# ACADEMIA NDT INTERNATIONAL

*Science and Technology*
*for Non-Destructive Testing and Diagnostics*



**Secretariat:** International Campus A. Einstein
street D.C. Pontevica, 9 – 25124 Folzano (Brescia - Italy)
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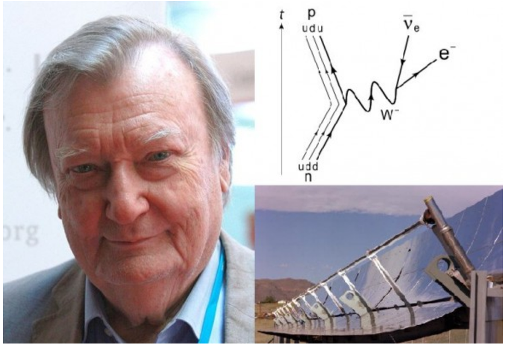
## KEY SPEAKERS OF EUROPEAN RESEARCH DAY




Prof. Carlo Rubbia, Nobel Prize


Carlo Rubbia, Italian physicist who in 1984 shared the Nobel prize in physics with Simon van der Meer "for their decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction".


Tibor Navracsics, European Commissioner for Education, Culture, Youth and Sport


Horizon 2020 is the biggest EU Research and Innovation program ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.


Yukiya Amano, director general of the International Atomic Energy Agency

Widely known as the world's "Atoms for Peace" organization within the United Nations family, the IAEA is the international centre for cooperation in the nuclear field. The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies.

Bernard Bigot, ITER's Director General Cadarache - France. Site of ITER under construction

ITER ("The Way" in Latin) is one of the most ambitious energy projects in the world today. In southern France, in 35 nations are collaborating to build the world's largest tokamak, a magnetic fusion device that has been designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy based on the same principle that powers our Sun and stars.

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## ABSTRACT RUBBIA

### The need of Research for Energy and Environment

Speaker: Carlo Rubbia

This lecture is delivered by Carlo Rubbia**,** Italian physicist who in 1984 shared the Nobel prize in physics with Simon van der Meer "for their decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction".

The Hiroshima tragic event was the cornerstone to guide the nuclear physics from war objectives to peaceful objectives. The most representative politicians of the world signed the CERN project, a worldwide research center, the highest accelerometer of the world, to enter into the matter discovering the new particles and the new rules of science.

Prof. Carlo Rubbia has been one of this scientist that participated with his team in the project of LHC. With this new powerful accelerator, he discovered the 2 particles for which he received the Nobel Prize.

The lecture will go over the Higgs boson to the Xi particle and will give an overview of the next path of physics.

Finally he will focus on the need of breakthroughs in energy and environment research, whether it's for getting low-cost energy or securing our energy supply or reducing environmental damage.

## ABSTRACT HORIZON 2020

## Reshaping Europe With Research And Innovation Horizon 2020 - The Europe Framework Program For Research And Innovation - From FP7 to Horizon

Speaker: Tibor Navracsics- Commissioner

The lecture is presenting latest achievements and next challenges of Horizon 2020, the biggest EU Research and Innovation program ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

The major priorities of the 2014 – 2020 agenda for Research and Innovation are Open Innovation, Open Science and Open to the World. Openness makes Europe more effective and more competitive.

Horizon 2020 is key to achieving EU ambitious objectives to support the priorities of the Juncker Commission in achieving openness in the research and innovation landscape of the EU and beyond.

Analyzing comparable data for 2014 and 2015, crucial to monitor progress and ensure that EU is achieving their goals, clearly shows how attractive Horizon 2020 is to research and innovation actors across Europe and beyond.

Communication and simplification efforts are bearing fruit, with the number of applications increasing by 23.9% between 2014 and 2015. The share of new participants, including SMEs and large companies, has also vastly increased. Moreover, the quality of applications has been very high - Horizon 2020 would have needed €41.6 billion more in the first two years to fund all proposals deemed excellent by independent evaluators.

The results and project examples clearly demonstrates the huge potential in Europe for excellent research and innovation and for turning it into economic value and a better quality of life.

EU will continue to work hard to ensure that Horizon 2020 keeps promoting the world's best research and innovation, creating jobs and growth and helping to solve our biggest societal challenges.

## ABSTRACT IAEA –International Atomic Energy Agency

## Contribution to research and training for safety of people and protection of the environment

Speaker: Yukiya Amano - General Director

The lecture make a statement on the actual nuclear power station strategy. According to latest estimations, currently in the world 440 nuclear power reactors are operative, 50 are under construction and more than 30 are planned for the future.

The biggest challenge the nuclear industry need to face is to increase the safety of power stations. The International Atomic Energy Agency (IAEA) is very active In this topic. The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies.

Following Fukushima accident, recently many progress and improvements have been already identified and implemented in next generation of nuclear plant.

For example the Advanced Passive 1000 (AP1000) is a nuclear pressurized water reactor (PWR) originally designed by Westinghouse Electric Company. With the AP1000, Westinghouse sought to design a reactor that operated using conventional pressurized water reactor principles, while incorporating novel safety measures in order to increase reliability and cost-competiveness relative to competing reactor plants. The simplified nature of the plant as a whole, lowering number of safety pipes and valves, actually provides greater safety margins than another current plant model in the event of failures such as a tube rupture or break. The second major factor is its passive safety mechanisms that handle major reactor accidents. Typical Gen II reactor plants operate off of electrical pump systems that actively replaces water in the event of coolant loss. These pumps often have several redundant "trains" of high and low pressure valves to decrease failure probabilities, which results in significant capital and labor investment for a system that should rarely, if ever, need to be used. To rectify this problem, the AP1000 passive core cooling system sought to simplify the process by utilizing reservoirs that are built to release water into the reactor at specific thresholds that would indicate an emergency. This results in fewer moving parts within the reactor and less initial capital investment into the reactor's safety components.

Finally the Agency has led international collaborative efforts to develop next generation nuclear energy systems that can help meet the world’s future energy needs. Generation IV designs will use fuel more efficiently, reduce waste production, be economically competitive, and meet stringent standards of safety and proliferation resistance.

## ABSTRACT ITER: International Thermonuclear Experimental Reactor The Construction Of The First Fusion Power Station Cadarache France

Speaker: Bernard Bigot - General Director

The lecture provides an overview on where we are with the construction of ITER.

ITER, "The Way" in Latin, is one of the most ambitious energy projects in the world today. In southern France, in Cadarache, 35 nations are collaborating to build the world's largest tokamak, a magnetic fusion device that has been designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy.

Fusion, the nuclear reaction that powers the Sun and the stars, is a potential source of safe, non-carbon emitting and virtually limitless energy. Harnessing fusion's power is the goal of ITER, which has been designed as the key experimental step between today's fusion research machines and tomorrow's fusion power plants.

The site is very active and little free space remains on the 42 hectares (100 acres) of the ITER scientific platform.

A year ago, the Assembly Building had just been insulated with several layers of cladding and equipped with overhead handling cranes; work on the circular bioshield was newly underway; the cryoplant was still at foundation level; and a large stretch of land now occupied by the twin Magnet Power Conversion buildings was but a barren steppe.

Today, in the seventh year of ITER building construction, the platform seems to have no room to spare. Activity has mushroomed in all corners and the pace of progress difficult to keep up with. Some 3,300 cubic meters of concrete have already gone into the ITER bioshield.

Currently, there are 1,900 workers participating in ITER construction in two daily shifts. Things will change rapidly not only on the ITER site and within the ITER Organization, but also within the global ITER Project and the worldwide fusion community.

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## International Academic Education in NDT at Master Level

Christian Boller[1,2]
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Non-destructive testing (NDT) has been widely recognized as an own field of science and technology covering a very broad range of applications. This starts from applied physics and is going its way through all disciplines of engineering and even encompassing applied mathematics as well as computer science those days. This broad field and the need for NDT experts not just at technical but also at academic level has been the motivation for establishing a postgraduate master course in NDT. Dresden International University (DIU), which is Dresden Technical University's university of advanced training has been a most suitable institution to get this idea of an NDT master course established. The flexibility in organising courses at DIU due to its status of being a private university has allowed an NDT master course to be established with renowned lecturers for the different modules required, recruited from different places in the world. This has allowed a course of excellence to be established, run now since 2013. The course is organised in four semesters and has a strong scientific and hence research focus. In the first semester students are taught in all the major fundamental disciplines such as metallic and polymer materials, measurement techniques, sound & vibration, signal processing, optics, electromagnetism and quality management. In the second semester major emphasis is on the different NDT techniques including acoustics, optics, electromagnetism, radiology and microscopy. The third semester is devoted to participating in the Basic Course of the German Society for NDT (DGZfP) and a research placement in reputable research centres such as the affiliations of the different lecturers including BAM in Berlin, Fraunhofer or different universities with a specific dedication to NDT. During the fourth and final semester students do perform their master thesis, most likely with the institutions they already performed their research placement with. The course is fully taught in English with modules run consecutively as a block. Location of teaching is mainly in Dresden/Germany. The course is also offered and further developed as a double degree (DD) course between DIU and another university abroad where the first and the last semester is taken at the sending university while the two middle semesters are taken at DIU.

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## NDT 4.0 - Overall Significance and Implications to NDT

R. Link 1), N. Riess 2)
1) Consultant
2) Helling GmbH

Industry 4.0 is named after three industrial revolutions, mechanizing industrial processes, assembly lines and robotic systems. It comprehends complete digitization and networking within industrial processes, raw materials, design with consideration to nondestructive testing, production and more or less central quality control. Industry 4.0 is the relevant parameter to be implemented and promoted by state institutions, but with available networking possibilities it will in addition be a self-fulfilling future aspect in industrial processes. It is believed, that nearly all areas involved in the industrial process are affected.

The question arises as to which extent it will influence the area and profession of NDT as a technique and related human resources. What would be the requirements of NDT4.0? Some aspects of the integration of the inspection results and quality control and online information to the production department are not really new for NDT.

In this paper an attempt is made to analyze strengths, weaknesses, opportunities and threats (SWOT) within the area of NDT.

The overall networking of NDT4.0, including all aspects within the industrial process requires more comprehensive automation in the NDT test procedures and available information. Intelligent sensors which are deciding IO or NIO, providing online statistics to the quality and back to the process department obviously will be additional demands to the NDT testing procedure.

During this presentation a completely automated system for magnetic particle inspection of steering knuckles, tubes and round bars is described as an example.

The systems consists of robotic placement of the part and the areas of interest to be inspected to the NDT system, camera and lightning components, automated evaluation of the defect indications in the computer by image processing techniques involving different filters. The computer is connected to the manipulation system and is deciding IO or NIO according to the quality requirements. Additionally the computer calculates relevant statistical information. Networking with all interested parties in the production process is provided.

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## The Frontier Of NDT at the 19th WCNDT – Munich 2016

Speaker: G.Nardoni

The world conference has the primate to collect the data of four years research on different methods all over the world.
New techniques and new methods, also in their early stage, are approaching.
All these findings remain into the proceeding and only 2000 people become novelty.

The document we are presenting make deep introspection of fields, methods, techniques, materials and more related to NDT to guarantee the integrity of structures.
The document will be particularly interesting for universities, manufacturing companies, products and equipments representatives.

From the beginning of world conferences, it is the first time we pursue such a project.
Based on this, also for the European conferences we can approach on this example.
We will print 2000 copies of this document and distribute inside the European conference as ACADEMIA NDT International.

BAM – 8.3 Radiological Methods

Dr. Uwe Ewert, Director and Professor

## Current Developments in Digital Radiography and Computed Tomography from nm to macro scale

Speaker:U. Ewert

Digital Detector Arrays enable an extraordinary increase of contrast sensitivity in comparison to film radiography. Computed radiography with phosphor imaging plates substitutes film applications. The increased sensitivity of digital detectors enables the efficient usage for dimensional measurements and functionality tests substituting manual maintenance. The digital measurement of wall thickness and corrosion status is state of the art in petrochemical industry. X-ray back scatter techniques have been applied in safety and security relevant applications with single sided access of source and detector. First inspections of CFRP in aerospace industry were successfully conducted. Computed tomography (CT) applications cover the range from nm to m scale. Small structures of integrated circuits are visualized and measured with lens based CT-systems or at synchrotrons. Phase contrast imaging provides enhanced structure contrast in micro radiography and micro CT. The scope of typical CT applications changes from flaw detection to dimensional measurement in industry substituting coordinate measurement machines. Mobile computed tomography is applied for in-service radiographic crack detection and sizing of welded pipes in nuclear power plants and for NDT of large CFRP structures in aerospace applications. New specialized high energy CT devices have been laid out for inspection of complete cars before and after crash tests. High speed applications with flash tubes permit the 3D measurement of fast process dynamics including car crash visualization. Digital radiography techniques, computed tomography and computed laminography designs are nowadays developed by numerical simulation before hardware construction. New X-ray source concepts based on laser wake field acceleration permit further reduction of spot sizes and minifocus high energy applications.

Keywords

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Digital radiography, computed tomography, laminography, Imaging plates, digital detector arrays, back scatter, CFRP, phase contrast, aerospace, automotive, wake field.

## NDT integrity engineering


Speaker: Peter Trampus1, Vjera Krstelj2

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Significant attention should be given to the subject of integrity engineering which integrates the requirements concerning the ability of structures, components and materials for keeping their function in accordance with the designer's intent, i.e. for ensuring their safe and reliable operation.

NDT Integrity Engineering is primarily focussing on non-destructive methods. Its knowledge basis encompasses all disciplines which contribute to establish any integrity related decision.

Core knowledge includes the physical bases, the possibilities and limitations of the major NDT methods; the evolution of NDT; the current tendency to provide early detection of materials degradation; the structural health monitoring strategies and techniques; the impact of the development of information technology and microelectronics on NDT and technical diagnostics; globalization of NDT; and many other issues.

The knowledge should cover also the awareness of the physical fields arising in the component during operation, including the basics of analytical and numerical methods of their calculations. From these operation and accident loading, stress / strain status, stress intensity factor and other operational conditions can be calculated (structural mechanics).

The properties of structural materials; the „material's response" to loading and environment, i.e. the materials ageing effects; the potential ageing processes such as embrittlement, loss of toughness, fatigue, corrosion, creep, wear and some more, and their effect on the component integrity.

The motivation of emphasizing NDT Integrity Engineering is that in the recent decades, enormous efforts have been provided to increase the capability of assets of high value and of high risk such as power and process plants, offshore platforms, bridges leading to their more intensive utilization. Besides this commercial goal, the social goal is equally important, i.e. to operate the engineering assets safely, and thus, saving human and environment. NDT Integrity Engineering supported by academic and educational system will evidently contribute to these goals.