Scuola per Dottorato LTL-2015

Monday, 8 June 2015 - Friday, 12 June 2015

UNICAL, Rende (CS)

Scientific Programme

The LTL-2015 offers a series of plenary lectures and 3 full days of hands-on lectures and laboratory activities. The first day is a plenary section to give an overview of the research activities of the research groups involved into this school. The following three days are devoted to the laboratory courses. Students are gathered into 10 groups of 4 students each. Each group follows only one topic offered by the school, with hands-on activities interleaved with lectures on the following topics:

Gaseous detectors (Physics)

Data analysis in HEP (Physics)

Testing building materials (DINCI)

Floods due to earth fill dam failures (DIATIC)

Electric Power Systems (DIMEG)

Carbonate rocks: origin and degradation (DIBEST)

Gas separation procedures (CNR-ITM)

Smart cities (DINCI)

Characterization of nanostructured materials (DIATIC)

Electron Microscopy Techniques (DIBEST)

For more details see below.

During these three days the students work, study and prepare a poster about their work/activity. The last day of the school is dedicated to the student poster session. Each group has 20 min to illustrate the laboratory activity and 10 min for discussion. Four Lectio Magistralis, one per school day, will complete the program.

The registration form includes a field in which the participant indicates three preferences for the laboratory, in order of priority. The organizing committee will pick one of them or will assign another one in order to maximize the number of students per group.

1. Gaseous particle detectors for tracking and triggering systems (High Energy Laboratory – Cubo 30/D)

CONVENER M. Schioppa (UNICAL-INFN)

LECTURERS M. Schioppa (UNICAL-INFN)

TUTORS L. Garritano (UNICAL)

The aim of the activity is the design, assembly and test of a fully working tracking and triggering system made of a single plane of MultiGap Resistive Plate Chamber, readout electronics, gas system and HV power supply. The system will be tested with cosmic ray. It can be used for tracking

and triggering purpose both for educational and professional activities.

RPC is a robust and relatively simple particle detector whose performance in terms of time resolution make it a very good candidate for trigger application in the high energy and astro particle physics experiments and in medical and industrial fields.

The program foresees a set of lab activities covering all the aspects of the project from the construction and commissioning to the cosmic ray tests. During the first day all the detector components are built (honeycomb, resistive plates, strips and front end electronics). Two hours are dedicated to a lecture on detector physics (first part). During the second day the chamber is assembled and filled with the gas mixture. Two hours are dedicated to a lecture on detector physics (second part). The third day the detector is commissioned and the cosmic ray test started. Two hours are dedicate to a lecture on detector applications. Part of the laboratory courses will be dedicated to the preparation of the poster summarizing the laboratory activities.

2. Data analysis in High Energy Physics (High Energy Laboratory – Cubo 30/D)

CONVENER A. Policicchio (INFN)

LECTURERS A. Policicchio (INFN), D. Salvatore (INFN), A. Mastroberardino (UNICAL-INFN)

TUTORS A. Policicchio (INFN), D. Salvatore (INFN), A. Mastroberardino (UNICAL-INFN)

The aim of the activity is to drive the participants through a typical search for signals of new physics beyond the Standard Model of elementary particle with the ATLAS experiment at the CERN's Large Hadron Collider (LHC). In the first part of the program the ATLAS detector at the LHC is presented. The Standard Model of elementary particles is briefly introduced. The Standard Model is inherently an incomplete theory. There are fundamental physical phenomena in nature that the Standard Model does not adequately explain (Gravity, Dark Matter and dark energy, neutrino masses, matter-antimmater asymmetry…). Hidden Sector models are presented ad a possible extension of the Standard Model, with particular emphasis on two simplified models of non-Standard Model Higgs boson decays to collimated jets of leptons and hadrons (LeptonJets, LJ). The experimental signatures of the events with production of LeptonJets are discussed. The laboratory program foresees a concrete example of the search for LJs using the experimental data collected by the ATLAS experiment during the 2012 LHC run. The LJ definition and search criteria are discussed. In particular the techniques for the reduction and the estimation of the background to the LJ signal are show.

3. Testing of traditional and innovative building materials (Lab. Prove Materiali e Strutture – Cubo 38/B)

CONVENER F. Bencardino (UNICAL)

LECTURERS D. Bruno, L. Ombres, F. Bencardino(UNICAL/DINCI)

TUTORS D. Bruno, L. Ombres, F. Bencardino(UNICAL/DINCI)

Evaluation of mechanical properties of traditional (concrete and steel) and innovative (FRP and FRCM) building materials

INTRODUCTION

The mechanical properties of building materials must be determined by standardized testing. The main advantages of standardized testing are the following:

Repeatable testing under fixed condition with comparable experimental results

Evaluation of mechanical properties of the material irrespective of geometrical, physical, and chemical conditions

With reference to some building materials as concrete, steel, FRP, FRCM, the following issues will be discussed: test set-up, data acquisition system, analysis of experimental data and evaluation of the mechanical properties.

LABORATORY ACTIVITY

Concrete compression test;
Concrete tensile test (split test);
Steel tensile test;
Tensile/shear tests on innovative materials (FRP, FRCM).

INSTRUMENTATION AND METHODOLOGY

The materials testing will be carried out using the following instrumentation: MFL 3000kN-Zwick, MFL 1200kN-Zwick, INSTRON 5582, Zwick-Roell Z250. Furthermore, strain gauges and LVDTs will be used to measure the material strains and displacements, respectively. The experimental data obtained during the test will be recorded by a data logger (HBM Spider 8). The data will be elaborated using a specific software (Tex Expert, Bluehill, Strain Smart, Catman) and they will be showed in graphs and tables format. All testing will be carried out according to the National and European standards.

ANALYSIS OF THE RESULTS

The data obtained through the tests (compressive/tensile tests on concrete, tensile tests on steel, tensile/shear tests on FRP and FRCM) will be adequately analyzed and the material mechanical parameter will be determined.

PROGRAMME

09/06/2015 09:00-13:00
Materials: concrete, steel, FRP/FRCM.
Standard and guidelines used to evaluate the mechanical parameters of steel, concrete and innovative materials.

09/06/2015 14:30-16:30
Compression test on concrete specimens (testing and acquisition data).
10/06/2015 09:00-13:00
Split test on concrete specimens (testing and acquisition data).
Tensile test on steel bars (testing and acquisition data).
10/06/2015 14:30-16:30
Test on innovative materials FRP/FRCM (testing and acquisition data).
11/06/2015 09:00-13:00
Analysis of the recorded data and evaluation of the material strengths.
11/06/2015 14:30-16:30
Presentation of the results obtained during the course.

4. Floods due to earth fill dam failures (LAMPIT - LAboratorio di Modellistica numerica per la Protezione Idraulica del Territorio - Cubo 42/b, 6th floor)

CONVENER C. Costanzo, F. Macchione (UNICAL/DIATIC)

LECTURERS C. Costanzo, F. Macchione (UNICAL/DIATIC)

TUTORS C. Costanzo, F. Macchione (UNICAL/DIATIC)

Lectures content:

Historical Italian dam failures events. The Italian legislation.

Failure of masonry dams: historical failure events; dam break modes; analytical solutions.

Failure of earth dams: historical failure events; dam breach modes. Models for the computational of the peak flow and flood hydrograph caused by an earthfill dam failure: statistical formulas; parametric models; formulation of the basic equations of parametric models; physically based models. Example of a physically based model valid for earthfill dams. Use for forecasting purposes.

Tutorials content:

Computation of the flood hydrograph of an historical dam failure event.

Computation of the flood hydrographs caused by the hypothetical failures of some Calabrian earth dams.

5. Electric Power Systems (LASEER – Cubo 42/C, 7th floor)

CONVENER D. Menniti (UNICAL/DIMEG)

LECTURERS A. Pinnarelli, D. Menniti, N. Sorrentino (UNICAL/DIMEG)

TUTORS G. Barone, G. Brusco, A. Burgio (UNICAL/DIMEG)

BRIEF INTRODUCTION TO THE SUBJECT

Activities in LASEER laboratory mainly concern: Electric Power System Stability and Control, Smart e Micro Grids, Power Quality, Energy Management System for Energy Efficiency of Buildings, Design and Testing of ac-ac, dc-dc and ac-dc Power Converter, Advanced Industrial Drives, Battery Energy Storage Systems.

ACTIVITIES PROPOSAL

Participating to experiments, measurements and data analisys in the field of: power quality, power flow monitoring, and power management in a microgrid.

INSTRUMENTS and METHODOLOGIES

National Instruments LABVIEW Academic Suite, CRio 9024, ATMEL AVR32bit micro-controller, AC500-PM564 ABB PLC, 3S CODESYS, ARDUINO MEGA 2560, Arduino 1.6.3 or later, Fritzing 0.9.2 or later, ANSYS Electromagnetic Suite vers. 15, simulation and analysis of power converters.

PROGRAMME
1st day: Introducing to the microgrid, instruments and methodologies; a first brief insight to theory and fundamentals; a first approach to instruments; exercise; assigning projects;

2nd day: refine the problem solving; a second brief insight to theory and fundamentals; finding a feasible solution; exercise;

3rd day: exercise ; support; concluding the projects.

6. Carbonate rocks in Cultural Heritage (Cubo 12/B, 2nd floor)

CONVENER D. Barca (UNICAL/DIBEST)

LECTURERS D. Barca, V. Comite, R. De Luca(UNICAL/DIBEST)

TUTORS V. Comite, R. De Luca (UNICAL/DIBEST)

INTRODUCTION

Nowadays, before a restoration work, it is necessary to execute an accurate analysis of the artefact from a scientific point of view. Indeed, its chemical, mineralogical and petrographic characterization allows us to obtain information about its executive technique and to individuate the presence of degradation forms. The cultural heritages are mainly composed by raw materials of geological

interest: natural stones (rocks) and artificial ones (mortars, plasters, and bricks). Rocks are widely used as natural building materials, thanks to their remarkable qualities of strength, durability and variety of colour. In particular, the carbonate rocks, such as limestone and dolostone, have found massive application since ancient times. These rocks have been used in ancient and modern buildings of important European and International sites, indeed, they have been employed both as building material and as raw material for the realization of the lime, the binder used for the production of mortars and plasters.

PROPOSED ACTIVITY

The proposed activity wants to provide to the students the skills for the characterization of stone materials used in the Cultural Heritage, by focusing principally on the degradation of natural materials, by environmental pollution, and on the provenance of the raw materials used for the production of artificial stone materials. The work has been divided in two different lines of research:

the first one focuses on the mineralogical-petrographic and geochemical characterization of black crusts collected from stone monuments, located in the city of Seville (Cathedral of Seville) - Dott.ssa Valeria Comite;

the second one concerns the study of provenance of limestone used for the production of the lime, on plaster sample coming from the archaeological area of Tenochtitlan (Mexico City) - Dott.ssa Raffaella De Luca.

DIAGNOSTIC METHODOLOGIES

The activity will be conducted through a series of diagnostic methodologies, listed below:

Optical microscopy analysis. Observations by OM will be carried out on polished thin sections under a Zeiss Axiolab microscope (equipped with a digital camera), used for the mineral-petrographic study of natural and artificial stone materials and related forms of degradation. This analysis allow to determine the colour, the morphology, the thickness of the crusts, as well as the frequency, the distribution and the size of the particles incorporated. Also it allows to characterize both substrate and interaction the substrate/black crust interface. The analysis conducted on the plasters provides information on the characteristics of the binder, identifying the presence of lime lumps and fragments of partially burned limestone. Moreover, it allows to determine the mineral-petrographic composition of the aggregate, its size, its shape, distribution and orientation of the clasts within the binder. It also provides information on the porosity and the degradation forms of the material.

SEM-EDS microanalysis. It gives information on the morphology and the chemical composition of the material, in terms of major elements. The equipment used is a scanning electron microscope (FEI Quanta 200 Instrument) with a detector EDAX Si/Li.

SEM analyses provide information on the morphological features of the crusts and the interaction with substrates. Moreover, EDS analysis (raster mode) carried out on the samples, permit to achieve information on the chemical composition of examined damage layers. The analysis performed on plasters allows to determine the chemical composition of the binder, lime lumps and fragments of limestone partially burned. At the same time, it gives information on the composition of the aggregate, its morphology and the degradation forms of the material.

LA-ICP-MS analysis. This analysis allows to determine the chemical composition of the material, in terms of trace elements. The instrument used is an Elan DRCE (Perkin Elmer / SCIEX) connected to a probe New Wave UP213 solid state laser Nd-YAG laser (213 nm).

LA-ICP-MS methodology will be used, in order to get information about the geochemical composition, in terms of trace elements, of black crusts and the underlying substrates stone. Analyses will be performed on the crusts, on the unaltered substrate and on the portions of altered substrate if present, to investigate the possible migration of heavy metals from the crust to the carbonate rock. The aim is to obtain information of the major stationary and mobile combustion sources (by comparison in the literature) that cause the damage of architectural surfaces over time. This analysis performed on plasters allows to determine the trace elements present in the lime lumps, indentifying (through comparison with the raw materials) the provenance of the limestone used. For the study of black crusts will also be used the Fourier transform infrared spectroscopy (FT-IR/ATR) to identify the mineralogical phases constituting the examined damage layers, as well as the presence of protective and/or consolidant used in restoration. Analyses are performed through a Perkin Elmer Spectrum 100 spectrophotometer equipped with an ATR (attenuated total reflectance) accessory. Infrared spectra were recorded in ATR mode, in the range 500–4000 cm−1 at a resolution of 4 cm−1.

PROGRAM

The proposed activity will be carried out in three steps:

In the first day theoretical lessons on natural and artificial stone materials (limestone, dolostone, mortars and plasters), will be conducted by highlighting the problems related to the provenance and to the degradation of materials. The practical activity will be therefore illustrated. It will be carried out, by providing scientific publications and references on the subject.

On the second day analyses will be performed in the laboratories of Cultural Heritage of the Department of Biology, Ecology and Earth Sciences (DiBEST), using the diagnostic methods listed above.

The third day will be dedicated to processing the data using appropriate software.

7. Gas separation with membranes (ITM-CNR – Cubo 17/C and 18/D)

CONVENER G. Barbieri (CNR-ITM)

LECTURERS G. Barbieri , A. Brunetti (CNR-ITM) and A. Caravella (UNICAL/DIATIC)

TUTORS G. Barbieri , A. Brunetti (CNR-ITM) and A. Caravella (UNICAL/DIATIC)

BRIEF INTRODUCTION TO THE SUBJECT

The proposed activities will focus on using the palladium-based membranes for hydrogen separation/purification within a relatively high-temperature range (300-500°C). More specifically, fundamentals of hydrogen permeation (mechanisms, dependence on temperature and pressure) through this type of membranes as well as the main process parameters (feed composition, stage-cut, etc.) will be introduced theoretically and investigated experimentally, considering that the overall mechanism of hydrogen transport through metal membranes involves several elementary

steps, such as: hydrogen adsorption on surface, dissociation of hydrogen molecules, surface-to-bulk transition (i.e., absorption in the metal bulk), diffusion through the metal lattice and re-combinative desorption of hydrogen atoms. Additionally, the effect of both the non-ideal internal diffusion and the external mass transport in the gas phases (porous support included) will be discussed. Experimental permeation tests will be carried out with membrane units, appropriately set up for high temperature separations to analyze the permeation flux dependence on temperature and pressure.

PROPOSED ACTIVITIES
The proposed activity will be divided in:

Lectures on hydrogen purification, permeation mechanisms through Pd-based membranes including all the elementary steps, phenomena affecting permeation such as concentration gradients and inhibition by CO
Experimental analysis of hydrogen permeation through Pd-Ag membranes as function of some important variables such as temperature, feed pressure, feed compositions, etc.
Analysis of the experimental measures and discussion of the results.

8. Smart Cities (Laboratorio d'Immagini, Cubo 45/B, 2nd floor)

CONVENER G. Celani (UNICAL/DINCI)

LECTURERS G. Celani (UNICAL/DINCI)

TUTORS P. Celani. E. d’Alessandro, M. Zupi, G. Nicolaci (UNICAL/DINCI)

Lectures content:

Approaches to the contemporary city: Smart city, Creative city, Resilient city, Green city.

Living Labs: open innovation, real-life settings, end user engagement, user-driven innovation.

Tutorials content:
Collection and analysis of case studies on smart city and living labs.

Development of an evaluation matrix of the components of the smart city.

Simulation of a program of actions for the construction of smart city.

Programme:
1st day: Introduction to the concept of smart city; components and indicators of smart city; tutorial on definitions of smart city and best practices;

2st day: brain storming on the results of the first exercise; introduction to the concept of living lab; tutorial on definitions of creative city, resilient city, green city and case study on living labs;

3st day: brain storming on the results of the second exercise; final project: power point for the poster session.

9. Characterization of nanostructured materials (Laboratorio MAPSET - Materiali Ambiente Processi Sicurezza Energia Territorio - Cubo 42/A)

CONVENER L. Pasqua (UNICAL/DIATIC)

LECTURERS L. Pasqua (UNICAL/DIATIC)

TUTORS L. Pasqua (UNICAL/DIATIC)

BRIEF INTRODUCTION

Inorganic mesoporous silica nano-architectures can be used as the starting point for developing new nanostructured devices. Silica reactivity allows the selective functionalization of the external surface of the particles while also the inner pore surface can be used, after surfactant removal, with a different functionality to produce a multifunctional device. The strategies to design and synthesize nanostructured materials, through selective functionalizations approaches, represent new horizons in material science and technologies and materials engineering. Furthermore the biological structures offer a very broad series of models for developing new materials, in fact, very often the observation of biological systems indicates us the solution to a particular problem through the development of a new device. Multifunctional hybrid silica-based devices are potentially useful for drug targeting or as sensors. In the field of smart therapies, the creation and structuring of the matter as molecular systems, at the nanometer scale, produce devices that interact with biological systems as “actuators” and stimuli-responsive entity at the same time. Responsive and adaptive materials in which the properties depend on the (nano)structure, self-organization, and self-assembly of the molecular components are also obtained according to similar approaches.

PROPOSED ACTIVITIES
The approach to develop a multifunctional hybrid device will be presented;
One or more materials will be characterized;
Discussion of the results.

10. Electron microscopy technologies (CM2 – Centre for Microscopy and Microanalysis – Cubo 15A)

CONVENER R. De Rosa (UNICAL/DIBEST)

LECTURERS R. De Rosa, P. Donato, M.Davoli, D.Perrotta (UNICAL/DIBEST)

TUTORS R. De Rosa, P. Donato, M.Davoli, D.Perrotta (UNICAL/DIBEST)

BRIEF INTRODUCTION TO THE SUBJECT

The proposed activities will focus on theoretical and practical lessons providing a qualified introduction to transmission and scanning electron microscopy and microprobe techniques for materials science. A description of the main techniques for structural, morphological and analytical characterization will be provided. The practical course will take place at the CM2 laboratories where

the students will directly observe the instruments, under teachers supervision, practicing with the sample preparations instruments and analytical techniques exposed during the theoretical part.

PROPOSED ACTIVITIES
The proposed activity will be divided in:

Lectures on elements of cristallography, X-ray diffraction, electron-matter interaction, High resolution electron microscopy SEM and TEM, analytical methods (EDX and WDX).
Sample preparations, imaging analysis, x.ray analysis of different specimens, EDX and WDX analysis. Data processing softwares.