U.S. - China
Young Physicists Forum

February 28 - March 1, 2015
San Antonio, Texas

APS physics

中国物理学会
Chinese Physical Society

U.S. – China Young Physicists Forum
Advisory Committee Members

China

Professor Wei Bao, Chief Scientist, Laboratory of Condensed Matter Physics
Renmin University of China

Professor Xi Chen, Chair, Department of Physics
Tsinghua University

Professor Xi Dai, Assistant Director, Institute of Physics
Chinese Academy of Sciences

Professor Jianxin Li, Dean, School of Physics
Nanjing University

Professor Jian Shen, Chair, Department of Physics
Fudan University

Professor Xincheng Xie, Dean of Physics School
Peking University

Professor Zhenyu Zhang, University of Science and Technology of China

United States

Dr. Ercan Alp, Argonne National Laboratory,

Professor Gang Cao, Department of Physics and Astronomy
University of Kentucky

Professor E. Dan Dahlberg, School of Physics and Astronomy
University of Minnesota

Dr. Amy Flatten, Director of International Affairs
American Physical Society

Professor Laura H. Greene, Department of Physics and Materials Research Laboratory
University of Illinois at Urbana-Champaign

Professor Arthur Ramirez, University of California-Santa Cruz

Dr. Mu Wang, Associate Editor, Physical Review Letters (PRL)
Outreach Coordinator for APS Journals in China

We also gratefully acknowledge

Michele Irwin, International Programs Administrator, American Physical Society
Vinaya Sathyasheelappa, Senior Meeting Planner, American Physical Society
The Division of Condensed Matter Physics, APS
The Division of Materials Physics, APS

U.S. - China
Young Physicists Forum

General Program

Saturday, February 28, 2015

8:30-9:00	**Registration & Continental Breakfast (Room 201, Convention Center)**
9:00-9:20	**Welcoming Remarks** **Dr. Kate Kirby**, Chief Executive Officer, American Physical Society **Dr. Qikun Xue**, Executive Council, Chinese Physical Society **Dr. Li Lu**, Executive Council, Chinese Physical Society
9:20-9:30	**Introductions & Orientation** **Dr. Amy Flatten**, Director of International Affairs, American Physical Society
9:30-10:30	**Plenary Session – I (Room 201)** **A. Patterning Electronic States in Complex Oxides: A New Avenue Towards Designer's Materials** **Prof. Jian Shen**, Department of Physics, Fudan University **B. Magnetic Reversal in Stadium Shaped Particles** **Prof. E. Dan Dahlberg**, School of Physics and Astronomy, University of Minnesota
10:30-11:00	**Coffee Break**
11:00-12:30	**Parallel Sessions - I (Student Speakers)** A. Condensed Matter Physics **(Room 202 B)** B. Materials Physics, Condensed Matter Physics, Other **(Room 203 A)** C. Materials Physics, Condensed Matter Physics, Other **(Room 203 B)**
12:30-1:30	**Box Lunch (Room 202 A)**
1:30-3:00	**Publishing in Peer Reviewed Journals: The Basics of Writing a Good Manuscript (Room 201)** **Prof. Laura H. Greene**, Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign Vice-President, American Physical Society
3:00-5:00	**Panel Session on Careers Outside of Academia in the U.S. and China (Room 201)** Moderator: **Dr. Steven Lambert**, Industrial Physics Fellow, American Physical Society **Prof. Kai-li Jiang**, Department of Physics, Tsinghua University **Dr. Chris Keener**, HGST, a Western Digital company **Prof. Yalin Lu**, Department of Materials Science and Engineering, University of Science and Technology of China **Dr. John Rodriguez**, Texas Instruments

General Program

5:00-6:00	**BREAK until evening events** (poster set-up)
6:00-7:30	**Poster Session & Networking Reception** (Bowie Foyer, Hyatt Hotel)
7:30	**Banquet & photos** (Bowie Room, Hyatt Hotel)

Remarks by:
Dr. Sam Aronson, President, American Physical Society
Dr. Qikun Xue, Executive Council, Chinese Physical Society

Sunday, March 1, 2015

8:30-9:00 — **Continental Breakfast**

9:00-10:00 — **Plenary Session - II** (Room 201)

A. **Atomic Level Control of Quantum Material Growth: From Quantized Anomalous Hall Effect to Interface Enhanced High Temperature Superconductivity**
Dr. Qikun Xue, Tsinghua University
Executive Council, Chinese Physical Society

B. **Physical Constraints on the Tc of Superconductors**
Prof. Malcolm Beasley, Stanford University
Past-President, American Physical Society

10:00-11:30 — **Parallel Sessions – II** (Student Speakers)

A. Condensed Matter Physics **(Room 202 B)**
B. Materials Physics, Condensed Matter Physics, Other **(Room 203 A)**
C. Materials Physics, Condensed Matter Physics, Other **(Room 203 B)**

11:30-12:30 — **Panel Discussion on Life as a Graduate Student in China and the United States** (Room 201)

12:30-2:00 — **Networking Lunch** (Room 202 A)

Remarks by:
Prof. Malcolm Beasley, Past-President, American Physical Society
Prof. Jian Shen, Department of Physics, Fudan University

After Lunch — **APS March Meeting Registration**

U.S.-China Young Physicists Forum participants may use this time to register and pick up their materials for the 2015 March Meeting that will begin on Monday.

U.S. - China
Young Physicists Forum

Parallel Sessions

Saturday, February 28, 2015

Session I.A: Condensed Matter Physics (Room 202 B)

11:00 – 11:15	**A-1:**	**Jin-Ke Bao**, Zhejiang University **Exploring New Superconductivity in Antiferromagnetic Compounds by Chemical Doping**
11:15 – 11:30	**A-2:**	**Saicharan Aswartham,** University of Kentucky **Synthesis and Physical Properties of Iron Based Superconductors**
11:30 – 11:45	**A-3:**	**Hao Ding,** Tsinghua University **Interface-Induced High-Temperature Superconductivity in FeSe/TiO2(001) Heterostructure**
11:45 – 12:00	**A-4:**	**Hamilton Carter,** Texas A&M University **Experimental Probe of Ionizing Radiation from Superconductors Predicted by the Hole Theory of Superconductivity**
12:00 – 12:15	**A-5:**	**Hongli Guo,** University of Science and Technology of China **Polar-nonpolar Oxide Heterostructures for PhotocatalysiS**
12:15 – 12:30	**A-6:**	**Eteri Svanidze,** Rice University **Ti_{1-x}Au_x Alloys: Hard Biocompatible Metals and Their Possible Applications**

Session I.B: Materials Physics, Condensed Matter Physics, Other (Room 203 A)

11:00 – 11:15	**B-1:**	**Trevor Keiber**, University of California, Santa Cruz **An EXAFS Study of the Local Distortions in Thermoelectric Clathrates**
11:15 – 11:30	**B-2:**	**Mingqiang Gu**, Nanjing University **Controlling the Dimensionality of the Octahedra Network in SrRuO3/SrTiO3 Superlattice**
11:30 – 11:45	**B-3:**	**Kyle McElhinny**, University of Wisconsin - Madison **Mapping Nano Scale Phonons in Three Dimensions Via X-ray Thermal Diffuse Scattering**
11:45 – 12:00	**B-4:**	**Tao Jiang**, Fudan University **Interplay of Spin, Valley and Layer Pseudospins in Folded MoS2 Bilayers**

Parallel Sessions

12:00 – 12:15 B-5: Junhao Lin, Vanderbilt University
Vacancy-induced Formation and Growth of Inversion Domains in Transition-metal Dichalcogenide Monolayer

12:15 – 12:30 B-6: Yijun Yu, Fudan University
Tantalum Disulfide Ionic Field-Effect Transistors

Session I.C: Materials Physics, Condensed Matter Physics, Other (Room 203 B)

11:00 – 11:15 C-1: Samuel Markson, University of Connecticut
Pathways to Heavy Rydberg States

11:15 – 11:30 C-2: Shangchi Jiang, Nanjing University
Controlling the Polarization State of Light with a Dispersion-Free Metastructure

11:30 – 11:45 C-3: Travis Scholten, University of New Mexico
Physics for Computation: Using Novel Devices to Solve Hard Problems

11:45 – 12:00 C-4: Chong Sheng, Nanjing University
Trapping Light by Mimicking Gravitational Lensing

12:00 – 12:15 C-5: Shengtao Wang, University of Michigan - Ann Arbor
Quantized Electromagnetic Response of Three-Dimensional Chiral Topological Insulators

12:15 – 12:30 C-6: Xiangkun Xu, University of Science and Technology of China
Experimental Observing Non-Markovianity of Quantum Evolution with Entanglement in Solid State System

Sunday, March 1, 2015

Session II.A: Condensed Matter Physics (Room 202 B)

10:00 – 10:15 A-1: Defa Liu, Chinese Academy of Sciences
Electron Structure of FeSe/STO Film Revealed by ARPES

10:15 – 10:30 A-2: Jasminka Terzic, University of Kentucky
Magnetism and Anisotropy of Ir5+ Based Double Perovskites Sr2CoIrO6 and Sr2FeIrO6

10:30 – 10:45 A-3: Yafei Ren, University of Science and Technology of China
Single-Valley Engineering in Graphene Superlattices

10:45 – 11:00 A-4: Hilary Hurst, University of Maryland, College Park
Charged Skyrmions on the Surface of a 3D Topological Insulator

11:00 – 11:15 A-5: **Tong Zhou**, Fudan University
Controlled Formation of GeSi Nanostructures on Pillar-Patterned Si Substrates

11:15 – 11:30 A-6: **Jinchen Wang**, Joint PhD Program: University of Kentucky/Renmin University of China
Lattice-Tuned Magnetism of Ru4+(4d4) Ions in Single Crystals of the Layered Honeycomb Ruthenates

Session II.B: Materials Physics, Condensed Matter Physics, Other (Room 203 A)

10:00 – 10:15 B-1: **Yanming Che**, Zhejiang University
Effects of Nonmagnetic Impurities Throughout the BCS-BEC Crossove

10:15 – 10:30 B-2: **Feng Junya**, Institute of Physics, Chinese Academy of Sciences
Large Linear Magnetoresistance in Dirac Semi-Metal Cd3As2 with Fermi Surfaces Close to the Dirac Points

10:30 – 10:45 B-3: **Jesse Crossno**, Harvard University
Graphene Thermal Transport Studies via Radio-Frequency, Cross-Correlated Johnson Noise Thermometry

10:45 – 11:00 B-4: **Zibo Wang**, International Center for Quantum Materials, Peking University
Building Topological Device Through Emerging Robust Helical Surface States

11:00 – 11:15 B-5: **Shafat Mubin**, Pennsylvania State University
Forces and Dynamics in Aromatic Overlayers on Metal Surfaces

11:15 – 11:30 B-6: **Xiangzhi Meng**, International Center for Quantum Materials, Peking University
Direct Visualization of Concerted Proton Tunneling in a Water Nanocluster

Session II.C: Materials Physics, Condensed Matter Physics, Other (Room 203 B)

10:00 – 10:15 C-1: **Wei Qin**, University of Science and Technology of China
Persistent Ferromagnetism and Topological Phase Transition at the Interface of a Superconductor and a Topological Insulator

10:15 – 10:30 C-2: **Yilin Wang**, Institute of Physics, Chinese Academy of Sciences
Interaction-induced Quantum Anomalous Hall Phase in (111) Bilayer of LaCoO3

10:30 – 10:45 C-3: **Joshua Gild**, Rochester Institute of Technology
Physical Character and Morphology of Platinum Nanocrystals on Strontium Titanate

Parallel Sessions

10:45 – 11:00	**C-4:**	**Hu Miao**, Institute of Physics, Chinese Academy of Sciences **Spin Fluctuation Induced Non-Fermi Liquid with Suppressed Superconductivity in LiFe1-xCoxAs**
11:00 – 11:15	**C-5:**	**Sepideh Razavi**, City College of New York **Interfacial Behavior of Colloidal Particles: Impact of Particle Hydrophobicity and Amphiphilicity**
11:15 – 11:30	**C-6:**	**Lingna Wu**, Tsinghua University **Tunable Spin Orbit Coupling for Spin-1 Atoms with an Oscillating Gradient Magnetic Field**

U.S. - China
Young Physicists Forum

Poster Session

P.1: **Xiaoyu Dong**, Tsinghua University
Electrically Tunable Multiple Dirac Cones in Thin Films of (LaO)2(SbSe2)2 Family of Materials

P.2: **Matthew Daniels**, Carnegie Mellon University
Spin-transfer Torque Induced Spin Waves in Antiferromagnetic Insulators

P.3: **Yongping Du**, Nanjing University
Dirac and Weyl Semimetal in XY Bi (X=Ba, Eu; Y=Cu, Ag and Au)

P.4: **Cacie Hart**, Towson University
Structural and Electrical Properties of Electron-Doped Calcium Manganese Oxide Thin Films

P.5: **Tingxin Li**, Peking University
Ultra Low Temperature Measurements of the Conductance of Helical Edge States in As/GaSb 2D Topological Insulator

P.6: **Victoria R. Kortan**, University of Iowa
spds* Tight-Binding Model for Exchange Interaction Between Transition Metal Dopants in Diamond and SiC spds*

P.7: **Yanfei Zhao**, Peking University
Quantum Transport in Topological Insulator Heterostructure

P.8: **Tian Liang**, Princeton University
Ultrahigh Mobility and Giant Magnetoresistance in the Dirac Semimetal Cd3As2

P.9: **Xiaoming Zhang**, Institute of Physics, Chinese Academy of Sciences
The Observation of Reentrant Strain Glass Behavior in Ferroelastic-Martensitic System

P.10: **Sean Wagner**, Michigan State University
Tailoring Organic Molecular Growth Towards Highly Ordered Thin Films on Si Surfaces

P.11: **Qiong Zhu**, Zhejiang University
Critical Exponent of Integer Quantum Hall Plateau Transitions -- Disordered Hofstadter Model Calculation

P.12: **Aitian Chen**, Tsinghua University
Electric-field Manipulation of Magnetization Rotation and Tunneling Magnetoresistance of Magnetic Tunnel Junctions at Room Temperature

P.13: **Derek Vigil-Fowler**, University of California, Berkeley
Scattering, Lifetimes, and Mean Free Paths for Materials Design from the ab Initio GW Approximation

Poster Session

P.14: **Fang Yang**, Shanghai Jiao Tong University
Spatial and Energy Distribution of Topological Edge States in Single Bi(111) Bilayer

P.15: **Nazir Hossain**, University of South Dakota
Design of a Cryostat for HPGe Detector Characterization

P.16: **Jason Marmon**, University of North Carolina at Charlotte
Intrinsic and Extrinsic Effects on Electron-Phonon Coupling Strength in Individual ZnTe Nanowires

P.17: **Shengxi Huang**, Massachusetts Institue of Technology
Probing the Interlayer Coupling of Twisted Bilayer MoS2 Using Photoluminescence Spectroscopy

P.18: **Ivy Krystal Jones**, Hampton University
Material Preparation, Spectroscopic Analysis, and Cross-Section Modeling of Pr3+:PbCl2 for 1.6 μm Gain Media Application

P.19: **Lei Wang**, Beijing Normal University
Effective Spin Mixing Conductance of the Au|CoFe2O4 Interface by Damping Method

P.20: **Clarissa Vazquez Colon**, University of Texas at San Antonio
Single-crystal-like BaTiO3//SrTiO3 Multilayered Thin Films on Polycrystalline Ni Metal Tapes for Structural Health Monitoring Applications

P.21: **BenMaan Jawdat**, University of Houston
Superconductivity at 600 mK in a Novel Ternary Platinum Phosphide SrPt6P2

P.22: **Likai Li**, Fudan University
High Mobility 2D Electron Gas in Black Phosphorus

P.23: **Edward Lee**, Cornell University
Statistical Mechanics of the U.S. Supreme Court

P.24: **Tao Qu**, University of Minnesota-Twin Cities
Kambersky Damping in L10 Magnetic Materials of Ordered and Disordered States with Substitutional Defects

Saturday, February 28

Plenary Session – I

Prof. Jian Shen, Department of Physics, Fudan University

Patterning Electronic States in Complex Oxides: A New Avenue Towards Designer's Materials

The development of nanofabrication methods has been the key to success of nanoscience and nanotechnology. Conventional nanofabrication is accomplished by spatial confining structures into nanoscale following the designed patterns. In stark contrast, electronic nanofabrication is done by patterning electronic states of a material system in real space without actual removal of materials. This can only be applied to strongly correlated systems which energetically favor co-existence of electronic phases. In this work, we show that ferromagnetic metallic domains can be patterned in antiferromagnetic insulating matrix in manganites systems using localized magnetic and electric fields, and newly observed edge states. This approach allows us to control the physical properties of the system in a desired manner.

Prof. E. Dan Dahlberg, School of Physics and Astronomy, University of Minnesota

Magnetic Reversal in Stadium Shaped Particles

I will discuss the magnetic reversal in stadium shaped particles on the order of hundreds of nanometers wide and about twice that in length; the magnetic fields are applied perpendicular to the long axis. The reversal was studied using magnetic force microscopy (MFM) to study the reversal. In general a small aspect ratio stadium (length to width ratio) magnetization reverses by the formation of a single vortex and its propagation down the length of the stadium. The larger aspect ratio stadia are much more interesting and have given us two major surprises. The first is the discovery of the importance of vortex-antivortex pair creation and annihilation in the magnetic reversal in larger aspect ratio stadia; similar to the importance of virtual particles in many other physical processes. The second is our observation of an asymmetry in the vortex-antivortex annihilation due to conservation of skyrmion number. First I will present a very elementary introduction to micromagnetics research which includes a hands on demonstration of MFM.

Supported by ONR and the University of Minnesota MRSEC.

Special Session

Prof. Laura H. Greene, Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign; Vice-President, American Physical Society

Publishing in Peer Reviewed Journals: The Basics of Writing a Good Manuscript

This will be an interactive session to help in the understanding of how to successfully publish your research in peer-reviewed journals. I will stress the basics that are required by you as an author, including striving for perfection in the written language, choosing an appropriate journal, authorship, and that you should expect to be rejected and then re-submit, which helps demonstrate the importance of the peer review process. I will also discuss the editing process from the side of the journal. A major component of this workshop will be my presentation of what I have found to be the best procedure for writing a clear and successful scientific paper.

Invited Speakers

Panel Session: Careers Outside of Academia in the U.S. & China

Speakers:

Prof. Kai-li Jiang, Department of Physics, Tsinghua University

Kai-li Jiang received his bachelors, masters and Ph.D degrees from Tsinghua University, Beijing, China. He was appointed as an assistant professor at Tsinghua University in 1998, and became a full professor of Physics Department at the same university in 2008. His group focuses on the growth mechanisms, controlled synthesis, physical properties and applications of carbon nanotubes.

Dr. Chris Keener, Hitachi Global Storage Technologies

Chris Keener holds a Ph.D. in Physics from University of Illinois at Urbana-Champaign, where he researched electrical noise in magnetic thin films. After completing a postdoc in high temperature superconductivity, he began in 1997 to work on magnetic recording heads for hard disk drives at HGST, a Western Digital co, in San Jose, CA. Chris designed read heads, then managed engineers who focused on data analysis and design optimization for heads. He moved his family to China for 6 years, serving as director of test engineering, product engineering, program management and failure analysis, where he developed a series of engineering training classes, and returned to San Jose in 2010, where he worked in research, program management, and recently in hard drive development and product support.

Prof. Yalin Lu, Department of Materials Science and Engineering, University of Science and Technology of China

Dr. Yalin Lu is currently a Full Professor of the University of Science and Technology of China (USTC), P. R. China. He is now the Deputy Director of National Hefei Science Center, Director of National Synchrotron Radiation Laboratory, and Director of CAS Key Laboratory of Materials for Energy Conversion.

Dr. Lu owned his PhD in Physics in 1991 from Nanjing University, P. R. China. Since 1996, he has been a Visiting Professor in Lawrence Berkeley National Laboratory (1996-1998), a Research Professor in Electrical Engineering in Tufts University (1998-2000) and a Sr. Physicist in Physics in US Air Force Academy (2003-2012). He joined USTC in 2012, and his research group in USTC works on materials for energy conversion, long wavelength optics and associated materials, and complex oxides materials for quantum physics.

Dr. Lu also owns an interesting industrial career. He was an entrepreneur for three companies, and as a co-founder, one of them was merged with Corning Inc. He was then a R&D Manager in Corning Inc. and a R&D Director of the Photonics Division in Thermo Electron Corp. during the period from 2000 to 2003. He also managed many Air Force research programs, and acted as the Principle Investigator for many key projects including Multidisciplinary University Research Initiatives (MURI) and Broad Agency Announcement (BAA) programs.

Dr. Lu co-authored more than 180 publications and 4 book chapters, and owns more than 20 US and Chinese patents. He was the winner of the First Prize in China's top Natural Science Award (2006). His rich experience in academics, cutting edge researches, business and program management, and entrepreneur indicates a joyful career life.

Dr. John Rodriguez, Texas Instruments

John A. Rodriguez received the Ph.D. in electrical and computer engineering from Rice University in Houston, TX. Dr. Rodriguez is a Distinguished Member of the Technical Staff in Analog Technology Development at Texas Instruments in Dallas, where he researches the reliability physics of ferroelectric memory devices in advanced process technology. He has published or presented >40 papers and has been awarded 21 US patents. Dr. Rodriguez is a recipient of the 2002 IEEE Reliability Physics Symposium Outstanding Paper Award, the 2005 Electrical Over-Stress/Electrostatic Discharge Symposium Best Presentation Award and the 2012 Semiconductor Research Corporation Mahboob Khan Outstanding Industry Liaison Award. He received the Texas Instruments "Innovators in Action" Award in 2013 for his contributions to novel ultra-low-power circuits.

Sunday, March 1

Plenary Session – II

Dr. Qikun Xue, Tsinghua University; Executive Council, Chinese Physical Society

Atomic Level Control of Quantum Material Growth: From Quantized Anomalous Hall Effect to Interface Enhanced High Temperature Superconductivity

Molecular beam epitaxy (MBE) is a powerful technique for preparation of semiconductors and heterostructures, among which extremely high mobility two dimensional electron gas and multiple quantum well structure for cascade laser are two of the well-known examples. Combining MBE with scanning tunnelling microscopy (STM) and angle resolved photoemission spectroscopy (ARPES) can even push its power to an unprecedented level. In this talk, I would give an introduction to three techniques and present our MBE-STM-ARPES study of topological insulators and iron-based superconductors that have recently attracted extensive attention. I would first show how we can realize the quantized anomalous Hall effect by atomic-level control of band-engineered and magnetically doped topological insulators with MBE-STM-ARPES. I then show the advantage of such combination with interface enhanced high temperature superconductivity in single unit-cell FeSe films on $SrTiO_3$. Implications on exploring other exotic quantum phenomena such as Majorana fermions in topological insulators and high temperature superconductivity will also be discussed.

Prof. Malcolm R. Beasley, Stanford University; Past-President, American Physical Society

Physical Constraints on the Tc of Superconductors

One of the great remaining questions in superconductivity is how high Tc can be. In this talk, we discuss a universal physical constraint on the magnitude of Tc that results due to phase fluctuations of the superconducting wave function. We conclude that room temperature superconductivity is possible and discuss what guidance these insights provide in the search for very high temperature superconductors.

Session I.A: Condensed Matter Physics

Saturday, February 28 (Room 202 B)

I.A-1: **Jin-Ke Bao**, Zhejiang University

Exploring New Superconductivity in Antiferromagnetic Compounds by Chemical Doping

Magnetism and superconductivity are closely related in unconventional superconductivity, like cuprates, iron pnictide and heavy fermion superconductors. So we try exploring new exotic superconductors in antiferromagnetic compounds. Here we did hole doping investigations on BaMn2As2 by potassium [J. K. Bao et al., *Phys. Rev*. B 85, 144523 (2012)] and some recent efforts in other systems. BaMn2As2 is isostructural to the superconducting parent compound BaFe2As2. However, the ground states of these two compounds are totally different. BaMn2As2 is a checkerboard (G-type) antiferromagnetic insulator with a high TN (625K) and ordered moment (3.9μ?B/Mn). Only a little potassium doping could make Ba1-xKxMn2As2 a metal. The behavior of temperature-dependent resistivity for Ba1-xKxMn2As2 changes with the potassium doping level, which may be due to the increasing interaction between electrons. Weak ferromagnetism appears in Ba1-xKxMn2As2 when the potassium doping level is high. However, the antiferromagnetism couldn't be completely suppressed even in the high potassium doping range, which makes it an interesting material to do research on the coexistence of itinerant electrons, weak ferromagnetism and antiferromagnetism. Besides, I will give a brief introduction to the recent efforts in other systems.

I.A-2: **Saicharan Aswartham**, University of Kentucky

Synthesis and Physical Properties of Iron Based Superconductors

In this contribution, I will present the important aspects of crystal growth and the influence of chemical substitution in Fe based superconductors. Using self-flux high temperature solution growth technique, large centimeter-sized high quality single crystals of BaFe2As2 were grown. This pristine compound BaFe2As2 undergoes structural and magnetic transition at 137 K. By suppressing this magnetic ordering and stabilizing tetragonal phase with chemical substitution, like Co-doping and Na-doping, bulk superconductivity is achieved. Superconducting transitions of as high as Tc = 34 K with Na substitution and Tc = 25 K with Co-doping were obtained. The Fermi surface of hole-doped Ba1−xNaxFe2As2 is to a large extent the same as the Fermi surface found for the K-doped sister compounds, suggesting a similar impact of the substitution of Ba by either K or Na. A combined electronic phase diagram has been achieved for both electron doping with Co and hole doping with Na in BaFe2As2.

I.A-3: **Hao Ding**, Tsinghua University

Interface-Induced High-Temperature Superconductivity in FeSe/TiO2(001) Heterostructure

The recently discovered high transition temperature (Tc) superconductivity at the interface of single unit-cell (UC) FeSe films on SrTiO3(001) has generated considerable excitement [1], which may eventually lead to the discovery of a new family of high-Tc superconductors at many different interfaces. In this talk, we will present our recent work on a new interfacial system with high-Tc superconductivity, 1 UC FeSe films on anatase TiO2(001). By using molecular beam epitaxy (MBE) techniques, we have successfully prepared high-quality 1 UC FeSe films on anatase TiO2(001) formed on SrTiO3. In situ scanning tunneling spectroscopy (STS) reveals large superconducting gap (Δ) ranging from 17 meV to 22 meV, which is nearly one order of magnitude larger than Δ = 2.2 meV of bulk FeSe with Tc = 9.4 K, indicating the signature of high-Tc superconductivity. The superconductivity of this heterostructure system is further verified by imaging vortex lattice under external magnetic field. By examining the distinct properties of anatase TiO2 from SrTiO3, as well as their influences on superconductivity, we will discuss about the possible pairing mechanism of this system. Our work demonstrates that interface engineering is a powerful way to fabricate new high-Tc superconductors and investigate the mechanism of high-Tc superconductivity. [1] Q.-Y. Wang et al., *Chin. Phys. Lett*. 29, 037402 (2012).

Parallel Session Abstracts

I.A-4: **Hamilton Carter**, Texas A&M University

Experimental Probe of Ionizing Radiation from Superconductors Predicted by the Hole Theory of Superconductivity

In 2007, Hirsch reported that the hole theory of superconductivity predicts the emission of ionizing radiation from superconductors as they transition (quench) from the superconducting to the normal state (J. Phys.: Condens. Matter 19, 125217 (2007)). An experiment has been constructed to test this prediction. A Pb sample is quenched to its normal state by a pulsed magnetic field with a magnitude everywhere greater than Hc, while a NaI scintillator is used to detect the ionizing photons. We will present the experimental design, and its limitations; report the experimental results, and discuss their implications.

I.A-5: **Hongli Guo**, University of Science and Technology of China

Polar-nonpolar Oxide Heterostructures for PhotocatalysiS

The discovery of two-dimensional electron gas (2DEG) at the interface of polar $LaAlO_3$ (LAO) and non-polar $SrTiO_3$ (STO) open the research field of layered oxide heterostructures. In this study, we propose new application of oxide heterostructures for photocatalysis. We take a sandwich-like heterostructure STO/LAO/STO as an example and prove it to be a promising photocatalyst which is active for near-infrared light. Because the sandwiched LAO is polarized and generates a build-in electrostatic field, the valance band and conduction band locates on two opposite STO surfaces. First principles calculations prove that the band gap is reduced and the absorption of near-infrared to visible light is improved distinctly. Simultaneously, the build-in electric field in LAO accelerates the electrons and holes into opposite directions, preventing the recombination, and generates an electron doped surface and a hole doped STO surface, which could be used for H_2O reduction and oxidation separately. Our study gives a new perspective into the applications of oxide heterostructures in solar energy conversion.

I.A-6: **Eteri Svanidze**, Rice University

Ti_{1-x}Au_x Alloys: Hard Biocompatible Metals and Their Possible Applications

Itinerant and local moment magnetism have substantively different origins, and require distinct theoretical treatment. A unified theory of magnetism has long been sought after, and remains elusive, mainly due to the limited number of known itinerant magnetic systems. In the case of the two such examples discovered several decades ago, the itinerant ferromagnets $ZrZn_2$ and Sc_3In, the understanding of their magnetic ground states draws on the existence of 3d electrons subject to strong spin fluctuations. Similarly, in Cr, an elemental itinerant antiferromagnet (IAFM) with a spin density wave (SDW) ground state, its 3d character has been deemed crucial to it being magnetic. Here we report the discovery of the first IAFM compound with no magnetic constituents, TiAu. Antiferromagnetic order occurs below a Neel temperature T_N = 36 K, about an order of magnitude smaller than in Cr, rendering the spin fluctuations in TiAu more important at low temperatures. This new IAFM challenges the currently limited understanding of weak itinerant antiferromagnetism, while providing long sought-after insights into the effects of spin fluctuations in itinerant electron systems.

Session I.B: Materials Physics, Condensed Matter Physics, Other

Saturday, February 28 (Room 203 A)

I.B-1: **Trevor Keiber**, University of California, Santa Cruz

An EXAFS Study of the Local Distortions in Thermoelectric Clathrates

Good thermoelectric materials simultaneously have a low thermal conductivity and moderate electrical conductivity. One way to achieve this is with structures where atoms have large amplitude, low frequency vibrations which lead to a low thermal conductivity. I have used Extended X-ray Absorption Fine Structure (EXAFS) to analyze filled skutterudites and clathrates systems which have a cage-like crystal structures filled with ``rattler`` atoms located near the center of the cages. I will present examples for each of these compounds and provide evidence for off center Ba displacement and buckling of the cage in the clathrate Ba8Ga16X30, X=Sn,Si. The disorder will lead to increased scattering for both phonons and electrons.

I.B-2: **Mingqiang Gu**, Nanjing University

Controlling the Dimensionality of the Octahedra Network in SrRuO3/SrTiO3 Superlattice

Two dimensional (2D) systems in perovskites have been widely investigated by designing superlattices. We propose a way to control the dimensionality of the octahedra network in perovskite superlattices by selecting different substrate orientation and superlattice periods. Lower dimensionality like one-dimension (1D) and zero-dimension (0D) can be achieved. Taking SrRuO3/SrTiO3 as an example, we demonstrate that the 1D structure is in a 1D Ising state, which is paramagnetic, while the 0D structure is ferromagnetic insulator with fully saturated magnetic moment on the Ru sites. New phenomena in the magnetic and electronic properties are observed, including large strain response, half-metallicity, and orbital-selective quantum confinement effects.

I.B-3: **Kyle McElhinny**, University of Wisconsin - Madison

Mapping Nano Scale Phonons in Three Dimensions Via X-ray Thermal Diffuse Scattering

Phonon engineering in nanostructures has emerged as a powerful technique for tuning thermal and electronic properties. However, progress had been limited by a lack of probes that combine sufficient momentum range to probe the entire three-dimensional phonon dispersion with sufficiently strong signals to study nanoscale volumes. It has been established that synchrotron x-ray thermal diffuse scattering (TDS) is capable of probing large wavevector phonons within single crystal volumes of less than 10 cubic microns. We investigate the impact of creating a spatially/elastically anisotropic structure such as a quantum well on the directional dependence of the confined phonon dispersion. X-ray thermal diffuse scattering is used to probe phonon populations from throughout a full brillouin zone of silicon nanomembranes with thicknesses of 97 nm and 21 nm. Comparisons between the observed phonon population and predictions from elastic continuum theory are made. Results show the degeneracy in-plane and out-of-plane dispersions seen in bulk systems may be broken in confined systems.

Parallel Session Abstracts

I.B-4: **Tao Jiang**, Fudan University

Interplay of Spin, Valley and Layer Pseudospins in Folded MoS_2 Bilayers

Two dimensional material such as graphene and transition metal dichalcogenide is much like a piece of sheet paper. Different from sheet paper, each of two dimensional materials has its own crystal lattice. Folding of two dimensional materials can make artificial bilayer or even multilayer structures, whose structural symmetry depend on how the folding line is oriented relative to the crystal lattice. The folded artificial structures with different stacking orders are also expected to tune the interlayer coupling, thus leading to unusual behaviors and new phenomena. In this talk, I will present our recent study of folded MoS_2 bilayers, which were obtained by folding exfoliated MoS_2 monolayers. As characterized by second harmonic generation and photoluminescence, folded bilayers can exhibit broken inversion symmetry and reduced interlayer coupling, evoking strong valley and/or spin polarizations that were not achieved in natural MoS_2 bilayer of Bernal stacking. Our work provides an effective and versatile means to understand the interaction between spin, valley and layer pseudospin degrees of freedom in MoS_2 bilayer and engineer transition metal dichalcogenide materials with desirable electronic and optical properties.

I.B-5: **Junhao Lin**, Vanderbilt University

Vacancy-induced Formation and Growth of Inversion Domains in Transition-metal Dichalcogenide Monolayer

The recent development in aberration corrected scanning transmission electron microscope (STEM) has pushed the limit of spatial resolution to discrete atoms. With the combination of the first-principle density functional theory (DFT), the structure-property relationship in materials can be predicted and explained with single atom sensitivity. In this seminar, I'm going to discuss some of the recent results on the application of this combined technique to various two-dimensional monolayer materials, including graphene and transition metal dichalcogenide (TMDC) monolayers. Examples will be given as the identification of stacking boundary in bilayer graphene, origin of triangular inversion domain in TMDC materials and controllable fabrication of ultrasmall conducting interconnects within the TMDC monolayers.

I.B-6: **Yijun Yu**, Fudan University

Tantalum Disulfide Ionic Field-Effect Transistors

TaS_2 Ionic Field-Effect TransistorsThe ability to tune material properties using gate electric field is at the heart of the modern electronic technology. Electrolyte gating has recently emerged as an important technique to reach extremely high surface charge carrier concentration in a variety of materials through the formation of electric double layer (EDL) at the sample surface. Here we demonstrate a new mechanism of electrolyte gating that modulates the volumetric carrier density by gate-controlled intercalation in layered materials. We fabricate field-effect transistors (referred to as ionic field-effect transistor, iFET) based on transition metal dichalcogenides 1T-TaS_2 and 2H-TaS_2. The unprecedented large doping induces dramatic changes in the transport properties of the sample, including CDW phase transitions, superconductivity and metal-to-insulator transitions. The controllable and reversible intercalation of different ion spices into layered materials opens up new possibilities in searching for novel states of matter in the extreme charge-carrier-concentration limit.

Session I.C: Materials Physics, Condensed Matter Physics, Other

Saturday, February 28 **(Room 203 B)**

I.C-1: **Samuel Markson**, University of Connecticut

Pathways to Heavy Rydberg States

Authors: Samuel Markson and Hossein R. Sadeghpour. Heavy Rydberg States are molecular analogues of atomic Rydberg states, wherein the atomic anion serves the role of the electron in the Rydberg atom. In principle, these heavy Rydberg states could lead to formation of strongly coupled plasmas of positive and negative heavy ions. However, these excited molecular states are more likely to dissociate to covalent neutral species that remain ionic pairs, through avoided crossings between different electronic states. In this work, we will describe a method to minimize such dissociative losses for rubidium, through enhancing state-state transitions via off-resonant fields.

I.C-2: **Shangchi Jiang**, Nanjing University

Controlling the Polarization State of Light with a Dispersion-Free Metastructure

By combining the advantages of both a metallic metamaterial and a dielectric interlayer, we demonstrate the general mechanism to construct the dispersion-free metastructure, in which the intrinsic dispersion of the metallic structures is perfectly cancelled out by the thickness-dependent dispersion of the dielectric spacing layer. As examples to apply this concept, a broadband quarter-wave plate and a half-wave plate are demonstrated. By selecting the structural parameters, the polarization state of light can be freely tuned across a broad frequency range, and all of the polarization states on the Poincare sphere can be realized dispersion free.

I.C-3: **Travis Scholten**, University of New Mexico

Physics for Computation: Using Novel Devices to Solve Hard Problems

One of the great promises of quantum computation is to put the quantum world to work solving problems that are believed to be notefficiently tractable on a classical computer. It has been discovered that for some problems, such speedups are possible;the main bottleneck in using these speedups is the non-existence of a full-fledged quantum computer. Efforts towards constructingone have been hindered by the delicate nature of quantum information - unwanted disturbances can lead to the computer crashing. Consequently, there has been much work in developing techniques to build and control devices that, while not as computationally powerfulas a quantum computer, can but used to solve simple yet interesting problems. These devices are known as quantum information processors (QIPs). QIPs could provide a building block for a larger-scale quantum computer, performing a role analogous to arithmetic logical units in classical computers. QIPs are built upon a diverse range of physical systems such as superconductors, atomic traps, or photonics. I will reviewsome of the challenges involved in constructing QIPs and discuss their practical potential for changing the way we think ofand build computers. Sandia is a multi-program laboratory managed and operated by Sandia Corporation,a wholly owned subsidiary of Lockheed Martin Corporation,for the US Department of Energy's National Nuclear Security Administration under Contract No. DE-AC04-94AL85000.

I.C-4: **Chong Sheng**, Nanjing University

Trapping Light by Mimicking Gravitational Lensing

One of the most fascinating predictions of the theory of general relativity is the effect of gravitational lensing, the bendingof light in close proximity to massive stellar objects. Recently, artificial optical materials have been proposed to study the various aspects of curved spacetimes, including light trapping and Hawking radiation. However, the development of experimental "toy" models that simulate gravitational lensing in curved spacetimes remains a challenge, especially forvisible light. Here, by utilizing a microstructured optical waveguide around a microsphere, we propose to mimic curvedspacetimes caused by gravity, with high precision. We experimentally demonstrate both far-field gravitational lensingeffects and the critical phenomenon in close proximity to the photon sphere of astrophysical objects under hydrostaticequilibrium. The proposed microstructured waveguide can be used as an omnidirectional absorber, with potential lightharvesting and microcavity applications.

I.C-5: **Shengtao Wang**, University of Michigan - Ann Arbor

Quantized Electromagnetic Response of Three-Dimensional Chiral Topological Insulators

Protected by the chiral symmetry, three dimensional chiral topological insulators are characterized by an integer-valued topological invariant. How this invariant could emerge in physical observables is an important question. Here we show that the magneto-electric polarization can identify the integer-valued invariant if we gap the system without coating a quantum Hall layer on the surface. The quantized response is demonstrated to be robust against weak perturbations. We also study the topological properties by adiabatically coupling two nontrivial phases, and find that gapless states appear and are localized at the boundary region. Finally, an experimental scheme is proposed to realize the Hamiltonian and measure the quantized response with ultracold atoms in optical lattices.

I.C-6: **Xiangkun Xu**, University of Science and Technology of China

Experimental Observing Non-Markovianity of Quantum Evolution with Entanglement in Solid State System

The dynamics of an ideal Markovian open quantum systems is of the characteristics that the noise from the surroundings acts the same way all the time, and the information of system leaks into the environment unidirectionally. However, the dynamics of realistic open quantum systems can be a non-Markovian process, where information can flow back from the environment into the system. Here we quantify the non-Markovian character of the quantum evolution with entanglement for the diamond-based solid state system. We observe the non-Markovian characteristics of the entanglement evolution under dynamical decoupling and obtain the degree of non-Markovianity of the quantum evolution in diamond, from which we gain some knowledge of the real environment.This method is potentially useful to quantum information processing and quantum metrology.

Session II.A: Condensed Matter Physics

Sunday, March 1 (Room 202 B)

II.A-1: **Defa Liu**, Chinese Academy of Sciences

Electron Structure of FeSe/STO Film Revealed by ARPES

The recent report of high-Tc superconductivity in a single-layer FeSe/STO film has attracted much attention both in experiments and theory. One reason is that it is possible to break the superconductivity transition temperture record(maximum Tc~55K) in iron-based superconductors. The other is that there exists much higher Tc in single-layer FeSe/STO system than bulk FeSe system. In this talk, I will report our results on FeSe/STO film measured by ARPES including: 1, Observed distinct electronic structure and gap symmetry of the single-layer FeSe/SrTiO3 film[1]; 2, Established a phase diagram and observed a signature of high Tc over 65K in the annealed single-layer FeSe/SrTiO3 films[2]; 3, Reveal the dichotomy of electronic structure and superconductivity between the single-layer and double-layer FeSe/SrTiO3 films[3]; 4, Observed an insulator-superconductor Crossover in the single-layer FeSe/SrTiO3 films[4]. Our systematic study will provide insight in understanding mechanism of superconducting in iron-based superconductors. References: [1]. D. F. Liu et al. Electronic Origin of High Temperature Superconductivity in Single-Layer FeSe Superconductor. *Nature Communications* 3, 931 (2012); [2]. S. L. He et al. Phase Diagram and High Temperature Superconductivity at 65 K in Tuning Carrier Concentration of Single-Layer FeSe Films. *Nature Materials* 12 (2013) 605-610; [3]. X. Liu et al. Dichotomy of Electronic Structure and Superconductivity between Single-Layer and Double-Layer FeSe/SrTiO3 Films. *Nature Communications* 5 (2014) 5047f; [4]. J. F. He et al. Electronic Evidence of an Insulator-Superconductor Transition in Single-Layer FeSe/SrTiO3 Films. *PNAS* 111 (2014) 18501-18506

II.A-2: **Jasminka Terzic**, University of Kentucky

Magnetism and Anisotropy of Ir5+ Based Double Perovskites Sr2CoIrO6 and Sr2FeIrO6

*J. Terzic[1], S. J. Yuan[1], W. H. Song[1,2], S. Aswartham[1] and G. Cao[1]

[1]Center for Advanced Materials, Department of Physics and Astronomy, University of Kentucky, Lexington, KY 40506, USA

[2]Institute of Solid State Physics, Chinese Academy of Sciences, Hefei, China

We report on structural, thermodynamic and transport study of single-crystal double perovskites Sr2CoIrO6 and Sr2FeIrO6. The isostructural Sr2CoIrO6 and Sr2FeIrO6 feature a cubic crystal structure with pentavalent Ir5+(5d4) which are anticipated to have J=0 singlet ground states in the strong spin-orbit coupling limit. Here we observe magnetic coupling between 5d and 3d (Co, Fe) elements, which result in antiferromagnetic order at high temperatures in both double perovskites. Of the two, Sr2CoIrO6 displays antiferromagnetic metallic behavior with a pronounced magnetic anisotropy; in sharp contrast, the isostructural Sr2FeIrO6 exhibits an antiferroamagnetic, insulating ground state without discernible magnetic anisotropy. The data will be discussed and presented with comparisons drawn with similar systems. *This work was supported by NSF via Grant DMR 1265162.

Parallel Session Abstracts

II.A-3: **Yafei Ren**, University of Science and Technology of China

Single-Valley Engineering Coupling in Graphene Superlattices

Yafei Ren, Xinzhou Deng, Ke Wang, Changsheng Li, Jeil Jung, Changgan Zeng, Zhenyu Zhang, Qian Niu, and Zhenhua Qiao

When adatoms are located at hollow (bridge) sites of 33NN×or 33NN×graphene supercells, K and K' valleys are folded into Γ valley to produce an inter-valley coupling, which acts as a pseudo-magnetic field to open a bulk (local) gap. When adatoms reside at top sites, an additional Dresselhauls type valley-orbit coupling is induced. Both coupling mechanisms provide possibilities of coherently tuning valley polarization. Moreover, for top adsorption, the competition between intervalley coupling and sublattice potentials results in a topological phase transition from quantum valley Hall insulator to a valley-mixed metal with quadratic band touching at Γ point. This makes it possible to explore single Dirac-cone physics in graphene. We further show that these properties can also find applications in photonic crystals.

II.A-4: **Hilary Hurst**, University of Maryland, College Park

Charged Skyrmions on the Surface of a 3D Topological Insulator

Charged skyrmions on the surface of a 3D topological insulatorWe consider the interplay between magnetic skyrmions in an insulating thin film and the Dirac surface states of a 3D topological insulator (TI), coupled by proximity effect. The unique magnetic texture of skyrmions can lead to confinement of Dirac states at the skyrmion radius, where out of plane magnetization vanishes. This confinement results in charging of the skyrmion texture. We find that the bound states are robust in an external magnetic field, which is needed to stabilize skyrmions. It is expected that for reasonable experimental parameters skyrmions will have a few bound states that can be tuned using an external magnetic field. We arguethat these charged skyrmions can be manipulated directly by an electric field, with skyrmion mobility proportional to the number of bound states at the skyrmion radius. Coupling skyrmionic thin films to a TI surface can provide a more direct and efficient way of controlling skyrmion motion in insulating materials.

II.A-5: **Tong Zhou**, Fudan University

Controlled Formation of GeSi Nanostructures on Pillar-Patterned Si Substrates

The quantum efficiency of the GeSi quantum nanostructures (QNs) on flat Si (001) substrates is still quite poor due to the random spatial distribution and the broad size inhomogeneity, which hinder their optoelectronic applications. Numerous growth strategies have been proposed to control the formation of GeSi QNs for improving the optoelectronic performances. One promising way is to self-assemble GeSi QNs on patterned substrates, where the GeSi QNs can be feasibly manipulated in aspects of size, shape, composition, and arrangement. In this report, self-assembled GeSi QNs on periodic Si (001) sub-micro pillars (SPMs) are systematically studied. By controlling the growth conditions and the diameters of the SPMs, different GeSi QNs, including circularly arranged quantum dots (QDs), quantum rings (QRs), and quantum dot molecules (QDMs), are realized at the top edge of SMPs. By reducing the pillar size below 100 nm, fourfold symmetric GeSi QDMs can be also obtained at the base edges of the small pillar. The promising features of these self-assembled GeSi QNs are explained in terms of the surface chemical potential, which disclose the critical effect of surface morphology on the diffusion and the aggregation of Ge adatoms. The potential coupling between the spontaneous transition of the QNs and the cavity mode of the pillar and the photonic crystal enables these controllable GeSi QNs embedded in the periodic SPM to have promising futures in optoelectronic devices.

II.A-6: **Jinchen Wang**, Joint PhD Program: University of Kentucky/Renmin University of China

Lattice-Tuned Magnetism of Ru4+(4d4) Ions in Single Crystals of the Layered Honeycomb Ruthenates

We synthesize and study single crystals of the layered honeycomb lattice Mott insulators Na_2RuO_3 and Li_2RuO_3 with magnetic $Ru^{4+}(4d^4)$ ions. The newly found Na_2RuO_3 features a nearly ideal honeycomb lattice and orders antiferromagnetically at 30 K. Single-crystals of Li_2RuO_3 adopt a honeycomb lattice with either C2/m or more distorted P21/m below 300 K, depending on detailed synthesis conditions. We find that Li_2RuO_3 in both structures hosts a well-defined magnetic state, in contrast to the singlet ground state found in polycrystalline Li_2RuO_3. A phase diagram generated based on our results uncovers a new, direct correlation between the magnetic ground state and basal-plane distortions in the honeycomb ruthenates. This work was supported by NSF via Grant DMR 1265162. The applicant also would like to thankgreat support from Prof. Gang Cao (Univ. of Kentucky), Prof. Feng Ye (Oak Ridge National Lab)and Prof. Wei Bao (Renmin Univ. of China).

Session II.B: Materials Physics, Condensed Matter Physics, Other

Sunday, March 1 **(Room 203 A)**

II.B-1: **Yanming Che**, Zhejiang University

Effects of Nonmagnetic Impurities Throughout the BCS-BEC Crossover

The interplay of Cooper pairing and impurity is related to many physical systems, including superconducting alloys, disordered high T_χ superconductors, disordered superconducting thin films as well as ultracold atomic superfluids doped with atoms of foreign elements. We present a systematic investigation of the effects of nonmagnetic impurity scattering on the σ-wave BCS-BEC crossover, especially in the unitary (or resonant) impurity scattering regime. The impurity potential is treated in the T-matrix approximation and the impurity T-matrix and pairing T-matrix are treated in a self-consistent diagrammatic approach. Then a system of equations is solved numerically. We find that in the presence of strong impurity scattering, the frequency and gap in Green's function and anomalous Green's function are highly renormalized, and the coherence peak in density of states (DOS) is smeared by impurities. As a result, the superfluid T_χ throughout the BCS-BEC crossover is obviously reduced, which differs from the statement of Anderson's theorem. Besides, effects of varying impurity scattering strength on T_χ of a unitary Fermi gas, as well as the finite temperature superfluid density in the presence of resonant impurity scattering are also investigated. This work is in collaboration with Qijin Chen.

II.B-2: **Feng Junya**, Institute of Physics, Chinese Academy of Sciences

Large Linear Magnetoresistance in Dirac Semi-Metal Cd3As2 with Fermi Surfaces Close to the Dirac Points

We have investigated the magnetoresistive behavior of Dirac semi-metal Cd_3As_2 down to low temperatures and in high magnetic fields. A positive and linear magnetoresistance (LMR) as large as 3100% is observed in a magnetic field of 14 T, on high-quality single crystals of Cd_3As_2 with ultra-low electron density and large Lande g factor. Such a large LMR occurs when the magnetic field is applied perpendicular to both the current and the (100) surface, and when the temperature is low such that the thermal energy is smaller than the Zeeman splitting energy. Tilting the magnetic field or raising the temperature all degrade the LMR, leading to a less pronounced quadratic behavior. We propose that the phenomenon of LMR is related to the peculiar field-induced shifting/distortion of the helical electrons` Fermi surfaces in momentum space.

Parallel Session Abstracts

II.B-3: **Jesse Crossno**, Harvard University

Graphene Thermal Transport Studies via Radio-Frequency, Cross-Correlated Johnson Noise Thermometry

The electronic temperature of a dissipative, mesoscale device can be determined by monitoring the Johnson noise power emitted over a wide frequency range. Using radiometry techniques, we have developed a high-frequency, wide bandwidth, cross-correlation Johnson noise thermometer operating from room temperature to cryogenic levels that is compatible with strong magnetic fields. Precisions ranging from 2 to 25 mK are demonstrated over the temperature range of 3 to 300 K with 1 second of integration time. This non-invasive thermometer has enabled us to perform sensitive electronic thermal transport studies in boron nitride encapsulated monolayer graphene over two orders of magnitude in temperature. This versatile technique also enables precision Fano factor measurements as well as studies of correlated noise phenomena, such as those found in layered Van der Waals heterostructures.

II.B-4: **Zibo Wang**, International Center for Quantum Materials, Peking University

Building Topological Device Through Emerging Robust Helical Surface States

In a 3D Cd3As2 ribbon with proper sizes, the system can exhibit a unique finite-size effect. Namely, if magnetic impurities are doped on one side, the surface states on the other side can be altered according to the strengths of these magnetic impurities. As a result, the conductance of the system will also be changed. This finding can be explained by the backscattering between the hybridized surface states due to finite size confinement and the normal surface states. Moreover, this phenomenon can be used to build new topologic devices.

II.B-5: **Shafat Mubin**, Pennsylvania State University

Forces and Dynamics in Aromatic Overlayers on Metal Surfaces

Organic thin films have been the subject of intense research because of their suitability for applications in molecular electronics. The beneficial properties of these films are sensitive to the structure of the film. However, predicting and controlling organic thin-film structures is still a significant challenge. Owing to computational requirements, first-principles calculations cannot probe the link between thin-film deposition conditions and film structure. In this talk, we will discuss a multi-scale approach applied to quantify structures and dynamics of a thin film of benzene on Ag(111). Based on first-principles calculations, we developed a force field to describe the interaction of benzene with Ag(111). We applied this force-field to describe several aspects of this system, including its order-disorder phase transition and its desorption kinetics. Despite the apparent simplicity of this vdW dominated system, it exhibits surprising complexity in binding site preference and in ordering, leading to an interesting interplay between pi-conjugated electrons of benzene and surface-state electrons of Ag(111).

II.B-6: **Xiangzhi Meng**, International Center for Quantum Materials, Peking University

Direct Visualization of Concerted Proton Tunneling in a Water Nanocluster

Proton transfer through hydrogen bonds is of great importance to many aspects of physics, chemistry and biology, such as phase transition, signal transduction, topological organic ferroelectrics, photosynthesis, and enzyme catalysis. The proton dynamics is susceptible to nuclear quantum effect in terms of proton tunneling, which tends to involve many hydrogen bonds simultaneously, leading to correlated many-body tunneling. In contrast to the well-studied incoherent single particle tunneling, our understanding of the many-body tunneling, especially the effect of local environment on the tunneling process, is still in its infancy. Here we report the real-space observation of concerted proton tunneling within a hydrogen-bonded water tetramer using a cryogenic scanning tunneling microscope (STM). This is achieved by monitoring in real time the reversible interconversion of the hydrogen-bonding chirality of the cyclic water tetramer with a chlorine-terminated STM tip. Interestingly, we found that the presence of the Cl anion at the tip apex may either enhance or suppress the concerted tunneling process depending on the details of coupling symmetry between the Cl anion and the protons. This work opens up the possibility of controlling the quantum states of protons with atomic-scale precision.

Session II.C: Materials Physics, Condensed Matter Physics, Other

Sunday, March 1 (Room 203 B)

II.C-1: **Wei Qin**, University of Science and Technology of China

Persistent Ferromagnetism and Topological Phase Transition at the Interface of a Superconductor and a Topological Insulator

At the interface of an s-wave superconductor and a three-dimensional topological insulator, Majorana zero modes and Majorana helical states have been proposed to exist respectively around magnetic vortices andgeometrical edges. Here we first show that randomly distributed magnetic impurities at such an interface will induce bound states that broaden into impurity bands inside (but near the edges of) the superconducting gap, which remains open unless the impurity concentration is too high. Next we find that an increase in the superconducting gap suppresses both the oscillation magnitude and period of the RKKY interaction betweentwo magnetic impurities. Within a mean field approximation, the ferromagnetic Curie temperature is found to be essentially independent of the superconducting gap, an intriguing phenomenon due to a compensation effect between the short-range ferromagnetic and long-range anti-ferromagnetic interactions. The existence of robust superconductivity and persistent ferromagnetism at the interface allows realization of a novel topological phase transition from a non-chiral to a chiral superconducting state at sufficiently low temperatures, providing a new platform for topological quantum computation.

II.C-2: **Yilin Wang**, Institute of Physics, Chinese Academy of Sciences

Interaction-induced Quantum Anomalous Hall Phase in (111) Bilayer of LaCoO3

In the present paper, the Gutzwiller density functional theory (LDA+G) has been applied to studythe bilayer system of LaCoO3 grown along the (111) direction on SrTiO3. The LDA calculations show that there are two nearly flat bands located at the top and bottom of e g bands of Co atoms with the Fermi level crossing the lower one. After including both the spin-orbit coupling and the Coulomb interaction in the LDA+G method, we find that the interplay between spin-orbit coupling and Coulomb interaction stabilizes a very robust ferromagnetic insulator phase with non-zero Chern number indicating the possibility to realize quantum anomalous Hall effect in this system.

II.C-3: **Joshua Gild**, Rochester Institute of Technology

Physical Character and Morphology of Platinum Nanocrystals on Strontium Titanate

The physical characteristics of platinum nanocrystals on single crystal strontium titanate, SrTiO3, can effect the chemical properties of this important model catalyst. The morphology, epitaxy, distribution, and size of the Pt nano-crystals can all be controlled through different growth and processing mechanisms. Nanometer scale platinum thin films are deposited on strontium titanate at ambient temperatures then annealed at range of temperatures and in various oxidizing environments. The process of how these conditions influence the formation of uniformly epitaxial platinum crystals on the sample surface has been investigated using basic materials characterization techniques. Single crystal x-ray diffraction is the primary tool for these experiments, coupled with atomic force microscopy for morphology and x-ray and electron spectroscopy to determine chemical bonding between the particles and gases introduced into the system. These substrate supported nanoparticle samples will then be utilized in experiments to test their catalytic activity compared to an amorphous platinum film.

II.C-4: **Hu Miao**, Institute of Physics, Chinese Academy of Sciences

Spin Fluctuation Induced Non-Fermi Liquid with Suppressed Superconductivity in LiFe1-xCoxAs

The electronic properties of conventional metals are well described by Landau's Fermi liquid (FL) theory. Although deviation from this limit, also known as non-Fermi liquid (NFL), has been studied in many correlated materials, its microscopic origin and relationship to high-temperature superconductivity remain enigmatic. In this forum I will present that tuning the Fermi surface nesting via Co substitution in LiFe1-xCoxAs can enhance and then diminish low-energy spin fluctuations, inducing a FL-NFL-FL crossover whereas superconductivity is monotonically suppressed with increasing Co content. Our study reveals a unique phase diagram of LiFe1-xCoxAs where the region of NFL and enhanced low-energy spin fluctuations is moved to the boundary of the superconducting phase, thus challenging the notion of Fermi-surface-driven pairing mediated by low-energy spin fluctuations in iron-pnictides.

II.C-5: **Sepideh Razavi**, City College of New York

Interfacial Behavior of Colloidal Particles: Impact of Particle Hydrophobicity and Amphiphilicity

Colloidal particles of proper surface wettability can be confined to liquid interfaces with a capillary energy that is thousands of times the thermal energy. These systems offer an effective route to emulsion stabilization where the stability is influenced by the phase behavior of the particle-laden interfaces under deformation. Hence, understanding of the factors that affect the properties of these self-assembled structures at the interface can be exploited in designing emulsions with superior stability. Shape anisotropy of colloidal particles have recently been used to tune the interparticle interactions and assembly behavior. Analogously, tuning the amphiphilicity of colloidal particles is believed to significantly impact their interaction with interfaces provided that upon adsorption Janus particles possess the right orientation toward the preferred phase. Using molecular dynamics simulations and digital holography microscopy, we have monitored the translational and rotational motion of nano- and micron-sized Janus particles approaching and binding to an interface. Moreover, We have investigated the properties of interfaces decorated with colloidal particles of various chemical anisotropies. Our work elucidates the impact of particle wettability and amphiphilicity on the viscoelastic nature of these interfacial films. We find that the orientation of amphiphilic particles at the interface has consequences for stability and stiffness of interfacial particle films.

II.C-6: **Lingna Wu**, Tsinghua University

Tunable Spin Orbit Coupling for Spin-1 Atoms with an Oscillating Gradient Magnetic Field

Ultracold atomic systems are among the cleanest and most controllable quantum many-body systems, for which they are regarded as good candidates for quantum simulation research. In recent years, spin orbit coupling (SOC) has become one of the hottest topics in atomic quantum gases. The widely popular experimental scheme makes use of Raman atom-light interaction to implement a one dimensional synthetic SOC. Straightforward generalization to higher spatial dimensions need to overcome the experimental challenges from spontaneous photon emissions.We experimentally realized tunable SOC for ultracold spin-1 Rb87 atoms using spin dependent momentum impulses from gradient magnetic field pules. The strength of our synthesized SOC is related to the modulation amplitude, thus can be continuously tuned. We observe interference fringes in momentum space and study collective dipole oscillation dynamics. In addition, we discuss theoretical a protocol which we find can synthesize a spatially periodic artificial magnetic field, or a magnetic lattice (ML) by introducing a bias magnetic field to the free evolution part of the SOC experiment we report. Both the period and the depth of the artificial 2 dimensional ML can be tuned, and similarly is immune to atomic spontaneous emissions.

P.1: **Xiaoyu Dong**, Tsinghua University

Electrically Tunable Multiple Dirac Cones in Thin Films of $(LaO)_2(SbSe_2)_2$ Family of Materials

Two-dimensional Dirac physics has aroused great interests in condensed matter physics ever since the discovery of graphene and topological insulators due to its importance in both fundamental physics and device applications. The ability to control the properties of Dirac cones, such as band gap and Fermi velocity, is essential for the occurrence of various new phenomena and the development of next-generation electronic devices. Based on first-principles calculations and an analytical effective model, we propose a new Dirac system with eight Dirac cones in thin films of the $(LaO)_2(SbSe_2)_2$ family of materials with an external gate voltage. The advantage of this system lies in its tunability: the existence of gapless Dirac cones, their positions, Fermi velocities and anisotropy all can be controlled by an experimentally feasible gate voltage. We identify the layer dependent spin texture induced by spin-orbit coupling as the underlying physical reason for the tunability of Dirac cones in this system. As a consequence, we show that the electrically tunable quantum anomalous Hall effect with a high Chern number can be induced by introducing magnetization into this system.

P.2: **Matthew Daniels**, Carnegie Mellon University

Spin-transfer Torque Induced Spin Waves in Antiferromagnetic Insulators

We explore the possibility of exciting spin waves in insulating antiferromagnetic films by injecting spin current at the surface. We analyze both magnetically compensated and uncompensated interfaces. We find that the spin current induced spin-transfer torque can excite spin waves in insulating antiferromagnetic materials and that the chirality of the excited spin wave is determined by the polarization of the injected spin current. Furthermore, the presence of magnetic surface anisotropy can greatly increase the accessibility of these excitations.

P.3: **Yongping Du**, Nanjing University

Dirac and Weyl Semimetal in XY Bi (X=Ba, Eu; Y=Cu, Ag and Au)

Weyl and Dirac semimetals recently stimulate intense research activities due to their novel prop-erties. Combining first-principles calculations and effective model analysis, we predict that nonmag-netic compounds BaY Bi (Y =Au, Ag and Cu) are Dirac semimetals. As for the magnetic compound EuY Bi, although the time reversal symmetry is broken, their long-range magnetic ordering cannotsplit the Dirac point into pairs of Weyl points. However, we propose that partially substitute Euions by Ba ions will realize the Weyl semimetal.

P.4: **Cacie Hart**, Towson University

Structural and Electrical Properties of Electron-Doped Calcium Manganese Oxide Thin Films

Electron-doped Calcium Manganese Oxide ($CaMnO_{3-d}$) thin films are of interest for use as photocatalysts and fuel cell electrodes in renewable energy applications. Oxygen stoichiometry of the films is a key parameter for the functionality in these applications. Currently, we are investigating the properties of $CaMnO_{3-d}$ films grown by pulsed laser deposition. The thin films are epitaxially grown on $LaAlO_3$ and $SrTiO_3$ substrates. Both of these substrates have larger in-plane lattice parameters than $CaMnO_{3-d}$, which leads to bi-axial tensile strain in the thin films. We have characterized the thickness dependence of structural, electrical, and morphological properties of these films using high resolution x-ray diffraction, temperature dependent electrical resistivity measurements, and atomic force microscopy. The thickness dependence is characteristically different from what has been preciously observed in thin films of hole-doped manganites. Our results suggest that coupling between tensile strain and oxygen deficiency affect the electrical and structural properties of the material.

Poster Session

P.5: **Tingxin Li**, Peking University

Ultra Low Temperature Measurements of the Conductance of Helical Edge States in InAs/GaSb 2D Topological Insulator

Inverted InAs/GaSb quantum wells have been shown to be a 2D topological insulator hosting helical edge states. For mesoscopic samples, quantized conductance plateaus of 2e2/h have been observed. On the other hand, the longitudinal resistance in long samples increased linearly with device length, indicating certain scattering processes occurred in the helical edge. Moreover, edge states of InAs/GaSb system have a small Fermi velocity V_F, suggesting that interaction effects may play an important role in their electronic transport properties. We report work in progress for conductance measurements of InAs/GaSb helical edge states in ultra low temperatures. Experiments are performed in two millikelvin dilution refrigerators instrumented for fractional quantum Hall effects studies, one of them having attained 6mK electron temperature.

P.6: **Victoria R. Kortan**, University of Iowa

spds* Tight-Binding Model for Exchange Interaction Between Transition Metal Dopants in Diamond and SiC

Victoria R. Kortan, Cüneyt Şahin, and Michael E. Flatté

Diamond and SiC are wide-band-gap semiconductors with long-lived spin lifetimes[1,2] and promising for quantum information technology device design. Spin initialization, manipulation and readout has already been demonstrated for the NV center in diamond[3] and the divacancy in SiC[4]. Transition metal spin centers offer additional benefits in tetrahedral hosts due to the crystal field splitting of the d-states into localized and extended states. For example, the application of strain in diamond allows switching between two spin states of a single Ni dopant[5]. Here we use a spds* tight-binding model including spin-orbit interaction to describe transition metal spin centers in diamond and 3C-SiC as well as the NV center in diamond and divacancy in 3C-SiC. The energy levels for an isolated dopant are taken from experiment, when available, and density functional theory calculations otherwise. We calculate and compare the wavefunctions of these spin centers, as well as the strength of the exchange interaction between pairs of them. [1] A. Falk, et al, Nature Comm. 4, 1819 (2013). [2] G. Balasubramanian, et al, Nature Mat. 8, 383 (2009). [3] N.B. Manson, et al, Phys. Rev. B 74, 104303 (2006). [4] W.F. Koehl, et al, Nature 479, 84 (2011). [5] T. Chanier, et al, EPL 99, 67006 (2012).

P.7: **Yanfei Zhao**, Peking University

Quantum Transport in Topological Insulator Heterostructure

In spite of much work on topological insulators (TIs), systematic experiments for TI based heterostructures remain absent. First, we grow a high quality heterostructure containing single quintuple layer (QL) of Bi2Se3 on 19 QLs of Bi2Te3 and compare its transport properties with 20QLs Bi2Se3 and 20 QLs Bi2Te3. In situ ARPES provides direct evidence that the surface state of 1 QL Bi2Se3/19 QLs Bi2Te3 heterostructure is similar to the surface state of the 20 QLs Bi2Se3 and different with that of the 20 QLs Bi2Te3. In ex situ transport measurements, the observed linear magnetoresistance (MR) and weak antilocalization (WAL) of the hybrid heterostructure are similar to that of the pure Bi2Se3 film and not the Bi2Te3 film. This suggests that the single Bi2Se3 QL layer on top of 19 QLs Bi2Te3 dominates its transport properties. In the second part, we report first transport studies on the superlattices (SLs) composed of TI Bi2Se3 layers sandwiched by Normal Insulator(NI) In2Se3 layers artificially grown by molecular beam epitaxy (MBE). The transport properties of two kinds of SL samples show convincing evidence that the transport dimensionality changes from three-dimensional (3D) to two- dimensional (2D) when decreasing the thickness of building block Bi2Se3 layers, corresponding to the crossover from coherent TI transport to separated TI channels. Our findings provide the possibility to realizing “3D surface states” in TI/NI SLs.

P.8: **Tian Liang**, Princeton University

Ultrahigh Mobility and Giant Magnetoresistance in the Dirac Semimetal Cd3As2

Ultrahigh Electron Mobility in a Dirac SemimetalT. Liang, Q. Gibson, M. Ali, M. Liu, R. J. Cava, N. P. OngDirac semimetals and Weyl semimetals are 3D analogues of graphene in which crystalline symmetry protects the nodes against gap formation. Cd3As2 was predicted to be Dirac semimetal [1],and recently confirmed to be so by photoemission [2, 3]. Here we report an interesting property in Cd3As2 that was unpredicted, namely a remarkable protection mechanism that strongly suppressesbackscattering in zero H. In single crystals, the protection results in ultrahigh mobility ~9*10^6 cm^2 V^-1 s^-1 [4] at 5 K. Suppression of backscattering results in a transport lifetime 10^4 times longerthan the quantum lifetime. The lifting of this protection by H leads to a very large magnetoresistance. Quantum oscillations in resistivity, Seebeck and Nernst, show beating effect. We discuss how this may relate to changes to the Fermi surface induced by H.[1] Wang, Z. J. et al., *Phys. Rev. B* 88, 125427 (2013).[2] Sergey, B. et al., *Phys. Rev. Lett*. 113, 027603 (2014).[3] Neupane, M. et al., *Nature Commun*. 5, 3786 (2014).[4] Liang, T. et al., *Nature Materials* Nov. 24 2014, doi: 10.1038/NMAT4143

P.9: **Xiaoming Zhang**, Institute of Physics, Chinese Academy of Sciences

The Observation of Reentrant Strain Glass Behavior in Ferroelastic-Martensitic System

The concept of strain glass (SG) has recently received much attention because of its unique properties such as shape memory effect, superelasticity, and stress-tuned intelligent damping behavior. Recent in-situ TEM experiments have proved that, only local-symmetry change in the crystal structure has been observed during the SG transition, but the macroscopic symmetry or average structure is still keeping unchanged. In this presentation, we report the discovery of reentrant-strain-glass (RSG) behavior in a ferroelastic-martensitic system Ti50Pd50-xVx.

P.10: **Sean Wagner**, Michigan State University

Tailoring Organic Molecular Growth Towards Highly Ordered Thin Films on Si Surfaces

Control of highly ordered organic molecular thin films with extended Ï€ systems is currently of intense interest for integrating molecules into modern electronics due to their tunable nature. Selection of molecules and substrate can lead to desired transport properties such as charge transfer, charge injection, exciton diffusion, etc., at the heterointerface, which is crucial to the development of organic and molecular electronics. However, achieving large-scale molecular ordering remains a significant challenge. Here, we report our recent discovery of the anisotropic crystalline step-flow growth of prototypical metal phthalocyanine (MPc) molecules on the deactivated Si(111)-B surface. Access to the anisotropic step-flow growth offers both long-range in-plane and out-of-plane molecular ordering. We also demonstrate that the molecular ordering and molecular orientation can be effectively modified by substituting different coordinated transition-metal ions in the MPc. This growth mode is likely to be generalized for a range of organic molecules and access to it offers the potential for improved performance in organic field effect transistors, photovoltaics and nanowire/nanoribbon devices. *This work is funded by the U. S. DOE Office of Science Early Career Research Program (DE-SC0006400) through the Office of Basic Energy Sciences.

P.11: **Qiong Zhu**, Zhejiang University

Critical Exponent of Integer Quantum Hall Plateau Transitions -- Disordered Hofstadter Model Calculation

Recent numerical calculations show that the localization length criticalexponent of the quantum Hall plateau phase transition was underestimated. Motivated by this, we revisited the exponent calculation of the disorderedHofstadter model and confirmed that the earlier calculation on the lattice model have also underestimated the localization critical exponent. In this poster, I`ll first review some recent numerical results on quantumHall plateau phase transitions and then discuss the results from our lattice model calculation in detail.

Poster Session

P.12: **Aitian Chen**, Tsinghua University

Electric-field Manipulation of Magnetization Rotation and Tunneling Magnetoresistance of Magnetic Tunnel Junctions at Room Temperature

Recent studies on the electric-field control of tunneling magnetoresistance (TMR) have attracted considerable attention for low power consumption. So far two methods have been demonstrated for electric-field control of TMR. One method uses ferroelectric or multiferroic barriers, which is limited by low temperature. The other is nanoscale thin film magnetic tunnel junction (MTJ), but the assistance of a magnetic field is required. Therefore, electric-field control of TMR at room temperature without a magnetic field is highly desired. One promising way is to employ strain-mediated coupling in ferromagnetic/piezoelectric structure. Though MTJs/piezoelectric has been predicted by theory, experiment work is still lacking. We deposited CoFeB/AlOx/CoFeB on Pb(Mg1/3Nb2/3)0.7Ti0.3O3 (PMN-PT) ferroelectric single crystal. Under external electric fields, PMN-PT will produce a piezostrain due to piezoelectric effect, and the piezostrain transfers to ferromagnetic film to change the magnetic anisotropy. We demonstrate a reversible, continuous magnetization rotation and manipulation of TMR at room temperature by electric fields without the assistance of a magnetic field. Our work should be significant for the ultralow energy modulated MTJs and electric-field controlled spintronics.

P.13: **Derek Vigil-Fowler**, University of California, Berkeley

Scattering, Lifetimes, and Mean Free Paths for Materials Design from the ab Initio GW Approximation

Precise knowledge of the interactions between various particles in complex materials systems is of rapidly increasing importance. The particles – technically, elementary excitations – range from electrons and holes, to plasmons, phonons, and photons, among others. The systems in which these particles exist range from 0- to 3-dimensional and have additional complexities such as interfaces and defects that make the theoretical description of their interactions particularly challenging.I will describe my work on these systems using ab initio calculations, particularly the many-body GW approximation and Bethe-Salpter equation methodologies. I will focus on my study in doped graphene of the effect substrate screening on the electron-plasmon and electron-electron interaction (e-e), hot carrier lifetimes in Si and GaAs due to e-e and electron-phonon scattering, and the electronic bandstructure, carrier lifetimes, and optical spectrum ofthe organometallic perovskite CH3NH3PbI3. I will describe the complex exchanges of energy between the particles in these system and the role of defects and substrates from my perspective. Taken together, these constitute a vision for understanding materials – and the devices that are made from them from an atomistic with as many realistic features as possible, but with a simple underlying picture of interacting constituent particles.

P.14: **Fang Yang**, Shanghai Jiao Tong University

Spatial and Energy Distribution of Topological Edge States in Single Bi(111) Bilayer

By combining scanning tunneling microscopy and spectroscopy, angle-resolved photoemission spectroscopy, and density functional theory band calculations, we directly observe and resolve the onedimensional edge states of single bilayer Bi(111) islands on clean Bi2Te3 and Bi(111)-covered Bi2Te3 substrates. The edge states are localized in the vicinity of step edges having an ~2 nm wide spatial distribution in real space and reside in the energy gap of the Bi(111) BL. Our results demonstrate the existence of nontrivial topological edge states of single Bi(111) bilayer as a two-dimensional topological insulator.

P.15: **Nazir Hossain**, University of South Dakota

Design of a Cryostat for HPGe Detector Characterization

Despite the progress in developing room temperature semiconductor detectors for use as gamma ray detectors, the best material which is able to achieve high energy resolution, stability, and superior detection efficiency is still high purity germanium (HPGe). This kind of radiation detectors have a wide range of application in scientific research, nuclear security, medical, and industry for their exquisite energy resolution. However, HPGe detectors needs cooling to cryogenic temperatures (<130 ?K) to operate as gamma-ray detectors since it has very narrow bandgap (0.7eV), would generate thermally induced leakage current. High vacuum pressure must be maintained to avoid condensation of impurity gases on the detector surface. The surface contamination leads to increases in the leakage current from the detector, potentially spoiling its energy resolution. Thus germanium detectors need to be operated in high vacuum at liquid nitrogen temperature. This work presents the design of a vacuum cryostat to test germanium detectors.

P.16: **Jason Marmon**, University of North Carolina at Charlotte

Intrinsic and Extrinsic Effects on Electron-Phonon Coupling Strength in Individual ZnTe Nanowires

Electron-phonon coupling is typically studied as an intrinsic property for a given bulk material, and modifying the coupling has been explored in a nanostructure. We point out that the coupling strength can be easily perturbed both significantly and unintentionally. Nanowires, with their large surface-to-volume ratio, are more susceptible to extrinsic perturbations that affect coupling strength, although literature assumes that coupling is intrinsic. This work uses Raman spectroscopy under a near resonant condition to probe the coupling strength of individual ZnTe nanowires. Using the intensity ratio of the first and second order Raman peaks, R = I2LO/I1LO, as a measure of the electron-phonon coupling strength (proportional to the Huang-Rhys factor), we find that the ratio can change greatly when varying either the sample or measurement condition, for instance, the presence of defects in the as-grown sample and their removal though laser illumination.

P.17: **Shengxi Huang**, Massachusetts Institue of Technology

Probing the Interlayer Coupling of Twisted Bilayer MoS2 Using Photoluminescence Spectroscopy

Two-dimensional molybdenum disulfide (MoS2) is a promising material for optoelectronic devices due to its strong and stable photoluminescence emissions. In this work, the photoluminescence spectra of twisted bilayer MoS2 are investigated, revealing a tunability of the interlayer coupling of bilayer MoS2. For the twisted angle 0° or 60°, the photoluminescence from the trion and exciton of bilayer MoS2 shows the highest intensity ratio, and the trion binding energy reaches its maximum value. For the twisted angle 30° or 90°, the situation is the opposite. These experimental observations are mainly attributed to the change of the interlayer coupling with the twisted angles. The first-principles density functional theory analyses further confirm the change of the interlayer coupling with the twisted angle, and these analyses interpret and support our experimental results.

Poster Session

P.18: **Ivy Krystal Jones**, Hampton University

Material Preparation, Spectroscopic Analysis, and Cross-Section Modeling of Pr3+:PbCl2 for 1.6 µm Gain Media Application

A new eye-safe laser transition at ~ 1.6 µm was recently reported from Pr3+ doped into the low-phonon energy host RbPb2Cl5. In this work, results of the purification, crystal, and IR spectroscopy of Pr3+ doped PbCl2 are presented. PbCl2 is non-hygroscopic and has a low maximum phonon energy (~ 180 cm-1), which enables efficient emission in the infrared (IR) spectral region. Commercial PbCl2 was purified through a combination of zone-refinement and chlorination of the melt. The dopant PrCl3 was added to the purified PbCl2 and molten under bubbling of HCl gas. The crystal growth of Pr3+:PbCl2 was performed using horizontal Bridgman technique. The resulting Pr3+ doped PbCl2 crystal exhibited strong IR absorption bands in the 1.4 - 1.6 µm region, which allow for resonant pumping using commercial diode lasers. Pumping at ~ 1.45 µm resulted in a broad IR emission band (~ 75 nm @ FWHM) assigned to the 3F3 →3H4 transition. Decay time studies revealed an average lifetime of ~ 170 µs at room-temperature, which increased to ~ 340 µs at 77 K. Results of temperature dependent absorption and emission studies as well as an analysis of the 1.6 µm emission cross-section will also be presented.

P.19: **Lei Wang**, Beijing Normal University

Effective Spin Mixing Conductance of the Au|CoFe2O4 Interface by Damping Method

In recent decades, YIG has been a real hot material in both theoretical and experimental research on spintronics, and it hasbeen fully studied. Now, a new material of magnetic insulator named CoFe2O4 (CFO) which is a variant type of Fe3O4 called spinel structure has been under investigating. In this paper we report spin mixing conductances of Au|CFO interfaces calculatedwith the LDA/GGA+C method that depend on both crystal orientation and termination of the ferromagnet. The results showthat for the fcc(111) orientation, the spin mixing conductances can differ by more than a factor of 10 between Fe1Co and O-terminations. With this effect, we built up a more general theory to give a predication on spin Hall Magnetoresistance (SMR)at Au|CFO interface. And a model analysis shows that the spin mixing conductance depends linearly on the interfacial magneticmoment density. While we confirm that large anisotropies exist, a detailed agreement is not observed and requires more investigations.

P.20: **Clarissa Vazquez Colon**, University of Texas at San Antonio

Single-crystal-like BaTiO3//SrTiO3 Multilayered Thin Films on Polycrystalline Ni Metal Tapes for Structural Health Monitoring Applications

Single-crystal ferroelectric BaTiO3//SrTiO3 multilayered thin films were fabricated on polycrystalline Ni metal tapes by using pulsed laser deposition. The microstructure studies from transmission electron microscopy reveal that most areas of the multilayered thin films have excellent single-crystal qualities. The dielectric property measurements show that the multilayered thin films have very low loss tangent in the range of 1kHz to 1MHz where the average loss is about 0.0085. The leakage current and ferroelectric measurements show that the multilayered thin films have very low leakage current density and excellent ferroelectric properties. All the results above indicate that the BTO//STO multilayered thin films on Ni have excellent potential for the development of structural health monitoring applications.

P.21: **BenMaan Jawdat**, University of Houston

Superconductivity at 600 mK in a Novel Ternary Platinum Phosphide SrPt6P2

In the course of our search for novel superconducting materials, we have synthesized a novel, metal-rich ternary platinum phosphide superconductor with a unique structure type and an onset Tc of 600 mK, SrPt6P2. The crystal structure was determined by single crystal X-ray diffraction, and features a unique three-dimensional anionic network of vertex-shared Pt6P trigonal prisms. Furthermore, we have investigated the superconductivity in this material resistively, magnetically, and calorimetrically. The results of these studies will be presented.

P.22: **Likai Li**, Fudan University

High Mobility 2D Electron Gas in Black Phosphorus

Black phosphorus has recently emerged as a new member in the family of two-dimensional (2D) atomic crystals. It is a semiconductor with a tunable bandgap and high carrier mobility-material properties that are important for potential opto-electronic and high-speed device applications. In this work, we achieve a record-high carrier mobility in black phosphorus by placing it on hexagonal boron nitride (h-BN) substrate. The exceptional mobility of the 2D electron gas created at the interface allows us to observe quantum oscillations for the first time in this material. The temperature and magnetic field dependence of the oscillations yields crucial information about the black phosphorus 2DEG, such as cyclotron mass of the charge carriers and their lifetime. Our results pave the way to future research on quantum transport in black phosphorus.

P.23: **Edward Lee**, Cornell University

Statistical Mechanics of the U.S. Supreme Court

We build simple models for the distribution of voting patterns in a group, using the Supreme Court of the United States as an example. The maximum entropy model consistent with the observed pairwise correlations among justices' votes, an Ising spin glass, agrees quantitatively with the data. While all correlations (perhaps surprisingly) are positive, the effective pairwise interactions in the spin glass model have both signs, recovering the intuition that ideologically opposite justices negatively influence each another. Despite the competing interactions, a strong tendency toward unanimity emerges from the model, organizing the voting patterns in a relatively simple "energy landscape." Besides unanimity, other energy minima in this landscape, or maxima in probability, correspond to prototypical voting states, such as the ideological split or a tightly correlated, conservative core. The model correctly predicts the correlation of justices with the majority and gives us a measure of their influence on the majority decision. These results suggest that simple models, grounded in statistical physics, can capture essential features of collective decision making quantitatively, even in a complex political context.

P.24: **Tao Qu**, University of Minnesota-Twin Cities

Kambersky Damping in L10 Magnetic Materials of Ordered and Disordered States with Substitutional Defects

Effect of Substitutional Defects on Kambersky Damping in L10 Magnetic Materials: L10 phase alloys with high magnetic anisotropy play a key role in spintronics. The damping constant Î± affects the energy efficiency. However, the intrinsic Kambersky damping reported experimentally differs among investigators and the effect of defects on Î± is never investigated. Here, we apply Kambersky's torque correlation technique, within the tight-binding method, to L10 ordered and disordered alloys FePt, FePd,CoPt and CoPd. In the ordered phase, CoPt has the largest damping of 0.067 while FePd has the minimum value of 0.009 at room temperature. The calculated damping value of FePt 0.02 agrees well with the experiment. The main contribution to the damping is from spin-orbit interaction of the 3d transition elements in Pd-based alloys. Artificially shifting Ef, as might be accomplished by doping with impurity atoms, shows that Î± follows the density of states at Ef in these four L10 alloys. We introduce lattice defects through exchanging the positions of 3d and non-3d transition elements in supercells. The damping increases with reduced degree of chemical order, due to the enhanced spin-flip channel. The two mechanisms in Kambersky damping-intraband and interband behave oppositely versus the degree of order. The intraband damping decreases quickly from ordered to disordered electronic states, while the interband monotonically increases when more defects are included.

American Physical Society
One Physics Ellipse
College Park, MD 20740-3844