COST

Domain Materials, Physics and Nanosciences (MPNS)

COST Action *MP1001*

Start Date *6/12/2010*
End Date *5/12/2014*

Ion Traps for Tomorrow's Applications

FINAL EVALUATION REPORT

This Report contains four parts:

I. Management Report *prepared by the COST Office/Grant Holder*
II. Scientific Report *prepared by the Chair of the Management Committee of the Action.*
III. Evaluation Report *prepared by the "ad hoc" Evaluation Panel, established by the Domain Committee, and edited by the COST Office.*
IV. Evaluation Summary

Appendices:

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation* and *IV. Evaluation Summary.*

Executive summary of the Scientific Report (max.250 words):

COST Action MP1001 can look back on four years of interesting agenda with many fruitful meetings. All objectives of the MoU have been attained, some of them partially, others to beyond the imagined goals. The common effort has allowed to make notable progress regarding the fabrication of microtraps or the understanding of anomalous heating of trapped ions. Various novel methods for the cooling of molecules have been proposed and experimentally demonstrated. Reaction rates of cold collisions could be measured at the individual particle level. Quantum simulations on a theoretical and an experimental level are a novel and very promising road in ion trapping, and have generated interesting results for example regarding frustrated systems or structural phase transitions. The probing of individual atoms by microwave radiation is among the smartest results in the investigation of trapped ions with electromagnetic radiation. The impact of face-to-face interactions has been very high generating a large number of new collaborations, some of which are supported by FET and ITN tools. We have organized two major training schools, (and a third one planned for January 2015). The Action has established new workshops, which are now held annually due to the large demand. The regular newsletter is a success with an ever increasing number of subscribers. Workshop series, newsletter and website will be continued after the end of the Action. The external highlight for the Action has been the awarding of the Nobel Prize 2012 to the ion trapping pioneer Dave Wineland, international partner of MP1001.

I. Management Report prepared by the COST Office/Grant Holder

I.A. COST Action Fact Sheet

- **COST Action** *MP1001 – Ion Traps for Tomorrow's Applications*
- **Domain** *Materials, Physical and Nanosciences*

- **Action details:**

CSO Approval: *20/05/2010* **End date:** *05/12/2014*
Entry into force: *22/07/2010* **Extension:** *(day/month/year)*

- **Objectives** *(from DB as in About COST)*

In the last two decades our ability to study individual quantum systems (or controlled ensembles of them), virtually free from outside perturbations, has been transformed from a dream to a reality. Trapped atomic and molecular ions have been at the heart of this revolution, providing the key to a deeper understanding of many of the underlying principles of Physics and Chemistry. Physicists can now trap single atoms or photons, prepare these particles in well-defined states and follow their evolution in real time. Deeper insight into the fundamental scientific principles leads to the emergence of innovative applications and stimulates technical evolution. Scientific and technological applications include frequency metrology for the precise determination of fundamental constants; frequency standards e.g. global positioning; the determination of atomic ground state properties e.g. mass, life-time, spin; quantum information and cavity quantum electrodynamics. Notably, the production of cold molecules and the study of chemical dynamics at ultralow temperatures are areas of remarkable current growth within the field. This Action will advance the frontier of knowledge regarding basic questions in order to foster the emergence of novel applications.

- **Parties:** *list of countries and date of acceptance*

Austria *9/11/2010*	Greece *(date)*	Poland *22/07/2010*
Belgium *30/09/2010*	Hungary *(date)*	Portugal *17/11/2010*
Bulgaria *7/06/2011*	Iceland *(date)*	Romania *17/11/2010*
Croatia *(date)*	Ireland *(date)*	Serbia *(date)*
Cyprus *(date)*	Israel *22/07/2010*	Slovakia *(date)*
Czech Rep. *(date)*	Italy *28/10/2010*	Slovenia *(date)*
Denmark *8/12/2010*	Latvia *(date)*	Spain *22/07/2010*
Estonia *(date)*	Lithuania *(date)*	Sweden *(date)*

Finland *20/10/2010*	Luxembourg *(date)*	Switzerland *22/07/2010*
FYR of Macedonia *(date)*	Malta *(date)*	Turkey *(date)*
France *28/07/2010*	Netherlands *18/04/2011*	United Kingdom *22/07/2010*
Germany *14/09/2010*	Norway *(date)*	

- **Intentions to accept:** *list of countries and date*

- **Other participants:**

(Institution Name, Country, Town)

Chair: *Dr. Martina KNOOP*

Université d'Aix-Marseille/CNRS, Centre de St Jérôme, Case C21, 13397 Marseille Cedex 20, France

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DC Rapporteur: *Prof. Lucia SORBA*

Nest, Istituto Nanoscienze-CNR, Pza S. Silvestro 12, I-56127 Pisa, Italy

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Science Officer:
Mr Ralph STUEBNER
ralph.stuebner@cost.eu

Administrative Officer:
Milena STOYANOVA
milena.stoyanova@cost.eu

- **Action Web site:** *http://www.cost-iota.org*

- **Grant Holder Representative** *Prof. Yvon Berland, presidence@univ-amu.fr*

- **Working Groups** *(list of WGs and names and affiliations of participants)*

WG1 Technology
WG2 Various Scales
WG3 Interaction of ions with electromagnetic radiation
WG4 Cold Molecular Ions

Each WG has a leader and a junior leader, they are listed in the following

WG1			
Prof. Laurent HILICO	Evry University, Kastler Brossel Laboratory, CNRS UMR 8552 (EVRY, France)	hilico@spectro.jussieu.fr	FR
Dr. Frédéric ROSU	*Until end of 2012, has then resigned for personal reasons/change of activity*		BE
WG2			
Dr Winfried Hensinger	University of Sussex (Falmer, United Kingdom)	W.K.Hensinger@sussex.ac.uk	UK
Dr Diego Porras Torre	Universidad Complutense de Madrid (Madrid, Spain)	diego.porras@fis.ucm.es	ES
WG3			
Prof. Christof Wunderlich	University of SIegen	wunderlich@physik.uni-siegen.de	DE
Dr Roee Ozeri	Weizmann Institute of Science (Rehovot, Israel)	ozeri@weizmann.ac.il	IL
WG4			
Prof. Michael Drewsen	University of Aarhus (Aarhus, Denmark)	drewsen@phys.au.dk	DK
Prof. Stefan Willitsch	University of Basel (Basel, Switzerland)	stefan.willitsch@unibas.ch	CH

I.B. Management Committee member list

Name	*Country*	*E-mail*
Prof. Rainer Blatt	AT	rainer.blatt@uibk.ac.at
Prof. Michael Drewsen	DK	drewsen@phys.au.dk
Dr Juan Jose Garcia Ripoll	ES	juanjose.garciaripoll@gmail.com
Prof. Liviu Giurgiu	RO	liviu.giurgiu@gmail.com
Prof. Ariel GUERREIRO	PT	asguerre@fc.up.pt
Prof. Michael Hass	IL	Michael.hass@weizmann.ac.il
Dr Winfried Hensinger	UK	W.K.Hensinger@sussex.ac.uk
Prof. Laurent HILICO	FR	hilico@spectro.jussieu.fr
Prof. Jonathan Home	CH	jhome@phys.ethz.ch

Dr Martina Knoop	FR	Martina.Knoop@univ-provence.fr
Dr Jeroen Koelemeij	NL	koel@few.vu.nl
Dr David Lucas	UK	d.lucas@physics.ox.ac.uk
Dr Sabrina Maniscalco	FI	smanis@utu.fi
Dr Irene Marzoli	IT	irene.marzoli@unicam.it
Dr Bogdan Mihalcea	RO	bmihal@infim.ro
Dr Yasser Omar	PT	yasser.omar@ist.utl.pt
Dr Roee Ozeri	IL	ozeri@weizmann.ac.il
Dr Jyrki Piilo	FI	jyrki.piilo@utu.fi
Dr Diego Porras Torre	ES	diego.porras@fis.ucm.es
Dr Wolfgang Quint	DE	W.Quint@gsi.de
Prof. Stephan Schiller	DE	step.schiller@uni-duesseldorf.de
Prof. Stephan Schlemmer	DE	schlemmer@ph1.uni-koeln.de
Prof. Ewa Stachowska	PL	ewa.stachowska@put.poznan.pl
Dr Ovidiu-Sorin Stoican	RO	stoican@infim.ro
Dr Xavier Urbain	BE	xavier.urbain@uclouvain.be
Prof. Nikolay Vitanov	BG	vitanov@phys.uni-sofia.bg
Prof. Richard Thompson	UK	r.thompson@imperial.ac.uk
Prof. Roland Wester	AT	roland.wester@uibk.ac.at
Prof. Stefan Willitsch	CH	stefan.willitsch@unibas.ch
Prof. Christof Wunderlich	DE	wunderlich@physik.uni-siegen.de

I.C. Overview activities and expenditure

(2014) Budget

Total Action Budget: 461 922 €

Remaining Action Commitment: 43494 €

Meetings

Meeting Type	*Date*	*Place*	*Participants*		*Cost*	*Total*
Kick-off	06-déc-2010	Brussels/BE	18/18			11730.41 €
Scientific kick-off (MC and all WG)	23-25/03/2011	Heidelberg/DE	43/75			28401.47 €
Qion	26-29/04/2011	Madrid/ES	11/35			8489.73 €
Core group	21/09/11	Paris/FR	6/8			3178.51 €
Qion	26-29/3/12	Tel Aviv/IL	12/40			9980 €
IonTech	7-9/5/12	Siegen/DE	17/67			11778.42 €
NNP	27-30/08/12	Greifswald/DE	8/56			4730.82 €
ECTI-2	9-14/09/12	Obergurgl/AT	46/120			37263.28 €
Qion 13	2-5/04/13	Obergurgl/AT	16/33			8955 €
Wiki meeting	27-28/4/13	Paris/F	3/4			1625.9 €
CAMEL	17-21/6/13	Nessebar/BG	14/49			6230 €
Cold Molecules	2-5/9/13	Arosa/CH	19/65			10640 €
IonTech2+ MC meeting	23-25/10/13	Paris/F	23/70			16573 €
Quantum Simulations	15-18/12/13	Brighton/UK	28/55			12196.42 €
Qion 14	31/03-04/04/14	Cartagena/ES	20/52			9431.2 €
CAMEL 10	23-27/6/14	Nessebar/ BG	10/50			4600 €
Implementing Quantum Science	29/6-19/7/14	Benasque/.ES	5/50			5428.64 **€**
ECTI-3	14-19/9/14	Mainz/DE	55/145			**26901.14 €**
					Total	**218 133.94 €**

STSM

Beneficiary	*Date from*	*to*	*Place*	*Cost*	*Total*
Przemysław Głowacki	04/07/2011	31/07/2011	PTB/Germany		2200 €
Benjamin Szymanski	17/07/2011	13/08/2011	Oxford/UK		1200 €
Alexander Winderberger	09/09/2011	07/10/2011	Aarhus/Denmark		2000 €
Maria Schwarz	09/09/2011	07/10/2011	Aarhus/Denmark		2000 €
Kevin Sheridan	1/10/2011	30/11/2011	VU Amsterdam/NL		2500 €
Lukas Klosowski	17/10/11	16/12/11	Aarhus/Denmark		2500 €
Bogdan Mihalcea	31/10/11	19/11/11	PTB Braunschweig/DE		1725 €
Peter Zahariev	16/01/12	17/02/12	Uni Mainz		2300 €
Sebastian Menk	09/01/12	19/02/12	Weizmann Institute		2015 €
Peter Ivanov	06/02/12	06/03/12	Univ Complutense Madrid		2000 €
Oscar Versolato	07/05/12	31/07/12	Aarhus University		2500 €
Christopher Balance	08/07/12	18/08/12	ETH Zürich		2300 €
Matthias Germann	26/08/12	9/09/12	CSIC, Madrid		1340 €
Alex Retzker	18/02/13	24/02/13	Uni Siegen/DE		900 €
Tanveer Baig	25/02/13	22/03/13	NPL, Teddington/UK		2100 €
Martin Berglund	11/03/13	22/03/13	Aarhus University/DK		700 €
Claudiu Genes	18/03/13	20/04/13	ISIS, Strasbourg/F		1800 €
Diego Porras	15/07/13	21/07/13	Univ of Sussex, Brighton/UK		850 €
Haggai Landa	1/09/13	30/09/13	Orsay, France		2400 €
Lisa Woerner	11/11/14	19/11/14	Uni Basel, CH		800 €
Henning Hahn	15/11/13	31/12/13	Univ of Sydney, Australia		2500 €
Alejandro Bermudez	20/11/13	20/12/13	Univ of Sussex, Brighton/UK		2300 €
Jurriaan Biesheuvel	23/1/14	31/1/14	Univ Pierre et Marie Curie, Paris/F		700 €
Jofre Pedregosa	2/2/14	8/2/14	MPI fuer Kernphysik, Heidelberg/D		780 €
William Groom	3/3/14	31/3/14	NICT, Tokyo/JP		2140 €

Henning Hahn	1/3/14	15/3/14	Univ of Sydney, Australia			1000 €
Olga Lakhmanskaya	1/5/14	2/6/14	Univ Cologne, DE			1400 €
Stephen Rardin	18/6/14	29/7/14	GSI, Darmstadt/DE			1550 €
Itzik Cohen	15/6/14	29/6/14	Univ Sussex, Brighton/UK			1213 €
Mikel Palmero	22/9/14	26/9/14	ETH Zürich/CH			750 €
					Total	**50 463 €**

Workshops

Title	*Date*		*Place*	*Participants*		*Cost*	*Total*
	From	**To**					
Scientific kick-off (MC and all WG)	23-25/3/11		Heidelberg/DE	75			2 190 €
Qion	26-29/4/11		Madrid/ES	35			1 050 **€**
Core group	21/09/11		Paris/FR	8			210 €
Qion	26-29/3/11		Tel Aviv/IL	35			1 050 **€**
IonTech	07-9/05/12		Siegen/DE	67			2 010 €
ECTI-2	9-14/09/12		Obergurgl/AT	120			3 600 €
Qion 13	2-5/04/13		Obergurgl/AT	33			990 €
CAMEL	17-21/6/13		Nessebar/BG	49			1 470 €
IonTech2+ MC meeting	23-25/10/13		Paris/F	70			3840 €
Quantum Simulations	15-18/12/13		Brighton/UK	55			10000 €
Qion 14	31/03-04/04/14		Cartagena/ES	52			2300
CAMEL 10	23-27/6/14		Nessebar/BG	50			5000
ECTI-3	14-19/9/14		Mainz/DE	145			10 000 €
						Total	**43 710 €**

General Support Grants

Beneficiary	Date						Cost	Total
Université de Provence	Nov 201							8 235.74 €
Université d'Aix-Marseille	Nov 201							13 947.23 €
Université d'Aix-	Nov 201							16 134.06 €

Marseille								
Université d'Aix-Marseille	Sept 20							16 209 €
							Total	**54 526.03 €**

Schools

Title	*Date*	*Place*					*Cost*	*Total*
Training Event "Cold Molecules	23/11/11	25/11/11	Sandbjerg/DK		34/50			19001.50 €
Physics with Trapped Charged Particles	9/1/12	20/1/12	Les Houches, France		76			13 310.43 €
Enrico Fermi School – Course 189	21/7/13	30/7/13	Varenna, Italy		32/75			24 674.82 €
							Total	**56 986.75 €**

Dissemination

Title	*Date*	*Place*					*Cost*	*Total*
Web page	2011							1842 €
Web hosting	2011							158 €
Newsletter editor	2012							1500 €
Applied Phys B – special edition	2012							500 €
Web hosting	2013							210.13 €
Newsletter editor	2013							1 791.92
Dissemination movie	2014							2000
							Total	**8002 €**

Others

Action Total **431 821.7 €**

List of reimbursed participants 2011-2014

	Title	First Name	Last Name	Category/WG membership	Country
1	Ms	Aarouj	Aarouij	Trainee	IT
2	Mr	Patric	Ackermann	[WG2], [WG3]	DE
3	Mr	Nati	Aharon	[WG2]	IL
4	Mr	Abdelfatah	Ahmed	[WG1]	SD
5	Mr	Jun Sik	Ahn	Trainee	KR
6	Mr	Nitzan	Akerman	[WG2]	IL
7	Mr	Andreas	Albrecht	[WG3],Trainee	DE
8	Mr	Soroosh	Alighanbari	Trainee	DE
9	Mr	David	Allcock	[WG2]	UK
10	Mr	Joseba	Alonso	[WG1]	CH
11	Dr	Wolfgang	Alt	[WG1]	DE
12	Mr	Robert	Altmann	Trainee	NL
13	Dr	Jason	Amini	Expert/Invited Speaker	US
14	Mr	Kasra	Amini	[WG4]	UK
15	Prof.	François	Anderegg	Trainer	US
16	Mr	Hans Harhoff	Andersen	Trainee	DK
17	Mr	Gilad	Arrad	Trainee	IL
18	Dr	Oskar	Asvany	[WG4]	DE
19	Ms	Marianne	Bader	[WG3]	DE
20	Mr	Muhammad Tanveer	Baig	[WG3]	DE
21	Mr	Chris	Ballance	[WG2]	UK
22	Mr	Tim	Ballance	Trainee	UK
23	Mr	Jens	Baltrusch	[WG2], [WG3],Trainee	DE
24	Mr	Leonardo	Banchi	[WG2]	UK
25	Dr	Julio	Barreiro	[WG3]	AT
26	Ms	Humairah	Bassa	Trainee	ZA
27	Mr	Valentin	Batteiger	[WG2]	DE
28	Mr	Ingo	Baumgart	Trainee	DE
29	Dr	Tim	Bayer	[WG2]	DE
30	Mr	Alejandro	Bermudez	[WG2]	ES
31	Mr	Thorsten	Best	Trainee	AT
32	Mr	Ralf	Betzholz	Trainee	DE

	Title	First Name	Last Name	Category/WG membership	Country
33	Dr	Michael	Biercuk	COST International Partner Country	AU
34	Mr	Juriaan	Biesheuvel	Trainee	NL
35	Prof.	Gerhard	Birkl	[WG1]	DE
36	Prof.	Rainer	Blatt	MC Member	AT
37	Prof	Rainer	Blatt	[WG1], [WG2], [WG3],Local organiser	AT
38	Prof.	Klaus	Blaum	[WG1]	DE
39	Dr	Michael	Block	[WG1]	DE
40	Mr	Ivan	Boldin	[WG2]	DE
41	Dr	John	Bollinger	Expert/Invited Speaker	US
42	Mr	Sougato	Bose	[WG2]	UK
43	Ms	Hendrike	Braun	[WG2], [WG3]	DE
44	Dr	Kenneth	Brown	Expert/Invited Speaker	US
45	Dr	Michael	Brownnutt	[WG2]	AT
46	Mr	Tobias	Burgermeister	Trainee	DE
47	Prof	Tommaso	Calarco	[WG2], [WG3]	DE
48	Mr	Ruggero	Caravita	Trainee	IT
49	Mr	Ruggero	Caravita	Trainee	IT
50	Ms	Martina	Carsjens	[WG1], [WG3], [WG4]	DE
51	Mr	Florian	Cartarius	[WG3]	DE
52	Dr	Caroline	Champenois	[WG2], [WG4]	FR
53	Ms	Qiong	Chen	Trainee	CN
54	Mr	James	Chou	Expert/Invited Speaker	US
55	Mr	Michael	Chwalla	[WG2]	AT
56	Mr	Marco	Ciancaruso	Trainee	IT
57	Mr	Itsik	Cohen	[WG2]	IL
58	Mr	Thomas	Collath	[WG3]	DE
59	Dr	Yves	Colombe	Expert/Invited Speaker	US
60	Ms	Pauline	Comini	Trainee	FR
61	Dr	Cecilia	Cormick	[WG3]	DE
62	Mr	Franck	Cozijn	[WG1], [WG4]	NL
63	Dr	Stephen	Crain	[WG2],Expert/Invited Speaker	US
64	Prof.	José	Crespo	[WG2],Trainer,Expert/Invited Speaker	DE

	Title	First Name	Last Name	Category/WG membership	Country
65	Dr	José	Crespo	[WG1], [WG4]	DE
66	Ms	April	Cridland	[WG1], [WG2]	UK
67	Dr	Frederick	Currell	Trainer	UK
68	Ms	Cricia	de Carvalho Rodegheri	[WG1], [WG2], [WG3]	DE
69	Ms	Nabanita	Deb	[WG4]	UK
70	Mr	Ludwig	Declercq	Trainee	CH
71	Mr	Christophe	Dehon	[WG4]	FR
72	Mr	Darren	DeMotte	[WG2]	UK
73	Prof	Jens	Dilling	Expert/Invited Speaker	CA
74	Ms	Emiliya	Dimova	[WG2], [WG3]	BG
75	Ms	Shiqian	Ding	[WG3]	SG
76	Dr	Albane	Douillet	[WG1]	FR
77	Prof.	Michael	Drewsen	MC Member	DK
78	Dr	Francois	Dubin	[WG2]	ES
79	Prof.	Daniel H.	Dubin	Trainer,Expert/Invited Speaker	US
80	Dr	Olivier	Dulieu	[WG4]	FR
81	Ms	Katrin	Dulitz	Trainee	UK
82	Mr	Andreas	Dörr	[WG1]	DE
83	Mr	Pascal	Eich	Trainee	DE
84	Dr	Sergey	Eliseev	[WG2], [WG3],Expert/Invited Speaker	DE
85	Prof.	Jürgen	Eschner	[WG2]	DE
86	Prof.	Joël	Fajans	Trainer	US
87	Mr	Thomas	Feldker	Trainee	DE
88	Mr	Martin	Fischer	[WG3]	DE
89	Prof	Shmuel	Fishman	Trainer	IL
90	Dr	Regine	Frank	Trainee	DE
91	Mr	Kurt	Franke	Trainee	CH
92	Prof	Jim	Freericks	Expert/Invited Speaker	US
93	Mr	Konstantin	Friebe	[WG2]	AT
94	Mr	Henning	Fuerst	[WG2], [WG3]	DE
95	Dr	Géraldine	Féraud	[WG4]	FR
96	Prof	Gerald	Gabrielse	Trainer	US
97	Dr	Meng	Gao	[WG2]	SG

	Title	First Name	Last Name	Category/WG membership	Country
98	Dr	Juan Jose	Garcia Ripoll	MC Member	ES
99	Ms	Amy	Gardner	[WG1], [WG2], [WG3]	UK
100	Prof	Barry	Garraway	[WG2], [WG3]	UK
101	Dr	Claudiu	Genes	[WG2]	AT
102	Mr	Genko	Genov	[WG2], [WG3]	BG
103	Mr	Mathias	Gerbaux	Trainee	FR
104	Prof.	Dieter	Gerlich	[WG4]	DE
105	Dr	Rene	Gerritsma	[WG2], [WG3]	DE
106	Mr	Johannes	Ghetta	Trainee	AT
107	Prof.	Francesco	Gianturco	Expert/Invited Speaker	IT
108	Mr	Alex	Gingell	Trainee	DK
109	Ms	Gouri	Giri	[WG1], [WG2]	UK
110	Prof.	Liviu	Giurgiu	MC Member	RO
111	Mr	Alexander	Glaetzle	[WG2], [WG3]	AT
112	Mr	Timm	Gloger	[WG3]	DE
113	Ms	Rachel	Godun	[WG1]	UK
114	Mr	Joe	Goodwin	[WG2]	UK
115	Mr	Pierre	Grandemange	Trainee	FR
116	Mr	Matt	Grau	Trainee	US
117	Mr	William	Groom	[WG1], [WG2],STSM candidate	UK
118	Dr	Stéphane	Grévy	[WG1],Expert/Invited Speaker	FR
119	Mr	Alan	Guenther	Trainee	DE
120	Dr	Stephane	Guerin	[WG1], [WG2], [WG3]	FR
121	Prof.	Ariel	Guerreiro	MC Member	PT
122	Dr	Luca	Guidoni	[WG1], [WG2]	FR
123	Mr	Roland Esteban	Habluetzel	Expert/Invited Speaker	SG
124	Mr	Farhang	Haddadfarshi	Trainee	DE
125	Dr	Sylvi	Haendel	[WG2],Expert/Invited Speaker	US
126	Dr	Gaëtan	HAGEL	[WG1]	FR
127	Mr	Henning	Hahn	Trainee	DE
128	Mr	Felix	Hall	Trainee	CH
129	Mr	Felix	Hall	[WG2], [WG4]	CH
130	Mr	Thilo	Hannemann	Expert/Invited Speaker	DE

	Title	First Name	Last Name	Category/WG membership	Country
131	Mr	Stephan	Hannig	Trainee	DE
132	Mr	Anders	Hansen	Trainee	DK
133	Mr	Michael	Hansen	Trainee	DE
134	Mr	Thomas	Harty	[WG1]	UK
135	Mr	Thomas	Harty	[WG2]	UK
136	Prof	Shuichi	Hasegawa	Trainer	JP
137	Ms	Avazeh	Hashemloo	Expert/Invited Speaker	SE
138	Prof.	Michael	Hass	MC Member	IL
139	Dr	Philipp	Hauke	[WG2], [WG3]	AT
140	Dr	Kazuhiro	Hayasaka	COST International Partner Country	JP
141	Dr	David Lee	Hayes	Expert/Invited Speaker	US
142	Prof.	Johannes	Hecker Denschlag	[WG1], [WG4]	DE
143	Mr	Reinhard	Heinke	[WG1], [WG2]	DE
144	Dr	Cornelius	Hempel	[WG2], [WG3],Expert/Invited Speaker	AT
145	Dr	Markus	Hennrich	[WG1], [WG2], [WG3]	AT
146	Dr	Winfried	Hensinger	MC Member	UK
147	Dr	Frank	Herfurth	[WG1], [WG3]	DE
148	Mr	Oscar	Herrera	[WG1]	DE
149	Dr	Peter	Herskind	[WG2]	DK
150	Mr	Gabriel	Hetet	[WG3]	AT
151	Mr	Max	Hettrich	[WG2], [WG3]	DE
152	Prof	Laurent	HILICO	MC Member	FR
153	Mr	Johannes	Hoffrogge	[WG3]	DE
154	Mr	Philip	Holz	Trainee	AT
155	Prof.	Jonathan	Home	[WG3]	CH
156	Prof.	Jonathan	Home	MC Member	CH
157	Dr	Seokjun	Hong	Trainee	KR
158	Prof.	Marie	Houssin	[WG2]	FR
159	Ms	Hristina	Hristova	[WG2], [WG3]	BG
160	Mr	Thomas	Huber	[WG4]	DE
161	Prof.	Eric	Hudson	COST International Partner Country	---
162	Mr	Kent	Hung	Other (e.g. observer, etc)	BE
163	Mr	Nils	Huntemann	[WG1]	DE

	Title	First Name	Last Name	Category/WG membership	Country
164	Mr	Jan	Huwer	[WG1], [WG3]	DE
165	Prof.	Hartmut	Häffner	Expert/Invited Speaker	US
166	Mr	Martin	Höcker	[WG1], [WG2]	DE
167	Mr	Bastian	Höltkemeier	Trainee	DE
168	Prof	Zbigniew	Idziaszek	Expert/Invited Speaker	PL
169	Mr	Aled	Isaac	Trainee	UK
170	Mr	Svetoslav	Ivanov	[WG2], [WG3]	UK
171	Dr	Svetoslav	Ivanov	[WG2], [WG3]	BG
172	Dr	Peter	Ivanov	[WG2], [WG3]	BG
173	Mr	Georg	Jacob	[WG1]	DE
174	Mr	Georg	Jacob	Trainee	DE
175	Prof.	Hans Rudolf	Jauslin	[WG3]	FR
176	Mr	Florian	Jessen	[WG3]	DE
177	Mr	Jannis	Joger	[WG2], [WG3]	DE
178	Dr	Michael	Johanning	[WG1], [WG3]	DE
179	Mr	Endre	Kajari	[WG3]	DE
180	Mr	Marius	Kamsap	Trainee	FR
181	Mr	jean-philippe	Karr	[WG1], [WG3], [WG4]	FR
182	Dr	Savely	Karshenboim	Expert/Invited Speaker	DE
183	Mr	Nadav	Katz	[WG2], [WG3]	IL
184	Dr	Delia	Kaufmann	[WG3]	DE
185	Mr	Peter	Kaufmann	[WG3]	DE
186	Mr	Ben	Keitch	[WG3]	CH
187	Dr	Matthias	Keller	[WG4]	UK
188	Prof	David	Kielpinski	COST International Partner Country	AU
189	Mr	Daniel	Kienzler	[WG2], [WG3]	CH
190	Dr	Jungsan	Kim	[WG2],Expert/Invited Speaker	US
191	Dr	Lukasz	Klosowski	Trainee	PL
192	Mr	Stefan	Knauer	[WG1], [WG2], [WG4]	DE
193	Dr	Martina	Knoop	MC Chair	FR
194	Dr	Michael	Koehl	[WG3]	DE
195	Mr	Florian	Koehler	Trainee	DE
196	Dr	Jeroen	Koelemeij	[WG1], [WG2], [WG3], [WG4]	NL

	Title	First Name	Last Name	Category/WG membership	Country
197	Dr	Jeroen	Koelemeij	MC Member	NL
198	Mr	Matthias	Kohnen	[WG1], [WG2]	DE
199	Prof	Svetlana	Kotochigova	COST International Partner Country	US
200	Mr	Holger	Kracke	[WG1], [WG2], [WG3]	DE
201	Mr	Daniel	Krasnicky	Trainee	IT
202	Mr	Artjom	Kruekow	Trainee	DE
203	Mr	Dawid	Kucharski	Trainee	PL
204	Mr	Peter	Kunert	[WG3]	DE
205	Mr	Christof	Kurz	[WG2], [WG3]	DE
206	Dr	Alex	Kuzmich	Expert/Invited Speaker	US
207	Ms	Olga	Lakhmanskaya	Trainee	AT
208	Ms	Jessica	Lam	Trainee	UK
209	Dr	Lucas	Lamata	[WG2]	ES
210	Mr	Haggai	Landa	[WG3]	IL
211	Prof.	Wolfgang	Lange	[WG3]	UK
212	Dr	Ben	Lanyon	[WG2]	AT
213	Dr	Dietrich	Leibfried	Expert/Invited Speaker	US
214	Dr	Dietrich	Leibfried	COST International Partner Country	US
215	Mr	Bjoern	Lekitsch	[WG2]	UK
216	Mr	Andreas	Lemmer	[WG2]	DE
217	Mr	Andreas	Lemmer	Trainee	DE
218	Dr	Juan	Leon	MC Substitute	ES
219	Dr	Igor	Lesanovsky	[WG2], [WG3]	UK
220	Prof.	Maciej	Lewenstein	[WG3]	ES
221	Mr	Weibin	Li	Trainee	UK
222	Mr	David von	Lindenfels	[WG1], [WG3]	DE
223	Mr	Norbert	Linke	[WG1], [WG2], [WG3]	UK
224	Dr	Yurij	Litvinov	[WG3],Expert/Invited Speaker	DE
225	Mr	Hsiang-yu	Lo	Trainee	CH
226	Mr	Henry	Lopez	Trainee	DE
227	Dr	David	Lucas	MC Member	UK
228	Dr	Niels	Madsen	[WG2],Local organiser,Trainer	UK
229	Prof	Niels	Madsen	[WG1], [WG2],Trainer	CH

	Title	First Name	Last Name	Category/WG membership	Country
230	Mr	Vladimir	Manea	Trainee	FR
231	Dr	Sabrina	Maniscalco	MC Member	FI
232	Dr	Helen	Margolis	[WG2],Trainer	UK
233	Mr	Franklin	Martinez	[WG1]	DE
234	Dr	Miguel Angel	Martín-Delgado Alcántara	MC Substitute	ES
235	Dr	Irene	Marzoli	MC Vice-Chair	IT
236	Dr	Irene	Marzoli	Core Group Member, [WG3]	IT
237	Dr	Tanja	Mehlstaeubler	[WG1]	DE
238	Mr	David-Marcel	Meier	[WG3], [WG4]	DE
239	Prof.	Frans	Meijer	[WG1], [WG4]	IE
240	Dr	Ziv	Meir	[WG2]	IL
241	Mr	Ziv	Meir	[WG2], [WG3]	IL
242	Mr	Simon	Mieth	[WG3]	DE
243	Dr	Bogdan Vasile	Mihalcea	MC Member	RO
244	Mr	Jonathan	Mizrahi	Trainee	US
245	Mr	Amir	Mohammadi	Trainee	DE
246	Ms	Arezoo	Mokhberi	Trainee	CH
247	Prof	Christopher	Monroe	Trainer,Expert/Invited Speaker	US
248	Ms	Simone	Montangero	[WG2]	DE
249	Mr	Thomas	Monz	[WG3]	AT
250	Dr	Andreas	Mooser	[WG1], [WG3]	CH
251	Prof.	Giovanna	Morigi	[WG3]	DE
252	Prof	Giovanna	Morigi	[WG3]	DE
253	Mr	Olivier	Morizot	Trainee	FR
254	Mr	Markus	Mueller	[WG2]	AT
255	Mr	Markus	Mueller	[WG2]	ES
256	Mr	Philipp	Mueller	[WG1], [WG3], [WG4]	DE
257	Mr	Jordi	Mur-Petit	[WG3], [WG4]	ES
258	Mr	Tomas	Navickas	[WG1], [WG2]	UK
259	Mr	Nir	Navon	[WG2]	IL
260	Mr	Vlad	Negnevitsky	Trainee	CH
261	Mr	Vlad	Negnevitsky	Trainee	CH
262	Mr	Antonio	Negretti	[WG4]	DE

	Title	First Name	Last Name	Category/WG membership	Country
263	Mr	Pedro	Nevado-Serrano	[WG2]	UK
264	Mr	Pablo	Nieto	[WG4]	DE
265	Mr	Ramil	Nigmatullin	[WG3]	UK
266	Mr	Boaz	Nissan-Cohen	Trainee	IL
267	Dr	Altaf	Nizamani	COST International Partner Country	PK
268	Dr	Tracy	Northup	[WG3]	AT
269	Mr	Benjamin	Norton	Trainee	AU
270	Ms	Mayerlin	Nunez Portela	Trainee	NL
271	Prof.	Brian	Odom	Trainer	US
272	Dr	Yasser	Omar	MC Member	PT
273	Dr	Christian	Ospelkaus	[WG1], [WG3], [WG4]	DE
274	Dr	Roee	Ozeri	MC Member	IL
275	Mr	Mikel	Palmero	[WG1], [WG3],STSM candidate	ES
276	Mr	Giuseppe Davide	Paparo	[WG2]	IT
277	Dr	Alexander	Papash	Trainer	DE
278	Ms	Anna-Greta	Paschke	[WG1]	DE
279	Prof.	Thomas Sunn	Pedersen	Trainer	DE
280	Dr	Jofre	Pedregosa	[WG1]	FR
281	Dr	Ekkehard	Peik	[WG1], [WG3],Expert/Invited Speaker	DE
282	Dr	Alexander	Petrov	COST International Partner Country	---
283	Dr	Jyrki	Piilo	MC Substitute	FI
284	Mr	Chrisitian	Piltz	[WG3]	DE
285	Prof.	Martin	Plenio	[WG2]	DE
286	Ms	Laura	Pollum	Trainee	UK
287	Dr	Diego	Porras Torre	MC Member	ES
288	Mr	Ulrich	Poschinger	[WG1], [WG3]	DE
289	Mr	Gregers	Poulsen	Trainee	DK
290	Mr	Diana	Prado Lopes	[WG2], [WG3]	UK
291	Dr	Javier	Prior	[WG2], [WG3]	ES
292	Mr	Karsten	Pyka	[WG1]	DE
293	Dr	Wolfgang	Quint	MC Substitute	DE
294	Mr	Joe	Randall	[WG1], [WG2]	UK
295	Mr	Andon	Rangelov	[WG2]	BG

	Title	First Name	Last Name	Category/WG membership	Country
296	Mr	Lothar	Ratschbacher	[WG1], [WG3],Trainee	UK
297	Prof	Mark	Reed	Expert/Invited Speaker	US
298	Dr	Christopher	Rennick	[WG4]	UK
299	Dr	Alex	Retzker	[WG2], [WG3]	DE
300	Dr	Alex	Retzker	[WG2], [WG3],STSM candidate,Local organiser	IL
301	Prof.	Benni	Reznik	[WG2]	IL
302	Dr	Phil	Richerme	Expert/Invited Speaker	US
303	Prof	Thomas	Rizzo	[WG2], [WG4]	CH
304	Dr	Francis	Robicheaux	Expert/Invited Speaker	US
305	Mr	Daniel	Roesch	[WG4]	CH
306	Dr	Christian	Roos	[WG3]	AT
307	Dr	Christian	Roos	[WG3]	AT
308	Mr	Marco	Rosenbusch	[WG1]	DE
309	Mr	Johannes	Rossnagel	[WG1],STSM candidate,Trainee	DE
310	Mr	Stepan	Roucka	Trainee	CZ
311	Mr	Ian	Rouse	Trainee	CH
312	Mr	Benjamin	Rousseaux	[WG2], [WG3]	FR
313	Dr	Guido	Saathoff	[WG3]	DE
314	Ms	Jyothi	Saraladevi	Trainee	IN
315	Dr	Xabier	Sarasola	[WG1]	DE
316	Dr	Birgit	Schabinger	[WG3]	DE
317	Dr	Tobias	Schaetz	[WG2], [WG4]	DE
318	Mr	Benedikt	Scharfenberger	[WG3]	DE
319	Mr	Nils	Scharnhorst	[WG1]	DE
320	Prof.	Stephan	Schiller	MC Member	DE
321	Mr	Philipp	Schindler	[WG2]	AT
322	Prof	Wolfgang	Schleich	Trainer	DE
323	Prof	Stephan	Schlemmer	MC Substitute	DE
324	Mr	Philipp	Schmid	Trainee	AT
325	Dr	Piet Oliver	Schmidt	[WG1], [WG3], [WG4]	DE
326	Mr	Julian	Schmidt	Trainee	DE
327	Prof.	Ferdinand	Schmidt-Kaler	[WG2]	DE
328	Dr	Roman	Schmied	[WG1], [WG3]	CH

	Title	First Name	Last Name	Category/WG membership	Country
329	Mr	Christian	Schmiegelow	[WG1], [WG3]	AR
330	Ms	Lisa	Schmoeger	[WG1], [WG2],Trainee	DE
331	Mr	Daniel	Schraft	[WG2], [WG3]	DE
332	Ms	Rima	Schuessler	[WG4],Trainee	DE
333	Prof	Lutz	Schweikhard	[WG1], [WG2],Expert/Invited Speaker	DE
334	Prof	Daniel	Segal	[WG1]	UK
335	Prof	Danny	Segal	[WG2]	UK
336	Ms	Crystal	Senko	[WG2]	US
337	Mr	Martin	Sepiol	Trainee	UK
338	Mr	Nicolas Roberto	Seymour-Smith	[WG1], [WG4]	UK
339	Prof	Vladimir	Shabaev	Expert/Invited Speaker	RU
340	Mr	Jianwei	Shen	Trainee	DE
341	Mr	Kevin	Sheridan	STSM candidate,Trainee	UK
342	Mr	Kevin	Sheridan	STSM candidate,Trainee	UK
343	Mr	Carlos	Sias	Trainee	UK
344	Dr	Pietro	Silvi	Trainee	DE
345	Mr	Lachezar	Simeonov	[WG1], [WG2]	BG
346	Dr	Kilian	Singer	[WG2]	DE
347	Mr	Lukas	Slodicka	[WG3]	AT
348	Prof.	Tim	Softley	[WG1], [WG4]	UK
349	Mr	Magnus Aagard	Sorensen	Trainee	DK
350	Mr	Theeraphot	Sriarunothai	Trainee	DE
351	Prof.	Ewa	Stachowska	MC Member	PL
352	Mr	Eamon	Standing	[WG1], [WG2]	UK
353	Mr	Edward	Steer	[WG4]	UK
354	Mr	Matthias	Steiner	[WG1], [WG3],Trainee	UK
355	Dr	Eve	Stenson	[WG2]	DE
356	Mr	Alexander	Stoffels	[WG4]	NL
357	Dr	Ovidiu-Sorin	Stoican	MC Substitute	RO
358	Dr	Juergen	Stuhler	Expert/Invited Speaker	DE
359	Mr	Sven	Sturm	[WG3]	CH
360	Dr	Sven	Sturm	[WG1], [WG2]	CH
361	Mr	Graham	Stutter	[WG2]	UK

	Title	First Name	Last Name	Category/WG membership	Country
362	Mr	Sunil Kumar	Sudhakaran	[WG4]	AT
363	Prof.	Cliff	Surko	Trainer	US
364	Dr	Annette	Svendsen	[WG4],Trainer	DK
365	Ms	Csilla	Szabo-Foster	Trainee	FR
366	Mr	Benjamin	SZYMANSKI	[WG2], [WG3]	FR
367	Mr	Joseph	Thom	Trainee	UK
368	Prof.	Richard	Thompson	MC Substitute	UK
369	Mr	Edoardo	Tignone	Trainee	FR
370	Mr	Jonathan	Toker	Trainee	DK
371	Dr	Xin	Tong	Trainee	CH
372	Mr	Boyan	Torosov	[WG2]	BG
373	Dr	Kenji	Toyoda	Expert/Invited Speaker	JP
374	Mr	Quang-Vu	Tran	Trainee	FR
375	Mr	Philipp	Treutlein	[WG4]	CH
376	Ms	Kathryn	Twyman	Trainee	UK
377	Prof.	Wim	Ubachs	[WG2], [WG3], [WG4]	NL
378	Prof	Joachim	Ullrich	[WG1],Expert/Invited Speaker	DE
379	Mr	Stefan	Ulmer	[WG1], [WG2]	DE
380	Prof	Xavier	Urbain	MC Member	BE
381	Prof	Xavier	Urbain	[WG4]	BE
382	Dr	Hermann	Uys	COST International Partner Country	ZA
383	Mr	Joost	Van den Berg	Trainee	NL
384	Dr	Andres	Varon	[WG3]	DE
385	Dr	José	Verdu Galiana	[WG1],Trainer	UK
386	Dr	Oscar	Versolato	[WG4]	DE
387	Mr	Yuval	Vinkler	Trainee	IL
388	Prof	Nikolay	Vitanov	[WG2], [WG3]	BG
389	Prof	Nikolay	Vitanov	MC Member	BG
390	Mr	Oscar	Viyuela	[WG2]	ES
391	Dr	Manuel	Vogel	[WG1], [WG3]	DE
392	Dr	Joachim	Von Zanthier	[WG1], [WG3]	DE
393	Ms	Anke	Wagner	[WG1], [WG2], [WG3]	DE
394	Prof	Jochen	Walz	[WG1],Expert/Invited Speaker	DE

	Title	First Name	Last Name	Category/WG membership	Country
395	Mr	Yong	Wan	Trainee	DE
396	Dr	Ulrich	Warring	Expert/Invited Speaker	US
397	Ms	Claudia	Warschburger	Trainee	DE
398	Mr	Tobias N.	Wassermann	[WG4]	CH
399	Dr	Stephen	Webster	[WG1], [WG2]	UK
400	Mr	Simon	Webster	[WG1], [WG2]	UK
401	Mr	Pascal	Weckesser	[WG1], [WG3], [WG4]	DE
402	Prof.	Matthias	Weidemüller	[WG4]	DE
403	Mr	Seb	Weidt	[WG1], [WG2]	UK
404	Mr	Christian	Wellers	Trainee	DE
405	Prof.	Günther	Werth	[WG1]	DE
406	Prof	Roland	Wester	MC Member	AT
407	Mr	Marco	Wiesel	Trainee	DE
408	Prof.	Stefan	Willitsch	MC Member	CH
409	Dr	Guido	Wilpers	[WG1], [WG2]	UK
410	Mr	Alexander	Windberger	[WG3], [WG4],STSM candidate	DE
411	Dr	Danyal	Winters	[WG2], [WG3]	DE
412	Dr	Lisa	Woerner	Trainee	AT
413	Dr	Robert	Wolf	[WG1], [WG3],Expert/Invited Speaker	DE
414	Mr	Jannes	Wuebbena	Trainee	DE
415	Prof.	Christof	Wunderlich	MC Member	DE
416	Mr	Yuriy	Yeliseyev	Expert/Invited Speaker	UA
417	Mr	Jong Keon	Yoon	Trainee	KR

II. Scientific Report prepared by the Chair of the Management Committee of the Action (same layout as in the Monitoring Progress Report)

Additional documentation such as extended scientific reports, proceedings of workshops, seminars or conferences may be provided separately as an annex to this report, and should be referenced in the report.

After 4 years, COST Action MP1001 can look back on an interesting agenda with many exciting meetings, which have generated a large number of new bi- and multilateral collaborations. The impact of face-to-face interactions has been very high. We have organized two major ten-day schools, training over 160 students (and a third one is planned to be held in January 2015, just after the end of the Action). The Action has established new and fruitful workshops, which were so successful, that they are now held annually (and will be continued after the end of the Action). Our major effort was to propose events with a transverse thematic approach including some tutorials and it has largely paid off. All Action events were very popular, attracting also a large fraction of colleagues from outside Europe and from neighbouring domains. Only participants being reimbursed figure on e-COST, and there are over 400 to this date (some of them being refunded multiple times). We estimate, that the total number of participants is around 1500. ESRs appreciated our efforts for organizing schools and dedicating an important budget to STSMs.

The awarding of the Nobel Prize in Physics 2012 to David Wineland from NIST for his pioneering work in ion trapping was spectacular news for the Action. David and his group were the first non-COST institution to join our Action in its first year; they are regular participants to all our events. The Nobel Prize for an Ion Trapper has also given an increased visibility to the Action topics (see for example the COST press release (http://www.cost.eu/library/newsroom/Nobelprize2012).

The regular newsletter is a success with an ever increasing number of subscribers. The MC has decided to continue this important service to the community by funding on their proper research budgets after the end of the Action.

Regarding our results compared to the objectives announced four years ago, we can affirm that we have attained our main objective to “create scientific added value by organising a Europe-wide joint effort to develop new basic experimental set-ups and theoretical methods for the trapping and control of cold ions” which has been the prerequisite for the “emergence of novel technologies and applications”, as can be seen by specific examples in the following text and the full list of publications on our website (www.cost-iota.org). We are proud to say that we have fulfilled the secondary objectives by “integrating experimental and theoretical approaches” which has enormously contributed to “gain insight into the fundamental interaction processes of trapped ions”. We continue to promote the use of ion trapping for “various applications in quantum information, frequency metrology and the determination of fundamental constants, ion-ion or ion-neutral interactions at ultralow energies, cavity QED or the production of cold molecules. Specific examples will follow in the text [*all citations from MoU*].

II.A. Innovative networking

- *Innovative knowledge resulting from COST networking through the Action. (Specific examples of Results vs. Objectives)*

The corresponding objectives from the MoU are cited in brackets at the beginning of each example [M=main, a=secondary objective a), …] Examples for objective g) are given in section II.B, as they concern very interdisciplinary work.

[M,a,b,c] Action MP1001 has proposed workshops along “unusual” lines - topics that are in general not found in other workshops or conferences. An example is the “IonTech” series on the technical aspects of ion trapping, started with a first meeting in 2012 in Siegen, organized by C. Wunderlich et al. (followed by a second edition in autumn 2013 in Paris (organiser L Hilico et al.)). Resumed by a participant: “We spend 95 % of our time in the lab struggling with technical problems, and in a traditional conferences we discuss the 5% of physics we really do. This is the first workshop, where we can exchange about the underlying practical questions.” Interactions with participants from industry and from other fields (mainly cold atoms), talks about technical solutions and some tutorials about the major techniques (ie laser stabilisation), a poster session and many discussions made this approach extremely successful.

[M,c,e,h] A key enabling technology in ion trapping are microfabrication techniques, which include the challenge of scaling in different contexts. Several STSMs have focussed on microfabrication techniques for miniature and surface traps, and have resulted in the implementation of new procedures Based on interactions with groups within this COST action, we created a comprehensive guide of microfabricated ion traps listing different fabrication methods and designs, providing a comprehensive database of fabrication methods, materials and design considerations, which is resumed in:

- *Microfabricated Ion Traps*, M.D. Hughes, Bjoern Lekitsch, J.A. Broersma and W.K. Hensinger, Contemporary Physics 52, 505 (2011).

[M,a,c,d,e,h] One of the highly debated phenomenon in the community is anomalous heating, which had been very poorly understood before the commencement of the COST action. Microtraps destined for the use in quantum computers suffer from electrical noise which increases the heating rates of the trapped ions and degrades coherence times. There is a large effort of different groups in the Action (Oxford, Mainz, Paris, Siegen, NIST, ..) to overcome this problem by cleaning the surface either with an ion beam or with laser ablation. These experiments are extremely expensive in terms of time and human resources, and the common shared approach has already allowed to create a database of experiments in order to identify new routes to solving this problem. Following in-depth discussions at a number of COST meetings, in particular the QIon conferences, it was found that a lot of what had been previously thought of heating resulting from surface effects on the trap electrodes, may be in fact due to electrical noise of the electronics involved. These discussions were initiated by Hartmut Haeffner and others and have led to a new understanding of this phenomenon. Discussions about anomalous heating were enabled by numerous STSMs (ie *Reduction of heating rate in a microfabricated ion trap by pulsed-laser cleaning*; D.T.C. Allcock, L. Guidoni, T.P. Harty, C.J. Ballance, M.G. Blain, A.M. Steane, D.M. Lucas; New J. Phys. 13 123023) and Action meetings that were part of WG2’s activity. The Action played therefore a critical role in obtaining a new understanding of this phenomenon. Michael Brownnutt and colleagues from Innsbruck University recently created a comprehensive overview of these discussions effectively producing a comprehensive database about this phenomenon:

- *Ion-trap measurements of electric-field noise near surface*s, M. Brownnutt, M. Kumph, P. Rabl, R. Blatt, arXiv:1409.6572 [quant-ph]

[M,a, b, c, and tasks of WG1] An inventory of technological issues and open questions was written at the very beginning of the action, and led to the outline of the ion trapper’s wiki published on the COST IOTA website (http://www.cost-iota.org/iota-wiki), the idea being that all the groups contribute to it by giving the relevant references to the international literature. This task is much more important than we had estimated, so far, the items of the wiki are still only partially filled.

[M, c,d,e,f,h] STSM's have played an important role in advancing the Action's scientific objectives. STSM's have been pivotal in enabling critical collaboration work, since they have allowed interchanging ideas between theory groups and also theory-experiment collaborations. There is a significant body of work associated with such collaboration and it is out of the scope of the report to provide a comprehensive overview. To illustrate the tremendous success, we provide one example below having emerged from a network of STSM's in the field of quantum simulation and its relation to WG2 "Various Scales". In this context, a network of researchers was able to produce a whole range of seminal works

- Review on quantum simulations with trapped ions that makes relevant information on the use of microtraps and 2D arrays to the trapped ion community (see Ch. Schneider, T. Schaetz, D. Porras, Reports on Progress in Physics 75, 024401 (2012)).
- Theoretical investigation on the use of dissipation in 2D arrays of ion microtraps and large ion crystals, (see A. Bermudez and M. Plenio, Phys. Rev. Lett. 111, 040601 (2013)) and A. Bermudez, T. Schaetz, and M. B. Plenio m Phys. Rev. Lett. 110, 110502 (2013)).
- Theoretical investigations related to Quantum Simulation with microwaves and magnetic field gradients (P. Ivanov, D. Porras, S. Ivanov, F. Schmidt-Kaler, Jour. of Phys. B: Atomic, Molecular, and Optical Physics, 46,104003 (2013).

[M,a,b,c,e,f,h] The workshop *Quantum Simulations with Trapped Ions*, held in Brighton, 16-19 December 2013, has been the first scientific meeting focused on that specific application of trapped ions, and it has benefited from the participation of the leading experimental and theoretical groups in the field. The workshop has allowed participants to interchange ideas and also to get complementary points of view from experts in related areas like quantum information and quantum technologies.

The achievements of our Action with respect to the milestones outlined in the MoU are very convincing, almost all proposed tasks have been fulfilled. Joining forces for microtrap fabrication protocols [WG1,WG2] has had a high impact. There has been a sound distribution of approaches between the groups in order to reach a better understanding rather than sterile competition. Results and major approaches have been formalized by a review publication already in the first year of our Action (M.D. Hughes,et al. Contemporary Physics 52, 505 (2011)).This diagnosis also applies for the investigation of anomalous heating (cited above, M. Brownutt et al.)) which has been one of the central working themes in WG1 and WG2. "Filling the gaps" and tackling the rare missing approaches can be critical in a small community such as the ion trappers, as it depends largely on National funding sources. The very good coverage obtained is also due to shared efforts in particular with our colleagues in the US.

WG3 certainly spans the widest range of topics, and there have been many advances in all domains of state preparation, entanglement, cooling and probing with different sorts of electromagnetic radiation. The use of microwaves to interact with individual atoms is certainly among the most spectacular (see the FET project IQIT and some of its results). The development of a common numerical code to simulate ions and their interaction with EM radiation, is not fully complete, but makes good progress. Starting from an interaction between Evry, Marseille and Garching, this has now spread out to Amsterdam, Heidelberg, Aarhus, Mainz, Paris, and Oxford. A modular FORTRAN code can run on high –performance computers, there is also a GPU based adaption under development. At least 2 STSM have been focused on the use and development of this code [Biesheuvel 2014, Pedregosa 2014].

All milestones of WG4 have been largely achieved, leading to major publications in top-level scientific publications, with a very large fraction of collaborative work, see some examples in the following publications:

Efficient rotational cooling of Coulomb-crystallized molecular ions by a helium buffer gas

A. K. Hansen, O. O. Versolato, L. Klosowski, S. B. Kristensen, A. Gingell, M. Schwarz, A. Windberger, J. Ullrich, J. R. Crespo Lopez-Urrutia, and M. Drewsen; Nature 508, 76-79 (2014)

Two-photon spectroscopy of trapped HD+ ions in the Lamb-Dicke regime

Vu Quang Tran, Jean-Philippe Karr, Albane Douillet, J. C. J. Koelemeij, and Laurent Hilico; Phys. Rev. A 88, 033421 (2013)

Microwave quantum logic spectroscopy and control of molecular ions

M Shi, P F Herskind, M Drewsen and I L Chuang; New J. Phys. 15, 113019 (2013)

Light-assisted cold chemical reactions of barium ions with rubidium atoms

Felix H.J. Hall, Mireille Aymar, Maurice Raoult, Olivier Dulieu & S. Willitsch, Molecular Physics 10.1080/00268976.2013.770930

Temperature-independent quantum logic for molecular spectroscopy,

J. Mur-Petit, J. Pérez-Ríos, J. Campos-Martínez, M. I. Hernández, S. Willitsch, J. J. García-Ripoll, Phys. Rev. A 85, 022308 (2012)

Cavity sideband cooling of trapped molecules

Markus Kowalewski, Giovanna Morigi, Pepijn W.H. Pinkse, and Regina de Vivie-Riedle; Phys. Rev. A 84, 033408 (2011)

The ITN COMIQ (see below) is a pure product from interactions in WG4.

We did not manage to bring the "common knowledge basis" to a full success. Our aim was to realize a technical and scientific inventory of protocols and experiments through a web-based Wiki. Different technical and strategic questions have made this more complex to implement than we imagined (formatting, searchability, moderation, ...). Today, the outline is less than half filled.
On the other hand, the development of more generalized instrumentation is underway but takes more time than foreseen. The collaboration of several groups with the existing (spin-off) company Stahl electronics has allowed to propose new equipment (e.g. trap rf drives, which were not available by the time we wrote the proposal and can now be purchased), other collaborations concern FPGA implementations in order to realize fast protocols [e.g. STSM Baig 2013].

- *Significant scientific breakthroughs as part of the COST Action. (Specific examples)*

The interaction with electro-magnetic (EM) radiation is at the heart of atomic and molecular ion trapping. In fact, almost every experimental interface with trapped ions is performed using the interaction of trapped ions with either light, microwave or radio-frequency fields; all of which are different manifestations of electromagnetic waves. Many of the member groups of the COST Action have therefore performed research using the interaction of EM fields as a tool or subject matter. Spectacular achievements have been reached which broadly fall under three different categories:

- **The use of EM fields in order to implement quantum computing protocols in trapped ion qubit registers.** Examples for achievements in this category include the pioneering of novel methods to implement quantum logic gates on trapped ion qubits with microwave fields in groups at Siegen, Oxford, Sussex and Boulder. The improvement of laser-driven entanglement gates in groups at Innsbruck, Oxford, Boulder and the Weizmann Institute. Demonstration of novel methods for laser-cooling of ions at the Imperial College. The development of novel optical detection of ion internal state detection at Oxford, Boulder and Griffith University. The development of optical methods for ion trapping and Freiburg and Aarhus and the use of spontaneous photon scattering to dissipatively generate non-classical states at Boulder, Innsbruck and Zurich.
- **Precision spectroscopy of atomic or molecular trapped ions.** Examples for achievements in this category include the development of state of the art optical atomic clocks in groups at Boulder, Braunschweig, London and Paris. Measurement of the g-factor of heavy ions at Mainz and Heidelberg, and progress towards measuring parity violation in trapped radioactive ions in Groningen. The very weak magnetic interaction between two electrons was studied at a separation in the micron scale.

- **Quantum Optics.** Examples for progress in this category include the study of trapped-ion cavity quantum electrodynamics in Innsbruck, Aarhus, Sussex, and Bonn. The study of ion-photon correlations in spontaneous photon scattering in Saarbrucken, Weizmann Institute and Innsbruck. The efficient coupling of free-space photons to a single trapped ion at Innsbruck and Erlangen.

More specific examples are

- An example of the versatility of trapped ion technology is demonstrated by nanoscopic transmission microscopy with a deterministic single-particle source. Sharper images of a transmission foil are obtained using exactly three ions at a time as a probe (G. Jakob *et al.*, arXiv:1405.6480). Hence, ion traps may lead to deterministic implantation of ions in a host material matrix.
- A new method for Doppler-free high resolution spectroscopy in HD+ ions was proposed relying on an effective Lamb-Dicke regime in collaboration between the groups of J. Koelemeij (VU Amsterdam) and L. Hilico (UPMC, France) [Two-photon spectroscopy of trapped HD+ ions in the Lamb-Dicke regime, Vu Quang Tran, Jean-Philippe Karr, Albane Douillet, Jeroen C. J. Koelemeij, and Laurent Hilico, Phys. Rev. A 88, 033421 (2013)]
- Action MP1001 has made possible a proposal to use trapped ion quantum simulators for quantum metrological applications [P.A. Ivanov and D. Porras, Phys. Rev. A 88, 023803 (2013)]. In this work connections between quantum phases of many ions and schemes for accurate measurements that can be applied to atomic clocks and magnetometry have been pointed out.
- Using a segmented ion trap, the Mainz group has experimentally demonstrated the fast separation (80 µs) of two ions from a single potential well into a double well, with just a minimum mean excitation of n = 4.16(0.16) vibrational quanta per ion. This achievement is a fundamental step towards scalable schemes such as teleportation over mm distances, entanglement swapping and interfacing with a cavity mode (T. Ruster et al., *Experimental realization of fast ion separation in segmented Paul traps*, arXiv:1405.5046).
- Within the workgroup on cold molecular ions (WG4), the IOTA network has led to several scientific breakthroughs by bringing people together from different European institutions with each their specialities. One examples of this is the recent first demonstration general method of rotational cooling of Coulomb crystallized molecular ions by a helium buffer gas [Nature 508, 76 (2014)], which was realized in a tight collaboration between Aarhus University, Denmark, and the Max-Planck Institute for Nuclear Physics – (MPIK), Heidelberg, Germany, with significant support from IOTA through STSM grants to young people.
- The realisation of a ion microchip holding a 2D ion lattice (R. C. Sterling, H. Rattanasonti, S. Weidt, K. Lake, P. Srinivasan, S. C. Webster, M. Kraft & W. K. Hensinger, Nature Communications 5:3637 doi: 10.1038/ncomms4637 (2014)) may be an important ingredient for the implementation of portable quantum sensors with trapped ions and it is an important step towards the implementation of quantum simulators with trapped ions.
- Quantum simulators and computers hold the promise to outperform classical computers exploiting the unique features of quantum mechanical systems. Even though the route to a commercially available quantum computer is still long, the exquisite control of trapped ions interactions has made it possible to observe the entanglement propagation along a string of up to 15 trapped ions [P. Jurcevic *et al.*, *Quasiparticle engineering and entanglement propagation in a quantum many-body system,* Nature **511**, 202-205 (2014)] as well as to implement error correction with seven trapped ions (D. Nigg *et al.*, *Quantum computations on a topologically encoded qubit,* Science Express 12 June 2014 [DOI:10.1126/science.1253742]).
- An extremely interesting analogy of a trapped ion with an Otto motor is exploited by the Mainz group

(Single-Ion Heat Engine at Maximum Power, O. Abah, J. Roßnagel, G. Jacob, S. Deffner, F. Schmidt-Kaler, K. Singer, and E. Lutz; Phys. Rev. Lett. 109, 203006 (2012)). Due to their interest in thermal machines, the group is also participating in the recent COST Action MP1209 "Thermodynamics in the quantum regime".

- Among others, this can lead to new insight in the measurement of the thermodynamics of a single atom (see for example *Controlling chemical reactions of a single particle*, Lothar Ratschbacher, Christoph Zipkes, Carlo Sias & Michael Köhl, Nature Phys., Vol. 8, 649–652 (2012)). The addressing of individual ions by microwave radiation opens the door for a scalable quantum computer and has been demonstrated in parallel at the University of Siegen/DE and at NIST – with two slightly different approaches. There are many ongoing efforts on this subject in different groups throughout Europe (and in the US).
- Tomorrow's clocks might be based on nuclear transitions, the STSM of P Glowacki to PTB explored new routes in the spectroscopy of the thorium ion (*Two-photon laser excitation of trapped $^{232}Th^{+}$ ions via the 402 nm resonance line*, A. Herrera-Sancho, M. V. Okhapkin, K. Zimmermann, Chr. Tamm, E. Peik, A. V. Taichenachev, V. I. Yudin, P. Glowacki, Phys. Rev. A **85**, 033402 (2012))

- *Tangible medium term socio-economic impacts achieved or expected. (Specific examples)*

There is a lot of progress concerning the microfabrication techniques, concerning processes of fabrication, but also and most importantly the integration of microtraps with either fibers and optics (see for example *Fibre–ion integration*, Oliver Graydon, Nature Photonics 7, 505 (2013)), or with other qubit systems as there are for example superconducting qubits. The development of integrated technologies for quantum sensors and quantum information processing with atoms and molecules are among the innovative activities pursued in the Action.

Regarding the socio-economic impact there is also a large potential in a common view of instrumentation. Different groups have started to develop innovative instrumentation (see for example *A new Pulse-Pattern Generator based on LabVIEW FPGA*, F. Ziegler, D. Beck, H. Brand, H. Hahn, G. Marx, L. Schweikhard, Nucl. Instrum. Meth. A 679, 1-6 (2012), and some of these prototypes are started to be commercialized. One of the objectives of the Action is to bring together existing initiatives to be able to propose instrumentation to a larger public.

The workshops on Ion Trapping Technology was the opportunity to link the Action more tightly to industrial activities; representatives of different companies have been attending the events, their presentations have triggered many discussions with participants. Today, two partners commercialize products which have been developed in the ion groups (Toptica, Stahl-electronics), our aim is to multiply the existing connections.

- *Spin off of new EC RTD Framework Programme proposals/projects. (List)*

- A proposal on Quantum Simulations with trapped ions has been submitted which resulted from scientific interactions at a number of COST meetings, particularly the first workshop on quantum simulations with trapped ions in Brighton. Many ion trapping groups are involved in the SIQS FET Proactive (Qurope). Several FET proposals have been submitted by end of September 2014.

- An ITN on Cold Molecules (COMIQ Cold Molecular ions at the Quantum Limit - http://itn-comiq.eu/welcome-to-comiq/) joining the partners of the Action has been accepted in early 2013.

- IQIT (Integrated Quantum Information Technology) is a project in FP7-ICT, bringing together seven experimental and theoretical groups.

- FET-ICT project “PICC: The Physics of Ion Coulomb Crystals – Thermodynamics, Quantum Control and Quantum Simulators” emerges from the Ion trappers community.

- One of the work packages of the AQUTE (Atomic QUantum TEchnologies) Integrating Project is focussed on Trapped Ions and involves several groups of this Action.

- *Spin off of new National Programme proposals/projects. (List)*

There is an impressive list of direct National projects, in the following I only give the list of the projects for National funding which are directly related to the COST Action

- Jonathan Home, ETH Zürich, CH, "Ultrafast control of trapped-ion motional states", and Stefan Willitsch, Universität Basel, CH, “A cold-chemistry laboratory on a chip: microtraps for ultracold molecular ions”; two proposals selected by the Swiss National Fund. To our knowledge, Switzerland is the only country which offers spin-off funding for Action activities.

- The joint proposal on the gbar project submitted by the groups led by F. Schmidt Kaler (Mainz University) and L. Hilico (UPMC, France) has been accepted in 2013 (grant DFG/ ANR13-ISO4-0002).

- Bogdan Mihalcea, Bucarest, has presented a research project in Romania in 2012 (in collaboration with PTB’s Quantum Sensor group), entitled “"Sympathetic cooling and Ion dynamics of Coulomb crystals in linear Paul traps", which was the first project on the complementary list.

- Martina Knoop, Marseille, project Metaphor (with A Amy Klein, G Morigi, J Eschner) funded by Amidex, Aix Marseille.

II.B. Inter-disciplinary networking

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*

The ion trapping community itself gathers people from different backgrounds in physics and chemistry and the organized workshops aimed for subjects with common interests to a large number of researchers. The common approach of technical aspects (IonTech), control of quantum dynamics (CAMEL) or quantum information processing (Qion) opened to a heterogeneous public and therefore trigger many interesting discussions. As is reflected by the publication list, these encounters generate novel scientific approaches (i.e., the use of cold molecules in quantum computing).
The workshops on Cold Molecules in November 2012 and September 2013 extended far beyond the ion trap community. It triggered many collaborations in that field, and gave rise to a first “Cold Molecules” conference in September 2014, uniting a larger cold molecule community.
The first workshop on quantum simulations with trapped ions brought together experts from different disciplines such as theoretical physics, condensed matter and experimentalists using Penning traps and Paul traps to gain a thorough understanding of the field and its opportunities. The meeting was highly successful providing a whole range of scientific collaborations within this exciting new field of science.

The development of sympathetic cooling of molecular ions by the interaction with laser-cooled atomic ions had prior to the foundation of the Action, for the first time, enabled the preparation of ensembles of molecular ions at millikelvin temperatures. The unique properties of such cold molecular ions (very low temperatures, localisation of the ions in ordered structures, minimal interactions with the environment) had then paved the way for exciting new fields of research in molecular and chemical physics with

promising applications in the domains of mass spectrometry, low-temperature chemical reaction dynamics and high-resolution molecular spectroscopy. The aim of WG4 has been concentrated on the task of advancing the experimental methods to prepare cold molecular ions and address new applications. The original main scientific objectives of this WG were: 1) the development of cooling methods for a variety of molecular species, 2) the establishment of new optical protocols for the preparation and interrogation of trapped cold molecular ions, 3) the implementation of new experimental approaches to study sympathetic cooling, 4) investigations of ion-neutral interactions, including collisions and chemical reactions.
All the scientific objects of the main four objectives 1) - 4) mentioned above for WG4 have been met very successfully during the IOTA COST Action (see specific examples next section)

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts. (Specific examples)*

At the frontier of physics and chemistry different groups have focussed on the realisation of objective [g], but also [f,h].
The collaboration between Basel University, Switzerland, and DESY, Germany, lead to a new method to control the conformational state of large molecules in chemical reactions [Science 342, 98 (2013)]. Other breakthroughs include the manipulation of individual hyperfine states in cold trapped molecular ions [Phys. Rev. Lett. 108 (2012), 183003], the characterization of the effects of single solvent molecules on chemical reactions [Nature Chemistry 4, 534 (2012)] and the elucidation of the H-bonding dynamics in progressively solvated peptides [Science, vol. 336, p. 320, 2012].

In 2012/13, two groups have published the first reaction rates measured with single trapped molecules. This constitutes an important step in the progress of ultra-cold, extremely well-controlled chemistry, and is completely in line with our objective *Investigation of atomic-molecular ion and ion-neutral interactions to elucidate the scattering and chemical dynamics at ultralow collision energies*..."

- F. H. J. Hall, P. Eberle, G. Hegi, M. Raoult, M. Aymar, O. Dulieu, S. Willitsch, Ion-neutral chemistry at ultralow energies : Dynamics of reactive collisions between laser-cooled Ca+ ions and Rb atoms in an ion-atom hybrid trap, Mol. Phys. 111, 2020 (2013)
- F. H. J. Hall, M. Aymar, M. Raoult, O. Dulieu, S. Willitsch, Light-assisted cold chemical reactions of barium ions with rubidium atoms, Mol. Phys. 111, 1683 (2013)
- Hall F. H. J., Aymar M., Bouloufa-Maafa N., Dulieu O. & Willitsch S. Light-Assisted Ion-Neutral Reactive Processes in the Cold Regime : Radiative Molecule Formation versus Charge Exchange. Physical Review Letters, 107 , 243202 (2011)

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

The advances in ultra-cold chemistry can be called spectacular, they rely on different methods and techniques developed in physics to measure variables and coefficients which rather belong to the chemistry domain. A new field is explored, but it is certainly a bit early to provide direct socio-economic impacts. In the long run, there will necessarily be an impact regarding (quantum) sensors, but more experiments and theory are required.

II.C. New networking

- *Additional new members joining the Action during its life.* From the first year of its existence the MoU was signed by 16 countries, representing all European countries who do have experimental or theoretical ion trapping activities. Over the lifetime of the Action, 8 international partners have officially signed up, the first one being Dave Wineland's group, NIST; Boulder/CO, and the last one that of Dave Kielpinski, Griffith University, Brisbane, Australia. Many additional groups from outside Europe have attended the events organized by the Action, contributing to fruitful exchanges. For most of the events, the local organisers had applied for additional funding, which allowed to give travel grants and or fee waivers also to early-stage researchers from outside Europe.

- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants).* Around 1500 participants have attended the Action's events, and less than a third has been financially supported directly by COST money. The number of female researchers has reached an average of 10 % for our activities, although we made particular efforts to increase the number of female participants (proposing reimbursements preferentially to women; organizing events outside school holidays; a gender balance web page...). It is impressive how the number of women physicists drops with age: typical values are up to 15 to 20% of female participants at PhD level, and 5 to 10% at group leader level.

We had a female student prize winner in Israel in 2012, and we organized her encounter with the Nobel Prize winner D Wineland – and asked her to write an article which was published in europhysics news (http://dx.doi.org/10.1051/epn/2013202). The Summer School we organized in Varenna in July 2013 had 3 female scientific directors. The president of the Italian Physical Society (a lady) came to the opening, and we took the opportunity to communicate about women in science.

- *Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs, networking activities, and Training Schools. In addition, justification should be provided if less than 4 STSMs were carried out during the year.*

The part of ESR participating in events of the Action is at an average of 60%.

STSMs are considered a very important tool to exchange information and further collaboration between different groups participating in a COST action. IOTA can be considered rather successful in this aspect as can be seen in the following table. 30 out of 33 STSMs were made by early-stage researchers.

year	spending per year	number of STSMs	average cost per STSM	average number of weeks	average cost per week w/o travel
2011	15225	7	2175	5	386
2012	12555	6	2092	4	403

2013	16000	10	1600	3	365
2014	8683	8	804	2	372
average	13116	8	1692	3.5	382
total	52463	31			

Remarkable is that the duration of the STSMs continuously dropped over time. This also explains why the expenditures for the last year are much lower than the years before.

The following table gives an impression of the distribution of the STSMs :

country	AU	AT	BG	CH	**DE**	**DK**	ES	FR	IL	JP	NL	PL	RO	UK
home institute		3	2	1	**10**		3	3	4		1	2	1	4
host institute	2			3	**8**	**7**	2	3	1	1	1			6

That Germany has the largest number of participants both concerning home and host institute is not so strange, it being the largest participating country. Denmark and the United Kingdom were however nearly as attractive as destination, where of course especially Denmark stands out. Indeed, a very frequent exchange was from Heidelberg to Aarhus, four times, COST IOTA supporting the development of a common cryo-trap design. Multiple visits occurred also between Madrid and Brighton, resp. Marseille and Heidelberg.

In six cases the STSM resulted in submitting a common publication, while four more are in preparation. In nine further cases a common publication was planned. In most cases the STSM resulted in starting a collaboration, some were in fact continuation of a collaboration started by a previous STSM.

- *Involvement of researchers from outside of COST Countries. (Number of participants from non-COST Countries approved by the CSO. Give % of such participants from countries with reciprocal agreements. Specify their contribution)* Almost all events have been attended by Ion trappers coming from the US, Japan, Australia, India or South Africa. For many events, the local organizers applied for additional funds (non-COST) at their university or research organisation, they provide money from other sources (research projects, companies, etc), so that travel grants and /or fee waivers could be proposed for participants from non-COST countries. The percentage of people from non-COST countries was higher for the international conferences (ECTI) and for the two training schools. (15 %)

- *Advancement and promotion of scientific knowledge through publications and other outreach activities. (Number of publications and other outreach activities that resulted from COST networking through the Action. Complete list should be given in an annex)*

Regarding dissemination, a special issue on Ion Trapping (http://www.springerlink.com/content/1654124l2l58h76x/?MUD=MP) has been published in July 2012 by Applied Physics B. Proceedings of the Workshop on Non-neutral Plasma were published in a special volume of AIP conference proceedings (http://proceedings.aip.org/resource/2/apcpcs/1521/1) . All publications are listed on our website, and publications involving members from more than one European country are listed in the Annex of this report. A review volume which unites lectures given at 2012's School in Les Houches has been published in December 2013 by Imperial College Press ("Physics with Trapped Charged Particles, ISBN: 978-1-78326-404-9). Proceedings of the 2014 School will be published under the auspices of the Italian Physical Society in the traditional format (http://en.sif.it/books/series/rendiconti_fermi). Following a demand by the early-stage researchers, we will publish a textbook (with Imperial College Press) with the WinterSchool on Trapped Charged Particles, scheduled in Les Houches, France from 19 -30 January 2015.
The Action has been presented by its chair at COST's Science Night in December 2012.
In connection with the celebration of the 100th year of the Bohr atomic model in 2013, Prof. Drewsen at Aarhus University has given a series of 5 popular lectures about this model and its connection to modern ion trapping physics.

- *Activities and projects with COST network colleagues.*

As a final publication, we are producing a promotional movie on Ion Traps and the Action. Among our objectives (outlined in the MoU) is the promotion of ion trapping techniques for the study of fundamental phenomena and further applications, and we think that a movie is the right vector for this.
The activity of COST Action MP1001 will be pursued even after the official end of this Action. A Winter School on Trapped Charged Particles is organized from 19-30 January 2015 in Les Houches, France, and 75 PhD students have already applied. Following a demand from the audience we will publish a textbook (with exercises) based on the tutorials given at the School.
The Newsletter of the Action, and in particular its database of publications, jobs and events is much appreciated by the Community. MC has decided to pursue this activity and to share the costs for a newsletter editor by contributing from our National research funding.

- *The capacity of the Action members to raise research funds.*

The capacity to raise money is important for this Action. If we normalize the obtained grants with respect to the COST budget spent on scientific activities, we can estimate a gain factor of at least 40 regarding European project money.

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Annex – Collaboration Publications 2010-2014

(only publications involving at least two groups from different countries are listed, a full list of all publications is on http://www.cost-iota.org/publications/publications-by-year/2014)

Dissipative production of a maximally entangled steady state of two quantum bits
Y. Lin, J. P. Gaebler, F. Reiter, T. R. Tan, R. Bowler, A. S. Sørensen, D. Leibfried & D. J. Wineland
Nature 504, 415–418 (2014)

Fast transitionless expansions of Gaussian anharmonic traps for cold atoms: Bang-singular-bang control
Xiao-Jing Lu, Xi Chen, J. Alonso, and J. G. Muga
Phys. Rev. A 89, 023627 (2014)

Generalized Dicke Nonequilibrium Dynamics in Trapped Ions
Sam Genway, Weibin Li, Cenap Ates, Benjamin P. Lanyon, and Igor Lesanovsky
Phys. Rev. Lett. 112, 023603 (2014)

Frontiers of ion trap and atomic physics: Wolfgang Paul 100
Edited by Gunter Werth, Ferdinand Schmidt-Kaler, Rainer Blatt
Appl. Phys. B 114, issue 1-2 (2014)

Electromagnetically-induced-transparency control of single-atom motion in an optical cavity
T. Kampschulte, W. Alt, S. Manz, M. Martinez-Dorantes, R. Reimann, S. Yoon, D. Meschede, M. Bienert, and G. Morigi
Phys. Rev. A 89, 033404 (2014)

Test of mp/me changes using vibrational transitions in N2+
Masatoshi Kajita, Geetha Gopakumar, Minori Abe, Masahiko Hada, and Matthias Keller
Phys. Rev. A 89, 032509 (2014)

The Gbar project, or how does antimatter fall?
Paul Indelicato, G. Chardin, P. Grandemange, D. Lunney, V. Manea, A. Badertscher, P. Crivelli, A. Curioni, A. Marchionni, et al
Hyperfine Interactions, February 2014

Theoretical transition frequencies beyond 0.1 ppb accuracy in H+2, HD+, and antiprotonic helium
Vladimir I. Korobov, Laurent Hilico, and Jean-Philippe Karr
Phys. Rev. A 89, 032511 (2014)

m?7-Order Corrections in the Hydrogen Molecular Ions and Antiprotonic Helium
Vladimir I. Korobov, Laurent Hilico, and Jean-Philippe Karr
Phys. Rev. Lett. 112, 103003 (2014)

Adiabatic quantum simulation with a segmented ion trap: Application to long-distance entanglement in quantum spin systems
S. Zippilli, M. Johanning, S. M. Giampaolo, Ch. Wunderlich, and F. Illuminati
Phys. Rev. A 89, 042308 (2014)

Static and dynamic polarizability and the Stark and blackbody-radiation frequency shifts of the molecular hydrogen ions H2+, HD+, and D2+
S. Schiller, D. Bakalov, A. K. Bekbaev, and V. I. Korobov
Phys. Rev. A 89, 052521 (2014)

Efficient rotational cooling of Coulomb-crystallized molecular ions by a helium buffer gas
A. K. Hansen, O. O. Versolato, ?. K?osowski, S. B. Kristensen, A. Gingell, M. Schwarz, A. Windberger, J. Ullrich, J. R. Crespo Lopez-Urrutia, and M. Drewsen
Nature 508, 76-79 (2014)

Simulation of ion behaviour in an open three-dimensional Paul trap using a power series method
Mustapha Said Herbane, Hamid Berriche, Alaa Abd El-hady, Ghadah Al Shahrani, Gilles Ban, Xavier Fléchard, Etienne Liénard
Nucl. Instr. Meth. Phys. Res. Sec. A 751, 11-18 (2014)

Preparing single ultra-cold antihydrogen atoms for the free-fall in GBAR,
L. Hilico, J.-Ph. Karr, Albane Douillet, P. Indelicato, S. Wolf, F. Schmidt Kaler, International Journal of Modern Physics, Conference Series 30, 1460269 (2014)

Integrated fiber-mirror ion trap for strong ion-cavity coupling
B. Brandstätter, A. McClung, K. Schüppert, B. Casabone, K. Friebe, A. Stute, P. O. Schmidt, C. Deutsch, J. Reichel, R. Blatt and T.E. Northup
Rev. Sci. Instrum. 84, 123104 (2013)

Micro-fabricated stylus ion trap
C. L. Arrington, K. S. McKay, Ehren D. Baca, J. J. Coleman, Y. Colombe, P. Finnegan, D. A. Hite et al
Rev. Sci. Instrum. 84, 085001 (2013)

General Scheme for the Construction of a Protected Qubit Subspace
N. Aharon, M. Drewsen, and A. Retzker
Phys. Rev. Lett. 111, 230507 (2013)

Dynamics of topological defects in ion Coulomb crystals
H L Partner, R Nigmatullin, T Burgermeister, K Pyka, J Keller, A Retzker, M B Plenio and T E Mehlstaubler
New J. Phys. 15, 103013 (2013)

Microwave quantum logic spectroscopy and control of molecular ions
M Shi, P F Herskind, M Drewsen and I L Chuang
New J. Phys. 15, 113019 (2013)

Specific Chemical Reactivities of Spatially Separated 3-Aminophenol Conformers with Cold Ca+ Ions
Yuan-Pin Chang, Karol Dlugolecki, Jochen Kupper, Daniel Rosch, Dieter Wild, Stefan Willitsch
Science 342(6154):98-101 (2013)

Structure, dynamics and bifurcations of discrete solitons in trapped ion crystals
H Landa, B Reznik, J Brox, M Mielenz, and T Schaetz
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IV. Evaluation Summary

The MP1001 was a very dynamic Action and in four years many meetings and workshops (16 Workshops and 2 Conferences) were organized in order to improve the interaction and the collaboration between the different groups participating in the Action. In particular, strong effort was devoted to increase the interaction between experimental and theoretical activities. Large emphasis was devoted to outreach activities through the organization of training schools. Several communication and dissemination activities such as regular newsletter, movie, special edition of Applied Phys. B issue, and updated website were also carried out. This networking effort has led to important common publications with different scientific highlights like, e.g in Quantum Computing protocols using microwave fields or the development of record breaking optical clocks. In particular, this last achievement could have a significant socio-economic impact revolutionizing global positioning systems and mineral exploration.

The Action main strength relies on enabling the relevant scientific success of its members. This clearly emerges from the many National and International collaborative projects proposed in the framework of FP7 program and recently in Horizon 2020.

Furthermore the Action has been highly proficient in attracting key researchers like Dave Wineland, who was awarded the 2011 Nobel Prize in Physics, or Roee Ozeri and Roland Wester who both received ERC awards. Another clear strength was visible in the training of young researchers through important schools and in the launch of an ITN by members of the Action.