XII Symposium of PhD Students

Abstract Book

IFPAN, CFT, MagTop, IWC

03-04.12.2020

Spis treści

1. Quantum Physics

Thursday, 3 December·09:00–09:45
Chairperson: Jan Krzywda

1.1 Piotr Grochowski (CFT) : Breathing Mode of a Bose-Einstein Condensate Immersed in a Fermi Sea (9:00)

By analyzing breathing mode of a BEC repulsively interacting with a Fermi cloud, we further the understanding of a Bose-Fermi mixture recently realized in Innsbruck. We show that a hydrodynamic description of a domain wall between bosonic and fermionic atoms reproduces the experimental data. In order to replicate nonmonotonic behavior of the oscillation frequency, temperature effects have to be included. We find that the frequency down-shift is caused by the fermion-induced compression and rethermalization of the bosonic species as the system is quenched into the strongly interacting regime.

1.2 Rafael Santos (CFT): Self-testing quantum devices based on noncontextuality inequalities (9:10)

Violation of a noncontextuality inequality or the phenomenon referred to `quantum contextuality' is a fundamental feature of quantum theory. In this work, we derive a novel family of noncontextuality inequalities in the simplest (odd-cycle) sequential-measurement scenario capable to demonstrate Kochen-Specker contextuality. With their help, we prove that our inequalities can be used for self-testing of three-dimensional quantum state and measurements. Remarkably, the presented self-testing results rely on weaker assumptions than the ones considered in Kochen-Specker contextuality.

1.3 Filip Gampel (IFPAN): Continouos observation of a few-body quantum system (9:20)

We study the influence of frequent observation of a single or several quantum particles. To this end we introduce a model of detectors on a grid measuring position and momentum. Using the Monte Carlo wavefuntion (MCWF) method allows us to develop a framework to predict single possible trajectories of the particle(s). The statistical properties of these trajectories are studied for scenarios including various external potentials and varying measurement parameters.

2. Topological Instulators (Experiment)

Thursday, 3 December·10:00–10:45

Chairperson: Julius Serbenta

2.1 Bartłomiej Turowski (IFPAN): ARPES studies of transition metal/ topological crystalline insulator interface (10:00)

Topological insulator/magnetic material heterostructures are efficient materials for charge-spin interconversion.TCI Pb1-xSnxSe epilayers were prepared by MBE on (111) BaF2 and (001) KCl substrates. The evolution of ARPES spectra was investigated as a function of thickness of deposited Mn and Fe TMs (TM/TCI interface).Formation of Rashba splitted surface states (RSS) was detected for (111) samples. For (001) films, decrease of separation in k-space between Dirac points of the double Dirac cone was observed. The reasons of band structure modification with TM deposition will be discussed.

2.2 Ashutosh Wadge (MagTop): A Non-Magnetic semimetal TaAs2: crystal growth, transport measurement and ARPES study (10:10)

An extensive material research with extremely large magnetoresistance are interesting from the point of view of applications in various magneto-electronic devices. Recently, it was found that non-magnetic semimetal, TaAs2, exhibits non-saturated magnetoresistance of order 5, in the magnetic field range up to 9 T. We observe multi-carrier Shubnikov-De Haas SdH oscillations whose periods shows pronounced band anisotropy. The band anisotropy is shown in the preliminary results of ARPES studies of our TaAs2 crystals and the more detailed analysis is under investigation.

2.3 Jakub Polaczyński (MagTop): NEGATIVE LONGITUDINAL MAGNETORESISTANCE AND CHIRAL ANOMALY IN ELEMENTAL DIRAC SEMIMETAL “GREY” TIN (10:20)

Elemental topological Dirac semimetal – α-Sn or “grey” Sn - is a very interesting material because it can host the so-called chiral anomaly, a phenomenon known from theoretical particle physics. During my presentation I will briefly introduce the concept of chiral anomaly and how it arises in Dirac/Weyl semimetals. I will also present my magnetotransport data for MBE-grown α-Sn, showing negative longitudinal magnetoresistance, collected with magnetic field applied parallel to the current, which is an expected manifestation of chiral anomaly in electric transport.

3. Topological Insulators (Theory)

Thursday, 3 December·11:00–11:45
Chairperson: Tania Paul

3.1 Minh Nguyen Nguyen (MagTop): Topological end states in SnTe nanowires (11:00)

In condensed matter systems, Majorana bound states are exotic excitations of zero energy and these electronic states are nonlocal means that any local perturbations cannot destroy this state. Hence such systems are immune to decoherence which is one of the biggest problems faced by other quantum computation schemes and there were experimetal signatures of their presence in the InSb nanowires. In this work, we will study the possibility of having topological end states, Majorana or non-Majorana, in the SnTe nanowires.

3.2 Rajibul Islam (MagTop): Topology phase of 3D superlattices based on Hg-based chalcogenides – ab intio studies (11:10)

The research on topological materials emerges as one of the most active fields in the condensed matter physics. We have investigated the electronic topological properties of the 3D superlattice of Hg-based chalcogenide materials (HgX, X=S, Se, Te) by means of the density functional theory. The Weyl semimetal phase is found for such interfaces. Finally, we have investigated the effect of hydrostatic pressure on the topological properties

3.3 Saeed Samadi (IFPAN): One-dimensional Dirac modes in the core of a pentagonal topological crystalline insulator nanowires (11:20)

We study topological properties of IV-VI semiconductor nanowires (NWs) grown in [011] direction. The NWs have pentagonal cross-section and host five twinned boundaries which can be either cationic or anionic. We perform band structure calculations with various thicknesses. In cationic case there exists topological states at the core with their counterparts in the entire surfaces. We investigate the properties of these states, particularly how their localization pertain to the wire thickness and bulk gap energy. Moreover, we discuss the issue of topological protection against symmetry breaking.

4. GaN

Thursday, 3 December·13:50–14:45
Chairperson: Waqas Pervez

4.1 Paweł Wolny (IWC): Keeping the substrate temperature stable during GaN growth in Plasma Assisted Molecular Beam Epitaxy (PAMBE): impact of n-type doping. (13:50)

Growth of GaN based structures by PAMBE in metal rich regime is very sensitive to the substrate temperature. Growth window required for high quality structures is quite narrow and requires precise control of the growth temperature. Temperature of the substrate in PAMBE is defined by the balance of heat absorbed and lost from the substrate, usually in the form of IR radiation. In this presentation we will discuss how the heat absorption is influenced by the substrate doping levels and how this affects the substrate heater temperature settings during growth.

4.2 Mikołaj Żak (IWC): Tunnel junctions with doped InGaN quantum well for vertical integration of III-nitride optoelectronic devices (14:00)

Properties of tunnel junctions (TJs) grown by plasma-assisted molecular beam epitaxy are investigated. Examined TJs consist of InGaN quantum well (QW) sandwiched between GaN barriers. The crystal quality of TJs as a function of magnesium and silicon doping in InGaN QW is discussed. High doping leads to deterioration of surface morphology. TJs with low resistance and high crystalline quality are demonstrated. A theoretical model for calculation of tunneling currents is proposed based on Kane tunneling theory. A good agreement with the experimental data is obtained.

4.3 Pavlo Sai (IWC): Beats of ratchet current magnetooscillations in asymmetric AlGaN/GaN dual grating gate structures (14:10)

One of the most fascinating phenomena in optoelectronics is the ratchet effect. This phenomena can be observed in periodic grating gate structures (GGS) with asymmetric configuration of gate electrodes. One of the interesting questions that has not yet been discussed in the literature is the manifestation of the effects of spin-orbit (SO) interaction in the ratchet effect. Here we demonstrate that SO interaction dramatically modifies ratchet effect in the regime of the SdH oscillations, that leads to beating of the observed giant magnetooscillations of the ratchet current.

4.4 Maksum Dub (IWC): Low frequency noise and trap density in GaN/AlGaN field effect transistors (14:20)

We report experimental results on the low-frequency noise in GaN/AlGaN transistors fabricated under different conditions and evaluate different methods to extract the effective trap density using the McWhorter model. The nois measurement is a very sensitive parameter for the analisis material quality and technology of GaN/AlGaN FinFETs structures. The experimentally obtained trap densities in the investigated structures are relatively low is of the same order of magnitude as that reported in Si MOSFETs with a high-k dielectric.

5. Lasers

Thursday, 3 December·15:00–15:45
Chairperson: Juby Alphonsa Mathew

5.1 Kiran Saba (IWC): Towards realization of horizontal-to-vertical surface emitting laser diode and superluminescent diode (15:00)

Integration of 2D arrays with Vertical Cavity Surface Emitting Nitride-based Laser Diode (VCSEL) is very crucial. In this study, we propose an alternative approach which will combine the properties of both VCSEL and EEL (Edge Emitting Laser) giving insight to its possible applications and advantages over conventional light emitting laser diodes. We hope to develop compact, high quality, energy saving and environmental friendly lighting system suitable for all modern optoelectronic applications.

5.2 Mateusz Hajdel (IWC): III-nitride laser diodes with InGaN waveguides grown by plasma assisted molecular beam epitaxy (15:10)

III-nitride laser diodes (LDs) are finding applications as efficient light sources for projectors, general lighting, sensors and communication. The majority of violet LDs utilize GaN waveguides, but previous studies showed that it can be replaced with InGaN. Use of InGaN waveguides increases the confinement factor of light with active region, which is beneficial especially for LDs emitting at λ>450nm. In this talk, the influence of InGaN waveguide design on the properties of III-nitride LDs grown by PAMBE will be discussed.

5.3 Joanna Łoś (IWC): Polarized light microscopy of 5CB liquid crystal and 5CB-C60 composite (15:20)

The addition of nanodopant in an amount even smaller than 1wt% leads to significant changes in liquid crystal properties, like dielectric constant value or ionic conductivity. A polarized light microscope was used to observe textures of a pure liquid crystal and its nanocolloid doped with fullerene C60. During temperature-dependent measurements, no significant change in clearing temperature was found, whereas pressure studies revealed shifts of phase transitions (isotropic→nematic and nematic→solid) towards lower values for the doped sample.

6. Experimental Methods

Thursday, 3 December·16:00–16:45

Chairperson: Ishika Palit

6.1 Aleksandra Seweryn (IFPAN): Atomic Layer Deposition Technology as a method allowing functionalization of the implant surfaces designed for the osteoporotic patient.(16:00)

With the use of Atomic Layer Deposition (ALD) technology thin films of HfO2, ZrO2, TiO2 were characterised for their biocompatibility. The physical analysis of the films indicates uniform, amorphous structure of the films. The study of the development of bone marrow stromal cells in contact with the ALD layers indicate that all the materials could support the osteogenesis, which was confirmed by an increase in the basic markers of osteogenesis, including Runx-2. Additionally, the hafnium dioxide has anti-inflammatory properties which are particularly important after implant surgeries.

6.2 Aneta Wardak (IFPAN): The 0.55 eV deep band in high-resistivity Bridgman-grown CdMnTe studied by photoluminescence spectroscopy (16:10)

In photoluminescence (PL) spectra of several high-resistivity (10^8 Ωcm) Bridgman-grown Cd0.95Mn0.05Te crystals for nuclear detectors we have observed a deep 0.55 eV PL band. It occurs in the spectrum together with the 1.1 eV PL band, which is related to Te secondary phases. Two interpretations of the 0.55 eV PL band origin are suggested. It can be connected with the deionization of a deep acceptor, such as Cd2−, or with simultaneous transitions of an electron from CB (1.1 eV) and a hole from VB (0.55 eV). These two energies together give the band gap value for Cd0.95Mn0.05Te at 5 K.

6.3 Houri SadatRahimi Mosafer (IFPAN): X-ray diffraction study of structure of Ca10M0.5(VO4)7 (M=Co, Cu) (16:20)

Calcium orthovanadate and orthophosphate Ca3(XO4)2, X=P or V, are known to crystallize in R3c space group. We study the structural properties of two modified crystals,Ca10M0.5(VO4)7, where M=Co,Cu. The insight of the structural properties of these materials,not available until now, is therefore important for their full characterization.New materials, Ca10M0.5(VO4)7 were synthesized by solid state reaction. PXRD measurements were performed at Philips X'Pert Pro Alpha1 diffractometer. The structure refinement results allow for determination of the site occupancy preference by the Co and Cu atoms

7. Nanotechnology

Friday, 4 December·09:00–09:30
Chairperson: TBA

7.1 Sukanta Kumar Jena (IFPAN): Investigation of interfacial Dzyaloshinskii-Moriya interaction MBE grown W/Co/Pt heterostructures (9:00)

The interfacial Dzyaloshinskii-Moriya interaction (DMI) is responsible for the chiral magnetic spin structure creating like skyrmions. Here, we show that the DMI at the interface of heavy metal (Pt and W) and magnetic material (Co) with epitaxial growth of W(10A)/Co(6A)/Pt(10A) heterostructure. The interfacial DMI strength equals to 2.49 mJ/m2 has been calculated by Keff method. The strength of interfacial DMI 2.56 mJ/m2 has been calculated by density functional theory calculation and micromagnetic simulation.

7.2 Quyen Vu (IFPAN): The Driving Force for Co-translational Protein Folding is Weaker Near the Ribosome Surface due to Greater Water Ordering (9:10)

Electrostatic interactions between the ribosome and nascent chain tend to slow down co-translational protein folding, according to single-molecule experiments. An additional mechanism, however, may also be at play. Here, we test whether hydrophobic association is weakened near the ribosome. Using all-atom molecular dynamic simulations we find that inside the ribosome exit tunnel associated methane's are half as stable as compared to bulk, demonstrating that the hydrophobic effect is weakened by the presence of the ribosome.

8. Superconductors

Friday, 4 December·09:30–10:00
Chairperson: TBA

8.1 Andrzej Dąbrowski (IFPAN): Point-contact differential conductance across NbP-superconductor junctions (9:30)

Our previous research on differential conductance across NbP-superconductor junctions show potential for inducing superconductivity in NbP through proximity effect, especially with indium layers. Unfortunatelly, the junctions between NbP and superconducting layers were found to be lacking the active area, posibbly through oxidation during creation proces. We are currently aiming to minimize the junction area, and therefore maximize the active area, through a point contact measuring method. The experiments are still ongoing, and I will present current state of results.

8.2 Konrad Norowski (IFPAN): Direct measurement of hot electron diffusion in superconducting nanowire (9:40)

Near the critical value of current applied to the superconducting nanowire, switching to normal metal state can occur. Probability of this transition depends on the temperature, which makes such structures promising in low temperature thermometry. Combining this with pulse measurements in nanosecond range allows us to trace fast thermal transients in nanostructures. I'm going to present my group's work, concerning measurements of hot electron (heated above bath temperature of cryostat) diffusion in superconducting nanowire. We are first in the world to observe such fast processes!

9. Quantum Information

Friday, 4 December·10:10–10:55
Chairperson: Filip Maciejewski

9.1 Shubhayan Sarkar (CFT): Certification of quantum measurements (10:10)

Imagine that we are given a quantum device whose internal working is unknown to us and our task is to verify whether this device operates on the promised quantum state and performs the promised quantum operations on it, without opening this device, and thus destroying it. A possible way to tackle this problem is self-testing. In this presentation, I show different self-testing schemes that certify states and measurements in fully-device and semi-device independent scenarios. An important application of this work is certifying unbounded randomness.

9.2 Grzegorz Rajchel-Mieldzioć (CFT): In search for 36 entangled officers of Euler (10:20)

We investigate branch of combinatorics which proves to be useful for quantum information, specifically in search for Absolutely Maximally Entangled states of local dimension 6. This can be achieved by considering generalization of famous Euler problem. We found improvement, as well as answers to some questions posed before [Phys. Rev. A 72, 012314 (2005)].

9.3 Lorenzo Mattioli (CFT): Membership Problem in Quantum Computation (10:30)

In Quantum Computation it is natural to ask if we can arbitrarily approximate every gate of a given target subset using only gates from a given finite subset. The extreme cases are the Universality Problem, where the target subset is the whole group of Quantum Gates, and the Membership Problem, where the same is just one gate. In this talk I will show that Lie Algebras and Lie Groups Theory can help us tackle this problem, and (possibly) I will sketch a failed attempt to find an algorithm for solving it.

10. Quantum Computing

Friday, 4 December·11:10–11:40
Chairperson: Shubhayan Sarkar

10.1 Andrzej Opala (IFPAN): Reservoir computing in polariton lattice systems (11:10)

Reservoir computing is a recent and increasingly popular bio-inspired computing scheme which holds promise for efficient temporal information processing. We demonstrate the applicability and performance of reservoir computing in a general complex Ginzburg-Landau lattice model. In particular, we propose that the concept can be readily applied in exciton-polariton lattices, which are characterized by unprecedented photonic nonlinearity, opening the way to signal processing atrates of the order of 1 Tbit/s.

10.2 Jan Krzywda (IFPAN): Bucket Brigade vs Conveyor Belt in Silicon Quantum Computer (11:20)

Exploiting quantum advantage in future Silicon quantum computer, depends on the answer to the connectivity problem, caused by short-ranged exchange interaction between error corrected qubits in 2D array. Possible solution uses electron as a flying qubit, which is adiabatically transferred: a) between consecutive dots (Bucket Brigade) or b) in traveling potential (Conveyor Belt). We compare both approaches against disorder induced transfer errors and dephasing caused by experimentally relevant valley states, charge noise and phonons.

11. Thermal Methods

Friday, 4 December·14:00–14:45
Chairperson: Jakub Polaczyński

11.1 Julita Rosowska (IFPAN): The effect of Iron content on properties of ZnO nanoparticles prepared by microwave hydrothermal method (14:10)

Iron doped ZnO nanoparticles were synthesized by microwave hydrothermal method. Scanning electron microscopy, X-ray diffraction, energy-dispersive X-ray spectroscopy, photoluminescence and magnetic measurements have been carried out to determine the effect of iron content on properties of ZnO NPs. XRD studies revealed presence of ZnFe2O4 foreign phase in NPs for iron doping concentrations above 5% placing the solubility limit of Fe in ZnO NPs near this value. According to magnetic mesurements, ZnO:Fe nanoparticles show superparamagnetic behavior.

11.3 Monika Ozga (IFPAN): Ultra-fast growth of copper oxide (II) thin films using hydrothermal method (14:20)

Extremely fast growth method of CuO thin films using a modified hydrothermal method has been developed. The process takes place in an open system, at a low temperature (below 100 °C) and in a very short time (in the range of 6 min–38 s) in an open system. The growth technology does not require the use of toxic precursors or sophisticated equipment. The method developed makes it possible to control the thickness of the films over a wide range. The impact of individual parameters: pH, heating power, process duration and Cu(II) concentration, on layer thickness is discussed.

12. Exotic Materials

Friday, 4 December·15:00–15:45
Chairperson: TBA

12.1 Katarzyna Małgorzata Kosyl (IFPAN): A new insight into a structural disorder in Ca3RE2(BO3)4:A single crystal XRD study (15:00)

The characteristic feature of Ca3RE2(BO3)4 structure (RE = a rare earth element; space group Pnma) is sharing three cationic sites by A and RE atoms, surrounded by 8-9 oxygen atoms. Between as-created irregular polyhedra, three boron sites are present, in the centres of triangles formed by three neighbouring oxygen ions. In this study, a new insight into disorder of the Ca3RE2(BO3)4 materials is proposed, on the basis of single-crystal XRD experiments. Applying appropriate modifications to the structure description allows to achieve much more reasonable atomic displacement parameters.

12.2 Miriam Karpińska (IFPAN): Energy transfer in the (PEA)2PbI4/WS2 heterostructure (15:10)

Layered two dimensional materials have become widely investigated since the discovery of graphene in 2004. The possibility to tune their properties by selection of specific materials or applying external fields is one of the greatest advantages of such structures. Here we show the proof of energy transfer from 2d perovskite - PEA2PbI4 to transition metal dichalcogenide (TMD) - WS2 in a heterostructure encapsulated by hexagonal boron nitride. This result shows promising possibilities for the novel optoelectronic devices based on the heterostructures of low dimensional perovskites and TMDs.

12.3 Magdalena Duda (IFPAN): Core/shell/shell nanoparticles doped with Nd3 + and Tm3+ ions for generation of reactive oxygen species (15:20)

Photodynamic therapy take advantage of an energy transfer between an up-converting nanoparticles (UCNP) and the photosensitizer, that generates reactive oxygen species (ROS). UCNPs are usually sensitized by Yb3+ ions that absorb around 980nm. Absorption of Yb3+ ions overlaps with absorption of water, which decreases the penetration depth.To address this issue, the synthesis of core/shell/shell UCNPs doped with Nd3+, Yb3+ and Tm3+ ions was carried out. The architecture was optimized to assure efficient upconversion under 808nm excitation and efficient ROS generation due to Nd3+ and Tm3+ ions.

13. Astrophysics

Friday, 4 December·16:00–16:45

Chairperson: TBA

13.1 Ishika Palit (CFT): Clumpy wind accretion onto Cygnus X-1 (16:00)

Accretion disks in High mass X-ray binaries (HMXB's) are mostly fed by the stellar wind from their companion star. These winds also affect the observed X-ray spectra arising from the hot flow close to the black hole. I will talk about my recent work on 2D numerical modeling, replicating such focused, clumpy wind from the binary companion fed for accretion onto the black hole. We modeled an inviscid, non-magnetized, accretion flow with a low angular momentum profile and a time dependent outer boundary conditions.

13.2 Julius Serbenta (CFT): New framework for geometric optics in general relativity: static spherically symmetric spacetimes (16:10)

In general relativity propagation of light is affected by gravity through the geometry of spacetime. Well known effects include deflection of light, Shapiro delays and gravitational redshift. Furthemore, motion of the observer and the emitter also influence the observation through aberration, time dilation and Shklovsky effect. I will show that all these contributions can be described in a unified way in terms of geodesic bilocal operators. I will explain how to evaluate them analytically for a static spherically symmetric spacetime.

13.3 Michele Grasso (CFT): Light propagation in Numerical Relativity with BiGONLight (16:20)

The improvement in the astronomical data quality has pushed for a better modelling and prediction of cosmological observables. In this scenario, numerical simulations have covered a crucial role to test models and compare theoretical predictions with observations. During my talk, I will present a new numerical tool to study light propagation in cosmological simulations called \texttt{BiGONLIght}. The mathematical machinery is based on the covariant formulation of the geometric optics using the bilocal geodesic operators (BGO) recently proposed in [PRD, 99(6), 064038].

Schedule

Thursday

09:00	**Opening**		Quantum Physics	Krzywda
09:05	1.1	Grochowski		
	1.2	Santos		
	1.3	Gampel		
09:35	Q&A Topic 1			
09:50	"Coffee" break 1			
10:00	2.1	Turowski	Topological Experiment	Serbenta
	2.2	Wadge		
	2.3	Polaczyński		
10:30	Q&A Topic 2			
10:45	"Coffee" break 2			
11:00	3.1	Nguyen	Topological Theory	Paul
	3.2	Islam		
	3.3	Samadi		
11:30	Q&A Topic 3			
11:45	"Lunch" Break			
13:50	4.1	Wolny	GaN	Pervez
	4.2	Żak		
	4.3	Sai		
	4.4	Dub		
14:30	Q&A Topic 4			
14:45	"Coffee" break 3			
15:00	5.1	Saba	Lasers	Mathew
	5.2	Hajdel		
	5.3	Łoś		
15:30	Q&A Topic 5			
15:45	"Coffee" break 4			
16:00	6.1	Seweryn	Experimental Methods	Palit
	6.2	Wardak		
	6.3	Rahimi Mosafer		
16:30	Q&A Topic 6			
16:45	"Coffee" break 5			
17:00	Students Meeting			
18:00	Games and fun			

Firday

09:00	7.1	Jena	Nanotechnology	Wołkanowicz
	7.2	Vu		
09:20	Q&A Topic 7			
09:30	8.1	Dąbrowski	Superconductors	
	8.2	Norowski		
09:50	Q&A Topic 8			
10:00	"Coffee" break 6			
10:10	9.1	Shubhayan	Quantum Infromation	Maciejewski
	9.2	Rajchel-Mieldzioć		
	9.3	Mattioli		
10:40	Q&A Topic 9			
10:55	"Coffee" break 7			
11:10	10.1	Opala	Quantum Computing	Sarkar
	10.2	Krzywda		
11:30	Q&A Topic 10			
11:40	Special Agent (TU Delft) *Diamonds are forever, so live and let the qubit die*			Dr No
12:00	Q&A Guest			
	"Lunch" Break			
14:10	11.1	Rosowska	Thermal Methods	Polaczyński
	11.2	Ozga		
14:30	Q&A Topic 11			
14:45	"Coffee" break 8			
15:00	12.1	Kosyl	Exotic Materials	?
	12.2	Karpińska		
	12.3	Duda		
15:30	Q&A Topic 12			
15:45	"Coffee" break 9			
16:00	13.1	Palit	Astrophysics	?
	13.2	Serbenta		
	13.3	Grasso		
16:30	Q&A Topic 13			
17:00	**Closing**			