Bose-Einstein Condensation 2007:Frontiers in Quantum Gases

Saint Feliu de Guixols (Costa Brava) Spain 15-20 September 2007

Chair: Massimo Inguscio (Firenze, Italy)
Vice-Chair: Peter Zoller (Innsbruck, Austria)

Abstract:

Bose-Einstein Condensation has been a hot topic from its very first observation in 1995. BEC2007 conference will provide a fresh view on all the novel emerging subjects in this area bringing together leading scientists from all over the world to discuss novelties such as new quantum phase transitions in ordered and disordered system, mixtures of different bosonic or fermionic atoms, the formation of condensed molecular systems and research towards Quantum Information and precision measurements with degenerate atoms.

Scientific summary:

In a Bose-Einstein Condensate all atoms occupy the same quantum state and can be described by a macroscopic wave-function. Condensed atomic samples can thus be used as coherent matter-wave sources giving access to a yield of new physical phenomena.

Atomic interferometers are a powerful method to study time and space coherence and probing peculiar effects of quantum degenerate gases. On the other hand, once deeply characterized, condensed gases can be used as coherent sources (atom lasers) to implement performances of atomic interferometers for applications where atomic beams are used as atomic clocks, precision measurements of fundamental constants, atom lithography and tests of fundamental symmetries.

Quantum gases as condensates and degenerate fermions, thanks to their very low energy, can be easily manipulated with light. The use of light allows to realize a broad range of trapping potentials with different geometries creating both ordered and disordered structure. Indeed, ultra-cold atoms in optical lattices are an ideal testing ground for many issues involving quantum transport since they experience none of the complications of thermal effects, impurities, multi-particle interactions, or defects of electrons in crystals. Applications of Quantum Gases in optical potentials range from matter-wave transport to the emergence of new quantum phase transitions and from precision measurements to quantum computing.

Conference Outcome and Outlook:

BEC2007 conference has provided a fresh view on all the hot emerging topics in BEC research bringing together leading scientists from all over the world. Following the well established tradition started in Levico (I) in 1993 and continued biannually in Saint Odile (F) in 1995, Castelvecchio (I) in 1997 and Saint Feliu de Guixols (E) from 1999 to 2005 the 2007 conference has been once again held in Saint Feliu de Guixols (Costa Brava) Spain.

The success of this year edition has been tremendous with 169 participants from all over the world, with an increase of almost 50% with respect to the previous edition. The scientific quality of the speakers and chairmen was of extremely high level including three Nobel prize winners (E. A. Cornell, W. Ketterle, W.D. Phillips) and virtually all the leading experts in the field. Long discussion time in the program ensured also a very lively atmosphere to which the two poster sessions were also instrumental.

ESF support also meant that we were able to finance a good number of young participants including 17 students.

The topics treated included techniques to manipulate matter on the atomic-molecular scale which have had an overwhelming development in the past ten years thanks to new cooling methods capable of producing atomic samples at temperatures well below one microKelvin. At these temperatures the atoms can no longer be considered as classical particles but have to be described by quantum matter waves. Bose-Einstein condensates and quantum degenerate Fermi gases of alkali atoms, obtained with a combination of most of the new cooling methods, are the most spectacular example of the new attainable regimes.

Most perspectives opened by trapped atoms have been already reported: the observation of the superfluid-Mott insulator quantum phase transition, the analysis of the Tonks-Girardeau regime in strongly interacting bosons, quantum degenerate mixtures and molecules. A strong accent has been posed on novel quantum systems different from ultracold atoms in order to enrich research opportunities. We had brilliant reports on polariton condensation and Quantum Chromodynamics which will surely find some analogous ion the field of quantum degenerate gases

Program of the conference:

Saturday 15 September

Late afternoon /

early evening Registration at the hotel reception

20.30 Dinner

22.00 Get-together-drinks

Sunday 16 September

Session 1 - Chair: Massimo Inguscio

08.30 Conference Opening

08.45 Eric Cornell "Fluctuations and Strong Interactions in BEC"

09.30 Discussion

09.40 Wolfgang Ketterle "Recent results at MIT on ultracold Fermi gases"

10.25 Discussion

10.35 Coffee break

11.05 Zoran Hadzibabic "Bose gas in Flatland"

11.40 Discussion

11.45 Dave Weiss "Experiments with 1D Bose gases"

12.20 Discussion

12.30 Lunch

Session 2

15.30 Chair: Jook Walraven

15.45 Gora Shlyapnikov "Strongly interacting Fermi mixtures"

16.30 Discussion

16.40 Lev Pitaevskii "Collisionless shock waves in BEC and interference of interacting condensates."

17.25 Discussion

17.35 Coffee break

18.05 Chair: Christophe Salomon

18.20 Eugene Demler "Strongly correlated quantum systems: from electronic materials to cold atoms"

18.55 Discussion

19.00 Jason Ho "Cooling Quantum Gases to Strongly Correlated Regime in Optical Lattices"

19.35 Discussion

19.45 Dinner

21.00 Poster session 1 (Posters from 1 to 58)

Monday 17 September

Session 3

8.30 Chair: Sandro Stringari

08.45 Krishna Rajagopal "Cold Quarks, Cold Atoms and Hot Quarks"

09.30 Discussion

09.40 Rudi Grimm "Cold Dipolar gases"

10.25 Discussion

10.35 Coffee break

11.05 Randi Hulet "Experiments with a Fermi gas with unequal spin populations"

11.50 Discussion

12.00 John Thomas "Strongly interacting Fermi gases as nearly perfect fluids"

12.45 Discussion

13.00 Lunch

Session 4

15.30 Chair: Alain Aspect

15.45 Bill Phillips "Creating vortices and persistent atom currents with optical orbital angular momentum"

16.30 Discussion

16.40 Boris Altshuler

17.25 Discussion

17.35 Coffee break

18.05 Chiara Fort "Experiments with ultracold atoms in a bichromatic optical lattice: searching for disorder induced effects"

18.40 Discussion

18.45 Vincenzo Savona "Bose-Einstein condensation of polaritons in a semiconductor microcavity"

19.20 Discussion

19.25 Dinner

21.00 Poster session 2 (Posters from 59 to 115)

Tuesday 18 September

Session 5

08.30 Chair: Ennio Arimondo

08.45 Dan Stamper-Kurn "Cavity quantum electrodynamics with trapped ultracold atoms"

09.20 Discussion

09.25 Klaus Sengstock "Physics with quantum gas mixtures"

10.00 Discussion

10.05 Coffee break

10.35 Tilman Esslinger "Quantum gases in optical cavities and lattices"

11.10 Discussion

11.15 Nir Davidson "Bulk excitations in BEC: beyond Bogoliubov"

11.50 Discussion

11.55 Francesca Ferlaino "Few-body physics with ultracold Cs atoms and molecules"

12.15 Discussion

12.20 Stephan Duerr “How dissipation creates a Tonks gas of molecules”

12.40 Discussion

13:00 Lunch

14.30 Excursion

19.30 Conference Dinner

Wednesday 19 September

Session 6

08.30 Chair: Wolfgang Ertmer

08.45 Mark Kasevich “2D Quantum Gases”

09.30 Discussion

09.40 Augusto Smerzi “Quantum Interferometry”

10.15 Discussion

10.20 Coffee break

10.50 Chair: Klaasjan van Druten

11.05 Nicolaj Prokofiev "Quantum phases of bosons in optical lattice"

11.40 Discussion

11.45 Ehud Altman “Hidden topological order in one dimensional Bose insulators”

12.20 Discussion

12.25 Nandini Trivedi “Strongly interacting Fermions and Bosons in Optical Lattices”

13.00 Discussion

13.05 Lunch

Session 7

15.30 Chair: Masahito Ueda

15.45 Tilmann Pfau "Novel interactions in quantum gases"

16.20 Discussion

16.30 Peter Engels

17.05 Discussion

17.10 Coffee break

17:40 Chair : Francesco Cataliotti

17.55 Fujio Shimizu “Manipulation of cold atoms on a superconductive atom chip”

18.30 Discussion

18.35 Thorsten Schumm “Correlations and Coherence in 1D Bose gases”

19.10 Discussion

19.15 Jae Choi “Interferometry with interacting BEC”

19.35 Discussion

19.40 Hans Buechler Three-body interactions with cold polar molecules

20.00 Discussion

20.05 Dinner

Thursday 20 September

Session 8

08.30 Chair : Peter Zoller

08.45 Trey Porto “Sub-lattice addressing and controlled exchange interactions in a double-well optical lattice”

09.30 Discussion

09.40 Immanuel Bloch “Towards Quantum Magnetism with Ultracold Atoms in Optical Lattices”

10.25 Discussion

10.35 Coffee break

11.05 Chris Westbrook "Production of correlated atoms in BEC collisions"

11.40 Discussion

11.45 Maciej Lewenstein “New trends with ultracold spinor gases”

12.20 Discussion

12.25 Jean Dalibard : Summary and Outlook

13.00 Closing of the conference