



The Abdus Salam  
**International Centre  
for Theoretical Physics**



## Innovations in Strongly Correlated Electronic Systems: School and Workshop

Cosponsor(s): Co-sponsored by: ICAM-12CAM, INTEL BIOMAT (funded by ESF), University of Tokyo/RIKEN and  
Department of Physics, Nanjing University

Organizer(s): P. Coleman, A. Chubukov, A. Schofield, Hai-Hu Wen, H. Takagi. Local Organiser: E. Tosatti  
Trieste - Italy, 06 - 17 August 2012

### Programme

#### WEEK No. 1 - SCHOOL from 6 - 10 August 2012

#### Monday, 6 August 2012

##### 6 August 2012

- 08:30 - 09:30** --- REGISTRATIION & ADMINISTRATIVE FORMALITIES at the Leonardo da Vinci Building, reception area ---  
PLEASE NOTE: Participants receiving MEAL COUPONS may collect the total amount of coupons for the duration of your stay ONE DAY AFTER you have completed the ONLINE REGISTRATION with the Secretary of the activity. THE MEAL COUPONS MUST BE COLLECTED DIRECTLY FROM THE GUEST HOUSE RECEPTION DESKS AS FOLLOWS: ADRIATICO GUEST HOUSE: Tuesday to Friday, from 13.00 to 15.00 GALILEO GUEST HOSUE: Tuesday to Friday, from 10.00 to 12.00 and from 13.00 to 15.00
- 09:30 - 09:40** **OPENING REMARKS** Profs. A. Chubukov, P. Coleman, A. Schofield, H.Takagi, H-H. Wen an E. Tosatti

**New Directions** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Andy SCHOFIELD**

##### 6 August 2012

- 09:40 - 10:55**     **Andre-Marie TREMBLAY** / *Université de Sherbrooke, Canada*  
**Mott transition, Hubbard model and superconductivity: an introduction - Part I**
- 10:55 - 11:15**     --- Coffee Break ---
- 11:15 - 12:30**     **Ali YAZDANI** / *Princeton University, U.S.A.*  
**Visualizing the emergence of heavy fermions and their exotic properties - Part I**
- 12:30 - 14:00**     --- Lunch Break ---

**Monday, 6 August 2012** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Hide TAKAGI**

- 14:00 - 15:15**     **Andre-Marie TREMBLAY** / *Universite de Sherbrooke, Canada*  
**Mott transition, Hubbard model and superconductivity: an introduction - Part II**
- 15:15 - 15:35**     --- Coffee Break ---
- 15:35 - 16:50**     **Ali YAZDANI** / *Princeton University, U.S.A.*  
**Visualizing the emergence of heavy fermions and their exotic properties - Part II**
- 16:50 - 17:50**     **Student run discussion session**
- 18:00 - 20:00**     (Room: Leonardo da Vinci Building Terrace)  
--- WELCOME RECEPTION ---

**Tuesday, 7 August 2012**

**Quantum Magnetism** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Natalia PERKINS**

**7 August 2012**

- 09:15 - 10:30**     **Hide TAKAGI** / *University of Tokyo/RIKEN, Japan*  
**An overview of quantum spin liquid: from toy of theorists to reality - Part I**
- 10:30 - 11:00**     --- Coffee Break ---
- 11:00 - 12:15**     **Yong-Baek KIM** / *University of Toronto, Canada*  
**Lightning review on quantum spin liquid - Part I**
- 12:15 - 13:45**     --- Lunch Break ---

**Tuesday, 7 August 2012** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Hae-Young KEE**

- 13:45 - 15:00**     **Hide TAKAGI** / *University of Tokyo / RIKEN, Japan*  
**An overview of quantum spin liquid: from toy of theorists to reality - Part II**

- 15:00 - 15:30 --- Coffee Break ---
- 15:30 - 16:45 **Yong-Baek KIM / University of Toronto, Canada**  
**Topological phases in quantum materials - Part II**
- 16:45 - 17:45 **Student run discussion session**

**Wednesday, 8 August 2012**

**Spectroscopy/Optics and Beyond:**  
**Review application of optics to strongly correlated electron systems (Room:Leonardo da Vinci Building Main Lecture Hall)**  
**Chairperson: Andre-Marie TREMBLAY**

8 August 2012

- 09:15 - 10:30 **Dmitri BASOV / University of California at San Diego, La Jolla, U.S.A.**  
**An infrared probe of electronic correlations and many body effects in solids: a case study of high-Tc pnictides and graphene - Part I**
- 10:30 - 11:00 --- Coffee Break ---
- 11:00 - 12:15 **Lara BENFATTO / University of Rome, La Sapienza, ISC CNR, Italy**  
**Optical properties of correlated electron systems: basic theoretical aspects and optical sum rule - Part I**
- 12:15 - 13:45 --- Lunch Break ---

**Wednesday, 8 August 2012 (Room:Leonardo da Vinci Building Main Lecture Hall)**  
**Chairperson: Elena BASCONES**

- 13:45 - 15:00 **Dmitri BASOV / University of California at San Diego, La Jolla, U.S.A.**  
**An infrared probe of electronic correlations and many-body effects in solids: a case study of high-Tc pnictides and graphene - Part II**
- 15:00 - 16:15 **Lara BENFATTO / University of Rome "La Sapienza", Italy**  
**Optical properties of correlated electron systems: Basic theoretical aspects and optical sum rule - Part II**
- 16:15 - 16:45 --- Coffee Break ---
- 16:45 - 18:30 **Poster Session - I (Poster Gallery behind the Main Lecture Hall)**

**Thursday, 9 August 2012**

**Mott** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: Rafael FERNANDES**

**9 August 2012**

**09:15 - 10:30**      **Elena BASCONES** / *Universidad Autonoma de Madrid, Spain*  
**Mott physics: from basic concepts to iron superconductors - Part I**

**10:30 - 11:00**      --- Coffee Break ---

**11:00 - 12:15**      **Andy SCHOFIELD** / *University of Birmingham, U.K.*  
**Quantum criticality 1**

**12:15 - 13:45**      --- Lunch Break ---

**Thursday, 9 August 2012**

**Chairperson: Yong-Baek KIM**

**9 August 2012**

**13:45 - 15:00**      **Elena BASCONES** / *Universidad Autonoma de Madrid, Spain*  
**Mott physics: from basic concepts to iron superconductors - Part II**

**15:00 - 15:15**      --- Coffee Break ---

**15:15 - 16:30**      **Andy SCHOFIELD** / *University of Birmingham, U.K.*  
**Quantum Criticality 2**

**16:30 - 18:00**      **Student run discussion session for Wednesday and Thursday sessions**

**Friday, 10 August 2012**

**Iron** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: Dmitri BASOV**

**10 August 2012**

**09:15 - 10:30**      **Hai-Hu WEN** / *Nanjing University, China*  
**Materials and pairing mechanism in iron pnictides/chalcogenides: what we have learnt and what are left - Part I**

**10:30 - 11:00**      --- Coffee Break ---

**11:00 - 12:00**      **Ado JORIO** / *Universidade Federal de Minas Gerais, Belo Horizonte, Brazil*  
**Electronic and Vibrational Properties of Graphene-Based Systems**  
ICTP PRAVEEN CHAUDHARI PRIZE CEREMONY

**12:00 - 13:30**      --- Lunch Break ---

**Friday, 10 August 2012 (Room:Leonardo da Vinci Building Main Lecture Hall)**

**Chairperson: Lara BENFATTO**

- 13:30 - 14:45**      **Rafael FERNANDES / Columbia University, New York, U.S.A.**  
**Interplay between superconductivity, magnetism and nematic/orbital order in the iron pnictides - Part I**
- 14:45 - 16:00**      **Hai-Hu WEN / Nanjing University, China**  
**Materials and pairing mechanism in iron Pnictides/Chalcogenides: What we have learnt and what are left - Part II**
- 16:00 - 16:30**      --- Coffee Break ---
- 16:30 - 17:45**      **Rafael FERNANDES / Columbia University, New York, U.S.A.**  
**Interplay between superconductivity, magnetism and nematic/orbital order in the iron pnictides - Part II**
- 17:45 - 18:30**      **Student run discussion session**

**WEEK No. 2 - WORKSHOP from 13 - 17 August 2012**

**Monday 13 August 2012**

**13 August 2012**

- 08:30 - 09:00**      --- REGISTRATION & ADMINISTRATIVE FORMALITIES at the Leonardo da Vinci Building, reception area ---  
PLEASE NOTE: THIS REGISTRATION IS ONLY FOR VISITORS SPECIFICALLY INVITED FOR THE WORKSHOP - SECOND WEEK. Those visitors who have already attended the School - First Week, DO NOT NEED TO REGISTER AGAIN
- 09:00 - 09:10**      **OPENING REMARKS Profs. A. Chubukov, P. Coleman, A. Schofield, H. Takagi, H-H. Wen and E. Tosatti**

**Innovative Concepts and Techniques in Quantum Matter (Room:Leonardo da Vinci Building Main Lecture Hall)**

**Chairperson: Dirk MORR**

**13 August 2012**

- 09:10 - 10:00**      **Kristjan HAULE / Rutgers State University, Piscataway, U.S.A.**  
**The physics of Hund's metals and its relevance for ruthenates, iron Pnictides and Chalcogenides**
- 10:00 - 10:30**      --- Coffee Break ---
- 10:30 - 11:20**      **Sung-Sik LEE / McMaster University, Hamilton, Canada**  
**From renormalization group to emergent gravity: holographic description of quantum many-body systems**
- 11:20 - 12:10**      **Michael NORMAN / Argonne National Laboratory, U.S.A.**  
**Arcs versus Pockets - To d-wave or not to d-wave, that is the question**
- 12:10 - 14:00**      --- Lunch Break ---

**Developments in Quantum Magnetism** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: Silke PASCHEN**

**13 August 2012**

- 14:00 - 14:50**     **Hae-Young KEE** / *Stanford University, U.S.A.*  
**Theory of magnetic structure in layered iridates: spin-orbit band or Mott insulators**
- 14:50 - 15:40**     **Kedar DAMLE** / *Tata Institute of Fundamental Research, Mumbai, India*  
**Vacancy-induced spin textures and their interactions in a classical spin liquid**
- 15:40 - 16:10**     --- Coffee Break ---
- 16:10 - 17:00**     **Collin BROHOLM** / *John Hopkins University, Baltimore, U.S.A.*  
**From incommensurate correlations to mesoscopic spin resonance in YbRh<sub>2</sub>Si<sub>2</sub>**

**Tuesday 14 August 2012**

**New Directions in Topological Matter** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: Hai-Hu WEN**

**14 August 2012**

- 09:00 - 09:50**     **Andrey BERNEVIG** / *Princeton University, U.S.A.*  
**Fractional topological insulators**
- 09:50 - 10:40**     **Liang FU** / *Harvard University, Cambridge, U.S.A.*  
**Topological superconductivity from odd-parity pairing in strongly spin-orbit-coupled materials**
- 10:40 - 11:10**     --- Coffee Break ---

**New Directions in Pnictides** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: TBC**

**14 August 2012**

- 11:10 - 12:00**     **Takasada SHIBAUCHI** / *Kyoto University, Japan*  
**Quantum critical point inside the superconducting dome and electronic nematic transition above the dome in BaFe<sub>2</sub>(As<sub>1-x</sub>P<sub>x</sub>)<sub>2</sub>**
- 12:00 - 14:00**     --- Lunch Break ---

**New Directions in Pnictides (cont'd)** (Room:Leonardo da Vinci Building Main Lecture Hall)

**Chairperson: Andrey CHUBUKOV**

**14 August 2012**

- 14:00 - 14:50**     **Shik SHIN** / *The University of Tokyo, Japan*  
**Laser-ARPES study on Fe-pnictide superconductors**

- 14:50 - 15:40**     **Hong DING / CAS, Beijing, China**  
**Probing iron-based superconductivity by photoelectrons**
- 15:40 - 16:10**     --- Coffee Break ---
- 16:10 - 16:35**     **Minghu FANG / Zhejiang University, China**  
**Exploration of Fe-Chalcogenide superconductors: Fe-vacancy order, new AFM ground state and superconductivity**
- 16:35 - 17:00**     **Natalia PERKINS / University of Wisconsin-Madison, U.S.A.**  
**Magnetism in parent Fe-chalcogenides**

**Wednesday, 15 August 2012**

**Quantum Critical Theory of Strange Metals (Room:Leonardo da Vinci Building Main Lecture Hall)**

**Chairperson: Michael NORMAN**

**15 August 2012**

- 09:00 - 09:50**     **Piers COLEMAN / Rutgers State University, Piscataway, U.S.A.**  
**The unsolved problem of heavy fermion superconductivity**
- 09:50 - 10:40**     **Satoru NAKATSUJI / University of Tokyo, Japan**  
**Unconventional quantum criticality, anomalous metal with strong valence/orbital fluctuations**
- 10:40 - 11:10**     --- Coffee Break ---
- 11:10 - 12:00**     **Silke PASCHEN / Vienna University of Technology, Austria**  
**Exploring heavy-fermion quantum criticality in the extreme 3D limit**
- 12:00 - 14:00**     --- Lunch Break ---

**Hidden Order (Room:Leonardo da Vinci Building Main Lecture Hall)**

**Chairperson: Piers COLEMAN**

**15 August 2012**

- 14:00 - 14:50**     **Thomas TIMUSK / McMaster University, Hamilton, Canada**  
**The normal state of URu<sub>2</sub>Si<sub>2</sub>: spectroscopic evidence for an anomalous Fermi liquid**
- 14:50 - 15:40**     **Rebecca FLINT / Rutgers, the State University of New Jersey, Piscataway, U.S.A.**  
**Hastatic order in URu<sub>2</sub>Si<sub>2</sub>**
- 15:40 - 16:10**     --- Coffee Break ---
- 16:10 - 16:35**     **Dirk MORR / University of Illinois at Chicago, U.S.A**  
**A nanoscopic approach to heavy fermions: from Kondo droplets to Kondo holes**
- 16:35 - 18:25**     **Poster Session - II (Poster Gallery behind the Main Lecture Hall)**

Thursday, 16 August 2012

**Superconductivity and its Interplay with Charge and Spin Order** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Kedar DAMLE**

16 August 2012

- 09:00 - 09:50**      **Sergei BORISENKO** / *Institut fuer Festkoerper, Dresden, Germany*  
**Fermiology and order parameter of iron-based superconductors from ARPES**
- 09:50 - 10:40**      **Aharon KAPITULNIK** / *Stanford University, U.S.A.*  
**Time reversal symmetry breaking and charge ordering in the Pseudogap phase of high-temperature superconductors**
- 10:40 - 11:10**      --- Coffee Break ---
- 11:10 - 11:35**      **Girsh BLUMBERG** / *Rutgers, the State University of New Jersey, Piscataway, U.S.A.*  
**CaMn<sub>2</sub>Sb<sub>2</sub> with buckled hexagonal Mn plane structure: removal of Hund's spin blockade**
- 11:35 - 12:00**      **Maxim DZERO** / *Kent State University, U.S.A.*  
**Kondo semiconductors with a twist: f-orbital topological insulators**
- 12:00 - 14:00**      --- Lunch Break ---

**Graphene and Non-Equilibrium** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Girsh BLUMBERG**

16 August 2012

- 14:00 - 14:50**      **Oscar VAFEK** / *Florida State University, Tallahassee, U.S.A.*  
**Electronic multicriticality on a honeycomb bilayer**
- 14:50 - 15:40**      **Andrey CHUBUKOV** / *University of Wisconsin-Madison, U.S.A.*  
**Collective instabilities in doped graphene**
- 15:40 - 16:00**      --- Coffee Break ---

**Non-Equilibrium** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Maxim DZERO**

16 August 2012

- 16:00 - 16:50**      **Aditi MITRA** / *New York University, U.S.A.*  
**Quantum quenches in one-dimension: A renormalization group approach**
- 16:50 - 17:40**      **Natan ANDREI** / *Rutgers, the State University of New Jersey, Piscataway, U.S.A.*  
**Quench dynamics of the interacting Bose gas in one dimension**

Friday, 17 August 2012



**Novel Kinds of Order** (Room:Leonardo da Vinci Building Main Lecture Hall)  
**Chairperson: Rebecca FLINT**

**17 August 2012**

- 09:00 - 09:50**      **Massimo CAPONE** / *CNR IOM and SISSA, Trieste, Italy*  
**When Mott meets BCS. Molecular conductors and the search for high-Tc superconductivity**
- 09:50 - 10:40**      **Ryotaro ARITA** / *The University of Tokyo, Japan*  
**Density functional theory for superconductors and its application to layered nitride superconductors**
- 10:40 - 10:50**      --- Coffee Break ---
- 10:50 - 11:40**      **Federico BECCA** / *CNR IOM and SISSA, Trieste, Italy*  
**Localization and glassy dynamics of many-body quantum systems**
- 11:40 - 12:30**      **Discussion and Closing Remarks**  
Prof. A. Chubukov, P. Coleman, A. Schofield, H. Takagi, H-H. Wen and E. Tosatti