CIFAR Quantum Materials Summer School 2013

Modern Techniques for
Probing, Understanding and Applying Quantum Materials

May 5-8, 2013, Vancouver

CIFAR

CIFAR Quantum Material Summer School (2013) Schedule

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locations:

- **Reception: Coast Plaza hotel, 35th Floor, Shoreline Suite**
- **Lectures: Nelson/Denman Room**
- **Breakfast/Lunch: Comox Room**
- **Poster Session: Conference Foyer outside the Nelson/Denman**
- **Group Dinner (Banquet): Banana Leaf Malaysian Cuisine, 1043 Davie St, Vancouver BC**

Speaker Abstracts and Biographies

Marcel Franz

University of British Columbia

More is different: The magic of quantum materials
Monday 8:30-9:30

In this talk I will start with a brief overview of the history of the CIfAR Quantum Materials Program. This will be followed by some remarks illustrating the importance and the allure of quantum materials ranging from high-temperature cuprate superconductors to topological insulators. Finally, as an example, I will discuss the emergence of Majorana fermions, exotic particles conjectured more that 70 years ago in the high-energy physics context, but never before seen, in a solid state device combining several different quantum materials.

Biography: Marcel Franz studied physics as an undergraduate at the Comenius University in Bratislava, Czechoslovakia, and received his Ph.D. from the University of Rochester in 1994. After postdoctoral appointments at McMaster and Johns Hopkins Universities, he was appointed Assistant Professor (2000), and later Associate Professor (2006) at the University of British Columbia. He received the A. P. Sloan Fellowship (2004), and become a member of the Canadian Institute for Advanced Research (2003). His main research interests include superconductivity, topological states of quantum matter, and all things unusual. He also likes to spend time at the Aspen Center for Physics and the Kavli Institute for Theoretical Physics (KITP) in Santa Barbara.

Mona Berciu

University of British Columbia

A brief introduction to polarons and bipolarons
Monday 9:30-10:30

A charge carrier interacts with all of its crystal's elementary excitations, be they phonons (lattice vibrations), magnons and orbitons (in magnetically and/or orbitally ordered systems), and particle-hole excitations including plasmons, excitons, etc. The result is a dressed quasiparticle, also known as a polaron, dragging along a cloud of such possible excitations that are continuously absorbed and re-emitted. This leads to a significant renormalization of the properties of the quasiparticle compared to those of the bare carrier, while exchange of excitations between the clouds of two quasiparticles can also drastically alter their interactions. Understanding the properties of these polarons and their influence on the physical properties of the host material is one of the main challenges in condensed matter physics. In this short lecture I will introduce three simple models of polarons and bipolarons (lattice, magnetic and electronic) and contrast some of the similarities and differences between their behaviour.

Biography: Mona Berciu received her B.Sc. in Physics from University of Bucharest, Romania. She did her M.Sc. and Ph.D. at University of Toronto, working on strongly-correlated systems (high temperature superconductors). This was followed by a two year postdoctoral appointment at Princeton University, where she worked on dilute magnetic semiconductors. She has been at University of British Columbia since 2002, and has worked on a variety of topics, of which the most proeminent, recently, is the study of polarons.

Sarah Burke
University of British Columbia

Scanning Probe Microscopy techniques, and their application to carbon-based materials
Monday 10:45-11:45

The family of Scanning Probe Microscopy (SPM) techniques, including Scanning Tunnelling Microscopy (STM) and numerous modes of Atomic Force Microscopy (AFM) operation, allow access to structural information and properties of materials on the nanoscale. Carbon-based materials, from organic molecules through nanotubes and graphene, have interesting electronic properties on the nanoscale that are readily probed by SPM techniques and that are of interest for current and future technological applications. I will introduce STM and high-resolution AFM methods, specifically discussing their application to carbon-based materials and some of the special considerations and results that have emerged from such measurements.

Biography: Prof. Burke's research group uses scanning probe microscopy tools to characterize materials at the nanoscale. A major effort in her group is in understanding the connection between structure and electronic properties on the atomic scale, with a specific interest in carbon-based materials such as organic electronic and photovoltaic materials as well as graphene. She has published 23 papers and given more than a dozen invited talks and seminars on applying scanning probe techniques to a wide variety of materials systems.

Andrea Damascelli
University of British Columbia

Probing the Electronic Structure of Complex Systems by State-of-the-Art ARPES
Monday 12:45-13:45

I will briefly review the fundamentals of angle-resolved photoemission spectroscopy (ARPES), and present some illustrative results with the emphasis on superconducting ruthenates and cuprates, as well as large spin-orbit coupling materials [1,2]. I will in particular show how ARPES can probe the momentum-dependent electronic structure of solids, providing detailed information on band dispersion, Fermi surface, superconducting gap, spin-orbital entanglement, and the strength and nature of many-body correlations; this defines the one-electron excitation spectrum and, in turn, the macroscopic physical properties.

[1] A. Damascelli, Probing the Electronic Structure of Complex Systems by State-of-the-Art ARPES, Physica Scripta T109, 61 (2004).
[2] R. Comin and A. Damascelli, ARPES: A probe of electronic correlations, http://arxiv.org/abs/1303.1438.

Biography: Prof. Andrea Damascelli is an expert in the electronic structure of quantum materials. He received his PhD in 1999 from the University of Groningen, where he worked on low-dimensional spin systems. After a two-year postdoctoral stay at Stanford University and one year research associate at Stanford Synchrotron Radiation Laboratory –where he mainly worked on superconducting cuprates and ruthenates- in 2002 he moved to UBC where he became Associate Professor in 2007. In this period, he continued his study of transition metal oxides, with renewed emphasis on large spin-orbit coupling materials, such as the 5d transition metals and also topological insulators.

Steve Dodge

Simon Fraser University

Introduction to optics and probing quantum materials with light

Monday 13:45-14:45

In this lecture I will review some important results from optical measurements on quantum materials, in particular cuprate superconductors. I will review the optical properties of Mott insulators, and show how these evolve with chemical doping as superconductivity emerges from the Mott insulating state. I will discuss the role of optics in identifying and characterizing the pseudogap phase of underdoped superconductors, and describe how time-resolved techniques can be used to obtain information that would be inaccessible through conventional optics.

Biography: Steve Dodge joined the faculty of Simon Fraser University in 2000, and became a member of CIFAR in the same year. He received his PhD from Stanford University in 1997 and his AB from Harvard University in 1989. He specializes in the optical properties of materials, with an emphasis on the development of optical methods based on femtosecond-pulsed lasers.

David Broun

Simon Fraser University

Electrodynamics of superconductors

Monday 15:00-16:00

This talk will introduce a number of key ideas in the electrodynamics of superconductors, including: London theory; superfluid density and phase fluctuations; the Kosterlitz-Thouless transition; and vortex dynamics. In each case, relevant experiment probes will be described, and the interpretation of results discussed.

Biography: David Broun received his PhD from Cambridge University and his BSc from the University of Western Australia. He is currently an associate professor at Simon Fraser University and studies superconductors and other quantum materials using microwave spectroscopy.

George Sawatzky

University of British Columbia

Electronic structure of correlated electron systems

Tuesday 8:30-9:30 and 9:30-10:30

I plan to treat the basics of the electronic structure of mainly transition metal compound systems as examples of strongly correlated electron systems. I will discuss things like the evidence for strong correlations , the Hubbard model and the charge transfer gap model, crystal and ligand field theories , the role of spin orbit coupling, and orbital degeneracy's leading to orbital ordering and orbiton elementary excitations. I will discuss the interplay between the orbital spin and charge degrees of freedom using the Goodenough -Kanamori -Anderson rules. I will introduce some new ideas important for treating high oxidation state materials which for a special class of potentially negative charge transfer gap systems. For example the Nickelates possible belong to this class of systems. I also will introduce resonant elastic and inelastic x ray scattering as methods to study the various kinds of possible orderings. Time permitting I also hope to discuss the new field of transition metal oxide heterostructures and the new physics that occurs at the interfaces.

Biography: Dr. Sawatzky holds a joint tier 1 Canada Research Chair in the departments of Chemistry and Physics & Astronomy at the University of British Columbia in condensed matter physics and chemistry since 2001. He received his education at the University of Manitoba in Canada with a PhD in physics in 1969. He then spend 31 years first as a post doctoral fellow and then as a professor at the University of Groningen in the Netherlands in the departments of Physics and Chemistry. He was director of the Material Science Center at the University of Groningen for 8 years. More than 40 PhD students have graduated in his research group. He is presently also director of the newly formed Quantum Matter Institute at UBC and a joint director together with Professor Keimer from MP Stuttgart of the Max Planck /UBC Quantum Materials center at UBC. Dr. Sawatzky's research focuses on the electronic structure of strongly correlated materials, such as magnetic materials, high temperature superconductors, and materials for molecular electronics applications; the development and use of various synchrotron-based spectroscopic methods to study such systems; as well as theoretical methods to describe the relationship between the physical properties and the chemical composition, structure and morphology. Dr. Sawatzky has won several prestigious awards for his work, including the NWO-Spinoza award from the Netherlands Organization for Scientific Research (1996), the Nieuwsblad van het Noorden prize (1997). He has been a Member of the RoyalDutchAcademy of Sciences (KNAW) since 1991, and was elected Fellow of the Royal Society of Canada in 2002 and an elected fellow of the Royal Society (London) in 2008. In 2007 Dr. Sawatzky was awarded the Henry Marshall Tory Medal by the Royal Society of Canada. He was appointed as a consulting professor at Stanford University in 2008. He is listed among the ISI most cited physicists in the world with more than 26000 citations and an h index of 82.

Alberto Morpurgo
University of Geneva

Organic single-crystal transistors and interfaces
Tuesday 10:45-11:45

The field of plastic electronics aims at exploiting the unique properties of organic semiconductors based on conjugated molecules and polymers to realize new types of electronic devices. For this reason, most research focuses on the study of devices produced with techniques that are compatible with low-cost mass production. As a result, the materials employed are affected by considerable structural disorder and contain large concentration of chemical impurities that make it virtually impossible to explore the intrinsic electronic properties of organic semiconductors. Therefore, despite impressive technological progress, our physical understanding of these properties has remained limited. In this talk, I will discuss a different approach based on materials of the highest possible quality –namely pure single-crystals- to study the intrinsic electronic transport properties of organic semiconductors using field-effect transistors and related devices. These devices have led to the clean observation of different physical phenomena, such as increasing carrier mobility with lowering temperature, observation of the Hall effect, mobility anisotropy, and the formation of interfacial polarons in transistors with highly polarizable dielectrics. They have also given important insight in the investigation of different important aspects of organic devices, e.g. contact resistance, the characterization of Schottky barriers , and charge transfer at metal/organic interfaces. The results obtained so far indicate that, despite the fact that much remains to be understood, devices based on high-quality single molecular crystals enable the discrimination of extrinsic effects from the intrinsic properties of organic semiconductors.

Biography: Prof. Alberto Morpurgo is an expert in the investigation of the electronic properties of materials through the study of transport in nano-fabricated devices. He received his PhD in 1998 from the University of Groningen, where he worked on mesoscopic superconducting proximity effect and other aspects of mesoscopic physics (for which he was awarded the Miedema Prize for the best Dutch PhD thesis in condensed matter physics). After a two-year postdoctoral stay at Stanford University –where he mainly worked on carbon nanotubes- he moved to Delft University where he remained nearly nine years and became Associate Professor. In this period, next from starting his research on organic semiconductors, he worked on different aspects of quantum transport (Cooper pair splitting, Rashba two-dimensional electron gases, spintronics with carbon nanotubes) and started a successful research line on graphene electronics in 2006, just after the discovery of this material. Since Septembber 2008, Prof. Morpurgo is Professeur Ordinaire at the University of Geneva, where he is continuing his work on organic semiconductors and graphene, and starting work in new areas, such as topological insulators, oxide heterostructures, diatomically thin layered materials, and ionic liquid gating.

Mohammad Hamidian
Cornell University

Visualizing Electronic Structure: Spectroscopic Imaging Scanning Tunneling Microscopy (SI-STM)
Tuesday 12:45-13:45 and 13:45-14:45

Scanning tunneling microscopy provides a powerful tool capable of making simultaneous measurement of both momentum space and atomically resolved real space electronic structure. Having access to both pictures is invaluable to understanding strongly correlated quantum material systems for which a description in either of the two limits in typically insufficient. These set of lectures are devoted to understanding the frontier principles of SI-STM.

Lecture I:
The first lecture will cover the basics of scanning tunneling microscopy and spectroscopy including interpreting STM data. We will go onto cover the method of quasiparticle-interference imaging (QPI) which uses real space data to arrive at momentum space electronic structure. If time permits, QPI will be discussed in terms of the Green's function formalism which is essential to understanding the phenomena in strongly correlated materials.

Lecture II:
Using the principles from the first lecture we will apply them to cuprate high temperature superconductors and heavy fermion compounds. After covering some background physics we will show in detail two distinct examples of how QPI has been used to infer band structure and further how having simultaneous access to real space data leads to new insights. If time permits, the concepts of determining superconducting gap structure in momentum space will also be discussed.

Biography: Born in Isfahan, Iran, Mohammad at the age of 6 immigrated to Canada with his family. His academic career began at the University of Toronto, in the Engineering Science program where he specialized in the physics option and while his focus finally landed on condensed matter physics Mohammad was also involved in experimental particle physics, group theoretical methods, and fluid dynamics. Staying on at U of T for his Masters, Mohammad spent a year pursing models for the non-linear dynamics of the El-Nino Southern Oscillation before making his way to Cornell University to begin his Ph.D. Under the guidance of Professor Séamus Davis, he undertook experimental STM work in the field strongly correlated electronic systems with particular emphasis on heavy fermions and cuprate high temperature superconductors. Currently, Mohammad is finishing his post-doc in the Davis Lab, studying the microscopic mechanisms of quantum criticality and developing technology for atomically resolved shot-noise STM.

Ruixing Liang

University of British Columbia

Single Crystal Growth from Melt

Tuesday 15:00-16:00

The most single crystals used in condensed matter physics experiments are grown from high temperature melts. This lecture will talk about (1) the basic thermodynamics of phase relationships, (2) advantages and disadvantages of various techniques of crystal growth from melt, and (3) actual examples of crystal growth to demonstrate how to choose and design the growth approach according to chemical properties of the compounds and availability of phase diagram, and how to solve the problems often encountered in crystal growth projects.

Biography: Ruixing Liang is a Materials Scientist in the Department of Physics and Astronomy at the University of British Columbia. He holds a B.Sc. (1982) in Inorganic Materials from Qinghua University in China, and an M.Sc. (1986) and D.Sc. (1989) in Materials Science from the Tokyo Institute of Technology. He came to UBC as a Post-Doctoral Fellow in 1990, became a Research Associate in 1993, and took on his current position in 1996. Dr. Liang was awarded NSERC's 2005 Brockhouse Canada Prize for Interdisciplinary Research in Science and Engineering, together with his UBC and CIFAR colleagues, Drs. Walter Hardy and Doug Bonn. Dr. Liang is widely regarded as one of the world's best crystal growers in cuprate high-temperature superconductors. His high-quality crystals of yttrium barium copper oxide (YBCO) have been facilitating the worldwide collaboration aiming at solving the high Tc superconductivity problem, which has so far generated over 150 publications, including many in published in *Nature*. Recently he also works on the growth of crystals of ion arsenide based superconducting compounds.

George Kirczenow

Simon Fraser University

The Quantum Physics of Nanostructures: Theory and Experiments

Wednesday 8:30-9:30

Nanostructures are condensed matter systems having one or more dimensions d on the nanometer length scale. Since the electron de Broglie wavelengths in these systems are similar in size to their dimensions, nanostructures are inherently quantum systems. In this lecture I will discuss the electronic quantum transport properties that are characteristic of nanostructures, including conductance quantization and Coulomb blockade. I will also discuss experiments that demonstrate these phenomena and exploit them to detect and manipulate individual electrons at the nanoscale.

Biography: George Kirczenow received his Bachelor degree with first class honours in Physics from the University of Western Australia and his Doctorate in Theoretical Physics from Oxford University where he was the last graduate student of Sir Rudolf Peierls. He was a Postdoctoral Fellow at the University of British Columbia and afterwards at Northwestern University. After 4 years as an Assistant Professor at Boston University he joined the Department of Physics at Simon Fraser University as an Associate Professor and has stayed at SFU since then, being promoted to Professor in 1987. He became interested in Nanophysics in the late 1980's and has made many theoretical contributions to that field. In 1986 he was awarded the British Columbia Science and Engineering Gold Medal for work on excitons in semiconductors. In 1990 he was awarded a University Research Professorship at SFU. Papers published by him and his group were recognized as "The best paper in Condensed Matter Physics published in the Canadian Journal of Physics" in two successive years in the 1990's by the Canadian Association of Physicists. He is a Fellow of the American Physical Society and a Senior Fellow of the CIFAR Nanoelectronics Program.

Rafael M. Fernandes

University of Minnesota

Competing orders in quantum materials

Wednesday 9:30-10:30

Quantum materials provide a unique pathway to understand how interacting electrons collectively behave at low temperatures. Their phase diagrams usually display a variety of ordered states that break different symmetries of the system, from magnetism and structural order to superconductivity and electronic liquid-crystalline phases. Understanding the interplay between these often competing states provides invaluable information about the role played by each degree of freedom in promoting unusual quantum phases. In this talk, we will present microscopic and phenomenological models that describe the competition between unconventional superconductivity and magnetism, as well as nematicity, in the recently discovered iron-based superconductors. By comparing experimental data with theoretical results, we will show that the competition between these ordered phases reveals important information about the symmetry of the Cooper pair-wave function, the nature of the magnetic state, and the origin of the nematic degrees of freedom. We will also briefly discuss competing phases in other materials, such as the pseudogap and the d-wave superconducting state of the cuprates.

Biography: Rafael M. Fernandes received his PhD at the State University of Campinas, in Brazil in 2008. Before joining the University of Minnesota in 2012, he was a postdoc in Ames Laboratory and a joint postdoc in Columbia University/Los Alamos National Lab. He is a theorist working on strongly correlated electronic many-body systems. His interests are very broad, and much of his research is strongly experiment-oriented. In general, he is interested in clean and disordered systems in which ordered phases associated with different broken symmetries are present, such as superconductivity, magnetism, structural ordering and electronic liquid-crystalline states.

Andy Mackenzie

University of St Andrews

Probing low temperature phase formation in Sr3Ru2O7

Wednesday 10:45-11:45

Sr3Ru2O7 is a bilayer ruthenate metal on the border of ferromagnetism, which can be driven towards a series of metamagnetic transitions by externally applied fields. In ultra-pure samples a low temperature phase forms which, after a number of years of research, was discovered to be accompanied by a large resistive anisotropy. It is now thought to be an electronic analogue of a nematic liquid crystal. In this talk I will describe the experimental research that uncovered these phenomena. In the spirit of the school, I will concentrate on a didactic description of the experiments used to probe this novel state and what can be inferred from them, rather than a detailed seminar on the implications of the physics that was uncovered.

Biography: Andy Mackenzie's research career has been in experimental condensed matter physics. Before taking up his chair at the University of St Andrews in 2001, he was a Reader at the University of Birmingham, and Royal Society University Research Fellow at the University of Cambridge. He is in the process of moving to the Max Planck Institute for Chemical Physics of Solids in Dresden, Germany, where he will become Director of the Physics of Quantum Materials department.

Steve Johnston

University of British Columbia

Modeling spectroscopies on simple and complex quantum materials

Wednesday 12:45-13:45

Over the last two decades a number of spectroscopies have been significantly refined through the study of modern quantum materials. As a result, these techniques have become powerful probes in condensed matter physics however, modeling them can be a daunting task. In this lecture I will provide an overview of the quantities accessible to various spectroscopies and cover examples of their modeling by considering both simplified toy models and examples from modern literature. Time permitting, I will also discuss complications such as the role of matrix elements and surface related effects. This talk will provide a basic overview of the link between theory and experiment in modern spectroscopies on quantum materials.

Biography: Steve Johnston is an MPI/UBC post-doctoral fellow at the University of British Columbia. His research focuses on electron-boson interactions in strongly correlated systems and high-temperature superconductors while facilitating direct comparisons with experimental probes. Previously he was a post-doctoral researcher at the Leibniz Institute for Solid State and Materials Research Dresden where he studied electron-phonon coupling in quasi-1D cuprates via resonant inelastic x-ray scattering. He completed his Ph.D. in 2010 at the University of Waterloo and was a visiting researcher at Stanford University. His thesis work examined electron-phonon interactions in the high-Tc cuprates as probed by angle-resolved photoemission and scanning tunneling microscopy.

Antoine Georges

Collège de France and Ecole Polytechnique, France

Materials with Strong Electronic Correlations: An Introduction and a Perspectivefrom Dynamical Mean-Field Theory

Wednesday 16:15-17:15

From copper-oxide superconductors to rare-earth compounds, materials with strong electronic correlations have focused enormous attention over several decades. Solid-state chemistry, new elaboration techniques and improved experimental probes are constantly providing us with examples of novel materials with surprising electronic properties, the latest example being the recent discovery of iron-based high-temperature superconductors. In this lecture, I will review some salient physical aspects of strong electronic correlations. I will emphasize that the classic paradigm of solid-state physics, in which electrons form a gas of wave-like quasiparticles, must be seriously revised for strongly correlated materials. Instead, a description accounting for both atomic-like excitations in real-space and quasiparticle excitations in momentum space is requested. I will review how Dynamical Mean- Field Theory -an approach that has led to significant advances in our understanding of strongly correlated materials- fulfills this goal.

Biography: Antoine Georges is a condensed matter theorist. His initial training was in the statistical physics of disordered systems, but his research interests in the past 20 years or so have mostly focused on quantum correlated matter in its diverse incarnations: materials with strong electronic correlations, as well as ultra-cold atomic gases. He is best known as one of the co-inventors of Dynamical Mean-Field Theory, for which he shared the 2006 Europhysics Condensed Matter Prize. Antoine Georges is a professor at Collège de France (Paris) where he holds the chair of Condensed Matter Physics.

Louis Taillefer
Université de Sherbrooke
Canadian Institute for Advanced Research

Change of pairing symmetry in the iron-arsenide superconductor KFe2As2
Wednesday 17:15-18:15

The iron-based superconductors discovered in 2008 offer a new and powerful route to understand the mechanisms that can lead to superconductivity with a high Tc. In this lecture, I will focus on one material in this family of superconductors: KFe2As2. I will present our recent discovery of a sudden reversal in the pressure dependence of Tc, which we attribute to a change in the pairing symmetry, from d-wave to s-wave. I will explain what this tells us about the nature of pairing in this material, and more broadly in the entire family of superconductors. **Relevant article:** F. F. Tafti et al. Change of pairing symmetry in the iron-based superconductor KFe2As2, Nature Physics (in press); preprint at : arXiv:1303.2961.

Biography: Louis Taillefer got his BSc from McGill University in 1982 and his PhD from the University of Cambridge in 1986. After working at the CNRS labs in Grenoble, France for a few years, he was appointed professor at McGill in 1992. He moved to the University of Toronto in 1998 and then to the University of Sherbrooke in 2002, where he holds the Canada Research Chair in Quantum Materials. Louis Taillefer has been director of the Quantum Materials Program of the Canadian Institute for Advanced Research since 1998, continuing until 2018. He has a passion for superconductivity and his research team of students and postdocs has made fascinating discoveries over the past 20 years, in all families of unconventional superconductors – organics, heavy fermions, cuprates and pnictides.

James Day

University of British Columbia

Panelist – Tuesday 4:00pm-6:00pm

James came to UBC, from the University of Alberta, in early 2008 as a postdoctoral research fellow. Since arriving, he has been the recipient of an NSERC Postdoctoral Fellowship and an Izaak Walton Killam Postdoctoral Research Fellowship. Also, in 2009, he won the NSERC Doctoral Prize for his Ph.D. work on solid helium and to support excellence in postgraduate research.

His doctoral studies resulted in the first deathblow to the notion of supersolidity in helium, as well as seeded new research on what has become known as quantum plasticity—the tendency of a material to deform macroscopically based on its quantum properties. It was his expertise in low temperature physics that brought him to the superconductivity group at UBC.

Life in Vancouver changed his priorities. Surrounded by ocean and mountains, and with a young family to raise, finding a faculty position as a professor at a major research university became significantly less important. James endeavored to continue researching physics while never having to move cities again. He currently works as a Research Associate for the Department of Physics at UBC, studying unconventional superconductivity and, also, taking a lead role in their Physics Education Research efforts.

Mark Johnson

Scientist in D-wave Quantum Computing Company

Panelist – Tuesday 4:00pm-6:00pm

Since joining D-Wave in 2005, Dr. Johnson has been engaged in the design, testing & characterization of D-Waves's processors. He joined D-Wave from Northrop Grumman Corp. (formerly TRW Inc.), where he worked in the Superconductor Electronics Organization. While at TRW he worked on design and testing of A/D converters and digital signal processing circuits in both superconducting Niobium and Niobium Nitride based superconductor technologies, as well as supporting the manufacture and qualification testing of satellite communication payloads. Dr. Johnson has a PhD. in Physics from the University of Rochester, NY, and a Bachelors in Physics from Harvey Mudd College in Claremont, CA. He holds 11 granted US patents and is the author of dozens of professional publications.

Panel Discussion

Studies and careers in QM research

Answer to your questions about careers options

Tuesday May 7th 16:00-18:00

Speakers:

- James Day (Research Associate at UBC)
- Steve Johnston (Recent Postdoc and now Tenure Track Faculty at U. of Tennessee)
- Steve Dodge (Tenured Faculty at SFU)
- Mark Johnson (Scientist at D-wave Quantum Computing Company)

The speakers have been selected due to their diverse careers in both academia and industry.

Facilitator : Mahyad Aghigh

The Summer School Panel Discussion at a Glance:

I LOVE Physics, but what can I do with a graduate degree in Physics?	Am I in the right place?
I'm not quite sure if this degree takes me anywhere. Should I still stick with it?	What if I can't find a job?
Should I continue my studies up to PhD? Should I stop after my Masters?	What if I am "OVER QUALIFIED"? What does that mean by the way?

If these are among your questions and concerns as well, don't worry. You are not the only one. We believe there must be a place in which we could at least share our concerns. We have arranged a panel discussion to address as many questions and concerns as possible regarding careers in Physics.

There are four panelists all with backgrounds in Physics, yet currently having different careers. They include two faculty members, a research associate, and an industry expert, making this session one of a kind in the series of CIFAR QM summer schools. This is your opportunity to have your questions answered.

Students have the chance to ask their questions from the panelists either anonymously through the panel moderator, or publicly during the session. You should have received a question sheet with this booklet which you can drop into the box at the registration table to have your question asked. Students should also feel free to directly approach Mahyad during the Summer School to request he ask a question.

We hope discussion amongst the panelists will expose the students and postdoctoral fellows to different schools of thought, which may help them better direct their studies and careers.

Presented Posters:

Board No.	Name	Poster Title
29	Aaron Sutton	High Field Fermi Surface of $YbRh_2Si_2$
15	Alannah Hallas	$Ho_2Ge_2O_7$ and $Pr_2Zr_2O_7$: A Tale of Two Spin Ices
10	Alex Petrescu	Bosonic Mott insulator with pseudospin Meissner currents
8	Andrew Macdonald	A Spin Polarized STM and Monte Carlo Study of Expitaxial Chromium
13	Ashley Cook	Spin-Orbit Locking in the Double Perovskite Ba_2FeRe_O6
27	Bongju Kim	Step induced anisotropy in ultra-thin manganite film
16	Chris Granstrom	Point Contact Andreev Reflection Spectroscopy of Bismuth-Chalcogenide Topological Insulators
31	Derek Sahota	Pump Probe Excitation Spectroscopy of Noble Metals and Insulating Cuprates
1	Di Tian	High Pressure Studies of Quantum Materials
26	Di Lu	Continuous Strain Control in High-Quality Perovskite Oxide Thin Films
38	Dylan Jervis	Ultracold atoms in an optical lattice one millimeter from air
25	Edward Taylor	Anomalous Hall effect in current- carrying states of matter: topology, commensuration effects, and optics
34	Eric Lee	Magnetic excitation spectra in pyrochlore iridates
28	Fatemeh Rostamzadeh	Switching of a quantum dot spin valve by single molecule magnets
5	Giorgio Levy	Probing the Role of Co Substitution in the Electronic Structure of Iron Pnictides
39	Hamed Karimi	TBA
2	Hideyuki Kawasoko	High thermoelectric performance in pseudogapped $Ru_2Sn_{3-\delta}$
3	Hilary Noad	Scanning SQUID measurements of delta-doped strontium titanate bilayers
37	Jeffrey Rau	Symmetry breaking via Kondo hybridization: Applications to $Pr_2Ir_2O_7$
22	Jesse Hall	Effects of doping on hidden order of URu_2Si_2 from far-infrared optical conductivity
7	Kostin Andrey	Imaging Heavy Fermions with SI-STM
17	Kyusung Hwang	Three-dimensional nematic spin liquid in the stacked triangular lattice 6H-B structure
30	Laleh Mohtahsemi	Terahertz Plasma Frequency Measurement of MnSi
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4	Wen Huang	Edge current in multi-band chiral p-wave superconductor Sr_2RuO_4
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21	Zhou Li	Longitudinal and spin/valley Hall optical conductivity in MoS_2 and similar materials
39	Zheng Shi	Non-interacting two-dimensional junctions of three quantum wires"

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