

## Abstracts TC7

### Gravitation, Cosmology & Astrophysics

I wish to contribute	
	a talk (only).
Title	
	Gravitational wave physics and binary black holes
Author(s)	
	Harald Pfeiffer (on behalf of the SXS collaboration)
Speaker/Presenter	
	Harald Pfeiffer
Email Address	
	pfeiffer@cita.utoronto.ca
Abstract	
	The coming years will see the first direct detection of gravitational waves, opening an entirely new observational window on compact objects and other phenomena that involve strong gravity. This talk briefly discusses status and promises of gravitational wave astronomy. The talk will then focus on the modelling of one particularly exciting source of gravitational waves: binary black holes.

I wish to contribute	
	a talk (only).
Title	
	Primordial Magnetism in CMB B-modes
Author(s)	
	Levon Pogossian, Amit Yadav, Bess Ng, and Tanmay Vachaspati
Speaker/Presenter	
	Levon Pogossian
Email Address	

	levon@sfu.ca
Abstract	
	CMB polarization B-modes induced by Faraday Rotation (FR) can provide a distinctive signature of primordial magnetic fields because of their characteristic frequency dependence and because they are only weakly damped on small scales, allowing them to dominate B-modes from other sources. They also produce non-trivial 4-point correlations of the CMB variables that can further help distinguish magnetic fields from other sources of B-modes. I will discuss the formalism we developed for calculating the FR induced B-modes, along with the constraints on primordial magnetism that can be expected from upcoming CMB experiments.

I wish to contribute	
	a talk (only).
Title	
	Five-Dimensional Eguchi-Hanson Solitons in Einstein-Gauss-Bonnet Gravity
Author(s)	
	Anson W.C. Wong, Robert B. Mann
Speaker/Presenter	
	Anson Wong
Email Address	
	anson.ao@gmail.com
Abstract	
	Eguchi-Hanson solitons are odd-dimensional generalizations of the four-dimensional Eguchi-Hanson metric and are asymptotic to $AdS_5/\mathbb{Z}_p$ when the cosmological constant is either positive or negative. We find soliton solutions to Lovelock gravity in 5 dimensions that are generalizations of these objects.

I wish to contribute	
	a talk (only).

Title	
	How to Measure the Speed of Gravity
Author(s)	
	M. B. Paranjape
Speaker/Presenter	
	M. B. Paranjape
Abstract	
	<p>We propose an experiment to directly detect the consequence of the finite speed of propagation of changes in the gravitational field and to measure this speed. Our analysis is based on the idea that if one is able to detect the static gravitational field of a massive body in the laboratory, then moving that body induces changes in the gravitational field that propagate to the detector with a finite delay. The delay is equal to the distance between the body and the detector divided by the speed of propagation. Moving just one body in the presence of a detector simply introduces the corresponding changes in the gravitational field at the position of the detector at the appropriately advanced time. However with two or more bodies moving in the presence of the detector, it is easy to conceive of a situation where the changes in the gravitational field at the position of the detector will contribute constructively or destructively. Observing this interference should be possible would allow for the determination of the speed of propagation of the changes in the gravitational field.</p>

I wish to contribute	
	a talk (only).
Title	
	The Gibbs free energy in the collapse to a RN black hole
Author(s)	
	Hugues Beauchesne and Ariel Ederly
Speaker/Presenter	
	Ariel Ederly
Email Address	
	aedery@ubishops.ca
Abstract	
	<p>We investigate numerically the thermodynamics during the collapse of a charged (complex) scalar field to a Reissner-Nordström (RN) black hole in isotropic coordinates. The relevant thermodynamic potential for the RN black hole is the Gibbs free energy <math>G=E-TS-\Phi_H Q</math> where <math>Q</math> is the charge and <math>\Phi_H</math> the electrostatic potential at the outer horizon. We find that the matter contribution to the Gibbs free energy in the interior is zero; it stems entirely from the gravitational sector. In the interior, the free energy accumulates in a thin shell just inside the horizon. This shows, in a dynamical setting, that the entropy resides directly on the horizon and is entirely gravitational in origin. We also make a comparison between the numerical values of the interior Lagrangian (its negative) to the interior Gibbs free energy.</p>

I wish to contribute	
	a talk (only).
Title	
	Geometroynamics of Lovelock Gravity
Author(s)	
	Gabor Kunstatter, Tim Taves and Hideki Maeda
Speaker/Presenter	

	Gabor Kunstatter
Email Address	
	g.kunstatter@uwinnipeg.ca
Abstract	
	<p>We derive the Hamiltonian for spherically symmetric Lovelock gravity using the geometrodynamics approach pioneered by Kucha\{r}\~\cite{kuchar94} in the context of four-dimensional general relativity. When written in terms of the areal radius, the generalized Misner-Sharp mass and their conjugate momenta, the generic Lovelock action and Hamiltonian take on precisely the same simple forms as in general relativity. This result supports the interpretation of Lovelock gravity as the natural higher-dimensional extension of general relativity. It also provides an important first step towards the study of the quantum mechanics, Hamiltonian thermodynamics and formation of generic Lovelock black holes.</p>

#### Quantum Gravity & Strings

I wish to contribute	
a talk (only).	
Title	
Group Action in Topos Quantum Physics.	
Author(s)	
Cecilia Flori	
Speaker/Presenter	
Cecilia Flori	
Email Address	
cflori@perimeterinstitute.ca	
Abstract	
<p>Topos theory has been suggested first by Isham and Butterfield, and then by Isham and Doering, as an alternative mathematical structure within which to formulate physical theories.</p>	

<p>In particular it has been used to reformulate standard quantum mechanics. The aim of this new formulation is to overcome the Copenhagen interpretation (instrumentalist interpretation) quantum theory and replace it with an observer-independent, non-instrumentalist interpretation. The interesting feature of such a reformulation is that it induced a novel type of logic to reason about quantum propositions, namely an intuitionistic (multivalued) type logic. In this talk I will first briefly describe this formalism and then extend it in order to include the notion of a group and group transformation. As we will see this will lead to a different type of topos in which to describe quantum theory.</p>	
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I wish to contribute	
a talk (only).	
Title	
F-Theory, Seiberg-Witten Curves and $N = 2$ Dualities	
Author(s)	
Keshav Dasgupta	
Speaker/Presenter	
Keshav Dasgupta	
Email Address	
Keshav Dasgupta [keshav@hep.physics.mcgill.ca]	
Abstract	
<p>F-theoretic constructions can alternatively be understood as consequences of certain <math>N = 2</math> Seiberg-Witten theories via type IIB r D3s probing the quantum corrected orientifold backgrounds. In this talk I'll present four models that come out from such consideration. These models will deal with various compactification of F-theory and the connections to <math>N= 2</math> Gaiotto's model, among other things. I'll also discuss possible constraints on these models coming from global charge and anomaly cancellations in F-theory.</p>	

<b>I wish to contribute</b>	
	a talk (only).

<b>Title</b>	
	Kerr-Sen Spacetime in Generalized Hidden Kerr/CFT Correspondence
<b>Author(s)</b>	
	Masoud Ghezelbash and Haryanto Siahaan
<b>Speaker/Presenter</b>	
	Haryanto Siahaan
<b>Abstract</b>	
	<p>It is recently conjectured that generic non-extreme Kerr black hole could be holographically dual to a hidden conformal field theory in two dimensions. The hidden conformal structure can be revealed by looking at charged scalar wave equation in some appropriate values of frequency and charge. In this regard, we consider the wave equation of a charged massless scalar field in background of Kerr-Sen black hole and show in the "near region", the wave equation can be reproduced by the Casimir operator of a local <math>SL(2, \mathbb{R})_L \times SL(2, \mathbb{R})_R</math> hidden conformal symmetry. We then find exact agreement between macroscopic and microscopic physical quantities like entropy and absorption cross section of scalars for Kerr-Sen black hole. We then find an extension of vector fields that in turn yields an extended local <math>SL(2, \mathbb{R})_L \times SL(2, \mathbb{R})_R</math> hidden conformal symmetry.</p>

I wish to contribute	
	a talk (only).
<b>Title</b>	
	Point particle dynamics in 3d semiclassical loop gravity
<b>Author(s)</b>	

	Jonathan Ziprick & Gabor Kunstatter
Speaker/Presenter	
	Jonathan Ziprick
Email Address	
	jziprick@perimeterinstitute.ca
Abstract	
	<p>The Hilbert space of loop quantum gravity (LQG) is built from subspaces associated to oriented graphs. Each subspace is obtained from the quantization of a classical phase space that assigns a holonomy and a flux to each link of the graph. Each phase space corresponds to a truncation of the general relativity (GR) phase space. There are then two limits to be taken for comparing LQG with GR: the classical limit and the continuous limit.</p> <p>We propose to study the classical limit of LQG without taking the continuous limit, giving a semiclassical theory of gravity written in terms of holonomy-flux phase spaces. This allows us to put aside for the moment technicalities arising from quantization, and focus on the effects of truncation.</p> <p>Here we consider the simple model of point particles in three dimensions. We show how the degrees of freedom are captured by holonomies and fluxes, and how the ADM mass and angular momentum are determined from these variables. We discuss the additional challenges that await in four dimensions.</p>

I wish to contribute	
	a talk (only).
Title	
	Gluing pairs of pants
Author(s)	
	Vincent Bouchard



Speaker/Presenter	
	Vincent Bouchard
Email Address	
	vincent.bouchard@ualberta.ca
Abstract	
	In this talk I will show how to glue pairs of pants to construct general Riemann surfaces with punctures. Then I'll explain how this gluing process fits into the new recursive framework for mirror symmetry and topological string theory.

I wish to contribute	
	a talk (only).
Title	
	Manifold invariants affect dynamics in quantum gravity
Author(s)	
	Tomas Liko
Speaker/Presenter	
	Tomas Liko
Email Address	
	tliko@math.ualberta.ca
Abstract	

	<p>The action for gravity with an asymptotic boundary is divergent and requires a regularization. The first-order Holst action with negative cosmological constant is regularized by the Euler and Pontryagin densities with fixed weight factors. We discuss two explicit examples, demonstrating that the presence of these densities in the action can produce physical effects in quantum gravity. Specifically, the manifold invariants alter the first and second laws of black-hole mechanics: the Euler density results in an upper bound on the cosmological scale in terms of the surface areas of black holes that merge, and the Pontryagin density results in the Barbero-Immirzi parameter shifting the gravitational entropy of spacetimes with metrics that are non-diagonalizable.</p>
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#### Quantum Physics & Information

I wish to contribute	
	a talk (only).
Title	
	University quantum simulation for fun & profit
Author(s)	
	Barry C. Sanders
Speaker/Presenter	
	Barry C. Sanders
Email Address	
	barryhbar@gmail.com
Abstract	

	<p>By making certain classically intractable computational problems easy-to-solve with quantum algorithms, quantum computers offer long-term disruptive capability. In the near term, the original motivation of quantum computers being efficient universal simulators of quantum dynamics is even more exciting. Quantum simulators are especially important to physicists as a potentially efficient means to discover otherwise hard-to-evaluate properties of Hamiltonian systems. Furthermore just dozens of qubits and hundreds of quantum gates on a quantum Turing machine are required to exceed the processing capability of current and foreseeable classical computers, which makes useful quantum simulators feasible in the foreseeable future. I present an historical account of quantum simulator research since Feynman's proposal of a universal quantum simulator and Deutsch's quantum Turing machine for implementing quantum computation. Then we delve into the essence of quantum algorithms for realizing universal quantum simulation based on Lie-Trotter-Suzuki expansions and the assumption of sparse Hamiltonians. Finally we will explore current experimental developments in realizing quantum simulations.</p>
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I wish to contribute	
	a talk
Title	
	Reconstructing Quantum Theory from Quantum Information Principles
Author(s)	
	Giulio Chiribella, Perimeter Institute for Theoretical Physics
Speaker/Presenter	
	Giulio Chiribella, Perimeter Institute for Theoretical Physics
Email Address	
	gchiribella@perimeterinstitute.ca
Abstract	

	<p>Quantum Theory is traditionally defined by a set of mathematical axioms phrased in the language of Hilbert spaces. This framework offers a rich dowry of mathematical tools, but from the fundamental point of view it appears rather ad hoc: Why should nature be described by this very specific piece of mathematics? Which fundamental principles are encapsulated within the quantum framework?</p> <p>Over the past three decades, Quantum Information provided an enormous contribution to answering these questions, putting forward an operational approach and unearthing many concrete operational consequences of the formalism. Stimulated by these new insights, Fuchs and Brassard proposed that the full quantum formalism could (and should) be reconstructed from few fundamental principles about information: Hilbert spaces, unit vectors, unitary and self-adjoint operators should be avoided in the statement of the basic principles, and should appear only in the end as the result of a derivation.</p> <p>Following this inspiration, in this talk I will present a complete set of principles that capture finite dimensional Quantum Theory using only the elementary language of physics and information.</p>
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I wish to contribute	
	a talk (only).
Title	
	Simulating Covariant Transformations With Local Operations
Author(s)	
	Borzu Toloui, Gilad Gour
Speaker/Presenter	
	Borzu Toloui
Email Address	
	borzumehr@gmail.com
Abstract	
	<p>We show how quantum evolutions that are characterized by covariant transformations and restricted by superselection rules can be mapped to LOCC operations. We further show how measures of entanglement can be used to quantify the asymmetry, or frameness, of any state, pure or mixed. Our results make it possible for the first time to construct a wide range of asymmetry monotones for general symmetry groups associated with</p>

	different superselection rules, and highlights the deep links that exist between entanglement theory and the resource theories of asymmetry.
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<b>I wish to contribute</b>	
	a talk
<b>Title</b>	
	Operational interpretation of the G-asymmetry for Abelian groups
<b>Author(s)</b>	
	Michael Skotiniotis, and Gilad Gour
<b>Speaker/Presenter</b>	
	Michael Skotiniotis
<b>Abstract</b>	

	<p>We determine the quantum states and measurements that optimize the accessible information in a reference frame alignment protocol associated with the groups <math>U(1)</math>, corresponding to a phase reference, and <math>\mathbb{Z}_M</math>, the cyclic group of <math>M</math> elements. Our result provides an operational interpretation for the <math>G</math>-asymmetry which is information-theoretic and which was thus far lacking. In particular, we show that in the limit of many copies of the bounded-size quantum reference frame, the accessible information approaches the Holevo bound. This implies that the rate of alignment of reference frames, measured by the (linearized) accessible information per system, is equal to the regularized, linearized <math>G</math>-asymmetry. The latter quantity is equal to the variance in the case where <math>G=U(1)</math>.</p> <p>Quite surprisingly, for the case where <math>G=\mathbb{Z}_M</math> and <math>M \geq 4</math>, it is equal to a quantity that is not additive in general, but instead can be superadditive under tensor product of two distinct bounded-size reference frames.</p> <p>This remarkable phenomenon is purely quantum and has no classical analog.</p>
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I wish to contribute	
	a talk
Title	
	Matter copy dynamics in a BEC
Author(s)	

	Khulud Almutairi, Collin Trail, Barry Sanders, Christoph Simon
Speaker/Presenter	
	Khulud Almutairi
Email Address	
	kalmutai@ucalgary.ca
Abstract	
	<p>Light can be stored in Bose-Einstein condensates for more than one second using quantum memory techniques based on electromagnetically induced transparency [1]. In recent theoretical work [2], Rispe et al. proposed a method for storing photons in Bose-Einstein condensates to create a photon-photon gate. This gate uses the collisions between atoms in order to generate a phase shift that is dependent on the presence or absence of photons. We go beyond the single photon case considered in the previous scheme [2] to the many-photon case in the mean-field treatment and under the Thomas-Fermi approximation, where this scheme leads to strong phase self-modulation. That medium will allow superposition of an arbitrary number of photons to undergoing nonlinear evolution and in particular produce "cat states" [3]. We generate "cat states" [3] from coherent states through the collision-induced interaction.</p> <p>References:  [1] R. Zhang, S. R. Garner, and L.V. Hau, Phys. Rev. Lett. 103, 233602 (2009).  [2] A. Rispe, B. He, and C. Simon ,Phys. Rev. Lett. 107, 043601 (2011).  [3] B. Yurke, and D. Stoler, Phys. Rev. Lett. 57, 13 (1986).</p>

Subatomic & Mathematical Physics

I wish to contribute	
	a talk (only).
Title	
	Supersymmetry with Dirac gaugino masses
Author(s)	
	Thomas Grégoire
Speaker/Presenter	
	Thomas Grégoire
Email Address	
	gregoire@physics.carleton.ca
Abstract	
	In this talk I will review the advantages of having gauginos with Dirac masses instead of Majorana masses for supersymmetric models. I will explain how they can evade constraints from the LHC and how they can be used to build models with a $U(1)_R$ lepton number.

I wish to contribute	
	a talk (only).
Title	
	Aharonov-Bohm Effect without Potentials
Author(s)	
	T. A. Osborn and Karl-Peter Marzlin
Speaker/Presenter	
	Tom Osborn
Email Address	
	tosborn@cc.umanitoba.ca
Abstract	



	<p>Charged particle quantum mechanics has two different forms — one being a gauge dependent Hilbert space framework and the second a gauge invariant quantum phase space representation. In quantum phase space, operators are described by Weyl symbols. The associated non-commutative product of symbols is defined by a fundamental geometrical invariant. This invariant is a symplectic area in phase space defined by a loop integral which gets contributions from both a magnetic flux and geometrical flux. It is shown that the phase entering the Aharonov-Bohm effect is just this symplectic area. In this way the A-B effect senses quantum noncommutativity, but does not require a vector potential.</p>
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<b>I wish to contribute</b>	
	a talk (only).
<b>Title</b>	
	A New Perspective on Path Integral Quantum Mechanics in Curved Space-Time
<b>Author(s)</b>	
	Dinesh Singh, Nader Mobed
<b>Speaker/Presenter</b>	
	Dinesh Singh
<b>Email Address</b>	
	dinesh.singh@uregina.ca
<b>Abstract</b>	
	<p>A fundamentally different approach to path integral quantum mechanics in curved space-time is presented for scalar particle propagation on a locally curved space-time background, as described by Fermi or Riemann normal co-ordinates. While using a strictly non-unitary form of local time translation involving Lie transport, the formalism nevertheless correctly recovers the free-particle Lagrangian in curved space-time, plus new contributions. Computation of the propagator yields the prediction that all probability violating terms due to curvature contribute to a quantum violation of the weak equivalence principle and time reversal invariance,</p>

	<p>while the remaining terms that conserve probability also correspondingly satisfy the weak equivalence principle, at least to leading order in the particle's Compton wavelength. Furthermore, the propagator also yields an overall curvature-dependent and gauge-invariant phase factor that can be interpreted as the gravitational Aharonov-Bohm effect and Berry's phase. Potential future directions following from this approach are also presented.</p>
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I wish to contribute	
	a talk (only).
Title	
	Superconformal field theory and Jack superpolynomials
Author(s)	
	Patrick Desrosiers, Luc Lapointe, Pierre Mathieu
Speaker/Presenter	
	Patrick Desrosiers
Email Address	
	desrosiers@inst-mat.utalca.cl
Abstract	

	<p>We uncover a deep connection between the <math>N=1</math> superconformal field theory in 2D and eigenfunctions of the supersymmetric Sutherland model known as Jack superpolynomials (sJacks). Specifically, the singular vector at level <math>rs/2</math> of the Kac module labeled by the two integers <math>r</math> and <math>s</math> can be obtained explicitly as a sum of sJacks whose indexing Young diagrams are contained in a rectangle with <math>r</math> columns and <math>s</math> rows. As a second compelling evidence for the distinguished status of the sJack-basis in SCFT, we find that the degenerate Whittaker vectors (Gaiotto states), in both the Neveu-Schwarz and Ramond sectors, can be expressed rather simply in terms of sJacks. As a consequence, we are able to reformulate the supersymmetric version of the (degenerate) AGT conjecture in terms of the combinatorics of sJacks.</p>
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I wish to contribute	
	a talk (only).
Title	
	Holography for non-relativistic systems
Author(s)	
	Wissam Chemissany, Jelle Hartong, Bert Vercoe
Speaker/Presenter	
	Wissam Chemissany
Email Address	
	Chemissany.wissam@gmail.com
Abstract	
	<p>We find a way to construct Fefferman-Graham expansions for asymptotically Lifshitz, ALif, spaces by reduction of asymptotically AdS spaces. This allows us to perform holographic renormalization ALif. We compare our results with the one previously achieved. In addition, we study ALif black holes, answering questions like why they are difficult to construct analytically and how to embed them in string theory and supergravities. We observe that there is a class related to higher dimensional black strings that can be found analytically.</p>

I wish to contribute	
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	a talk (only).
Title	
	PROGRESS ON A NEW WAY TO BREAK SUSY
Author(s)	
	JOHN DIXON
Speaker/Presenter	
	JOHN DIXON
Email Address	
	jadixg@gmail.com
Abstract	
	<p>There are SUSY invariants that are special to the standard model. These use the equations of motion and so they are highly sensitive to the exact particle content of the theory. I will discuss their form and the effect that they have in the SSM, and I will explain why they might yield a more successful way to break SUSY than the spontaneous or explicit methods. It appears that the SUSY breaking arises at the same time as the breaking of gauge symmetry, and that it does not generate a non-zero vacuum energy. The unsolved problems will be discussed.</p>

Condensed Matter & General Theory

<b>I wish to contribute</b>	
	a talk (only).

<b>Title</b>	
	Engineering Holographic Graphene
<b>Author(s)</b>	
	Gordon Semenoff
<b>Speaker/Presenter</b>	
	Gordon Semenoff
<b>Abstract</b>	
	<p>The AdS/CFT correspondence of string theory offers the hope of direct, mathematically precise and systematically correctable study of strongly coupled quantum systems. Progress toward this goal will be described in the context of a simple example: the gravitational dual of a class of relativistic field theories which resemble the description of graphene by relativistic fermions. A hypothesis that graphene can be such a strongly correlated quantum fluid and at the same time exhibit behaviors which are well modeled by non-interacting relativistic fermions will be discussed. Some interesting new phase transitions which are suggested by the D-brane construction will also be discussed .</p>

I wish to contribute	
	a talk (only).

Title	
	Adiabatic Quantum Computation
Author(s)	
	Jordan Kyriakidis
Speaker/Presenter	
	Jordan Kyriakidis
Email Address	
	jordan.kyriakidis@dal.ca
Abstract	
	<p>The currently dominant paradigm of quantum computation is the gate model, where, similar to classical computation, an algorithm is defined by a collection of qubits (quantum bits) temporally manipulated by a series of well-defined logic gates. Adiabatic quantum computing -- and the closely related quantum annealing and ground-state models -- are an alternative unconventional model of quantum computing. It arguably has a much greater probability of being realized experimentally in an appreciable scale, and is informed more by physics than computer science. I will focus exclusively on quantum optimization, and I will discuss 1) how an algorithm can be defined in this model, 2) how general NP problems and (non-Shor-based) factoring in particular can be implemented on such a machine, 3) what we can say about the efficiency of computations in this model, and 4) how the efficiency problem is really a path-finding problem.</p>

I wish to contribute	
a talk (only).	
Title	

On momentum conservation in disordered semiconductors	
Author(s)	
O. Rubel and A. Darbandi	
Speaker/Presenter	
O. Rubel	
Email Address	
orubel@lakeheadu.ca	
Abstract	
<p>The electronic structure of ideal crystals is traditionally represented in terms of the crystal momentum (<math>k</math>). In the case of disordered solids, which lack of a long-range order, <math>k</math> is believed to be not a “good quantum number”. Consequently, it is generally postulated that the momentum conservation no longer holds. We examine the electronic structure of a simple tight-binding model with energetic disorder (Anderson model) in momentum representation and show that the momentum is indeed well defined for extended states. These states obey the same dispersion relation as the states in unperturbed model. In contrast to the extended states, the localized states near to the band edges feature a distribution of momentum, which is a manifestation of the uncertainty principle. As a result, the uncertainty in momentum space can facilitate the transitions involving localized states, which are otherwise forbidden in ordered structures by the <math>k</math>-conservation law. Implications to optical transitions and Auger processes will be discussed.</p>	

<b>I wish to contribute</b>	
	a talk
<b>Title</b>	
	Effects of band structure and electron-phonon coupling on charge density waves
<b>Author(s)</b>	
	K. Tanaka, J. W. Sadowski, Y. Nagai
<b>Speaker/Presenter</b>	
	K. Tanaka
<b>Email Address</b>	
	kaori.tanaka@usask.ca
<b>Abstract</b>	



	<p>Charge density waves (CDW) and superconductivity (SC) are observed in a wide variety of materials such as layered transition-metal dichalcogenides, high-temperature superconductors, organic compounds, and other novel superconductors. The question as to whether CDW compete with or boost SC in those materials is under hot debate. Furthermore, recent ARPES measurements with contradictory results on CDW vs. SC [1,2] have raised the fundamental issue of the origin of CDW itself. Motivated by these experiments, we study the mechanism of CDW and its possible interplay with SC in a minimal tight-binding model. In particular, we show that van Hove singularities far from the Fermi level can lead to a substantial energy gain and enhanced quasiparticle coherence due to electron-phonon coupling. [1] T. Kiss et al., Nature Physics 3 (2007) 720. [2] S. V. Borisenko et al., Phys. Rev. Lett. 102 (2009) 166402.</p>
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#### Posters

I wish to contribute	
	a poster.
Title	
	The endpoint of black hole collapse in scalar-tensor gravity
Author(s)	
	Thomas P. Sotiriou and Valerio Faraoni
Speaker/Presenter	
	Valerio Faraoni
Abstract	

	<p>We extend Hawking's result that stationary black holes which are the endpoint of gravitational collapse in Brans–Dicke theory (without a potential) are the same as in General Relativity. We reach the same conclusion for the much more general class of scalar-tensor and <math>f(R)</math> gravity theories, without assuming any additional symmetries.</p> <p>[Based on T.P. Sotiriou &amp; V. Faraoni, Phys. Rev. Lett., in press (arXiv:arXiv:1109.6324).]</p>
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I wish to contribute	
	a poster.
Title	
	Computer simulation of functional materials for therapeutic ultrasound
Author(s)	
	Sheikh Jamil Ahmed, Jon Kivinen, Samuel Pichardo, Laura Curiel, Oleg Rubl
Speaker/Presenter	
	Sheikh Jamil Ahmed
Email Address	
	sahmed5@lakeheadu.ca
Abstract	

	<p>The research is focused on modeling of piezoelectric materials, which are utilized as an actuator for high intensity focused ultrasound (HIFU) treatment. HIFU uses ultrasound waves in order to deliver energy to a local spot inside the body thereby destroying tumors. Presently, the actuators suffer from internal heat generation caused by a mechanical damping and dielectric losses. Currently, only about 50% of the input electrical energy is converted into the useful mechanical output, while 2% of the input power is transformed into the internal heat. Our long-term objective is to design a material with improved efficiency and reduced dielectric dissipation. The first step in achieving that goal is development of a platform for quantitative modeling of the piezoelectric response from first principles. The later can be achieved using the density functional theory in conjunction with the modern theory of polarization (a geometrical Berry phase).</p>
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I wish to contribute	
	a poster.
Title	
	Signs and Cosmology
Author(s)	
	Arundhati Dasgulta, Adamantia Zampeli
Speaker/Presenter	
	Adamantia Zampeli
Email Address	
	a.zampeli@uleth.ca
Abstract	
	<p>We examine the possibility that the phantom scalar fields of quantum cosmology originate from an inversion of the sign in the Euclidean Einstein action obtained from the use of a new effective action predicted from quantum gravity.</p>

I wish to contribute	
	a poster.
Title	
	Vacuum Polarization and Hawking Radiation
Author(s)	
	Shohreh Rahmati
Speaker/Presenter	
	Shohreh Rahmati
Email Address	
	shohreh.rahmati@uleth.ca
Abstract	
	<p>My project is about finding the Hawking radiation in the vicinity of the horizon of the black hole by using the concept of vacuum polarization. We considered a Quasi-Local region that includes the horizon. This Quasi-Local volume is enclosed by two cylindrical membranes, one inside the horizon and the other one outside the horizon. The net rate of the decay of the vacuum due to the interaction of the scalar field with the background classical gravitational field in this volume will give us the Hawking radiation rate.</p>

I wish to contribute	
	a poster.
Title	
	Rational conformal field theory and matrix level for strings on a torus
Author(s)	
	Ali Nassar and Mark A. Walton
Speaker/Presenter	
	Ali Nassar
Email Address	

	nassar@uleth.ca
Abstract	
	<p>Two-dimensional conformal field theories are important in the study of critical phenomena and perturbative string theory. An interesting class are rational conformal field theories, characterized by having a finite number of primary fields. It is important to know the conditions for rationality. For example, the simplest compactifications of a string theory are on tori-- when are they described by rational conformal field theories? For a two-dimensional torus, Gukov and Vafa gave a simple, geometric criterion for rationality. The modular parameter <math>\tau</math> and Kähler parameter <math>\rho</math> must take special values <math>\tau, \rho \in \mathbb{Q}(D)</math> so that the torus possesses the property of complex multiplication. On the other hand, Gannon has studied the algebras involved in the corresponding conformal field theories: <math>U_{m,K}</math> Kac-Moody algebras with a matrix-valued level <math>K</math>. We investigate the relation between the Gukov-Vafa geometric characterization of rationality and the algebraic results of Gannon. The Gauss product is used to give a geometric interpretation of <math>U_{2,K}</math> in terms of rational points in the Narain moduli space which correspond to complex multiplication tori.</p>

<b>I wish to contribute</b>	
	a poster.
<b>Title</b>	
	Efficient quantum communication under collective noise
<b>Author(s)</b>	
	Michael Skotiniotis, Barbara Kraus, and Wolfgang Dür
<b>Speaker/Presenter</b>	
	Michael Skotiniotis

<b>Abstract</b>	
	<p>We introduce a new quantum communication protocol for the transmission of quantum information under collective noise. Our protocol utilizes a decoherence-free subspace in such a way that an optimal asymptotic transmission rate is achieved, while at the same time encoding and decoding operations can be efficiently implemented. The encoding and decoding circuit requires a number of elementary gates that scale linearly with the number of transmitted qudits, <math>m</math>. The logical depth of our encoding and decoding operations is constant and depends only on the channel in question. For channels described by an arbitrary discrete group, <math>G</math>, perfect transmission at a rate <math>m/(m+r)</math> is achieved with an overhead that scales at most as <math>\mathcal{O}(d^r)</math> where the number of auxiliary qudits, <math>r</math>, solely depends on the group in question. and is independent of the number of transmitted qudits, <math>m</math>. For cyclic groups, we find that the overhead scales only linearly with the number of group elements <math> G </math>. For collective phase noise channels, associated with the group <math>U(1)</math>, we devise an efficient scheme for transmission of quantum data with arbitrarily high fidelity.</p>

<b>I wish to contribute</b>	
	a poster.
<b>Title</b>	
	Microscopic modelling of high-field charge transport in a-Se
<b>Author(s)</b>	

	Ali Darbandi and Oleg Rubel
<b>Speaker/Presenter</b>	
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<b>Abstract</b>	
	<p>The process in a material by which the energetic carrier ionize the other atoms and create electron-hole pairs is called impact ionization. The carriers should reach a certain threshold energy to initiate this process, however carriers lose their energy in a real material due to the scattering events [1]. Among various amorphous materials, avalanche multiplication can be seen only in amorphous Selenium (a-Se) at practical electric field. It is still unclear, what makes a-Se a unique disordered semiconductor that features impact ionization at practical electric fields? The purpose of the present communication is to uncover this question by analyzing the energy loss mechanism in charge carrier transport. The latter is performed by calculating the Fermi's golden rule transition rate using the electron-phonon interaction Hamiltonian [2]. Our microscopic modelling based on a density functional theory will lead to the development of solid state photon detectors for diagnostic medical imaging.</p> <p>References:</p> <ol style="list-style-type: none"> <li>1. O. Rubel et al , J. Phys. Condens. Matter, 23, (2011)</li> <li>2. A. Darbandi, O. Rubel, J. Non-Cryst. Solids (2011), doi:10.1016/j.jnoncrysol.2011.11.032</li> </ol>

I wish to contribute	
a poster.	
Title	
Study of the Ideality Factor for non-Ideal diodes	
Author(s)	
Mohammed Alzamil	
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Abstract	



Numerical calculation of the ideality factor of non ideal diodes has been performed. The diode cell was modulated in terms of a parallel connected double diode circuit model containing parasitic shunt and series resistance effects. The influence of the series resistance on the diode ideality factor has been investigated. At fixed temperature, the ideality factor remains nearly constant for a large range of the series resistance and then it starts to decrease at resistance around nearly  $105\ \Omega$ . The results indicated that the ideality factor reaches unity at currents  $0.5\ \mu\text{A}$ ,  $2.5\ \mu\text{A}$ ,  $3.9\ \mu\text{A}$  and  $4.2\ \mu\text{A}$  at temperatures 400 K, 300 K, 100 K and 77 K respectively. The influence of the temperature on the ideality factor has been analyzed. When the temperature increases the ideality factor decreases exponentially with a level depends on the fixed diode current. In general, the values of the ideality factor are small at 300 K and 400 K while these values are high at 100 K. The behavior of the ideality factor is investigated when the voltage is changed while the current of the diode is kept constant. When the voltage increases the ideality factor increases linearly.