

SCIENTIFIC REPORT

PhD Workshop on
Ultracold Bose-Fermi Mixtures,
26th to 28th September,
University of Potsdam, Germany

1. Summary, scientific content, scientific discussions, results and impact on the future direction of the field

Mixtures of ultracold bosonic and fermionic particles have attracted a considerable amount of attention in recent years, to a high extent triggered by the perspective of achieving transitions to superfluidity in systems of neutral fermionic atoms. Spectacular progress has already been achieved in the experimental manipulation of cold atoms in optical lattices with an astonishingly high degree of control.

In addition to the work on ultracold atoms, the formation of bosonic or fermionic molecules using Feshbach resonances or photoassociation provides an additional tool to the study of strongly correlated atoms and molecules.

A perspective of key interest in this field lies in the possibility of discovering and probing new quantum phases of matter by combining ideas from the study of Bose-Fermi mixtures in solid state systems and of cold quantum gases in optical lattices.

The PhD workshop *Ultracold Bose-Fermi Mixtures* has brought together PhD students from leading scientific groups working on the theory of cold gases and solid state physics and on experiments concerning the realization of mixtures of bosons and fermions (in optical lattices). Beside introductory and more specialized talks a significant amount of time was reserved for informal discussions and working groups. Topics included

- Experiments on ultracold bosonic atoms in optical lattices (including effects of disorder)
- Production of mixtures of ultracold fermionic and bosonic atoms
- Theory of the Bose-Fermi-Hubbard Hamiltonian
- The BEC-BCS crossover

- Dynamical mean-field theory and numerical renormalization group approach

The program of the workshop promoted the dialogue between the best researchers in the above mentioned fields. The relaxed atmosphere stemming from the fact that all speakers and participants were PhD students resulted in lively discussions and scientific exchanges during and after program hours. An impressive amount of questions were raised during the talks and many discussion groups gathered during the informal discussions and in the spare time.

The workshop has been a great success mainly due to the large amount of time dedicated to informal discussions and the age of speakers and participants. The path to collaborations among researchers from different fields was paved.

Finally, we would like to recommend the continuation of Workshops in this type of setting in general and concerning research on Bose-Fermi mixtures in particular.

2. Final program

	Sept. 26th	Sept. 27th	Sept. 28th
9:00 - 9:30		V. Guarrera: Effect of an optical disordered potential and of a single defect on the expansion of a BEC in a 1D waveguide	K. Glaum: Bose-Einstein condensates in trapped Systems from a canonical point of view
9:30 - 10:00		S. Falke: Spectroscopy of hetero-nuclear dimers	A. Eckardt: Superfluid-insulator transition in a periodically driven optical lattice
10:00 - 10:30		O. Topic: Production of a quantum degenerate Boson (87Rb) and Fermion (40K) mixture	A. Ponomarev: Dipole and Bloch oscillations of cold atoms in a parabolic lattice
10:30 - 11:00		Refreshments	S. Roethel: Stability of a dilute ultracold trapped gas of Bose and Fermi atoms
11:00 - 11:30			Refreshments
11:30 - 12:30		M. Zaccanti: Experimental study of interspecies Feshbach resonances in a 87Rb and 40K Bose-Fermi mixture	
12:30 - 13:00		Lunch	H. Fehrmann: From a Bose-Fermi-Hubbard model to a system of interacting spinless fermions
13:00 - 14:00	Welcome		Closing remarks
14:00 - 15:00	A. Mering: Bose-Fermi-Hubbard model: phases and fluctuations	S. Ospelkaus: Collapse Dynamics of a quantum degenerate Fermi-Bose Mixture of 40K and 87Rb	
15:00 - 15:30	J. Bauer: Applications of the DMFT-NRG approach	L. De Sarlo: From Fermi-Bose to Bose-Bose mixtures	
15:30 - 16:00		C. Marzok: Degenerate mixture of 6Li and 87Rb	
16:00 - 17:00	Coffe break	Coffee break	
17:00 - 17:30	S. Diehl: Universality in the BEC-BCS crossover	V. Ahufinger: Fermi-Bose mixtures in inhomogeneous and random optical lattices	
17:30 - 18:00	M. Romans: Dressed Feshbach molecules in the BEC-BCS crossover		
18:00 - 19:00	Informal Discussions	Informal Discussions	

