploration is planned to what extent it can be applied to a "European" arm of an ILC laboratory, with the main council running under different or adapted rules.

In order to maintain good contacts with funding authorities and governments inside Europe, the European Director of the GDE has continued a programme of visits including to the French CNRS, where on January 27th he met with M. Spiro in Paris to discuss ILC governance matters and the future of CERN; M. Spiro had shortly before taken over as President of CERN Council. B. Foster visited the BMBF in Bonn in June to exchange views with Frau B. Vierkorn-Rudolph on the German approach to ILC Governance, where there is directly relevant experience from the European XFEL and FAIR. He is in a continuous process of discussion with the funding authorities in the UK. In addition, in June in Vancouver he gave a presentation on governance issues to the Programme Advisory Committee (PAC) set up by the ILCSC and has given a number of such presentations to other bodies throughout the year. Future visits to INFN and to the BMBF in Bonn are planned.

These activities show that the first milestone of Work Package 4, “Development of new Governance Structures” has indeed been passed. In fact, it should be added that complementary activities in Japan augment the effort to arrive at a comprehensive understanding of the requirements for a global activity such as planned for the ILC. The example set by the recent European infrastructures is most helpful. The activities will culminate in a report to FALC in the summer of 2010.

Meeting	Location	Date
Phone Conference	–	Feb 23, 2009
TILC09 Joint ACFA Physics and Detector Workshop and GDE Meeting on International Linear Collider and Accelerator Advisory Panel Review Meeting	Tsukuba, Japan	April 17 to 21, 2009
Phone Conference	–	June 3, 2009
Phone Conference	–	August 28, 2009
Phone Conference	–	October 12-13, 2009
Phone Conference	–	November 27, 2009
Phone Conference	–	February 1, 2010

Table 1: Meetings and phone conferences of Working Group 4

3.4 WP5 – ILC Siting in Europe

Work package number	WP5	**Start date or starting event:**						1
Work package title	ILC Siting in Europe							
Activity type	SUPP							
Participant id	1	3	4					
Person-months per beneficiary	12.00	6.60	0.51					

The purpose of this Work Package is the preparation and the investigation of potential European sites for the construction of the International Linear Collider. The work in the past period concentrated on the investigation of potential sites in Europe in the framework of the GDE activities.

Considerable progress has been made in Europe and worldwide to develop the requirements for the respective sites and configurations. The progress has been possible through regular (phone) meetings and particularly through detailed discussion during major meetings.

Technically several tunnel configurations seem viable for the ILC; seven different tunnel configurations have been explored: single and twin shallow or deep tunnels with service buildings located only at the shafts, cut-and-cover construction for all or only for the service buildings or a gallery for the services at the surface. One deep site with a twin tunnel near CERN at Geneva has been considered. This is the only European site discussed in the Reference Design Report (RDR) of the International Linear Collider in 2007. Another possibility is a near-surface solution as was chosen for the European XFEL project in Hamburg, which is currently under construction. A proposal for a site near Hamburg had already been developed for the Linear Collider project TESLA. The big advantage of this design could be the cost savings especially if one would make use of a single tunnel design. For the RDR a twin tunnel solution has been considered. A second European sample site near DESY in Hamburg is developed for the International Linear Collider. This site is significantly different from the RDR sites. The route is in a populated area; hence services can only be located at the shafts. The tunnel lies in water-saturated soft ground and has to be reinforced with watertight concrete blocks. In addition, the Joint Institute for Nuclear Research has proposed a shallow-tunnel, soft-ground site in the vicinity of Dubna in the Moscow region of the Russian Federation. Quite similar to the Hamburg site a single tunnel could be envisaged with most of the infrastructure installed along the accelerator at the surface. Such an implementation bodes well for an additional cost saving for the ILC Conventional Facilities cost, which are currently the largest fraction of the total costs.

In the past year the CERN deep site and the Russian shallow site were further developed. Important topics are the single tunnel design, the safety concept for the different designs and the stability of the sites. A joint meeting with JINR for the discussion of the Dubna site was organized at DESY. In addition, a meeting with P. Crosby from SKA to discuss the common aspects of large-scale physical instruments took place at DESY.

The results of the site investigation have been summarized in a “Siting Study for European ILC Sites”, which is a deliverable for this reporting period. The report includes a description of the Hamburg site, which is based on an extrapolation of the original research carried out in the framework of the TESLA proposal.

The report also summarizes the requirements of a European site, both in a shallow and in a deep-tunnel configuration. The information contained thus substantiates the “preparation for the European site”, a milestone that has been taken during the course of the reporting period. A report in the subsequent reporting period will detail the technical requirements for a site selection.

Table 2 summarizes the phone meetings and Table 3 all physical meetings where besides other subjects the site development was discussed. The references are a collection of the Civil Facilities and Siting (CFS) presentations of the Technical Design Phase (TDP) during the last year.

Meeting	Frequency
TDP CFS Meeting	(Bi-)weekly on Tuesdays
TDP CFS and Global Systems Mtng.	Monthly on Wednesdays
CLIC-ILC Cost and Schedule Mtng.	Monthly on Fridays

Table 2 Frequency of regular phone meetings

InDiCo	Meeting	Location	Date
3154	TILC09 Joint ACFA Physics and Detector Workshop and GDE Meeting on International Linear Collider and Accelerator Advisory Panel Review Meeting	Tsukuba, Japan	April 17 to 21, 2009
3646	Joint GDE, ILC-HiGrade and JINR Conventional Facilities and Siting Meeting	DESY, Hamburg	June 25 and 26, 2009
	Visit of Phil Crosby, SKA and University of Manchester	DESY, Hamburg	July 13 and 14, 2009
3461	2009 Linear Collider Workshop of the Americas	Albuquerque, New Mexico, US	September 29 to October 3, 2009
4253	Accelerator Advisory Panel Review Meeting	Oxford University, Oxford, UK	January 6 to 8, 2010
4408	ILC-HiGrade Scientific and Annual Meeting	CERN, Geneva	February 25, 2010
4175	International Linear Collider Workshop LCWS10	Beijing, China	March 26 to 30, 2010

Table 3 Meetings of Work Package 5

References:

- ILC Global Design Effort and World Wide Study, *International Linear Collider Reference Design Report, Volume 3: Accelerator, Chapter 4: Conventional Facilities and Siting and Chapter 5: Sample Sites*, August 2007.
- J.A. Osborne, *Collaboration Efforts*, TILC09 Joint ACFA Physics and Detector Workshop and GDE Meeting on International Linear Collider and Accelerator Advisory Panel Review Meeting (3154), Tsukuba, Japan, April 17-21, 2009.

- W. Bialowons, *Potential ILC Site at DESY in Hamburg*, Joint GDE, ILC-HiGrade and JINR Conventional Facilities and Siting Meeting (3646), DESY, Hamburg, June 25/26, 2009.
- V. Kuchler, *Overview of CFS Tunnel Configuration Study and Opportunities for JINR/GSPI Participation*, Joint GDE, ILC-HiGrade and JINR Conventional Facilities and Siting Meeting (3646), DESY, Hamburg, June 25/26, 2009.
- G. Shirkov, *A Potential ILC Site at Dubna, Moscow Region,* Joint GDE, ILC-HiGrade and JINR Conventional Facilities and Siting Meeting (3646), DESY, Hamburg, June 25/26, 2009.
- A. Dudarev and V. Sokolov, *The Results of the Preliminary Geological Engineering Surveys Along the Supposed Route of the ILC in Dubna Area of Moscow Region*, Joint GDE, ILC-HiGrade and JINR Conventional Facilities and Siting Meeting (3646), DESY, Hamburg, June 25 and 26, 2009.
- J.A. Osborne, *3D Status European Region*, 2009 Linear Collider Workshop of the Americas (3461), Albuquerque, New Mexico, US, September 29 to October 3, 2009.
- J.A. Osborne, *Status of European Tunnel Costs*, 2009 Linear Collider Workshop of the Americas (3461), Albuquerque, New Mexico, US, September 29 to October 3, 2009.
- J.A. Osborne, *European Life Safety and Egress*, 2009 Linear Collider Workshop of the Americas (3461), Albuquerque, New Mexico, US, September 29 to October 3, 2009.
- J.A. Osborne, *European Tunnel Configuration*, 2009 Linear Collider Workshop of the Americas (3461), Albuquerque, New Mexico, US, September 29 to October 3, 2009.
- V. Kuchler, *Single tunnel, CFS aspects*, Accelerator Advisory Panel Review Meeting (4253), Oxford University, Oxford, UK, January 6-8, 2010.
- W. Bialowons and J.A. Osborne, *WP 5 ILC Siting in Europe Work Package Report*, ILC-HiGrade Sientific and Annual Meeting (4408), CERN, Geneva, February 25, 2010.

3.5 WP6 – High gradient cavities

Work package number	WP6		**Start date or starting event:**				1	
Work package title	Cavities							
Activity type	RTD							
Participant id	1	2						
Person-months per beneficiary	40.08	2.67						

The goals of the activities in this work package are focussing on reaching a high yield of superconducting cavities that perform at a high gradient. High-gradient cavities have been produced in the laboratory with gradients well above 30 MV/m. It is hence safe to assume that the manufacturing process of such cavities is sufficiently well understood to yield high performance cavities. To achieve a high yield in the production process thus necessitates high reproducibility of the manufacturing process and stringent quality assessment.

Several preparatory steps have been taken to improve the reproducibility of the production and to assess the properties of the cavities. Once established they will be exercised in the production of the cavities that are taken as test samples. To date ILC-HiGrade has been exercising the methods on existing cavities produced for the FLASH upgrade at DESY and for the preparation of the European XFEL.

3.5.1 Vertical test insert

Since the cavities will be transported several times between remote testing stations in Saclay and DESY it is important that the transport of the cavities introduce the minimum stress to the cavities themselves.

The transport frame developed in the first reporting period has thus been further examined. At the same time the resulting forces (accelerations) on various parts of the cavity have been extensively measured. Figure 3 shows the setup at the Institut für Beratung, Forschung, Systemplanung, Verpackungsentwicklung und -prüfung (BFSV) that concentrates on simulating the effects of a long distance road transport under controlled conditions. The tests of the prototype have shown promising shock absorbing performance using shock sensors. A deterioration of the test cavity gradient observed earlier on a XFEL-like cavity could be traced to the antenna used during the test. Overall satisfying results have been achieved.

The result of the test studies and the logistics at the receiving laboratories indicate that it will be more advantageous to transport individual cavities rather than four. Consequently the transport frame developed has been redesigned to house a single cavity. At the same time this approach adds to the flexibility of the installation. Such transport frames have also been tested under similar conditions.

Figure 3 Vibration test stand at the institute BFSV that carried out acceleration studies of the transport frame with the cavity under well-defined conditions.

3.5.2 Optical Inspection

The high-resolution camera system developed at KEK and Kyoto University, Japan continued to be used in exploring the inner surface of cavities in much detail. A large number of cavities have been examined at various stages of the manufacturing process. The goal is to identify the surface features that limit the gradient performance of the cavity. In 2009 an upgrade of the system introduced an even higher-resolution camera and an improvement of the illumination (LEDs) of the observation point, which is key to the clarity of the pictures.

More than 30 cavities have been inspected, often repeatedly to monitor e.g. the effects of particular surface treatments. A vast amount of images has been recorded manually and is available for visual inspection and serves as a sample repository for development of scanning algorithms. The recording process is time consuming and labour intensive. In this form it is hence not suitable for mass application.

Figure 4 shows the example of a cavity surface section that gave indications of a surface feature before the chemical treatment. The structure is more pronounced after bulk material removal during the electro-polishing step. After final treatment of the cavity the defect is clearly visible with the camera system. Under RF test a quench is observed. Such a picture shows the potential of the method and the need to develop sophisticated pattern recognition methods.

The camera is hence intended to be used both as a research instrument in the laboratory, investigating the defects that limit the accelerating gradient, as well as a possible part of quality assurance in cavity mass production. Included into the production process it can be a useful tool for detection of defects at an early point of time.

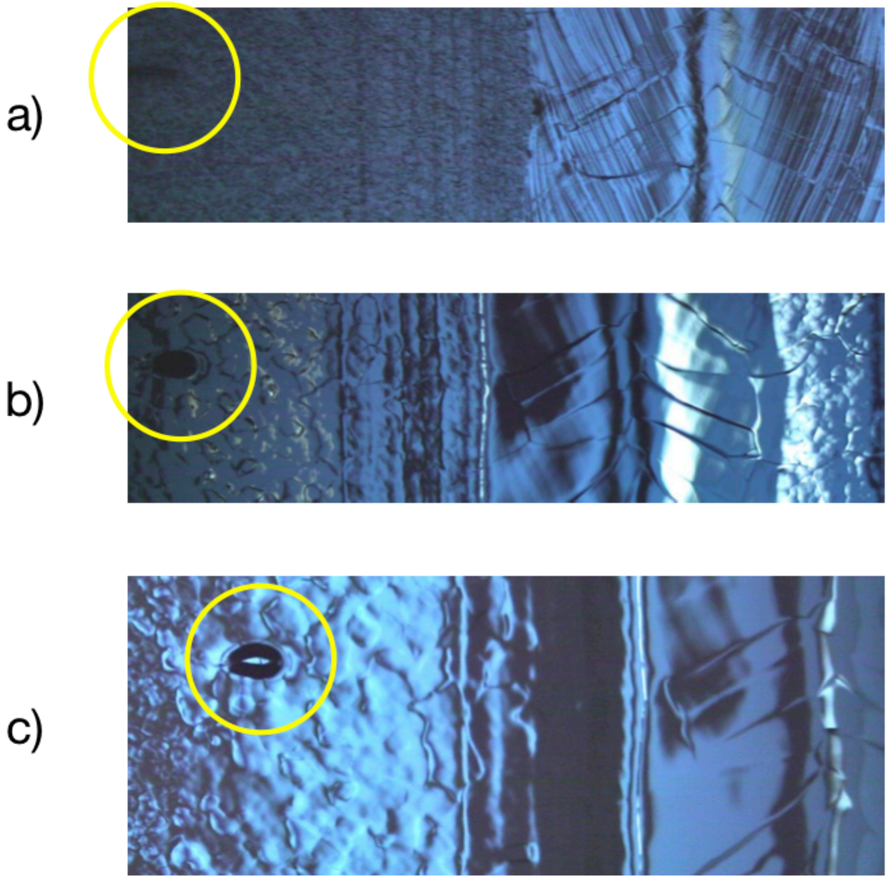


Figure 4 A surface defect (inside yellow circle) that could be traced through all stages of the preparation: a) before surface treatment, b) after bulk surface removal and c) after final treatment and RF-test. The size of the defect is ~0.5 mm.

In view of the potential of the method the decision had been taken already last year to automate the scanning process. The activities over the reporting period have yielded a design for the Optical Bench for Automated Cavity inspection with High resolution on short Timescales (OBACHT). A 3d-model of the design for OBACHT is shown in Figure 5. It consists of a stiff bench that carries the drive for a linear motor. The motor moves the cavity over the camera. The camera itself can be rotated by a separate drive. An optical guide system monitors the alignment of the camera so that it will not inadvertently touch the delicate inner surface of the cavity.

The design has significantly profited from the experience of the initial optical test bench. For the high-speed application mechanical rigidity is mandatory to reduced oscillations and consequently settling times before the next picture can be taken. The precision of the motors for longitudinal movements of the cavity and for the camera rotations has been matched to the required precision for the image resolution. The spatial resolution is of order 10 µm, a range that seems adequate for the limiting size of surface features that will sustain a cavity gradient of 35 MV/m. The respective tolerances have all been taken into account and resulted in the design of Figure 5. The ordering of parts is well advance and the construction and commissioning of the system is planned for the next reporting period.

It is expected that the processing time with roughly 1000 pictures for a single cavity can be reduced to 2-3 hours, a huge factor over the 2-3 days currently required for the manual operation.

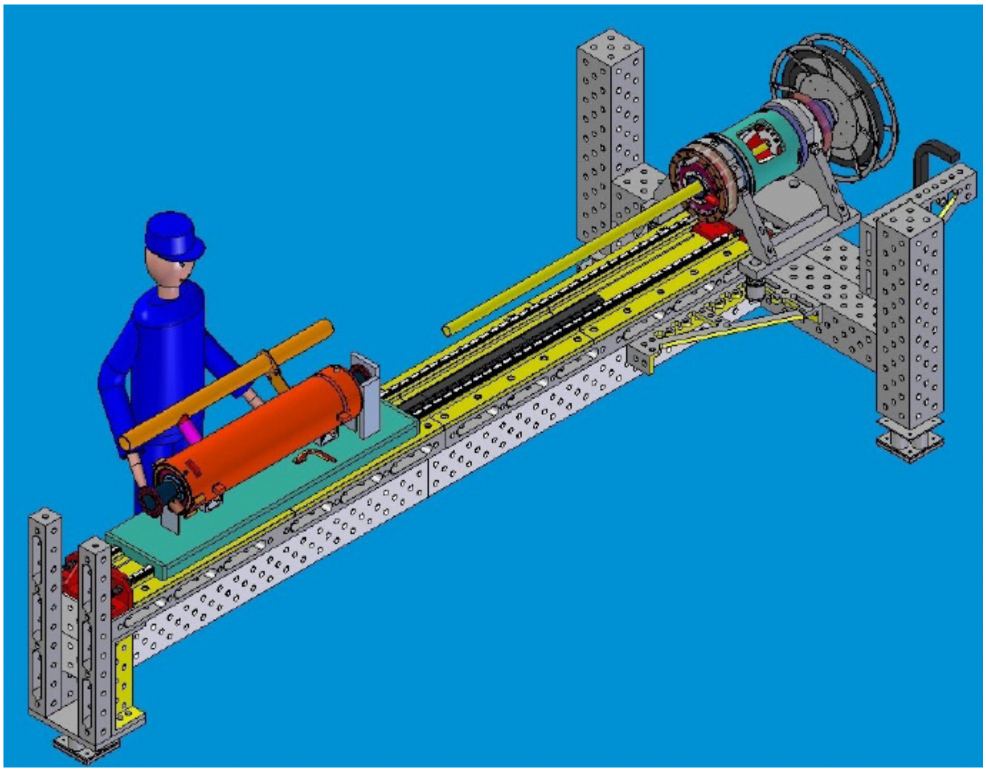


Figure 5 3d-model of the OBACHT setup for automated cavity inspection.

3.5.3 Second Sound System

Quench of the superconducting cavity is one effect that reduces the operational gradients. Such quenches occur when a surface structure or defect generates an excessive magnetic field that exceeds the critical field for the superconducting state. The quench induces a local heat injection that propagates through the Nb wall into the surrounding helium bath. A small amount of heat is sufficient to cause a phase transition from He II to He I. The phase transition propagates with a velocity of some 20 m/s through the helium – the so-called second sound. Similar to sound waves and a microphone these phase transitions can be capacitively recorded using oscillating superleak transducers (OST).

This effect is being exploited to locate the position of a quench without harnessing each individual cavity cell with a resistor grid, as is conventionally done. Currently the so-called vertical test stand is being equipped with individual OSTs to verify the performance of the method. The method has been pioneered at Cornell University on individual cells. The setup will allow with a relatively small number of sensors (less than ten) to make a triangulation on the second sound waves generated by a thermal quench of a superconducting cavity. This system is much more simple than the classical temperature mapping system composed of a complex setup of roughly 100 temperature sensors which have to be rotated around the cavity under test. Additionally, a permanent installation to the test cryostats is planned thus reducing the preparation time for the cryogenic cold tests. An interesting option to be tested in a prototype setup is the test of cavities equipped with a helium tank. If feasible, such system would enable testing of completely *dressed* cavities as a final verification of their performance. Experience has shown that while individual cells sustain very high electric fields the cavity quenches after completion of the mechanical structures despite of precautions taken in the assembly. This programme thus aids to diagnose the cavity gradient limitations for mass-produced cavities and the XFEL series production is a welcome additional testing ground.

3.5.4 Automated vertical testing

The throughput of cavities is also limited by the time required in the test cryostat. Again the procedure can be improved by automating the RF test, i.e. the measurement of the cavity quality factor Q versus electric field. Methods have been developed that eliminate manual adjustments and characterize the cavities in an objective fashion. New digital control and measurement units have been introduced and are compared to the installed analogue circuitry. The system is now under prototype test.

3.5.5 Vertical EP

At CEA a system for vertical electropolishing (EP) of cavities is under design. The goal is to simplify the operations of the most crucial surface treatment process needed for the superconducting niobium cavities, namely electropolishing. So far, most systems rely on a “horizontal” EP (cavity is placed horizontally), which necessitates a mechanical rotation of the cavity. The disadvantage of the setup is mechanical complexity over a system where the cavity is held vertically. In addition a vertical system allows for simpler draining of the process liquids. An initial design is produced (c.f. Figure 6).

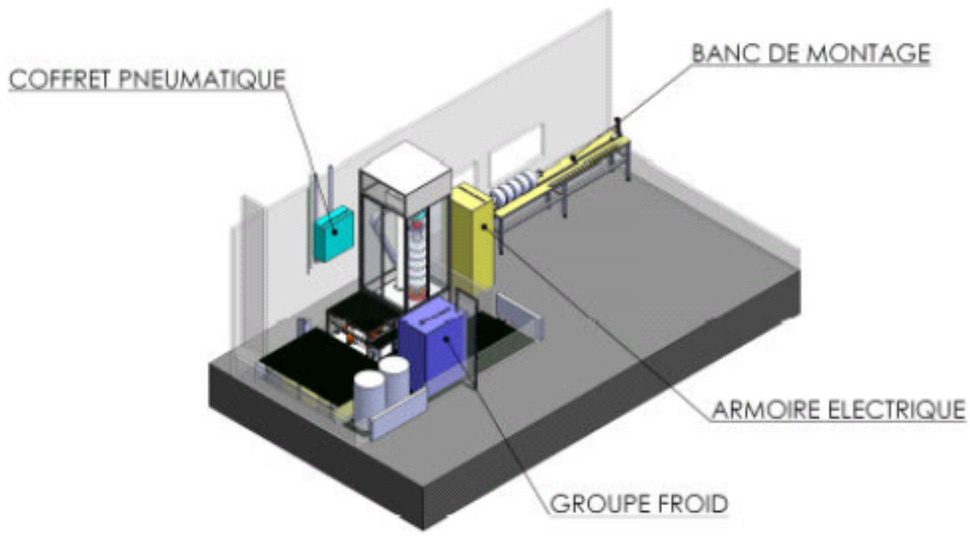


Figure 6 A sketch of the vertical EP facility currently being planned at CEA Saclay.

Meeting	Location	Frequency
Cavity Meeting	DESY including Phone Meeting	weekly on Wednesdays

Table 4: Regular Meetings of Work Package 6

3.6 WP7 – RF couplers

Work package number	WP7	Start date or starting event:				1
Work package title	Couplers					
Activity type	RTD					
Participant id	4					
Person-months per beneficiary	2.28					

3.6.1 Design

The high-power input couplers for the cavities have to transfer the power into the cavity. At the same time they provide the transition between warm exterior and cold interior of the cavity. Since the power loads are varied through the couplers they constitute a delicate piece of the SRF equipment and consequently of the cost.

3.6.1.1 Cost Reduction

A major effort in this reporting period went into reducing the cost of the couplers by systematic simplification and improvement. At the same time the reliability of the couplers during operation is a major issue that deserved special attention.

Figure 7 shows the synopsis the main modifications:

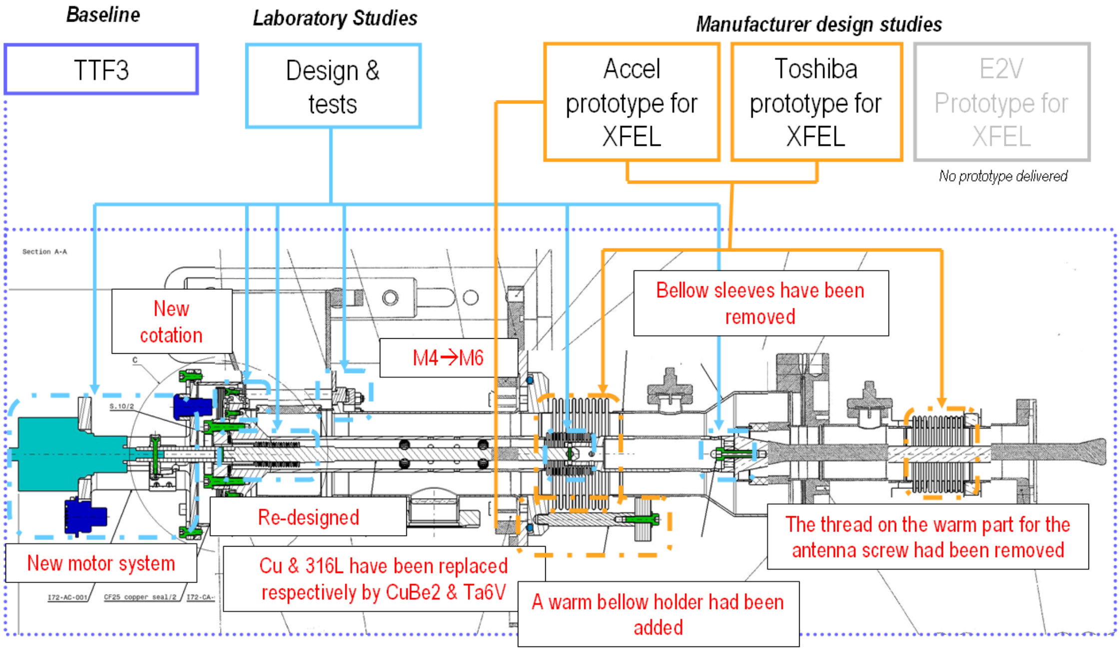


Figure 7 Synopsis of the design modifications of the coupler for 1.3 GHz cavities.

Starting from a TTF coupler design as a baseline several changes were introduced into the mechanical design following the series of tests: motor design, the dimensioning of components, the selection of materials. Some bellows were removed and simplified. The contacts with companies were particular useful to give early feedback on the prototype construction.

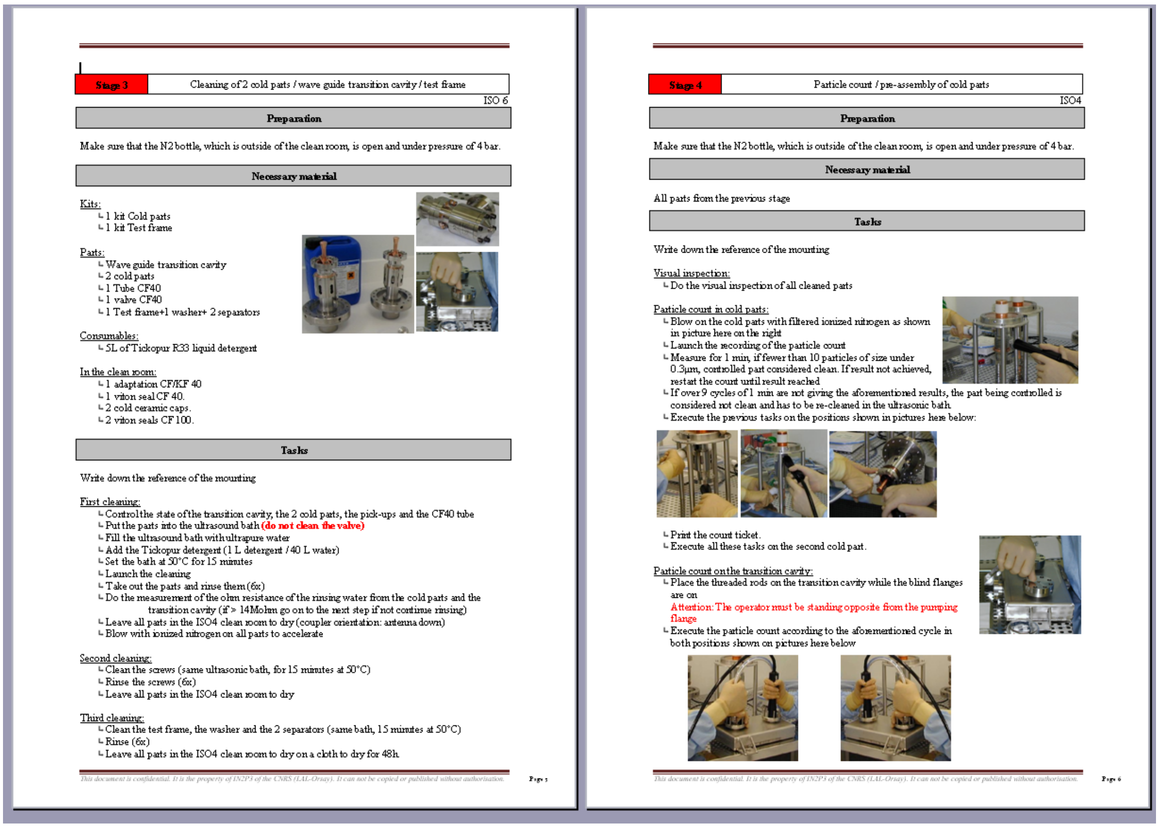
3.6.1.2 Quality improvements

A systematic approach has been chosen to address the quality of the cavity. The available database of all test records for coupler controls and conditioning (entire history) has been examined. The study revealed the faults that limited the performance of the coupler. The causes of these faults have been marked on the manufacturing drawing to gain a complete overview.

This fault collection phase has ended. The goal is now to implement the fault prevention measures with the manufacturers and to make sure that the high quality can be sustained. This activity will be a major element of the activities for the coming reporting period.

3.6.2 Industrialisation of the cleaning & assembling process

For the ILC, it will not be possible for a research laboratory to manage the cleaning and the assembling of 8000 couplers. It is thus mandatory that the manufacturers be made familiar with the required steps, which is why for ILC-HiGrade the subcontractor will be asked to manage these steps. To prepare this task the process was simplified as far as possible and fully documented. An extract of the written document: "TTF3 Fundamental Power Couplers - Cleaning and Assembly Procedure" is shown in Figure 8.



Stage 3 | Cleaning of 2 cold parts / wave guide transition cavity / test frame

ISO 6

Preparation

Make sure that the N2 bottle, which is outside of the clean room, is open and under pressure of 4 bar.

Necessary material

Kits:
- 1 kit Cold parts
- 1 kit Test frame

Parts:
- Wave guide transition cavity
- 2 cold parts
- 1 Tube CF40
- 1 valve CF40
- 1 Test frame+1 washer+ 2 separators

Consumables:
- 5L of Tickopur R33 liquid detergent

In the clean room:
- 1 adaptation CF/KF 40
- 1 viton seal CF 40.
- 2 cold ceramic caps.
- 2 viton seals CF 100.

Tasks

Write down the reference of the mounting

First cleaning:
- Control the state of the transition cavity, the 2 cold parts, the pick-ups and the CF40 tube
- Put the parts into the ultrasound bath **(do not clean the valve)**
- Fill the ultrasound bath with ultrapure water
- Add the Tickopur detergent (1 L detergent / 40 L water)
- Set the bath at 50°C for 15 minutes
- Launch the cleaning
- Take out the parts and rinse them (6x)
- Do the measurement of the ohm resistance of the rinsing water from the cold parts and the transition cavity (if > 14Mohm go on to the next step if not continue rinsing)
- Leave all parts in the ISO4 clean room to dry (coupler orientation: antenna down)
- Blow with ionized nitrogen on all parts to accelerate

Second cleaning:
- Clean the screws (same ultrasonic bath, for 15 minutes at 50°C)
- Rinse the screws (6x)
- Leave all parts in the ISO4 clean room to dry

Third cleaning:
- Clean the test frame, the washer and the 2 separators (same bath, 15 minutes at 50°C)
- Rinse (6x)
- Leave all parts in the ISO4 clean room to dry on a cloth to dry for 48h.

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Stage 4 | Particle count / pre-assembly of cold parts

ISO4

Preparation

Make sure that the N2 bottle, which is outside of the clean room, is open and under pressure of 4 bar.

Necessary material

All parts from the previous stage

Tasks

Write down the reference of the mounting

Visual inspection:
- Do the visual inspection of all cleaned parts

Particle count in cold parts:
- Blow on the cold parts with filtered ionized nitrogen as shown in picture here on the right
- Launch the recording of the particle count
- Measure for 1 min, if fewer than 10 particles of size under 0.3μm, controlled part considered clean. If result not achieved, restart the count until result reached
- If over 9 cycles of 1 min are not giving the aforementioned results, the part being controlled is considered not clean and has to be re-cleaned in the ultrasonic bath.
- Execute the previous tasks on the positions shown in pictures here below:
- Print the count ticket.
- Execute all these tasks on the second cold part.

Particle count on the transition cavity:
- Place the threaded rods on the transition cavity while the blind flanges are on
  Attention: The operator must be standing opposite from the pumping flange
- Execute the particle count according to the aforementioned cycle in both positions shown on pictures here below

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Figure 8 Example of the documentation of the two cleaning steps for the couplers

3.6.3 Conditioning

Couplers cannot easily be operated at full power without break-down. The respective conditioning at successively higher fields is a delicate process that requires many careful attempts and effectively is very time consuming.

3.6.3.1 *Industrialisation of the process*

The LAL laboratory always carried out the initial conditioning at room temperature of the fundamental power couplers. This conditioning is followed by the RF conditioning on the superconducting cavities within the cryomodule at room temperature; which in turn is followed by the RF conditioning with the cryomodule at operating conditions, i.e. at cryogenic temperatures. Performing an efficient RF conditioning at room temperature substantially improves the speed and reliability of the subsequent conditioning stages. Currently the industrialisation of the process is set up to deliver the couplers for one cryomodule per week, i.e. 8 couplers. Consequently one cryomodule per week and per production site can be delivered.

To reach this efficiency of RF conditioning the preparation stages have been carefully optimized and located. These various stages a coupler is required to pass are depicted in Figure 9.

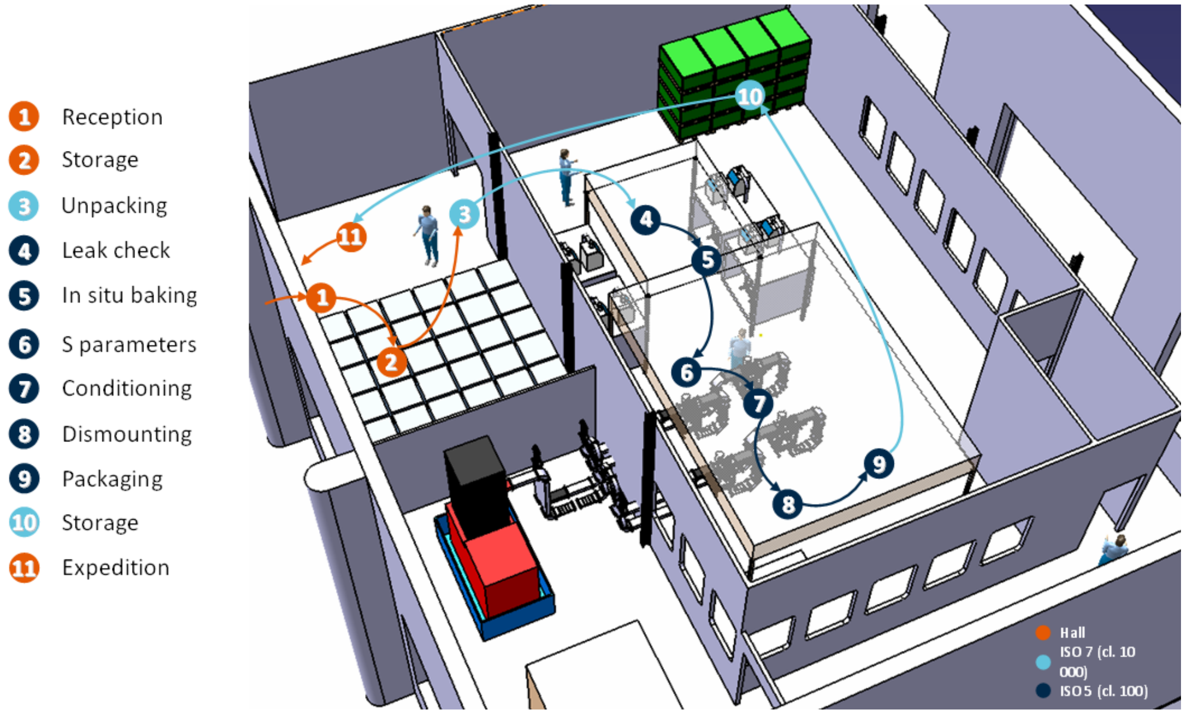

Figure 9 The complete coupler RF conditioning process optimized for industrial scale production

All parts of the infrastructure are designed to facilitate passing from one stage to the next, in particular the mounting and dismounting of the coupler pairs on the conditioning test lines. Most of the processing is taking place in an ISO5 clean room so as to prevent any risk of contamination of the couplers. A single power source of sufficient capacity was chosen so as to allow usage both for the RF conditioning and later on in the accelerator itself. The RF system has been dimensioned to simultaneously condition four coupler pairs in parallel. In case of higher time demands in the coupler conditioning the installation can be upgraded to condition up to eight pairs since each of the four initial lines can be equipped with two pairs in series.

3.6.3.2 *Conditioning in series*

The processing mentioned above has been optimized for industrial scale processing with a concentration of power source and simultaneous conditioning of several coupler pairs. Using the automated RF conditioning procedure one has to assess the influence of a slowly conditioning coupler pair on the other coupler treated in parallel. It is also necessary to measure the power loss between the first and the second pair, so as to be able to guarantee the operating capacity of both pairs.

Considerable efforts went into measuring this impact. The test required the installation of new extra equipment in terms of vacuum systems and the fabrication and use of a new digital card to include the extra signals for the control and steering of the automated procedure.

The power levels measured during coupler charging turned out to be approximately the same as for single pair conditioning. The results of the conditioning are given in the Figure 10 to Figure 12.

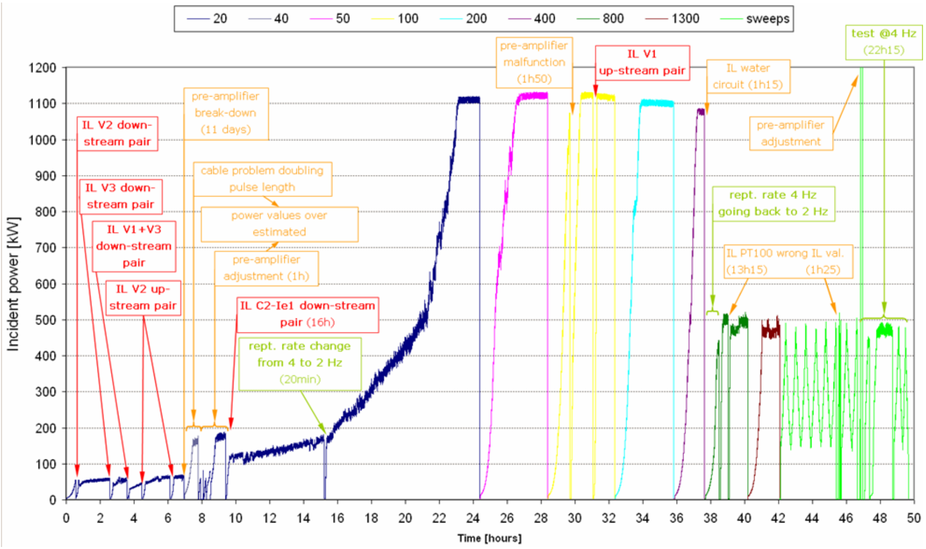

Figure 10 Forward power level variation during the series conditioning of the 2 pairs

Figure 10 illustrates the various steps of a complete powering cycle annotated with the various actions taken during the powering and the observations made during the cycle. The power levels reached for the pairs are indicated.

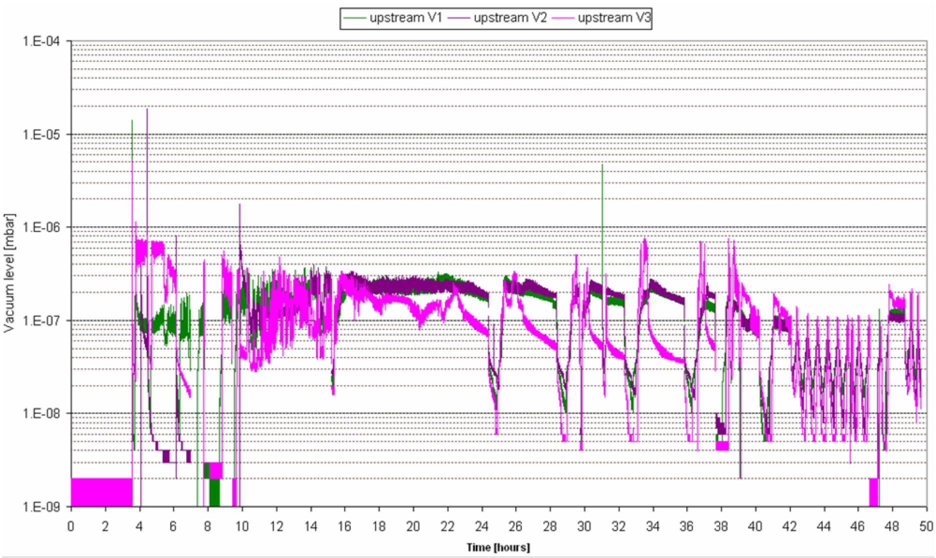

Figure 11 Variations of the vacuum for the first coupler pair exposed to the RF wave

The vacuum of the first coupler pair changes when the coupler is exposed to RF as is seen in Figure 11. However, the level stays generally well below 10^{-6} mb. The power levels at the corresponding time can be inferred from Figure 10. The respective variation for the second coupler pair is shown in Figure 12.

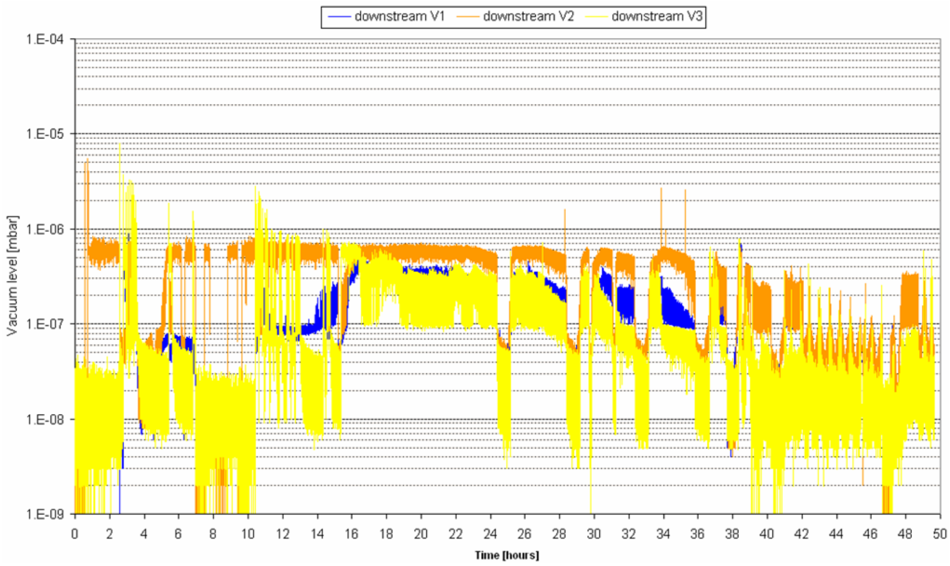

Figure 12 Variations of the vacuum for the second pair of couplers exposed to the RF wave

As can be observed from the results, it is the second pair that imposed the power increase speed. The regular procedure was followed by a series of power sweeps so as to validate the use of this conditioning method. This first test gives encouraging results, which are to be confirmed by the upcoming tests of conditioning coupler pairs in series.

3.6.3.3 Future Planning

The ILC-HiGrade coupler order will be added to the European XFEL order to profit from the standardized quality control and cost reduction of the European XFEL coupler mass production as outlined earlier. The current procurement schedule is shown in Figure 13.

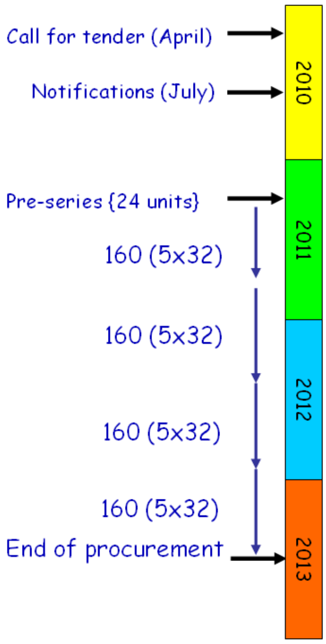

Figure 13 ILC-HiGrade & European XFEL coupler procurement schedule

Naturally this strategy introduces an interdependence of both projects both in time and cost. While the outcome of the cost of the couplers has to be waited for one can start to examine various scenarios:

1) The price of a coupler turns out higher than estimated and the apportioned ILC-HiGrade budget is too low to purchase 24 couplers. The budget gap should be from other sources.
2) The price of a coupler turns out lower than expected and the ILC-HiGrade budget is enough to purchase 24 coupler and 6 spare couplers.
3) The price of a coupler meets the expectations and the ILC-HiGrade budget covers the cost of 24 to 30 couplers.

The tendering process has been essentially delayed by one year so that the couplers will arrive later than scheduled. Nonetheless it is hoped that the couplers can be purchased before the ILC-HiGrade project comes to completion and that scenario 3 is the one that is met. More details will become known over the course of the next reporting period when appropriate action will be taken.

References

- E. Kako et al., “ADVANCES AND PERFORMANCE OF INPUT COUPLERS AT KEK”, Proceedings of SRF2009, Berlin, Germany

3.7 WP8 – Cavity tuners

Work package number	WP8	Start date or starting event:				1
Work package title	Tuners					
Activity type	RTD					
Participant id	5					
Person-months per beneficiary	18.8					

In the time frame considered in this report, significant results have been achieved in view of the demonstration of suitability of the tuner design in tests and establishment of a cost-effective tuner production that represent the final goal of this work package.

3.7.1 Tuner production

3.7.1.1 Manufacturing and room temperature acceptance tests

The international collaborations in which the LASA group is involved, particularly with Fermilab (US) and KEK (Japan), have been the initial test bench for the production of the revised design Blade Tuner. In fact this new Blade Tuner model has been chosen to equip the second cryomodule (CM2) of the ILCTA NML facility at Fermilab, therefore a total of 8 tuner units have been initially ordered and produced. This set of eight units have been manufactured by Ettore Zanon S.p.A. (Italy) and delivered to LASA by July 2008.

In March 2009, two additional units have been manufactured within the collaboration with Fermilab in order to equip the cryomodule C of the S1-Global project in KEK, Japan.

An accurate process of validation has been carried out for the ten units produced so far. It includes both a visual and dimensional check for all components and an experimental test procedure at room temperature based on an ad-hoc single cell test facility realized at LASA laboratory. Results for all the produced units are here presented.

As an additional safeguard (accidental plastic deformation could occur within this special test bench at high strain values) a limitation has been imposed to the tuning range measurement at room temperature. This range has been tested over up to 11 complete screw turns, an interval that sufficiently large for a conservative evaluation of the tuner performances.

Figure 14 the first set of 8 ILC Blade Tuner units produced

The physical strength of the Blade Tuners has also been verified by applying a compressive load of 10 kN to the tuner, the maximum allowed in our test facility for safe operation at room temperature.

The series of ten units has been thoroughly tested and the results have well confirmed the expectations, both in terms of homogeneity of produced units and in terms of correspondence with FEM predictions. In both cases results are within a 5% error, a tolerable discrepancy. It should be noted that for the FEM idealized constraints (infinitely rigid drive unit, for instance) have been used. Data are presented in Figure 15 and Figure 16; they are related to tuner stroke measured as average displacement at position of the piezo actuators.

Moreover the tuner stiffness was evaluated in operative conditions, i.e. when the load was transferred through the piezo elements to the cavity. Also in this case the experimental results are encouraging, confirming the numerical simulation data where the estimated stiffness is greater than 30 kN/mm on almost the entire tuning range.

Figure 15 All results collected for tuning range measurements, in terms of tuner stroke, for produced ILC design Blade Tuners.

Thanks to the data collected a direct comparison with the tuner stroke expected by FE simulation was possible. This comparison is presented in the plot of Figure 16.

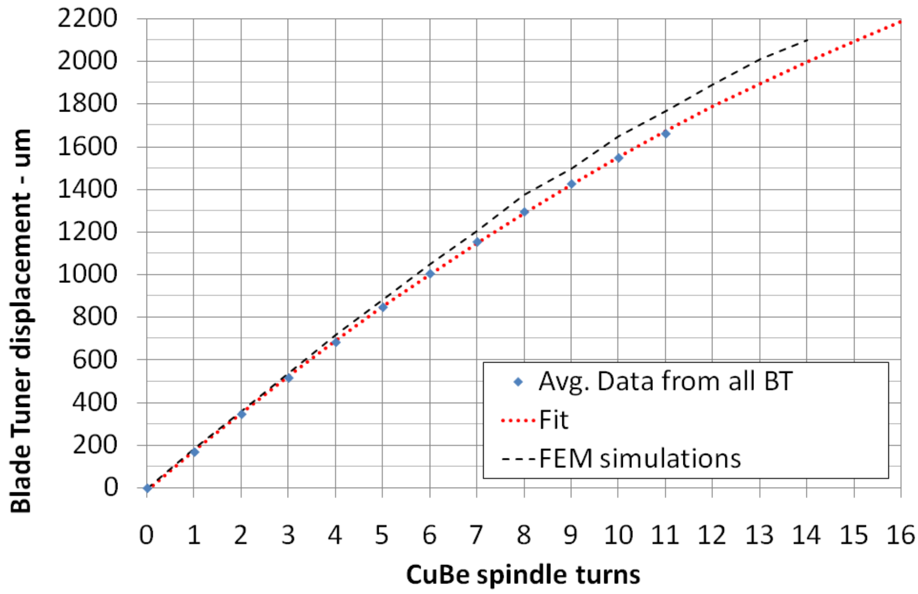

Figure 16 Comparison of data average from acceptance tests and expectations from FEM analyses produced units.

3.7.1.2 Toward the second production set

The production of the first set of ten new Blade Tuners for the projects at Fermilab and KEK has been a rich and fruitful experience and the incoming ILC-HiGrade production will take full benefit from it. As of today a first ILC-HiGrade Blade Tuner set composed of six units has been purchased from the same manufacturer (E. Zanon). The delivery is expected by April 2010.

In view of this additional purchasing several interactions with the manufacturer have been conducted by the end of 2009. The aim has been to thoroughly analyze the manufacturing procedure adopted for the first set and optimize it as much as possible. This joint activity positively concluded with a significant impact on the Blade Tuner unit cost as well as improvement on the quality of the final product.

This has been achieved with a thorough review of major tuner manufacturing issues:

- Machining procedure for the Blade Tuner semi-rings, including acceptance test at the manufacturer to verify the correct shape.
- Handling of the blades before welding to the tuner rings, in order to simplify the mounting and save time.
- Review of the explicit tolerances in the tuner drawings, including adding few new ones that were critical and removing other non-fundamental ones.

A first feedback about this optimisation introduced will come with the next tuner production. If proved to be effective this will be a major step forward, especially within the ILC-HiGrade WP8 task.

3.7.2 Cold testing at BESSY

3.7.2.1 Cold test at setup at BESSY

The existing cavity Z86 has been tested once again inside HoBiCaT horizontal facility for CW superconducting cavity testing at the BESSY laboratory in Berlin. The Z86 has been equipped with one of the revised design ILC Blade Tuner recently produced. The purpose of the test was the evaluation of the piezo tuner and possibly a deeper investigation of the lower range properties both for the tuner and the piezo elements. In order to install the new Blade Tuner into the old helium tank of the Z86 cavity several special stainless steel parts have been realized and installed between the tuner body and the tank ring as well as between the piezo actuators and their supporting rods. Specific test conducted at LASA on the same configuration confirmed that no modifications are introduced by these additional elements.

In series to the Z86 cavity, a huge and massive SQUID type dark current monitor (CCC) has been installed for a parallel experiment. No bellows have been inserted between the cavity and the CCC that is sliding over the HoBiCaT reference support, joint to the cavity. Special spherical supports have been installed to sustain the CCC load of about 30 kg. As a result this led to an increase of the inertial mass for the tuner by the same amount.

The room temperature installation was performed at the middle of December. Two NOLIAC piezo SCMA/S1, 40 mm long, have been used as active elements.

The cold piezo tuner test occurred at the mid of January 2010 and lasted one full week. The cavity frequency at stable cold condition (T=1.8 K, bath pressure 16.05 mBar) was 1299.852 MHz. Before starting the planned measurements, an ”alive and kicking” test on the piezo-ceramics has been performed to check the effectiveness of their capability of tuning the cavity. This is accomplished by measuring piezo capacitances and exciting each piezo one at a time, recording the frequency shift, as shown in Table 5.

Piezo # 2			**Piezo # 1**	
V piezo [V]	**f0 [MHz]**	**Δf [Hz]**	**f0 [MHz]**	**Δf [Hz]**
0	1299.851816		1299.851970	0
50	1299.852075	259	1299.852292	322
100	1299.852526	710	1299.852874	904
0	1299.851974	158	1299.852206	236
	C [μF]	2.516	C [μF]	2.521

Table 5 piezos “alive and kickin’” test

The piezo Blade Tuner once installed on the Z86 cavity is shown in the following pictures.

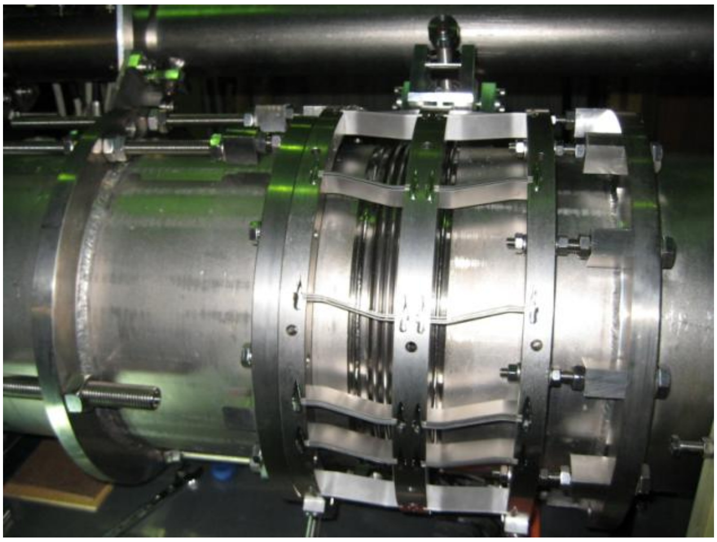

Figure 17 T the new ILC Blade Tuner installed on the Z86 cavity. The adaptation elements are also visible.

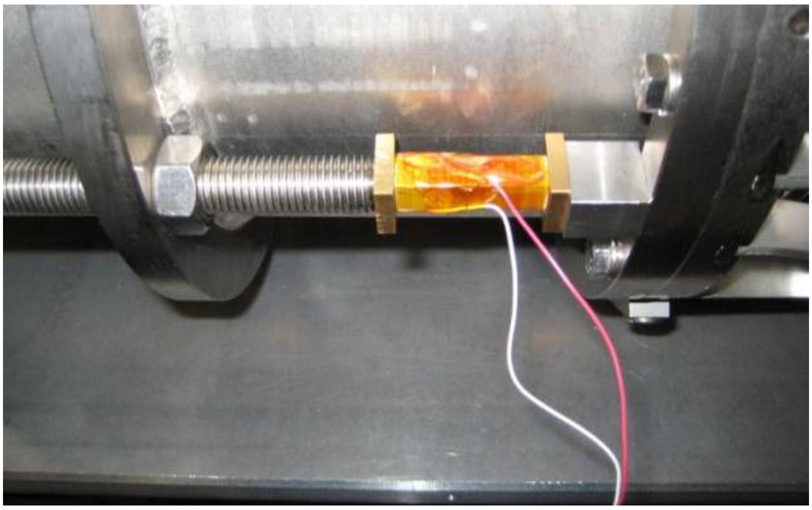

Figure 18 One of the two Noliac piezo-ceramic actuators in place

The cavity is closed inside a Phase Locked Loop (PLL). The frequency variations are read both with the use of a frequency meter and with the PLL loop error signal (input to the EXT FM port of the frequency synthesizer). This latter method, once the frequency modulation coefficient [f/V] is set and with the help of remote acquisition and averaging, allows the tracking of frequency shift of the order of Hz with very high reproducibility. This method has been used extensively for low range tuner stability investigation. On the other hand, the sensitivity of the frequency meter itself is of one tenth of a Hz. As a result the actual resolution for the frequency measurements is highly dominated by the stability of the helium bath pressure.

The motor driver is a commercial Phytron device, with output current capability up to 2.5 A, the half-step driving scheme has been used. The piezo drivers are a Piezomechanick high voltage piezo amplifier, for 200 V piezo driving operation, and a PiezoJena 150 V device, but with higher output current capability, for parallel high voltage piezo driving. The voltage input to the piezo-amplifier can be set via the offset knob on the amplifier, or by an external function generator for piezo pulsed tests.

3.7.2.2 Motor and piezo tuning range results

The starting motor setting is 800 Hz motor frequency, 0 A stop current, 2 A output current. The same motor driving unit of the previous Z86 cold test has been used. The motor coil has 200 windings and the reduction ratio of the planetary gear is 100, therefore exactly as for the previous prototype test, a total of 20000 full-steps are required for one complete motor screw turn. The installed motor screw has a pitch of 1.5 mm.

As a first measure, the coarse tuning range has been acquired. Resulting plot is presented in Figure 19.

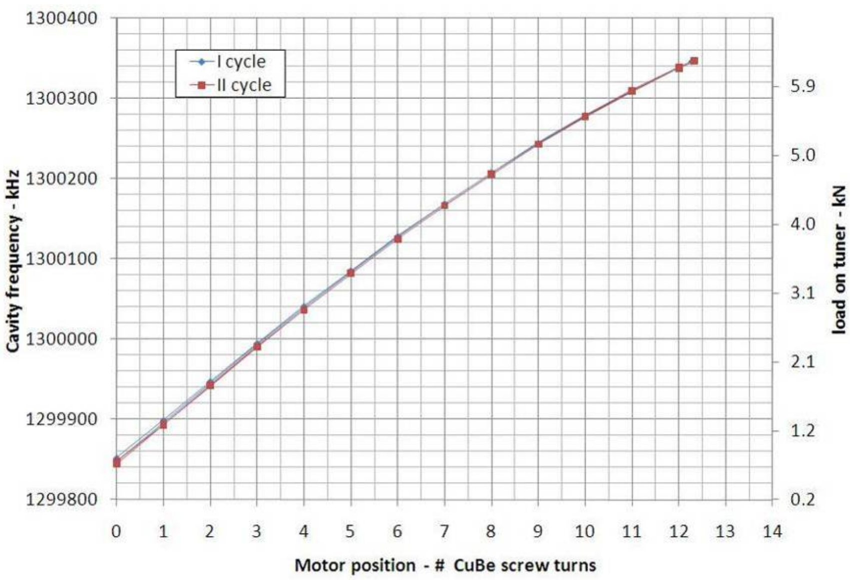

Figure 19 resonant frequency range and load on tuner vs. motor displacement, expressed in screw turns

During the first forth-and-back tuner cycle, no hysteresis has been observed on the scale of the coarse tuning range, which is very small indeed. A second full cycle has been performed with 2.5 A feed current to the motor. The two plots coincide. A tuning range of 500 kHz has been reached with 12.5 screw turns, with a sensitivity spanning from 2.5 to 1.5 Hz/step. Due to the limitations of the current test setup (and to the presence of the CCC) the tuning range test has not been further extended to the nominal 14 screw turns.

After this test, the tuner has been set at the position corresponding to the nominal working frequency of 1300 MHz and the tuning reproducibility on a smaller range has been investigated. In order to evaluate the amount of backlash in the system a ± 1000 steps spanning curve has been initially acquired, resulting plot is shown in Figure 20.

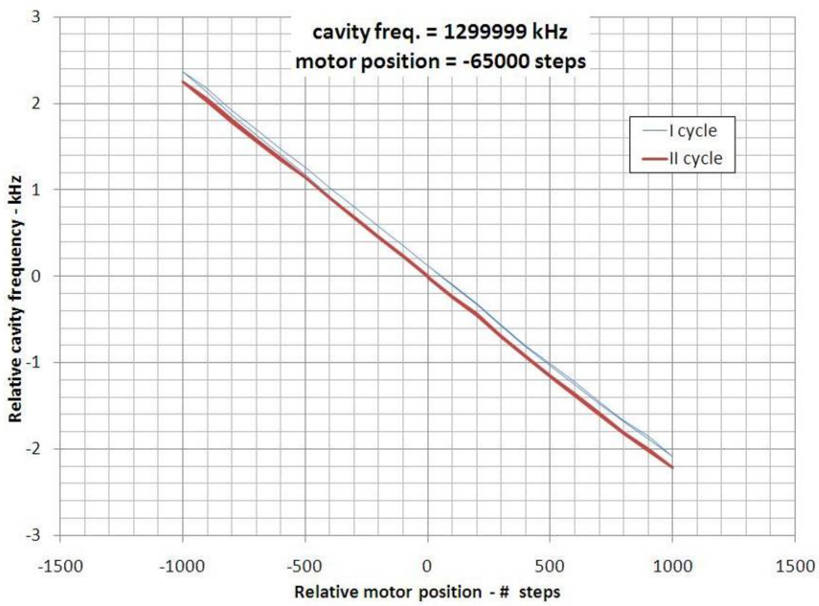

Figure 20 frequency shift around 1.3 GHz for ± 1000 steps around stable motor position

The plot in Figure 20 shows a very good reproducibility and almost no backlash on this scale. Subsequently the same test has been repeated for shorter range of cycling, namely ± 60 steps around 1.3 GHz position (Figure 21).

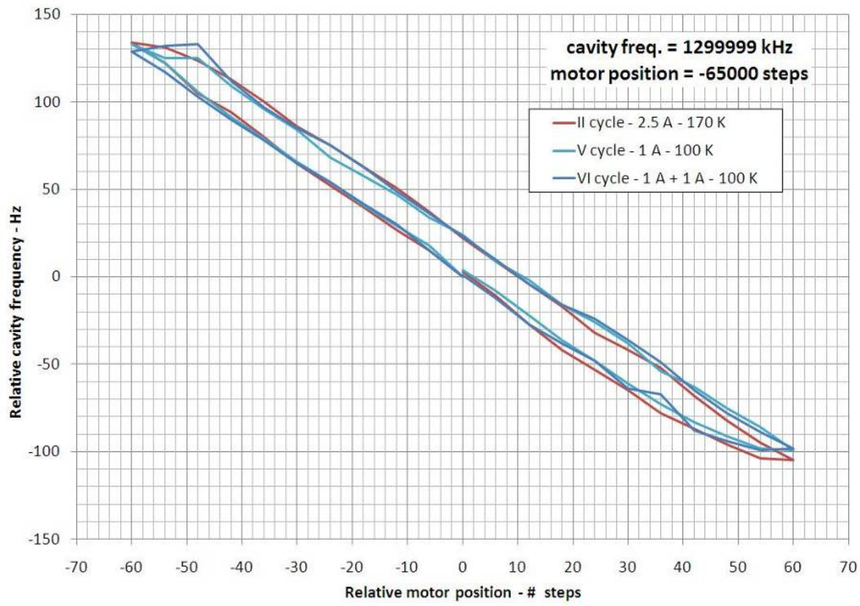

Figure 21 Frequency shift around 1.3 GHz for ± 60 steps around stable motor position. Motor performance was possible at nominal setup with no step losses. Turning on stop current has not influent on the backlash.

In order to obtain the data shown in Figure 21, several tests have been performed within this range, with different motor setups. The second cycle is performed with the same settings as the coarse tuning tests, except for the motor temperature, that normally is kept well below 100 K (no thermal short circuit has been provided for the motor). The cycle # 5 is performed with run current of 1 A, i.e. the nominal motor driver set up, while the last cycle has been performed with 1 A stop current, normally kept at zero. The latter cycles have been performed leaving the motor body temperature to settle at 100 K (after one night). The results of this test are more than satisfactory: the three loops coincide. It is definitely possible to conclude that the overall amount of backlash in the tuning system in lower than 10 Hz, correlated curves are reproducible and drift is observed.

Finally, in order to evaluate piezo actuator static performances, each piezo is fed by the piezo-amplifier using the DC offset capability up to its maximum nominal drive voltage. Eventually both piezo are fed together, in this latter case 5 kHz of frequency shift has been achieved for 200 V of input voltage. The acquired plots are shown in Figure 22. As already observed during the tuner prototype tests the piezo-ceramic intrinsic hysteresis behaviour is clearly visible.

The test is then repeated for different working points, the aim is to investigate the performances of piezo actuators for different value of mechanical load applied. The load is generated as an elastic restoring force by tuning the cavity to a different length with the stepper motor. Results are completely aligned with expectations by piezoelectric effect theory: since the overall load is well below the load limit of piezo stacks their performances are only slightly affected by the external load.

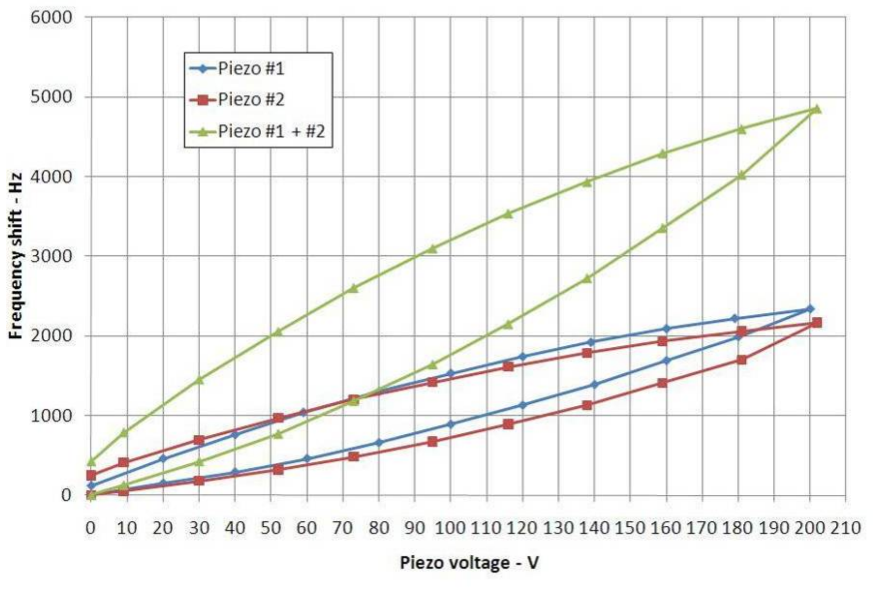

Figure 22 frequency shift due to piezo DC voltage excitation up to maximum nominal values

As a way to directly measure the efficiency of the coupling of piezo to cavity at a sub-micrometer level, the cavity has been phase-locked at 1.3 GHz with 500 Hz/V frequency modulation index and the piezo have been driven in parallel with a sine wave of 5 Hz frequency and varying small amplitude. Results shown in Figure 23 reveal an extremely smooth coupling, free of any sticking or threshold effect.

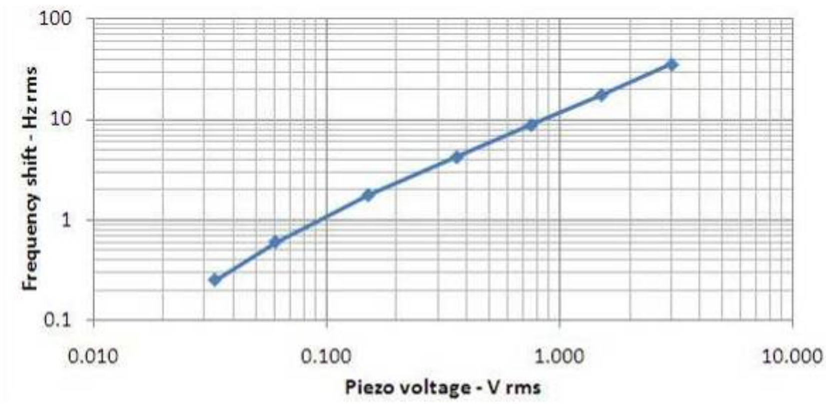

Figure 23 frequency shift detected with low signal harmonic piezo voltage excitation

A lock in amplifier is used for this measurement. The piezo feeding voltage is generated by the lock in amplifier, which reads the PLL error signal in input at the EXT FM port of the synthesizer. The lowest point in the graph is about 0.5 mV RMS error signal and this remarkably means that a 0.25 Hz RMS of frequency shift is detected.

3.7.3 Blade Tuner installations and ongoing projects

3.7.3.1 CM2 at Fermilab

The second cryomodule for the ILC-TA facility at Fermilab, also named CM2, will be fully equipped with Blade Tuners. These will be the first cavity units specifically designed for Blade Tuner, including a new helium tank design, new magnetic shielding and MLI wrapping. A joint activity has been conducted during these last two years by Fermilab and LASA groups to address these issues and define a consistent and robust cavity unit design. A CAD drawing is shown in Figure 24.

As of today six complete tuner units out of the eight needed for CM2 are already at FNAL, the two remaining units are being shipped at the time of the writing of this document.

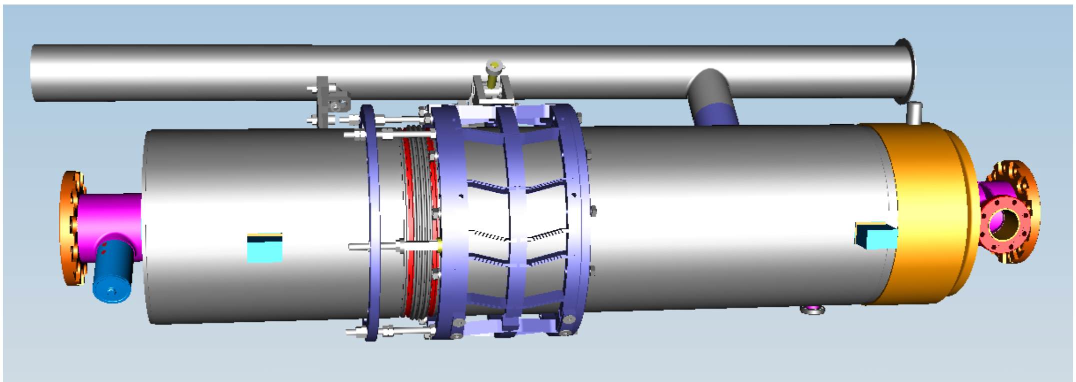

Figure 24 CAD view of a complete cavity unit equipped with ILC Blade Tuner

The first units of new helium tank have been manufactured and 3 cavities have been equipped. Tuner installation has been completed for two cavities, the latter being right now in HTS horizontal cryostat for cold testing. Tuner testing results will be available for publishing within the following weeks.

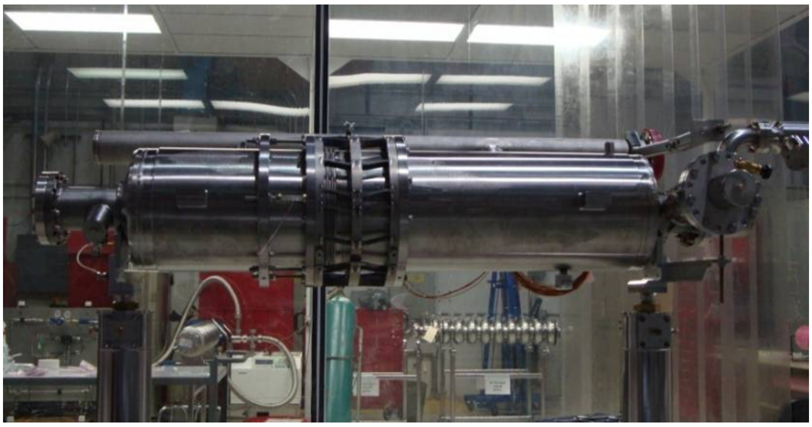

Figure 25 the actual complete cavity unit at FNAL, with Blade Tuner installed

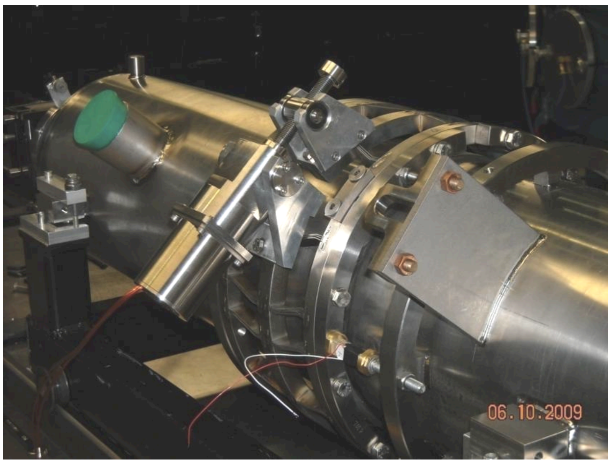

Figure 26 A close view of the Blade Tuner installed on the helium tank specifically designed for the CM2 at FNAL

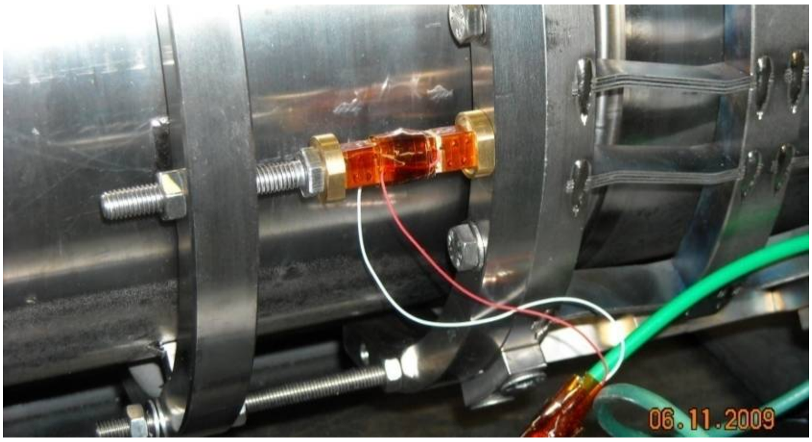

Figure 27 one of the piezo fast actuators installed

3.7.3.2 S1-Global at KEK

The S1-Global (S1G) project in KEK (Japan) aims to demonstrate the effective cryomodule operations at the ILC goal gradient. This result will be addressed by two sample cryomodules that will also provide on line comparison of different cavity and cold tuning solutions: a step toward the concept of plug-compatibility.

Cryomodule C of the S1G project is designed as a four cavity vessel with an unique mixed configuration; not only cavities from different manufacturer are installed but also two different cold tuning systems within the same cold string.

Namely the module is composed by:

- Cavity number 1 from AES company (US), equipped with Blade Tuner
- Cavity number 2 from Accel company (Germany), equipped with Blade Tuner
- Cavities number 3 and 4 from E. Zanon company (Italy), equipped with the latest model of DESY FLASH tuners

Two complete Blade Tuner units have been shipped and delivered to KEK by the end of 2009. The complete installation of all four tuning systems on the cold string took place on February 2010, a joint group composed by experts from INFN, FNAL and KEK took charge of all operations.

The cold string installation experience has been positive. During installation minor problems emerged, in particular a starightforward machining on two of the tuner connecting plates was required. This issue will be taken into consideration and eventually ad-hoc modifications will be introduced in the design of these specific elements.

The resonant frequencies of all the cavities have been continuously measured and the tuner installation has been safely concluded for the cavity without introducing additional and unwanted frequency shifts. The two pairs of Noliac SCMA/S1 40 mm actuators have been installed and, once the suspensions of the entire cold string over the gas return pipe were completed, finally preloaded. The amount of preload was set differently between the two cavity equipped with Blade Tuner (AES4 and ACC11) in order to cope with the different starting frequency of the two cavities that in both cases was higher than required by Blade Tuner nominal specifications. Cavity frequencies before and after tuner installation and piezo preloading are summarised in Table 6.

cavity	Frequency after BT installation	Frequency before piezo preloading	Frequency after piezo preloading	Total preload	
	MHz	MHz	MHz	kHz	kN
AES004	1297.341	1297.362	1297.412	50	0.9
ACC011	1397.262	1297.313	1297.413	100	1.8

Table 6 Blade Tuner cavity frequencies recorded during tuner installation

Some impressions of the Blade Tuner installation and cold string preparation are shown in the following pictures Figure 28, Figure 29 and Figure 30.

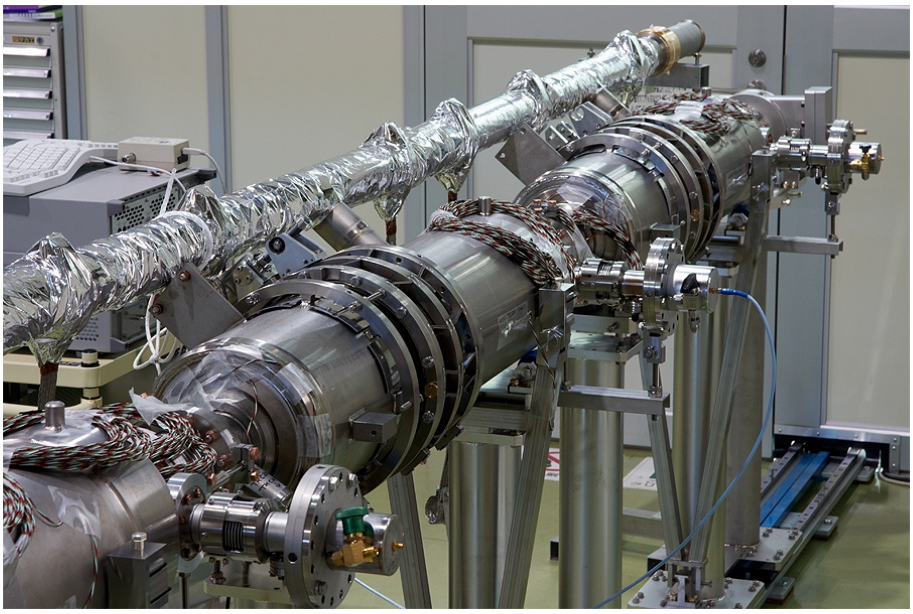

Figure 28 The two cavities of the S1-Global cold string equipped with Blade Tuner

Figure 29 A closer view of the motor drive unit installed for the Blade Tuner

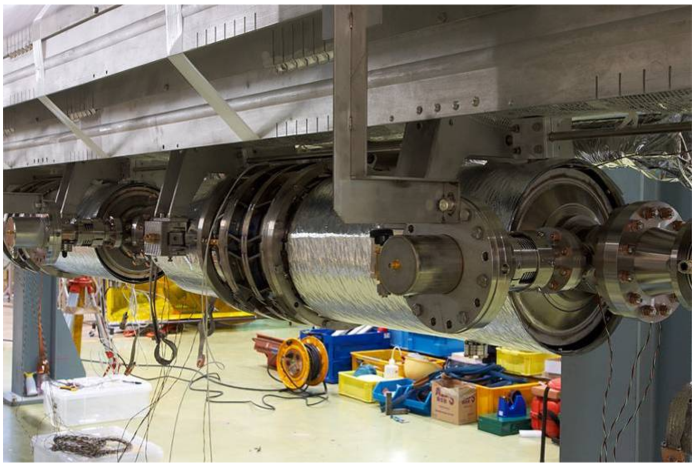

Figure 30 One of the Blade Tuner cavity suspended on the cold mass of the cryomodule

The cavity supports existing at KEK revealed not to be fully compatible with the design of magnetic shielding parts for the two Blade Tuner equipped cavities. In the meantime this problem has been addressed and solved by splitting the installation of magnetic shielding in two different stages, before and after cavity suspension to the cold mass. At the end the schedule initially foreseen for this activity has been fully matched.

Before considering the installation as completed, each tuning system has been subjected to a basic acceptance test after installation: frequency shifts induced by motor unit and by piezos have been measured with the use of a network analyzer, a small displacement has been imposed in both cases for safety reasons. Results of this validation measurement are presented in Table 7.

cavity	Motor action	Meas. Response to motor	Piezo action	Meas. Response to piezo
AES004	17600 steps (1 turn)	+26 kHz	200 VDC	+15 kHz
ACC011	17600 steps (1 turn)	+31 kHz	200 VDC	+18 kHz

Table 7 results of the Blade Tuner acceptance test after installation on the cold string

Although this measurement is subjected to a large error due to the very large cavity bandwidth at room temperature, the results were satisfactory and in agreement with the expectations.

3.7.4 Summary of Tuner Developments

After the intensive activity with Blade Tuner prototypes performed since 2008, the production and the experimental validation of the new Blade Tuner devices could be successfully initiated. The design has been revised and optimized for the ILC.

As of today a large amount of data and information are already available concerning tuner manufacturing as well as experimental characterisations both at room temperature and at cold. Further tests of the Blade Tuners are planned complete the experimental characterisation of the ILC Blade Tuner.

Indeed horizontal test are ongoing at Fermilab at the HTS horizontal cryostat, results will be soon available for publishing. Moreover between June and July cold testing is scheduled for the S1-Global cryomodule at KEK, this will be an outstanding testing environment with one entire month of low power CW operations specially intended for cold tuning measurements.

4 Deliverables and milestones tables

4.1 Deliverables (excluding the periodic and final reports)

The following deliverables were due during the reporting period. No other deliverables from earlier or later periods were added.

TABLE 1. DELIVERABLES[3]

Del. no.	Deliverable name	WP no.	Lead beneficiary	Nature	Dissemi -nation level	Delivery date from Annex I (proj month)	Delivered Yes/No	Actual / Forecast delivery date	Comments
2.2	Organisation of GDE Mtg, 1st and 2nd ADI Workshop	WP2	6	R	PU	18	yes	15 and 22	GDE Accelerator Design & Integration Workshops held at DESY[4]
5.1	Siting Study	WP5	3	R	PU	24	yes	24	ILC-HiGrade-2010-004-1 [5])
6.1	Cavity Process	WP6	1	R	PU	24	yes	24	ILC-HiGrade-2010-005-1 [5])
7.1	Coupler Report	WP7	4	R	PU	24	yes	24	ILC-HiGrade-2010-002-1 [5])
8.1	Tuner Report	WP8	5	R	PU	24	yes	24	ILC-HiGrade-2010-001-1 [5])

[3] For Security Projects the template for the deliverables list in Annex A1 has to be used.
[4] The web-pages are accessible at http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=3526 and http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=4255.
[5] Report separately supplied.

4.2 Milestones

TABLE 2. MILESTONES							
Milestone no.	**Milestone name**	**Work package no**	**Lead beneficiary**	**Delivery date from Annex I**	**Achieved Yes/No**	**Actual / Forecast achievement date**	**Comments**
3	European Site Preparation	WP5	3	12 or 24	yes	24	ILC-HiGrade-2010-004-1 [5])
4	MAC[6] Reports 2 and 3	WP2	6	18 and 30	yes	15 and 21	[5])
5	Development of new Governance Structures	WP4	6	18	yes	24	Included as part of the Work Package description of this report, cf. section 3.3

[6] Since 2007 the Machine Advisory Committee (MAC) has been recreated by the International Linear Collider Steering Committee as the Physics Advisory Committee (PAC). The PAC met in Vancouver, Canada in May and in Pohang, Korea in November 2009.

5 Project management

Work package number	WP1	Start date or starting event:				1	
Work package title	Coordination of European GDE Activity						
Activity type	MGT						
Participant id	1						
Person-months per beneficiary	12						

5.1 Organisation of the Consortium

Overall the work inside the consortium proceeded smoothly. The individual activities in the work packages are described in the preceding chapters.

The 2nd Annual meeting was held at CERN, Geneva, Switzerland on February 25, 2010. It showed impressive progress and new developments in many areas. The results are condensed into this Annual report.

The Coordinator, who was in contact with the respective partners, had initiated the reporting process earlier. The financial statements were received and entered into the FORCE tool. Given the respective spending profiles formal audits were only necessary for one partner, namely DESY. The partner CERN carried out the formal audit nevertheless, as in the previous year.

5.2 Financial Reports

Global considerations with the financial reporting method of one partner[7] led to delays in the acceptance of the first Annual Report by the European Commission. These concerns extended beyond ILC-HiGrade and had to be settled on a wider scale. Effectively the financial reports for the first and second reporting period for this partner had to be modified and resubmitted, a process that caused delays for all the partners.

5.1 Use of ILC-HiGrade webpage

The ILC-HiGrade webpage continues to be used as a tool for communication. Most of the activities are described in the Outreach Work package 4. Some of the webpages, notably affecting governance issues, find themselves on webpages with restricted access. These issues are not yet disclosed since they are in a developing stage. Results and conclusions of those meetings that are interesting for a wider audience are made accessible to everyone.

5.2 ILC-HiGrade embedded in European Infrastructure Discussion

ILC-HiGrade entered the ESFRI-list of Research Infrastructures via the CERN Council Strategy document that represents the European strategy for particle physics. For the development of the ILC project it is thus important to follow the strategic decision of CERN Council concerning its future plans. As the LHC is being taken into operation key decision on the future of the field will be taken. ILC-HiGrade is well embedded into this process as is being evidenced by the participation in various bodies below. It is also important that the Secretary of the Strategy Group of CERN Council takes part in the meetings concerning the development of Governance Structures for the International Linear Collider.

[7] The partner CNRS had estimated the personnel effort on an average cost methodology. This assumption was later challenged.

5.2.1 ECFA

ECFA, the European Committee for Future Accelerators, is the representation of users of accelerator projects in Europe. It regularly pays visits to the countries participating in High Energy Physics and reports on the involvement of these countries. ECFA discusses future accelerator projects. The European GDE director and Work Package 4 coordinator, B. Foster, made regular presentations at the ECFA meetings and ILC-HiGrade was well represented.

5.2.2 Other Global Projects

ILC-HiGrade maintained the contacts to other large Research Infrastructures. The report of Work Package 4 indicates the assessment of Governance structures for cognate projects. The specific contact to SKA is mentioned in Work Package 5 for the methodology on site selection and selection criteria, where a common meeting was held.

5.2.3 Initiatives of the European Commission

The initiative of building European Research Infrastructures, defining their operational status and regulating the participation of foreign institutes is thus very important. It was very much welcome that the ERIC framework for a European approach has now been released which includes the assessment of tax regulations etc. However, for the ILC, this European framework has to be expanded into a global framework.

The European Commission has organised two meetings in Brussels to foster the exchange of experience and best practices between the various Preparatory Phase Projects of the ESFRI-list. ILC-HiGrade has taken part in both of these European Research Infrastructure (ERI) meetings. A recurring topic naturally consists in how to facilitate the transition from preparatory to construction phase. Despite of all discussions and consensus building in the consortia the key issue is that of hosting the infrastructure where one country will have to assume a special role. The challenge is particularly large for a global endeavour, such as the International Linear Collider.

5.3 Meetings organised or attended

The list of meetings that are of relevance for the consortium as a whole is summarized in Table 8.

Meeting	Venue and Date	Purpose
1st Scientific Meeting (already mentioned in previous report)	Orsay, 6.3.2009	Presentation of the results of ILC-HiGrade and preparation of presentation for Annual Report
1st Annual Meeting (already mentioned in previous report)	Orsay, 6.3.2009	Preparation of the Financial Statements, discussion Management of the project and communication.
TILC09 Joint ACFA Physics and Detector Workshop and GDE Meeting on International Linear Collider and Accelerator Advisory Panel Review Meeting	Tsukuba, Japan, 17.-23.4.2009	Representation of the ILC-HiGrade activities in the Global context and during the Review.

85th Plenary ECFA and Joint EPS-ECFA	Cracow, 18.7.2009	Representation of ILC-HiGrade in the European Context
ERI Meeting	Brussels, 6.2.2009	Exchange of experience between PP projects
Linear Collider Workshop of the Americas	Albuquerque, US, 29.9.-3.10.2009	Status of the Global Project and the role of the regional activities
European Research Area Conference	Brussels, 21.-23.10.2009	Strengthening the collaboration for research in Europe
ERI Meeting	Brussels, 30.10.2009	Exchange of experience between PP projects
ECFA Meeting	CERN, 26.-27.11.2009	Representation of ILC-HiGrade in the European Context
2nd Scientific Meeting	CERN, 25.2.2010	Presentation of the results of ILC-HiGrade and preparation of presentation for Annual Report
2nd Annual Meeting	CERN, 25.2.2010	Preparation of the Financial Statements, discussion Management of the project and communication.

Table 8: Meeting of relevance for the ILC-HiGrade consortium as a whole

6 Explanation of the use of the resources

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 1, DESY, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
1, 2, 3, 5, 6	Personnel costs	518799.19 €	Salaries
6	DESY Workshop	47193.92 €	Construction of Optical Scanner
3, 6	Travel	2067.83 €	Travel to CERN and ILC related conferences
6	Consumables	953.11 €	Miscellaneous electronic component for scanner development
	Remaining direct costs		
	TOTAL DIRECT COSTS	569014.05 €	

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 2, CEA, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
6	Personnel costs	15526.58 €	Salaries
	Remaining direct costs	915.53 €	
	TOTAL DIRECT COSTS	16442.11 €	

TABLE 3.3 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 3, CERN, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
4, 5	Personnel costs	119797.10 €	Salaries
	Remaining direct costs		
	TOTAL DIRECT COSTS	119797.10 €	

TABLE 3.4 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 4, CNRS, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
3, 4, 7	Personnel costs	49210.84 €	Salaries
4	Travel	5195.67 €	Travel to ILC meetings (TILC09, ALCPG, ILCSC)
	TOTAL DIRECT COSTS	93484.34 €	

TABLE 3.5 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 5, INFN, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
4, 8	Personnel costs	83565.08 €	Salaries
8	Consumables	12242.31 €	CuBe pipe, LiHe, LVDT displacement sensor, etc.
8	Travel	12691.82 €	Representation at ILC meetings and conferences
	TOTAL DIRECT COSTS	108499.21 €	

TABLE 3.6 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 6, UOXF.DL, FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
2, 3, 4	Personnel costs	73406.95 €	Salaries
	TOTAL DIRECT COSTS	73406.95 €	

7 Financial statements – Form C and Summary financial report

The Form C has been submitted for each beneficiary using the FORCE tool. Printed copies are attached separately.

8 Certificates

List of Certificates, which are due for this period, in accordance with Article II.4.4 of the Grant Agreement.

Beneficiary	**Organisation short name**	**Certificate on the financial statements provided? yes / no**	**Any useful comment, in particular if a certificate is not provided**
1	DESY	yes	
2	CEA	no	Expenditure threshold not reached
3	CERN	yes[8]	
4	CNRS	no	Expenditure threshold not reached
5	INFN	no	Ditto.
6	UOXF.DL	no	Ditto.

[8] The Certificates for CERN for reporting period 1 have been separately included in the Annual Report for the second reporting period.