PROJECT FINAL REPORT

Publishable Summary report

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1.1.1 List of beneficiaries

Number	Beneficiary name	Short name	Country	Date enter project	Date exit project
1 Co	Consiglio Nazionale delle Ricerche – Istituto Nazionale di Ottica	CNR	Italy	Month 1	Month 40
2	Johannes Gutenberg-Universität Mainz	JGUM	Germany	Month 1	Month 12
3	Eidgenössische Technische Hochschule Zürich	ETHZ	Switzerland	Month 1	Month 40
4	European Laboratory for Non Linear Spectroscopy	LENS	Italy	Month 1	Month 40
5	Universität Innsbruck	UIBK	Austria	Month 1	Month 40
6	Institut de Ciencies Fotoniques, Fund. Priv.	ICFO	Spain	Month 1	Month 40
7	Max Planck für Gesellschaft zur Foerderung der Wissenschaften E.V.	MPG	Germany	Month 1	Month 40
8	Institute of Physics, Polish Academy of Sciences	IFPAN	Poland	Month 17	Month 40
9	Vilniaus Universitetas	VU	Lithuania	Month 17	Month 40

1. Final publishable summary report

Nanodesigning of Atomic and MolEcular QUAntum Matter
(NAME-QUAM)

Project coordinator Ennio ARIMONDO

Coordinator:
-Consiglio Nazionale delle Ricerche- Istituto Nazionale di Ottica, Dipartimento di Fisica, Universita' di Pisa, Pisa, Italy (CNR)

Partners:
- Swiss Federal Institute of Technology, ETHZ Zurich, Switzerland (ETHZ)
- European Laboratory for Non Linear Spectroscopy (LENS)
- Institut für Theoretische Physik, Universität Innsbruck and Österreichische Akademie der Wissenschaften, Austrian Academy of Sciences, Innsbruck, Austria (UIBK)
- Institut de Ciencies Fotoniques, Fund. Priv. Barcelona, Spain (ICFO)
- Max Planck für Gesellschaft zur Foerderung der Wissenschaften E.V., Garching (Muenchen) Germany (MPG)
- Institute of Physics, Polish Academy of Sciences, Varsaw, Poland (IFPAN)
- Vilniaus Universitetas, Vilnius, Lithuania (VU).

Project public Website: http://namequam.df.unipi.it/

The NAMEQUAM Project has investigated the use of ultracold atom/molecule quantum matter technology for quantum information computational tasks. Parallel quantum processing in periodic nanostructures is expected to lead to significant advances in different areas of quantum information.

The Project efforts concentrated on atoms/molecules confined in periodic nanostructures, mainly externally imposed by optical lattices, with some theoretical effort also on structures self-generated by the atomic/molecular interactions. The Project developed novel techniques for quantum engineering and quantum control of ultracold atoms and molecules confined in the periodic nanostructures. The objectives relied on the nanodesign of atomic/molecular quantum matter at the mesoscopic scale of few-body systems. An innovative aspect was the development of appropriate tools for achieving quantum control of strongly correlated many body systems at the nanoscale by exploiting moderate- and long-range quantum mechanical interactions. Strongly correlated interacting systems offer a level of computational power that cannot be reached with traditional qubits based on spin, or hyperfine atomic states. Generation and detection of multiparticle quantum entanglement, robusteness of non-traditional qubits, quantum memories characterised the investigations. Moderate and long, range interactions were exploited in few body quantum systems in order to produce fast quantum gates using novel robust qubit concepts and using quantum states with topological order, all of them highly relevant for next generation quantum information implementations.

The following breakthroughs of the Project open the road for new quantum information technologies: characterization of long range interacting systems for optimal quantum information; realization of individual manipulation integrated in proper algorithms; design of new protected qubits or quantum information processors based on long range interactions; developing techniques for topological quantum computation; create multi-particle entanglement for quantum simulation investigations. As far as the visionary aspects are concerned, the technological and conceptual advances resulting from the investigations on multi-particle entanglement, topological structures and nano-optical engineering may lead to the identification of new directions and alternative approaches towards scalable and miniaturisable quantum information processing. A persistent and long-term commitment to emerging applications and the transition towards a knowledge-based high-technology industry may be originated if the NAME-QUAM tools could be combined to chip technologies and quantum hybrid structures.

The ultracold atom community was a pioneer in introducing periodic potentials for atomic qubits. Today similar structures are examined by other quantum information communities aiming to cahtch up with the Project quantum information objectives. However the ultracold atom community maintains its leading role owing to the flexible design of the periodic structures.

The main Project objectives are listed in the following and highlighted in Fig. 1:

1. Attain nanoscale control over the atomic/molecular quantum matter. This nanoscale control is achieved for different lattice systems with mesoscopic assemblies of three or four atoms, as in the single plaquette of an optical lattice, with quantum gases strongly coupled to high finesse cavities the so called quantum optical lattices, with Rydberg atoms, with polar molecules, and with alkaline earth atoms. All these different approaches represent "non-traditional" qubits for quantum computing. The preparation of qubits stored on plaquettes allows the realisation of topological quantum computing. Quantum memories based on quantum optical lattices have been also investigated.
2. Create, control and detect quantum entanglement in these systems through the application of two-qubit gates, which can be utilised either for general-purpose quantum computing or quantum simulation.

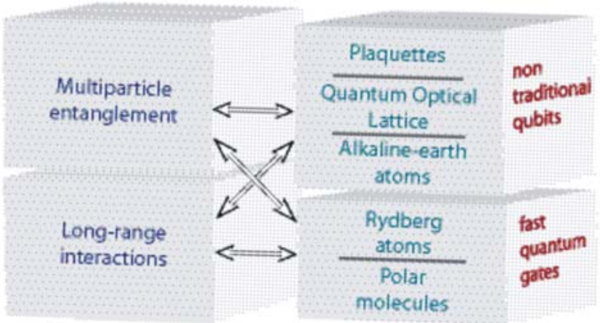

Fig. 1. Main pillars of NAME-QUAM: main tools are shown on the left, the system realisations in the middle and the key elements on the right.

The physical implementation of quantum information schemes based on optical lattices makes it necessary to individually address single-site and single-qubit. I. Bloch group, at JGUM first and later at MPG, and T. Esslinger group at ETHZ have obtained high-resolution images of ultracold atoms in an optical lattice where one clearly distinguishes individual atoms, as shown in the images of Fig. 2. MPG has demonstrated how such control can be extended down to the most fundamental level of a single spin at a specific site of an optical lattice. Using a tightly focused laser beam together with a microwave field, MPG was able to flip the spin of individual atoms in a Mott insulator with sub-diffraction-limited resolution, well below the lattice spacing.

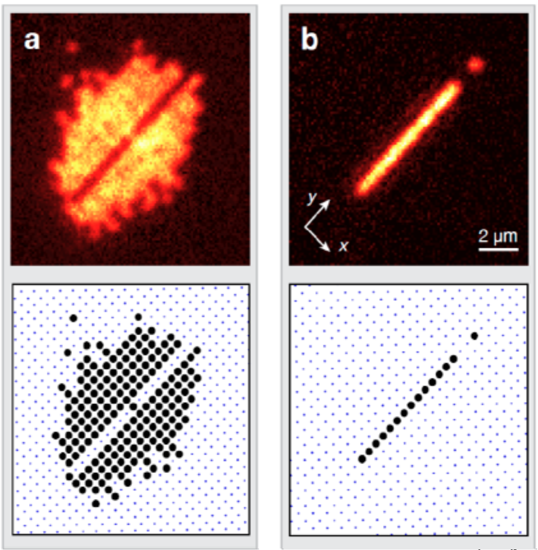

Fig. 2. Single-site addressing from [Weitenberg2012]. **a**, Experimentally obtained fluorescence image of a Mott insulator with unity filling in which the spin of selected atoms was flipped from |0> to |1> using the single-site addressing scheme. Atoms in state |1> were removed by a resonant laser pulse before detection. The lower part shows the reconstructed atom number distribution on the lattice. Each circle indicates a single atom, the points mark the lattice sites. **b** Same as **a**, but a global microwave sweep exchanged the population in |0> and |1>, such that only the addressed atoms were observed. The line in **b** shows 14 atoms on neighbouring sites.

A large part of the Project effort was on the quantum simulations with ultracold quantum gases, because these systems offer a unique setting for quantum simulation of interacting many-body systems [Esslinger2010, Bloch12, Cirac12, Lewenstein2102]. The high degree of controllability, the novel detection possibilities and the extreme physical parameter regimes that can be reached in these ‘artificial solids’ provide an exciting complementary set-up compared with natural condensed-matter systems, much in the spirit of Feynman’s vision of a quantum simulator. Predicting the evolution of a multicomponent system is often a challenge that can be solved either by direct mathematical analysis or by a device that simulates its behavior. In many cases the latter approach may offer a faster solution, better accuracy and/or a more illustrative representation than possible with available numerical methods. The general interest in the simulation of physical phenomena has been greatly revitalized during the past decade. This renaissance resulted from the conjunction of new needs and new tools. The new needs originate in the increasing role of quantum effects in the states of matter relevant for modern technology. The computational power required to describe an assembly of particles in quantum physics increases exponentially with the number of its constituents. The numerical description of a sample of quantum matter is thus often limited to a small number of constituents, and this may prevent one from addressing with the desired accuracy important phenomena such as high-Tc superconductivity. The new tools have emerged thanks to recent advances in the control of ultracold atomic gases within periodic potentials and the Partners have greatly contribute to this advance through several major breakthroughs. As in the preface to the Nature Physics Insight special issue of April 2012, “The competition between the different (quantum simulation) platforms isn’t, however, a ‘winner takes all’ situation. Each platform has its own advantages and limitations, and different approaches often tackle complementary aspects of quantum simulation.”

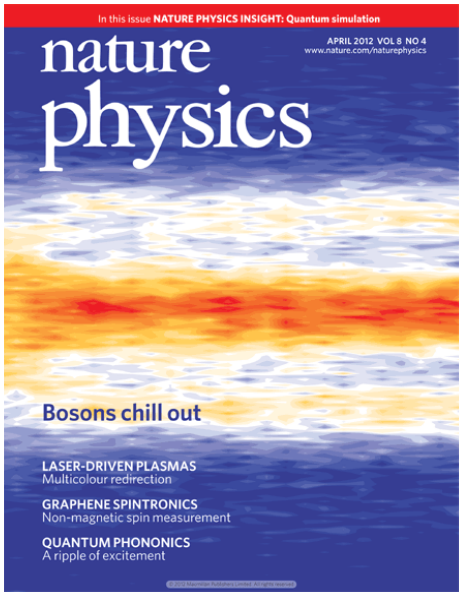

Fig. 3. On the left “Dirac Action” Cover of 15th March 2012 Nature issue reporting the band structure of artificial graphene with intersections at two Dirac points. On the right ”Bosons Chill out” Cover of 1th April 2012 Nature Physics issue, reporting how quantum many-body systems relax from an initial non-equilibrium state, one of the outstanding problems in quantum statistical physics.

ETHZ has developed a tunable two-dimensional optical lattice that can be continuously adjusted to create square, triangular, dimer and honeycomb structures [Tarruell2102]. In the honeycomb lattice, Dirac points were created; these are points where two energy bands intersect linearly. The Dirac points lie at the heart of many fascinating phenomena in condensed-matter physics. In graphene, for example, they cause electrons to act as massless Dirac fermions, able to travel at the speed of light. In conventional solids, the electronic structure of the material cannot be varied, so it is difficult to see how the properties of Dirac fermions could be controlled. The adjustable honeycomb optical lattice of Tarruel et al simulates condensed-matter physics, with atoms in the role of electrons. The Dirac points can be moved and merged to explore the physics of exotic materials such as topological insulators and graphene, as presented in the Nature cover reported in Fig. 3 on the left. These results highlight the great potential that ultracold gases in optical lattices have as a platform for quantum simulations, in particular in situations where the topology of the band structure has an important role. Production of topologically ordered states in optical superlattices opens the road to their use in quantum computation applications.

MPG has probed the relaxation dynamics of a one-dimensional bosonic density [Trotzky2012] as shown in Fig. 3 right. Using an optical super-lattice, a BEC is loaded into Bose-Hubbard chains with each second lattice site occupied. Furthermore, as presented above MPG has developed a method to read-out in parallel from all sites quasi-local densities, currents and correlations, which probe the non-equilibrium dynamics emerging after rapidly switching on the tunnel coupling along the chain. A rapid relaxation of all these quantities to steady-state values compatible with those of a maximum entropy state was observed. On short timescales, parameter-free time-dependent DMRG numerical simulations could track the many-body dynamics and therefore benchmark the experimental quantum simulation. For long evolution times, however, these classical methods have to fail for the concomitant entanglement growth rendering a classical description infeasible. The experiment, on the other hand, tracks the evolution well beyond the time scale of theoretical predictions, demonstrating that a system of ultra-cold atoms can be used as an efficient dynamical quantum simulator for relaxation physics in many-body systems.

In solid-state materials, the static and dynamic properties as well as the magnetic and electronic characteristics are crucially influenced by the crystal symmetry. Hexagonal structures play a particularly important role and lead to novel physics, such as that of carbon nanotubes or graphene. In [SoltanPanahi2011] the realization of ultracold atoms in a spin-dependent optical lattice with hexagonal symmetry by ICFO has shown how the combined effects of the lattice and interactions between atoms lead to a forced antiferromagnetic Nöel order when two spin-components localize at different lattice sites. ICFO has also demonstrated that the coexistence of two components, one Mott-insulating and the other one superfluid. Magnetism plays a key role in modern technology and stimulates research in several branches of condensed matter physics. Although the theory of classical magnetism is well developed, the demonstration of a widely tunable experimental system has remained an elusive goal. A collaboration between ICFO and an experimental group at Hamburg presented the realization of a large-scale simulator for classical magnetism on a triangular lattice by exploiting the particular properties of a quantum system. By using the motional degrees of freedom of atoms trapped in an optical lattice, those authors simulate a large variety of magnetic phases: ferromagnetic, antiferromagnetic, and even frustrated spin configurations. A rich phase diagram is created with different types of phase transitions. These results provide a route to study highly debated phases like spin-liquids as well as the dynamics of quantum phase transitions.

UIBK has demonstrated that robust edge states and non-Abelian excitations are the trademark of topological states of matter, with promising applications such as "topologically protected" quantum memory and computing [Diehl2011]. While so far topological phases have been exclusively discussed in a Hamiltonian context, UIBK has shown that such phases and the associated topological protection and phenomena also emerge in open quantum systems with engineered dissipation. The specific system studied here is a quantum wire of spin-less atomic fermions in an optical lattice coupled to a bath. The key feature of the dissipative dynamics described by a Lindblad master equation is the existence of Majorana edge modes, representing a non-local de-coherence free subspace. The isolation of the edge states is enforced by a dissipative gap in the p-wave paired bulk of the wire. UIBK describes dissipative non-Abelian braiding operations within the Majorana subspace, and UIBK illustrates the insensitivity to imperfections. Topological protection was granted by a nontrivial winding number of the system density matrix.

The polar molecules having large dipole moments represent a very flexible tool for the application of the long-range interactions to the quantum computation. However the quantum control of molecular states is not well developed as that for the atomic ones. Then the collisions between molecules and atoms may represents the handle towards the molecular control. UIBK has examined the laser dressed dipolar and Van der Waals interactions between atoms and polar molecules, when a cold atomic gas with laser admixed Rydberg levels acts as a designed reservoir for both elastic and inelastic collisional molecular processes [Zhao2012]. The elastic scattering channel is characterized by large elastic scattering cross sections and repulsive shields to protect from close encounter collisions. In addition, UIBK has investigated a dissipative (inelastic) collision where a spontaneously emitted photon carries away (kinetic) energy of the collision partners, thus providing a significant energy loss in a single collision. This leads to the scenario of rapid thermalization and cooling of a molecule in the mili-Kelvin down to the micro-Kelvin regime by cold atoms. UIBK has discussed a scenario where a molecule scatters successively from cold (stationary) atoms in designed elastic and inelastic processes. In this situation reminiscent of a “microscopic version of a pin- ball machine”, inelastic scattering events are associated with the emission of a photon implying a “collisional Sisyphus” cooling. While UIBK focused on the simplest possible setup based on Van der Waals interactions, variants based on, e.g. dipole-dipole interactions and low dimensional trapping geometries seem possible.

Within the plan to prepare qubits based on Rydberg states CNR has produced excitation to high Rydberg states for a rubidium Bose-Einstein condensate. CNR has developed methods for detecting Rydberg excitations through the collection of charged ions/electrons with high efficiency. Making use of the dipole blockade associated to the Rydberg preparation, CNR has demonstrated the realization of one-dimensional chains of Rydberg excitations [Viteau2011]. CNR has observed the excitation dynamics of up to 30 Rydberg states in a condensate occupying around 100 sites of a 1D optical lattice. The measurement of how many super-atoms fit into a self-assembled chain of a given size allowed a confirmation of the ‘super-atom’ picture of collective Rydberg excitations.

Within the frame of new strategies for quantum simulation and computation with optical lattices, the use of alkaline-earth atoms allows a novel approach in which multiple qubits can be encoded and manipulated using the electronic and nuclear degrees of freedom of those atoms. Within that objective LENS loaded a condensed ytterbium Bose-Einstein condensate into an optical lattice, which offers very interesting possibilities for the realization of robust nuclear qubits and convenient manipulation schemes. A large-NA optical system will allow to perform high-resolution imaging of the atoms trapped in optical lattices, for which the 2D geometry is the best suited.

No exploitable results, defined as knowledge having a potential for industrial or commercial application in research activities or for developing, creating or marketing a product or process or for creating or providing a service, are produced by this Project. The main target of the Project is to produce advanced and high quality basic knowledge to be exploited or used in further research.

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4.1 Use and dissemination of foreground

- **Table A.1**

List of all **scientific (peer reviewed) publications** relating to the foreground of the project

- **Table A.2**

List of all **dissemination activities** (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

Publications - Articles

	Title of the article	Author_1		Title of the periodical or the series	Number, date, frequency	Year of Publication	Relevant pages	Permanent identifier	is /WILL OA provided this publication?
1	Realization of an Excited, Strongly Correlated Quantum Gas Phase	E.	Haller	Science	325	2009	1224		yes
2	Observation of Correlated Particle-Hole Pairs and String Order in Low-Dimensional Mott Insulators	M.	Endres	Science	334	2011	200-3		yes
3	Quantum simulation of frustrated classical magnetism in triangular optical lattices	J.	Struck	Science	333	2011	6045		yes
4	Dicke quantum phase transition with a superfluid gas in an optical cavity	K.	Baumann	Nature	464	2010	1301-1306	10.1038/nature09009	yes
5	Observation of the commensurate/incommensurate quantum phase transition for a Luttinger Liquid of strongly interacting bosons	E.	Haller	Nature	466	2010	597-600	10.1038/nature0925	yes
6	Single-atom-resolved fluorescence imaging of an atomic Mott insulator	J.F.	Sherson	Nature	467	2010	68	10.1038/nature09378	yes
7	An open-system quantum simulator with trapped ions	J.T.	Barreiro	Nature	470	2011	486-491	10.1038/nature09801	yes
8	Single-Spin Addressing in an Atomic Mott Insulator	C.	Weitenberg	Nature	471	2011	319-24	10.1038/nature09827	yes
9	Light-cone-like spreading of correlations in a quantum many-body system	M.	Cheneau	Nature	481	2012	484-7		yes
10	The `Higgs' Amplitude Mode at the Two-Dimensional Superfluid-Mott Insulator Transition	M.	Endres	Nature	487	2012	454		
11	Creating, moving and merging Dirac points with a Fermi gas in a tunable honeycomb lattice	L.	Tarruell	Nature	483	2012	302-305		yes
12	Measurement-based quantum computation	H.	Briegel	Nature Physics	5	2009	19-26		yes
13	Experimental multiparticle entanglement dynamics induced by decoherence	J.T.	Barreiro	Nature Physics	6	2010	943	10.1038/nphys1781	yes
14	A Rydberg quantum simulator	H.	Weimer	Nature Physics	6	2010	382-388	10.1038/nphys1614	yes
15	Many-body Landau-Zener dynamics in coupled 1D Bose liquids	Y.A.	Chen	Nature Physics	7	2011	61-67	10.1038/nphys1801	yes
16	Multi-component quantum gases in spin-dependent hexagonal lattices	P.	Soltan-Panahi	Nature Physics	7	2011	434-440	10.1038/nphys1916	yes
17	Topology by dissipation in atomic quantum wires	S.	Dihel	Nature Physics	7	2011	971		yes
18	High-fidelity quantum driving	M.	Bason	Nature Physics	8	2012	147-152		yes
19	Quantum simulations with ultracold quantum gases	J.	Bloch	Nature Physics	8	2012	267		yes
20	Interferometric measurement of local spin fluctuations in a quantum gas	J.	Meineke	Nature Physics	8	2012	455-59	doi:10.1038/nphys2280	yes
21	Probing the relaxation towards equilibrium in an isolated strongly correlated 1D Bose gas		Trotzky	Nature Physics	8	2012	325		yes
22									
23	Quantum computing with alkaline earth atoms	A.J.	Daley	Phys. Rev. Lett.	101	2008	170504	http://link.aps.org/doi/10.1103/PhysRevL	yes
24	Observation of Heteronuclear Atomic Efimov Resonances	G.	Barontini	Phys. Rev. Lett.	103	2009	43201	http://link.aps.org/doi/10.1103/PhysRevLett.103.043201	yes
25	Entropy Exchange in a Mixture of Ultracold Atoms	J.	Catani	Phys. Rev. Lett.	103	2009	140401	http://prl.aps.org/abstract/PRL/v103/i14/e	yes

26	Exploring Correlated 1D Bose Gases from the Superfluid to the Mott-Insulator State by Inelastic Light Scattering	D.	Clément	Phys. Rev. Lett.	102	2009	155301	http://link.aps.org/doi/10.1103/PhysRevLett.102.155301	yes
27	Non-Abelian optical lattices: Anomalous quantum Hall effect and Dirac fermions	N.	Goldman	Phys. Rev. Lett.	103	2009	35301	http://link.aps.org/doi/10.1103/PhysRevLett.103.035301	yes
28	Alkaline-Earth Atoms as Few-Qubit Quantum Registers	A.V.	Gorshkov	Phys. Rev. Lett.	102	2009	110503	http://link.aps.org/doi/10.1103/PhysRevLett.102.110503	yes
29	Mesoscopic Rydberg Gate Based on Electromagnetically Induced Transparency	M.	Mueller	Phys. Rev. Lett.	102	2009	170502		yes
30	Electromagnetically Induced Transparency and Light Storage in an Atomic Mott Insulator	U.	Schnorrberger	Phys. Rev. Lett.	103	2009	33003		yes
31	Pair-supersolid phase in a bilayer system of dipolar lattice bosons	C.	Trefzger	Phys. Rev. Lett.	103	2009	35304	http://link.aps.org/doi/10.1103/PhysRevL	yes
32	Coherent Control of Dressed Matter Waves	A.	Zenesini	Phys. Rev. Lett.	102	2009	100403	http://link.aps.org/doi/10.1103/PhysRevL	yes
33	Time-resolved measurement of Landau-Zener tunneling in periodic potentials	A.	Zenesini	Phys. Rev. Lett.	103	2009	90403	http://link.aps.org/doi/10.1103/PhysRevLett.103.090403	yes
34	Unified framework for correlations in terms of local quantum observables	A.	Acin	Phys. Rev. Lett.	104	2010	140404	10.1103/PhysRevLett.104.140404	yes
35	Perfect quantum privacy implies nonlocality	R.	Augusiak	Phys. Rev. Lett.	104	2010	230401	10.1103/PhysRevLett.104.230401	yes
36	Wilson fermions and axion electrodynamics in optical lattices	A.	Bermudez	Phys. Rev. Lett.	105	2010	190404	10.1103/PhysRevLett.105.190404	yes
37	Supersolid droplet crystal in a dipole-blockaded gas	F.	Cinti	Phys. Rev. Lett.	105	2010	135301	10.1103/PhysRevLett.105.135301	yes
38	One-Dimensional Quantum Liquids with Power-Law Interactions: The Luttinger Staircase	M.	Dalmonte	Phys. Rev. Lett.	105	2010	140401	10.1103/PhysRevLett.105.140401	yes
39	Realistic time-reversal invariant topological insulators with neutral atoms	N.	Goldman	Phys. Rev. Lett.	105	2010	255302	10.1103/PhysRevLett.105.255302	yes
40	Quantitative Determination of Temperature in the Approach to Magnetic Order of Ultracold Fermions in an Optical Lattice	R.	Jordens	Phys. Rev. Lett.	104	2010	180401	10.1103/PhysRevLett.104.180401	yes
41	Increasing the Statistical Significance of Entanglement Detection in Experiments	B.	Junnitsch	Phys. Rev. Lett.	104	2010	210401	10.1103/PhysRevLett.104.210401	yes
42	Scattering in Mixed Dimensions with Ultracold Gases	G.	Lamporesi	Phys. Rev. Lett.	104	2010	153202	10.1103/PhysRevLett.104.153202	yes
43	Rotonlike Instability and Pattern Formation in Spinor Bose-Einstein Condensate	M.	Matuszewski	Phys. Rev. Lett.	105	2010	20405	10.1103/PhysRevLett.105.020405	yes
44	Universal Rates for Reactive Ultracold Polar Molecules in Reduced Dimensions	A.	Micheli	Phys. Rev. Lett.	105	2010	73202	10.1103/PhysRevLett.105.073202	yes
45	Local Observation of Antibunching in a Trapped Fermi Gas	T.	Mueller	Phys. Rev. Lett.	105	2010	40401	10.1103/PhysRevLett.105.040401	yes
46	The Dicke model phase transition in the quantum motion of a Bose-Einstein condensate in an optical cavity	D.	Nagy	Phys. Rev. Lett.	104	2010	130401	10.1103/PhysRevLett.104.130401	yes
47	Strongly correlated gases of Rydbergdressed atoms: quantum and classical dynamics	G.	Pupillo	Phys. Rev. Lett.	104	2010	223022	10.1103/PhysRevLett.104.223002	yes
48	Observation of elastic doublon decay in the Fermi-Hubbard model	N.	Strohmaier	Phys. Rev. Lett.	104	2010	80401	10.1103/PhysRevLett.104.080401	yes
49	Controlling and Detecting Spin Correlations of Ultracold Atoms in Optical lattices	S.	Trotzky	Phys. Rev. Lett.	105	2010	265303	10.1103/PhysRevLett.105.265303	yes
50	Spinor Slow-Light and Dirac Particles with Variable Mass	R.G.	Unanyan	Phys. Rev. Lett.	105	2010	173603	10.1103/PhysRevLett.105.173603	yes
51	Exploring symmetry breaking at the Dicke quantum phase transition	K.	Baumann	Phys. Rev. Lett.	107	2011	140402		yes

52	Controlling Correlated Tunneling and Superexchange Interactions with ac-Driven Optical Lattices.	Y.A.	Chen	Phys. Rev. Lett.	107	2011	210405		yes
53	Trimer Liquids and Crystals of Polar Molecules in Coupled Wires	M.	Dalmonte	Phys. Rev. Lett.	107	2011	163202		yes
54	Three-Body Correlation Functions and Recombination Rates for Bosons in Three Dimensions and One Dimension	E.	Haller	Phys. Rev. Lett.	107	2011	230404		yes
55	Landau-Zener Sweeps and Sudden Quenches in Coupled Bose-Hubbard Chains	C.	Kasztelan	Phys. Rev. Lett.	106	2011	155302		yes
56	Tunable multiple layered Dirac cones in optical lattices	Z.	Lan	Phys. Rev. Lett.	107	2011	253001		yes
57	Coherent light scattering from a two-dimensional Mott insulator	C.	Weitenberg	Phys. Rev. Lett.	106	2011	215301		yes
58	Rydberg Excitations in Bose-Einstein Condensates in Quasi-One-Dimensional Potentials and Optical Lattices	M.	Viteau	Phys. Rev. Lett.	107	2011	60402		yes
59	Creation on demand of higher orbital states in a vibrating optical lattice	T.	Sowiński	Phys. Rev. Lett.	108	2012	165301		yes
60	Supersolid Vortex Crystals in Rydberg-dressed Bose-Einstein Condensates	N.	Henkel	Phys. Rev. Lett.	108	2012	265301		yes
61	Experimental realization of plaquette resonating valence bond states with ultracold atoms in optical superlattices	S.	Nascimbène	Phys. Rev. Lett.	108	2012	205301		yes
62	Quantum memory assisted probing of dynamical spin correlations	O.	Romero-Isart	Phys. Rev. Lett.	108	2012	65302		yes
63	Dipolar molecules in optical lattices revisited	T.	Sowiński	Phys. Rev. Lett.	108	2012	115301		yes
64	Synthetic 3D Spin-Orbit Coupling	B.M.	Anderson	Phys. Rev. Lett.	108	2012	235301		yes
65	Cooperative excitation and many-body interactions in a cold Rydberg gas	M.	Viteau	Phys. Rev. Lett.	109	2012	53002		yes
66	Atomic Rydberg Reservoirs for Polar Molecules	B.	Zhao	Phys. Rev. Lett.	108	2012	193007		yes
67	Towards measurable bounds on entanglement measures	R.	Augusiak	Quantum Inf. Process.	8	2009	493-521		yes
68	Vortex nucleation in mesoscopic Bose superfluid and breaking of the parity symmetry	D.	Dagnino	Phys. Rev. A	80	2009	53611	http://link.aps.org/doi/10.1103/PhysRevA.80.053611	yes
69	Entanglement enhances security in quantum communication	R.	Demkowicz-Dobrza	Phys. Rev. A	80	2009	12311	http://link.aps.org/doi/10.1103/PhysRevA.80.012311	yes
70	Exploring dynamic localization with a Bose-Einstein condensate	A.	Eckardt	Phys. Rev. A	79	2009	13611	http://link.aps.org/doi/10.1103/PhysRevA.79.013611	yes
71	Excitations of Bose-Einstein condensates in a one-dimensional periodic potential	N.	Fabbri	Phys. Rev. A	79	2009	43623	http://link.aps.org/doi/10.1103/PhysRevA	yes
72	The physics of dipolar bosonic quantum gases	Th.	Lahaye	Rep. Prog. Phys.	72	2009	126401	http://www.iop.org/EJ/abstract/0034-4885/72/12/126401/	yes
73	Trap-modulation spectroscopy of the Mott-insulator transition in opt	H.	Lignier	Phys. Rev. A	79	2009	41601	http://link.aps.org/doi/10.1103/PhysRevA	yes
74	Dipole oscillations of confined lattice bosons in one dimension	S.	Montangero	Phys. Rev. A	79	2009	41602		yes
75	A new phase for ytterbium atoms	H.	Moritz	Physics	2	2009	31	10.1103/Physics.2.31	yes
76	Quantum simulations of extended Hubbard models with dipolar crys	M.	Ortner	New J. Phys.	11	2009	55045		yes
77	Quantum polarization spectroscopy of correlations in attractive ferm	T.	Roscilde	New J. Phys.	11	2009	55041	http://dx.doi.org/10.1088/1367-2630/11/5	yes
78	Collisional and molecular spectroscopy in an ultracold Bose–Bose mixture	G.	Thalhammer	NJP	11	2009	55044		yes
79	Association of ultracold double-species bosonic molecules	C.	Weber	Phys. Rev. A	78	2009	61601	http://link.aps.org/doi/10.1103/PhysRevA	yes
80	Searching for extremal PPT entangled states	R.	Augusiak	Opt. Comm.	282	2010	805-813	10.1016/j.optcom.2009.10.050	yes

81	Quantum kinetic Ising models	R.	Augusiak	New J. Phys.	12	2010	25021	10.1088/1367-2630/12/2/025021	yes
82	Topological phase transitions in the non-Abelian honeycomb lattice	A.	Bermudez	New J. Phys.	12	2010	33041	10.1088/1367-2630/12/3/033041	yes
83	Universal quantum computer from a quantum magnet	J.	Cai	Phys. Review A	82	2010	52309	10.1103/PhysRevA.82.052309	yes
84	Bragg Spectroscopy of Strongly Correlated Bosons in Optical Lattices	D.	Clément	J. Low Temp Phys	158	2010	158	10.1007/s10909-009-0040-7	yes
85	Expansion of matter waves in static and driven periodic potentials	C.E.	Creffield	Phys. Review A	82	2010	35601	10.1103/PhysRevA.82.035601	yes
86	Mapping all classical spin models to a lattice gauge theory	G.	Cuevas - De las	New J. Phys.	12	2010	43014	10.1088/1367-2630/12/4/043014	yes
87	Bose-Hubbard model with occupation dependent parameters	O.	Dutta	New J. Phys.	13	2010	23019	10.1088/1367-2630/13/2/023019	yes
88	Controlled hole doping of a Mott insulator of ultracold fermionic atoms	A.	Eckardt	Phys. Review A	82	2010	11606	10.1103/PhysRevA.82.011606	yes
89	Frustrated quantum antiferromagnetism with ultracold bosons in a triangular lattice	A.	Eckardt	EPL	89	2010	10010	10.1209/0295-5075/89/10010	yes
90	Fermi-Hubbard physics with atoms in an optical lattice	T.	Esslinger	Annual Review of Condensed Matter Physics	1	2010	129	10.1146/annurev-conmatphys-070909-104059	yes
91	Pastor Coherent addition of laser beams in resonant passive optical cavities	G.	Ferrari	Opt. Lett.	35	2010	3105-7	10.1364/OL.35.003105	yes
92	Tensor operators: Constructions and applications for longrange interaction systems	F.	Froewis	Phys. Review A	81	2010	62337	10.1103/PhysRevA.81.062337	yes
93	Local renormalization method for random systems	O.	Gittsovich	New J. Phys.	12	2010	25020	10.1088/1367-2630/12/2/025020	yes
94	Cavity quantum electrodynamics with a Rydberg blocked atomic ensemble	C.	Guerlin	Phys. Review A	82	2010	53832	10.1103/PhysRevA.82.053832	yes
95	Complete devil's staircase and crystal-superfluid transitions in a dipolar XXZ spin chain: a trapped ion quantum simulation	P.	Hauke	New J. Phys.	12	2010	113037	10.1088/1367-2630/12/11/113037	yes
96	Not all pure entangled states are useful for sub-shot-noise interferometry	P.	Hyllus	Phys. Review A	82	2010	12337	10.1103/PhysRevA.82.012337	yes
97	Macroscopic self trapping in BECs: analysis of a dynamical quantum phase transition	B.	Julia-Diaz	Phys. Review A	81	2010	23615	10.1103/PhysRevA.81.023615	yes
98	Engineering Dresselhaus spin-orbit coupling for cold atoms in a double tripod configuration	G.	Juzeliunas	Proc. SPIE	7950	2010		10.1117/12.874137	yes
99	Generalized Rashba-Dresselhaus spin-orbit coupling for cold atoms	G.	Juzeliūnas	Phys. Rev. A	81	2010	53403	http://link.aps.org/doi/10.1103/PhysRevA	yes
100	Dark solitons near the Mott-insulator--superfluid phase transition	K.V.	Krutitsky	Phys. Review A	82	2010	33618	10.1103/PhysRevA.82.033618	yes
101	Topological superfluids on a lattice with non-Abelian gauge fields	A.	Kubasiak	Europhys. Lett.	92	2010	46004	10.1209/0295-5075/92/46004	yes
102	Creating p-wave superfluids and topological excitations in optical lattices	P.	Massignan	Phys. Review A	81	2010	31607	10.1103/PhysRevA.81.031607	yes
103	Ground states of trapped spin-1 condensates in magnetic field	M.	Matuszewski	Phys. Review A	82	2010	53630	10.1103/PhysRevA.82.053630	yes
104	Emerging bosons with three-body interactions from spin-1 atoms in optical lattices	L.	Mazza	Phys. Review A	82	2010	43629	10.1103/PhysRevA.82.043629	yes
105	Universal resources for approximate and stochastic measurement-based quantum computation	C.E.	Mora	Phys. Review A	81	2010	42315	10.1103/PhysRevA.81.042315	yes
106	Disorder-induced order in quantum XY chains	A.	Niederberger	Phys. Review A	82	2010	13630	10.1103/PhysRevA.82.013630	yes

107	Generation of optical and matter-wave solitons in binary systems with a periodically modulated coupling	A.	Niederberger	Phys. Review A	82	2010	436522	10.1103/PhysRevA.82.043622	yes
108	Discrimination strategies for inequivalent classes of multipartite entangled states	S.	Niekamp	Phys. Review A	82	2010	22322	10.1103/PhysRevA.82.022322	yes
109	Slow polaritons with orbital angular momentum in atomic gases	J.F.	Ruseckas	Phys. Review A	83	2010	23812	10.1103/PhysRevA.83.023812	yes
110	Lifetime of double occupancies in the Fermi-Hubbard model	R.	Sensarma	Phys. Review B	82	2010	224302	10.1103/PhysRevB.82.224302	yes
111	Dynamics and decoherence of two cold bosons in a one-dimensional harmonic trap	T.	Sowinski	Phys. Review A	82	2010	53631	10.1103/PhysRevA.82.053631	yes
112	Quantum noise of a Bose-Einstein condensate in an optical cavity, correlations and entanglement	G.	Szirmai	Phys. Review A	81	2010	43639	10.1103/PhysRevA.81.043639	yes
113	Time-resolved measurement of Landau-Zener tunneling in different bases	G.	Tayebirad	Phys. Review A	82	2010	13633	10.1103/PhysRevA.82.013633	yes
114	Quantum magnetism and counterflow supersolidity of up-down bosonic dipoles	C.	Trefzger	New J. Phys.	12	2010	93008	10.1088/1367-2630/12/9/093008	yes
115	Ion detection in the photoionization of a Rb Bose-Einstein condensate	M.	Viteau	J. Phys. B: At Mol. Opt. Phys.	43	2010	155301	10.1088/0953-4075/43/15/155301	yes
116	Tunneling control and localization for Bose-Einstein condensates in a frequency modulated optical lattice	A.	Zenesini	Laser Physics	20	2010	1182	10.1134/S1054660X10090410	yes
117	Observation of Stückelberg oscillations in accelerated optical lattices	A.	Zenesini	Phys. Rev. A.	82	2010	65601	10.1103/PhysRevA.82.065601	yes
118	Optimal decomposable witnesses without the spanning property	R.	Augusiak	Phys. Rev. A.	84	2011	52323		yes
119	Atoms, Photons and Entanglement for Quantum Information Technologies	J.T.	Barreiro	Procedia Computer Science	7	2011	52-55		yes
120	Dirac Equation For Cold Atoms In Artificial Curved Spacetimes	O.	Boada	New J. Phys.	13	2011	35002		yes
121	Conduction of Ultracold Fermions Through a Mesoscopic Channel	J.	Braun	Phys. Rev. A.	84	2011	63616		yes
122	Counting of fermions and spins in strongly correlated systems in and out of thermal equilibrium	S.	Braungardt	Phys. Review A	83	2011	13601	10.1103/PhysRevA.83.013601	yes
123	Atom counting in expanding ultracold clouds	S.	Braungardt	Phys. Rev. A.	84	2011	43635		yes
124	Realistic Rashba and Dresselhaus spin-orbit coupling for neutral atoms	D.L.	Campbell	Phys. Rev. A.	84	2011	25602		yes
125	Experimental investigations of tunneling times using Bose-Einstein condensates	D.	Ciampini	J. Phys: Conference Series	306	2011	12301		yes
126	Quantum control in strongly driven optical lattices	D.	Ciampini	Int. J. Quant. Inf.	9	2011	139-144		yes
127	State-dependent lattices for quantum computing with alkaline-earth-metal atoms	A.	Daley	Eur. Phys. J. D	65	2011	207		yes
128	Colloquium: Artificial gauge potentials for neutral atoms	J.	Dalibard	Rev. Mod. Phys	83	2011	1523		yes
129	Bilinear-biquadratic spin-1 chain undergoing quadratic Zeeman effect	G.	De Chiara	Phys. Rev. B	84	2011	54451		yes
130	Robustness of fractional quantum Hall states with dipolar atoms in artificial gauge fields	T.	Graß	Phys. Rev. A.	84	2011	43605		yes
131	Quantum phase transition of ultracold bosons in the presence of a non-Abelian synthetic gauge field	T.	Graß	Phys. Rev. A.	84	2011	53632		yes

132	Orbital order of spinless fermions near an optical Feshbach resonance	P.	Hauke	Phys. Rev. A.	84	2011	51603		yes
133	Modified spin-wave theory with ordering vector optimization: spatially anisotropic triangular lattice and J1J2J3 model with Heisenberg interactions	P.	Hauke	New J. Phys.	13	2011	75017		yes
134	Strongly correlated states of a small cold-atom cloud from geometric gauge fields	B.	Juliá-Díaz	Phys. Rev. A.	84	2011	53605		yes
135	Seeing Topological Order	G.	Juzeliūnas	Physics	4	2011	99		yes
136	Quantum information processing in self-assembled crystals of cold polar molecules	M.	Ortner	Quantum Inf. Processing	10	2011	793		yes
137	Photonic-band-gap properties for two-component slow light	J.	Ruseckas	Phys. Rev. A	83	2011	63811		yes
138	Optical vortices of slow light using a tripod schem	J.	Ruseckas	J. Opt.	13	2011	64013		yes
139	Creation of topological states of a Bose-Einstein condensate in a plaquette		Świsłocki	Phys. Rev. A	84	2011	23625		yes
140	Tunable dipolar resonances and Einstein-de Haas effect in a Rubidium 87-atom condensate	T.	Świsłocki	Phys. Rev. A.	83	2011	63617		yes
141	Gauge fields emerging from time-reversal symmetry breaking for spin-5/2 fermions	G.	Szirmai	Phys. Rev. A	84	2011	11611		yes
142	Ultracold dipolar gases in optical lattices	C.	Trefzger	J. Phys. B: At. Mol. Opt. Phys.	44	2011	193001		yes
143	Rydberg spectroscopy of a Rb MOT in the presence of applied or ion created electric fields	M.	Viteau	Opt. Exp.	19	2011	6007	10.1364/OE.19.006007	yes
144	Layered Quantum Hall Insulators with Ultracold Atoms	A.	Zamora	Phys. Rev. A	84	2011	53620		yes
145	Long-range and frustrated spin-spin interactions in crystals of cold polar molecules	Y.L.	Zhou	Phys. Rev. A	84	2011	52332		yes
146	High-resolution imaging of ultracold fermions in microscopically tailored optical potentials	B.	Zimmermann	New J. Physics	13	2011	43007		yes
147	Kilohertz-driven Bose-Einstein condensates in optical lattices		Arimondo	Adv. At. Mol. Phys.	61	2012			yes
148	Tight Bell inequalities with no quantum violation from qubit unextendible product bases	R.	Augusiak	Phys. Rev. A.	85	2012	42113		yes
149	Many body physics from a quantum information perspective, Review,	R.	Augusiak	Lecture Notes in Physics (Springer Verlag), Lectures from the Les Houches School on "Modern theories of correlated electron Systems"	843	2012			yes
150	Condensed matter physics of dipolar quantum gases,	M.	Baranov	Chemical Reviews (August 2012) Editors by D. Jin and J. Ye					yes
151	Rydberg Excitations in BECs and Cold Clouds	M.	Bason	Int. J. Mod. Phys.: Conf. Ser.	15	2012	1-8		yes
152	Particle-counting statistics of time- and space-dependent fields	S.	Braungardt	Phys. Rev. A.	85	2012	33818		yes
153	Quantum dynamics of impurities in a one-dimensional Bose gas	J.	Catani	Phys. Rev. A.	85	2012	23623		yes
154	Schemes of transmission of classical information via quantum channels with many senders: discrete and continuous variables cases	L.	Czekaj	Phys. Rev. A.	85	2012	12316		yes

155	An intra-cavity frequency doubled H2 Raman laser scheme for generating narrow-linewidth yellow radiation	J.T.	Green	J. Opt. Soc. Am. B	29	2012	1065		yes
156	Fractional quantum Hall states of a few bosonic atoms in geometric gauge fields	B.	Juliá-Díaz	New J. Phys.	14	2012	55003		yes
157	Formation of optical flux lattices for ultra cold atoms	G.	Juzeliūnas	Proceedings of SPIE	8274	2012	8274H		yes
158	Distribution of entanglement in networks of bi-partite full-rank mixed states	G.J.	Lapeyre	Quantum Inf. Comp.	12	2012	502		yes
159	Ultracold Atoms in Optical Lattices, Simulating quantum many-body systems	M.	Lewenstein	Oxford University Press		2012			yes
160	Wave Function Renormalization Effects in Resonantly Enhanced Tunneling	N.	Lörch	Phys. Rev. A.	85	2012	53602		yes
161	An optical-lattice-based quantum simulator for relativistic field theories and topological insulators	L.	Mazza	New J. Phys.	14	2012	15007		yes
162	Observation of roton-type mode softening in a quantum gas with cavity-mediated long-range interactions	R.	Mottl	Science	336	2012	1570		yes
163	Engineered open systems and quantum simulations with atoms and ions	M.	Mueller	Advances in Atomic Molecular and Optical Physics	61	2012	1-80		yes
164	Two component Bose-Hubbard model with higher angular momentum states	J.	Pietraszewicz	Phys. Rev. A.	85	2012	53638		yes
165	Exact diagonalization of the one dimensional Bose-Hubbard model with local 3-body interactions	T.	Sowiński	Phys. Rev. A	85	2012	65601		yes
166	Controlled creation of spin domains in spin-1 Bose-Einstein condensates by phase separation	T.	Świsłocki	Phys. Rev. A	85	2012	23601		yes

	Type of Activity	Main Leader	Title	Date/ period	Place	Type of Audience	Size of audience	Countries addressed
1	Press Release	MPG	*Bosons chill ou*	11/04/2012	Nature Physics Cover	Journal Readers	Higher Education and Research	World
2	Press Release	ETHZ	*Dirac action*	12/02/2012	Nature Cover story	Journal Readers	Higher Education and Research	World
3	Press Release	MPG	*J. V. Porto, Optical lattices: More than a look*	01/04/2011	Nature Physics News and Views, 7, 280 (2011) http://www.nature.cor	Journal Readers	Higher Education and Research	World
4	Press Release	CNR	Lloyd C. L. Hollenberg, *Through the Quantum Chicane*	01/04/2012	Nature Physics News and Views, 8, 113 (2012) http://www.nature.cor	Journal Readers	Higher Education and Research	World
5	Press Release	ETHZ	J. Simon and M. Greiner, *A duo of graphene mimics*	15/03/2012	Nature News and Views, 284, 282 (2012) http://www.nature.com/nat	Journal Readers	Higher Education and Research	World
6	Popular Press	ETHZ	*C. Speicher, Ein Simulator für Graphen*	21/03/2012	Neue Zürcher Zeitung	Journal Readers	Higher Education and Research	CH and DE
7	Popular Press	ETHZ	S. Ulmer, *Ultrakalte Atome simulieren Graphen*	01/04/2912	ChemieXtra	Journal Readers	Higher Education and Research	CH and DE
8	Society News	MPG	D. Jaksch, *Kalte Atome im Quantenkarussell*	01/03/2012	Physik Journal	Journal Readers	Higher Education and Research	DE
9	Society News	MPG	E. J. Mueller, *Viewpoint: Strong Staggered Flux Lattices for Cold Atoms*	12/12/2011	APS Physics 4, 107 (2011)	APS Open access	Higher Education and Research	World
10	Society News	MPG	J. H. Thywissen, *Viewpoint: Bragging rights*	23/05/2011	APS Physics 4, 41 (2011)	APS Open access	Higher Education and Research	World
11	Public lecture	ETHZ	T. Esslinger, *From synthetic quantum many-body systems to quantum simulation*	04/04/2011	37th Hanan Rosenthal Memorial Lecture, Yale University, New Haven CT (USA)	Public lecture	Higher Education and Research	USA
12	Press Release	ETHZ	C. Chin, N. Gemelke, *Atoms in chequerboard order*.	29/04/2010	Nature News and Views, 464, 1289 (2010)http://www.nature.com/nature/journal/v464/n7293/full/4641289a.html	Journal Readers	Higher Education and Research	World
13	Press Release	ETHZ	Z. Hadzibabic, *The cold reality of exclusion*.	01/09/2010	Nature Physics News and Views, 6, 643 (2010) http://www.nature.cor	Journal Readers	Higher Education and Research	World
14	Press Release	ETHZ	*Breakthrough of the Year The Runners up*	17/12/2010	Science 330, 1605-1607 (2010)http://www.sciencemag.org/content/33	Journal Readers	Higher Education and Research	World
15	Press Release	UIBK	*Breakthrough of the Year The Runners up*	17/12/2010	Science 330, 1605-1607 (2010), http://www.sciencemag.org/content/	Journal Readers	Higher Education and Research	World
16	Society News	CNR	O. Morsch, D. Ciampini and E. Arimondo, *Controlling Atomic Matter waves by shaking*.	21/06/2010	Europhysics News 41/3, 21 (2010)	Journal Readers	Higher Education and Research	World
17	Society News	ETHZ	C. I. Westbrook, *Suppressed fluctuations in Fermi gases*.	19/07/2010	APS Physics, 3, 59 (2010) http://physics.aps.org/articles/v3/59	APS Open access	Higher Education and Research	World
18	Society News	MPG	B. Goss Levi, *Putting quantum gases under the microscope*.	01/09/2010	Search and Discovery, Physics Today, September 2010, page 18, http	APS Members	Higher Education and Research	World
19	Popular Press	LV	Gediminas Juzeliunas and his group joining the NAMEQAUM Project	03/04/2010	Lietuvos Zinios newspaper, http://www.itpa.lt/quantumgroup/files/lietuvoszinios-2010-03-09.pdf	Journal Readers	Medias	LV
20	Popular Press	ETHZ	Rainer Scharf, *Als die Teilchen rechnen lernten*	07/01/2009	Frankfurter Allgemeine Zeitung	Journal Readers	Medias	CH and DE
21	Popular Press	ETHZ	Stefan Maier, *Bose-Einstein-Kondensat mit Swing,*	01/03/2009	SPEKTRUM DER WISSENSCHAFT	Journal Readers	Medias	CH and DE
22	Society News	CNR	F. Dalfovo, *Shaking atoms to make them stop*	01/01/2009	APS physics, http://physics.aps.org/synopsis-for/10.1103/PhysRevA.79.013611	APS Open access	Higher Education and Research	World
23	Press Release	CNR	M. Marquit, *Exerting better control over matter waves*	27/03/2009	PhysicsOrg.com, http://www.physorg.com/news157375449.html	Web news	Medias	World
24	Society News	LENS	Dieter Jaksch, *A stimulated atomic response*	13/04/2009	APS Physics 2, 29 (2009). http://physics.aps.org/articles/v2/29,	APS Open access	Higher Education and Research	World
25	Press Release	LENS	H. Johnston, *Ultracold trios tell us more about Efimov states*	30/07/2009	PhysicsOrg.com, http://physicsworld.com/cws/article/news/39989	Web news	Higher Education and Research	World
26	Society News	LENS	Dan M. Stamper-Kurn, *Shifting entropy elsewhere*,	28/09/2009	APS Physics 2, 80 (2009) http://physics.aps.org/authors/dan_stamper-kurn, .	APS Open access	Higher Education and Research	World

27	Press Release	LENS	*Pushing the cold frontier in an orderly fashion*	28/09/2009	PhysicsOrg.com, http://www.physorg.com/news173353018.html	Web news	Higher Education and Research	World
28	Press Release	LENS	*Scheme removes entropy from ultracold atoms*	01/10/2009	PhysicsOrg.com, http://physicsworld.com/cws/article/news/40570	Web news	Higher Education and Research	World

4.2 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	225187
Title of Project:	Nanodesigning of atomic and molecular quantum matter NAMEQUAM
Name and Title of Coordinator:	Ennio ARIMONDO Professor

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0Yes 0No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***NO***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	

• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	NO
• Research having the potential for terrorist abuse	NO

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	8
Work package leaders	1	6
Experienced researchers (i.e. PhD holders)	4	20
PhD Students	4	21
Other	3	3

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**15**
Of which, indicate the number of men:	12

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
X No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				Very effective
❑ Design and implement an equal opportunity policy	○	○	○	○	○
❑ Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑ Organise conferences and workshops on gender	○	○	○	○	○
❑ Actions to improve work-life balance	○	○	○	○	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify

X No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

X No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[5]:

X Associated discipline: 1.1; 2.2; 2.3

○ Associated discipline[5]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

○ Yes
x No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

x No
○ Yes- in determining what research should be performed
○ Yes - in implementing the research
○ Yes, in communicating /disseminating / using the results of the project

[5] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ x	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- x Yes- in framing the research agenda
- x Yes - in implementing the research agenda
- x Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- x Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture Audiovisual and Media Budget Competition Consumers Culture Customs Development Economic and Monetary Affairs Education, Training, Youth Employment and Social Affairs		Energy Enlargement Enterprise Environment External Relations External Trade Fisheries and Maritime Affairs Food Safety Foreign and Security Policy Fraud Humanitarian aid		Human rights Information Society Institutional affairs Internal Market Justice, freedom and security Public Health Regional Policy Research and Innovation Space Taxation Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- x International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	
To how many of these is open access[6] provided?	**100%**
How many of these are published in open access journals?	
How many of these are published in open repositories?	**100%**
To how many of these is open access not provided?	**0**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[7]: ……………	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*	**0**

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**

17. How many spin-off companies were created / are planned as a direct result of the project?	**0**
Indicate the approximate number of additional jobs in these companies:	**0**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	x In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
❑ Difficult to estimate / not possible to quantify	

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*

[6] Open Access is defined as free of charge access for anyone via Internet.
[7] For instance: classification for security project.

Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

x Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

x Yes ○ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

x	Press Release	x	Coverage in specialist press
❑	Media briefing	x	Coverage in general (non-specialist) press
❑	TV coverage / report	x	Coverage in national press
❑	Radio coverage / report	x	Coverage in international press
❑	Brochures /posters / flyers	x	Website for the general public / internet
❑	DVD /Film /Multimedia	x	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	x	English
x	Other language(s)		

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES
1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
1.3 Chemical sciences (chemistry, other allied subjects)
1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY
2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology
5.2 Economics
5.3 Educational sciences (education and training and other allied subjects)
5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
6.2 Languages and literature (ancient and modern)
6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

2. FINAL REPORT ON THE DISTRIBUTION OF THE EUROPEAN UNION FINANCIAL CONTRIBUTION

This report shall be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.

Report on the distribution of the European Union financial contribution between beneficiaries

Name of beneficiary	Final amount of EU contribution per beneficiary in Euros
CNR- INO	527.740
JGUM	65.040
ETHZ	402.131
LENS	405.118
UIBK	216.199
ICFO	182.380
MPG	329.864
IFPAN	150.002
VU	148.725
Total	**2.427.199**