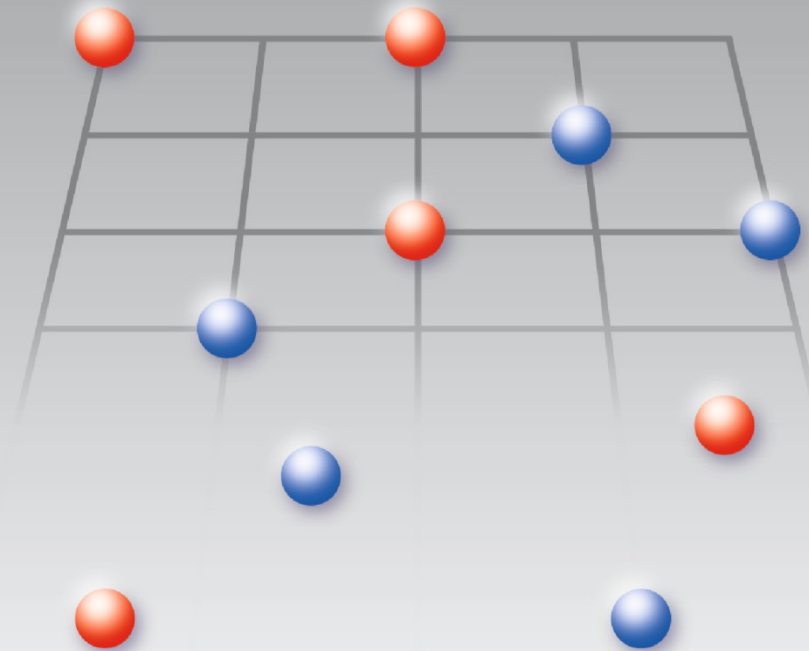


Condensed Matter Systems with Variable Many-Body Interactions

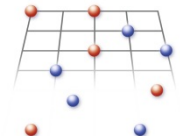


Funding Proposal 1.7.2015 – 30.6.2019
Frankfurt - Kaiserslautern - Mainz

Programme

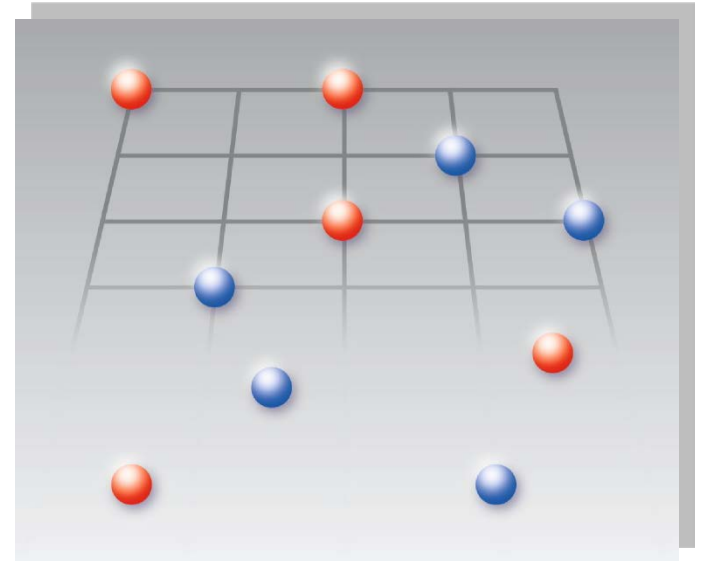
- 9.35 – 10.10 **Scientific concept and structure of SFB/TR 49**
Michael Lang
Young researchers – Integrated Graduate School (MGK)
Sebastian Eggert
Discussion
- 10.10 – 10.50 **Materials design – synthesis and modelling**
Herwig Ott, Rene Gerritsma , Cornelius Krellner*
Discussion
- 10.50 – 11.10 Coffee break
- 11.10 – 11.50 **Cooperative phenomena**
*Michael Fleischhauer, Roser Valentí**
Discussion
- 11.50 – 12.25 **Excitations and interactions**
Burkard Hillebrands, Gerd Schönhense
Discussion

***New aspects from young researchers**
(Kateryna Foyevtsova, Rene Gerritsma)

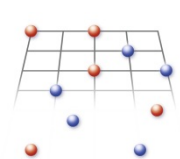


Many-Body Systems with Variable Interactions

- Electrons in narrow-band metals
- Magnetic excitations in spin systems
- Cold atoms/ions in traps



$$\gamma = \frac{\text{Interaction Energy}}{\text{Kinetic Energy}}$$



Scientific Concept – Topics

Mott transition & anomalous states nearby

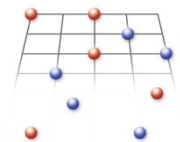
- Spin liquids
- Charge order
- Neutral-ionic transition
- Unconventional superconductivity
- Multiferroicity
- Effects of inhomogeneities

Cooperative phenomena

- Bose-Einstein condensation
- Dimensionality-driven phenomena
- Berezinskii-Kosterlitz-Thouless scenario
- (Quantum)-criticality
- Quantum magnetism – effects of frustration

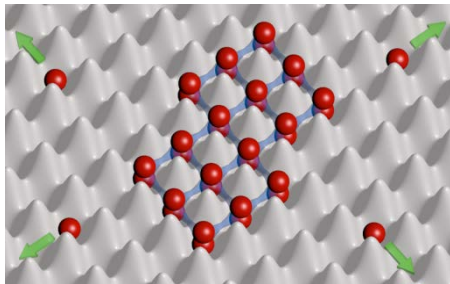
Dynamics of coherence and correlations

- Dynamical response @ strong correlations
- Condensation dynamics
- Non-equilibrium phenomena

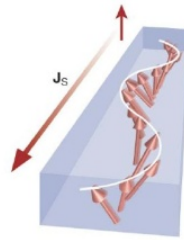


Ansatz – phenomenon oriented

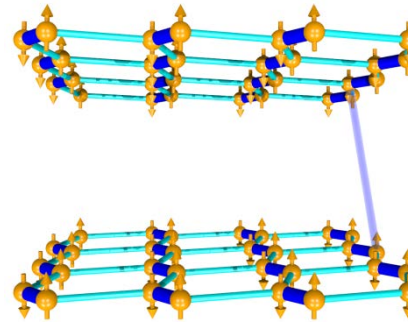
Materials



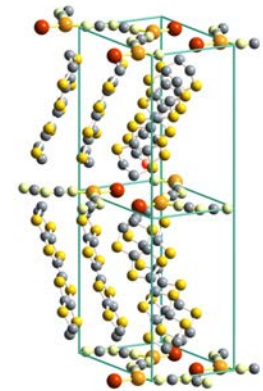
ultracold atoms/ions



magnon gases



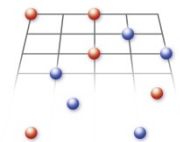
quantum spin systems



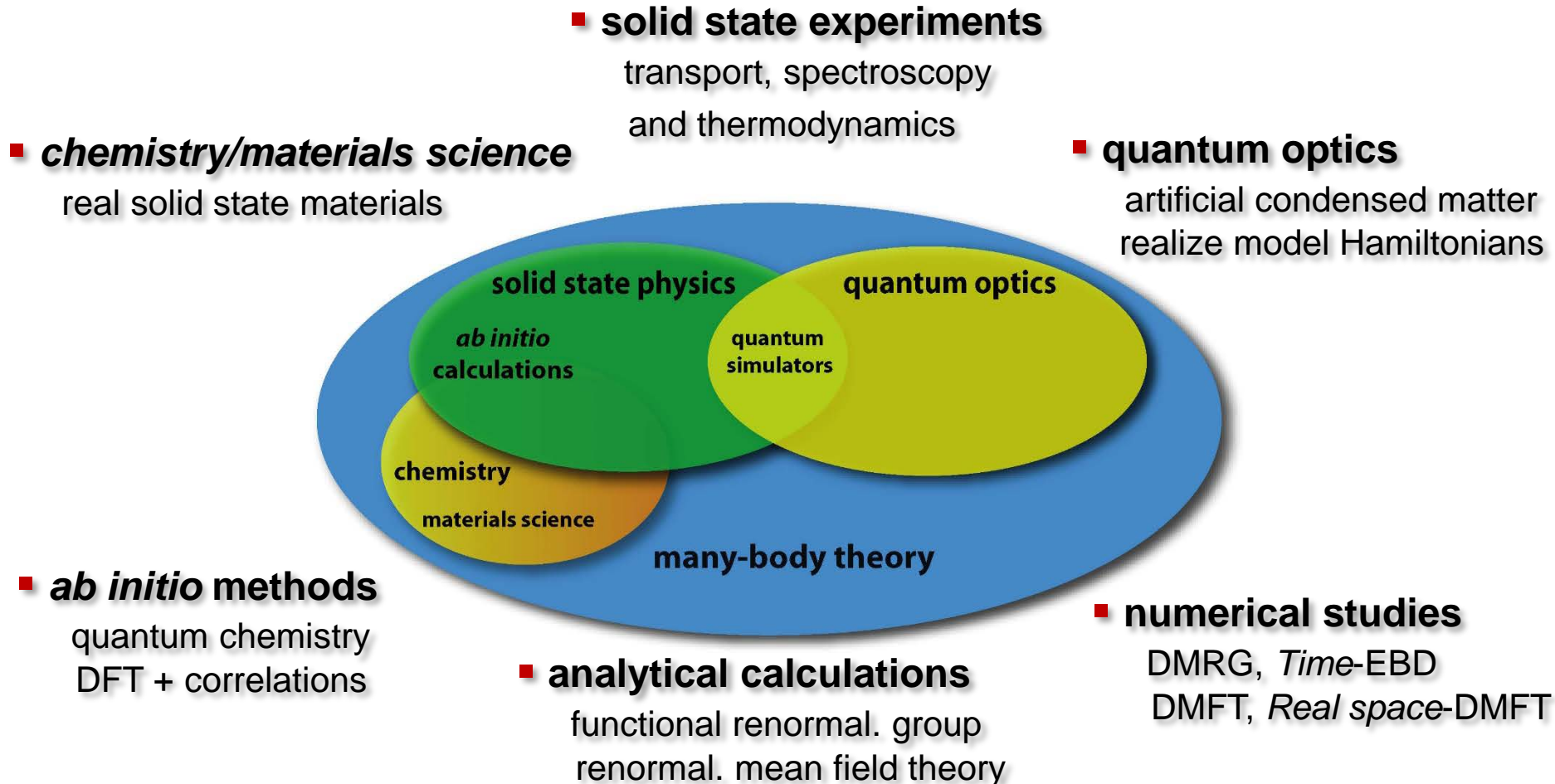
charge-transfer salts

- high degree of controllability & tunability

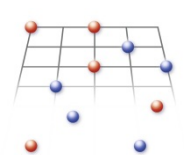
⇒ progress in tailoring model systems: spin-spin interactions, frustration effects, non-equilibrium dynamics, **spin-lattice** ...



Interdisciplinary approach

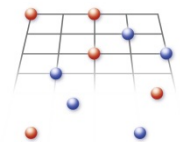


novel techniques \Rightarrow talks „Fields of Research“



Structure within the SFB/TR 49 – “Fields of Research”

Frankfurt am Main	Kaiserslautern	Mainz
B1, B2, B4, B6, B13 _N	A7, A9, A12	A10, B5, B8
Materials Design - Synthesis & Modelling		
A3, A8, B1, B2, B4, B6, B9, B11, B13 _N	A5, A7, A9, A12, B3	A10, B5, B8, B12
Cooperative Phenomena		
A3, A8, B1, B2, B4, B6, B9, B11, B13 _N	A5, A7, A9, A12, B3	A10, B5, B8, B12
Excitations & Interactions		



Project Areas – Formal Sectioning

A: Model-Based Systems

B: Solid State Real Materials

2011-2015

10 experimental projects

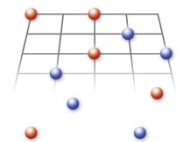
8 theoretical projects

2 experimental / theoretical projects

20 scientific projects

1 graduate school project (MGK)

1 central project



Personnel developments (2011-2015)

New appointments (\Leftrightarrow SFB/TR 49):

2011 **A. Widera** (Kaiserslautern);
ultracold atomic gases, polaron physics

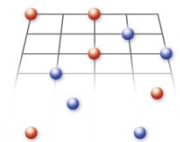


joined the SFB/TR49 in 2012 with A12 (transferred DFG project)

2012 **C. Krellner** (Frankfurt);
materials development & single crystal growth,
(successor of W. Aßmus, retired in 2012)



joined the SFB/TR49 in 2012 as associate member,
now Co-PI in B4 (Ritter, Krellner)



Personnel developments (2011-2015)

Young researchers as new PIs

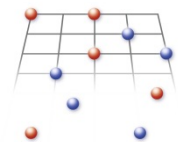
2014 **Rene Gerritsma** (Mainz);
mixtures of ultracold atoms and ions

Co-PI in project A10 (Gerritsma, Schmidt-Kaler)



2015 **Kateryna Foyevtsova** (Vancouver, Frankfurt);
ab initio Quantum Monte Carlo & perturbation theory,

Co-PI in **new project B13_N** (Foyevtsova, Valentí)

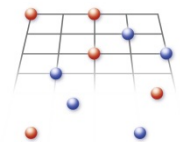
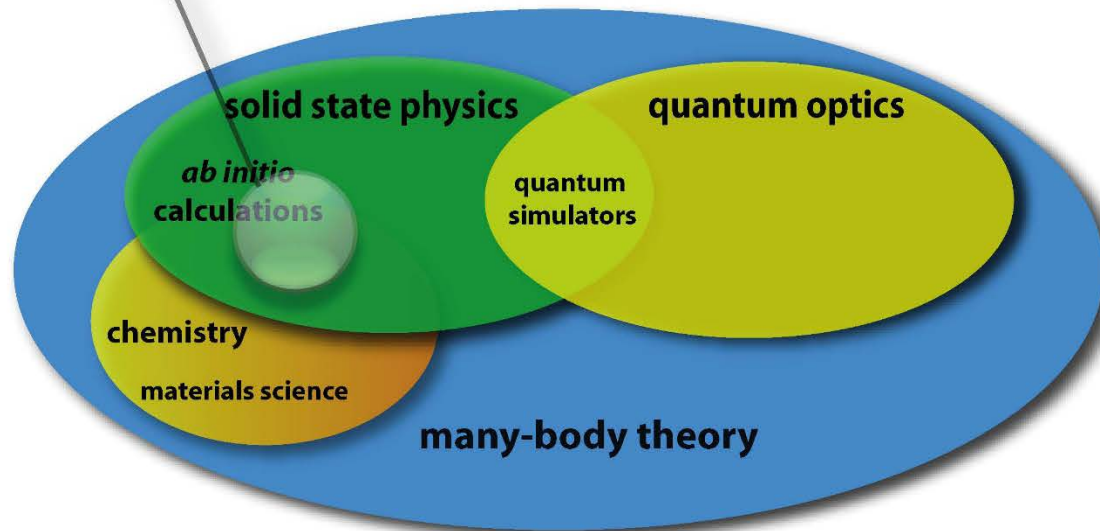


New activities (2015-2019)

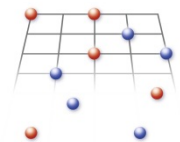
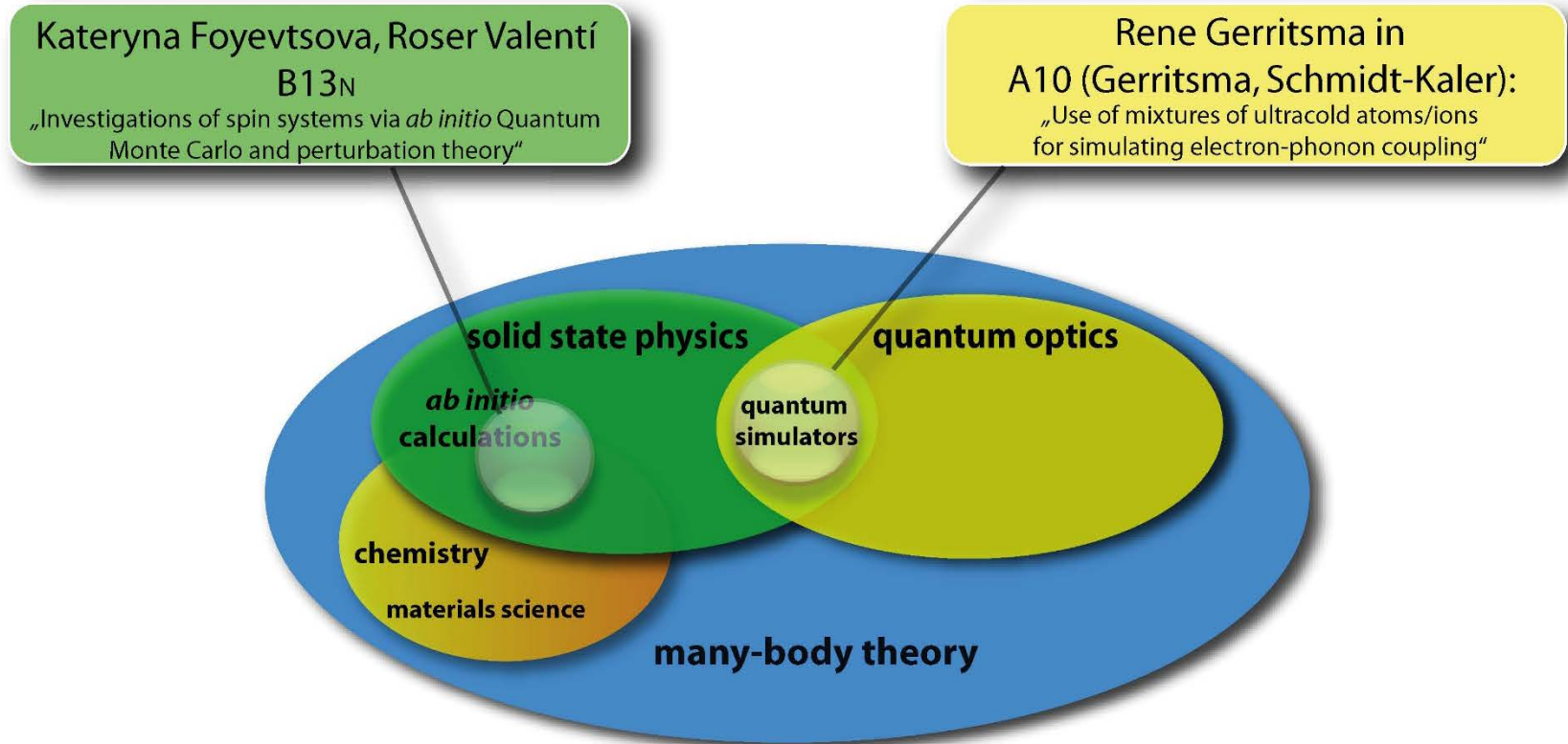
Kateryna Foyevtsova, Roser Valentí

B13N

„Investigations of spin systems via *ab initio* Quantum Monte Carlo and perturbation theory“



New activities (2015-2019)



Project Area A: Model-Based Systems

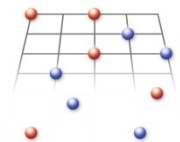
ultracold
atomic/ionic gases

- A3 *W. Hofstetter*
- A5 *M. Fleischhauer, S. Eggert*
- A9 *H. Ott*
- A10 *R. Gerritsma, F. Schmidt-Kaler,*
- A12 *A. Widera*



magnon
gases

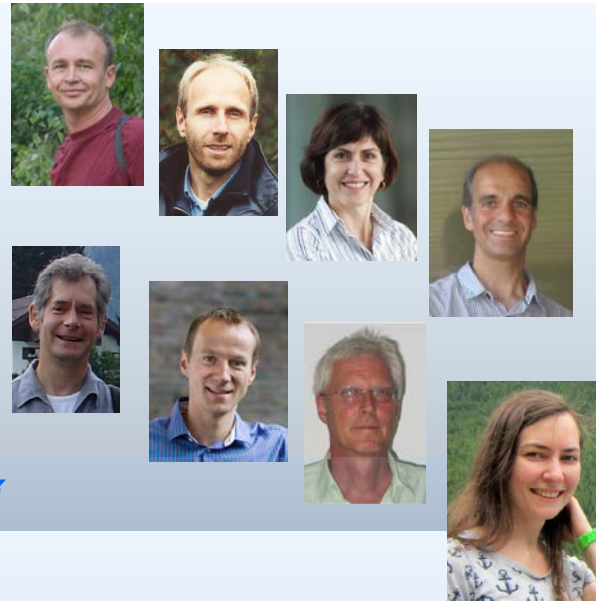
- A7 *B. Hillebrands, O. Serha*
- A8 *P. Kopietz*



Project Area B: Solid State Real Materials

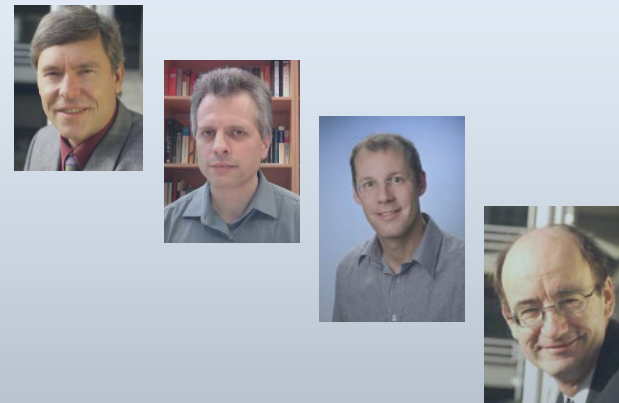
quantum
spin systems

- B1 *B. Wolf, M. Lang*
- B2 *R. Valenti*
- B3 *S. Eggert*
- B4 *F. Ritter, C. Krellner*
- B5 *M. Baumgarten*
- B13_N K. Foyevtsova, R. Valenti*

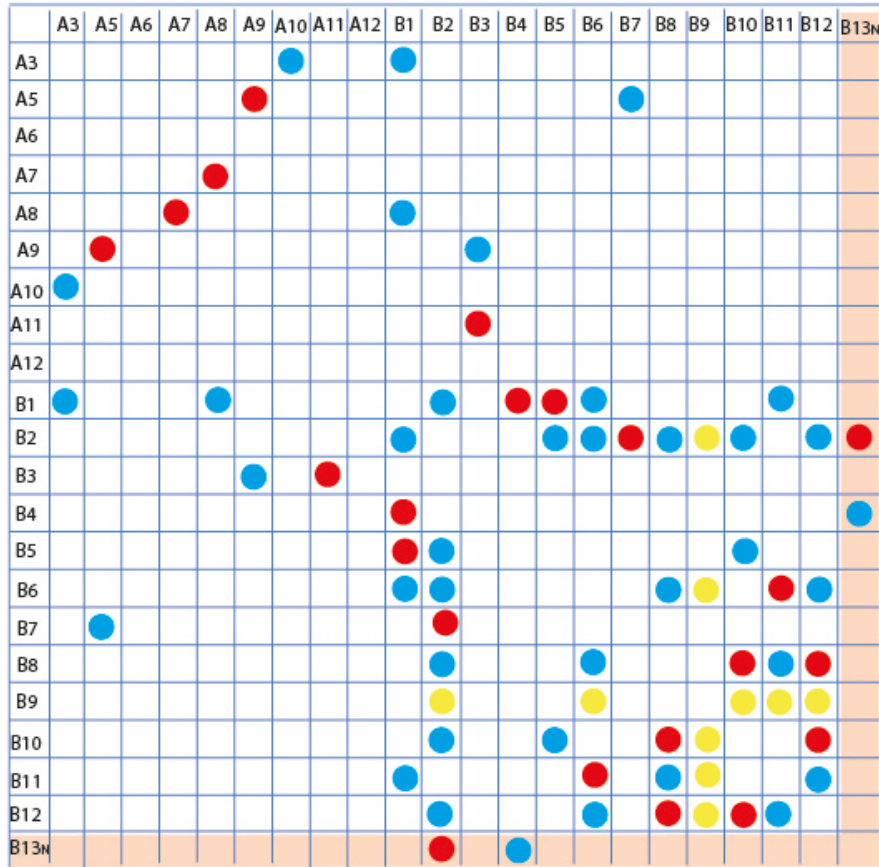


charge-transfer
salts

- B6 *M. Lang*
- B8 *G. Schönhense*
- B9 *M. Huth*
- B11 *J. Müller*
- B12 *H.J. Elmers*



Collaboration within the SFB/TR49

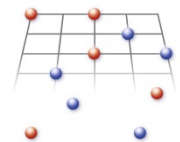


2011 - 2015 (2007 - 2011)

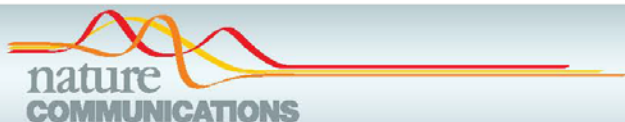
- 45 joint publications (27) (2-4 groups)

joint publication

- 1
- > 1
- arXiv



Joint publications



ARTICLE

Received 21 Feb 2014 | Accepted 8 Sep 2014 | Published 27 Oct 2014

DOI: 10.1038/ncomms6169

Evidence of a field-induced Berezinskii-Kosterlitz-Thouless scenario in a two-dimensional spin-dimer system

U. Tutsch¹, B. Wolf¹, S. Wessel², L. Postulka¹, Y. Tsui¹, H.O. Jeschke³, I. Opahle⁴, T. Saha-Dasgupta⁵, R. Valentí³, A. Brühl¹, K. Removič-Langer¹, T. Kretz⁶, H.-W. Lerner⁶, M. Wagner⁶ & M. Lang¹

B1 B2 B5

J | A | C | S
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

pubs.acs.org/JACS

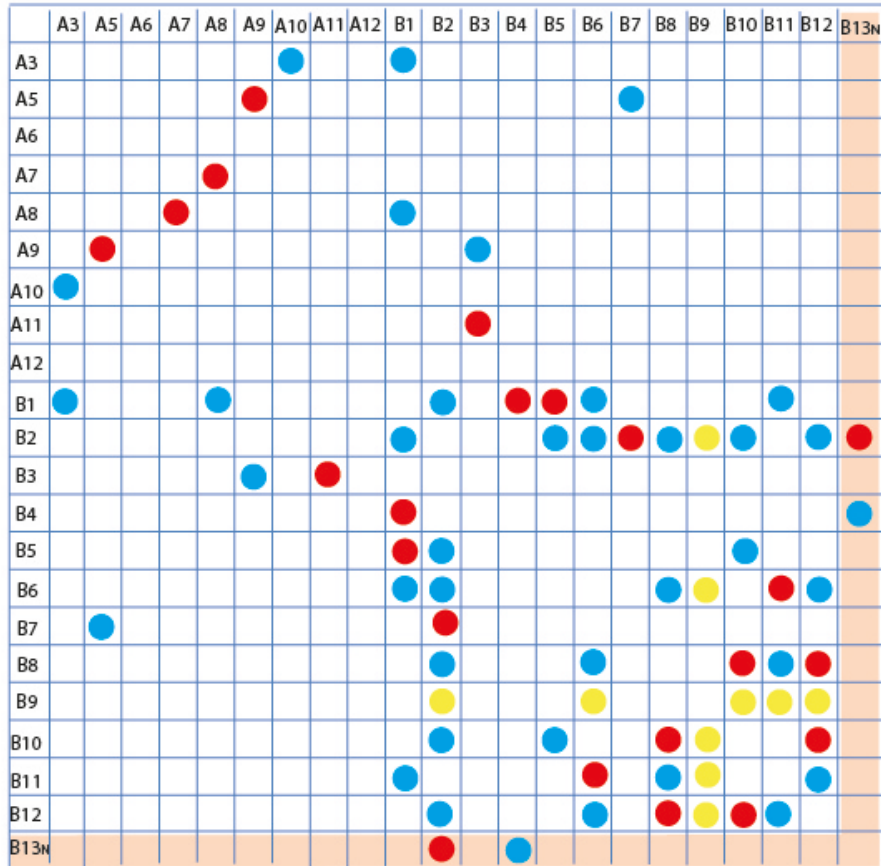
Orbital-Resolved Partial Charge Transfer from the Methoxy Groups of Substituted Pyrenes in Complexes with Tetracyanoquinodimethane—A NEXAFS Study

Katerina Medjanik,^{†,*} Dennis Chercka,[‡] Peter Nagel,[§] Michael Merz,[§] Stefan Schuppler,[§] Martin Baumgarten,[‡] Klaus Müllen,[‡] Sergej A. Nepijko,[‡] Hans-Joachim Elmers,[‡] Gerd Schönhense,[†] Harald O. Jeschke,^{||} and Roser Valentí^{||}

Transregio 49
Frankfurt / Kaiserslautern / Mainz

B2 B8 B10_E B12

Collaboration within the SFB/TR49



2011 - 2015

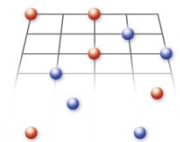
(2007 - 2011)

- 45 joint publications (27)
- out of >180 publications (130)
- 41 in "high-impact" journals (35)

Nature family (6), PNAS (2),
JACS (6), PRL (23), APL (4)

joint publication

- 1
- > 1
- arXiv



Guests - Seminars - Conferences

- 35 guests (typ. stays 1 – 3 weeks)
- 69 SFB colloquia rotating between the 3 locations + 53 SFB seminars

- **2nd International Symposium 2014 on**

*“Novel States in Correlated Condensed Matter –
From Model Systems to Real Materials“*

27 external invited speakers
> 110 participants



April 8-10, Königstein (Taunus)

- **Co-organization of international conferences (9) by SFB/TR49 members:**

- WE-Heraeus-Seminar 2013: *“Quantum Many-Body-Dynamics in Open Systems“*

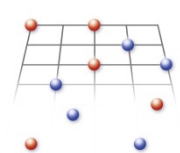
M. Fleischhauer, A. Widera, J. Sirker

- NewSpin3 Conference 2013: *“Spin phenomena: From Model Systems to Complex Matter“*

H. Ott, W. Hofstetter

- ISCOM 2015: *“11th International Symposium on Crystalline Organic Metals, Superconductors and Magnets“*

M. Lang, J. Müller, R. Valentí



Changes in projects

Projects ceased

A6(E) [Nils Blümer](#)

A11(E) [Jesko Sirker](#) (Prof. position at Univ. Manitoba, Canada)

B7(E) [Claudius Gros](#)

B10(E) [Klaus Müllen](#) (retirement in 2016) and [Martin Baumgarten](#)

Changes in project leadership

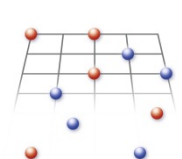
B2 ([Jeschke](#), Valentí) ⇒ B2 (Valentí)

B5 ([Wagner](#), Baumgarten) ⇒ B5 (Baumgarten)

B6 ([de Souza](#), Lang) ⇒ B6 (Lang)

B8 ([Aeschlimann](#), Schönhense) ⇒ B8 (Schönhense)

⇒ key aspects will be continued in other projects



Funding Proposal 2015-2019

11 experimental projects

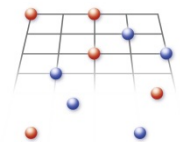
6 theoretical projects

1 experimental / theoretical projects

18 scientific projects

1 graduate school project (MGK)

1 central project



Funding Proposal 2015-2019 – new aspects

Mott transition & anomalous states nearby

- Spin liquids
- Charge order
- Neutral-ionic transition
- Unconventional superconductivity
- Multiferroicity
- Effects of inhomogeneities

Cooperative phenomena

- Bose-Einstein condensation
- Dimensionality-driven phenomena
- Berezinskii-Kosterlitz-Thouless scenario
- (Quantum)-criticality
- Quantum magnetism – effects of frustration

Dynamics of coherence and correlations

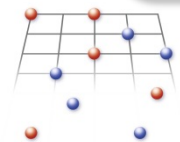
- Dynamical response @ strong correlations
- Condensation dynamics
- Non-equilibrium phenomena

2007-2011: formation of collective states, thermodynamic properties

2011-2015: dynamical aspects, effects of inhomogeneities and frustration

Advances in controlling & treating relevant parameters (\Leftrightarrow model systems)

2015-2019: coupling to lattice degrees of freedom: polaron physics, novel phenomena at QCP, multiferroic effects, ...



Measures at the participating universities

- Service centers:
gender & diversity controlling, dual career-service, family service;
Training programmes: gender & diversity trainings for leadership positions,
junior researchers,...
- Mentoring, training & coaching
“MentorinnenNetzwerk“, “SciMento“, “ProProfessur“,
- Gender and Diversity competence: awareness training for leading personnel
- Special offers:
Day-care facilities, family-friendly infrastructure
baby nursing, changing facilities, ...



FB PHYSIK
SPIELKISTE

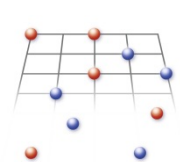


Special measures by the SFB/TR 49

- Job announcements using suitable networks & mailing lists; encouraging qualified women to apply
- Active participation in special events: “Girlsday“, “Physikerinnentagung“, ...

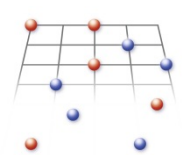


- Dual-career service for young researchers (2 couples employed)
- Additional flexible support: day-care service on evening hours/weekends during conference travels, ...
- Discussion forum (\Leftrightarrow SFB colloquium) : Meeting with female senior scientists



Female next-generation scientists within the SFB/TR 49

	percentage of women (2007-2015)		physics throughout Germany
PhD students	19-25%		20%
Postdocs	20-22%		17%
	(2007-2011)	(2011-2015)	(2015-2019)
Female PIs	Roser Valentí Claudia Felser	Roser Valentí	Roser Valentí Kateryna Foyevtsova



SFB/TR49 \Leftrightarrow Structures at the Universities

The SFB/TR49

- matches **priority research areas** at the participating Universities
- has strongly influenced **personnel developments**
 - FFM: Prof. Müller, 2009; Prof. Krellner, 2012;
 - KL: Prof. Ott, 2009; JProf Sirker, 2009; Prof. Widera, 2012;
 - MZ: Prof. Schmidt-Kaler, 2010;
- interacts with local Research Centers
 - OPTIMAS - Optics and Materials Science (KL)
 - CINEMA – Centre for INnovative & EMerging Materials (MZ)
- is supported by **additional infrastructure**
 - He-liquefier (FFM), Nanostructuring facilities (KL), access to high-performance computers, ...
- has significantly strengthened **education of young scientists**

