Time/Day	Monday	Tuesday	Wednesday	Thursday
8.30–9.15 am	**A Godsil**	**E Thomason**	**I Solomon**	**M Abiad**
9.20–9.40 am	1 Zhan	10 Bukh	19 Srinivasan	24 Reichard
9.45–10.05 am	2 Ye	11 Martin	20 Sumalroj	25 Xu
10.05–10.35 am	break	break	break	break
10.35–10.55 am	3 Dalfó	12 Kamat	21 Bencs	26 Peng
11.00–11.20 am	4 McGinnis	13 Timmons	22 Guo	27 Kravitz
11.25–12.10 pm	**B Van Dam**	**F Balbuena**	**J Muzychuk**	**N Xiang**
12.10–2.00 pm	lunch	lunch	lunch	lunch
2.00–2.45 pm	**C Kantor**	**G Füredi**	**K Williford**	
2.50–3.10 pm	5 Gu	14 Tait	23 Ducey	
3.15–3.35 pm	6 Coutinho	15 Kodess	**L Woldar**	
3.40–4.00 pm	7 Greaves	16 Y. Wang		
4.00–4.30 pm	break	break		
4.30–4.50 pm	8 Fiol	17 Kronenthal		
4:55–5.15 pm	9 W. Wang	18 Moorhouse		
5.20–6.10 pm	**D Haemers**	**H Lazebnik**		

Monday, Aug 7	8.30–9.15 am	A **Chris Godsil**	Spectral invariants from embeddings
	9.20–9.40 am	1 Harmony Zhan	Quantum walks and mixing
	9.45–10.05 am	2 Dong Ye	Median eigenvalues and graph inverse
	10.35–10.55 am	3 Cristina Dalfó	Characterizing identifying codes from the spectrum of a graph or digraph
	11.00–11.20 am	4 Matt McGinnis	The smallest eigenvalues of the Hamming graphs
	11.25–12:10 pm	B **Edwin van Dam**	Partially metric association schemes with a small multiplicity
	2.00–2.45 pm	C **Bill Kantor**	MUBs
	2.50–3.10 pm	5 Xiaofeng Gu	Toughness, connectivity and the spectrum of regular graphs
	3.15–3.35 pm	6 Gabriel Coutinho	Average mixing matrix
	3.40–4.00 pm	7 Gary Greaves	Edge-regular graphs and regular cliques
	4.30–4.50 pm	8 Miguel Angel Fiol	An algebraic approach to lifts of digraphs
	4.55–5.15 pm	9 Wei Wang	A positive proportion of multigraphs are determined by their generalized spectra
	5.20–6.10 pm	D **Willem Haemers**	Spectral characterizations of mixed extensions of small graphs
Tuesday, Aug 8	8.30–9.15 am	E **Andrew Thomason**	List colourings and preference orders
	9.20–9.40 am	10 Boris Bukh	Ranks of matrices with few distinct entries
	9.45–10.05 am	11 Ryan Martin	An asymptotic multipartite Kühn-Osthus theorem
	10.35–10.55 am	12 Vikram Kamat	On Chvátal’s conjecture and Erdős-Ko-Rado graphs
	11.00–11.20 am	13 Craig Timmons	An extremal problem involving 4-cycles and planar polynomials
	11.25–12:10 pm	F **Camino Balbuena**	New small regular graphs of girth 5
	2.00–2.45 pm	G **Zoltán Füredi**	Designs and extremal hypergraphs problems
	2.50–3.10 pm	14 Mike Tait	Degree Ramsey numbers for even cycles
	3.15–3.35 pm	15 Alex Kodess	Algebraically defined digraphs
	3.40–4.00 pm	16 Ye Wang	On some cycles in linearized Wenger graphs
	4.30–4.50 pm	17 Brian Kronenthal	On the girth of some algebraically defined graphs
	4.55–5.15 pm	18 Eric Moorhouse	The eigenvalues of the graphs $D(4,q)$
	5.20–6.10 pm	H **Felix Lazebnik**	On some problems in combinatorics, graph theory and finite geometries
Wednesday, Aug 9	8.30–9.15 am	I **Ron Solomon**	All about the CFSG
	9.20–9.40 am	19 Murali Srinivasan	Eigenvalues and eigenvectors of the perfect matching association schemes
	9.45–10.05 am	20 Spalak Sumalroj	A new characterization of Q-polynomial distance-regular graphs
	10.35–10.55 am	21 Ferenc Bencs	Some results on the roots of independence polynomials
	11.00–11.20 am	22 Krystal Guo	Quantum walks on graphs
	11.25–12:10 pm	J **Misha Muzychuk**	On non-commutative association schemes of rank 6
	2.00–2.45 pm	K **Jason Williford**	The graphs $CD(k,q)$ and their relatives
	2.50–3.10 pm	23 Josh Ducey	The Smith group and the critical group of the Grassmann graph of lines in a finite projective space
	3:15-4:05 pm	L **Andy Woldar**	The underlying geometry of the graphs $CD(k;q)$
Thursday, Aug 10	8.30–9.15 am	M **Aida Abiad**	An application of Hoffman graphs for spectral characterizations of graphs
	9.20–9.40 am	24 Sven Reichard	Algorithms for coherent configurations
	9.45–10.05 am	25 Yian Xu	On constructing normal and non-normal Cayley graphs
	10.35–10.55 am	26 Xing Peng	Proof of a conjecture by Hansen and Lucas
	11.00–11.20 am	27 David Kravitz	Centrality measures in the real world
	11.25–12:10 pm	N **Qing Xiang**	Applications of linear algebraic methods in combinatorics and finite geometry

Plenary Talks

Aida Abiad
Maastricht University, The Netherlands
An application of Hoffman graphs for spectral characterizations of graphs

Godsil-McKay switching is an operation on graphs that does not change the spectrum of the adjacency matrix. Usually the obtained graph is non-isomorphic with the original graph. In this talk, we will discuss a sufficient condition for being isomorphic after switching, and give examples which show that this condition is not necessary. For some graph products we obtain sufficient conditions for being non-isomorphic after switching. As an example we find that the q-coclique extension of the square grid is not determined by its spectrum. In the second part of this talk we will see that, surprisingly, the 2-clique extension of the square grid is characterized by its spectrum. For the first time, Hoffman graphs are used to prove spectral characterizations of graphs.

Camino Balbuena
Universitat Politecnica de Catalunyia, Spain
New small regular graphs of girth 5

A (k, g)-graph is a k-regular graph with girth g, and a (k, g)-cage is a (k, g)-graph with the fewest possible number of vertices. The *Cage Problem* consists of constructing regular graphs of given girth g and minimum order. We focus on girth $g = 5$, where cages are known only for degree $k \leq 7$. We construct $(k, 5)$-cages using techniques exposed by Funk [Note di Matematica. 29 (2009) 91-114] and Abreu et al. [Discrete Math. 312 (2012) 2832-2842] to obtain the best upper bounds known hitherto. The talk is mainly based on the joint work with E. Abajo, G. Araujo-Pardo and M. Bendala.

Edwin van Dam
Tilburg University, The Netherlands
Partially metric association schemes with a small multiplicity

An association scheme is called partially metric if it has a connected relation whose distance-two relation is also a relation of the scheme. We determine the symmetric partially metric association schemes with a multiplicity three. Among these are schemes related to the Platonic solids and to well-known 2-arc-transitive covers of the cube: the Möbius-Kantor graph, the Nauru graph, and the Foster graph F048A. Moreover, we construct an infinite family of cubic arc-transitive graphs that give rise to non-commutative association schemes with a symmetric relation of valency three and an eigenvalue with multiplicity three. This is joint work with Jack Koolen and Jongyook Park.

Zoltán Füredi
University of Illinois, Urbana-Champaign, USA and Rényi Institute, Hungary
Designs and Extremal Hypergraphs Problems

Let $\mathcal{F}$ be a (finite) class of k-uniform hypergraphs, and let $\mathrm{ex}(n, \mathcal{F})$ denote its Turan number, i.e., the maximum size of the $\mathcal{F}$-free, n-vertex, k-uniform hypergraphs. In other words, we consider maximal k-hypergraphs satisfying a local constraint. E.g., a Steiner system $S(n, k, t)$ is just a maximum k-hypergraph with no two sets intersecting in t or more elements.

In this lecture old and new *Turán type problems* are considered. We emphasize constructions applying algebraic/design theoretic tools with some additional twists. As an example, here is a conjecture from the 1980's.

Let $\mathcal{U} = \{123, 456, 124, 356\}$ and $\mathcal{H}$ be a $\mathcal{U}$-free triple system on n vertices. I.e., $\mathcal{H}$ does not contain four distinct members $A, B, C, D \in \mathcal{H}$ such that $A \cap B = C \cap D = \emptyset$ and $A \cup B = C \cup D$, in other words, $\mathcal{H}$ does not have two disjoint pairs with the same union. We conjecture that $|\mathcal{H}| \leq \binom{n}{2}$. Equality can be obtained by replacing the 5-element blocks of an $S(n, 5, 2)$ by its 3-subsets.

Chris Godsil
University of Waterloo, Canada
Spectral Invariants from Embeddings

I will discuss two recent projects that use graph embeddings to provide spectral invariants of graphs:

1) A *sesquivalent graph* is a graph where each vertex has degree one or two, equivalently each component is an edge or a cycle. The characteristic polynomial of a graph X can be defined as a weighted sum over the sesquivalent subgraphs of X. If X is embedded in a surface, we can define a modified polynomial where we restrict the above to the sesquivalent subgraphs that only use contractible cycles. This gives us a family of polynomials, with the characteristic polynomial and the matching polynomial as extreme cases. I will describe some recent work (joint with K. Guo and H. Zhan) on these polynomials.

2) A discrete quantum walk on a graph is a unitary matrix with rows and columns indexed by the arcs (ordered pairs of adjacent vertices) of the graph. There are further restrictions and, in a range of interesting cases, to specify the walk we must specify an embedding of the underlying graph in a surface. The goal now is to relate properties of the quantum walk with properties of the embedding. (This is joint work with H. Zhan.)

Willem Haemers
Tilburg University, The Netherlands
Spectral characterizations of mixed extensions of small graphs

A mixed extension H of a graph G is obtained by replacing each vertex of G by a clique or a coclique, where vertices of H coming from different vertices of G are adjacent if and only if the original vertices are adjacent in G. If G and H have order m and n respectively, then H has at least $n-m$ adjacency eigenvalues equal to 0 or -1. So, if G has no more than three vertices, H has all by at most three eigenvalues equal to 0 or -1.

In the talk we consider the converse problem, and determine the class $\mathcal{G}$ of all connected graphs with at most three eigenvalues unequal to 0 and -1. We find that $\mathcal{G}$ consists of all mixed extensions of connected graphs on at most three vertices together with some particular mixed extensions of the paths P_4 and P_5.

William M. Kantor
University of Oregon, USA
MUBs

Versions of Mutually Unbiased Bases arise in various contexts: quantum physics, correlations of complex sequences, orthogonal decompositions of complex Lie algebras, Euclidean configurations, coding theory, finite symplectic geometry and projective planes. This talk will briefly describe their occurrence in complex geometry and finite projective planes, stating some known results and the many open questions concerning MUBs.

Felix Lazebnik
University of Delaware, USA
On some problems in combinatorics, graph theory and finite geometries

In this talk I will discuss several problems I worked on, mention related old and new results, and share several questions that I am interested in.

Misha Muzychuk
Netanya Academic College, Israel
On non-commutative association schemes of rank 6

An association scheme is a coloring of a complete graph satisfying certain regularity conditions. It is a generalization of groups and has many applications in algebraic combinatorics. Every association scheme yields a special matrix algebra called the Bose-Mesner algebra of a scheme. A scheme is called commutative if its Bose-Mesner algebra is commutative. Commutative schemes were the main topic of the research in this area for decades. Only recently non-commutative association schemes attracted attention of the researches. In my talk I'll present the results about non-commutative association schemes of the smallest possible rank, namely the rank 6. This is a joint work with A. Herman and B. Xu.

Ron Solomon
Ohio State University, USA
All about the CFSG

Rabbi Hillel was asked to explain the Torah while staying on one foot. A comparable challenge is to explain the proof of the Classification of Finite Simple Groups in one lecture. I will try. And like Hillel, I will end by saying, "Now, go and study it yourself."

Andrew Thomason
University of Cambridge, England.
List colourings and preference orders

The list colouring number of a graph, or hypergraph, is the smallest number k such that whenever, for each vertex, we specify a list of k colours that might be used there (the colours being from some large palette), then it is possible to choose a colour for each vertex from its own list, so that no edge has all vertices the same colour.

Unlike the ordinary chromatic number, the list colouring number grows with the average degree. We describe recent progress in understanding this phenomenon. It turns out that an effective algorithm for colouring relevant types of hypergraphs, such as latin square graphs, can be based on a simple notion that we call preference orders. (The work described is joint with Arès Méroueh.)

Jason Williford
University of Wyoming, USA
The Graphs $CD(k,q)$ and Their Relatives

Two decades ago, Lazebnik, Ustimenko and Woldar published the paper "A New Series of Dense Graphs of High Girth", introducing the graphs $CD(k,q)$. Twenty-two years later, these graphs still give the best known lower bounds for Turan type problems on even cycles of length greater than 14, despite a large gap between these lower bounds and the corresponding upper bounds. In this talk, we will explore families of graphs which are natural relatives of $CD(k,q)$, but whose cycle spectra are unknown. This and other open problems on these graphs will be discussed. The construction is based on certain generalized Kac-Moody algebras.

Andrew Woldar
Villanova University, USA
The underlying geometry of the graphs $CD(k;q)$

The graphs $CD(k;q)$ arose in the context of extremal graph theory, due to the fact that they have the greatest number of edges among all known graphs of a fixed order and girth at least g for $g \geq 5, g \neq 11, 12$. (For $g = 11, 12$, the generalized hexagon of type G_2 performs slightly better.) They have since been shown to have broad application to coding theory and cryptography, and they serve as credible candidates for infinitely many families of bipartite expanders of fixed valency.

Although it is fairly straightforward to define the graphs $CD(k;q)$ in terms of certain numerical adjacency relations, there is a plethora of deep mathematics underlying their construction. This includes first identifying a candidate family of nested rank-2 geometries that closely mimic the behavior of generalized polygons of type A_2, B_2, and then exploiting a method of V.A. Ustimenko for embedding these geometries into the corresponding affine Lie algebra. As a consequence of this embedding, one obtains the desired adjacency relations.

Qing Xiang
University of Delaware, USA
Applications of Linear Algebraic Methods in Combinatorics and Finite Geometry

Most combinatorial objects can be described by incidence, adjacency, or some other $(0,1)$-matrices. So one basic approach in combinatorics is to investigate combinatorial objects by using linear algebraic parameters (ranks over various fields, spectrum, Smith normal forms, etc.) of their corresponding matrices. In this talk, we will look at some successful examples of this approach; some examples are old, and some are new. In particular, we will talk about the recent bounds on the size of partial spreads of $H(2d-1, q^2)$ and on the size of partial ovoids of the Ree-Tits octagon.

Contributed Talks

Ferenc Bencs
Central European University, Hungary
Some results on the roots of independence polynomials

The independence polynomial of a graph G is $I(G,x) = \sum_{k\geq 0} i_k(G)x^k$, where $i_k(G)$ denotes the number of independent sets of G of size k (note that $i_0(G) = 1$). In this talk we will investigate some properties of this graph polynomial. As an application we will have a new method to prove the real-rootedness of the independence polynomial of some graph families (e.g. centipede, caterpillar, Fibonacci tree). Moreover we will see that the root counting measure of the independence polynomial of any sequence of d-regular graphs with girth tending to infinity weakly converges to a measure on the reals.

Boris Bukh
Carnegie Mellon University, USA
Ranks of matrices with few distinct entries

Many applications of linear algebra method to combinatorics rely on the bounds on ranks of matrices with few distinct entries and constant diagonal. In this talk, I will explain some of these application. I will also present a classification of sets L for which no low-rank matrix with entries in L exists.

Gabriel Coutinho
Federal University of Minas Gerais, Brazil
Average Mixing Matrix

Given a symmetric n by n matrix M, M induces a decomposition of $\mathbb{R}^n$ into the direct sum of its orthogonal eigenspaces, and to each of them, there is a corresponding orthogonal projection. We associate to M another matrix, say M', which is the sum of the entry-wise squares of these projections. This matrix satisfies many interesting properties: it is (1) doubly-stochastic (2) positive semi-definite (in fact, completely positive semi-definite) (3) non-negative (4) rational if M is rational; and (5) the average of the mixing matrices of a quantum walk defined on M.

In this talk, we investigate some properties of M'. For instance, we try to characterize when M' has low rank, and to derive combinatorial properties of M based on the spectrum of M'.

Cristina Dalfó
Universitat Politecnica de Catalunyia, Spain
Characterizing identifying codes from the spectrum of a graph or digraph

A $(1,\ell)$-identifying code in a digraph D is a dominating subset C of vertices of D, such that all distinct subsets of vertices of D with cardinality at most ℓ have distinct closed in-neighbourhoods within C. In this talk we study the relation between identifying codes in digraphs and their spectra. The obtained results can also be applied on graphs.

Joshua Ducey
James Madison University, USA
The Smith group and the critical group of the Grassmann graph of lines in a finite projective space

The Smith group and critical group of a graph are the groups presented by the Smith normal form of an adjacency or Laplacian matrix of the graph, respectively. In this talk methods of representation theory are applied to compute these for the Grassmann graph of 2-dimensional subspaces of a finite vector space. The corresponding invariants of the complement graph (skewness relation of lines in projective space) are also computed.

Miquel Angel Fiol
Universitat Politecnica de Catalunyia, Spain
An algebraic approach to lifts of digraphs

We study the relationship between two key concepts in the theory of (di)graphs: the quotient digraph, and the lift Γ^{α} of a base (voltage) digraph. These techniques contract or expand a given digraph in order to study its characteristics, or obtain more involved structures. This study is carried out by introducing a quotient-like matrix, with complex polynomial entries, which fully represents Γ^{α}. In particular, such a matrix gives the quotient matrix of a regular partition of Γ^{α}, and it completely determines the spectrum of Γ^{α}. As some examples of our techniques, we study some basic properties of the Alegre digraph, and in addition we completely characterize the spectrum of a new family of digraphs, which contains the generalized Petersen graphs. This is joint work with C. Dalfó, M. Miller^{c}, J. Ryan, and J. Širáň

Gary Greaves
Nanyang Technological University, Singapore
Edge-regular graphs and regular cliques

We solve a problem of Neumaier about the existence of non-strongly-regular edge-regular graphs that possess regular cliques. In this talk, we will present a construction of such graphs. This talk is based on joint work with Jack Koolen.

Xiaofeng Gu
University of West Georgia, USA
Toughness, connectivity and the spectrum of regular graphs

The toughness $t(G)$ of a connected graph G is defined as $t(G) = \min \frac{|S|}{c(G-S)}$, where the minimum is taken over all proper subset $S \subset V(G)$ such that $c(G-S) > 1$. This parameter was introduced by Chvátal in 1973 and is closely related to many graph properties, including Hamiltonicity, pancyclicity and spanning trees. In this talk, we will discuss the relationship between toughness and eigenvalues of a regular graph, as well as some related problems. This is joint work with Sebastian M. Cioabă at University of Delaware.

Krystal Guo
University of Waterloo, Canada
Quantum walks on graphs

Quantum walks are an important concept in the study of quantum algorithms, which have been shown to perform exponentially or polynomially better for various black box problems. Problems about quantum walks on graphs provide new applications of techniques in algebraic graph theory, and also produce numerous interesting mathematical problems about the eigenvalues of graphs. We discuss some of these problems.

Vikram Kamat
Virginia Commonwealth University, USA
On Chvátal's conjecture and Erdős-Ko-Rado Graphs

A fundamental theorem of Erdős, Ko and Rado states that the size of a family of pairwise intersecting r-subsets of $[n] = \{1, \ldots, n\}$, when $r \leq n/2$, is at most $\binom{n-1}{r-1}$, with equality holding in the case $r < n/2$ if and only if is a collection of all r-subsets containing a fixed element. In this talk, we focus our attention on a longstanding conjecture of Chvátal that aims to generalize the EKR theorem for *hereditary* set systems and another closely-related conjecture of Holroyd and Talbot pertaining to a graph-theoretic generalization of the EKR theorem for independent sets in graphs. We present a result that verifies Chvátal's conjecture for hereditary families containing sets of size at most 3, and also multiple results that verify the Holroyd-Talbot conjecture and its variants for certain graph classes.

Alex Kodess
University of Rhode Island, USA
Algebraically Defined Digraphs

Let q be a prime power, $\mathbb{F}_q$ denote the finite field of q elements. Let $f_i\colon \mathbb{F}_q^2 \to \mathbb{F}_q$ be arbitrary functions, $1 \leq i \leq l$. The digraph $D = D(q; \mathbf{f})$, where $\mathbf{f} = (f_1, \ldots, f_l)\colon \mathbb{F}_q^2 \to \mathbb{F}_q^l$, is defined as follows. The vertex set V of D is $\mathbb{F}_q^{l+1}$. There is an arc from $(x_1, \ldots, x_{l+1}) \in V$ to $(y_1, \ldots, y_{l+1}) \in V$ if and only if $x_i + y_i = f_{i-1}(x_1, y_1)$ for all $i, 2 \leq i \leq l+1$.

When $l = 1$ and $f = f_1$ can be represented by the polynomial $X_1^m X_2^n$, the digraph $D = D(q; m, n)$ is called a *monomial* digraph. The digraphs $D(q; \mathbf{f})$ and $D(q; m, n)$ are directed analogues of a well studied class of algebraically defined undirected bipartite graphs $B\Gamma(q; \mathbf{f})$ having many applications, most noticeably in extremal graph theory supplying a lower bound of the best magnitude on some $\mathrm{ex}(n, C_{2l})$.

We present a number of results on the strong connectivity of the general algebraic digraph $D(q; \mathbf{f})$ and the diameters of monomial digraphs. We also discuss the isomorphism problem for all monomial digraphs for a fixed q.

David Kravitz
RAND Corporation
Centrality Measures in the Real World

Centrality measures are popular in the analysis of many types of graphs. From social media, to college football to rankings, to pages for search engines, the value of knowing the highest ranking entities is enormous. Here we show the algorithms that are used the most, along with the algorithms which are most effective, along with several real-world examples illustrating the effectiveness of each.

Brian Kronenthal
Kutztown University, USA
On the girth of some algebraically defined graphs

In this talk, we will discuss algebraically defined bipartite graphs. Indeed, let $\mathbb{F}$ denote a field, and consider the bipartite graph with partite sets $P = \mathbb{F}^3 = L$ such that $(p_1, p_2, p_3) \in P$ and $[\ell_1, \ell_2, \ell_3] \in L$ are adjacent if and only if $p_2 + \ell_2 = p_1\ell_1$ and $p_3 + \ell_3 = p_1\ell_1^2$. This graph has girth eight, and of particular interest is whether it is possible to alter these equations by replacing $p_1\ell_1$ and $p_1\ell_1^2$ with other bivariate polynomials to create a nonisomorphic girth eight graph. In addition to discussing some results related to this question, we will also explain the connection between algebraically defined graphs and the point-line incidence graphs of generalized quadrangles, which partially motivates the study of the objects in this talk.

Ryan R. Martin
Iowa State University, USA
An asymptotic multipartite Kühn-Osthus theorem

An h-vertex graph H is said to perfectly tile an n-vertex graph G if there is a subgraph of G consisting of n/h vertex-disjoint copies of H. Kühn and Osthus showed that n sufficiently large, $h \mid n$, and $\delta(G) \geq \left(1 - \frac{1}{\chi^*(H)}\right) n + C$ is sufficient for a perfect H-tiling. Here, $\chi^*(H)$ is a parameter related to Komlós' critical chromatic number and C is a constant depending only on H. This generalizes classical results by Hajnal and Szemerédi, among others.

When the underlying graph is a balanced multipartite graph, the picture changes and seems even more difficult. We prove an asymptotic multipartite version of the Kühn-Osthus result. For an r-partite graph G, the relevant parameter is denoted $\delta^*(G)$, the minimum number of neighbors a vertex in G has in any of the other $r-1$ vertex classes. We show that if H is an h-vertex, r-colorable graph, $\alpha > 0$ is fixed, n is sufficiently large, and $h \mid n$, then any balanced r-partite graph G on rn vertices with $\delta^*(G) \geq \left(1 - \frac{1}{\chi^*(H)}\right) n + \alpha n$, then G has a perfect H tiling. Moreover, this cannot be improved, apart from replacing the αn term by a constant C.

This talk is based on joint work with Richard Mycroft and Jozef Skokan.

Matt McGinnis
University of Delaware, USA
The smallest eigenvalues in the Hamming scheme

We prove a conjecture of Van Dam and Sotirov on the smallest eigenvalues of graphs in the Hamming association scheme.

Eric Moorhouse
University of Wyoming, USA
The eigenvalues of the graphs $D(4, q)$

In a series of papers, Lazebnik, Woldar and Ustimenko have considered infinite families of graphs defined algebraically over $\mathbb{F}_q$. In particular for each q they consider a sequence of covering graphs $\cdots \to D(4, q) \to D(3, q) \to D(2, q)$ where $D(k, q)$ is bipartite q-regular on $2q^k$ vertices. The graph $CD(k, q)$ (a connected component of $D(k, q)$) is notable for its extremal and expansion properties. It has been conjectured that the eigenvalues of $CD(k, q)$, other than $\pm q$, have absolute value bounded by $2\sqrt{q}$; and this has been known for several years for $k < 4$ by explicit computation of the spectrum. We determine the spectrum for $k = 4$ and find that the bound $2\sqrt{q}$ holds. (Joint work with Jason Williford and Shuying Sun).

Xing Peng
Tianjin University, China
Proof of a conjecture by Hansen and Lucas

For a connected graph, Hansen and Lucas (2010) conjectured that the ratio of the signless Laplacian spectral radius to the Randic index can be bounded from above by a function of the number of vertices. In this talk, we will present a proof of this conjecture.

Sven Reichard
TU Dresden, Germany
Algorithms for Coherent Configurations

Computation plays a big role in Algebraic Graph Theory. Computer architecture has evolved from single processors with uniform memory access to multi-core systems with with a hierarchical memory system. We consider two problems related to coherent configurations, namely Weisfeiler-Leman stabilization and enumeration of mergings. We discuss practically efficient implementations of their solutions.

Supalak Simalroj
Silpakorn University, Thailand
A new characterization of Q-polynomial distance-regular graphs

Given a primitive distance-regular graph Γ. We use intersection numbers to find a positive semidefinite matrix with integer entries. We show the matrix has determinant zero if and only if Γ is Q-polynomial.

Murali Srinivasan
Indian Institute of Technology, Bombay, India
Eigenvalues and eigenvectors of the perfect matching association scheme

The symmetric group S_{2n} has a natural action on the perfect matchings of the complete graph K_{2n}. The corresponding (complex) permutation representation is multiplicity free. The commutant of this action is the Bose-Mesner algebra of the perfect matching association scheme. We inductively write down a (common) canonical orthogonal eigenbasis (the so called Gelfand-Tsetlin basis) for the elements of the Bose-Mesner algebra. The orbital basis of the Bose-Mesner algebra is indexed by even partitions of $2n$ (i.e., partitions of 2n with all parts even) and the common eigenspaces of the elements of the Bose-Mesner algebra are indexed by even Young diagrams with $2n$ boxes (i.e., Young diagrams with $2n$ boxes with all rows of even length). Any even partition $\mu \vdash 2n$ can also be regarded as an even partition of $2m$, for $m \geq n$, by adding $m - n$ parts equal to 2 to μ. Let $\mu \vdash 2n$ be an even partition and let λ be a Young diagram with $2m$ boxes, $m \geq n$. Regarding μ as an even partition of $2m$ as above, we show that the eigenvalue of the orbital basis element indexed by μ on the eigenspace indexed by λ depends only on λ and is a symmetric function of the multiset of contents of the Young diagram ?.

Michael Tait
Carnegie Mellon University, USA
Degree Ramsey numbers for even cycles

Let $H \xrightarrow{s} G$ denote that any s-coloring of $E(H)$ contains a monochromatic G. The degree Ramsey number of a graph G, denoted by $R_\Delta(G, s)$, is $\min\{\Delta(H) : H \xrightarrow{s} G\}$. We consider degree Ramsey numbers where G is a fixed even cycle. Kinnersley, Milans, and West showed that $R_\Delta(C_{2k}, s) \geq 2s$, and Kang and Perarnau showed that $R_\Delta(C_4, s) = \Theta(s^2)$. Our main result is that $R_\Delta(C_6, s) = \Theta(s^{3/2})$ and $R_\Delta(C_{10}, s) = \Theta(s^{5/4})$. Additionally, we substantially improve the lower bound for $R_\Delta(C_{2k}, s)$ for general k.

Craig Timmons
California State University, Sacramento, USA
An extremal problem involving 4-cycles and planar polynomials

Suppose that G is a 3-partite graph with k vertices in each part and between any two parts, there is no cycle of length four. How many triangles can such a graph have? Using a specific planar polynomial over a finite field, we show that there is such a graph with roughly $k^{5/3}$ triangles. This is joint work with Robert Coulter and Rex Matthews.

Wei Wang
School of Mathematics and Statistics, Xian Jiaotong University, China
A positive proportion of multigraphs are determined by their generalized spectra

A multigraph G is determined by its generalized spectrum if any multigraph that is cospectral with G with cospectral complement is isomorphic to G. In this talk, we show that a positive proportion of multigraphs are determined by their generalized spectra. This is joint work with Tao Yu.

Ye Wang
Shanghai Lixin University of Accounting and Finance, China
On some cycles in Linearized Wenger graphs

Let $\mathbb{F}_q$ be the finite field of q elements for prime power q and let p be the character of F_q. For any positive integer m, the linearized Wenger graph $L_m(q)$ is defined as follows: it is a bipartite graph with the vertex partitions being two copies of the $(m+1)$-dimensional vector space $\mathbb{F}_q^{m+1}$, and two vertices $p = (p(1), ..., p(m+1))$ and $l = [l(1), ..., l(m+1)]$ being adjacent if $p(i) + l(i) = p(1)(l(1))^{p^{i-2}}$, for all $i = 2, 3, ..., m+1$. In this paper, we show that for any positive integers m and k with $3 < k < p^2$, $L_m(q)$ contains even cycles of length $2k$ which is an open problem put forward by Cao et al. (2015).

Yian Xu
University of Western Australia, Australia
On Constructing Normal and Non-Normal Cayley Graphs

We call a graph that is normal and non-normal for two isomorphic regular groups an NNN-graph. Bamberg and Giudici (2011) showed that the point graphs of certain generalised quadrangles of order $(q-1, q+1)$, where $q = p^k$ is a prime power with $p \geq 5$, are NNN-graphs (we call these graphs BG-graphs) and Royle (2008) proved that the halved folded 8-cube is an NNN-graph for $\mathbb{Z}_2^6$. In this talk, we show that the Cayley graphs obtained from a finite number of BG-graphs by Cartesian product, direct product, and strong product are NNN-graphs, and based on the same arguments, we show that there exists an NNN-graph for $\mathbb{Z}_2^k$ if and only if $k \geq 6$.

Dong Ye
Middle Tennessee State University, USA
Median Eigenvalues and Graph Inverse

Let G be a graph and A be its adjacency matrix. The eigenvalues of A are also called the eigenvalues of G, denoted in decreasing order by $\lambda_1(G) \geq \lambda_2(G) \geq \cdots \geq \lambda_n(G)$ where n is the number of vertices of G. The two eigenvalues $\lambda_{\lfloor (n+1)/2 \rfloor}$ and $\lambda_{\lceil (n+1)/2 \rceil}$ are called median eigenvalues of G, which have physical meanings in quantum Chemistry. In this talk, we are going to present using graph inverse to bound the median eigenvalues, and a characterization of bipartite graphs with a unique perfect matching whose inverses are balanced signed graphs, which answers a question of Godsil.

Harmony Zhan
University of Waterloo, Canada
Quantum Walks and Mixing

A quantum walk on a graph is determined by the transition matrix $U(t) = exp(itA)$, where A is the adjacency matrix of the graph. The Schur product of the transition matrix with its inverse, $U(t) \circ U(-t)$, is doubly stochastic at any time t, and thus represents probability distributions of the walk. We say a graph admits uniform mixing at time τ if $U(\tau)$ is flat. While this is a rare phenomenon, various tools have been applied in characterizing uniform mixing. We will give an overview of some of the results, with an emphasis on the algebraic techniques involved.