International Conference of Physics Students

August $11^{th} - 17^{th}$, 2016

Abstract Booklet

University of Malta

icps2016.com

Contents

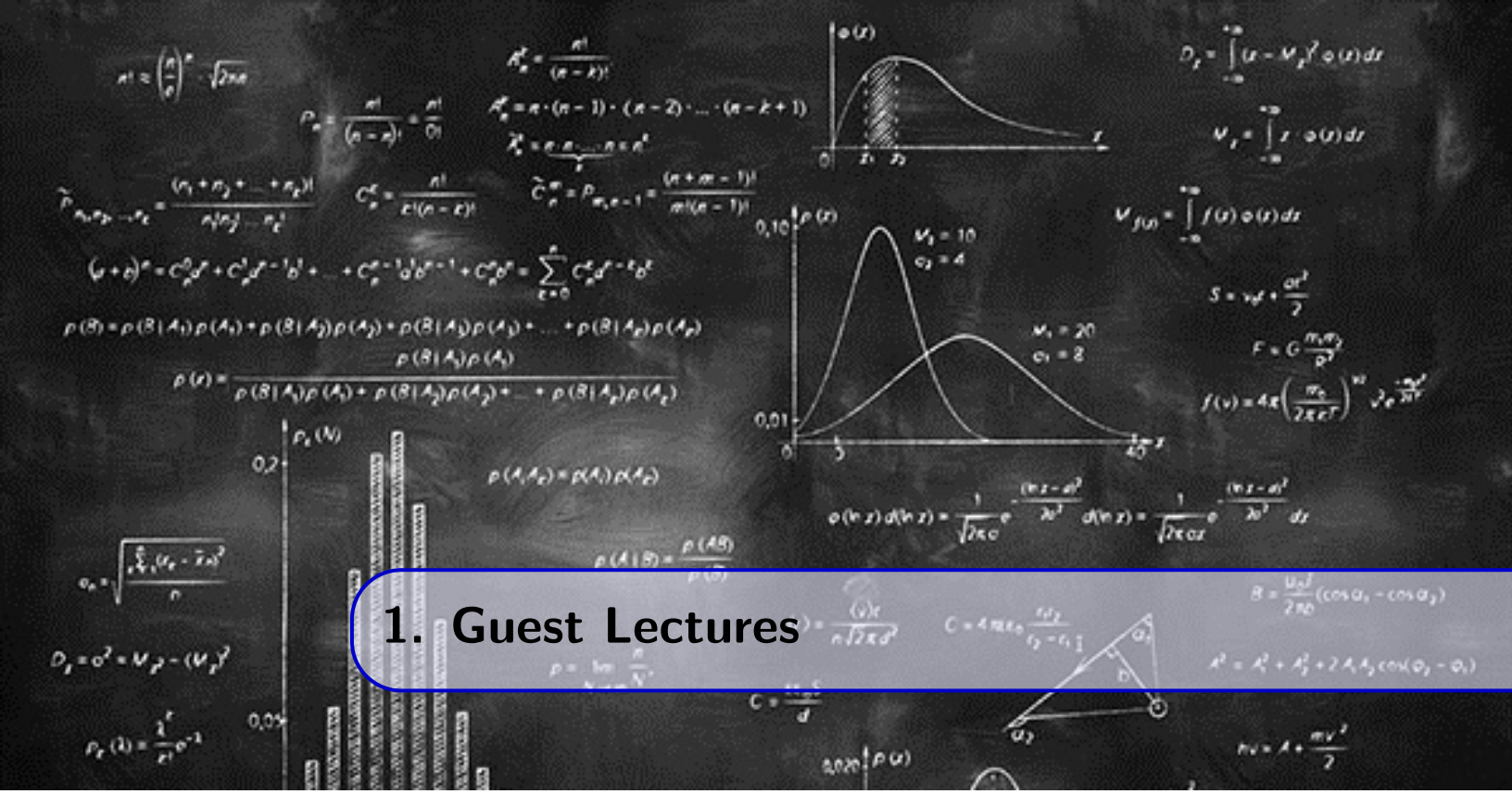
Merħba!

In this booklet you will find all information concerning the lectures and posters sessions of ICPS 2016.

During the conference the student lectures will be held in parallel at B1 and B2 halls inside the Gateway building, which the building opposite hospital and looks like a gate.

The guest lectures, opening and closing ceremonies will be held inside Sir Temi Zammit Hall.

While the poster session will be held in the KSU Student Common Room which is near the Quadrangle. These mentioned locations are indicated on the campus map in the end of the booklet.



1. Guest Lectures

From quantum weirdness to quantum technologies

Dr. André Xeureb, University of Malta

Sir Temi Zammit Hall

Thursday, August 11^{th} 21:00 - 22:00

Quantum mechanics arose out of trying to understand how the world works on the atomic scale. A century later, it has revolutionised our understanding of the laws of the universe; many long-held ideas, such as the possibility to watch an object without disturbing it, have been turned upside down in the process. In this talk I will run through some basic concepts of quantum mechanics and show they are no longer just theoretical curiosities but well-established realities. I will focus on what is being termed the next industrial revolution, where we will start exploiting the power of quantum mechanics to communicate with absolute secrecy, produce computers that can solve problems ordinary computers cannot, develop sensors that are more sensitive than is otherwise possible, and build super-efficient engines.

About André Xeureb

Dr André Xuereb read for his undergraduate BSc degree in mathematics and physics at the University of Malta. In 2007 he started reading for a PhD in the UK studying laser cooling of atoms at the University of Southampton, following which he spent some time as a post-doctoral researcher in Hanover in 2011. From 2011 to 2014 he was a fellow of the Royal Commission of the Exhibition of 1851, working closely with the Belfast quantum technologies group. In late 2014 he was awarded a faculty position in quantum optics and quantum information at the University of Malta. His current interests span from fundamental and technological applications of optomechanics through to quantum thermodynamics.

Transient astronomy - bursts, bangs and things that go bump in the night

Dame Jocelyn Bell Burnell, University of Oxford

Sir Temi Zammit Hall

Friday, August 12^{th} 17:00 - 18:30

Often when we view the Universe in a new way, new and unexpected phenomena are discovered. Recent developments in detectors (for example CCDs) and in computers are now allowing astronomers to search systematically for short duration phenomena – flares, bursts and other kinds of changes in the brightness of stars and galaxies. Some such phenomena were already known (supernovae, for example), and some have been accidentally discovered (gamma ray bursts, for example). There has also recently been more systematic searching for moving objects, such as asteroids that might impact the earth.

We are now entering a new phase with more and bigger telescopes, larger data flows, and observations with new, lower frequency, radio telescopes. This talk will describe this burgeoning field and speculate on what might be found.

About Jocelyn Bell Burnell

Dame (Susan) Jocelyn Bell Burnell, DBE, FRS, PRSE FRAS (born 15 July 1943) is a Northern Irish astrophysicist. As a postgraduate student, she discovered the first radio pulsars - the by-products of supernova explosions which make all life in the universe possible. Bell Burnell was President of the Royal Astronomical Society from 2002 to 2004, president of the Institute of Physics from October 2008 until October 2010, and was interim president by early 2011. Bell Burnell was elected President of the Royal Society of Edinburgh in October 2014. In March 2013 she was elected Pro-Chancellor of the University of Dublin.

Rosetta: To Catch a Comet!

Prof Mark McCaughrean, European Space Agency
Sir Temi Zammit Hall
Monday, August 15^{th} 11:30 - 13:00

The European Space Agency's Rosetta mission captured the imagination of the world in 2014, as it rendezvoused with Comet 67P/Churyumov-Gerasimenko and deployed a lander, Philae, to its surface. In this talk, I'll give a behind-the-scenes view of the mission, its history, the 10-year journey to reach the comet, and the exciting events that have been taking place there. I'll talk about some of the challenges and risks involved in the mission, and give some idea of what scientists are finding as they unlock this treasure chest of information about the formation of our solar system, the origins of water and perhaps even life on Earth. And to end, a look forward to the final phase of the mission, now that Rosetta, Philae, and the comet are past their closest approach to the Sun and heading back out into the cold.

About Mark McCaughrean

Prof Mark McCaughrean is Senior Science Advisor in the Directorate of Science at the European Space Agency. He is also responsible for communicating results from ESA's astronomy, heliophysics, planetary, and fundamental physics missions to the scientific community and wider general public. Following a PhD from the University of Edinburgh, he worked at the NASA Goddard Space Flight Centre, followed by astronomical institutes in Tucson, Heidelberg, Bonn, and Potsdam, and taught as a professor of astrophysics at the University of Exeter before joining ESA in 2009. His personal scientific research involves observational studies of the formation of stars and their planetary systems, and he is also an Interdisciplinary Scientist for the NASA/ESA/CSA James Webb Space Telescope.

Fluid Mechanics: from simple applications to operational oceanography

Dr Anthony Galea, University of Malta

Sir Temi Zammit Hall

Tuesday, August 16^{th} 11:30 - 13:00

Fluid dynamics has many important practical applications, and is consequently of immense technological and economic significance. The movement of a gas or liquid (collectively referred to as 'fluids') is called the 'flow', and its study is called 'fluid mechanics'. The atmosphere (gas) and ocean (liquid) are essential environments for organisms that inhabit them naturally, and for daily men's activities. Information about the sea has served navigators to exploit ocean winds and currents, merchants to reach distant harbours, fishermen to ascertain their catches, and navies to master ocean space. The practical study of the sea has in the last two decades leaped forward with the advancement in science and technology, improved sensors to observe it by direct measurements as well as remotely from space, and in particular with the progress in numerical modelling techniques and information technology applications. The ultimate objective is to learn enough about the structure and motions of the ocean to be able to predict its future state. The simulation of turbulent water mixing in harbours is required to understand the sea currents and circulation within the bays and thereby to quantify the water renewal within the basins.

The Physical Oceanography Research Group (PO-Res.Grp) in Malta is involved in various research activities and also provides various scientific services. The group's oceanographic research includes operational observations and model forecasts, specialised data management analysis and participation in international cooperative ventures. The research themes of the PO-Res.Grp cover coastal meteorology, hydrography and physical oceanography with a main emphasis on the experimental study of the hydrodynamics of the sea in the vicinity of the Maltese Islands.

About Anthony Galea

Dr Anthony Galea is a resident academic lecturer at the Physical Oceanography Research Group (Department of Geosciences) within the University of Malta. He got his Ph.D. in 'Environmental and Industrial Fluid Mechanics' from the University of Trieste, in Italy. His research involves the numerical modelling (LES and RANS) of coastal areas to decipher the in-harbour sea currents and the turbulent water mixing within bays. He is also interested in numerical modelling of coastal/regional areas, computational fluid mechanics, and operational oceanography, and is an avid kayaker.

Building the world's largest Radio Telescope: The Square Kilometer Array

Dr Alessio Magro, University of Malta

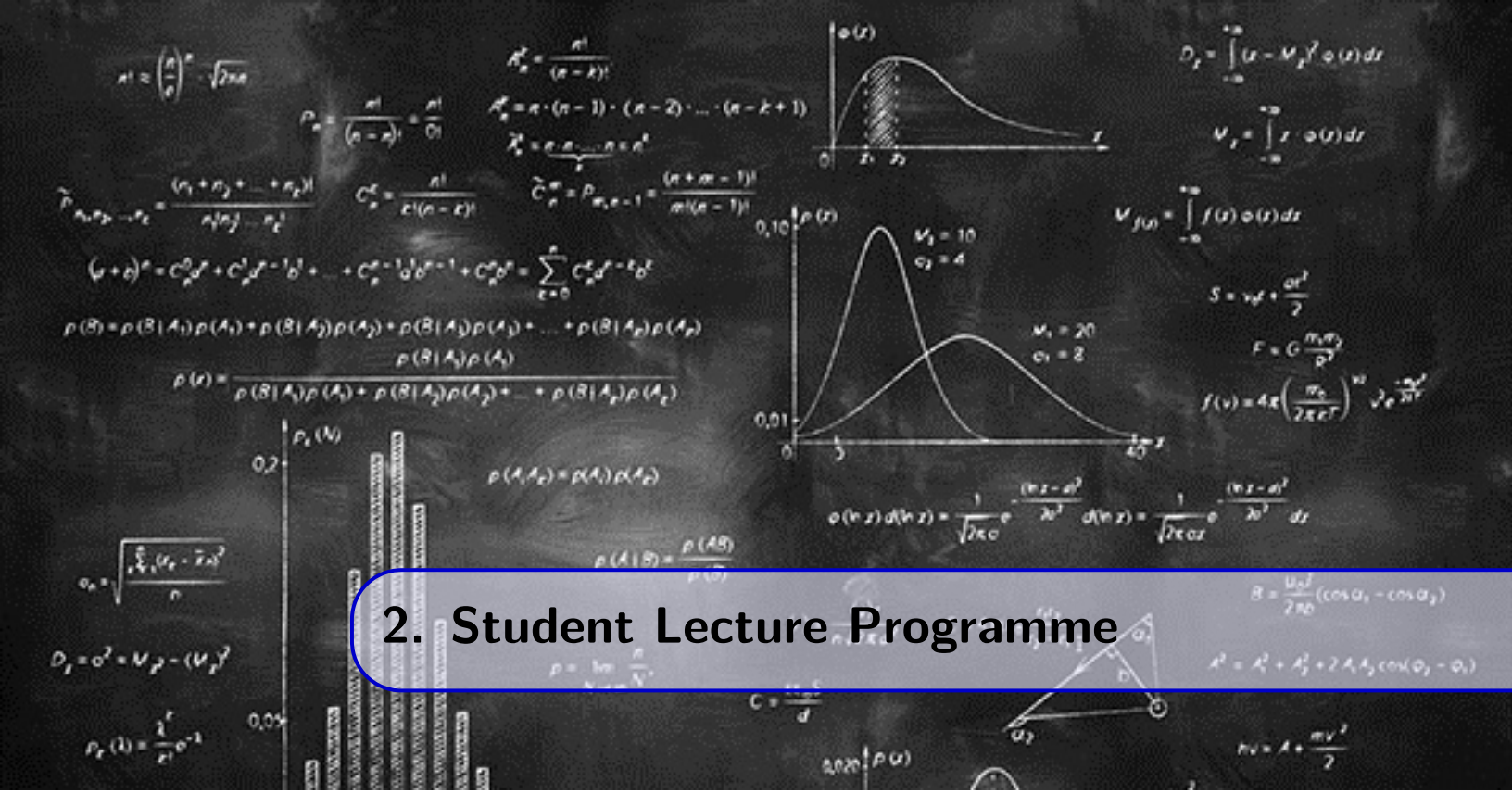
Sir Temi Zammit Hall

Tuesday, August 16^{th} 14:30 - 16:00

The Square Kilometer Array (SKA), when built, will be the largest radio telescope in existence, with a total collecting area of approximately one square kilometer and will be 50 times more sensitive than any other radio instrument. Several countries and a large number of institutes are involved in designing, prototyping and testing all the components making up the multi-part telescope. The SKA is predominantly a software-telescope, whereby most of the signal processing, online analysis and data transport is performed in software. In this talk I will provide an overview of how to build a radio telescope, and focus on the efforts being expended to build the SKA. The talk will mostly focus on the signal processing and software aspect of radio telescope, and delve into the staggering requirements of the SKA and how to tackle them: an exaflop supercomputer, an exabyte a day of raw data, managing hundreds of thousand of antennas and dishes.

About Alessio Magro

Dr Alessio Magro is a resident lecturer with the Institute of Space Sciences and Astronomy (ISSA) at the University of Malta. After reading for his undergraduate degree in Information and Communications Technology, he spent a year working in the software industry, after which he started his PhD with the Department of Physics at the University of Malta, working closely with the radio astronomy group at the University of Oxford, and spent and an additional year as a postdoc with the same department. His main research area is high performance software instrumentation for radio telescopes, primarily working on the Square Kilometer Array.



2. Student Lecture Programme

Friday 12^{th} **August**
Session 1 (15:00 - 16:30)

	Planetary Astrophysics (B1)	**Philosophy of Science** (B2)
15:00	**Miss Andreea Munteanu**: Massive Stellar Evolution and Neutrino Physics	**Mr. Daniel Czegel**: What is understanding in science?
15:18	**Mr. Leonardo Espinoza Zepeda**: Journey to Mars	**Mr. Adrian Solymos**: Reference frame-free spacetime model
15:36	**Mr. Erik Johnson**: Reducing effect of RV scatter around active M Dwarfs	**Ms. Sabina Džafić**: A quick course on physics teaching
15:54	**Mr. Kunal Deoskar**: Active Galactic Nuclei - Are they responsible for the IceCube neutrino detections?	**Dr. David Jacome**: Outreach and Physics Education in the 2020
16:12	**Miss Gvantsa Ghutishvili**: Study of Instabilities in the Great Red Spot of Jupiter	**Miss Ildikó Stark**: A new way to determine causality
16:30	Coffee break	

Saturday 13^{th} **August**

Session 2 (9:30 - 11:00)

	Material Physics 1 (B1)	**Astrophysics and Cosmology 1** (B2)
09:30	**Mr. Bogdan Butoi**: GLAD technique in plasma polymerisation - controlling morphological growth of polymers	**Mr. Alexandru Balaceanu**: The Development of Cosmic-Ray Detectors in Bucharest
09:48	**Mr. Pavao Andricevic**: A new old compound is the star in photovoltaics	**Mr. Jan Kwapisz**: Mass in de Sitter space
10:06	**Mr. Lamborghini Sotelo**: A little bit of photon pair generation in optical fibers	**Ms. Stina Scheer**: Optomechanics of photonic crystal membranes
10:24	**Mr. Jannis Dickmann**: Diffusion of Radon in Tissue	**Mr. János Takátsy**: Testing globular cluster models with future detections of gravitational waves from eccentric binary black holes
10:42	**Mr. Fraser Pike**: Combining Multiple Mid-Infrared Laser Diodes into a "Superbeam"	**Mr. Alexandru Gherghel-Lascu**: The KASCADE-Grande and Pierre Auger Cosmic Ray Experiments
11:00	Coffee break	

Session 3 (14:30 - 16:00)

	Material Physics 2 (B1)	**Data Analysis, Simulation and Imaging 1** (B2)
14:30	**Miss Danielle Harper**: What Makes a Flute a Flute? A Mathematical Analysis of Timbre	**Mr. Ulrich Haselmann**: FEBID
14:48	**Miss Joanna Symonowicz**: Light trapping in the Organic Solar Cells	**Mr. Diego Benusiglio**: Physics in Neuroscience - measuring and modelling of neural circuits.
15:06	**Mr. Krishna Seegoolam**: Engineering dielectric tunability at perovskite interfaces	**Mr. Kristóf Rozgonyi**: Wide-field analysis of VLBI survey data
15:24	**Ms. Ganna Shchygol**: Modelling reactions with ReaxFF in MOFs with defects	**Miss Sofia Luisa Soares Ferreira Nunes Teixeira**: Numerical simulations of flexible thermoelectrics
15:42	**Mr. Lukas Deuchler**: DFT study of the diffusion of S adsorbates on a Br pre-covered Cu(100)-surface	**Mr. Simo Tuomisto**: Simulating a sun with your computer
16:00	Coffee break	

Session 4 (16:30 - 17:30)

	Nuclear Physics (B1)	**Geophysics** (B2)
16:30	**Miss Lilla Vanó**: Characterisation of density fluctuations during the inter-ELM periods in the MAST spherical tokamak	**Mr. Kamil Ciesielski**: Novel rock sampling technique for use on Mars
16:48	**Mr. Zvonimir Domazet**: Introduction to Nondestructive Testing in Nuclear Power Applications	**Ms. Mariam Abuladze**: Influence of one specific turbulence on the stable structure of tornadoes
17:06	**Mr. Thomas Potocar**: Nuclear reactor	**Miss Caracas Ioana-Alexandra**: Geo-neutrinos as messengers of the Earth's interior and as radioactive background in new generation of neutrino oscillations experiments
17:24	Transport	

Sunday 14^{th} **August**

Session 5 (9:30 - 11:00)

	Quantum Physics 1 (B1)	**Electromagnetism** (B2)
09:30	**Mr. Müller Lukas**: Categories in physics	**Mr. Timo Eckstein**: Accelerators on a Chip
09:48	**Mr. Matthias Dahlmans**: Particle creation in expanding universes	**Mr. Vittorio Erba**: Jack Polynomials and Quantum Hall Effects
10:06	**Mr. Gerhard Dorn**: Quantum dynamics	**Mr. Giorgi Bakhtadze**: Motion of charged particles in strong magnetic field of pulsar
10:24	**Mr. Michal Dragowski**: Quantum Spin Correlations	**Miss Ida Friis**: The Molecular Biocompass
10:42	**Dr. Ross Donaldson**: Fighting quantum with quantum.	**Mr. Dewan Woods**: Radio Frequency (RF) source for Optically Detected Magnetic Resonance
11:00	Coffee break	

Session 6 (11:30 - 13:00)

	Medical Physics (B1)	**Material Physics 3** (B2)
11:30	**Mr. Andrii Repula**: Measuring the effect of local electric field in biomimetic self-assembled membranes	**Mr. Anton Saressalo**: Ferroelectric properties of BFBT thin films
11:48	**Mr. Alexandru Nistorescu**: Characterisation of Striated Muscular Tissue- Device development and testing method	**Mr. James Kneller**: Optically Induced Dielectric Changes in Organic Semiconductors and their Non-Adherence to Classical Plasma Theory
12:06	**Mr. Luka Luketin**: Neuromagnetic studies of the earliest effects of the spatial visual attention	**Mr. Toni Marković**: Topological insulators - Synthesis and transport measurements
12:24	**Mr. Lari Koponen**: Transcranial magnetic stimulation (TMS) for in vivo brain research	**Mr. Alexander Schiffmann**: n-MOSFET Ageing Measurements and Modeling
12:42	**Ms. Eva Hrabrić**: The role of cross-linking proteins and microtubule pivoting in formation of parallel bundles	**Mr. Markus Karppinen** : From London to Msida - A Decade of ICPS
13:00	Lunch	

Monday 15^{th} **August**

Session 7 (9:30 - 11:00)

	Data Analysis, Simulation and Imaging 2 (B1)	**Astrophysics and Cosmology 2** (B2)
09:30	**Mr. Piotr Kucharski**: Quantisation from the perspective of knot invariants	**Miss Karen Macías**: Sky's Law - light pollution
09:48	**Mr. Joona Havukainen**: Neural networks and High Energy Physics	**Mr. Baptiste Ravina**: Cosmological axion - a Dark Matter candidate
10:06	**Miss Wiebke Hahn**: High resolution imaging of scanning tunnelling luminescence from InGaN/GaN QWs	**Mr. Maximilian Düll**: Gravity - It can be derived from matter!
10:24	**Gabriella Koncz**: Study of exotic nuclei with radioactive ion beams	**Mrs. Jacqueline Catalano**: A trigger ASIC for the Cherenkov Telescope Array
10:42	**Mr. Tamas Almos Vami**: Reconstruction of the CMS Pixel Pilot Blade	**Mr. Florian Wolz**: Gravitational dynamics beyond the standard model - a case study
11:00	Coffee break	

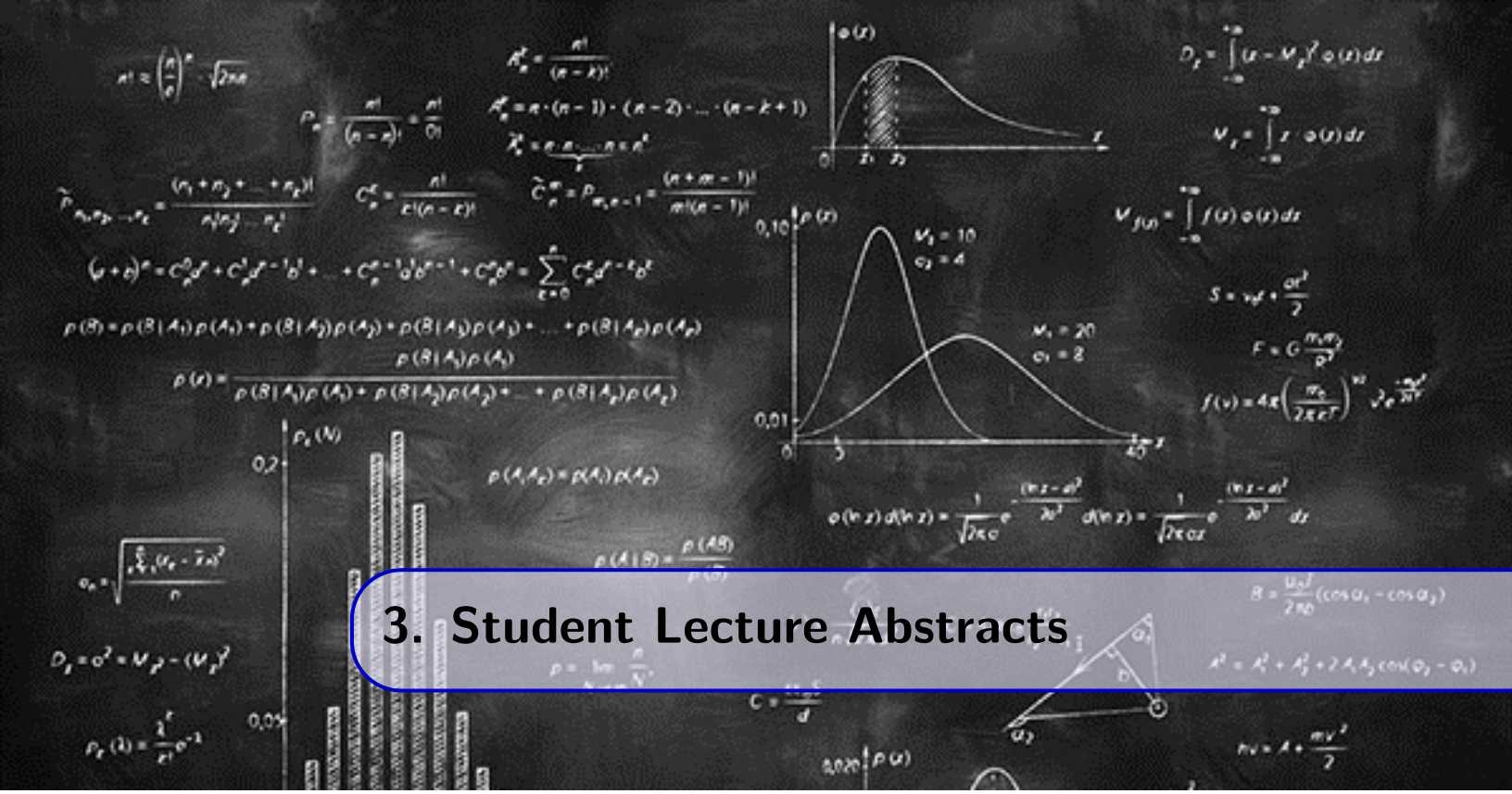
Session 8 (14:30 - 16:00)

	Quantum Physics 2 (B1)	**Atomic and Particle Physics 1** (B2)
14:30	**Mr. Nicola Mosco**: A path-sum approach for Weyl and Dirac Quantum Walks	**Ms.Angela Ludvigsen**: Laser Power Effects on the Size of an Optically Trapped Aerosol Droplet Determined Via Whispering Gallery Modes
14:48	**Mr. Dániel Németh**: CDT - A Non-perturbative Quantum Gravity Theory	**Mr. Petar Marevic**: When atomic nucleus goes pear-shaped
15:06	**Ms. Kinga Sára Bodó**: Quantum game theory	**Mr. Áron Kripkó**: Neutron detection in NeuLAND
15:24	**Miss Oana Daciana Botta and Miss Loredana Angelica Mares**: Electric and magnetic characterisation of the fluorescence properties of a quantum dot-liquid crystal composite	**Mr. Florian Lippert**: Nanoparticles - Production and characterisation
15:42	**Miss Valeriya Mykhaylova**: Phase diagrams in QCD	**Miss Joanna Peszka**: Exotic nuclei decay products detection by using Optical Time Projection Chamber
16:00	Coffee break	

Tuesday 16^{th} **August**

Session 9 (9:30 - 11:00)

	Material Physics 4 (B1)	**Particle Physics 2** (B2)
09:30	**Mr. Adrian Salo**: Creation of Superoxide at the Qo active site of the BC1 complex	**Mr. Jack Woolley**: Dynamics of Molecular Ring Currents
09:48	**Ms. Bettina Leibundgut**: Oxidic Thin-Film Quasicrystals	**Mr. Dominik Gerstung**: Large-N_c Constraints on Nuclear Forces
10:06	**Mr. Viktor Könye**: Optical conductivity of graphene	**Mr. Louis Varriano**: Neutron-mirror neutron oscillations in a residual gas environment
10:24	**Ms. Maria Gieysztor**: PEDOT:PSS as a transparent electrode in perovskite solar cells	**Ms. Aleksandra Snoch**: Prototype of Time-of-Flight detector for NA61/SHINE experiment
11:00	Coffee break	



3. Student Lecture Abstracts

3.1 Session 1: Friday 12^{th} (15:00 - 16:30)

Massive Stellar Evolution and Neutrino Physics

Miss Andreea Munteanu
Hall B1 - 15:00-15:17

This lecture is based on the study the evolution of high mass stars with all the physical processes that occur from their formation and until they collapse and also aspects of the properties of neutrinos and how these can be deduced using fundamental equations. Regarding this, nuclear fusion features were introduced and calculations were made based on the reactions that take place within the core of massive stars in order to better understand stellar evolution.

Further, properties of neutron stars were modelled, this being the key to better comprehend what is happening to a star and how it modifies in the last stage of its evolution: going supernova.

By studying the hypercritical phase of a new neutron star, we can deduce the neutrino cooling effect in the formation of a supernova's gas envelope which is in quasistatic equilibrium. In particular, Supernova 1987A was studied and the analysis of the registrations that took place in the time it was observed gave the possibility to make the statement that the collapse of a star starts with the modification of the massive electron neutrinos.

The properties of neutrino flux that was registered by the ground detector Kamiokande were consistent with the calculations. Also, it will be shown that by investigating the luminosities in SNe IIn and linking them with the element diversity in the wind, one can assume that these luminosities are affected mainly by the intrinsic properties of the supernovae.

Journey to Mars

Mr. Leonardo Espinoza Zepeda
Hall B1 - 15:18-15:35

In this lecture I will show you the concepts and equations that we need in order to be in Mars, such as Kepler's laws, gravitational equations, Hohmann transfer, the Tsiolkovsky equation, etc. But the main idea is to show an experiment that we are trying to develop at the Astronomy Institute in Ensenada, the use of a drone on the red planet to do some measurements such as temperature and humidity and to take some pictures. The problem that we are trying to solve right now gravity and the density of air. So, enjoy this lecture and please comment your ideas and suggestions.

Reducing effect of RV scatter around active M Dwarfs

Mr. Erik Johnson
Hall B1 - 15:36-15:53

In the last 20 years, since the discovery of the first exoplanet around a main sequence type star, there has been a great period of discovery of new planets. Many of these planets are of types that had not even been considered before their discovery and do not exist within our own solar system. Some of these, such as Hot Jupiters, exist in areas of their systems that they could not have formed in and has resulted in additional research and understanding of how planetary systems form. These planets have been discovered by an ever increasing variety of methods. The first, and still most used, method was that of high precision radial velocity measurements of the planet's parent star. The second, most popularized by NASA's Kepler mission, is the transit method. This method observes a star for a long period of time to see the periodic luminosity decrease of a planet moving in front of the star. Other methods include gravitational microlensing, direct imaging and astrometry. Each method has a particular set of planets that is ideal for detection and reveals differing information about these planets once discovered. Additionally each of these methods can be affected by differing characteristics of the observed star such as stellar activity influence on precision radial velocity measurements. Taken together these factors have lead to a very informative distribution of discovered planets that still has significant observational biases. It is the hope of everyone in the field that upcoming missions and surveys, such as GAIA, JWST and CARMENES, will help to close some of these gaps and give us a better picture of the planetary distribution in our galaxy.

Active Galactic Nuclei - Are they responsible for the IceCube neutrino detections?

Mr. Kunal Deoskar
Hall B1 - 15:54-16:11

An Active Galactic Nucleus (AGN) is a compact central region of a galaxy that has extremely high luminosity that even outshines the combined luminosity of the rest of the galaxy. The emissions from these galaxies are observed to be bright at all wavelengths. Radio-loud AGN have relativistic outflows of matter, perpendicular to the disk of the host galaxy. In a subclass of AGN, called blazars, these jets point at Earth.It has been theoretically predicted that AGNs can emit neutrinos. Neutrinos can travel large cosmic distances

greatly undisturbed owning to their small size, extremely low mass and charge neutrality. Moreover, neutrinos cannot be detected directly, because they do not ionize the materials they are passing through. In the IceCube detector, they are indirectly detected by the Cherenkov radiation emitted when an incoming neutrino creates an electron (or muon) in the ice. An analysis of this radiation can help us determine the general direction for the incoming neutrino 'event' and also the energy of the event. We investigated if blazars from the Fermi 3LAC catalogue within the error bars of certain neutrino events observed by the IceCube Neutrino Observatory could explain the respective neutrino counts.

There are certain estimated atmospheric processes that can amount to neutrino production in the atmosphere. These are however lower in energy. Hence to account for neutrinos of mainly cosmic origin, neutrino events with energies greater than 100 TeV were considered in our investigation and the observations were limited to the X-ray and -ray ranges. The sources (AGNs) that were considered for each event were the Fermi 3LAC sources which were within the error boxes of the respective neutrino events.The X-ray data was used from Swift/XRT, ROSAT and INTEGRAL observations. The -ray data was used from the Fermi/LAT 3FGL catalogue. The data was taken over a period of 998 days. Log parabolic model was used to understand the behaviour of blazars and to fit the data. Fitting for the observations was done in the ISIS software package developed by the MIT. Chi-sqr analysis was used to obtain the best fit for observational data of each blazar. The parameters obtained by the best fit were used to calculate the neutrino counts from the respective blazars. The neutrino counts were tallied with the neutrino observations published by the IceCube Neutrino Observatory.

94 AGNs were analyzed from 7 neutrino events. It was observed that most of the sources gave very low neutrino count. However, the combined count from all the blazars in each event was significant.

Preliminary results show that AGNs can explain the neutrino counts in certain events. This is, however, not true for all the events considered as AGNs for certain events did not have good observational data and thus those sources couldn't be trusted.

Study of Instabilities in the Great Red Spot of Jupiter

Miss Gvantsa Ghutishvili
Hall B1 - 16:12-16:29

We study hydrodynamic instabilities in the velocity shear flows. In particular, we discuss instabilities in the Great Red Spot of Jupiter. For this purpose, we derived the behaviour of velocity and density of the flow by means of the governing equations, Euler equation and the continuity equation. We studied the linear analysis of the problem and solved the obtained differential equations by using MATLAB. It has been shown that initial velocity perturbations inevitably leads to generation of sound waves and vice versa – by inducing initially only sound waves in due course of time velocity perturbations also occur. We have found that wave energy increases exponentially so fast that the process either terminates by means of some processes or there are some other sources of energy.

What is understanding in science?

Mr. Daniel Czegel
Hall B2 - 15:00-15:17

In the age of Big Data and the explosion of machine learning techniques, the question whether prediction equals understanding became one of the most fundamental issues in the philosophy of science. Based on the ideas of algorithmic information theory (Chaitin, 2006), I will discuss why and how these formerly similar concepts "bifurcate" nowadays and why is it important to be aware of it as a scientist.

Reference frame-free spacetime model

Mr. Adrian Solymos
Hall B2 - 15:18-15:35

The fundamental structure behind mechanics (and most of physics) is a spacetime model that tries to describe the properties of the physical reality in which events take place. Sadly, spacetime models are usually unmentioned in the treatment of physics, or are covered by simply stating that the framework is non-, special- or general-relativistic.

It is also important to keep in mind that physicists use a lot of mathematical structures that aren't linked to spacetime such as coordinates, synchronisation, concrete units of measurement-observers.

These are of course essential when treating real life problems, but do not reflect the general properties of spacetime. Thus, a mathematical model for it has to be void of any such unnecessary structures. This is the main idea behind a 'reference frame-free' spacetime model.

The lecture gives a semi-formal introduction to a flat spacetime model based on human scale observations, developed in the book 'Spacetime Without Reference Frames' by Tamás Matolcsi. It places emphasis on the ideas governing the choices for the structures in the model and will show how, by restraining the general structure of the model, one can arrive at the non-relativistic and the special relativistic ones.

A quick course on physics teaching

Ms. Sabina Džafić
Hall B2 - 15:36-15:53

If you've ever wondered how to approach teaching physics in a classroom, this lecture is for you. We will discuss questions such as what basic didactic and developmental psychology principles to keep in mind and what should be the goal of our teaching? An overview of the most effective physics teaching methods will be given and we will see how to implement them in teaching a few physics chapters.

Outreach and Physics Education in the 2020

Dr. David Jacome
Hall B2 - 15:54-16:11

The way we communicate with each other is changing each day. We have gone from face to face interactions using the World Wide Web on Desktop computers, to using smart phones for Skype or FaceTime, and recently having watches send replies to each other in a matter of seconds. If we traveled back in time to the 1950s and spoke directly to people about the future, they would probably respond by saying, "I would never expect a person to see another person live on a television screen." Even growing up watching Willy Wonka and the Chocolate Factory, nobody would have imagined during the scene when TV boy is transported to a small screen disappearing in front of everyone. Today, I will tell you a story of how outreach and physics education will be done in 2020. Just imagine sitting in a classroom by yourself, with no classmates or even a professor. Think of a hologram appearing in front of your eyes, asking you questions in Physics, and moving around in the classroom teaching you the Theory of Relativity. The hologram would be programmed to look exactly how you want, with your own specifications, and speak to you in a way that makes you learn the materials. Many of you would say exactly what someone back in 1950s would, "This is futuristic, and not possible to have someone teach me without being physically present in a room." However, this idea is currently being tested, and we are not far away from universities moving towards buying technology to replace professors. In my talk, the focus will be on discussing the physics of holograms, and how in 2020 you will be taught by one.

A new way to determine causality

Miss Ildikó Stark
Hall B2 - 16:11-16:29

What are the consequences of X? Will changing Y cause a change in Z? Questions like these are old and arise everywhere in science as well as in everyday life. Although the questions are old answering them is still a scientific challenge of our days. There are widely-used methods to answer them but each of them has its own flaws.

In my lecture I wish to introduce a relatively new theoretical approach to determine causality between two quantities. Quick overlook of possible casual relations, introducing the method, simple applications, improving the method, where next?, examples of complex applications.

3.2 Session 2: Saturday 13^{th} (09:30 - 11:00)

GLAD technique in plasma polymerisation - controlling morphological growth of polymers

Mr. Bogdan Butoi
Hall B1 - 09:30-09:47

Plasma polymerisation uses plasma sources to generate a gas discharge that provides energy to enable or fragment a liquid or gaseous monomer which often contains a vinyl group, to

initiate polymerisation. Polymers formed by this method are generally highly branched and highly reticulated, and adheres well to solid surfaces unlike polymers obtained by the classical method. This work presents a new method of obtaining different morphological surfaces by combining the Glancing Angle Deposition technique with plasma polymerisation. By controlling the different discharge parameters as well as the angle and rotational speed of the substrate, unique patterns can be obtained. The polymer thin films obtained by this method can be used in a wide range of applications like liquid crystal cells, polarisers and anti-reflex coatings. Structural and morphological studies (FTIR, SEM, AFM) as well as applications of the thin films are presented.

A new old compound is the star in photovoltaics

Mr. Pavao Andricevic
Hall B1 - 09:48-10:05

Organometal halide perovskite are a small class of perovskite structure compounds which were first synthesised in 1978 by D. Weber and intensively studied in the early nineties by Mitzi, Miura and co-workers in the context of superconductivity. The compound was then forgotten until 2009 when the introduction of hybrid perovskite structures in photovoltaic started. In the last 7 years solar cell efficiencies of devices using these materials have increased from 3.8% to 22.1%, making this the fastest-advancing solar technology to date. Today this compound is used in many potential applications from already mentioned solar cells to lasers, light-emitting diodes, photodetectors and hydrogen production. My Laboratory of Physics of Complex Matter at EPFL Lausanne immediately picked up this material and I will present some work I've done on it during the first year of my PhD.

A little bit of photon pair generation in optical fibres

Mr. Lamborghini Sotelo
Hall B1 - 10:06-10:23

A study about the generation of entangled photon-pair in gas-filled kagome photonic crystal fibres, through the process of spontaneous four wave mixing, is going to be described, from the process of producing the photon pair state, describing how to manipulate their state of entanglement and some of its applications. Results about spectral correlation properties of the two-photon states and details of a particular source design, likewise the advances in its experimental implementation, will be shown.

Diffusion of Radon in Tissue

Mr. Jannis Dickmann
Hall B1 - 10:24-10:41

To better understand the biological effects of radon, the knowledge of the distribution and accumulation in the human body is important. An unequal distribution of radon and its radioactive daughter nuclei and subsequent local low dose irradiation could be an explanation of the anti-inflammatory effect of radon treatment. We exposed tissue samples like muscle or fat in a radon exposure chamber and measured the -spectra of the decay products Pb-214 and Bi-214. We then calculated back to the initial amount of radon

in the sample. To measure the diffusion of radon directly through different materials, we constructed a radon diffusion chamber that can be located inside our radon exposure chamber. Subsequently, we performed experiments with different materials like polymer films, fatty tissue or water. We also used different thicknesses of the samples. We want to present the measurement setup for alpha spectroscopy, the interpretation of the spectra and first data of the diffusion parameters.

Combining Multiple Mid-Infrared Laser Diodes into a "Superbeam"

Mr. Fraser Pike
Hall B1 - 10:42-10:59

New-generation 2 µm laser diodes were characterised with the aim of spatially combining multiple beams into a single well-collimated beam. Wavelength, polarisation and M^2 quality factor of the sources were measured using the chopper method and produced results with interesting applications to defence. Two beams were successfully combined and the M^2 was compared to those of the individual diodes. The comparison showed that the beams had been effectively combined, using a repeatable method. Future work may involve combining more diodes to increase the output power. The properties of an unexpected multimode pattern being emitted from the diodes, and the thermal stability of the sources are also discussed.

The Development of Cosmic-Ray Detectors in Bucharest

Mr. Alexandru Balaceanu
Hall B2 - 09:30-09:47

Primary cosmic rays entering the Earth's atmosphere, initiate Extensive Air Showers (EAS). The Astroparticle Physics Group from IFIN-HH Bucharest is involved in the development of muon detectors, studying the behaviour of EAS at different angles, building and using detectors of various capabilities and sensitivity, in order to better understand the processes that they undergo. Also, different experiments around the world, employing mini-arrays of detectors to study the cosmic-ray air showers are reviewed.

Mass in de Sitter space

Mr. Jan Kwapisz
Hall B2 - 09:48-10:05

Nowadays our Universe is in accelerating expanding era. It goes as far as we know to asymptotically de Sitter space. In General Relativity there are certain ways to describe mass eg. Hawking mass. Those definitions are applicable in different circumstances. First I will briefly present main concepts. Then I will show how to construct Penrose diagrams for de Sitter space. Finally I will talk about the problems in definition of mass in de Sitter space and I will present some of my solutions to this problem.

Optomechanics of photonic crystal membranes

Ms. Stina Scheer
Hall B2 - 10:06-10:23

The placement of a mechanical membrane into an optical cavity is an interesting case of interaction between the light field and a mechanical system. While the positioning of such a membrane inside the cavity has been theoretically studied as well as experimentally realized, the usage of it as an incoupling mirror has not yet been investigated due to material limitations. In this talk I will give a brief introduction to the optomechanics of such a system as well as possible applications to gravitational wave interferometry.

Testing globular cluster models with future detections of gravitational waves from eccentric binary black holes

Mr. János Takátsy
Hall B2 - 10:24-10:41

The proper modelling of GCs can be difficult due to the high number of constituents, each interacting with one another. Accordingly, there are many different analytic and numeric GC models competing against each other. Thus, an efficient observational method is required to test these models, and to find the most realistic one. Electromagnetic observations are limited in this regard, because they cannot provide us information about the deeper structure of GCs. However, detections of gravitational-waves (GWs) from eccentric binary black holes (EBBHs) could serve as a tool for testing and constraining these GC models. EBBHs are expected to form in dense stellar systems, such as GCs. Properties of GCs affect the formation of EBBHs within them, and consequently, we may gain information about properties of GCs by detecting EBBHs and reconstructing their parameters. Our goal is to determine the minimal number of EBBH detections with GW detectors that allows testing implications of different GC models on the observable distribution of EBBH parameters, such as orbital eccentricity and pericenter distance at the time EBBH signals enter the sensitive band of Advanced LIGO (aLIGO). When aLIGO reaches its full sensitivity, which is proposed to happen in 2019, the expected rate of EBBH observations will be 5-20/year. We find that this detection rate can already provide enough data to carry out an actual test of GC models on a reasonable timescale.

The KASCADE-Grande and Pierre Auger Cosmic Ray Experiments

Mr. Alexandru Gherghel-Lascu
Hall B2 - 10:42-10:59

The Pierre Auger Observatory is a “hybrid detector” employing two independent methods to detect and study high-energy cosmic rays. One technique detects high energy particles through their interaction with water placed in surface detector tanks. The other technique tracks the development of air showers by observing ultraviolet light emitted high in the Earth’s atmosphere.

In this context, I will describe the experimental techniques used in both Pierre Auger and KASCADE-Grande which studies the cosmic ray primary composition and the hadronic interactions in the energy range $E0 = 1016 - 1018eV$.

3.3 Session 3: Saturday 13^{th} (14:30 - 16:00)

What Makes a Flute a Flute? A Mathematical Analysis of Timbre

Miss Danielle Harper
Hall B1 - 14:30-14:47

Musical instruments all have their own, distinctive sounds. Even when they appear to be playing the same note (or emitting the same frequency), humans are capable of distinguishing which instrument they hear.

In this study, three main instruments have been selected (flute, clarinet and violin) and their audible differences have been explored and explained by physics. Firstly, a recording of a single note played by a selected instrument was taken. Then by taking a Fourier Transform of the resulting sound spectrum, we see the true frequencies which are produced by the instrument. As an example, in the Western music scale the musical note A4 corresponds to a frequency of 440 Hz and yet the spectrum shows many more peaks than one at this frequency.

Upon seeing this, it becomes clear why it is so difficult to produce digital music which can truly replicate these instruments. A spectral analysis was also conducted on notes from Sibelius software as an example and their differences compared to that of a real instrument. There are some clear similarities between the spectra of the "real" musical instrument and the artificially created one, however there is still something which, to the ear, sounds different.

In addition, this analysis was also carried out on the progression of a single note as it is played. Through time, the frequency spectrum shifts, typically beginning and ending with only the dominant frequency. When changing between instruments, this characteristic shift changes again.

All of these things combined contribute to the set of subconscious criteria which humans use to determine which instrument they hear. The knowledge of such phenomena allows us to not only to work towards the creation of digital music, but also to appreciate the mathematical complexity of something as "simple" as music.

Light trapping in the Organic Solar Cells

Miss Joanna Symonowicz
Hall B1 - 14:48-15:05

The organic solar cells seems to be the future of the energy industry. They are not only eco-friendly but also very cheap to produce. Despite of all these virtues, they are not common due to its fast aging-process resulting in poor efficiency in less than half a year. Impedance spectroscopy allows for the exploration of the light dependence on cells' structure and, thus, for the more conscious development of the device. The measurement of the electric permittivity and modulus of the PCBM:P3HT solar cells before and after the light exposure was followed by the evolution of the relaxation processes.

Engineering dielectric tunability at perovskite interfaces

Mr. Krishna Seegoolam
Hall B1 - 15:06-15:23

Perovskite oxide materials show a wide range of physical properties of scientific and technological interest, such as ferroelectricity, multiferroicity, and superconductivity. They also exhibit a large degree of tuneability of their properties via variation of their chemical composition (A and B cations). For example, perovskites can be found in many different structural polymorphs, which is often determined by the relative ionic sizes of the ions.

Using first-principles simulations, we investigate the tunability of the properties of a variety of different perovskite oxide materials. This will give us insight into the general design principles for engineering the dielectic of perovskite oxide materials. The combination of high-throughput and structure searching methods will enable searching in previously unexplored phase space in the hope of identifying altogether new structural polymorphs with large tunability.

Modelling reactions with ReaxFF in MOFs with defects

Ms. Ganna Shchygol
Hall B1 - 15:24-15:41

Local and long-range defects strongly affect sorption and catalytic properties of metal organic frameworks (MOFs), but are very difficult to study both experimentally and computationally.

The reactive MD method ReaxFF is suitable to tackle such complex chemical systems, however, suitable force field parameters are usually not immediately available. I will discuss a systematic approach to tackle ReaxFF parameterisation as well as automated tools for analysing reactive events.

We improve the effectiveness of global optimisation methods, which sample a vast, complex parameter space, by grouping ReaxFF parameters and statistically analysing them across many sets, and applying smart filters.

DFT study of the diffusion of S adsorbates on a Br pre-covered Cu(100)-surface

Mr. Lukas Deuchler
Hall B1 - 15:42-15:59

Diffusion at electrochemical interfaces is a decisive factor for, e.g., metal electrodeposition using halogen ion containing electrolytes (1,2). Nanoscale processes determining the growth dynamics during such processes are not yet fully understood. The potential dependent growth has been ascribed to the variation of activation energy barriers due to the interaction of adsorbate induced electric dipoles with the electric field at the surface (1-3). In order to identify relevant mechanisms in the diffusion process of a S atom on a Br-c(2x2) covered Cu(100)-surface, a study based on density-functional total-energy calculations with VASP[6-9] was realised that took advantage of the nudged elastic band method and yielded

a first insight into the dependence of the S atom's hopping rate on sample potential.

References
1. M. Ruge, F. Golks, J. Zegenhagen, O. Magnussen, J. Stettner, Phys. Rev. Lett. 112, 055503 (2014).
2. F. Golks, Y. Gründer, J. Stettner, K. Krug, J. Zegenhagen, O. Magnussen, Surf. Sci. 631, 112 (2015).
3. M. Giesen, G. Beltramo, S. Dieluweit, J. Müller, H. Ibach, W. Schmickler, Surf. Sci. 595, 127 (2005).
4. G. Mills, H. Jonsson and G. K. Schenter, Surface Science, 324, 305 (1995).
5. H. Jonsson, G. Mills and K. W. Jacobsen, in 'Classical and Quantum Dynamics in Condensed Phase Simulations', 1998.
6. G. Kresse, J. Hafner, Phys. Rev. B 49, 14251 (1994).
7. G. Kresse, J. Furthmüller, Comput. Mat. Sci. 6, 15 (1996).
8. G. Kresse, J. Furthmüller, Phys. Rev. B 54 , 11 169 (1996).
9. See www.vasp.at.

FEBID, nanofabrication and its applications

Mr. Ulrich Haselmann
Hall B2 - 14:30-14:47

EBID (Focused Electron Beam Induced Deposition) is a technique were a so called precursor gas is injected into the chamber of a Scanning electron microscope. The precursor gas adsorbs to the surface and when the electron beam is turned on, on the position where it hits the surface, the gas molecules split up into a volatile and a non-volatile parts. The non-volatile part forms a deposition on the surface. This can be used as a 3D printer for nanoscale resulting in 3D structures down to a size of 50 nm.

Physics in Neuroscience - measuring and modelling of neural circuits.

Mr. Diego Benusiglio
Hall B2 - 14:48-15:05

The major challenge for a student in neuroscience is to integrate the diverse knowledge derived from various levels of analysis, such as measurements of the electrical activity of neurones, of the distributions of neurotransmitters in space and time, and the description of the connectivity of neural circuits in order to explain how nervous systems are organised, and how they function to generate behaviour.

Recent advances in electrophysiology techniques allows to record electrical signals of neurones in the deepest region of the brain, giving new insights on how our brain regulates hunger, fear, stress, and emotions.

Wide-field analysis of VLBI survey data

Mr. Kristóf Rozgonyi
Hall B2 - 15:06-15:23

Sky surveys allow us to conduct statistical investigations of large source samples, and also to discover new phenomena or types of objects. Radio surveys are special, because the the resolution and the field of view of a single dish is relatively small. Nevertheless we can perform simultaneous observations using several antennas to increase the resolution, thus the innermost pc-scale structure of radio-loud active galactic nuclei (AGN) can be directly studied with this technique called very long baseline interferometry (VLBI). High-resolution VLBI imaging observations reveal the geometry and the physical properties of relativistic jets emanating from the vicinity of the accreting central supermassive black holes. High-quality VLBI imaging of hundreds or thousands of radio sources is an observationally and computationally intensive task. Moreover, the compact radio jet structure in AGN is usually confined to the central region of tens of milli-arcseconds (mas). The VLBI technique does not allow imaging with an undistorted field of view larger than typically a few arcseconds at cm wavelengths. However, for practical reasons, often a much smaller fraction of the field, the central region is imaged only. Here I introduce an automated imaging process and present its application to the publicly available calibrated visibility data of a prominent VLBI survey. I imaged the 1.5-arcsec radius fields around more than 1000 radio sources, and found a variety of radio structures that extend to 100-mas scales in a small subset of the sample. Some of them were missed in the original survey and are yet unknown in the literature. I also give possible interpretations of these structures.

Numerical simulations of flexible thermoelectrics

Miss Sofia Luisa Soares Ferreira Nunes Teixeira
Hall B2 - 15:24-15:41

Energy is one of the main requests of our society nowadays since our modern world depends largely on it to live. The necessity for the improvement of energy generation boosts the search of alternative energy generation. Thermoelectrics appear as one of the best candidates since around 60% of the wasted energy is in the form of heat. Thermoelectric generators are small, possess no moving parts and require almost no maintenance. These qualities make them an improved way of generating energy, but their efficiency is still low for large scale applications. Thus, the study and improvement of their efficiency is of utmost importance. In this presentation, thermoelectric devices are explained. Simulations performed using the COMSOL Multiphysics software regarding the efficiency of thermoelectric devices are discussed, emphasising how to optimise and improve their operation. Finally, developed flexible thermoelectric devices and their COMSOL's simulation will be presented.
Co-authors - Pedro Resende and André Pereira

References
1. Teixeira, S.F. and Pereira, A.M. (2016), Geometrical optimization of a Thermoelectric Device numerical simulations, submitted to Applied Energy

2. Bell, L.E. (2008), Cooling, heating, generating power, and recovering waste heat with thermoelectric systems, Science, 321(5895), 1457-1461.

Simulating a sun with your computer

Mr. Simo Tuomisto
Hall B2 - 15:42-15:59

Turbulent movement of ionised plasma within solar convection zone that spans from the radiative zone at r on Ro approximately 0.7 to the photosphere visible to the naked eye is the main cause of large scale magnetic phenomena in the sun. These magnetic fields in turn result in e.g. solar activity cycles, sunspots and flares.

Even though these effects are widely known and documented, studying their creation is hard mathematically as the system consists of Navier-Stokes equations coupled with Maxwell equations under the extreme circumstances of the sun.

Mean field theory was created in the 20th century to ease these calculations. These theories average over turbulence and obtain a mean electromotive force that drives the solar dynamo. Mean field theory was very successful in providing insight of solar phenomena, but due to their generality they lose some specificity.

Within last few decades solving these equations by straight integration with magnetohydrodynamic simulation programs has become an another option, but due to computational costs it is still hard to get knowledge of the processes that create solar magnetic fields.

In my masters thesis I implemented a mean field simulator routines to a widely used magnetohydrodynamic simulator and compared results from mean field simulations to ones done by large scale simulations. The goal was to make the gap between theory and widely used methods in computational astrophysics shorter.

In my lecture I will try to explain how solar magnetic field is generated, how turbulence can be averaged over in mean field theories and how to simulate a simple version of the sun in your computer.

3.4 Session 4: Saturday 13^{th} (16:30 - 17:30)

Characterization of density fluctuations during the inter-ELM periods in the MAST spherical tokamak

Miss Lilla Vanó
Hall B1 - 16:30-16:47

The tokamak is so far the most developed type of the magnetic confined fusion devices. In a tokamak, the fuel is in plasma state. Special periodic plasma instabilities, the so-called Edge Localised Modes (ELMs) exist in high confinement operational mode. During an ELM significant amount of energy and particle is lost which cause large damage on the plasma facing components. But the ELMs also have advantages, such as throwing out impurities.

Thus the understanding of the emergence of the ELMs is crucial for a future fusion reactor, like ITER.

The intervals between the ELMs are called inter-ELM periods. The profiles of the plasma parameters mostly stay stably during an inter-ELM period. In various fusion devices radially localised fluctuation modes can be observed during the inter-ELM periods. In this study these kind of fluctuations were examined. These are probably connected with the phenomenon or structure that dominates the transport in an inter-ELM period and holds the profiles stably during it. In the presentation it will be presented that this kind of fluctuation can be also observed in the MAST (Mega Amp Spherical Tokamak) and some characterisation of it will be given. The MAST is equipped with a 2D turbulence imaging spectroscopy diagnostic, called Beam Emission Spectroscopy, where the measured data is proportional to the local density. Thus the results are suitable for researching the density fluctuations. Data from this diagnostic was examined mostly.

Introduction to Nondestructive Testing in Nuclear Power Applications

Mr. Zvonimir Domazet
Hall B1 - 16:48-17:05

Due to potentially catastrophic consequences that might occur in case of failure, safety is of top priority in all countries with operational nuclear power plants. In order to maintain the plant and perform repairs, every reactor must be periodically shut down for inspection, and only after receiving a green light from an independent inspection company may be reactivated. A nuclear reactor is a fairly complex machine, and it is constantly under extreme stress. Consequently, a number of failure modes are possible, which complicates the inspection process. Likewise, a number of different materials may be used in construction of the reactor, each requiring special attention. This talk will address the basic construction of a power plant, the most common failure modes and methods of inspection usually employed, as well as some of the current challenges in the field.

Nuclear reactor, neutrons and perfect-crystalls

Mr. Thomas Potocar
Hall B1 - 17:06-16:24

Nuclear research reactors are located for instance in Vienna (Austria), Garching (Germany), Villigen (Switzerland), or Grenoble (France). They can be used e.g. to produce a neutron beam for neutron scattering experiments, tomography, as well as interferometry. Such an interferometer, which is similar to the one used for x-ray interferometry was successfully tested for the first time in 1974 in Vienna with thermal neutrons.

The extracted neutron beam of the reactor can pass through a crystalline medium. In this case the neutron beam changes its phase, however at a certain angle between the beam and the crystal (Bragg condition) an additional diffracted beam appears (beam splitter). Such beam splitters are used as part of a neutron-interferometer as well as a sample within this interferometer.

We study the phase shift of the neutron beam, induced by a crystalline sample in the vicinity of the Bragg condition. The interferometer with its phase shifter is necessary to measure this phase shift.

We also searched for further influences on the phase and found a sensitive dependence on the rocking angle, monochromator function and beam divergence. The rocking angle describes the alignment of the monochromator crystal relative to the interferometer. The monochromator function describes which monochromator is used (mosaicity of the crystal). While its neutron beam divergence depends on the wavelength.

Our calculations with the software IFMSIM are in good agreement with the observed data.

Novel rock sampling technique for use on Mars

Mr. Kamil Ciesielski
Hall B2 - 16:30-16:47

The Small Planetary Linear Impulse Tool (SPLIT), developed in Space Research Centre, University of Leicester, was started as a response for NASA's Call for Proposals for this mission Mars 2020 (Mars Sample Return). It is a novel geotechnical tool for use on Mars and other rocky or icy planets or moons. Its aim is to sample rocks for biosignature search in an efficient and highly controlled way from as well as scientific, as engineering point of view. SPLIT's main advantages, when compared to currently working devices are minimised contamination of stone's pristine surface, extended depth of penetration and lower usage of energy.

The focus of the interdisciplinary student's project was to use the new prototype in order to learn to search for water traces and morphological biosignatures on pristine rocks' surfaces and look at the dependence of the above on stones' chemical composition and its structure. From the technical point of view, the project was aimed a finding the most efficient way of sampling the rocks.

Results turned out to be very encouraging - with use of a variety of planetary analogues from local sources and Atacama Desert, it was demonstrated that SPLIT is able to deliver its primary function - to uncover perfect location for biosignatures search in Martian conditions. What is more, we learned a few technical issues about its operation modes, and micro-astrobiology, which can improve the science of future planetary missions.

Influence of one specific turbulence on the stable structure of tornadoes

Ms. Mariam Abuladze
Hall B2 - 16:48-17:05

There is large diversity of instabilities in nature which are able to absorb the energy from pre-existing wave and abolish its stable structure. One more such kind of instability will be considered in this paper. More precisely, the role of this particular turbulence in decaying process of tornadoes will be verified by numerical methods. The idea of numerical analysis is that, possessing information about initial conditions of the flow (dissipation of velocities

and density) we can determine the energy of turbulent wave at any moment in future. The period required for energy absorption will be compared with the life-span of average tornadoes on the earth.

Geo-neutrinos as messengers of the Earth's interior and as radioactive background in new generation of neutrino oscillations experiments

Miss Caracas Ioana-Alexandra
Hall B2 - 17:06-16:24

The study of the electronic antineutrinos of low energy (10 MeV) is an active and multidisciplinary field. The next generation of large underground neutrino detectors used to study neutrino oscillations is affected by the presence of nuclear reactors and in the same time is influenced by the continuously emitted of geo-neutrinos from the beta decays of the antineutrinos from the progenies of U, Th and 40K decays in the Earth. Also geo-neutrinos represent a new probe of composition and structure of our planet and contributed to the heat of the Earth. Accidentally, bursts of antineutrinos in the same energetic range are registered by Earth following a supernova explosion in our Galaxy. In this contribution the effects of the geo-neutrinos are discussed and are taken into consideration as essentials elements for the knowledge of the Earth mantle and for the detection of low-energy antineutrinos in the next oscillations experiments.

3.5 Session 5: Sunday 14^{th} (09:30 - 11:00)

Categories in physics

Mr. Müller Lukas
Hall B1 - 09:30-09:47

Categories were introduced in the 40s by Eilenberg and Mac Lane in the context of algebraic topology. In the last decades, categories have been used to understand and study the structure of quantum field theories, especially topological field theories and conformal field theories. Furthermore, categories are used to give a more conceptional approach to quantum mechanics.

In my talk I will introduce the basic concepts of category theory, like functors and natural transformations. Afterwards, I will explain on an example, how these notions appear naturally in physics.

Particle creation in expanding universes

Mr. Matthias Dahlman
Hall B1 - 09:48-10:05

The research for a unified theory yields today two fundamentally different theories. On one hand Quantum Field Theory, describing the electroweak and strong interactions using exchange particles (known as the standard model of particle physics), and on the other hand General Relativity, identifying gravity as the dynamics of the spacetime geometry. So, why don't combine these two theories? That's exactly what Quantum Field Theory in

Curved Spacetimes is doing. This combined theory - first investigated by Leonard Parker - leads to the prediction of Hawking radiation, the Unruh effect as well as particle creation in expanding universes.

In my talk, I will explain this mechanism considering the most easiest case the scalar field. Since solving Einstein's field equations is in general not easy, I'm considering a cosmological model instead to get the metric and its evolution. Imposing this metric into the equation of motion shows that, in general, particles are created over time.

Quantum dynamics

Mr. Gerhard Dorn
Hall B1 - 10:06-10:23

Following Moore's law are transistors rapidly approach the molecular and atomic limit where physics gets interesting again. Especially quantum effects manifesting in strongly correlated electrons play an important role for the current characteristics and give rise to interesting effects like Coulomb blockade or the Kondo effect. I will present some of the well established tools to address such strongly correlated electron systems out of equilibrium to look at quantum current.

Quantum Spin Correlations

Mr. Michal Dragowski
Hall B1 - 10:24-10:41

The phenomenon of quantum spin correlations will be presented beginning with the famous EPR paradox and Bell inequalities. Results of historical experiments will also be shortly summarized. The talk will, however, focus on recent theoretical discoveries and experimental plans regarding the relativistic regime, which has not yet been experimentally investigated. A planned experiment investigating quantum spin correlations of relativistic electrons will be presented. Electron pairs under study will originate from polarized electron beam scattering on atomic electrons (Moller scattering). The measurement regards correlations of spin projections on chosen directions for the final state pair. The detector is planned as a double Mott polarimeter. This measurement, planned for year 2017, will be the first attempt to verify the predictions of quantum mechanics in the domain of spin correlations of massive relativistic particles.

Fighting quantum with quantum.

Dr. Ross Donaldson
Hall B1 - 10:42-10:59

With technological progress over the past few decades, working universal quantum computers look like they may become reality in the near future. While this would be fantastic for quantum simulation, there is a real worry that a universal quantum computer could be used for malicious attacks on cryptographic systems. Many cryptographic systems used online today implement public-key cryptography, where the security is based on the assumption that it is difficult to reverse a one-way function. Unfortunately for us, Shor's algorithm,

which can be implemented using a universal quantum computer, is very efficient at reversing commonly used one-way functions. This will allow a malicious party the ability to crack cryptosystems much much faster than on a conventional computer.

This talk gives an overview of two research field which are developing cryptographic systems that are thought to be robust against quantum computer attacks. One field implements quantum mechanics is the protocols, essentially fighting fire with fire. The other field implements mathematics which cannot easily be solved with quantum algorithms, therefore there is no advantage in using a quantum computer to try break the system.

Accelerators on a Chip

Mr. Timo Eckstein
Hall B2 - 09:30-09:47

Nowadays commonly used particle accelerators consist of radio-frequency cavities. Their performance is limited by the electromagnetic breakdown field of the inner metallic cavity surfaces. This breakdown happens at a field strength of approximately 100 MV/m (1) which restricts the achievable acceleration gradient of the device. To overcome this limitation, there has been developed several techniques of laser-driven acceleration in recent years.

In this contribution we focus on one of these techniques, namely the dielectric laser acceleration (DLA), which is based on the synchronous interaction between electron and optical near-fields of a nanostructure and allows to apply accelerating fields with amplitude exceeding GV/m (2). By using dielectrics instead of metals or superconductors and optical frequencies of the driving field, the field breakdown threshold increases by two orders of magnitude. Although the laser-driven particle acceleration in the vicinity of metallic grating was proposed already in 1960s (3, 4), it took until 2013 to demonstrate the first experimental proof of this concept. It was confirmed nearly simultaneously by DLA experiments of the AChIP collaboration in Erlangen (5) and Stanford (6).

The designated mid-term aim of DLA is achieving acceleration rates which are beyond GV/m. Up to now, peak acceleration gradients of 300 MeV/m have already been observed (7). Current tasks include both development of a suitable laser-triggered nanotip electron source and further development of the nanostructures used for generation of accelerating near-fields. Overall millimetre-sized sub-relativistic electron guns appear to be possible within the next years (8).

References

1. Solyak, N. A., Schroeder, C. B., Leemans, W. & Esarey, E. Gradient Limitations in Room Temperature and Superconducting Acceleration Structures. In AIP Conference Proceedings, 365–372 (AIP, 2009).
2. Rosenzweig, J., Murokh, A. & Pellegrini, C. A proposed dielectric-loaded resonant laser accelerator. Physical Review Letters 74, 2467–2470 (1995).
3. Shimoda, K. Proposal for an Electron Accelerator Using an Optical Maser. Applied Optics 1, 33 (1962).
4. Takeda, Y. & Matsui, I. Laser linac with grating. Nuclear Instruments and Methods 62,

306–310 (1968).
5. Breuer, J. & Hommelhoff, P. Laser-Based Acceleration of Nonrelativistic Electrons at a Dielectric Structure. Physical Review Letters 111, 134803 (2013).
6. Peralta, E. a., Soong, K., England, R. J., Colby, E. R., Wu, Z., Montazeri, B., McGuinness, C., McNeur, J., Leedle, K. J., Walz, D., Sozer, E. B., Cowan, B., Schwartz, B., Travish, G. & Byer, R. L. Demonstration of electron acceleration in a laser-driven dielectric microstructure. Nature 503, 91–94 (2013).
7. Breuer, J., McNeur, J. & Hommelhoff, P. Dielectric laser acceleration of electrons in the vicinity of single and double grating structures—theory and simulations. Journal of Physics B Atomic, Molecular and Optical Physics 47, 234004 (2014). arXiv:1407.6688v1.
8. McNeur, J., Kozak, M., Schonenberger, N., Leedle, K. J., Deng, H., Ceballos, A., Hoogland, H., Ruehl, A., Hartl, I. & Solgaard, O. Elements of a dielectric laser accelerator. arXiv preprint arXiv 1604.07684 1–7 (2016).

Jack Polynomials and Quantum Hall Effects

Mr. Vittorio Erba
Hall B2 - 09:48-10:05

Quantum Hall Effects are still not completely understood. Classically, Hall resistivity measured in semiconductors in magnetic fields grows linearly in the magnetic field strength. In high magnetic field conditions, and very low temperatures, the behaviour changes and the resistivity shows plateaux at certain integer and fractional multiples of a resistivity quantum. The theoretical picture to explain these plateaux is far to be complete. Understanding those effects would be a big improve in our knowledge of interacting electrons in magnetic fields. A witty guess for the ground state of the problem was made by Laughlin, who discovered a simple wave function which highly overlaps the numerically computed ground state. This ansatz opened the way for more and more ground state approximations in the following years. The problem is that it's not clear why such approximate ground states should work as well as they seem to. Recently, both Laughling and other approximate wave functions were recognised as Jack Polynomials, a particular class of symmetric functions whose properties may throw some light on the problem. I will review the Quantum Hall problem to finally present my bachelor thesis work on Jack Polynomials.

Motion of charged particles in strong magnetic field of pulsar

Mr. Giorgi Bakhtadze
Hall B2 - 10:06-10:23

There is a strong magnetic field near pulsars and any charged particle is highly influenced by it. The charged particles are accelerated in magnetosphere and sometimes achieve relativistic speed because pulsars are rotating very rapidly around their axis. In my research I have numerically investigated motion of charged particles near pulsars. To obtain results I had to solve the several problems. A charged particle moves alongside a spiral-like path in a very strong magnetic field so we can divide its motion into two components circular motion in the plane perpendicular to the field lines and motion alongside the field lines. If I included this circular motion in numerical simulation, there would be needed huge amount of computational power and time. I observed that the behaviour of particle's motion alongside

field line is similar to motion of particle attached to a string with shape of this field line and capable only of moving alongside it. So I could interpret whole simulation as particle moving alongside string. This leads us to second problem. Let's assume that a solid straight string of infinite length is rotating and we are observing it from this inertial reference frame. A particle, which is attached to this string and can only move alongside it, is accelerating radially because of centrifugal force in rotating reference frame. At some point its tangential speed should exceed speed of light but it is impossible. So the particle never reaches this point and starts periodical motion on the string. I have theoretically investigated that phenomenon and applied this theory to my model of particle's motion in strong magnetic field. After this I could make numerical simulation for large amount of charged particles and observe their behaviour. I have investigated several interesting parameters such as concentration of particles at some point, speed of particle as it accelerates alongside field line and etc.

The Molecular Biocompass

Miss Ida Friis
Hall B2 - 10:24-10:41

Want to know how migratory birds can find their way to Africa? Several species of animals, most notably migration birds, have been shown to use the Earth's magnetic field to navigate by. This talk will briefly cover the quantum biological theory of radical pair formation that explains the sensitivity to magnetic fields. A receptor molecule called crypto-chrome located in their eyes was suggested to serve as a magneto receptor. However, the exact mechanism of how the magneto receptive properties of crypto-chrome causes birds' ability to navigate is not fully understood, especially when the changes of the external magnetic field are small. A recent investigation suggests that crypto-chrome couple to a larger protein complex that acts as a biological compass needle. This talk will guide you through the construction and validity of the proposed biological compass needle.

Radio Frequency (RF) source for Optically Detected Magnetic Resonance

Mr. Dewan Woods
Hall B2 - 10:42-10:59

The development and utilisation of a uniquely designed, tunable resonator microwave antenna is pursued here. The purpose of such design is for Optically Detected Magnetic Resonance (ODMR) in Nanodiamond (ND) Nitrogen-Vacancy (NV) centres. Both simulation and experimental results demonstrating our ability to tune the Q-factor of the resonator are shown – this tunability made possible via variation in the inductive-capacitive coupling network of the antenna. The goal is the address the spin transitions of the NV centres with both optical and microwave excitation – the bandwidth of the NV centres spin transition, with centre 2.87 GHz, is approximately 20 MHz. By employing the thermally stable, mechanically independent, and tunable system proposed, it is possible to easily and comfortably probe the resonances of the NV centres. We also investigate the correlation of ND lifetimes with the measured fluorescence. Preliminary results are shown and RF source performance will be the focus of this part of the talk. The novelty in controlling these spin transitions with coupled RF and optical sources is quite promising and applications are in

abundance. These applications include, but are not limited to, quantum computing and information technology and single-photon emission sources.

3.6 Session 6: Sunday 14^{th} (11:30 - 13:00)

Measuring the effect of local electric field in biomimetic self-assembled membranes

Mr. Andrii Repula
Hall B1 - 11:30-11:47

The purpose of my study is the investigation of the effect of a local electric field on a lipid bilayer. The local electric field was created by platinum tip which was in the contact with the water. The bilayer was deposited on a flat transparent electrode (ITO glass) using Langmuir trough. The bilayer on the ITO glass surface was immersed in the water. The potential and electric field were calculated using the method of images. It is known that a membrane undergoes a curvature change under the action of an electric field (flexoelectricity effect). This should lead to the generating of the bump, but this require water below the bilayer. In the theoretical part of my report I described the water transfer in the surrounding of a membrane.We evaluated two possible mechanisms for water transfer and find that water permeation through the bilayers most likely. By analysing experimental data, I discovered the existence three phenomenons at least - oscillation of bumps on the membrane surface, oscillation of the lipid tubes which attached to the membrane, and spider-like oscillation of the vesicles. The period of mentioned oscillations are completely corresponding to the period of the alternative electric field used in the experiments. The explanation of these phenomenons based on undulation instability of lipid membrane under electric field.

Characterisation of Striated Muscular Tissue Device development and testing method

Mr. Alexandru Nistorescu
Hall B1 - 11:48-12:05

This study aims to investigate the dynamics of muscular tissue response to a mechanical impulse using an in-house developed device. The present device is capable of applying a short moderate impulse (dirac impulse) and show on a screen the muscle response by recording normal acceleration values from different muscle fibre regions. This research continues our work on the subject of complex myotonometric measures, with the goal of creating both a device and testing methodology for the assessment of muscular health in the context of micro-gravity countermeasures.

Neuromagnetic studies of the earliest effects of the spatial visual attention

Mr. Luka Luketin
Hall B1 - 12:06-12:23

MEG is a noninvasive method of research of human brain which has a great time resolution, on the order of magnitude 1 ms. Earlier research showed first effects of selective visual attention in the primary visual cortex (V1) already on 150 ms in return connection with V2, in opposite with the traditional model of serial processing when the effect is expected at 300 ms. Using the experimental paradigm of top-down cuing we can even show that

earliest effects can be seen on the latencies before 100 ms. Using the non-linear model of spatio-temporal localising we are trying to get the insight on the cortical level how much the earliest visual responses are sensitive to the modulation by selective visual attention.

Transcranial magnetic stimulation (TMS) for in vivo brain research

Mr. Lari Koponen
Hall B1 - 12:24-12:41

In this lecture, I will introduce the audience to the basics of transcranial magnetic stimulation (TMS), and its possibilities in non-invasive brain research using healthy volunteers.

The lecture will cover at least the basics of TMS, major existing clinical and research applications for TMS, combining electroencephalography (EEG) with TMS, and some future prospects for TMS.

The lecture will be introductory in nature, so that it will be suitable for all physicists. That is, I'll assume you know the basics of electrodynamics.

The role of cross-linking proteins and microtubule pivoting in formation of parallel bundles

Ms. Eva Hrabrić
Hall B1 - 12:42-13:00

During mitosis, microtubules (MT) form a spindle , which is responsible for proper segregation of the genetic material between two daughter cells. Most of the spindle MTs are organised into bundles by cross-linking proteins. A key question is what are the physical principles underlying the formation and stability of MT bundles. Mean field theory for the formation of MT bundles suggests that elastic forces from cross-linking proteins and thermally driven pivoting of MTs are sufficient for formation of stable parallel MT bundles. However, it is unsure how the discrete nature of cross-linking proteins affects this process. We have studied formation of parallel bundles using numerical simulations. By calculating cross-linking protein distributions and average bundling times for MTs, we can compare the results of the numerical simulations with the mean-filed theory and experimental data.

Ferroelectric properties of BFBT thin films

Mr. Anton Saressalo
Hall B2 - 11:30-11:47

Ferroelectric materials show many promising features for applications in tomorrow's electronics. The ability to use polarisation to store information in a dense space and good endurance make them one of the top contestants for the next generation memory applications, such as Ferroelectric or Resistive Random-Access Memory elements (FeRAM / ReRAM). The ReRAM elements are also a promising type for the missing circuit element, memristor, which links together the magnetic induction flux and the electric charge.

Some materials also exhibit simultaneous ferroelectric polarisation and magnetisation. These are called multiferroics and could be a key towards magneto-electric memories and a realisation of four-state logic in a single device.

A solid state ceramic, BiFeO 3 , has been under recent interest for such a multiferroic material since it exhibits large polarisation simultaneously with magnetisation. The challenges of BiFeO 3 include its high conductivity for an insulator and poor phase stability. Other materials with similar unit cell structure have been mixed with the material to successfully improve the properties.

The lecture shows results of various electric measurement on $0.80[BiFe_{0.95}Mn_{0.05}O_3]0.20[BaTiO_3]$, or BFBT(Mn). They confirm that the material is ferroelectric. They also show that the conduction mechanism inside the material varies with the applied electric field, hinting to Space Charge Limited Conduction mechanism and Resistive Switching. The phenomenon is expected to be linked to migration of oxygen vacancies inside the sample and formation of conductive filaments.

Optically Induced Dielectric Changes in Organic Semiconductors and their Non-Adherence to Classical Plasma Theory

Mr. James Kneller
Hall B2 - 11:48-12:05

In organic electronics on can optically induce dielectric changes. Current Classical Plasma Theory was derived for high mobility silicon and fails to account for the dielectric changes observed in low mobility organic semiconductors. This talk explains the basics of organic electronics, how one can measure dielectric changes, both experimentally and as predicted by theory and what causes the differences between them.

Topological insulators - Synthesis and transport measurements

Mr. Toni Marković
Hall B2 - 12:06-12:23

Topological insulators (TI) are a new class of quantum materials. What makes them interesting is their insulating bulk and conducting surface states. The goal of this work was to synthesise a TI with a large bulk resistivity so that the surface states could be studied by transport measurements. Two different TI were synthesised BiSbTeSe2 and BiSbTe2S. Both showed an increase in resistivity with lowering the temperature. An increase of an order of magnitude in resistivity was observed in BiSbTeSe2 and two orders of magnitude in BiSbTe2S. A holder for the ionic-liquid gating experiment was also built in order to make the study of surface states easier with transport measurements. A successful manipulation of surface state carrier concentration was achieved with the ionic-liquid gating setup.

n-MOSFET Aging Measurements and Modeling

Mr. Alexander Schiffmann
Hall B2 - 12:24-12:41

The presented work focuses on ageing effects due to hot-carrier-injection (HCI) in MOSFETs. Hot carrier refers to fast electrons in the conducting channel. Electrons are accelerated by very high electric fields in the pinch-off region of the transistor. Their energy is high enough to generate trap states at the interface between the semiconductor and the gate oxide. Those traps capture charge which shifts the characteristics of the transistor. To gain knowledge about the HCI effects, various measurements on n-MOSFET devices with a channel length of 0.18 µm have been performed. The devices were provided by ams AG. Ageing experiments were conducted with different stress voltages and important device parameters were extracted to find how they change over time. It is observed that the stress effects scale with stress voltage and time. A short stress at high voltage causes the same threshold voltage shift as a long stress at low bias voltage. This scaling behaviour is used to predict ageing effects at real life operating conditions. Since device ageing due to stress is a major issue in modern semiconductor fabrication, it is of importance to understand the effects and find reliable ways of predicting how changes in the devices will affect the overall circuit performance. We used the HiSIM2 ageing model developed at Hiroshima University. This model predicts the device degradation based on the bulk current which is affected by impact ionisation events. A beta version of HiSIM2 was used to fit the behaviour of the ams AG 0.18 µm MOSFET technology.

From London to Msida: A Decade of ICPS

Mr. Markus Karppinen
Hall B2 - 12:42-13:00

Since I was a freshman attending my first ICPS in London in 2007, this conference has held a special place in my heart; the people, the places, and the parties! From the tent sauna driven all the way from Finland to Poland, to claiming a whole Croatian street filled with bars as our own, I bring you an introspective and recollection from the view of a normal attender, with injections of presumed insight into how to keep a gathering of hundreds of physicists happy, fed and entertained. Come join me on a trip down memory lane to round up my ICPS career!

3.7 Session 7: Monday 15^{th} (09:30 - 11:00)

Quantisation from the perspective of knot invariants

Mr. Piotr Kucharski
Hall B1 - 09:30-09:47

Usually the quantisation is presented as a pretty obscure and little magical procedure enforced by black body radiation and other physical phenomena. In this talk I would like to look at it from a different point of view. I will put it into very simple abstract constructions in order to be closer to its essence.

When looking on quantum mechanics as a "modern symplectic geometry" (1) one can analyse knot theory in this language. The results of this approach contain new ideas in mathematics, some closely connected to works by Edward Witten and Vaughan Jones awarded the Fields Medal.

I will present a glimpse of this striking face of quantum mechanics and hope that the reward for the audience will be not only joy of watching how physics helps mathematics, but also better understanding of the quantisation itself.

References
1. Lectures on Knot Homology and Quantum Curves, Sergei Gukov, Ingmar Saberi, arXiv:1211.6075

Neural networks and High Energy Physics

Mr. Joona Havukainen
Hall B1 - 09:48-10:05

Artificial neural networks (ANNs) have become important tools for particle physicists in the recent years. There are many problems ranging from data filtering and reconstruction to offline analysis that can be solved with neural networks. In this talk I will present the concept of ANNs and some situations where they are useful, give concrete examples how they are used in particle physics and discuss their advantages and shortcomings. The talk is aimed to the beginner level in the subject.

High resolution imaging of scanning tunneling luminescence from InGaN/GaN QWs

Miss Wiebke Hahn
Hall B1 - 10:06-10:23

The pioneers Isamu Akasaki, Hiroshi Amano and Shuji Nakamura were jointly rewarded with the 2014 Nobel prize "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources" (1). However nitride LEDs exhibit such high efficiency performances only when operated at low current densities.

If it would also be possible to improve the efficiency of LEDs at high current densities which is mandatory for cheap lamps, the energy consumption due to lighting and the cost of ownership would drastically lower (2). Therefore LEDs have to work on their physical limit. However working at high current densities leads to a non-linear decrease of the efficiency, the so called droop (3). To understand this droop and as a conclusion improve LEDs, the used materials InGaN/GaN have to be understood better. There are several processes from which this droop in the external quantum efficiency can origin e.g. quantum-confined stark effect, Auger recombination, electron overflow … (4). Taking a look at the materials itself, strong disorder in the In content is exhibited (5) which leads to localisation effects. This might also decrease the external quantum efficiency. High resolution imaging of scanning tunnelling luminescence from InGaN/GaN QWs might provide information about the impact of disorder and localisation on the droop.

References
1. "The Nobel Prize in Physics 2014". Nobelprize.org. Nobel Media AB 2014. Web. 25 Jun 2016. http://www.nobelprize.org/nobel_prizes/physics/laureates/2014/
2. Weisbuch, C., Piccardo, M., Martinelli, L., Iveland, J., Peretti, J. and Speck, J. S. (2015), The efficiency challenge of nitride light-emitting diodes for lighting. Phys. Status Solidi A, 212:899–913. doi:10.1002/pssa.20143186
3. T. Mukai, M. Yamada and S. Nakamura, Characteristics of InGaN-Based UV Blue Green Amber Red Light-Emitting Diodes, Jpn. J. Appl. Phys., Part 1 38, 3976 (1999).
4. Polovodov, P. (2015), Cathodoluminescence in semiconductor structures under local tunnelling electron injection (Doctoral dissertation)
5. Yuh-Renn Wu, R. Shivaraman, Kuan-Chung Wang, and J. S. Speck, Analyzing the physical properties of InGaN multiple quantum well LEDs from nano scale structure, Appl. Phys. Lett. 101, 083505 (2012)

Study of exotic nuclei with radioactive ion beams

Gabriella Koncz
Hall B1 - 10:24-10:41

Studies of exotic nuclei (nuclei with ratios of neutron number N to proton number Z much larger or much smaller than those of nuclei found in nature) are at the forefront of nuclear research. Radioactive ion beam experiments are held in Japan, France and the USA. A lot of phenomena can be observed in exotic nuclei only. Certain nuclei have a nuclear halo (a core nucleus is surrounded by a halo of orbiting protons or neutrons). We have been working with the data collected in an experiment performed at Michigan NSCL (National Superconducting Cyclotron Laboratory) in 2012. I have used ROOT and GrROOT for the analysis of data. After incoming and transmitted beam identification I examined parallel momentum and gamma energy distributions of the identified nuclei. I would like to present the results of the data-analysis after a short description of the experiment.

Reconstruction of the CMS Pixel Pilot Blade

Mr. Tamas Almos Vami
Hall B1 - 10:42-10:59

The Compact Muon Solenoid (CMS) is a general-purpose detector used to study the products of high energy particle interactions at the CERN LHC. The silicon pixel detector is the innermost component of the CMS tracking system. The present pixel detector will be replaced by an upgraded version, called the Phase 1 Pixel Upgrade in the beginning of 2017.

During the last shutdown period of the LHC, a third disk was inserted into the present two-disk forward pixel detector. The new disk consists of eight modules that use new digital Read-Out Chips and a prototype readout system. Testing the performance of this Pilot System enables us to gain experience with the CMS Pixel Phase 1 Upgrade modules. In the talk, my experiences with the Pilot System simulation, the offline calibration procedures, and the re-commissioning of the pixel detector during first data taking in 2016 will be presented, with special regard to these new modules.

Sky's Law: light pollution

Miss Karen Macías
Hall B2 - 09:30-09:47

Light pollution is a serious problem that interferes with numerous aspects of our lives such as our sleep cycle, but also with scientific issues like astronomical observations, specially on those cities with observatories nearby. This lecture is about those problems, how can we help to reduce them and the physics behind light pollution as well as its consequences on scientific research. Also, it shows the law that exists in my hometown of Ensenada to prevent this excess of light reaching the National Astronomical Observatory of San Pedro Mártir and the importance of other countries on creating similar laws.

Cosmological axion: a Dark Matter candidate

Mr. Baptiste Ravina
Hall B2 - 09:48-10:05

The aim of this talk is to present the kind of reasoning behind a new theory of high energy physics. Specifically, we look at the Strong CP Problem in QCD - starting with a quick review of the QCD Lagrangian, we explain how the complex structure of the QCD vacuum leads us to include an additional term in the Lagrangian, which turns out to violate CP symmetry. Comparing this prediction to negative experimental results, we conclude that the new CP-violating term must be heavily suppressed, for reasons that go beyond the Standard Model. This is indeed a good example of the so-called naturalness problem theoretical physicists often run into. We then motivate the Peccei-Quinn proposal of an additional U(1) global symmetry as the simplest and most elegant solution to the Strong CP Problem, and work through its consequences both in particle physics and cosmology. In particular, we are interested in the dynamics of the pseudo-Nambu-Goldstone boson that arises from the breaking of this additional symmetry - the axion - and the way it explains the observed absence of CP violation in the strong sector. We narrow down the properties of the axion to those of a very light, very weakly interacting, neutral, scalar particle, which in turns makes it a good candidate for Dark Matter. Focusing now on the cosmological aspects of the theory, we discuss thermal and non-thermal productions in the early universe. Time permitting, we close our presentation with a brief overview of the status of experimental searches for axions, both in collider particle physics and cosmology/astrophysics.

Gravity: It can be derived from matter!

Mr. Maximilian Düll
Hall B2 - 10:06-10:23

Einstein postulated the dynamics of gravity by writing down the theory of General Relativity in 1915. With the dynamics, one gets the kinematics of spacetime for free. However, it was shown in the 1970's by Kuchar et al that the other way round is actually far more convenient. By specifying the kinematics of a spacetime carrying a Lorentzian metric – that is, saying how three-dimensional hypersurfaces carrying physical data evolve – one can fully derive the gravitational Lagrangian from General Relativity. The only question remains

how to arrive at the kinematics of spacetime.

This question was answered by Schuller et al in recent years. The kinematics of spacetime determined by the matter present on the spacetime. This matter does not necessarily need to be from the Standard Model of Particle Physics. Rather, any matter theory that is predictive and canonically quantizable is allowed. That means, a matter model has to allow basic physics, namely well-posed time evolution and having a corresponding quantum theory of matter. Then, the kinematics of the corresponding spacetime are settled. Based on the concept of geometrodynamics by Wheeler et al, Schuller et al then were able to show how to find the dynamics of spacetime and thus gravity as the solution of a set of partial differential equations.

In my talk, I will show the main results regarding the matter input into the kinematics of spacetime as well as the way from the kinematics to the gravitational dynamics. In the end, I will give a first glimpse at possible physical examples for new gravitational dynamics.

A trigger ASIC for the Cherenkov Telescope Array

Mrs. Jacqueline Catalano
Hall B2 - 10:24-10:41

High energy astrophysics became increasingly more advanced since its discovery by Viktor Hess in 1912. Very high energetic (VHE) gamma-ray radiation is produced by cosmic rays arising from a number of different sources in the universe. Examples for such sources are AGN or supernova remnants. For detecting VHE gamma rays, large detectors are required due to the fact that their flux is very low. The future Cherenkov Telescope Array (CTA) will cover such a big area 4 km2 and is expected to be sensitive to gamma-rays in the range between 10 GeV and 300 TeV. Gamma rays produce an air shower in the atmosphere whose particles emit short flashes of Cherenkov light. Therefore, fast cameras with special read-out electronics need to be developed to allow for very short (nanosecond) exposure to fulfil the scientific goals of CTA. In this talk the trigger ASIC T5TEA will be presented which is able to trigger at very low thresholds of a few single photo-electrons (p.e.). T5TEA is one of the proposed systems to be implemented in the cameras of the future CTA.

Gravitational dynamics beyond the standard model - a case study

Mr. Florian Wolz
Hall B2 - 10:42-10:59

Since the 70s it is known that Einstein's theory of general relativity can be derived by considering deformations of suitable initial data surfaces. In recent years, this idea was further developed by Schuller et al. and led to a universal set of linear partial differential equations that allows to determine the Lagrangians of any tensorial geometry. The only ingredient is a matter theory coupling to this geometry that is predictive and canonically quantizable.

In this talk, the geometry required for the most general linear electrodynamics is used as an exemplary theory beyond the standard model to discuss the programme, the physical effects

one can now calculate within this setup and the relation to our current understanding of physics.

3.8 Session 8: Monday 15^{th} (14:30 - 16:00)

A path-sum approach for Weyl and Dirac Quantum Walks

Mr. Nicola Mosco
Hall B1 - 14:30-14:47

Quantum Walks are the quantum counterpart of classical Random Walks which are models describing the motion of a particle on a lattice in discrete time-steps. Recently they have been considered as a possible fundamental description of relativistic particles (1-9). We consider here the Weyl and Dirac Quantum Walks, derived in (10) from general principles, from which one recovers Weyl's and Dirac's equations in the limit of small wave-vectors.

The walk dynamics is given by an update rule which can be conveniently expressed in terms of transition matrices acting on the internal degree of freedom (coin space). Exploiting the semigroup structure of the matrices one can study the walk evolution in terms of a path-sum on the lattice, leading to analytical solutions of the walk in direct space. Numerical analysis of the walk can be performed exploiting the update rule in direct space or by efficient FFT algorithms in momentum space, showing some general properties of these models, such as the Zitterbewegung effect (11).

A quantum walk, as its classical counterpart, can be viewed as the dynamical description of a single particle hopping in discrete steps from one lattice site to another. In order to study multi-particles systems one has to generalise the framework of quantum walks this leads to the notion of Quantum Cellular Automata, which are the corresponding quantum version of Cellular Automata, originally introduced by von Neumann. The connection between these two structures can be made explicit by replacing the quantum state with a quantum field, evaluated at each lattice site, obtaining a "second quantisation" of the walk. It would be interesting to explore the phenomenology of free quantum cellular automata in the thermodynamic limit. For example, one can study how the Chandrasekhar limit of white dwarfs is modified within this framework.

1. Succi, S.; Benzi, R. Lattice Boltzmann equation for quantum mechanics. Physica D Nonlinear Phenomena 1993, 69, 327–332.
2. Bialynicki-Birula, I. Weyl, Dirac, and Maxwell equations on a lattice as unitary cellular automata. Physical Review D 1994, 49, 6920–6927.
3. Meyer, D.A. From quantum cellular automata to quantum lattice gases. Journal of Statistical Physics 1996, 85, 551–574.
4. Strauch, F. Relativistic quantum walks. Physical Review A 2006, 73, 054302.
5. Yepez, J. Quantum lattice-gas model for computational fluid dynamics. Physical Review E 2001, 63, 046702.
6. D'Ariano, G.M. The quantum field as a quantum computer. Physics Letters A 2012, 376, 697 – 702.
7. Bisio, A.; D'Ariano, G.M.; Tosini, A. Quantum field as a quantum cellular automaton

The Dirac free evolution in one dimension. Annals of Physics 2015, 354, 244 – 264.
8. Arrighi, P.; Nesme, V.; Forets, M. The Dirac equation as a quantum walk higher dimensions, observational convergence. Journal of Physics A Mathematical and Theoretical 2014, 47, 465302.
9. Farrelly, T.C.; Short, A.J. Discrete spacetime and relativistic quantum particles. Phys. Rev. A 2014, 89, 062109.
10. D'Ariano, G.M.; Perinotti, P. Derivation of the Dirac equation from principles of information processing. Physical Review A 2014, 90.
11. D'Ariano, Giacomo Mauro, et al. "Discrete time Dirac quantum walk in 3+ 1 dimensions." arXiv preprint arXiv:1603.06442 (2016).

CDT: A Nonperturbative Quantum Gravity Theory

Mr. Dániel Németh
Hall B1 - 14:48-15:05

Numerical methods are playing an important role in many fields of theoretical physics and the power of computational technology is able to support the needs of it. There is some progress that allowed to understand and solve the problems of quantum gravity via these methods, e.g. Causal Dynamical Triangulations (CDT). CDT is using a nonperturbative quantum field approach via lattice regularisation. CDT is based on Feynman path integral method and Reggie Calculus, where d-dimensional triangles (simplices) generate the lattice and Wick rotated (t $\rightarrow$ -iτ) Lorentzian path integral turns to Euclidean regime. This theory deals with causality problems after summing over causal geometries only. Previous researches measured the behaviour of the coupling constants and other attributes of CDT in spherical ($S^3 \times S^1$) topology. During the recent studies we measured the toroidal condition ($M = T^3 \times S^1$, where $T^3 = S^1 \times S^1 \times S^1$) and realised the that the theory of CDT is not topology independent, however there is some behaviour of the system that remains the same in both cases.

Quantum game theory

Ms. Kinga Sára Bodó
Hall B1 - 15:06-15:23

What do we get if we combine game theory with quantum theory? My lecture aims to answer that question.

Game theory is one of the most widely used mathematical tool in all sciences. It gives us a deeper understanding of some evolutionary processes, it is often used to analyse social dilemmas, not to mention the applications in economy. The reason of this popularity is the mathematical simplicity, it is easy to modify game theory to certain problems. In my lecture I will focus on quantum game theory, which will be hopefully applicable in quantum computing in the future.

I will start my presentation with a brief introduction to classical game theory, showing some easy examples. Then, I will introduce quantum game theory and explain the differences through one example. Knowledge of basic quantum mechanics is recommended.

Electric and magnetic characterization of the fluorescence properties of a quantum dot-liquid crystal composite

Miss Oana Daciana Botta and Miss Loredana Angelica Mares
Hall B1 - 15:24-15:41

Fluorescence is a type of luminescence which can occur in the mostly known chemical states are gas, liquid and solid. Fluorescence is a secondary effect of a photon absorption, which promotes a singlet ground state to a singlet excited one. In comparison with phosphorescence, the spin of the excited electron remains paired with the one in the ground state. When the excited atom or molecule returns to its ground state, a photon is emitted leading to a visible luminescent effect. The emitted photon has lower energy, which means it has a longer wavelength than the absorbed photon. Fluorescence has found its place in various applications. These include fields such as biotechnology and life sciences, where fluorescence can be used in cellular signalling or DNA/RNA sequence identification, technology, when used in a quantum dot setup, display technology, one of the advantages being low power consumption, photonics and communications. In this paper, we study the wavelength shift of the quantum dot transition and the optical transmission performance of the nematic liquid crystal-quantum dot sample under external magnetic and electric fields.

Phase diagrams in QCD

Miss Valeriya Mykhaylova
Hall B1 - 15:42-16:00

QCD phase diagram is a conventional graph of strongly interacting matter phase transitions. Although the description of strong interactions is a main part of quantum chromodynamics, phase transitions in QCD can be described using traditional thermodynamic and statistical physics methods.

I formulate a transparent phenomenological model for the phase transition between quark-gluon plasma and hadronic phase which is approximated as an ideal pion gas. Comparing thermodynamic parameters (for example pressure) of two different hadronic states of QCD matter one can see an inconsistency between pion gas and quark-gluon plasma (QGP). It means that classical thermodynamic methods are not enough and we shall use another approximation for the diagram - MIT Bag Model, which corrects thermodynamic parameters of pion gas and QGP to make the phase transition possible.

References:
1. Vogt R., Ultrarelativistic Heavy-Ion Collisions. First Edition, Elsevier, Amsterdam, The Netherlands (2007)
2. Braun-Munzinger P., Wambach J., The Phase Diagram of Strongly Interacting Matter. Rev. Mod. Phys. Vol 81 (2009) 1031-1050

Laser Power Effects on the Size of an Optically Trapped Aerosol Droplet Determined Via Whispering Gallery Modes

Ms. Angela Ludvigsen
Hall B2 - 14:30-14:47

A laser can be used as an optical trap to catch and hold small, transparent objects. Observations of optically trapped aqueous aerosol droplets have demonstrated that the droplet moves between two or more stable positions dependent upon the power of the trapping laser. It is hypothesised that this movement coincides with a resonance between the trapping light and the droplet's surface, called a Whispering Gallery Mode. When this resonance occurs, forces acting on the droplet cause it to move. To investigate this behaviour, Raman scattered light from the droplet as well as the droplet's position are measured. The Raman spectrum exhibits a series of peaks resulting from the droplet's spherical shape, referred to as Cavity Enhanced Raman Spectroscopy (CERS). The location and spacing of these peaks are known to be related to the diameter and the optical properties of the droplet. From this spectrum, the magnitude of the electric and magnetic fields of the scattered light are calculated. This allows for a precise measurement of the droplet's radius at the moment that the droplet moves between stable positions. After determining the droplet's radius from the spectrum, the effect of varying the intensity of the trapping laser beam on the droplet radius can be investigated.

When atomic nucleus goes pear-shaped

Mr. Petar Marevic
Hall B2 - 14:48-15:05

Atomic nucleus is a quantum many-body system whose shape is determined by the number of nucleons and the interaction between them. Consequently, a variety of different shapes has been observed so far, including the quadrupole-deformed prolate (cigarette-like) and oblate (pancake-like) shapes, or triaxial shapes where axial symmetry has been explicitly broken. During the last decade, new experiments have established the existence of yet another shape in several nuclei. The octupole-deformed nuclei, marked by breaking of the reflection symmetry, are known to distort to the characteristic pear-like shape. In this talk, theoretical tools for studying nuclear structure, based on the relativistic mean-field theory and the generator coordinate method, will be presented. In particular, the application to study of octupole-deformed nuclei will be illustrated with few examples and the obtained results will be compared with new experimental results.

Neutron detection in NeuLAND

Mr. Áron Kripkó
Hall B2 - 15:06-15:23

The NeuLAND (new Large-Area Neutron Detector) is a next-generation fast neutron detector, which is designed for the R3B group. Exotic nuclei are being studied by detecting all reaction products and measuring their moments. Because of the high detection efficiency a lot of hits are being detected (usually 10 per incoming neutron), and for that reason finding the first hit is problematic. Therefore the reconstruction of the incoming neutron"s moment

and thus measuring the excitation energy of the nucleus is anything but trivial. Our aim was to solve this problem. I have made examinations with the aid of a Geant4 simulation. Based upon the results of the analysis I have developed an algorithm, which determines the number of the incoming neutrons, and chooses the best hits for the reconstruction. The algorithm uses neutron tracking and examine energy depletion. I would like to show my results after presenting the methods of the analysis.

Nanoparticles - Production and characterization

Mr. Florian Lippert
Hall B2 - 15:24-15:41

Producing samples of nanoparticles usually is a drawn-out process, taking up quite a lot of time. To increase the efficiency of the production of samples, the method of sputterdepostion is used to sputter silver-nanoparticels into an ionic liquid. The magnetron sputter device bundles up electrons in front of a small sample of silver to ionise argon atoms. These argon atoms crush into the silver sample, detaching small silver particles that fall into the ionic liquid. The ionic liquid BMIM-PF6 is used for its specific characteristics in high vacuum and for its ability to store nanoparticles in a stable condition. Using this method, it is possible to produce a sample within 30 minutes. In order to measure the quality of this process, the characterisation of the produced nanoparticles is necessary.

Characterisation can be obtained using optical methods like spectral analysis of the transmission and extinction of the sample. They are used to find plasmon resonances in the spectrum of the nanoparticles. The position and size of these resonances are an indication for the dimension and the growth behaviour of the synthesised nanoparticles.

By now varying the settings of the sputtering process, the possibilities of this method can be investigated. Also the ageing process in ionic liquids is studied to improve stable storage and transport of these particles.

At the end, a measurement method will be shown, that will help to measure the growth behaviour in ionic liquids by using total reflection at the Brewster angle.Applying this method, it should be possible to measure the plasmon resonance and, using this, the dimension of the nanoparticle at any given point of time during the sputtering process.

Exotic nuclei decay products detection by using Optical Time Projection Chamber (OTPC)

Miss Joanna Peszka
Hall B2 - 15:42-16:00

Nuclei with ratios of neutron number N to proton number Z significantly different than occurring in nature are called exotic nuclei. Synthesis and study properties of nuclei at the border of stability are the main area of interest of Flerov Laboratory of Nuclear Reactions in Dubna. In order to detect light exotic nuclei decay products fragments is used separation system ACCULINNA and novel technique of charged particles detection OTPC - Optical Time Projection Chamber. Construction and principle of operation of OTPC spectrometer

and analysis of experimental data - - delayed particle emission radioactivity of 27S will be discussed.

3.9 Session 9: Tuesday 16^{th} (09:30 - 11:00)

Creation of Superoxide at the Qo active site of the BC1 complex

Mr. Adrian Salo
Hall B1 - 09:30-09:47

The creation of superoxide is thought to be a major cause for cellular ageing due to the highly toxic effects of even small concentrations. The cytochrome bc1 complex, also called Complex III, is the third protein in the electron transport chain, which, coupled with proton transport serves to create an electrochemical gradient across the membrane.

Using a combination of molecular dynamics simulation and quantum chemistry, carried out numerically on the Abacus 2.0 supercomputer at SDU, the details of the electron pathways near the Qo site is studied.

This topic illustrates well how the boundaries between physics, chemistry and biology fades when entering the world of quantum mechanics.

Oxidic Thin-Film Quasicrystals

Ms. Bettina Leibundgut
Hall B1 - 09:48-10:05

The discovery of quasicrystals in 1982 by Dan Shechtman (1) led not only to the award of a Nobel Prize, but opened a new field of research in the physics community. It was believed that due to the restriction theorem, crystalline structures could only exist in two-, three-, four- and sixfold symmetry. The definition of a crystal was connected to translational symmetry, which is not fulfilled for quasicrystals. Due to their discovery, the definition had to be broadened to any solid having an essentially discrete diffraction diagram, and by 'aperiodic crystal' we mean any crystal in which three-dimensional lattice periodicity can be considered to be absent (2).

Quasicrystals do not only differ from other structures because of their art and beauty in nature. They vary electronically, mechanically and chemically such as an extremely high electric resistivity in aluminium dominated alloys, brittleness at low temperatures and on the same hand extremely deformation at high temperatures, or low wetting of surfaces and hydrogen storage, to name just a few.

A new member in the family of quasicrystals it the recently discovered 2D oxide quasicrystal formed from $BaTiO_3$ grown on Pt(111) (3). This example of ultrathin quasicrystals derived from a prototypical periodic perovskite oxide extends the quasicrystal concept to a broader range of materials.

This talk will give an introduction to the concepts of quasicrystals as a third form of solid state matter besides periodic crystals and the amorphous state. Furthermore, I will present the whole new field of oxide quasicrystals on the example of $BaTiO_3$ on Pt(111). The most recent results on $SrTiO_3$ which also shows a perovskite structure, will be covered. Despite a slightly reduced lattice constant, it also forms an oxidic quasicrystal at the Pt(111) surface, hence it paves the way to a deeper understanding of this interesting example of quasicrystal-crystal heteroepitaxy.

References
1. D.Shechtman, J. Blech, D.Gratias, J.W. Cahn; Phys.Rev. Lett. 53, 1951 (1984)
2. Acta Crystallographica Section A, 48, 922 (1992)
3. S.Förster, K.Meinel, R.Hammer, M.Trautmann and W.Widdra, Nature, 502, 215 (2013)

Optical conductivity of graphene

Mr. Viktor Könye
Hall B1 - 10:06-10:23

We study the optical conductivity of graphene described by nearest neighbour tight binding (TB) model. The band structure of the graphene in TB model is presented. A closed expression is derived for the current-current correlation function and from this result the optical conductivity is obtained. Our closed analytical expression reflects the underlying symmetry of the graphene. To the best of our knowledge this result is not known in the literature. Using our general result the allowed electronic transitions between different electronic states are demonstrated. We also study numerically the optical conductivity as a function of the frequency of the incident light at a given temperature and chemical potential. Our theoretical approach can be extended to other 2D materials such as bilayer graphene, silicene and Dirac-Weyl system.

PEDOT:PSS as a transparent electrode in perovskite solar cells

Ms. Maria Gieysztor
Hall B1 - 10:24-10:41

Perovskites are a group of compounds crystallising in a distinctive crystal structure ABX_3, called later perovskite structure. They appear in both, natural (e.g. calcium titanate) and synthetic (e.g. $CH_3NH_3PbI_3$) form. $CH_3NH_3PbI_3$ found use in solar cells, called later perovskite solar cells (1,2). It is a material that belongs to mixed organic-inorganic lead halide perovskites. Thanks to their dual nature, they can be used for flexible, semi-translucent and easy in fabrication solar cells with efficiencies catching up those based on polycrystalline silicon – 22.1% (3). Usually, in perovskite solar cells the transparent (bottom) electrode is made of ITO, which is a relatively expensive material. That is why research on substitutes is carried out.

My talk will be divided into two parts. In the first one I will introduce perovskites along with discussing their structure, main properties and applications in solar cells. Later I will present results of my work on PEDOT:PSS PH1000 as a possible transparent electrode in

perovskite solar cells.

References
1. O. Malinkiewicz, A. Yella, Y. H. Lee, G. M. Espallargas, M. Grätzel, M. K. Nazeeruddin, H. J. Bolink, Perovskite solar cells employing organic charge-transport layers, Nature Photonics 2014, 8, 128-132.
2. H. Jung, N. Park, Perovskite solar cells: from materials to devices, Small, 2014, 11, 10-25.
3. NREL, available on-line: `www.nrel.gov/ncpv/images/efficiency_chart.jpg`

Dynamics of Molecular Ring Currents

Mr. Jack Woolley
Hall B2 - 09:30-09:47

Internal Molecular processes occur on an ultrafast timescale (faster than 10-12s). To explore the dynamics of these process measurements need to be taken during a shorter time to accurately describe the evolution of the system as it progress along the reaction coordinate, this is achieved through the use of time resolved spectroscopy using pulses of light of the order femtoseconds (10-15s) in length. These pulses first 'pump' the molecule to a higher lying electronic state and then 'probe' the state through the process of multiphoton ionisation. Molecular ring currents have shown to be produced in aromatic compounds with electron systems, through the use of circularly polarised pulses of light of the order of a hundred femtoseconds. These ring current allow selective excitation to degenerate excited states within the molecule. This project set out to explore the dynamics of how ring currents evolve in a molecule as well as to probe how the molecule reacts when the chemical bonding in the ring is broken and the molecule fragments. The development of a technique involving the use of molecular ring currents may allow further dynamical as well as electronic information to be gleaned from molecules, due to the large variety of molecules that possess an aromatic element to there electronic structure.

Large-N_c Constraints on Nuclear Forces

Mr. Dominik Gerstung
Hall B2 - 09:48-10:05

Nuclear Forces have been studied for a long time, leading to the modern theory of Quantum Chromodynamics (QCD). Out of the several approaches to QCD, two are being tested for mutual consistency Large-N_c QCD and Chiral Perturbation Theory (ChPT).

Large-N_c is a perturbative analysis for QCD, where the number of colours, N_c, is assumed to be large (instead of 3). ChPT is an effective field theory (i.e. a low energy approximation) with Hadrons (e.g Nucleons and Pions) as effective degrees of freedom.

This talk will give a general introduction to Large-N_c QCD, followed by a small showcase of its implications and a consistency check with ChPT.

Neutron-mirror neutron oscillations in a residual gas environment

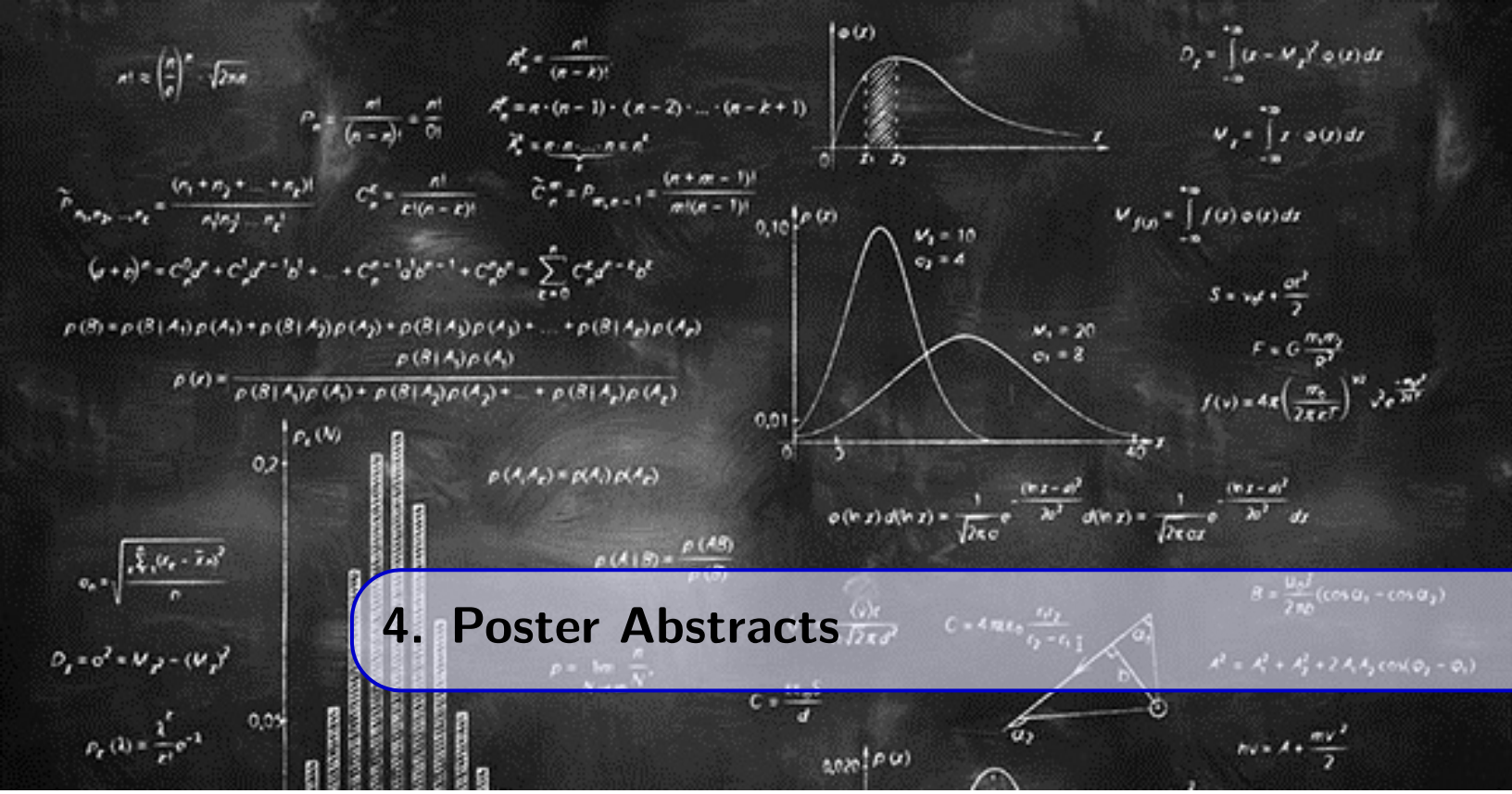
Mr. Louis Varriano
Hall B2 - 10:06-10:23

A precise measurement of the neutron lifetime is important for calculating the rate at which nucleosynthesis occurred after the Big Bang. The history of neutron lifetime measurements has demonstrated impressive continuous improvement in experimental technique and in accuracy. However, two most precise recent measurements performed by different techniques differ by about 3 standard deviations. This difference of 9.2 seconds can possibly be resolved by future experiments, but it may also be evidence of a mirror matter effect present in these experiments. Both mirror matter, a candidate for dark matter, and ordinary matter can have similar properties and self-interactions but will interact only gravitationally with each other, in accordance with observational evidence of dark matter. Although mirror matter does not couple to ordinary matter by Standard Model interactions, some additional interactions might exist, providing small mixing of ordinary matter neutral states, like the neutron, with mirror components. Three separate experiments have been performed in the last decade to detect the possibility of neutron-mirror neutron oscillations. This work provides a formalism for understanding the interaction of the residual gas in an experiment with ultra-cold neutrons. This residual gas effect was previously considered negligible but can have a significant impact on the probability of neutron to mirror neutron transition. This formalism is used to evaluate the three previous experiments and can provide a framework for future experiments. This work was performed in collaboration with Prof. Z. Berezhiani (University of L'Aquila, Italy), Prof. B. Kerbikov (Institute for Theoretical and Experimental Physics, Moscow) and Prof. Y. Kamyshkov (University of Tennessee).

Prototype of Time-of-Flight detector for NA61/SHINE experiment

Ms. Aleksandra Snoch
Hall B2 - 10:24-10:41

The NA61/SHINE experiment is a heavy-ion, fixed target experiment, constructed to investigate Quark Gluon Plasma and it"s properties, and to describe the phase diagram of strongly interacting matter. One of the parts of the detector is the Time-of-Flight system – necessary for particle identification. Because of its meaning for the experiment, constant improvements are needed. In my work, I tried to decrease the costs of the detector without changing the most important parameters (time resolution). The prototype was constructed using the scintillation crystals and silicon photomultipliers. To obtain the time resolution of the prototype the SiPM waveforms were recorded and analysed with the software constant fraction algorithm developed for this purpose.



4. Poster Abstracts

Laser driven ion acceleration at ELI-NP

Miss Iulia Mihaela Barbut

Poster 01

Laser driven particle acceleration concentrate since the year 1990 the join efforts of multiple research communities laser, plasma and nuclear physics related. This interdisciplinary field has a deep impact not only on the theoretical studies of laser-plasma interaction, but also to a long series of applications related to plasma physics (ex. controlled fusion studies) to particle production (ex. neutrons,) are to the development of a new generation of particle acceleration. The laser driven particle acceleration is essentially on experiment driven field. On the other hand, the analysis of experimental data has always been related to PIC simulations and analytical modelling. In the presented work we try to use the analytical modelling of laser plasma interactions for the prediction of the particle acceleration characteristics in the case of ELI-NP facility. We are focused on the proton acceleration since the theoretical development is in this case the most developed. We consider also some cases of heavy ion acceleration relevant for ELI-NP.

Merging black holes

Miss Isil Selcuk

Poster 02

Scientist have detected a strong force at the middle of our galaxy that even light can not escape from this region. This is called “black hole” which has great effects on the geometry of the galaxies even though on universe while they are merging. It is possible that two black holes can merge when they become close enough. So, tremendous energy is released and the space fluctuate as producing gravitational waves. Physicist have found out thanks to LIGO experiment - ESA’s project that these ripples can be detected. I will explain how black holes are evolving and creating such waves in my poster.

Studies of Li/W interactions and their temperature dependence

Mr. Arvydas Sepetys

Poster 03

Studies of Li/W interactions.In a Fusion Reactor based on liquid metals with a hot metal first wall, the issue of first wall erosion by the leaking metal from the diverter has to be addressed. Furthermore, the simultaneous impact of T ions may cause the formation of metal composites with an intolerable level of radioactive fuel. In particular, for a liquid lithium diverter and a hot W wall, chances of forming tritiated Li-W compounds must be considered, at least in the coldest parts of the first wall.

Physical properties of some transparent conductor oxides

Ms. Daniela-Emilia Dogaru

Poster 04

The transparent conductors oxides(TCOs) exhibit a useful combination of physical properties (high optical transparency and high electrical conductivity). Here we provide an overview of the results on the structural, optical and electrical characterisation of In2O3:Sn (ITO) and ZnO:Nd transparent oxide thin-films deposited on glass using rf-sputtering and Pulsed Electron Deposition (PED),respectively. Temperature dependent Hall effect and resistivity measurements was performed in the range 30 - 300 K; scattering mechanisms are discussed in order to explain the unusual temperature dependence of the electrical resistivity.

Neutron-mirror neutron oscillations in a residual gas environment

Mr. Louis Varriano

Poster 05

A precise measurement of the neutron lifetime is important for calculating the rate at which nucleosynthesis occurred after the Big Bang. The history of neutron lifetime measurements has demonstrated impressive continuous improvement in experimental technique and in accuracy. However, two most precise recent measurements performed by different techniques differ by about 3 standard deviations. This difference of 9.2 seconds can possibly be resolved by future experiments, but it may also be evidence of a mirror matter effect present in these experiments. Both mirror matter, a candidate for dark matter, and ordinary matter can have similar properties and self-interactions but will interact only gravitationally with each other, in accordance with observational evidence of dark matter. Although mirror matter does not couple to ordinary matter by Standard Model interactions, some additional interactions might exist, providing small mixing of ordinary matter neutral states, like the neutron, with mirror components. Three separate experiments have been performed in the last decade to detect the possibility of neutron-mirror neutron oscillations. This work provides a formalism for understanding the interaction of the residual gas in an experiment with ultra-cold neutrons. This residual gas effect was previously considered negligible but can have a significant impact on the probability of neutron to mirror neutron transition. This formalism is used to evaluate the three previous experiments and can provide a framework for future experiments.

This work was performed in collaboration with Prof. Z. Berezhiani (University of L'Aquila, Italy), Prof. B. Kerbikov (Institute for Theoretical and Experimental Physics, Moscow) and Prof. Y. Kamyshkov (University of Tennessee).

The role Condensation Particle Counters in aerosol research

Ms. Suvi Okkola
Poster 06

Condensation Particle Counters (also known as Condensation Nucleus Counters) measure the total number concentrations of particles which is an important measurement technique for particles less than 200 nm in aerosol research. However, particles in this size range are very difficult to measure using optical methods. That"s why the main idea of CPC is to make the particles grow by condensing to a size range of 5-15 m to make it possible to measure them by optical methods. In this poster I will introduce the specific working principle of CPCs, what types of CPC are used and what applications they have in aerosol science.

Magnetotransport properties of rare-earth-bearing half-Heusler phases (RTSb)

Mr. Kamil Ciesielski
Poster 07

Polycrystalline samples of several ternaries with the chemical formula RTSb (R = Er, Lu, Y, Tb, Gd; T = Ni, Pd, Pt), crystallising with the cubic MgAgAs-type structure, were investigated by means of magnetic susceptibility, electrical resistivity and magneto-resistivity measurements, carried out from 2 to 300 K. The nonmagnetic compounds LuNiSb, LuPdSb and YPdSb were found to exhibit negative temperature coefficients of the resistivity in the whole temperature range studied. In contrast, the resistivity of antiferromagnetic ErPdSb, GdPtSb and TbPtSb was found to decrease with lowering the temperature down to the onset of the ordered state. In turn, the resistivity of nonmagnetic YPtSb and antiferromagnetic ErNiSb was established to vary with temperature in a more complex non-monotonic manner. All the materials studied were classified as semimetals or narrow band-gap semiconductors, in line with the results of electronic band structure calculations, reported in the literature.

Remarkably, the low-temperature electrical resistivity of LuNiSb, ErNiSb, YPdSb and YPtSb, measured in zero and finite applied magnetic fields, was found to increase proportionally to the square-root of temperature, in a manner characteristic of structurally disordered metals, in which the low-temperature transport is notably influenced by electron-electron interactions. The scenario of quantum interference effects is supported by the observed large magnitude of the electrical resistivity and small values of the residual resistivity ratio, which both imply that the electrical transport in these materials is likely dominated by scattering conduction electrons on crystal structure imperfections.

Nano-surface Vanadim redox flow battery

Mr. Andru Fronoiu
Poster 08

As our society grows, the energy requirements of our devices and machines increase. As we can see, there are many ways to generate electrical power. However there are less ways to store it. The only logical solution to this problem is to change our approach, to slowly move toward developing technologies that generate the energy demanded by our society in a friendlier and more efficient manner. Thus the demand for more efficient storage units will increase. To make use of all that energy, we have to develop new energy storage technologies that are both efficient and cheap. With this in mind, the subject discussed is about a flow battery that, with enough research and development, can be one of the solutions for our future energy storage problem.

Mr. Alexander Schiffmann

n-MOSFET Ageing Measurements and Modelling
Poster 09

The presented work focuses on ageing effects due to hot-carrier-injection (HCI) in MOSFETs. Hot carrier refers to fast electrons in the conducting channel. Electrons are accelerated by very high electric fields in the pinch-off region of the transistor. Their energy is high enough to generate trap states at the interface between the semiconductor and the gate oxide. Those traps capture charge which shifts the characteristics of the transistor.

To gain knowledge about the HCI effects, various measurements on n-MOSFET devices with a channel length of 0.18 µm have been performed. The devices were provided by ams AG. Ageing experiments were conducted with different stress voltages and important device parameters were extracted to find how they change over time. It is observed that the stress effects scale with stress voltage and time. A short stress at high voltage causes the same threshold voltage shift as a long stress at low bias voltage. This scaling behaviour is used to predict ageing effects at real life operating conditions.

Since device ageing due to stress is a major issue in modern semiconductor fabrication, it is of importance to understand the effects and find reliable ways of predicting how changes in the devices will affect the overall circuit performance. We used the HiSIM2 ageing model developed at Hiroshima University. This model predicts the device degradation based on the bulk current which is affected by impact ionisation events. A beta version of HiSIM2 was used to fit the behaviour of the ams AG 0.18 µm MOSFET technology.

Creation of Superoxide at the Qo active site of the BC1 complex

Mr. Adrian Salo
Poster 10

The creation of superoxide is thought to be a major cause for cellular ageing due to the highly toxic effects of even small concentrations. The cytochrome bc1 complex, also called Complex III, is the third protein in the electron transport chain, which, coupled with proton transport serves to create an electrochemical gradient across the membrane.

Using a combination of molecular dynamics simulation and quantum chemistry, carried out numerically on the Abacus 2.0 supercomputer at SDU, the details of the electron pathways near the Qo site is studied.

This topic illustrates well how the boundaries between physics, chemistry and biology fades when entering the world of quantum mechanics.

Comparative study of dALA as a precursor of Porphyrins and a Hypericum perforatum extract

Miss Andreea Ioana Ciocănaru
Poster 11

Light-biological matter interactions have a great importance in our life; therefore, using sunlight as a therapeutic method has been explored and practiced since old times by the ancient civilisations. PDT (Photodynamic therapy), also known as photochemotherapy, uses nontoxic compounds that are light-sensitive; exposed selectively to light, they exhibit phototoxicity, becoming invasive to diseased cells (targets). The aim of this paper is to elaborate a comparative study of aminolevulinic acid as a precursor of porphyrins (used in Photodynamic therapy) and a Hypericum perforatum extract. Aminolevulinic acid (also known as 5-aminolevulinic acid or dALA) is the condensation result between Succynil-CoA and glycine in the heme forming process in mammals and chlorophyll in plants. Porphyrines are cyclic compounds generated by dALA that play an important role in the process of oxygen cycle. The study will consist of different monochromatic laser sources irradiation and UV irradiation (UV mercury lamp will be used). The spectral stability of the extract and dALA for different concentrations at various irradiation doses is studied.

The atomic scale structure of palladium nanoparticles studied by X-ray diffraction

Mr. Michał Kamiński
Poster 12

Over the last few years an increasing interest in nanomaterials can be observed, mostly due to their numerous applications. Palladium nanoparticles show good catalytic properties, therefore it is essential to acquire information about their structure. The nanopalladium samples were obtained by deposition of the metal precursor in sol-gel silica and then chemically purified. In this work structural studies of palladium nanoparticles using X-ray powder diffraction and transmission electron microscopy methods are presented.

High quality experimental data were recorded using a laboratory powder diffractometer. After correction and normalisation the diffraction data were converted to the real space representation in the form of the pair distribution function (PDF) via the Fourier sine transform. Such an approach is widely used when examining the structure of nanomaterials, as their structure cannot be described by the use of conventional crystallography. (1)

The X-ray diffraction studies were complemented by additional tests using the Rietveld refinement and the transmission electron microscopy observations. Using these techniques additional information about the structure of the investigated material was obtained. Transmission electron microscopy, as the most direct method, was applied to determine the size of nanoparticles.

All gained results were used to construct a computer model of the structure of palladium nanoparticles. Cartesian coordinates of atoms were computer generated under assumptions about the cell and disorder parameters. Then theoretical functions for a given cluster in both real and reciprocal space were calculated and compared with experimental results. (2)

Assumption about the undistorted crystalline structure is not valid for the examined palladium nanoparticles. Due to this reason, the theory of paracrystal [(3) was applied to the computer simulations. This led to the significantly better agreement with experimental data. From the simulated model, information about structure such as lattice constants, Debye-Waller factors and grain sizes were extracted.

References
1. S.J.L. Billinge, T. Dykhne, P. Juhas, Emil Bozin, R. Taylor, A.J. Florencec, K. Shanklandd, CrystEngComm, 12, 1366–1368, (2010)
2. A. Szczygielska, A. Burian, J.C. Dore, J. Phys. Condens. Matter, 13, 5545-5561, (2001)
3. R. Hosemann et al., J. Phys. C Solid State Phys., 16, 4959-4971, (1983)

Time-Resolved Photoion Yields of Hydroxyindoles

Mr. Stuart Crane
Poster 13

Rapid and efficient energy redistribution processes in biological chromophores following ultraviolet (UV) absorption are vital in providing an inherent photoprotection. Important examples of this include the DNA bases and the melanin pigments. Utilising gas-phase spectroscopic techniques can provide valuable insight into the fundamental dynamics of this mechanism, free of intermolecular and solvent effects. However, many large molecules of interest have low vapour pressures, with a propensity to decompose under vigorous heating, making gas-phase spectroscopy difficult.

This work presents a soft thermal desorption technique, incorporated within a time-of-flight mass spectrometer (TOFMS) set-up, facilitating studies of the UV-photoprotection in non-volatile model biological chromophores. Back irradiation of a thin sample foil with a CW laser produces neutral plumes of the molecule of interest. Time-resolved pump-probe photoion yield measurements have been used to investigate UV relaxation dynamics in 4, 5

and 6-hydroxyindole, as well as 5,6-dihydroxyindole. These are constituent building-blocks of the eumelanin complex. 5,6-dihydroxyindole appears to exhibit significantly different energy redistribution mechanisms by comparison, possibly confirming previous hypotheses of intramolecular group migration.

El Nino Southern Oscillation's projections on different fields

Miss DANIELA-LUCIA ZAHARIA

Poster 14

Wavelet analysis is a powerful tool used to identify stationary and non-stationary oscillatory components in geophysical time-series. I applied this technique on climate indices associated with the El Niño–Southern Oscillation(ENSO) phenomena, derived from several data sets, in order to investigate the stationarity of inter-annual variability related to ENSO in data obtained from different sources. The goal is to identify the fields in which ENSO related variations are most prominent.

Superconductivity on the edge of ferromagnetism – physical properties of La3Co compound

Miss Marta Roman

Poster 15

Numerous intermetallic compounds containing ferromagnetic elements like Ni, Fe or Co exist, but only few of them exhibit superconducting properties. Generally, compounds consisting of strongly magnetic atoms do not exhibit superconducting behaviour. However, superconductivity in the intermetallic compound La3Co, which contains a ferromagnetic element of the d block (Co), was reported [1], [2], [3]. This unexpected result motivated us to carry out a detailed experimental examination of the properties of this material, which is the subject of this presentation.

The superconducting transition (Tc 4.57 K) of La3Co was studied by measuring the magnetic susceptibility, resistivity and specific heat using the experimental system PPMS (Physical Property Measurement System) and the highlights of our results are presented. We also describe the procedure of preparation of the La3Co compound (arc melting under an atmosphere of highly purified argon; subsequent annealing in vacuum at 500 °C), the crystallographic structure of this material (orthorhombic, space group Pnma, number 62) and results of powder X-ray diffraction, which enabled the determination of the phase composition of the sample. Values of relevant physical parameters, recovered as a result of our experiments, and their implications for our understanding of the mechanism of superconductivity in this compound, will also be discussed.

Peak Effect on the DC Magnetization Curves of Nb-rich Nb-Ti alloys

Miss Marinela Alina Ionescu

Poster 16

We investigated the evolution of the peak effect on the DC magnetic hysteresis curves of Nb0.89Ti0.11 bulk samples by increasing the deformation degree. The alloy was prepared by arc melting. With a homogenisation heat treatment at ≈900 °C in vacuum, the critical temperature Tc becomes ≈9.4 K. After a first cold-rolling (≈60% deformation), the sample exhibits the well known anomalous peak effect (PE) not far from the DC irreversibility, and it can be evidenced over a wide temperature interval, up to close to Tc. By further increasing the deformation degree (through a second cold rolling, where the thickness was reduced from $\approx 0.2mm$ to $0.09mm$), the PE disappears, and a second magnetisation peak (SMP) sets is, with the onset field located well below the DC irreversibility line. While the standard (zero-field cooling) magnetic measurements at low temperatures are strongly affected by thermo-magnetic instabilities, in the high-temperature range (T above 7 K) a true SMP develops. The change of PE into an SMP is due to the increase of vortex pinning through deformation, and both effects appear to be caused by the pinning induced disordering of the low field Bragg vortex glass.

Global Positioning System and Einstein's Theory

Miss Joanna Dziekańska

Poster 17

My poster is devoted to present the connection between the relativity theory and the GPS system. It is quite surprising that without taking the influence of the gravity eld into account, one could not bene t from the ad- vantages of the global positioning system. The problem lies in the difference of the time measurement on the orbit and on the Earth. In practice, this issue was solved via lowering the frequency of the system installed on the satellite.

Detection method for accelerated particles in high intensity laser-matter interaction

Mr. Bogdan Butoi

Poster 18

In this study, we present the main methods for detection and characterisation of charged particles, resulting from high power laser field (PW) -solid target interaction. The characterisation employs the description of Scintillators, Radiochromic Films (RCF), Image Plates (IP) and Thomson Parabola (TP), as devices that are able to characterise the accelerated particles in function of type and energy and are immune to parasite EMP pulses, usually present in this type of applications.

Quantum Galielo's experiment and WEP in QM

Mr. Valerio Peri
Poster 19

We address the problem of estimating the mass of a (quantum) particle interacting with a classical gravitational field. In particular, we analyse in details the ultimate bounds to precision imposed by quantum mechanics and study the effects of gravity in a variety of settings. In addition, we discuss the compatibility of the weak equivalence principle (WEP) within the quantum regime using as a guide the notion of Fisher Information. Our results show that in an information-theoretic framework, no clash occurs between quantum mechanics and the WEP.

Two-dimensional MoS2: Optical properties

Miss Nadine Leisgang
Poster 20

Layered materials in their bulk form are widely known and were utilised for a long time, while the ability of extracting single or few layers of atoms has attracted considerable interest in the study of two-dimensional materials. Although, graphene, being the first and best-known example of two-dimensional atomic crystals, demonstrates unique physical, optical and mechanical properties, its lack of bandgap limits its use in various applications. Thus, other graphene-like two-dimensional materials such as molybdenum disulphide (MoS2) have recently been focused on in order to overcome the weakness of gapless graphene and to extend the field of possible applications. These two-dimensional transition metal dichalcogenides (TMDCs) are atomically thin and possess bandgaps lying in the visible range which makes them interesting for use in optoelectronic devices.

Nanopowders of cerium (IV) oxide: synthesis and applications

Miss Iga Lewandowska
Poster 21

Cerium oxide (ceria) is well known for its interesting, both mechanical and electrical, properties. While doped it exhibits relatively high values of oxygen ionic conductivity. It makes it a very good material for various applications like electrolyte in solid oxide fuel cells. Recently the main interest is put on the nanosize ceria. In our work the nanopowders of undoped and lanthacerium (IV) oxide were synthesised using the co-precipitation method. The series of samples was obtained each being prepared at different annealing temperature, ranging from 500 to 1100oC. All samples were measured by the means of X-ray diffraction. The direct correlation between the annealing temperature and grain size was observed. The higher annealing temperature was, the bigger nanoparticles were obtained. The size of nanoparticles was from the rage approximately 5 to 100 nm. After synthesis the nanopowders were pressed, sintered, and their electrical properties were tested. Using the co-precipitation method it is easy to synthesise ceria. In this work the synthesis route and properties of ceria, and lanthanum doped ceria (in 10 and 20mol%) was described.

Broadband transition radiation measurements for the diagnosis of ultra-short plasma-accelerated electron bunches

Mr. Michael Bornholdt
Poster 22

At Flash Forward (DESY, Hamburg) we receive ultra short electron bunches from plasma acceleration. One of the most important characteristics of these bunches are they're longitudinal appearance, or put in simpler terms - the length of such an electron bunch is what one wants to measure.

In order to do this one uses transition radiation (TR) which is a form of electromagnetic radiation emitted when charged particles move between to media of different dielectric constants. The longitudinal width of each electron bunch determines whether the transition radiation is coherent or not. To keep it simple, at wavelengths longer than the longitudinal length of an electron bunch we can detect coherent TR (CTR) resulting in a high intensity at the given wavelength due to interference. At wavelengths shorter than the longitudinal length of a bunch the TR interferes destructively thus minimising the intensity. This way one will be able to extract information about the electron bunch.

Analysis of topological properties of Chern insulators

Mr. Michal Kupczyński
Poster 23

Chern insulators are band insulators exhibiting a nonzero Hall conductance but preserving the lattice translational symmetry. (1) Unusual protection of quantised conductance is related to nontrivial topology of energy bands characterised by topological invariant, Chern number; topological properties are stable against small perturbations. In this work we investigate different Chern insulator lattice models. We analyse their common features by looking at band structures, edge states behaviour, and Berry curvature. We emphasise differences that can be responsible for distinct many body effects when electron-electron interactions are included. In particular, we indicate models that support stabilisation of Fraction Chern Insulator (FCI) phases. (3-6)

References
1. F. D. M. Haldane, Phys. Rev. Lett. 61, 2015 (1988).
2. K. Sun, Z. Gu, H. Katsura, and S. Das Sarma, Phys. Rev. Lett. 106, 236803 (2011).
3. T. Neupert, L. Santos, C. Chamon, and C. Mudry, Phys. Rev. Lett. 106, 236804 (2011).
4. D. Sheng, Z.-C. Gu, Gu, K. Sun, and L. Sheng, Nat. Commun. 2, 389 (2011).
5. N. Regnault and B. A. Bernevig, Phys. Rev. X 1, 021014 (2011).
6. B. Jaworowski, A. Manolescu, and P. Potasz, Phys. Rev. B 92, 245119 (2015).

Technology saves people

Miss Felicia Mihai
Poster 24

In a world where heart disease is the number one cause of death in the last years, a young electrical engineer studied the relation between the electric shocks and its effects on human

heart. His invention has been called a defibrillator and it has been used for the first time on a human in 1947.

Nowadays research is directed on lowering the dimensions of defibrillators and make them more accessible to operate. The most important part of this invention is the capacitor. This little piece stores a large amount of energy in the form of electrical charge and then releases it over a short period of time. The maximum working voltage is the voltage that when is voltage that cause a dielectric breakdown when is exceeded.

In my poster I will try to make and test a small defibrillator, charged from batteries to considerably reduce device dimensions. Also, I will explain how condensations in my circuit works and how the power of electrical current affect the heart beats. If you can understand how it works you can figure it out how to control a large amount of energy. I hope you will enjoy my presentation and you will remember how you can save the world with your own hands.

Solvophobic Solvation and Interaction of Small Apolar Particles in Imidazolium-Based Ionic Liquids

Miss Iryna Vornichesku
Poster 25

Ionic liquids are a new class of solvents for use in environmentally benign industrial processes and are seen as an alternative to toxic volatile organic compounds. The ionic nature of them has important consequences for the structure of the liquid on nanosomic level. Spectroscopic evidence is suggested the presence and importance of the formation of intermolecular cation-anion hydrogen bonds. Specific ion-cation interactions seem to the formations of a persistent anion-cation network, which has been shown to the quite tolerable to adding both and apolar particles.

The St. Petersburg paradox: The problem of unrealistic expectations

Mr. Stjepan Harapin and Mr. Frane Lunić
Poster 26

An optimal decision is a decision that leads to the best possible outcome for an agent. When facing lotteries, a naive decision criterion would be the comparison between the price of a lottery ticket and the expected value of a random variable representing the prize. However, it is possible to conceive of lotteries with finite prizes, but a divergent expected prize. In this case, the naive criterion would suggest playing as the optimal strategy for any finite price, and could lead to a suboptimal outcome for the agent. We will explore the St. Petersburg paradox, originally proposed by Nicolaus Bernoulli, as an example of this problem. The paradox arises when considering a theoretical lottery in which a player tosses a coin repeatedly until the first time it lands tails. If the number of times the coin had landed heads before landing tails (k) is greater than zero, the prize of 2 to the power of k cookies is awarded. Though many resolutions of the paradox have been proposed (most notably by Daniel Bernoulli), it is unclear if any of them are satisfactory. Our aim is to determine the most appropriate decision criterion. We will offer a theoretical consideration of the problem, and present the results of a simulation approach.

Phase retrieval for BEC in harmonic optical traps

Mr. Tomasz Szołdra
Poster 27

Ultra-cold atoms trapped in optical lattices are being intensively investigated both theoretically and experimentally. All spatial parameters of such system can easily be controlled in a laboratory. This allows one to reproduce quantum problems which are tremendous to be solved theoretically, leading to quantum simulators. However, one can directly measure only the atoms density distribution (the square modulus of the system's wave function). The phase is lost.

After removing the optical trap, after the time-of-flight, atoms distribution replicates initial momentum distribution. We use this information to recover the phase of the initial wave function. Iterative phase retrieval algorithm, widely known from diffraction imaging techniques, is employed.

We implement and test the algorithm for 2D and 3D triangular optical lattices, successfully recognising macroscopic areas of different phases of Bose systems. The recovery efficiency for different noise and imaging resolution is shown.

Exclusive Jet Production at the LHC

Miss Joanna Peszka
Poster 28

Jets are strongly collimated particle beams produced by the hadronization of quarks or gluons and are observed in the proton-proton collisions at the Large Hadron Collider. In exclusive jet production event (pp->p+jet+jet+p) both interacting protons stay intact and the final state contains two jets. According to the theoretical predictions in the region between proton and jet should be no particles. As the result of reconstruction these events some particles outside jets are observed and their properties have been measured.

Spatial and temporal resolved study of some atmospheric pressure discharges

Miss Biljana Stankov and Miss Milica Vinic
Poster 29

Atmospheric pressure discharges are interesting for many applications - material processing, textile modification, cleaning of archaeological artefacts, sterilisation of agricultural products and medical instruments, skin treatment etc. For optimisation of their applications, study of theirs spatial and temporal characteristics is very important. Namely, spatial distribution of neutrals, ions and electrons is always present in this type of sources forming different areas, so-called layers of plasma. Also, many of these discharges rapidly change their characteristics with time.

To visualise development of an atmospheric pressure discharge, short exposure time images were recorded using an iCCD camera (gated intensified charge coupled detector) coupled to an imaging spectrometer. iCCD camera can work in different modes, among others -

image and full vertical binning (FVB). Plasma images are recorded with wide open slit and with zero order of the diffraction grating of the spectrometer. After analysing gathered photographies, FVB mode allows us to record spectrum of wanted area by narrowing slit width and by changing the grating angle. Temporal evolution was performed using the signal from the current probe which triggers the camera with various time gate widths (tG) and delay times (tD).

Time-resolved images of discharge show us the beginning and duration of discharge. This is very significant because plasma volume and temperature evolves over time causing changes in line intensity. Thus, by choosing appropriate exposure time it is possible to monitor evolution of spectral lines.

From recorded spectral lines it is possible to do analytical measurement, but also to determine plasma parameters such as electron density and temperature. Here, for the electron density determination we used the measurement of the distance between allow and forbidden component of He I 447.1 nm neutral line. The plasma temperature may be estimated through the relative emission intensities of spectral lines using Boltzmann plot.

Two types of discharges were analysed. In first case, plasma is created by combining laser pulse and spark discharge. The main applications of such combined discharges are for detecting elements difficult to excite, such as carbon, chlorine, sulphur and fluorine. The main disadvantage of combined excitation is existence of a strong background induced by overlap of analytical lines with emission lines of matrix elements. By selecting proper area this problem has been overcome. Spatial distribution of present species mostly depends of temperature which is different in every layer of plasma. It means that two spectra recorded in same time but from different layers would be dissimilar, as it will be shown. Spatially resolved spectra show that limiting the recording volume improves signal to background ratio, enhances the analytical possibilities of such plasma and enable study of conditions for enhancement of analytical lines intensity. Thus, fast imaging enables choosing proper area for recording spectrum lines with good intensity and signal to noise ratio. Also, imaging of spatial distribution was used to monitor changes in the shape of plasma.

In second case, our source was microjet. The ultimate goal was to shed light on how the discharge morphology and emission intensity evolves over time.

Synthesis and physical properties of Nd6-xYxCo1.67Si3

Miss Alicja Szczepanska
Poster 30

We present the physical properties of Nd6-xYxCo1.67Si3 synthesised by arc-melting of pure elements (neodymium, yttrium, cobalt, silicon). The purity of crystallographic structure of the samples were tested by powder X-diffraction. Nd6Co1.67Si3 has been reported to crystallise in a hexagonal structure (space group P63/m) as well as the whole family of RE6Co1.67Si3 (RE=rare earths). A strong disorder of cobalt atoms in the chains of face-shared octahedral of neodymium is observed. Magnetisation measurements reveal the existence of two ferromagnetic transitions, around 35 K and 85 K. Although, this phe-

nomenon is also seen for yttrium doped compound it reveals different values. In this poster we present, discuss and compare measurements of the specific heat, heat capacity, electrical resistance and magnetic susceptibility, performed for yttrium doped Nd6-xYxCo1.67Si3.

Changes in Adriatic-Ionian thermohaline circulation

Miss Antonija Mravak and Ms. Maja Čičić
Poster 31

There are many causes that affect changes in the Adriatic-Ioninan thermohaline circulation - the movement of seawater in a pattern of flow caused by changes in density. Here we examine the influence of geostrophic current which enables water masses to enter the Mediterranean. Since different water masses have different properties, thermohaline properties will variate. Sea Surface Height (SSH) data from Aviso, between years 2012 and 2015 were used in order to determine the variations.

Uncertainties of Weibull Distribution Parameters Obtained by Monte Carlo Simulations of a Dielectric Breakdown in Thin Oxides

Ms. Biljana Mitreska
Poster 32

A dielectric breakdown in thin oxides is simulated by a Monte Carlo type of simulator based on the percolation concept. The outcomes of a series of numerical experiments, performed on samples with different size, are analysed in order to estimate the statistical spread of the Weibull slope and the mean critical density of defects. Two widely used models are tested, the lattice model with nearest neighbours' connections and the randomly distributed sphere model. An attempt is done to estimate the confidence intervals of the distribution parameters and to determine the minimum/optimal sample size which should be used for a quantitative comparison of of computational results with experimental ones.

Technological processes in the manufacturing of electronic devices

Mr. Octavian-Gabriel Simionescu
Poster 33

With the evolution of the world, humanity has become more and more dependent on their own creations. Electronic devices can now be found literally everywhere. So, we need to discuss the processes in creating such a device, more specifically we will be talking about the manufacturing of microprocessors.

Silicon is a key ingredient in electronics, due to its properties (good thermal conductivity, non-toxicity, excellent passivation by SiO2), so we will be using a silicon based wafer. By Plasma Enhanced Chemical Vapour Deposition (PECVD) we deposit SiO2 onto the silicon wafer and then with the photolithographic processes that include the etching process (RIE and DRIE) we reach our final product. Images were taken with a Scanning Electron Microscope (SEM), in between all processes and of the final product.

Feed-forward correction for amplification

Dr. Ross Donaldson
Poster 34

Quantum communications, which allows for secure sharing of digital signatures and key exchange, is a promising field for creating secure communications in a world with eavesdroppers and malicious attacks. One current issue is the limitation in transmission distance of the protocols. This is because of the low mean photon number used when implementing in experiments. Conventional communications systems can simply use optical amplifiers (at the cost of adding noise) to overcome losses, and allow inter-continental distances to be covered. Added noise is not a problem in conventional systems however it is an issue for our quantum signals, as noise will swamp any quantum state properties of the original signal.

We proposed a state comparison measurement which allows for non-deterministic noiseless amplification of low intensity coherent states. Initial experiments showed large gain, high fidelity and success rates. To improve the success rate further, a feed-forward mechanism is proposed to correct for mistakes during the initial state comparison. This device could be used as a coherent state receiver and repeater in quantum communications.

Entropy of Interval in Two-dimensional Conformal Field Theory

Mr. Paweł Grabiński
Poster 35

Conformal field theories are widely explored in many branches oh theoretical physics. We consider two-dimensional conformal quantum theory and in its frame we derive entropy of interval. Then we compare it with results of Ising model for a spin chain. As a result we find correspondence between continuous system of the interval and discrete system of spins. The result is one of many examples for application of two-dimensional conformal field theory in condensed matter.

Optically Induced Dielectric Changes in Organic Semiconductors and their Non-Adherence to Classical Plasma Theory

Mr. James Kneller
Poster 36

In organic electronics on can optically induce dielectric changes. Current Classical Plasma Theory was derived for high mobility silicon and fails to account for the dielectric changes observed in low mobility organic semiconductors. This poster explains the basics of organic electronics, how one can measure dielectric changes, both experimentally and as predicted by theory and what causes the differences between them.

Reducing effect of RV scatter around active M Dwarfs

Mr. Erik Johnson
Poster 37

The most abundant type of star in the galaxy is the M dwarf. These low-mass stars are, at first glance, ideal for planet surveys, such as CARMENES, attempting to detect terestrial-like planets as the planet will have a proportionally larger radial-velocity impact on its host as compared to a more massive Sun-like star. However,many M dwarfs are also extremely active with frequent flaring events and strong emission lines of the sodium doublet, H and the calcium Infrared triplet which complicate the acquisition of the high accuracy [1 m/s] radial-velocity measurements required for detection of an exoEarth. Therefore we have begun observations of CN Leo, a particularly active M Dwarf, with the high accuracy CARMENES spectrometer at the Calar-Alto Observatory in order to determine any correlation between these activity lines and the observed 10 m/s activity-induced radial-velocity scatter of CN Leo. After conducting 10 observations a correlation seems to be emerging but additional observations are required in order for this to be considered statistically significant.

Active Galactic Nuclei: Are they responsible for the IceCube neutrino detections?

Mr. Kunal Deoskar
Poster 38

An Active Galactic Nucleus (AGN) is a compact central region of a galaxy that has extremely high luminosity that even outshines the combined luminosity of the rest of the galaxy. The emissions from these galaxies are observed to be bright at all wavelengths. Radio-loud AGN have relativistic outflows of matter, perpendicular to the disk of the host galaxy. In a subclass of AGN, called blazars, these jets point at Earth.It has been theoretically predicted that AGNs can emit neutrinos. Neutrinos can travel large cosmic distances greatly undisturbed owning to their small size, extremely low mass and charge neutrality. Moreover, neutrinos cannot be detected directly, because they do not ionise the materials they are passing through. In the IceCube detector, they are indirectly detected by the Cherenkov radiation emitted when an incoming neutrino creates an electron (or muon) in the ice. An analysis of this radiation can help us determine the general direction for the incoming neutrino 'event' and also the energy of the event. We investigated if blazars from the Fermi 3LAC catalogue within the error bars of certain neutrino events observed by the IceCube Neutrino Observatory could explain the respective neutrino counts.

There are certain estimated atmospheric processes that can amount to neutrino production in the atmosphere. These are however lower in energy. Hence to account for neutrinos of mainly cosmic origin, neutrino events with energies greater than 100 TeV were considered in our investigation and the observations were limited to the X-ray and -ray ranges. The sources (AGNs) that were considered for each event were the Fermi 3LAC sources which were within the error boxes of the respective neutrino events.The X-ray data was used from Swift/XRT, ROSAT and INTEGRAL observations. The -ray data was used from the Fermi/LAT 3FGL catalogue. The data was taken over a period of 998 days. Log parabolic model was used to understand the behaviour of blazars and to fit the data. Fitting for the

observations was done in the ISIS software package developed by the MIT. Chi-sqr analysis was used to obtain the best fit for observational data of each blazar. The parameters obtained by the best fit were used to calculate the neutrino counts from the respective blazars. The neutrino counts were tallied with the neutrino observations published by the IceCube Neutrino Observatory.

94 AGNs were analysed from 7 neutrino events. It was observed that most of the sources gave very low neutrino count. However, the combined count from all the blazars in each event was significant.

Preliminary results show that AGNs can explain the neutrino counts in certain events. This is, however, not true for all the events considered as AGNs for certain events did not have good observational data and thus those sources couldn't be trusted.

The Multi-Stage Theory of Carcinogenesis in the Genomic Era

Miss Judit Börcsök
Poster 39

Today the individual fields of science do not terminate sharply from each other, rather support each other. We can use their combined knowledge and methods for tackling a wide variety of problems, for instance carcinogenesis, despite of its complexity, may be explained by applying the tools of biophysics, evolutionary biology and mathematics. Cancer is the breakdown of controls over cellular birth and death due to several key mutations. Through the examination of cancer, we shed light to the mechanisms and agents conducing and protecting against cancer formation, which may be useful in prevention and elaboration of more efficient treatment strategies. In my poster I will briefly present my bachelor's thesis in which I made an attempt at recapitulation the development of the multi-stage theory of carcinogenesis according to the most important articles over the past century. From the first experimental observations to the analysis of age-specific incidence patterns we get to know the first quantitative theories. Armitage and Doll's article, published in 1954, made a seminal contribution recognising the role of rate-limiting mutations, which still stands its ground. Subsequent models have built on this concept, whereas through clonal expansion and the information gained from genome sequencing we get to the up-to-date mathematical models which have been supplemented by evolutionary parameters considering the impact of passenger mutations. These models make it possible, arm-in-arm with genomic data, to estimate certain parameters, for instance selective advantage of a driver, which may lead to better understanding of cancer progression.

The amount of energy released in thunderstorms

Miss Tatjana Lukarić
Poster 40

A thunderstorm, also known as an electrical storm, is a storm characterised by the presence of lightning and its acoustic effect on the Earth's atmosphere, known as thunder. They are usually accompanied by strong winds, heavy rain, and sometimes snow. The amount of energy released in thunderstorms mostly depends on quantity of water. If the quantity of

water that is condensed in and subsequently precipitated from a cloud is known, then the total energy of a thunderstorm can be calculated. In a typical thunderstorm, approximately 5×108 kg of water vapour are lifted, and the amount of energy released when this condenses is 1015 joules. This is more energy than that released during the atomic bomb blast at Hiroshima, Japan in 1945.

Molybdenum bronzes: synthesis, structure and physical properties

Miss Natalia Majewska and Miss Aleksandra Bojar

Poster 41

A new transition metal molybdenum bronzes have received much attention due to their electronic and structural properties. These have found applications as electrode materials in solid state secondary lithium batteries and electrochemical sensors. By solid state synthesis, the series of samples was obtained for compounds of a formula MxMoO3 (for M = Cu, Bi). Crystallographic parameters have been determined by X-ray diffraction (XRD) analysis. The results are reported for a set of powder X-ray diffraction patterns for the product materials corresponding to various initial metal contents. Measurements of electrical resistivity and specific heat have been also carried out. On our poster we will discuss the synthesis methods, our results and future perspectives.

Automation of parts in a XRF spectrometer with tri-axial geometry

Mr Anthonio Barroso

Poster 41

This work has the main purpose of automate parts of a XRF spectrometer with a secondary target in a triaxial geometry existing in LIBPhys, DF, FCT-UNL.

The existent XRF spectrometer only allows users to have one filter (silver (Ag) 25 Ãm), one secondary target (molybdenum (Mo)) and one sample. With this setup, users should turn off the X-ray tube in each measurement, decreasing the lifetime of it, because of the effects of ramp up and ramp down of its applied current. Another problem on it is the number of times that users should change samples and be exposed to radiation. The restriction of having only one secondary target and one filter, doesn't allow changing them without turning off the system.

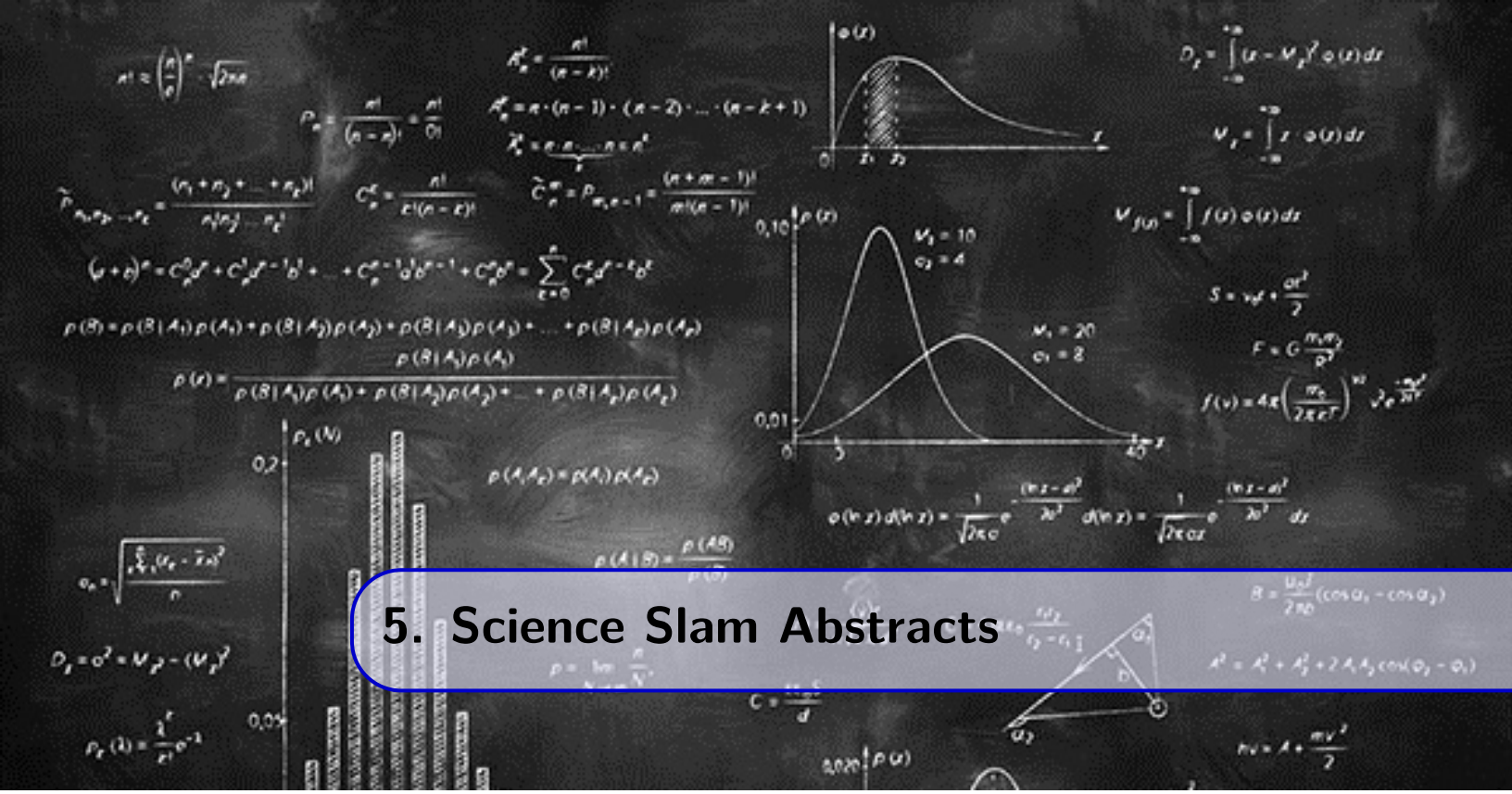
COMET AG, in (1), defines continuous operation as an operation that switches ON/OFF maximum 15 times per day (1). It also advises to slow ramp-up (> 1 s of high voltage when switching ON the tube) and ramp-down (> 300 ms of high voltage when switching OFF the tube) (1).

This new system allows users to have up to six samples on a cylindrical rotatory platform, moved by a stepper motor and controlled by an Arduino, up to four secondary targets (Nickel (Ni), Mo, Tantalum (Ta) and Bismuth (Bi)) in a sliding platform moved by a linear actuator and up to five filter brackets (No Filter, Aluminium (Al) 100 Ãm, Aluminium-Titanium (AlTi), Aluminium-Titanium-Copper (AlTiCu) and Ag).

As it is possible to have up to six samples, four secondary targets and five filter brackets users do not need to turn off the x-ray tube, increasing its lifetime. As users do not need to change samples so many times, their exposition to radiation is minimised. The access to different targets allows better lower limits of detection values throughout an extended atomic number region. The use of filters allows a more efficient monochromatization of the beam, which is of the utmost importance for several applications.

References

1. Technical Services Business Unit X-ray, COMET AG, Life time of HP-Tubes, Service-Bulletin 2012/003



5. Science Slam Abstracts

The Barcode conspiracy: a Physicist's point of view

Mr. Robert Rauter

The Barcode conspiracy is quite a big deal in Germany - but what is it really about. Time for a Physicist to really address this matter - in a fun but still scientific way.

Quantum Mechanics and Steam Engines

Mr. Wouter Verstraelen

The extensive study of phenomenological thermodynamics began in the early 19th century by the work of Joule, Carnot etc. for the practical reasons of optimising steam engines. It took quite a bit more time before its microscopic counterpart, the statistical mechanics of Boltzmann and Gibbs became widely accepted. Although some rather philosophical questions about the arrow of time etc. remain open, this statistical mechanics has been successfully unified with quantum mechanics by now. Some foundations of this were realised by Von Neumann, but the last decade a renewed interest has arisen in the thermalisation of many-body quantum systems because of the experimental access to quantum systems using cold gasses. We will take a look at how work can be extracted from integrable quantum systems, described by a Generalised Gibbs Ensemble, a concept introduced by E.T. Jaynes in 1957. Thus, we will take a look at the questions posed by Carnot et al. from a modern Quantum Statistical perspective.

Quantum model of space and its implications

Mr. Vlad-Cristian Lupu

The highest aim in theoretical physics, combining the quantum and relativity theories in a new approach: a qualitative model of a quantum space, in which some physical phenomenons are explained by the properties of a quantum space and its interaction with

matter. It is based on the idea of a quantum of space and the way it behaves when being occupied by matter, its interaction with surrounding quantum space locations and implications on the behaviour of time. The model offers a intuitive explanation of gravitation, quantum inseparability and some other relativistic effects.

What would Aristotle say?

Ms. Ana Milinović

Throughout history, it is possible to see scientific progress alongside big societal changes which allowed for them to happen. But can we say when physics started? What is physics? And what would Aristotle say to our modern scientific method?

These are some of the questions I will discuss in my slam lecture. They are without a clear answer so what will be covered is a couple of possible answers and their arguments, leaving you to think for yourself.

We've got them!

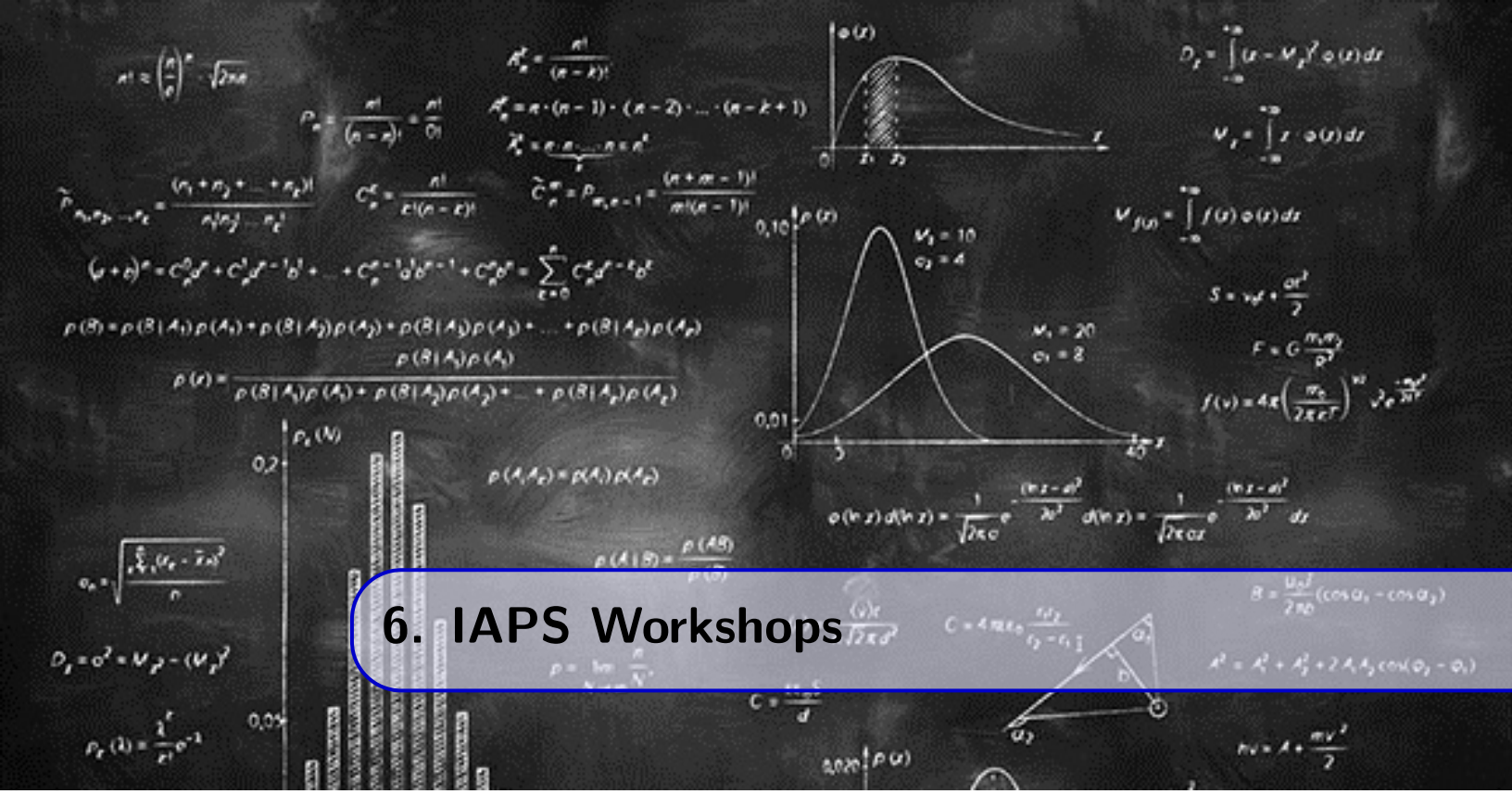
Ms. Stina Scheer

On Feb 11th there was a big party at my institute. The reason for that was the first detection of gravitational waves. I like to explain to you how this was actually done and why this is such a big deal. You will also learn what spacetime and jello have in common.

On children, bathtubes and Laser

Mr. Andre Sobotta

How to explain the LASER principle to non-scientists in a more or less accurate way...



6. IAPS Workshops

Ambassador programme

Henrik Siboni, IAPS Executive Committee
Hall B1
16:00-16:45

Are you tired of your university not being active in IAPS? Do something about it as a Student Ambassador! As an ambassador of IAPS, you are part of an international team working to improve the lives of physics students on a global plane by acting locally. Work areas can include putting up poster, telling your colleagues, setting up member committees and more - it's up to you. You will also have easy access to the PR volunteer with which you can discuss your progress. In this workshop you will become generation 0 for all the future IAPS ambassadors.

IAPS Contact Network

Sabrina Gronow, IAPS Executive Committee
Hall B1
16:45-17:30

To help each student interested in an exchange or starting at a new university, IAPS is establishing a Contact Network. The goal is to have at least one student at each university in it, willing to help others with information on the university, city or country. At the same time it's always nice to already know a person in the city you move to, e.g. to find good places to hang out.

In this workshop we will explore the options of establishing such a network. What universities are within IAPS reach? What universities should be targeted? How and which data should be exchanged? These are the types of questions to be answered.

Organise events with IAPS

Gerhard Dorn, PLANCKS Organising Committee 2017
Danielle Harper, NC UK
Hall B2
16:00-17:30

How to use IAPS environment to organise events - for physics students by physics students?

When cooking an event such as iaps2cern, iaps4fusion, Light of Tuscany or something else, you need several key ingredients. The base would be a good team to help build sturdy infrastructure, efficient communication and of course some time-management skills.

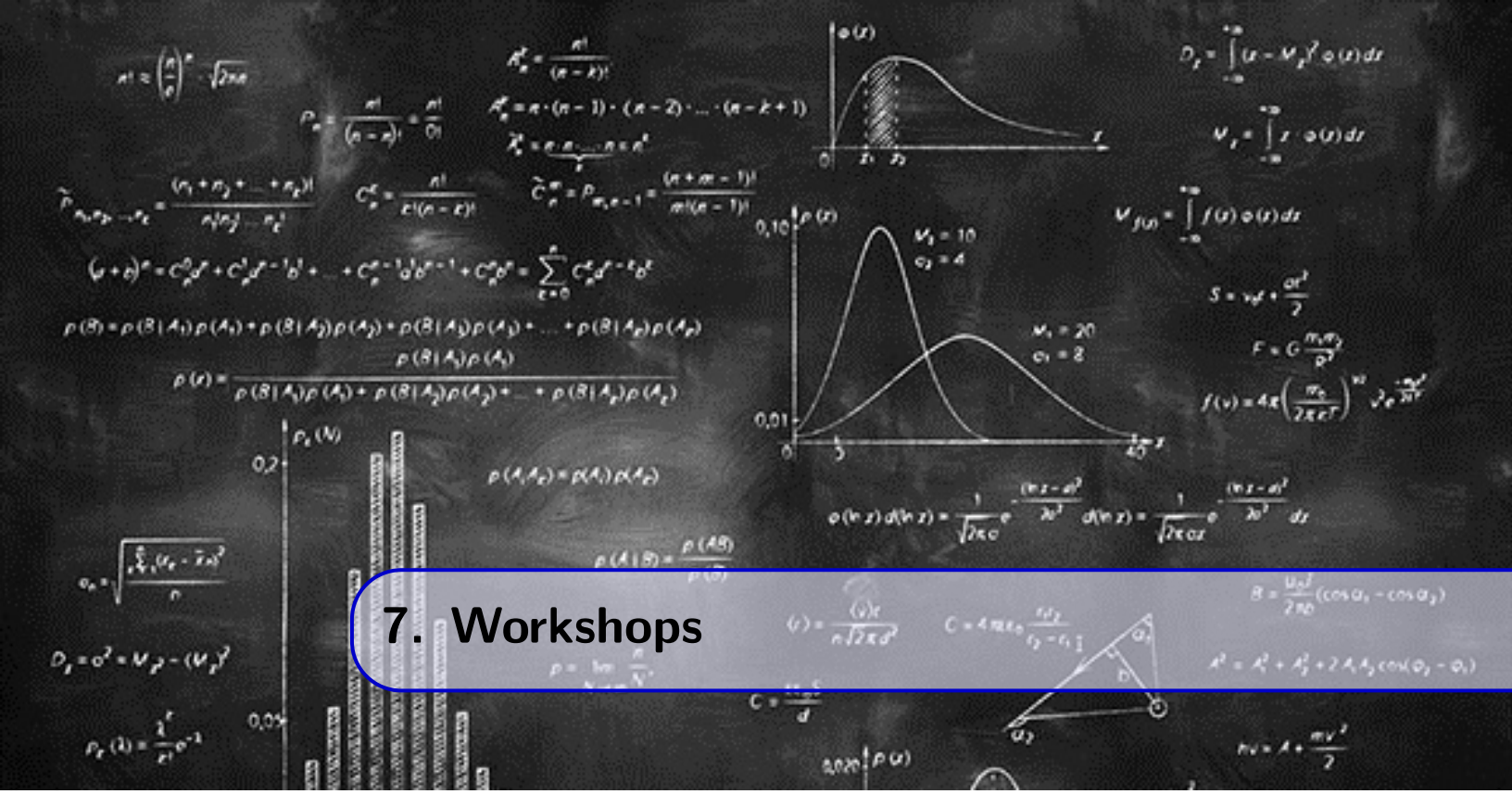
In this workshop we will discuss best IAPS recipes for events and try to devise new ones. Maybe you have already organised a local event or two and want to take things international? This workshop will also discuss scalability of events since in case of switch from national to international event, some new problem areas arise. Nothing a physics student can't handle though.

School Day

Sabrina Gronow and Ana Milinović, IAPS Executive Committee
Hall ALT
16:00-17:30

Last year IAPS, with its members, decided to organise an outreach event for the International Year of Light. Members came together and so the School Day took place. As last year, the event should take place on November 10th (2016), which coincides with UNESCO World Science Day for Peace and Development.

Following the AGMs' decision on the topic for 2016, this workshop will focus on logistics and science of the event. On an event of this scale, it is important to coordinate so together we will try figure out the best way to do just that. We will go through a couple of event templates and see which type can be implemented in your university. After you decide how you want to present, it is also important to discuss what you want to present so in the last part of this workshop we will discuss some experiment and showcase ideas.



7. Workshops

Gateway 2 Science: A Database for Academia

Dr. David Jacome, St. John's University
Hall B1
11:30-13:00

Our project involves connecting all levels of students to science. Members gain the opportunity to interact with others without having to leave the comfort of their schools or home country. Through the Portal, a door is automatically opened linking students to projects worldwide and expanding their knowledge on interdisciplinary science subjects each day on newer technologies in different countries. Within the database, we will have three role categories: Student, Instructor, and Professional. The student database will consist of about 1 million profiles from science students all over the world. Every student profile will have a picture, marketplace, research work, resumes, and previous experiences. Students will be able to transfer information from LinkedIn directly onto our platform. Instructors will have a similar database as students, but will be able to search for students in an effort to recruit them to projects, or research. The Professional role will allow schools to connect on our platform to plan events, post jobs, recruit students or instructors to there schools, and much more. We went from calling the idea Science Connection to Physics Connection to Physics Portals, and finally have a name we can all like – Gateway 2 Science: It's a New Way to Stay Connected!

Let's talk science

Dr. Edward Duca, University of Malta
Hall B2
11:30-13:00

Coming soon.

#FilKcinaMaTonna: An introduction to Maltese cuisine

Ms Antonella Cutajar and Ms Anita Farrugia, University of Malta

Quadrangle

11:30-13:00

Satisfied your hunger for knowledge? Now it's time to state your hunger for hearty and authentic Maltese food! Join Antonella and Anita as they take you through delicious world of Maltese cuisine. Dust off your aprons and/or lab coats and get ready to get your hands messy.

Warning: not suitable for the unadventurous or those with high blood pressure.

University of Malta
Msida Campus Map

Reception · Assembly Point · Study Area · Bus Stops · Food Outlet/Café · Post Office · CP Car Park · Electric Car Charging Point

FACULTIES AND DEPARTMENTS

18 **FACULTY OF ARTS**
18 Anthropological Sciences
58 Classics & Archaeology
18 English
18 French
18 Geography
16 German
18 History
18 History of Art
18 International Relations
18 Italian
18 Maltese
58 Oriental Studies
18 Philosophy
18 Sociology
18 Spanish & Latin American Studies
18 Translation, Terminology & Interpreting Studies

10 **FACULTY FOR THE BUILT ENVIRONMENT**
10 Architecture & Urban Design
10 Civil & Structural Engineering
10 Conservation and Built Heritage
10 Construction & Property Management
10 Environmental Design
10 Spatial Planning & Infrastructure
10, 45 Visual Arts

FACULTY OF DENTAL SURGERY (at Mater Dei Hospital)
32 Dental Surgery

15 **FACULTY OF ECONOMICS, MANAGEMENT & ACCOUNTANCY (FEMA)**
15 Accountancy
15 Banking & Finance
15 Economics
15 Management
15 Marketing
15 Public Policy

18 **FACULTY OF EDUCATION**
18 Arts & Languages in Education
18 Early Childhood & Primary Education
18 Education Studies
18 Mathematics, Science & Technical Education
18 Inclusion & Access to Learning Unit

31 **FACULTY OF ENGINEERING**
31 Electronic Systems Engineering
31 Industrial & Manufacturing Engineering
31 Industrial Electrical Power Conversion
31 Mechanical Engineering
31 Metallurgy & Materials Engineering
31 Systems & Control Engineering

FACULTY OF HEALTH SCIENCES (at Mater Dei Hospital)
Applied Biomedical Science (at Mater Dei Hospital)
Communication Therapy (at Mater Dei Hospital)
Food Studies & Environmental Health (at Mater Dei Hospital)
Health Services Management (at Mater Dei Hospital)
Medical Physics (at Mater Dei Hospital)
Midwifery (at Mater Dei Hospital)
Nursing (at Mater Dei Hospital)
Occupational Health (at Mater Dei Hospital)
Physiotherapy (at Mater Dei Hospital)
Podiatry (at Mater Dei Hospital)
Radiography (at Mater Dei Hospital)

35 **FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (ICT)**
35 Communications & Computer Engineering
35 Computer Information Systems
35 Computer Science
35 Intelligent Computer Systems
35 Microelectronics & Nanoelectronics

14 **FACULTY OF LAWS**
14 Civil Law
14 Commercial Law
14 Criminal Law
14 Environmental & Resources Law
14 European & Comparative Law
14 International Law
14 Legal History & Methodology
14 Media, Communications & Technology Law
14 Public Law

22 **FACULTY OF MEDIA & KNOWLEDGE SCIENCES (MaKS)**
22 Cognitive Science
22 Corporate Communication
22 Digital Arts
22 Information Policy & Governance
22 Library Information & Archive Sciences
22 Media & Communications

32 **FACULTY OF MEDICINE & SURGERY** (Msida Campus & Mater Dei Hospital)
32 Anatomy
30 Clinical Pharmacology & Therapeutics
Family Medicine (at Mater Dei Hospital)
Medicine (at Mater Dei Hospital)
Obstetrics & Gynaecology (at Mater Dei Hospital)
Paediatrics (at Mater Dei Hospital)
Pathology (at Mater Dei Hospital)
32 Pharmacy
33 Physiology & Biochemistry
Psychiatry (at Mater Dei Hospital)
Public Health (at Mater Dei Hospital)
Surgery (at Mater Dei Hospital)

29 **FACULTY OF SCIENCE**
33 Biology
30 Chemistry
29 Mathematics
29 Physics
29 Statistics & Operations Research
30 Metamaterials Unit
30 Physical Oceanography Unit

15 **FACULTY FOR SOCIAL WELLBEING**
37 Counselling
20 Criminology
18 Family Studies
14 Gender Studies
14 Gerontology
18 Psychology
15 Social Policy & Social Work
15 Youth & Community Studies
14 Disability Studies Unit

14 **FACULTY OF THEOLOGY**
14 Church History, Patrology & Paleo-Christian Archaeology
14 Fundamental & Dogmatic Theology
14 Moral Theology
14 Pastoral Theology, Liturgy & Canon Law
18 Philosophy
14 Sacred Scripture, Hebrew & Greek

INSTITUTES

18 Institute of Anglo-Italian Studies
10 International Institute for Baroque Studies
37 Institute for Climate Change & Sustainable Development
11 Confucius Institute
3 Institute of Digital Games
38 Institute of Earth Systems
25 Edward de Bono Institute for the Design & Development of Thinking
4 Institute for European Studies
12 Islands & Small States Institute
56 Institute of Linguistics
12 Institute for Maltese Studies
4 Mediterranean Academy of Diplomatic Studies (MEDAC)
18, 23 Mediterranean Institute
15 Institute of Public Administration & Management
64 Institute of Physical Education & Sport
29 Institute of Space Sciences and Astronomy
38 Institute for Sustainable Energy (and at M'Xlokk)
16 Institute for Tourism, Travel & Culture

CENTRES

31 Centre for Biomedical Cybernetics
18 Euro-Mediterranean Centre for Educational Research
12 Centre for English Language Proficiency
28 Centre for Entrepreneurship & Business Incubation
64 Centre for Environmental Education & Research
30 Euro-Mediterranean Centre on Insular Coastal Dynamics
15 Centre for Labour Studies
40 Centre for the Liberal Arts & Sciences
18 Centre for Literacy
18 Centre for Resilience & Socio-Emotional Health

SCHOOLS

36 **SCHOOL OF PERFORMING ARTS**
Dance Studies (in San Ġwann)
18 Music Studies
18 Theatre Studies

LECTURE HALLS

32 Anatomy Lecture Room (ALR)
19 Arts Lecture Theatre – P.P. Saydon Lecture Theatre (ALT)
30 Chemistry Lecture Room (CLR)
25 Dun Mikiel Xerri Lecture Centre (LC)
31 Engineering Lecture Theatre (ELT)
25 Lecture Theatre 1 – Erin Serracino Inglott Hall (LT1)
25 Lecture Theatre 2 – Francis Ebejer Hall (LT2)
7 M.A. Vassalli Conference Centre – Gateway Building (GW)
26 Science Lecture Theatre – John Borg Hall (SLT)
51 Sir Temi Zammit Hall (STZH) – Assembly Hall

BUILDINGS

53 Administration Building
57 Agriculture Farmhouse
58 Archaeology Centre
33 Biomedical Sciences Building
10 Built Environment Building (BEN)
44 Chapel St Thomas Moore
30 Chemistry Building (CHB)
28 Dar Ġużeppi Zahra
31 Engineering Building (EB)
27 Engineering Workshops
55 Estates & Works Building
35 Faculty of ICT Building
46 Garden's Lodge
12 Ġużè Cassar Pullicino Building
14 Humanities A (Laws, Theology)
15 Humanities B (FEMA)
34 IT Services
29 Maths & Physics Building (MP)
18 Mediterranean Institute (MDT)
7 Mikiel Anton Vassalli Conference Centre (Gateway Building)
18 Old Humanities Building (OH)
32 Pharmacy Building
59 Portacabins A
56 Portacabins B
36 Portacabins C
42 Porter's Lodge
23 Ir-Razzett tal-Ħursun – Mediterranean Institute Farmhouse
49 University House

OPEN SPACES

6 Arvid Pardo Monument
21 Arvid Pardo Study Area/Ġnien tal-Paċi fl-Ibħra
8 Climate Change Monument
48 Dun Karm Monument
9 Greek Theatre - TESPI
52 Japanese Garden/Ġnien l-Istudent
50 Mikiel Anton Vassalli Monument
50 Quadrangle (Atriju Vassalli)

FACILITIES & SERVICES

53 Academic Programmes Quality & Resources Unit (APQRU)
18 ACCESS – Disability Support Unit
53 Admissions & Records Office
39 AIMS Support Unit
54, 55 Arts Studio
18 CampusFM
53 Certification Office
44 Chaplaincy
53 Communications & Alumni Relations Office
12, 37 Counselling Services
49 Degree*Plus*
56 Early Learning Centre (ELC)
40 ERDF/ESF Projects Office
55 Estates & Works
40 EU Project Support Unit
7 Facilities Management Unit
53 Finance Office
24 Foundation Studies
54 Garden Unit
59 Health & Safety Office
53 International Admissions Office
53 International & EU Office
19 International School of Languages
34 IT Services
17 Kids Point (It-Tajra Playschool)
28 Knowledge Transfer Office
49 Kunsill Studenti Universitarji (KSU)
18 La Petite Auberge de France
53 Legal Services Office
28 Malta University Consulting (MUC)
41 MATSEC Support Unit
59 Messengers' Transport Pool
53 Office for Human Resources Management and Development
53 Office of the Pro-Rectors
53 Office of the Rector
53 Office of the Registrar
53 Office of the Secretary
2 Precincts Office
55 Printing Unit
53 Procurement Directorate
37 Project Support Unit
53 Reception Desk
53 Registry
Research & Innovation Facilities Support Unit
1 Security
18 Spanish Auberge
53 Stipends Office
7 Students' Advisory Services
53 Students' Information Management System (SIMS) Office
49 Student Organisations Offices
28 TAKEOFF Business Incubator
24 University Library
64 University Sports Facilities

ENTRANCES

1 Main Entrance (West Gate)
43 Old Main Entrance (South Gate)
67 Sports Area Entrance (East Gate)

SERVICES BY OUTSIDE ENTITIES

49 Agenda Bookshop
49 Bank of Valletta ATM
49 Canteen
49 HealthPlus
18 HSBC
7, 18 HSBC ATM
53 Maltapost
13 Nature Trust – Wied Għollieqa Environment Centre
49 Papierplus Studio

SPORTS AREA

66 5-a-Side Football Pitches
65 Changing Rooms
62 Football Pitch
61 Malta University Sports Club (MUSC)
63 Multipurpose Sports Hall
60 National Swimming Pool Complex
64 Sports Pavilion

INTERNATIONAL INSTITUTES

5 International Maritime Law Institute
4 International Ocean Institute