5th Summer School on INtelligent signal processing for FrontIEr Research and Industry

Sunday 12 May 2019 - Sunday 26 May 2019

Huazhong University of Science and Technology in Wuhan, China

Book of Abstracts

Contents

PLENARY MORNING SESSION / **16**

A VISION ON THE MAIN DIRECTIONS IN HIGH ENERGY PHYSICS IN THE NEXT DECADES

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After decades of success in exploring the ultimate components of the Matter, the large High Energy Physics worldwide community is continuying its fundamental research quest. The next two decades will witness exciting searches in the Neutrinos world thanks to three major experiments that are bult in USA (DUNE), in China (JUNO) and in Japon (Super/HyperKamiokande); meanwhile the largest accelerator in the world, the LHC (Large Hadron Collider), at CERN (Geneva, CH) will increase its exploration capability thanks to upgrading both the machine and the 4 associated experiments. The increase in Luminosity by a factor of at least 5 and increase to the nominal energy value of 14 TeV (currently 13TeV) in the center of mass, will strengthen the Physics reach of this Machine. This goes together with the major upgrades, on the ALICE, ATLAS, CMS and LHCb experiments. These upgrades consist in drastic modification of several detectors and/or of their associated signal processing or data handling, in rebuilding some major parts using novel technologies and in adding some new detection capabilities. This school will review some of these main aspects. The upgrades of these experiments will further increase the overall Physics potential of the HL-LHC era that will start in 2025. They are also pioneering the new detection technologies that will inspire and serve the design and construction of the experiments for the next generation of HEP machines, without forgetting their cross-disciplinary and high tech industrial outcomes.

Meanwhile, and in parallel to the success of the LHC, a long term R&D period on different next HEP machine concepts with the related Physics studies are ongoing, aiming to pursue on the Particle Physics ultimate Quest. Decisions on the main directions to go are expected by the end of this decade and are crucial for the next 50 years.

EVENING KEYNOTE / **14**

ARTIFICIAL INTELLIGENCE IN MEDICAL IMAGING – PEARL AND PITFALL

Prof. LI received his Doctoral Degree and accomplished Residence, Clinical fellow in Tongji Medical College (HUST), and study in Johns Hopkins hospital, Johns Hopkins School of Medicine, Baltimore, MD as a post research fellow. He had published about 160 articles and 10 Book Chapters, received more than 20 Extramural Funding in recently years. He is Editorial Board Member of Undergraduate national colleges and universities textbooks ‘Medical Imaging’, and Member of the Chinese Society Radiology Abdominal Committee, Chinese Association of Radiologist Digestive Committee, Chinese Association of Gastroenterologist and Hepatologist Digestive Imaging Committee, Chinese Geriatrics Radiology Society, International Hepato-Pancreato Biliary Association MDT Committee, Gastric Cancer Association (CACA) Radioloigy Committee, Chinese Research Hospital Society Pancreatic Diseases Committee, and Radiology Society of integrative Medicine in Chinese Medical Doctor Association. Reviewer for European Radiology, Abdominal Radiology Gynecologic Oncology, JMRI, AJR .

LAB SESSION / **44**

ASTRO1 DETECTION LAB: CHARACTERIZATION OF A CCD DETECTOR (ASTROPHYSICS)

See abstract in LABS TABLE

LAB SESSION / 45

ASTRO2 INTRODUCTION TO DARK MATTER DETECTION

Corresponding Author: tao@cppm.in2p3.fr

See abstract in LABS TABLE

LAB SESSION / 46

ASTRO3 USE OF SIPM IN ASTROPHYSICS EXPERIMENTS

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See abstract in LABS TABLE

LAB SESSION / 119

ASTRO4: Observational Laboratory

A one day observational Lab has been organized at 5 am (local time) by Jean Gabriel Cuby with a link to the Observatory of Haute Provence in FRANCE.
The results are summarized in the poster presented in the poster session by Shreya Suresh as a result of a collaborative work during the School.

AWARDS SESSION & FAREWELL PARTY / 105

Awards for the three best posters

Three among the 38 posters presented at this Poster session by the school attendants are awarded as the three best posters. The selection is made on JUNE 13 and the WINNERS ARE:

Best Poster: Dan ZHANG
BS at the Department of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai, China.
Now at Doctoral Program in the Department of Physics of the University of Maryland, USA.
She works on “WIMP Direct Detection with PANDAX-4T Detector”

2nd Best Poster: Patrick MORIISHI FREEMAN
Master of Science in Physics at the University of California in Santa Cruz.
Now PhD at the University of Birmingham, Department of Physics and Astronomy, UK
He works in the ATLAS experiment at CERN-LHC.

3rd Best Poster: Anyi LI
Undergraduate at the Ji Luan College, at the Automation School of Qianhu and Information Engineering, Nanchang University, Nanchang, China.

The poster and photos of the three winners are on the poster session here above.

CONGRATULATIONS to the THREE of THEM
and also

CONGRATULATIONS to ALL the PARTICIPANTS for their valuable contribution to this 6 hours poster session: it was not easy to select the 3 best posters!

AWARDS SESSION & FAREWELL PARTY / 104

Awards for the winners of the KERAS based Deep Learning Lab

Corresponding Authors: mareike.meyer@cern.ch, lisa.benato@cern.ch, patrick.connor@desy.de

The organizers of the KERAS based Deep Learning Lab (Lisa, Mareike and Patrick) have launched a competition among all the participants over the 2 weeks of this Lab.
They have attributed a prize to the 3 best candidates.
The award presentation is in the file Challenge_Winner.pdf here attached.
The description of the lab, the problem to be solved (top quark tagging) and the rules of the challenge can be found in the file:Lab_2nd_week.pdf here attached.

The three best final scores:

1. The Three Stooges, i.e., Oussama Djedidi, James Gooding, Patrick Freeman
2. Celia Fernandez Madrazo and Shreya Kakkenpara Suresh
3. LMF, i.e., Leonidas Fernandes do Prado, Marvin Khun, Fernando Aguilar Gomez

Winners received some excellent quality marzipan coming from Lübeck.
Many thanks and congratulations also to the Lab organizers.

AWARDS SESSION & FAREWELL PARTY / 103

Awards for the winners of the running race

A prize has been given to the 6 winners of the running race with a well deserved and warm ovation to the 6 of them:

The winners on the Ladies category are:
Chao Yong Tian (China) from PETLAB-HUST with 36’17”
Lara Lloret Iglesias (Spain) CSIC-IFCA (2nd) with 39’3”
Lisa Benato (Italy) Universitat Hamburg (3rd) with 45’30”

The winners on Men category are:
Lorenzo Bellizi (Italy) from INFN-PISA with 27’22”
Jesus Marco (Spain) from CSIC with 28’13”
Patrick Freeman (USA) from Birmingham University with 30’3”

PLENARY MORNING SESSION / 28

BIG DATA & FUNDAMENTAL RESEARCH: CHALLENGES & PERSPECTIVES

Corresponding Author: jesus.marco@cern.ch

The lecture will introduce different fundamental research challenges where Big Data techniques are

key, how they are being addressed, and the new ideas being explored at different levels (infrastructure, cloud-based platforms, data science solutions).

A general framework developed in the framework of EU initiatives will be presented and used as a guide to understand the roles of the various stakeholders. It will be translated into specific examples in different areas (physics, biodiversity, earth observation).

An approach to the implementation of the full data life cycle in an open science framework will be introduced, describing the importance of data "fairness" for reuse, and the need for a cloud platform supporting this activity.

Finally, the specific application of deep learning techniques to big data to derive new ideas in fundamental research will be discussed.

Prof. Jesus Marco coordinates the research line on Advanced Computing and e-Science at IFCA, and serves currently as vice president for research at CSIC (National Research Council in Spain). PhD in experimental HEP working in DELPHI experiment at CERN, he actively participated in the search for the Higgs boson at LEP. He has contributed to several EU projects on distributed computing infrastructure, and coordinates the DEEP Hybrid DataCloud H2020 project.

LAB SESSION / 51

CL1 INTRODUCTION TO INTEL FPGA BASED LAB

See abstract in LABS TABLE

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CL10 BEHIND A PUBLISHED PAPER - FROM BENCH TO MEDICAL COMMUNITY

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CL11 LAB ON COMPUTATIONAL SPECTRAL VIDEO IMAGING

See abstract in LABS TABLE

LAB SESSION / 52

CL2 MASSIVE PARALLEL COMPUTING (SESSION 1)

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See abstract in LABS TABLE

LAB SESSION / **53**

CL3 MASSIVE PARALLEL COMPUTING (SESSION 2)

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see abstract in LABS TABLE

LAB SESSION / **54**

CL4 MACHINE LEARNING & DEEP LEARNING APPLIED TO ASTROPHYSICS

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See abstract in LABS TABLE

LAB SESSION / **55**

CL5 DEEP LEARNING WITH KERAS I

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see abstract in LABS TABLE

LAB SESSION / **56**

CL6 DEEP LEARNING WITH KERAS II

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see abstract in LABS TABLE

LAB SESSION / **57**

CL7 INTRODUCTION TO NEW FPGAS SOFTWARE PLATFORM

See abstract in LABS TABLE

LAB SESSION / **58**

CL8 INTRODUCTION TO GPU COMPUTING SESSION 1

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See abstract in LABS TABLE

LAB SESSION / 59

CL9 INTRODUCTION TO GPU COMPUTING SESSION 2

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See abstract in LABS TABLE

PLENARY MORNING SESSION / 3

COLD DETECTORS: FROM ASTROPHYSICS TO QUANTUM COMPUTING

Corresponding Author: jean-luc.sauvageot@cea.fr

Here below attached the flyer by Jean-Luc Sauvageot describing the content of his lecture.

Dr. Jean-Luc Sauvageot is a high skilled astrophysicist at the Department of Astrophysics, DAP, of the Institute of Research into the Fundamental laws of the Universe (IRFU), a Fundamental Research Division at the Commissariat of Atomic Energy (CEA) in France. He has a wide range of contributions in Astrophysics experiments including a high expertise in some related instrumentation aspects.

PLENARY MORNING SESSION / 34

COMPUTATIONAL SPECTRAL VIDEO IMAGING

Spectral capture technique collects information with more color channels than traditional trichromatic sensing. Therefore, it provides more detailed properties of the light source and the scene. Possible applications span across lots of fields such as remote sensing, materials science, bio-photonics, environmental monitoring, and so on. Spectral capture technique needs to record massive data in spatial, temporal and spectral domains, traditional spectral capture systems suffer from temporal and spatial scanning, thus is not suitable for video capture. Nowadays, with rapid development in sampling theory and electronic techniques, spectral video acquisition is becoming tractable. In this talk, we present recent progresses on the high resolution spectral video acquisition. Prism-Mask Image Spectrometer (PMIS) is proposed which accomplishes high quality video capture in three domains: spectral (1nm), spatial (one mega-pixels) and temporal (real-time) resolution. Both the optical principle and the prototype setup of the PMIS are introduced. In the end, a bunch of machine vision applications (object tracking, skin detection, automatic white balance, etc) based on PMIS are also discussed. In addition, we will also introduce the emerging field of computational photography and other representative researches.

Xun Cao received his Ph.D. degree from Tsinghua University, Beijing, China and he is now a Professor of the Electronic Science & Engineering School, Nanjing University. He has been a visiting researcher at Philips Research, Aachen, Germany in 2008 and Microsoft Research Asia, in 2009 and 2010, and a visiting scholar at The University of Texas at Austin, U.S.A from 2010 to 2011.

Prof. Cao's research interests include Image Based Modeling and Computational Photography, he has published 30+ papers on premier journals (IEEE Signal Processing Magazine, IEEE T-PAMI, IEEE T-IP, Optica, Optics Letters, Optics Express, etc.) and leading conferences (CVPR, ICCV), and holds 30+ U.S. and China patents. His 3D reconstruction system has been successfully applied in the commercial software Roxio Creator, which share a major market in North America. The system has also been used in the first real-character CG movie in China. Prof. Cao directs the Laboratory of Computational Imaging Technology & Engineering (CITE Lab) in Nanjing University, in recent ten years, CITE lab focuses on spectral video imaging and its applications, for more information, please refer to: http://cite.nju.edu.cn

OPENING DAY / **117**

Closure of the Opening Ceremony and Start of the School, Aurore SAVOY-NAVARRO, co-chair INFIERI

This was a brief oral presentation without slides.

PLENARY MORNING SESSION / **4**

Cold Detectors: From Astrophysics to Quantum Computing

PLENARY MORNING SESSION / **21**

DARK MATTER SEARCHES: AN OVERVIEW

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We live in a mysterious Universe.
Recently, gravitational waves have been detected, black holes horizons have been observed,
Dark Energy could be a cosmological constant… Of the main challenges in physics, we still have to uncover the nature
of the observed Dark Matter, which is contributing more than 80% of the matter in the Universe.
Extensions of the Standard Model of Particle Physics like Supersymmetry expect particles which are neutral and interact very weaklywith other forms of matter. In this talk I will briefly review, what we really know about Dark Matter and address some detection issues.
Prof.Charling Tao is Research Director at the Center of Particle Physics of Marseille (CPPM), Laboratory of CNRS/IN2P3, Marseille, in France, and Emerita Professor at the Tsinghua University, in the Department of Astronomy, (she was a former Head of this Department), in Beijing (China).

PLENARY MORNING SESSION / **23**

DIGITAL PET 2.0

Qingguo Xie received his B. Sc. in Industrial Automation from Huazhong University of Science and Technology (HUST) in 1994, M. Sc. in Industrial Automation from Dalian University of Technology in 1997, and Ph. D. in Electrical Engineering from the HUST in 2001. He got profound experience

in high-energy physics during his time in U. Chicago and Argonne Lab.
He is currently a professor in Department of Biomedical Engineering at the HUST, Wuhan National Lab for Optoelectronics (WNLO), and Mediterranean Neurological Institute (NEUROMED).
His research interest centers on next generation PET imaging science and applications. He founded the PETLab at the HUST in 2001 and the PETLab at the NEUROMED in 2017. His team has endeavored to develop the all-digital PET technology architecture, with focuses on scintillation materials, high energy particle detectors, signal processing methods, reconstruction algorithms and etc. They are also exploring new applications for both preclinical and clinical researches, as well as the development and validation for new drugs and therapeutic approaches.
Dr. Xie has served, and is serving, as a charter member of study sections and/or grant reviewer for National Science Foundation of China (NSFC) and other funding agencies, universities, and hospitals. He has been devoted himself to mentoring students and post-doctoral fellows, who have also received numerous awards for their accomplishments. Most of his students have developed successful careers in pioneering industrial R&D centers and academic institutions.

EVENING KEYNOTE / 11

DUNE, JUNO, SUPER/HYPERKAMIOKANDE; THE LAST WORD ON NEUTRINOS?

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Three large scale experiments are under construction all over the world to explore over the next decades, the still pending questions related to the Neutrino Physics. These experiments are DUNE in USA, JUNO in China and Super/HyperKamiokande in Japan. All three are gathering large international collaborations.
Each of these three challenging projects are presented by their representatives.

LAB SESSION / 37

Digital SiPM

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LAB SESSION / 50

Digital Small Animal PET mouse image analysis (Radiomics)

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See abstract in LABS TABLE

AWARDS SESSION & FAREWELL PARTY / 106

FAREWELL PARTY organized by the School attendants in a hot ambiance…

LAB SESSION / **36**

FE1 FRONT-END ELECTRONICS ON DEEP SUB- MICRON CMOS TECHNOLOGY FOR THE NEXT GENERATION OF PIXEL BASED DETECTORS

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See abstract in LABS TABLE

LAB SESSION / **38**

FE2 INTRODUCTION TO FDSOI PIXEL DETECTORS

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See abstract in LABS TABLE

LAB SESSION / **39**

FE3 NEW SENSORS CHARACTERIZATION

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See abstract in LABS TABLE

LAB SESSION / **41**

FE4 2.5D AND 3D TECHNOLOGY: INTRODUCTION TO 3D INTERCONNECT TECHNOLOGY DESIGN

See abstract in LABS TABLE

LAB SESSION / **42**

FE5 STATIC SIPM CHARACTERIZATION

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LAB SESSION / **43**

FE6 MULTI VOLTAGE THRESHOLD LAB

See abstract in LABS TABLE

EVENING KEYNOTE / **12**

FROM LARGE TERRESTRIAL TELESCOPES TO SPACE INSTRUMENTS

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In the first part of this evening keynote session:
Dr. Jean Gabriel CUBY will report on the European Extra Large large terrestrial telescope E-ELT project, that will be the largest one in the world
The European Southern Observatory (ESO) is building the Extremely Large Telescope (ELT) located on top of Cerro Armazones in the Atacama Desert in Chile. Construction has started in 2015 and is expected to be completed in 2026. The ELT features a segmented 39-meter primary mirror, 4 relay mirrors delivering the optical beam to two Nasmyth platforms and a suite of instruments and adaptive optics modules. The ELT will address a large variety of scientific goals ranging from the observation of exoplanets to the farthest galaxies in the Universe.

Jean-Gabriel Cuby is senior astronomer and former director of Laboratoire d'Astrophysique de Marseille (LAM) in France. He worked at the European Southern Observatory (ESO) and was head of instrumentation at the Paranal Observatory (Chili) where the VLT (Very Large Telescope, made of 4 telescopes that can work independently or in an interferometric way) is installed. He is working on projects that will peer into the distant universe, most particularly the ESA Euclid space mission.

He is also involved in the SVOM spatial experiment which will be the second part of his keynote lecture.

PLENARY MORNING SESSION / **29**

GPGPU COMPUTING FOR REAL TIME EVENT FILTERING (WITH THE HEP AS AN EXAMPLE CASE)

Corresponding Author: dorothea.vom.bruch@cern.ch

With the ever increasing demand on computing power and Moore's law not being applicable any more, general purpose GPU computing (GPGPU) is used more and more widely in various fields of physics.
This lecture will give an introduction into the GPU architecture, highlight the differences to x86 and discuss which types of problems are specifically well suited for acceleration on GPUs. As example, event filtering on GPUs in real-time is discussed in the context of high energy physics experiments.

Note that a computer-based Lab will complete this introduction to GPU computing where Students will obtain first experience with programming GPUs using Nvidia's framework CUDA.

LAB SESSION / **47**

HEP1 ELECTRON BEAM TOMOGRAPHY OF A BASIC ELEMENT OF THE HIGH GRANULARITY CALORIMETRY FOR HL-LHC (CMS)

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See abstract in LABS TABLE

EVENING KEYNOTE / **13**

HIGH FIELD MAGNETS FROM FUNDAMENTAL RESEARCH TO MEDICAL APPLICATIONS

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The two speakers, experts in the domain, will present two types of applications of this advanced technology:
The lecture by Dr. Toru Ogitsu is on: “Superconducting Magnets for Accelerator Science”:
Superconducting magnets are widely used for accelerators and accelerator sciences.The lecture briefly summarizes the superconducting magnet applications in accelerators and accelerator sciences.

Dr. Toru Ogitsu is Head Cryogenics Science Center at the High Energy Accelerator Research Organization, KEK , Ibaraki, (Japan), in charge of the management of the R&D on Superconducting Technologies and Cryogenics Engineering Group. This Lab has achieved the design and construction of several worlwide class magnets as for instance magnets for the International Linear Collider (ILC) project or for the LHC including those for the HL-LHC.

Dr. Pierre VEDRINE will present the High Field magnets equipping the HEP experiments with as examples the 4 Teslas Magnet for the CMS experiment and the very large Toroid Magnet for the ATLAS experiment at the LHC-CERN.
He will describe how starting from this ATLAS Magnet, he and his team developed the design that led to the 11.7 Teslas magnet.This is the largest field MRI magnet in the world with these dimensions, installed and under test at the NEUROSPIN Center at IRFU-CEA, France.

Dr. Vedrine is the Head of the Department of Accelerators, Cryogenics and Magnets, DACM, at the IRFU-CEA in France.
Since decades, this Laboratory is involved in developing and producing these devices for equipping several High Energy Physics Research Centers in the world, with many of the most advanced magnets (e.g. at Serphukov in Russia, at various CERN machines including the LHC, at various international experiments such as LEP, LHC and at DESY, including the XFEL and the new Linear Collider in project.

PLENARY MORNING SESSION / **18**

HIGH PERFORMANCE TIMING DETECTORS FOR HIGH ENERGY PHYSICS EXPERIMENTS & NEW DEVELOPMENTS FOR High LUMINOSITY LHC

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In recent years precision timing detectors have increasingly captured the interest of the particle physicists, for their potential as time of flight detectors in high luminosity collider experiments as

the LHC.
In the phase-1 of the LHC, the experiments have exploited a global event description, making use of all the subdetector information (tracks, calorimeter hits and muon chamber hits) to optimize the particle energy and position measurement depending on the particle type.
This technique usually referred to as "particle flow" has a beneficial effect particularly on the jet energy and on the missing transverse energy resolution.
In 2025 a new phase of the Large Hadron Collider will begin with increased instantaneous luminosity (HL-LHC) and a number of concurrent proton-proton interactions per bunch crossing as high as 200. Therefore the events will have very high vertex and track density, and high hit occupancy will be detected in the calorimeters. Hence the need to exploit additional measurement, like the timing information, for the track to vertex matching algorithms and for the association of calorimeter hits to tracks, in order to be able to efficiently use the particle flow technique in these harsher conditions. This lecture will review the existing detectors with fast and precise timing measurement as well as the physics motivation for their use.
It will introduce the various detector technologies able to achieve high performance in timing: Micro-channel plates, scintillation crystals coupled to high gain photodetectors, and silicon based detectors as Low Gain Avalanche devices.

Dr. Francesca Cavallari is a Senior Research Scientist at INFN and University La Sapienza in Rome (Italy); she is currently Project Manager at the CMS experiment at LHC. She had/has important contributions and responsibility to one of the key element of the experiment, i.e the electromagnetic calorimeter from the beginning (i.e. construction) its running and now its upgrade.

PLENARY MORNING SESSION / 25

HIGH RATE/HIGH SPEED DATA TRANSMISSION CHALLENGES & SOLUTIONS: PHOTONICS APPLIED TO TELECOM

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Professor Ming Tang received his B. Eng. from Huazhong University of Science and Technology (HUST), Wuhan China, in 2001 and his PhD from Nanyang Technological University (NTU), Singapore, Singapore in 2005. His postdoctoral research in Network Technology Research center (NTRC) was focused on the optical fiber amplifiers, high-power fiber lasers, non-linear fiber optics and all-optics signal processing. From February 2009 he was with the Tera-Phoptonics Group led by Prof. H Ito in Riken, Waiko, Japan as a research scientist conducting research on terahertz wave generation, detection and application using non-linear optical technologies. Since March 2011, he has been a professor in the School of Optoelectronics Science and Engineering, Wuhan National Laboratory of Optoelectronics, HUST, Wuhan, China. He has published more than 70 technical papers in international recognized journals and conferences, and he serves as a regular reviewer for such journals as IEEE Journal of Quantum Electronics, IEEE Journal of Lightwave Technology, IEEE Photonics Technology Letters and Optical Society of America (PSA) publications. He has been a member of the Lasers and Electro-Optics Society (LEOS, now IEEE Photonics Society) since 2001.

EVENING KEYNOTE / 10

IMPACT OF THE INNOVATIONS IN SEMICONDUCTOR ADVANCED TECHNOLOGY ON THE TRACKING CONCEPTS IN FUNDAMENTAL RESEARCH

Corresponding Author: philip.patrick.allport@cern.ch

The impressive progress in semiconductor detectors and their associated microelectronics is leading to major advances in the track and vertex finding capabilities of current and future experiments.

This is already demonstrated in the ongoing upgrades to the inner tracking systems of detectors for the LHC and HL-LHC at CERN, as well as developments targeting future high energy physics facilities.

Phil Allport is director of the Birmingham Instrumentation Laboratory for Particle physics and Applications (BILPA) and professor of high energy physics at the University of Birmingham. He is a member of the European Committee for Future Accelerator (ECFA) Detectors Panel, he chairs the ATLAS Tracker Upgrade Institute Board and was Upgrade Coordinator of ATLAS (2011-2015). He is a leading international advocate of the High-Luminosity LHC, having been co-organiser of the ECFA sponsored HL-LHC Workshops. He has served on a large number of national and international committees including chairing the UK Particle Physics Advisory Panel and the Institute of Physics High Energy Particle Physics Group. He is a member of several consortia employing HL-LHC tracking detector technology in medical applications with particular emphasis on hadron radiotherapy.

EVENING KEYNOTE / 7

INNOVATION AND OPPORTUNITIS IN HANG ZHOU, CHINA

The session will include three contributions on:

1. Introduction of Liuheqiao. A brief introduction about Liuheqiao's expertise and experience in Innovation through incubation, angel investment and company service.
2. Introduction of Binjiang district. Introduction about how Binjiang district, as the National High-Tech District, leads innovation of high and new technology as well as incubation of small and medium-size tech-based enterprises.
3. Introduction of Hangzhou. Introduction about Hangzhou's diverse and mature entrepreneurial environment."

PLENARY MORNING SESSION / 22

INTRODUCTION TO QUANTUM COMPUTING

Professor Man-Hong YUNG is the Vice Dean of the Shenzhen Institute for Quantum Science and Engineering (SIQSE) in Shenzhen, Chief Scientist for quantum algorithms and software at Huawei Technologies, and Associate Professor at the Southern University of Science and Technology (SUSTECH).

His recent interests include quantum simulation, quantum control, quantum machine learning, and applications for near-term quantum devices. He is one of the inventors of the method of variational quantum eigensolver (VQE) for simulating quantum chemistry. He is also involved in the experimental demonstration of applying the unitary coupled-cluster ansatz on VQE.

NOTE the re-arrangement of the schedule for the agenda of saturday morning: the lecture of Professor Min ZHANG (Tongji Hospital and HUST) is postponed to the second week of the School. Many thanks to Professors ZHANG and YUNG to adjust their agenda in order to contribute to the School.

LAB SESSION / 40

INTRODUCTION TO THE LABS SESSION

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Registration to the Lab session, Labs organization and location, rules to follow…

PLENARY MORNING SESSION / 20

KAGRA: 2ND GENERATION OF GRAVITATIONAL WAVE (GW) EXPERIMENT & FIRST UNDERGROUND GW EXPERIMENT

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Deep under the mountain of the Kamioka mine in Kamioka-cho, Hida-city, Gifu-prefecture, in Japan, there are many leading edge facilities to answer questions about many physics, astronomical and cosmological subjects that haven't been answered, such as "Super Kamiokande", the successor of "Kamiokande".
In 2010, a new challenging science project, KAGRA (Kamioka Gravitational wave detector, Large-scale Cryogenic Gravitational wave Telescope) has started.
KAGRA aims to spot spacetime ripples by harnessing advanced technological twists: chilling key components to temperatures hovering just above absolute zero, and placing the ultrasensitive setup in an enormous underground cavern.
The new detector will join similar observatories in the search for the minute cosmic undulations, which are stirred up by violent events like collisions of black holes. The Laser Interferometer Gravitational-Wave Observatory, LIGO, in the USA and Virgo, located near Pisa, Italy. Those detectors sit above ground, and don't use the cooling technique, making KAGRA the first of its kind.

In this lecture, Professor Miyakawa explains some gravitational wave(GW) physics and main results of the GW detection achieved by LIGO and VIRGO with some historical development of the experimental side for the GW detectors. He will spend some time to explain principles of GW detection using Michelson interferometer and development for the optical configuration as Fabry Perot cavities, power recycling and signal recycling technics. In the second part, he introduces KAGRA that is a 3km scale interferometer currently being constructed underground. KAGRA has low temperature mirrors as test masses which will be cooled down to 16K to reduce thermal noise. Professor Miyakawa is working as a leader of commissioning task at KAGRA site, and he will show some interesting experiences and results obtained during KAGRA construction.

Osamu Miyakawa is Assistant Professor at the University of Tokyo, Institute of Cosmic Ray Research, ICRR, Tokyo, Japan.

5

KEYNOTE: FUNDAMENTAL RESEARCH, ADVANCED TECHNOLOGY AND SOCIETY

Corresponding Author: ian.shipsey@cern.ch

The Convener of this keynote session is: Prof. Yoshinobu UNNO (KEK, JP)

Instrumentation is the great enabler of science both pure and applied. New directions in science are launched by new tools much more often than by new concepts. Instrumentation is critical to the missions of fundamental research into the nature of quantum mechanics and general relativity, astrophysics, and particle physics and in the development of advanced technologies that enable our modern society. To explore the fundamental nature of energy, matter, space and time, to explore the

cosmos and the objects within it and to understand the workings of the human body and mind, and to diagnose and treat disease; we are in the midst of a new golden age of discovery.

In the 20th century, the discovery, formulation and understanding of quantum mechanics heralded a new generation of scientific advances that in turn led to technologies from micro-electronics and computers to MRI, which are vital in sustaining and improving the human condition. These technologies underpin significant sections of the economies of developed nations and have driven the "1st Quantum Revolution". Future scientific and technological exploration, will have deep and transformational consequences and form part of a "2nd Quantum Revolution", embedding quantum technologies into the fabric and to the service of our society. In the near-term this will profoundly influence areas including communication, finance, healthcare, aerospace, and defence.

The LHC and new experiments being planned at proposed new accelerators, deep underground, on mountain summits, at the poles, in space, and quantum sensing on the table-top, together will teach us more about the origin of mass, explain the matter anti-mater asymmetry of the universe, determine if extra spatial dimensions exist, reveal the nature of dark matter and dark energy, and probe the Planck scale. The application of the technologies developed will be applied to medical imaging, biomedical engineering and other aspects of modern life. For the very first time we may come to know how our universe was born, how it will evolve and its ultimate fate, and more about humankind and our place within it.

LAB SESSION / **62**

LAB on GW constant measurement

PLENARY MORNING SESSION / **31**

MACHINE LEARNING AND DEEP LEARNING

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This lecture is an introduction to Machine Learning/Deep Learning. Students will gain foundational knowledge of Deep Learning algorithms emphasizing in the current state-of-the-art Neural Networks for Computer Vision: the Convolutional Neural Networks. Several examples on applications of these techniques will be also shown.

Note that two computer-aided Labs are dedicated to this topic with complementary aspects and applications,
1) One organized by Dr. Dirk Kruecker et al. (DESY and Hamburg University) on "Deep Learning with Keras I+II" with application to Particle Physics or to a more generix case (see Labs Table
2) The other one by Dr L. LLoret & Dr D. Tuccillo (UC and CSIC, SP) on "Machine Learning & Deep Learning applied to Astrophysics " (see Labs Table).

AWARDS SESSION & FAREWELL PARTY / **107**

MANY THANKS to the HUST LOCAL ORGANIZERS

All our warmest thanks to the HUST University for hosting the School and especially to the WLNO Laboratory, the PETLAB Laboratory (part of the WLNO National research Center) and the TONGJI Hospital for the lecture contributions and the Lab sessions organized by this Hospital, part fo the HUST Medical School .

We would like to thank Professors Xie (head of the PETLAB) and d'Ascenzo, co-chairs of the School. Special thanks to Nicola d'Ascenzo for his instrumental role in the organization of the local Labs and providing the infrastructure for both the computer based Labs and the hardware based Labs, as well as his active participation to all the International Advisory Committee meetings that were held over several months for the preparation of the School.

Special thanks also to all the administrative staff led by Yaya and Yuqing and their colleagues who took care of the invitations, visas and all the administrative matters linked to this event organization.

Last but not least, our WARMEST THANKS to all the young PETLAB students that have been so friendly, so kind and so dedicated during the whole school, both for the school attendants and the Lecturers. They have been really impressive and we all are really thanksful to them. The list of these students is being provided.

LAB SESSION / 48

MED1 NEMA MEASUREMENT OF PET SENSITIVITY

See abstract in LABS TABLE

LAB SESSION / 49

MED2 SMALL ANIMAL PET MOUSE ACQUISITION

See abstract in LABS TABLE

OPENING DAY / 118

MEDIA INTERVIEW

MEETING at the PHYSICS SCHOOL / 121

Meeting between the Physics School representatives and the Lecturers from abroad contributing to the INFIERI 2019 School

This meeting was organized by the Physics School for exchanges between the organizers and lecturers from abroad present at that time and the representatives of the Physics School led byt the Dean of the School.
The contributors from abroad participating at this meeting were:
Phil Philip ALLPORT (University of Birmingham, UK), Aurore SAVOY-NAVARRO (IRFU-CEA, University Paris Saclay, FR), Jean Gabriel CUBY (Laboratory of Astrophysics of Marseille, CNRS/INSU, FR), Robert PATTI (Nhanced Semiconductors, CeO, USA), Lara LLORET IGLESIAS (IFCA-CSIC, SP), Dorothea Vom BRUCH (LPNHE, University Paris-Sorbonne, FR), Yoshinobu UNNO (KEK, JP), Osamu MIYAKAWA (University of Tokyo, ICRR, JP), Alba di PARDO (NEUROMED, IT), Emilia BELFIORE (INNOMED, IT).

Co-organizers of the Vth edition of the INFIERI School series at HUST: Nicola d'ASCENZO and Qingguo XIE

The Members of the Physics Department attending the meeting were in particular: Professor Zhang Kai, Professor Chen XiangSong, Head of the School, Professor Lu Zehuang, deputy Director of the Center of Gravimetry and Prof. Jean Michel Le Floch (member of this Center).

The Dean of the Physics School School, Prof. Chen XiangSong gave a presentation describing the HUST University and the School of Physics in terms of their academics achievements, main research Labs as well as their highlights and international opening.

This presentation was followed by exchanges between the lecturers coming from abroad and present at that time at HUST and the representatives of the HUST Physics School.
More information on the School of Physics at HUST: http://english.phys.hust.edu.cn/

PLENARY MORNING SESSION / 63

NEUROMORPHIC COMPUTING WITH SPINTRONIC NANODEVICES

Computing systems inspired by biological neural networks can perform complex tasks for which they were not explicitely programmed, by learning from examples. They demonstrate amazing performances in machine learning tasks such as image or speech recognition, or natural language processing. However, they are executed on traditional von Neuman architecture computers, resulting in huge energy consumption.

Building hardware inspired by brain enables analog neuromorphic computing and machine learning with low energy consumption. Due to their nanometric size and nonlinear properties, magnetic tunnel junctions are great candidates for artificial neurons. I will present few experiments that we have realized where spintronic circuits based on these artificial neurons were used to successfully classify different forms such as spoken digits or vowels, or distinguishing sines from squares.

Dr Danijela Markovic has obtained her PhD at Ecole Normale Superieure in Paris, on quantum information with superconducting circuits.. She currently works at the CNRS/Thales Laboratory at Palaiseau, Frsnce on neuromorphic computing with spin torque nano-oscillators.

PLENARY MORNING SESSION / 17

NEW DEVELOPMENTS ON SILICON TECHNOLOGY

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The use of the Silicon technology has been strongly increasing over the few last decades in the High Energy Physics experiments. This is because the impressive advances in this high tech domain as well as the cutting-edge performances demands moitvated by the Physics.

Abstract: Modern detector science and technology has originated from High Energy Physics experiment needs in the '80's of the past century, based on the achievement and knowledge of the silicon industry of the time. The first segmented array of diodes (a microstrip sensor) was developed to track vertices at the NA11 experiment at the SPS accelerator at CERN (Geneva, CH). During the following years, detector technology developed into a special branch of the huge silicon technology enterprise that has been arguably the biggest contributor to the evolution of most of the economical, social and scientific activities of mankind. If, and how, detector technology for science has kept the pace with the spectacular speed of evolution of mainstream silicon technology (namely, the microelectronics industry) is the object of this lecture, that will also point out the special requirements of detectors for science and how these can be linked to modern microelectronics trends.

Gianluigi Casse is Professor at the Physics Department, University of Liverpool, leading the detector group within Particle Physics in the Department. He is also Director of the Center for Materials and Microsystems of FBK , Trento (Italy) and Co-Spokesperson of the CERN/RD50 experiment (~ 300 scientists worldwide) on Radiation hard semiconductor devices for very high luminosity colliders.

In this School, two Labs are organized on Silicon sensors related to this lecture and one Lab to the associated FEE.
Two other lectures (by Prof. L. Ratti and the keynote by Prof. Allport) are also related to this lecture.

PLENARY MORNING SESSION / **19**

NEW HIGH GRANULARITY CALORIMETERS for HIGH ENERGY PHYSICS

Corresponding Author: dave.barney@cern.ch

Making calorimeters to be highly granular devices has been the subject of decades of R&D work within the High Energy Physics international community and is actively pursued worldwide.This is strongly motivated by the needs of the Physics to be explored in the particle accelerators.
The contribution of Dr Barney to this School includes two lectures:

Lecture 1: High-Energy Physics Calorimetry by Examples
In the first of two lectures on calorimetry, we give an overview of electromagnetic and hadronic shower development and how they lead to the design of modern calorimeters for energy measurements of high-energy particles. We explore the differences between sampling and homogeneous calorimeters and present the pros and cons of each. We focus on some real-world examples from the state-of-the-art detectors designed and operating at the Large Hadron Collider, and explore methods to increase the information content from future calorimeters and the challenges that these new calorimeters pose to detector physicists and engineers.

Lecture 2: The CMS High Granularity Calorimeter for High-Luminosity LHC
Calorimetry in high-energy physics is rapidly evolving, with new challenges and a wide variety of technologies being employed, both for signal creation and detection. Advances in large-area highly-segmented detectors are providing possibilities for high-granularity calorimetry. The CMS HGCAL, being designed to replace the existing CMS endcap calorimeters for the HL-LHC era, is one example. It is a sampling calorimeter, featuring unprecedented transverse and longitudinal readout segmentation for both electromagnetic (CE-E) and hadronic (CE-H) compartments. This will facilitate particle-flow calorimetry, where the fine structure of showers can be measured and used to enhance pileup rejection and particle identification, whilst still achieving good energy resolution. The CE-E and a large fraction of CE-H will use hexagonal silicon sensors as active detector material. The lower-radiation environment will be instrumented with scintillator tiles with on-tile SiPM readout. These concepts borrow heavily from designs produced by the CALICE collaboration but the design of such a detector at a hadron collider is considerably more challenging than at the linear colliders.

Dr David Barney is Senior Research Physicist and Group Leader at CERN (European Centre for Particle Physics), System & Beam Test Coordinator for High Granularity Calorimeter upgrade for the CMS experiment at the LHC: CMS is one of the two large multipurpose experiments at the LHC at CERN.

PLENARY MORNING SESSION / **32**

NEW INTEL FPGA TECHNOLOGY

INTEL is developing a family variants based on the new INTEL FPGA technology. Together with this advances on the hardware side, this lecture will give an introduction to a new collection of software, firmware, and tools that allow all developers to leverage the power of Intel® FPGAs.

Dylan Wang is Programmable Solutions Group (PSG) technical sales specialist with area of focus in IoT (INternet of Things). He joined Altera (now Intel PSG) in 2005 as Regional Applications Engineer focusing on the algorithm implementation and system architecture. Dylan holds a master degree at State University of New York in EE.

This lecture will be completed by a Lab session presented by Zhu Zhaojun. He will help to create all accounts to access the new FPGA cloud and he also will prepare the workshop material which can be running on the FPGA cloud for this class (See the table of Labs).
Zhu Zhaojun (Felix) joined Altera (now Intel PSG) in Aug 2014 as Regional Applications Engineer with expertise in OpenCL/HLS/HyperFlex technologies. He has been working closely with key customers to optimize their designs, customize OpenCL BSP and fix tough issues.

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NEWS…NEWS….NEWS…11.7 TESLAS: THE WORLD-RECORD MAGNETIC FIELD GENERATED by A HUMAN MRI MAGNET at NEUROSPIN, JULY 18, 2019

‼ LATEST NEWS FROM NEUROSPIN ‼:
11.7 TESLAS: THE WORLD-RECORD MAGNETIC FIELD GENERATED by A HUMAN MRI MAGNET, on JULY 18, 2019. SEE PRESENTATION by Pierre VEDRINE (IRFU-CEA, Saclay, FR) and ATTACHED DOCUMENT‼

PLENARY MORNING SESSION / 1

New Silicon Technology 1

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PLENARY MORNING SESSION / 2

New Silicon Technology 2

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OPENING DAY / 108

Openning by the Hosts

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The two chairs of this Opening Day and co-chair of the School organization, Professors D'Ascenzo and Xie are on stage delivering their speech.
In front of them the row with the Authorities of the HUST University attending the Opening Session:

with Prof. Yiqing Zhan HUST Vice Rector , Prof. Xianjun Liu, Deputy Director of Academic Committee, Prof Bifeng Liu Deputy Director of College of Life Science and Technology, Prof. Jun Zhou, Deputy Director of Wuhan National Laboratory for Optoelectronics (WLNO), Prof Xiaphong Zhao Deputy Director of School of International Education, Mrs Jie Chen Deputy Director of International Exchange Center at HUST.

PLENARY MORNING SESSION / **26**

PROGRAMMING FOR BIG DATA PROCESSING

Big data became popular with the MapReduce programming model, and the big ecosystems grow big with the Hadoop system, an open-source implementation of MapReduce model. Programming is the key to understand the big data processing. In this lecture, three popular big data processing paradigms and related programming issues are introduced. First, the programming for batch data processing is introduced. The content covers the motivation for new big data processing model, MapReduce programming model, the MapReduce framework and the Hadoop ecosystems. Then, the programming for graph processing is presented, as graph is one of most popular data structure in the big data era. This part covers graph programming model, graph processing frameworks, and the related system issues. At last, the streaming data processing is introduced. Stream data processing refer to the processing the big data with big velocity, and the real time data processing. In this part, typical streaming processing system architectures, typical systems and related programming models are introduced.

Hai Jin is a Cheung Kung Scholars Chair Professor of computer science and engineering at Huazhong University of Science and Technology (HUST) in China. Jin received his PhD in computer engineering from HUST in 1994. In 1996, he was awarded a German Academic Exchange Service fellowship to visit the Technical University of Chemnitz in Germany. Jin worked at The University of Hong Kong between 1998 and 2000, and as a visiting scholar at the University of Southern California between 1999 and 2000. He was awarded Excellent Youth Award from the National Science Foundation of China in 2001. Jin is the chief scientist of ChinaGrid, the largest grid computing project in China, and the chief scientists of National 973 Basic Research Program Project of Virtualization Technology of Computing System, and Cloud Security.

Jin is a Fellow of IEEE, Fellow of CCF, and a life member of the ACM. He has co-authored 22 books and published over 800 research papers. His research interests include computer architecture, virtualization technology, cluster computing and cloud computing, peer-to-peer computing, network storage, and network security.

POSTER SESSION / **71**

Poster 8

POSTER SESSION / **73**

Poster10

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POSTER SESSION / 74

Poster11

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Longlong's poster was presented by Kewei, as Longlong could not attend the poster presentation session.

POSTER SESSION / 75

Poster12

POSTER SESSION / 76

Poster13

POSTER SESSION / 77

Poster14

POSTER SESSION / 78

Poster15

POSTER SESSION / 79

Poster16

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Poster17

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Poster18

POSTER SESSION / 82

Poster19

POSTER SESSION / 64

Poster1:

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POSTER SESSION / 65

Poster2

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Poster20

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Poster28

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Poster29

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POSTER SESSION / 66

Poster3

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POSTER SESSION / 67

Poster4

POSTER SESSION / 68

Poster5

Pablo could not attend the poster presentation session and was thus replaced by his adviser

POSTER SESSION / 69

Poster6

POSTER SESSION / 70

Poster7

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POSTER SESSION / 72

Poster9

PLENARY MORNING SESSION / 24

QUANTUM COMPUTING: ALTERNATIVE APPROACHES

Quantum computing promises to solve hugely complex multi-variable problems that are impossible for classical computers to handle. It's an exciting prospect, and research has come a long way, but quantum computers aren't ready yet. Today's experimental quantum systems are still too small to be useful. An alternative is to use quantum inspired computing. Quantum inspired computing uses conventional computing elements to approximate the behavior of quantum computing. With exceptionally inventive architectures and algorithms, we can manipulate data in ways that mimic the behavior of quantum machines. These systems are slower than true quantum computers, but much larger and more capable. In this lecture we will discuss this new class of computing hardware. Dr Robert Patti is President NHanced Semi-conductors Inc., Naperville (Illinois) USA that develops cutting edge semiconductor technologies. NHanced implements and expands this expertise in many directions, under the leadership of 3D pioneer Bob Patti.

PLENARY MORNING SESSION / 33

QUANTUM PHOTONICS

‼ FOR YOUR INFORMATION: Please find here below not the abstract of the lecture but the definition of the topic ‼
Quantum technologies will be able to implement faster algorithms, allow more secure transmission of information, and perform more accurate measurements. For all its theoretical potential, we need

a solid experimental platform with which quantum properties can be addressed with ease and precision, whilst simultaneously preserving those fragile nonclassical features. Moreover, the ability to do so even in a hostile environment will be desirable, if not necessary, to facilitate further technology.

Photons are a viable option to probe and exploit quantum phenomena since they do not suffer from thermal coupling with the external world. They also benefit from a range of degrees of freedom onto which quantum states can be prepared, processed and measured with relative simplicity. Given the vast literature which has shown how to tame photons, the aim of our research is now to foster this novel technology to a point where it will realise the promises of the quantum revolution in information processing.

‼ THE ABSTRACT of this LECTURE WILL BE SOON PROVIDED. ‼

EVENING KEYNOTE / 6

SCIENTIFIC & TECHNOLOGICAL CHALLENGES OF SOLAR SYSTEM EXPLORATION OVER THE NEXT 30 YEARS

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Professors Linli GUO and Michel BLANC will combine their complementary high expertise on the technological and on the Scientific aspects of the Space conquest. The latest successes in this domain, including the exploration of the Dark side of the Moon, over these very last years are further and notably increasing the interest in this fundamental research field.

Prof. Linli GUO, will present the objectives in engineering and technology for the installation of manned scientific bases on the Moon serving as a new first stage for the Space exploration. She will describe the technological challenges to achieve the design of the robotic tools, the buildings, Labs and facilities and the plans for constructing them.
Prof. Michel Blanc, Planetary Scientist, Space Plasma Physicist, will present the scientific challenges and goals to explore the solar system, over these next decades, thanks to the impressive technological progress.

Linli Guo is Professor at China Academy of Space Technology, CAST, DFH Satellite CO., Ltd, and Vice Chief Engineer, Science and Technology Satellite System Engineering Department.
Michel Blanc is an Astronomer at the Institut of Research in Astrophysics and Planetology (IRAP), Observatory Midi-Pyrénées (OMP), University Paul Sabatier at Toulouse in France. He is also Academic affiliate, Climate and Space Department, University of Michigan, Ann Arbor, USA, and Visiting Professor, State Key Laboratory of Space Weather, NSSC, Chinese Academy of Sciences, Beijing.

OPENING DAY / 110

Speech by Aurore SAVOY-NAVARRO, Co-Chair INFIERI

OPENING DAY / 109

Speech by Yiqing ZHAN, Vice President of HUST

This was an oral presentation without slides

OPENING DAY / 112

Speech of Bifeng LIU, Deputy Director of College of Life Science and Technology, HUST

OPENING DAY / 114

Speech of Jie CHEN, Deputy Director of International Exchange Center, HUST

OPENING DAY / 113

Speech of Jun ZHOU, Deputy Director of Wuhan National Laboratory for Optoelectronics, WLNO, HUST

OPENING DAY / 116

Speech of Nicola d'ASCENZO, Co-Chair, HUST

OPENING DAY / 111

Speech of Xianjun LIU, Deputy Director of Academic Committee, HUST

OPENING DAY / 115

Speech of Xiaofeng ZHAO, Deputy Director of School of International Education, HUST

PLENARY MORNING SESSION / 30

THE BRAIN & THE NEW TECHNOLOGIES: THE MEDICAL POINT OF VIEW

Professor Zhang will introduce some desruptive tehnologies about brain, such as CT, MRI, PET, rTMS and MEG and present one clinical case for each tech. She is indeed pioneering a completely new field.

Zhang Min is professor of neurology, chief physician, deputy Director of the department at the Tongji Hospital affiliated to Tongji Medical College of the Huazhong University of Science and Technology. She graduated from Tongji Medical University with a master's degree in neurology in 1995 and a doctorate in neurology from Tongji Medical College, University of Science and universities in 2001. She was supported in 2009 by the Ministry of Education with the "New Century Outstanding Talent Program Project" and in the same year she granted the Hubei province "Chu Tian Scholar." She is currently a member of the Society of Dementia and Cognitive impairment of the Chinese Medical Association of Neurology, the executive Committee of the Cognitive Impairment Institute of the Chinese Geriatric Medical Association, and a member of the Vascular Cognitive Impairment Group of the Chinese Stroke Society. She performed her post-doctorate research in 2002.8-2004.6 and 2006.8-2007.6 at the University of Washington in USA and at the University of British Columbia, Canada. Since working at the Tongji Hospital in 1995, she has focused on clinical and basic research in Alzheimer's disease (AD) and conducted cognitive screening and documentation among community populations, and established a comprehensive database of AD clinical data and biological samples. She published in the Annal of Neurology, Cell Death & Disease, Stroke Brain Pathology etc.

NOTE THE CHANGE in TIME of this LECTURE previously scheduled on Saturday morning. This is for accomodating with her schedule and the one of Prof Yung.

EVENING KEYNOTE / 8

THE FUTURE MACHINES IN PROJECT FOR CONFRONTING THE FUTURE OF PARTICLE PHYSICS

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‼ THIS IS THE MOST IMPORTANT TOPIC IN THE HIGH ENERGY WORLD ‼
WHAT ARE THE NEXT MACHINES TO BE BUILT FOR EXPLORING and EXPLAIN THE ELEMENTARY PARTICLE WORLD MUCH BEYOND WHAT HAS BEEN ALREADY DISCOVERED??
These are WORLDWIDE & INTERNATIONAL PROJECTS for the next 50 or more years to come.
The accelerators of particles in project in the world, China, Europe and Japan will be presented, with their Physics reach as well as their Physics and Technological Challenges, by international experts.
These projects include:

- The electron-positron linear colliders; two such colliders in project:
  1) the ILC (International Linear Collider) at 250 GeV in c.m.s. in Japan (see abstract by Prof. Hitoshi Hayano). Five Technical Design Reports describe in details the whole project.
  2) CLIC (Compact Linear Collider) at CERN (CH) first at 380 GeV, then 1.5 TeV and up to 3TeV. Four Conceptual Design Reports (CDR) describe the Machine, Detectors and Physics of this project.

- Two combined e+e- and pp colliders in project:
  1) the CepC/SppC project in China aiming to build a 100 kms long circular machine. This machine will be in a first stage an electron-positron collider, running at 90, 160 and 250 GeV (Z, W factory, Higgs Factory, Flavor factory).The CepC is expected to run towards end of 2030.
  In a second stage of this project, the circular tunnel is used as a proton-proton collider running at about 100 TeV center of mass energy.
  2) The FCC (Future Circular Collider) in Europe (to be based at CERN) implemented as FCCee, an e+e- circular collider (from 90 to 365 GeV) and then implemented as a 100 TeV pp collider, FCC will also provide the possibility of an electron-hadron collider. The FCCee machine would start running after the end of the High Luminosity era of the LHC (HL-LHC), i.e. towards 2038.
  Both CepC-SppC and FCC have produced detailed Conceptual Design Reports (CDR) describing the Machine, Detectors and Physics at the end of 2018. Needless to stress how much these projects are extremely challenging. They explore different ways in the most tricky R&D aspects of these machines, especially the magnets.

"It's a huge leap, like planning a trip not to Mars, but to Uranus," says Gian Francesco Giudice, who heads CERN's theory department and represents the laboratory in the Physics Preparatory Group of the strategy update process."

"It's too early to say this is a competition. I think it's good to have different proposals and to explore the advantages and disadvantages of each proposal thoroughly. Then we can see which one is more feasible, and the community will decide." says Prof. Yifang Wang in an article on Nature January 2019.

The lecturers are;
- Prof. Joao GUIMARAES DA COSTA (IHEP, CAS, CN) for the Circular Electron Positron Collider, CEPC project
- Dr Michelangelo L. MANGANO (CERN, CH) for the Future Circular Collider, FCC project.
- Prof Hitoshi HAYANO (KEK-Japan) for the International Linear Collider, ILC Project (see abstract here attached).
- Prof. Aidan ROBSON (Glasgow University & CERN) for the Compact Linear Collider, CLICdp Project.

These presentations were followed at the end by a Q&A session.

PLENARY MORNING SESSION / **27**

THE HARDWARE SIDE OF ARTIFICIAL INTELLIGENCE: PIXEL-EMBEDDED SIGNAL PROCESSING FOR THE NEXT GENERATION OF RADIATION DETECTORS AT THE LHC AND FREE ELECTRON LASER MACHINES

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The fast evolution of microelectronic technologies has made the pixel detector a dependable, virtually essential device in a number of crucial applications in high energy physics (HEP) experiments and in photon science. With the upgrade of the LHC experiments and the advent of 4th generation free electron laser (FEL) machines, pixel front-end circuits developed in these two different fields have come to face a number of common challenges: use of scaled CMOS technologies to increase functional density in a limited pitch, large number of parallel channels in a single chip, with the relevant integration issues, huge amount of data to be processed and transferred off-chip to mass storage, ever faster processing speed, exposure to unprecedented doses of ionizing radiation.
This lecture will focus on the core of the pixel detection system, the front-end analog chain measuring the charge released by the detector, including the charge preamplifier and the shaping filter, in its time-invariant and time-variant flavors. Particular emphasis will be put on the signal processing methods and the front-end channel architectures adopted to comply with the demanding specifications of HEP and photon science experiments. Design criteria for minimum noise and optimization of threshold (offset) dispersion will be presented. Some specific topics, such as radiation tolerance, leakage current compensation, dynamic range compression and amplitude measurement digitization, will be discussed also with reference to some particular design cases.

EVENING KEYNOTE / **9**

THE NEW WAYS TO EXPLORE THE BRAIN FUNCTIONING

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The human brain is the command center for the human nervous system. It is made up of a large network of neurons and controls everything from senses to the muscles throughout the body. When the brain is damaged, it can affect many different things, including memory, motor function, sensation

and even personality. Brain disorders include several rare diseases which currently have little to no effective measures of diagnoses and treatments.
In the EU, a disease is considered to be rare when the number of people affected is less than 5 per 10 000. There are more than 7000 rare diseases, most of them with a genetic basis. However, the exact cause for many rare diseases remains still unknown. A very rough estimate would be that one out of 10 persons could be affected by rare diseases with about 300 million people worldwide.
Rare diseases, also referred to as orphan diseases, are serious, often chronic and progressive conditions.
In the last decades, considerable attention has been paid to efforts to stimulates preclinical and clinical research in the field of these diseases, however basic knowledge remains still limited or not available for most of them. To date, neurological rare disorders are vastly underdiagnosed and effective treatment is often lacking or only symptomatic. A global effort is necessary in order to raise awareness and improve knowledge, aiming for earlier diagnosis and specific research programs to identify underlying molecular mechanisms and lead to possible new and/or alternative therapies.

EVENING KEYNOTE / 120

The CEPC Porject

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PLENARY MORNING SESSION / 15

VISION ON THE NEW TRENDS ON ASTROPHYSICS AND COSMOLOGY: FROM LARGE GROUND BASE SURVEYS TO SPACE MISSIONS

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Since the 20th century, modern astronomy research has bloomed tremendously, thanks, partly and importantly, to various technological developments. For cosmological studies probing the origin and evolution of the Universe, we have observed signals from the baby Universe via the cosmic microwave background radiation, and from the mature large--scale structures through galaxy surveys and lensing observations.
The cosmic expansion history has also been revealed by distance measurements through standardizable candles and rulers. With the abundant information, a concordance cosmological model has emerged, In this model, about 68% of the energy budget is from the dark energy component responsible for driving the cosmic accelerating expansion, ~27% from the dark matter providing enough gravity to form the large--scale structures on time, and only ~5% from the normal baryonic matter.

To understand the nature of dark matter and dark energy is thus one of the most important frontiers in the 21st century. In this lecture, Professor Fan will introduce the development of cosmological studies, our current understanding of the Universe, and future advances and challenges in view of the next generation of large surveys.

Zuhui Fan is now a professor at South-Western Institute for Astronomy Research (SWIFAR) at Yunnan University. She received her Ph.D. in physics in 1995 from University of Washington, U.S.A., and then was a visiting scientist and postdoc at University of Chicago, U.S.A and Taiwan University/ASIAA, respectively. She joined Department of Astronomy, School of Physics at Peking University in 2002, and was a professor there since then. In Nov. 2018, she moved to Yunnan University. Her research field is in cosmology and the formation and evolution of large-scale structures.

PLENARY MORNING SESSION / 123

VISIT during the INFIERI School: ZAIGA project presentation at the WUHAN University

While participating to the INFIERI School at HUST, Professors Linli Guo and Michel Blanc had the opportunity to visit the Wuhan University. The ZAIGA project where the Wuhan University has a leading role was presented to them .

For more information about ZAIGA (see attached document)

PLENARY MORNING SESSION / 122

Visit of Dr Yann Moreau from the General Consulate of France at Wuhan

Dr Yann MOREAU, Attache for Science and Technology at the General Consulate of France in Wuhan, visited the INFIERI School at HUST in that morning. He attended the lecture of Dr Jean Lauc Sauvageot and met with the Lecturers from abroad present at that time as well as the co-organizers of the School at HUST, Profs Nicola d'Ascenzo and Qingguo Xie.

There was a lunch with the french lecturers present at that time, in the presence also of Ms CHEN JIE, Deputy Director of the HUST International Exchange Center.
During the lunch Dr Yann Moreau was introduced in more details to the International INFIERI School series and in particular the ongoing Vth edition of that series at the HUST Campus.
Dr Moreau indicated also the names of French Professors currently associated to HUST to be contacted during the School, among whom Prof Michel FARINE and Jean Michel LE FLOCH. A. Savoy-Navarro contacted both of them and met with J.M. Le Floch at the meeting with the Dean of the Physics School.

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