COST

Domain Committee "Materials, Physics and Nano Sciences"'

COST Action MP1001

Start Date 06/12/2010

Ion Traps for Tomorrow's Applications

MONITORING PROGRESS REPORT

Reporting Period: *from 06/12/2010 to 31/07/2013*

This Report is presented to the relevant Domain Committee.
It contains three 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. Previous versions of the Scientific Report*; i.e., part II of past reporting periods*

The report is a "cumulative" report, i.e. it is updated annually and covers the entire period of the Action.

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

Based on the monitoring results, the COST Office will decide on the following year's budget allocation.

Executive summary (max.250 words):
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).
All Action events are very popular attracting also a large fraction of colleagues from outside Europe and from neighbouring domains. ESR appreciate our efforts for organizing schools and dedicating an important budget to STSMs. The Action newsletter is very popular, and we hope that our recently launched Wiki will have the same success.

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 de Provence/CNRS, Centre de St Jérôme, Case C21, 13397 Marseille Cedex 20, France

Tel +33.491.28.8026, Martina.Knoop@univ-provence.fr

DC Rapporteur: *Prof. Lucia SORBA*

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

l.sorba@sns.it

Science Officer: *Ms Caroline WHELAN*
caroline.whelan@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	University of Liège (Liège, Belgium)	f.rosu@ulg.ac.be	BE
	(until April 2013, change of activity afterwards)		
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

List of WG members

	Title	First Name	Last Name	Category/Position	Country
1	Ms	Aarouj	Aarouij	Trainee	IT
2	Mr	Patric	Ackermann	WG Member [WG2],WG Member [WG3]	DE
3	Mr	Nati	Aharon	WG Member [WG2]	IL
4	Mr	Abdelfatah	Ahmed	WG Member [WG1]	SD
5	Mr	Jun Sik	Ahn	Trainee	KR
6	Mr	Nitzan	Akerman	WG Member [WG2]	IL
7	Mr	Andreas	Albrecht	WG Member [WG3],Trainee	DE
8	Mr	Soroosh	Alighanbari	Trainee	DE

9	Mr	David	Allcock	WG Member [WG2]	UK
10	Mr	Joseba	Alonso	WG Member [WG1]	CH
11	Dr	Wolfgang	Alt	WG Member [WG1]	DE
12	Mr	Robert	Altmann	Trainee	NL
13	Dr	Jason	Amini	Expert/Invited Speaker	US
14	Prof.	François	Anderegg	Trainer	US
15	Mr	Hans Harhoff	Andersen	Trainee	DK
16	Mr	Gilad	Arrad	Trainee	IL
17	Dr	Oskar	Asvany	WG Member [WG4]	DE
18	Ms	Marianne	Bader	WG Member [WG3]	DE
19	Mr	Muhammad Tanveer	Baig	WG Member [WG3]	DE
20	Mr	Chris	Ballance	WG Member [WG2]	UK
21	Mr	Tim	Ballance	Trainee	UK
22	Mr	Jens	Baltrusch	WG Member [WG2],WG Member [WG3],Trainee	DE
23	Dr	Julio	Barreiro	WG Member [WG3]	AT
24	Ms	Humairah	Bassa	Trainee	ZA
25	Mr	Valentin	Batteiger	WG Member [WG2]	DE
26	Mr	Ingo	Baumgart	Trainee	DE
27	Mr	Alejandro	Bermudez	WG Member [WG2]	ES
28	Mr	Thorsten	Best	Trainee	AT
29	Mr	Ralf	Betzholz	Trainee	DE
30	Mr	Juriaan	Biesheuvel	Trainee	NL
31	Prof.	Gerhard	Birkl	WG Member [WG1]	DE
32	Prof.	Rainer	Blatt	MC Member	AT
33	Prof.	Rainer	Blatt	WG Member [WG1],WG Member [WG2],WG Member [WG3],Local organiser	AT
34	Prof.	Klaus	Blaum	WG Member [WG1]	DE
35	Dr	Michael	Block	WG Member [WG1]	DE
36	Dr	John	Bollinger	Expert/Invited Speaker	US
37	Ms	Hendrike	Braun	WG Member [WG2],WG Member [WG3]	DE
38	Dr	Kenneth	Brown	Expert/Invited Speaker	US
39	Dr	Michael	Brownnutt	WG Member [WG2]	AT
40	Mr	Tobias	Burgermeister	Trainee	DE
41	Mr	Ruggero	Caravita	Trainee	IT
42	Mr	Ruggero	Caravita	Trainee	IT
43	Ms	Martina	Carsjens	WG Member [WG1],WG Member [WG3],WG Member [WG4]	DE

44	Mr	Florian	Cartarius	WG Member [WG3]	DE
45	Ms	Qiong	Chen	Trainee	CN
46	Mr	Michael	Chwalla	WG Member [WG2]	AT
47	Mr	Marco	Ciancaruso	Trainee	IT
48	Mr	Itsik	Cohen	WG Member [WG2]	IL
49	Mr	Thomas	Collath	WG Member [WG3]	DE
50	Dr	Yves	Colombe	Expert/Invited Speaker	US
51	Ms	Pauline	Comini	Trainee	FR
52	Dr	Cecilia	Cormick	WG Member [WG3]	DE
53	Prof.	José	Crespo	WG Member [WG2],Trainer,Expert/Invited Speaker	DE
54	Dr	Frederick	Currell	Trainer	UK
55	Ms	Cricia	de Carvalho Rodegheri	WG Member [WG1],WG Member [WG2],WG Member [WG3]	DE
56	Mr	Ludwig	Declercq	Trainee	CH
57	Mr	Darren	DeMotte	WG Member [WG2]	UK
58	Ms	Emiliya	Dimova	WG Member [WG2],WG Member [WG3]	BG
59	Ms	Shiqian	Ding	WG Member [WG3]	SG
60	Dr	Albane	Douillet	WG Member [WG1]	FR
61	Prof.	Michael	Drewsen	MC Member	DK
62	Dr	Francois	Dubin	WG Member [WG2]	ES
63	Prof.	Daniel H.	Dubin	Trainer,Expert/Invited Speaker	US
64	Dr	Olivier	Dulieu	WG Member [WG4]	FR
65	Ms	Katrin	Dulitz	Trainee	UK
66	Mr	Andreas	Dörr	WG Member [WG1]	DE
67	Mr	Pascal	Eich	Trainee	DE
68	Prof.	Jürgen	Eschner	WG Member [WG2]	DE
69	Prof.	Joël	Fajans	Trainer	US
70	Mr	Thomas	Feldker	Trainee	DE
71	Mr	Martin	Fischer	WG Member [WG3]	DE
72	Dr	Regine	Frank	Trainee	DE
73	Mr	Kurt	Franke	Trainee	CH
74	Mr	Konstantin	Friebe	WG Member [WG2]	AT
75	Prof	Gerald	Gabrielse	Trainer	US
76	Dr	Meng	Gao	WG Member [WG2]	SG
77	Dr	Juan Jose	Garcia Ripoll	MC Member	ES
78	Dr	Claudiu	Genes	WG Member [WG2]	AT

79	Mr	Genko	Genov	WG Member [WG2],WG Member [WG3]	BG
80	Mr	Mathias	Gerbaux	Trainee	FR
81	Prof.	Dieter	Gerlich	WG Member [WG4]	DE
82	Mr	Johannes	Ghetta	Trainee	AT
83	Prof.	Francesco	Gianturco	Expert/Invited Speaker	IT
84	Mr	Alex	Gingell	Trainee	DK
85	Prof.	Liviu	Giurgiu	MC Member	RO
86	Mr	Timm	Gloger	WG Member [WG3]	DE
87	Mr	Joe	Goodwin	WG Member [WG2]	UK
88	Mr	Pierre	Grandemange	Trainee	FR
89	Mr	Matt	Grau	Trainee	US
90	Dr	Stéphane	Grévy	WG Member [WG1],Expert/Invited Speaker	FR
91	Mr	Alan	Guenther	Trainee	DE
92	Dr	Stephane	Guerin	WG Member [WG1],WG Member [WG2],WG Member [WG3]	FR
93	Prof.	Ariel	Guerreiro	MC Member	PT
94	Dr	Luca	Guidoni	WG Member [WG1],WG Member [WG2]	FR
95	Mr	Farhang	Haddadfarshi	Trainee	DE
96	Dr	Gaëtan	HAGEL	WG Member [WG1]	FR
97	Mr	Henning	Hahn	Trainee	DE
98	Mr	Felix	Hall	Trainee	CH
99	Mr	Felix	Hall	WG Member [WG2],WG Member [WG4]	CH
100	Mr	Thilo	Hannemann	Expert/Invited Speaker	DE
101	Mr	Stephan	Hannig	Trainee	DE
102	Mr	Anders	Hansen	Trainee	DK
103	Mr	Michael	Hansen	Trainee	DE
104	Mr	Thomas	Harty	WG Member [WG1]	UK
105	Prof	Shuichi	Hasegawa	Trainer	JP
106	Prof.	Michael	Hass	MC Member	IL
107	Dr	David Lee	Hayes	Expert/Invited Speaker	US
108	Prof.	Johannes	Hecker Denschlag	WG Member [WG1],WG Member [WG4]	DE
109	Dr	Markus	Hennrich	WG Member [WG1],WG Member [WG2],WG Member [WG3]	AT
110	Dr	Winfried	Hensinger	MC Member	UK
111	Dr	Frank	Herfurth	WG Member [WG1],WG Member [WG3]	DE
112	Mr	Oscar	Herrera	WG Member [WG1]	DE
113	Dr	Peter	Herskind	WG Member [WG2]	DK

114	Mr	Gabriel	Hetet	WG Member [WG3]	AT
115	Prof.	Laurent	HILICO	MC Member	FR
116	Mr	Johannes	Hoffrogge	WG Member [WG3]	DE
117	Mr	Philip	Holz	Trainee	AT
118	Prof.	Jonathan	Home	WG Member [WG3]	CH
119	Prof.	Jonathan	Home	MC Member	CH
120	Prof.	Jonathan	Home	MC Member	CH
121	Dr	Seokjun	Hong	Trainee	KR
122	Prof.	Marie	Houssin	WG Member [WG2]	FR
123	Ms	Hristina	Hristova	WG Member [WG2],WG Member [WG3]	BG
124	Prof.	Eric	Hudson	COST International Partner Country	---
125	Mr	Kent	Hung	Other (e.g. observer, etc)	BE
126	Mr	Nils	Huntemann	WG Member [WG1]	DE
127	Mr	Jan	Huwer	WG Member [WG1],WG Member [WG3]	DE
128	Prof.	Hartmut	Häffner	Expert/Invited Speaker	US
129	Mr	Martin	Höcker	WG Member [WG1],WG Member [WG2]	DE
130	Mr	Bastian	Höltkemeier	Trainee	DE
131	Mr	Aled	Isaac	Trainee	UK
132	Mr	Svetoslav	Ivanov	WG Member [WG2],WG Member [WG3]	UK
133	Mr	Georg	Jacob	WG Member [WG1]	DE
134	Mr	Georg	Jacob	Trainee	DE
135	Prof.	Hans Rudolf	Jauslin	WG Member [WG3]	FR
136	Mr	Florian	Jessen	WG Member [WG3]	DE
137	Dr	Michael	Johanning	WG Member [WG1],WG Member [WG3]	DE
138	Mr	Endre	Kajari	WG Member [WG3]	DE
139	Mr	Marius	Kamsap	Trainee	FR
140	Mr	jean-philippe	Karr	WG Member [WG1],WG Member [WG3],WG Member [WG4]	FR
141	Dr	Savely	Karshenboim	Expert/Invited Speaker	DE
142	Dr	Delia	Kaufmann	WG Member [WG3]	DE
143	Mr	Peter	Kaufmann	WG Member [WG3]	DE
144	Mr	Ben	Keitch	WG Member [WG3]	CH
145	Dr	Matthias	Keller	WG Member [WG4]	UK
146	Dr	Lukasz	Klosowski	Trainee	PL
147	Dr	Martina	Knoop	MC Chair	FR
148	Dr	Michael	Koehl	WG Member [WG3]	UK

149	Mr	Florian	Koehler	Trainee	DE
150	Dr	Jeroen	Koelemeij	WG Member [WG1],WG Member [WG2],WG Member [WG3],WG Member [WG4]	NL
151	Dr	Jeroen	Koelemeij	MC Member	NL
152	Prof	Svetlana	Kotochigova	COST International Partner Country	US
153	Mr	Holger	Kracke	WG Member [WG1],WG Member [WG2],WG Member [WG3]	DE
154	Mr	Daniel	Krasnicky	Trainee	IT
155	Mr	Artjom	Kruekow	Trainee	DE
156	Mr	Dawid	Kucharski	Trainee	PL
157	Mr	Peter	Kunert	WG Member [WG3]	DE
158	Dr	Alex	Kuzmich	Expert/Invited Speaker	US
159	Ms	Olga	Lakhmanskaya	Trainee	AT
160	Ms	Jessica	Lam	Trainee	UK
161	Dr	Lucas	Lamata	WG Member [WG2]	ES
162	Mr	Haggai	Landa	WG Member [WG3]	IL
163	Prof.	Wolfgang	Lange	WG Member [WG3]	UK
164	Dr	Ben	Lanyon	WG Member [WG2]	AT
165	Dr	Dietrich	Leibfried	Expert/Invited Speaker	US
166	Dr	Dietrich	Leibfried	COST International Partner Country	US
167	Mr	Andreas	Lemmer	WG Member [WG2]	DE
168	Mr	Andreas	Lemmer	Trainee	DE
169	Dr	Juan	Leon Garcia	MC Substitute	ES
170	Dr	Igor	Lesanovsky	WG Member [WG2],WG Member [WG3]	UK
171	Prof.	Maciej	Lewenstein	WG Member [WG3]	ES
172	Mr	Weibin	Li	Trainee	UK
173	Mr	David von	Lindenfels	WG Member [WG1],WG Member [WG3]	DE
174	Mr	Norbert	Linke	WG Member [WG1],WG Member [WG2],WG Member [WG3]	UK
175	Mr	Hsiang-yu	Lo	Trainee	CH
176	Mr	Henry	Lopez	Trainee	DE
177	Dr	David	Lucas	MC Member	UK
178	Dr	Niels	Madsen	WG Member [WG2],Local organiser,Trainer	UK
179	Mr	Vladimir	Manea	Trainee	FR
180	Dr	Sabrina	Maniscalco	MC Member	FI
181	Dr	Helen	Margolis	WG Member [WG2],Trainer	UK
182	Mr	Franklin	Martinez	WG Member [WG1]	DE
183	Dr	Miguel Angel	Martín-Delgado Alcántara	MC Substitute	ES

184	Dr	Irene	Marzoli	MC Vice-Chair	IT
185	Dr	Irene	Marzoli	Core Group Member,WG Member [WG3]	IT
186	Dr	Tanja	Mehlstaeubler	WG Member [WG1]	DE
187	Prof.	Frans	Meijer	WG Member [WG1],WG Member [WG4]	IE
188	Dr	Ziv	Meir	WG Member [WG2]	IL
189	Dr	Bogdan Vasile	Mihalcea	MC Member	RO
190	Mr	Jonathan	Mizrahi	Trainee	US
191	Mr	Amir	Mohammadi	Trainee	DE
192	Ms	Arezoo	Mokhberi	Trainee	CH
193	Prof	Christopher	Monroe	Trainer	US
194	Ms	Simone	Montangero	WG Member [WG2]	DE
195	Mr	Thomas	Monz	WG Member [WG3]	AT
196	Prof.	Giovanna	Morigi	WG Member [WG3]	DE
197	Prof	Giovanna	Morigi	WG Member [WG3]	DE
198	Mr	Olivier	Morizot	Trainee	FR
199	Mr	Markus	Mueller	WG Member [WG2]	AT
200	Mr	Markus	Mueller	WG Member [WG2]	ES
201	Mr	Jordi	Mur-Petit	WG Member [WG3],WG Member [WG4]	ES
202	Mr	Nir	Navon	WG Member [WG2]	IL
203	Mr	Vlad	Negnevitsky	Trainee	CH
204	Mr	Vlad	Negnevitsky	Trainee	CH
205	Mr	Ramil	Nigmatullin	WG Member [WG3]	UK
206	Mr	Boaz	Nissan-Cohen	Trainee	IL
207	Dr	Altaf	Nizamani	COST International Partner Country	PK
208	Dr	Tracy	Northup	WG Member [WG3]	AT
209	Mr	Benjamin	Norton	Trainee	AU
210	Ms	Mayerlin	Nunez Portela	Trainee	NL
211	Prof.	Brian	Odom	Trainer	US
212	Dr	Yasser	Omar	MC Member	PT
213	Dr	Christian	Ospelkaus	WG Member [WG1],WG Member [WG3],WG Member [WG4]	DE
214	Dr	Roee	Ozeri	MC Member	IL
215	Mr	Giuseppe Davide	Paparo	WG Member [WG2]	IT
216	Dr	Alexander	Papash	Trainer	DE
217	Ms	Anna-Greta	Paschke	WG Member [WG1]	DE
218	Prof.	Thomas Sunn	Pedersen	Trainer	DE

219	Dr	Jofre	Pedregosa	WG Member [WG1]	FR
220	Dr	Ekkehard	Peik	WG Member [WG1],WG Member [WG3],Expert/Invited Speaker	DE
221	Dr	Alexander	Petrov	MC Non-COST Participant	---
222	Dr	Jyrki	Piilo	MC Substitute	FI
223	Mr	Chrisitian	Piltz	WG Member [WG3]	DE
224	Prof.	Martin	Plenio	WG Member [WG2]	DE
225	Ms	Laura	Pollum	Trainee	UK
226	Dr	Diego	Porras Torre	MC Member	ES
227	Mr	Gregers	Poulsen	Trainee	DK
228	Mr	Karsten	Pyka	WG Member [WG1]	DE
229	Dr	Wolfgang	Quint	MC Substitute	DE
230	Mr	Andon	Rangelov	WG Member [WG2]	BG
231	Mr	Lothar	Ratschbacher	WG Member [WG1],WG Member [WG3],Trainee	UK
232	Dr	Christopher	Rennick	WG Member [WG4]	UK
233	Dr	Alex	Retzker	WG Member [WG2],WG Member [WG3]	DE
234	Dr	Alex	Retzker	WG Member [WG2],WG Member [WG3],STSM candidate,Local organiser	IL
235	Prof.	Benni	Reznik	WG Member [WG2]	IL
236	Dr	Francis	Robicheaux	Expert/Invited Speaker	US
237	Dr	Christian	Roos	WG Member [WG3]	AT
238	Dr	Christian	Roos	WG Member [WG3]	AT
239	Mr	Marco	Rosenbusch	WG Member [WG1]	DE
240	Mr	Stepan	Roucka	Trainee	CZ
241	Mr	Ian	Rouse	Trainee	CH
242	Mr	Benjamin	Rousseaux	WG Member [WG2],WG Member [WG3]	FR
243	Dr	Guido	Saathoff	WG Member [WG3]	DE
244	Ms	Jyothi	Saraladevi	Trainee	IN
245	Dr	Xabier	Sarasola	WG Member [WG1]	DE
246	Dr	Birgit	Schabinger	WG Member [WG3]	DE
247	Dr	Tobias	Schaetz	WG Member [WG2],WG Member [WG4]	DE
248	Mr	Benedikt	Scharfenberger	WG Member [WG3]	DE
249	Mr	Nils	Scharnhorst	WG Member [WG1]	DE
250	Prof.	Stephan	Schiller	MC Member	DE
251	Mr	Philipp	Schindler	WG Member [WG2]	AT
252	Prof	Wolfgang	Schleich	Trainer	DE
253	Prof	Stephan	Schlemmer	MC Substitute	DE

254	Mr	Philipp	Schmid	Trainee	AT
255	Dr	Piet Oliver	Schmidt	WG Member [WG1],WG Member [WG3],WG Member [WG4]	DE
256	Mr	Julian	Schmidt	Trainee	DE
257	Prof.	Ferdinand	Schmidt-Kaler	WG Member [WG2]	DE
258	Dr	Roman	Schmied	WG Member [WG1],WG Member [WG3]	CH
259	Mr	Christian	Schmiegelow	WG Member [WG1],WG Member [WG3]	AR
260	Mr	Daniel	Schraft	WG Member [WG2],WG Member [WG3]	DE
261	Prof.	Daniel	Segal	WG Member [WG1]	UK
262	Prof	Danny	Segal	WG Member [WG2]	UK
263	Ms	Crystal	Senko	WG Member [WG2]	US
264	Mr	Martin	Sepiol	Trainee	UK
265	Mr	Nicolas Roberto	Seymour-Smith	WG Member [WG1],WG Member [WG4]	UK
266	Mr	Jianwei	Shen	Trainee	DE
267	Mr	Kevin	Sheridan	STSM candidate,Trainee	UK
268	Mr	Kevin	Sheridan	STSM candidate,Trainee	UK
269	Mr	Carlos	Sias	Trainee	UK
270	Dr	Pietro	Silvi	Trainee	DE
271	Mr	Lachezar	Simeonov	WG Member [WG1],WG Member [WG2]	BG
272	Dr	Kilian	Singer	WG Member [WG2]	DE
273	Mr	Lukas	Slodicka	WG Member [WG3]	AT
274	Prof.	Tim	Softley	WG Member [WG1],WG Member [WG4]	UK
275	Prof.	Lucia	Sorba	DC Rapporteur	IT
276	Mr	Magnus Aagard	Sorensen	Trainee	DK
277	Mr	Theeraphot	Sriarunothai	Trainee	DE
278	Prof.	Ewa	Stachowska	MC Member	PL
279	Mr	Matthias	Steiner	WG Member [WG1],WG Member [WG3],Trainee	UK
280	Dr	Eve	Stenson	WG Member [WG2]	DE
281	Dr	Ovidiu-Sorin	Stoican	MC Substitute	RO
282	Dr	Juergen	Stuhler	Expert/Invited Speaker	DE
283	Mr	Sven	Sturm	WG Member [WG3]	CH
284	Dr	Sven	Sturm	WG Member [WG1],WG Member [WG2]	CH
285	Mr	Graham	Stutter	WG Member [WG2]	UK
286	Prof.	Cliff	Surko	Trainer	US
287	Dr	Annette	Svendsen	WG Member [WG4],Trainer	DK
288	Ms	Csilla	Szabo-Foster	Trainee	FR

289	Mr	Benjamin	SZYMANSKI	WG Member [WG2],WG Member [WG3]	FR
290	Mr	Joseph	Thom	Trainee	UK
291	Mr	Joseph	Thom	Trainee	UK
292	Prof.	Richard	Thompson	MC Substitute	UK
293	Mr	Edoardo	Tignone	Trainee	FR
294	Mr	Jonathan	Toker	Trainee	DK
295	Dr	Xin	Tong	Trainee	CH
296	Mr	Boyan	Torosov	WG Member [WG2]	BG
297	Mr	Quang-Vu	Tran	Trainee	FR
298	Mr	Philipp	Treutlein	WG Member [WG4]	CH
299	Ms	Kathryn	Twyman	Trainee	UK
300	Prof.	Wim	Ubachs	WG Member [WG2],WG Member [WG3],WG Member [WG4]	NL
301	Mr	Stefan	Ulmer	WG Member [WG1],WG Member [WG2]	DE
302	Prof	Xavier	URBAIN	MC Member	BE
303	Dr	Hermann	Uys	COST International Partner Country	ZA
304	Mr	Joost	Van den Berg	Trainee	NL
305	Dr	Andres	Varon	WG Member [WG3]	DE
306	Dr	José	Verdu Galiana	WG Member [WG1],Trainer	UK
307	Mr	Yuval	Vinkler	Trainee	IL
308	Mr	Yuval	Vinkler	Trainee	IL
309	Mr	Nikolay	Vitanov	WG Member [WG2],WG Member [WG3]	BG
310	Prof	Nikolay	Vitanov	MC Member	BG
311	Mr	Oscar	Viyuela	WG Member [WG2]	ES
312	Dr	Manuel	Vogel	WG Member [WG1],WG Member [WG3]	DE
313	Dr	Joachim	Von Zanthier	WG Member [WG1],WG Member [WG3]	DE
314	Ms	Anke	Wagner	WG Member [WG1],WG Member [WG2],WG Member [WG3]	DE
315	Mr	Yong	Wan	Trainee	DE
316	Dr	Ulrich	Warring	Expert/Invited Speaker	US
317	Ms	Claudia	Warschburger	Trainee	DE
318	Mr	Tobias N.	Wassermann	WG Member [WG4]	CH
319	Dr	Stephen	Webster	WG Member [WG1],WG Member [WG2]	UK
320	Prof.	Matthias	Weidemüller	WG Member [WG4]	DE
321	Mr	Christian	Wellers	Trainee	DE
322	Prof.	Günther	Werth	WG Member [WG1]	DE
323	Prof.	Roland	Wester	MC Member	AT

324	Mr	Marco	Wiesel	Trainee	DE
325	Prof.	Stefan	Willitsch	MC Member	CH
326	Dr	Danyal	Winters	WG Member [WG2],WG Member [WG3]	DE
327	Dr	Lisa	Woerner	Trainee	AT
328	Mr	Jannes	Wuebbena	Trainee	DE
329	Prof.	Christof	Wunderlich	MC Member	DE
330	Mr	Yuriy	Yeliseyev	Expert/Invited Speaker	UA
331	Mr	Jong Keon	Yoon	Trainee	KR

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

(2013) Budget

Total Action Budget: 197 663 €
Remaining Action Commitment: 73 997 €

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 €
					Total	**132 363.54 €**

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 €
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 Ballance	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 €
				Total	**27 855 €**

Workshops

Title	Date		Place	Participants		Cost	Total
	From	To					
Scientific kick-off (MC and all WG)	23/3/11	25/3/11	Heidelberg/DE	75			2 190 €
Qion	26/4/11	29/4/11	Madrid/ES	35			1 050 **€**
Core group	21/09/11		Paris/FR	8			210 €
Qion	26/3/11	29/3/11	Tel Aviv/IL	35			1 050 **€**
IonTech	07/05	09/05	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 €
						Total	**12 570 €**

General Support Grants

Beneficiary	Date						Cost	Total
Université de Provence	Nov 2011							8 235.74 €
Université d'Aix-Marseille	Nov 2012							13 947.23 €
							Total	**22 182.97 €**

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	20/1	Les Houches, France				13 310.43 €
						Total	**32 311.93 €**

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 €
							Total	**4000 €**

Others

Action Total : 231 283.44 €

II. Scientific Report *prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is "cumulative"). All items listed in Sections A, B, and C, below, must be addressed.*

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.

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).
All Action events are very popular attracting also a large fraction of colleagues from outside Europe and from neighbouring domains. ESRs appreciate our efforts for organizing schools and dedicating an important budget to STSMs. The Action newsletter is very popular, and we hope that our recently launched Wiki will have the same success.

II.A. Innovative networking

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

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".
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..

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

Since last years, there are some spectacular experiments which demonstrate the interaction of trapped ions with cold atoms. 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).
Quantum simulations are a field where lots of activities are developed in our Action, as this topic relies on permanent interactions between theoretical and experimental groups. A special workshop will be dedicated to this topic in December 2013.

- *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.
Regarding the socio-economic impact there is 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 proto-types 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.

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

An ITN on Cold Molecules (COMIQ) joining the partners of the Action has been accepted in early 2013. A FP7-STREP is currently under negociation.

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

A joint proposal ANR-DFG on the gbar project has been submitted.

II.B. Inter-disciplinary networking

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

Since the beginning of the Action there is a lot of exchange with groups from chemistry and biochemistry concerning the topic of cold collisions and in particular the measurement of reaction rates. There is also increasing interaction with the community of cold atoms, quantum simulations and quantum information processing are the two major common interests.
The ion trapping community itself gathers people from different backgrounds in physics and chemistry and the organized workshops tend to aim 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) open 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).
It is somewhat early to evaluate the socio-economic impact of the highly interdisciplinary approaches developed in our Action. There are already several contacts and joint projects, which have a promising potential.

II.C. New networking

- *Additional new members joining the Action during its life.*
- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*
- *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.*
- *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)*
- *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)*
- *Activities and projects with COST network colleagues.*
- *The capacity of the Action members to raise research funds.*

All European countries with an Ion trapping activity have signed the MoU and are active in the Action. We have now 5 officially affiliated non-COST country partners and 2 applications which are in the state of DC approval (Dr. Kazuhiro Hayasaka, National Institute for Communication and

Information Technology, Japan; and Dr. Michael Biercuk, University of Sydney, Australia).
Since last July, a bit more than 200 participants have attended our events, this number is slightly inferior to last year, but can be explained by the fact, that most of our 2013 events are scheduled for the second half of the year. We make efforts to increase the number of female participants (proposing reimbursements preferentially to women; organizing events outside school holidays; a gender balance web page...). We had a female student prize winner last year, 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 (attached). The Summer School we are organizing in Varenna in July 2013 has 3 female scientific directors. The president of the Italian Physical Society (a lady) will come to the opening, and we take this opportunity to communicate about women in science. The number of female researchers is still of the order of ten percent reflecting the existing gender distribution in the groups.

In 2013 (as in 2012) we organize a training school with the participation of 55 students (10 from non-COST countries). The general participation rate of ESR in our events is of the order of 60%, with a slight fluctuation depending on the type of event. Non-COST country participation fluctuates around 15 %, where the largest part comes from our non-COST partners, the NIST group in particular.

For all events, we apply for additional funding to other organisations than COST, which allows us to reimburse a very large fraction of participants. For the (international) Summer School in 2013 that has permitted to financially support students from outside Europe.

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 have been published in a special volume of AIP conference proceedings (http://proceedings.aip.org/resource/2/apcpcs/1521/1?isAuthorized=no) .All publications are listed on our website, and publications involving members from more than one European country are listed in the Annex. We are also preparing a review volume which will publish the lectures given at last year's School in Les Houches, and will hopefully appear in September 2013 (Imperial College Press). Proceedings of this year's School will be published under the auspices of the Italian Physical Society in the traditional format (http://en.sif.it/books/series/rendiconti_fermi).

The European Conference on Ion Trapping was held in its third edition last September in Obergurgl/Austria. The location (the conference centre of the University of Innsbruck) had been voluntarily chosen to be limited in size (120 participants) and in a remote location in order to foster interactions. The event was so successful that a new location and date have already been chosen for 2014. Moreover, to give a mean-term frame to this conference, a permanent scientific committee has been installed.

The Action has also been presented at COST's Science Night in December 2012.

Annex – Collaboration Publications 2012-2013

(only publications involving at least two groups from different countries are listed)

Simulating the coupling of angular momenta in distant matter qubits
C. Ammon, A. Maser, U. Schilling, T. Bastin, and J. von Zanthier
Phys. Rev. A 86, 052308 (2012)

Precise Experimental Investigation of Eigenmodes in a Planar Ion Crystal
H. Kaufmann, S. Ulm1, G. Jacob, U. Poschinger, H. Landa, A. Retzker, M. B. Plenio, and F. Schmidt-Kaler
Phys. Rev. Lett. 109, 263003 (2012)

Reactive collisions of trapped anions with ultracold atoms
J. Deiglmayr, A. Göritz, T. Best, M. Weidemüller, and R. Wester
Phys. Rev. A 86, 043438 (2012)

Q value and half-life of double-electron capture in 184Os
C. Smorra et al.
Phys. Rev. C 86, 044604 (2012)

First on-line Application of a Multi-Reflection Time-of-Flight Device for Mass Separation of Short-Lived Nuclei
R.N. Wolf et al.
Nucl. Instrum. Meth. A 686, 82-90 (2012)

Bosonic Josephson Junction Controlled by a Single Trapped Ion
R. Gerritsma, A. Negretti, H. Doerk, Z. Idziaszek, T. Calarco, and F. Schmidt-Kaler
Phys. Rev. Lett., Vol. 109, 080402 (2012)

Dark-state suppression and optimization of laser cooling and fluorescence in a trapped alkaline-earth-metal single ion
T. Lindvall and M. Merimaa and I. Tittonen and A. A. Madej
Phys. Rev. A, Vol. 86, 033403 (2012)

An experiment for the direct determination of the g-factor of a single proton in a Penning trap
C C Rodegheri, K Blaum, H Kracke, S Kreim, A Mooser, W Quint, S Ulmer and J Walz
New J. Phys., Vol. 14, 063011 (2012)

First Measurement of Pure Electron Shakeoff in the B Decay of Trapped 6He+ Ions
C. Couratin et al.
Phys. Rev. Lett., Vol. 108, 243201 (2012)

Quantum Simulation of the Cooperative Jahn-Teller Transition in 1D Ion Crystals
Diego Porras, Peter A. Ivanov, and Ferdinand Schmidt-Kaler
Phys. Rev. Lett., Vol. 108, 235701 (2012)

Experimental g factor of hydrogenlike silicon-28
B. Schabinger, S. Sturm, A. Wagner, J. Alonso, W. Quint, G. Werth and K. Blaum
Eur. Phys. J. D, Vol. 66, 71 (2012)

Direct mass measurements of cadmium and palladium isotopes and their double-B transition Q values
C. Smorra et al.
Phys. Rev. C, Vol. 85, 027601 (2012)

Photon-assisted-tunneling toolbox for quantum simulations in ion traps
Alejandro Bermudez, Tobias Schaetz, and Diego Porras
New J. Phys., Vol. 14, 053049 (2012)

Heavy-ion storage-ring-lifetime measurement of metastable levels in the C-, N-, and O-like ions of Si, P, and S
E. Träbert, M. Grieser, J. Hoffmann, C. Krantz, R. Repnow, and A. Wolf
Phys. Rev. A., Vol. 85, 042508 (2012)

Robust trapped-ion quantum logic gates by continuous dynamical decoupling
A. Bermudez, P. O. Schmidt, M. B. Plenio, and A. Retzker
Phys. Rev. A., Vol. 85, 040302 (2012)

Two-photon laser excitation of trapped 232Th+ ions via the 402-nm resonance line
O. A. Herrera-Sancho, M. V. Okhapkin, K. Zimmermann, Chr. Tamm, and E. Peik, A. V. Taichenachev and V. I. Yudin, P. Glowacki
Phys. Rev. A., Vol. 85, 033402 (2012)

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)

One- and two-pulse quadrupolar excitation schemes of the ion motion in a Penning trap investigated with FT-ICR detection
M. Heck, K. Blaum, R. B. Cakirli, M. Kretzschmar, G. Marx, D. Rodríguez, L. Schweikhard, S. Stahl and M. Ubieto-Díaz
Appl. Phys. B., 10.1007/s00340-011-4865-9 (2012)

Non-Markovian qubit dynamics induced by Coulomb crystals
Massimo Borrelli, Pinja Haikka, Gabriele De Chiara, and Sabrina Maniscalco
Phys. Rev. A 88, 010101(R) (2013)

Laser cooling of beryllium ions using a frequency-doubled 626 nm diode laser
F. M. J. Cozijn, J. Biesheuvel, A. S. Flores, W. Ubachs, G. Blume, A. Wicht, K. Paschke, G. Erbert, and J. C. J. Koelemeij
Optics Letters 38, 2370-2372 (2013)

Scalable Reconstruction of Density Matrices
T. Baumgratz, D. Gross, M. Cramer, and M. B. Plenio
Phys. Rev. Lett. 111, 020401 (2013)

Masses of exotic calcium isotopes pin down nuclear forces
F. Wienholtz et al.
Nature 498, 346–349 (2013)

Calculation of the relativistic Bethe logarithm in the two-center problem
Vladimir I. Korobov, L. Hilico and J.-Ph. Karr
Phys. Rev. A 87, 062506 (2013)

Light-assisted cold chemical reactions of barium ions with rubidium atoms
Felix H.J. Hall, Mireille Aymar, Maurice Raoult, Olivier Dulieu & Stefan Willitsch
Molecular Physics 10.1080/00268976.2013.770930

Ion-neutral chemistry at ultralow energies: dynamics of reactive collisions between laser-cooled Ca+ ions and Rb atoms in an ion-atom hybrid trap
Felix H.J. Hall, Pascal Eberle, Gregor Hegi, Maurice Raoult, Mireille Aymar, Olivier Dulieu & Stefan Willitsch
Molecular Physics 10.1080/00268976.2013.780107

Widely tunable laser frequency offset lock with 30 GHz range and 5 THz offset
J. Biesheuvel, D. W. E. Noom, E. J. Salumbides, K. T. Sheridan, W. Ubachs, and J. C. J. Koelemeij
Optics Express 21, 14008-14016 (2013)

Entangling two defects via a surrounding crystal
T. Fogarty, E. Kajari, B. G. Taketani, A. Wolf, Th. Busch, and Giovanna Morigi
Phys. Rev. A 87, 050304(R) (2013)

Shot-Noise-Limited Monitoring and Phase Locking of the Motion of a Single Trapped Ion
P. Bushev1, G. Hetet, L. Slodicka, D. Rotter, M. A. Wilson, F. Schmidt-Kaler, J. Eschner, and R. Blatt
Phys. Rev. Lett. 110, 133602 (2013)

Trapping of Topological-Structural Defects in Coulomb Crystals
M. Mielenz et al.
Phys. Rev. Lett. 110, 133004 (2013)

g-factor measurement of hydrogenlike 28Si13+ as a challenge to QED calculations
S. Sturm, A. Wagner, M. Kretzschmar, W. Quint, G. Werth, and K. Blaum
Phys. Rev. A 87, 030501(R) (2013)

Techniques for microwave near-field quantum control of trapped ions
U. Warring, C. Ospelkaus, Y. Colombe, K. R. Brown, J. M. Amini, M. Carsjens, D. Leibfried, and D. J. Wineland
Phys. Rev. A 87, 013437 (2013)

Experimental access to higher-order Zeeman effects by precision spectroscopy of highly charged ions in a Penning trap
D. von Lindenfels et al.
Phys. Rev. A 87, 023412 (2013)

Dissipation-Assisted Quantum Information Processing with Trapped Ions
A. Bermudez, T. Schaetz, and M. B. Plenio
Phys. Rev. Lett. 110, 110502 (2013)

Creation of arbitrary Dicke and NOON states of trapped-ion qubits by global addressing with composite pulses
Svetoslav S Ivanov, Nikolay V Vitanov and Natalia V Korolkova
New J. Phys. 15:023039 (2013)

Analysis of a photon number resolving detector based on fluorescence readout of an ion Coulomb crystal quantum memory inside an optical cavity

Christoph Clausen, Nicolas Sangouard and Michael Drewsen
New J. Phys. 15:025021 (2013)

Plumbing Neutron Stars to New Depths with the Binding Energy of the Exotic Nuclide 82Zn

R. N. Wolf, et al.
Phys. Rev. Lett. 110, 041101 (2013)

III. Previous scientific report(s)

2012-III. Scientific Report *prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is "cumulative"). All items listed in Sections A, B, and C, below, must be addressed.*

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.

In its second year, COST Action MP1001 is considered as a success by the larger ion trap community. The number and quality of the workshops, and principally their topical outline, find a large resonance within the community. Our major effort to propose events with a more transverse thematic approach including some tutorials pays largely off. There is a big demand to continue in this way.
Since October 2011, the Action publishes a monthly newsletter announcing events, news, and the latest publications in the field. This newsletter provides a real service to the community and is extremely popular.
A major event will be the European Conference on Trapped Ions II, to be held in Austria from Sept 9-14, 2012.
We have a total of 12 STSMs in the last 18 months. Our aim is to slightly increase this number. All of the outgoing young researchers have been extremely satisfied about their experience from a scientific and a personal point of view.

2012-III.A. Innovative networking

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

Different collaborations on specific topics have started in the first few months of this Action, and they are now starting to pay off in terms of knowledge and publications. Several STSMs have focussed on microfabrication techniques for miniature and surface traps, and have resulted in the implementation of new procedures (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).
The development of integrated technologies for quantum sensor, quantum information processing with molecules, and the spectroscopy of highly-charge ions in a cryogenic trap are three innovative activities pursued in the Action.

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

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. Micro-fabrication techniques for surface traps are a "hot topic" for quantum information processing. Rapid progress is documented by a large number of publications (see for example the special issue on Ion Trapping in Applied Physics B.

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

The recent workshop on Ion Trapping Technology was the opportunity to link the Action more tightly to industrial activities; two representatives have been attending the workshop, 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)*

IQIT (Integrated Quantum Information Technology) is a project in FP7-ICT, bringing together seven experimental and theoretical groups. Several projects have been deposed in the FET-Open call (all

quantum information projects belong to the ICT thematics). These projects are anonymous in a first stage. At least three STREP proposals have been made in the frame of the network.
ERC-Starting Grant "Molecular Networks with precision Terahertz Spectroscopy (MoNTeS)", proposed by Roland Wester, Innsbruck, started January 2012.
An ITN on Cold Molecules has unfortunately been rejected, although the proposal has reached a score of 92.2 points!

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

Prof. Jonathan Home, ETH Zürich, CH, "Ultrafast control of trapped-ion motional states", proposal made to the Swiss National Fund. To our knowledge, Switzerland is the only country which offers spin-off funding for Action activities.
Bogdan Mihalcea, Bucarest, has presented a research project in Romania (in collaboration with PTB's Quantum Sensor group), entitled ""Sympathetic cooling and Ion dynamics of Coulomb crystals in linear Paul traps", it is the first project on the complementary list.

2012-III.B. Inter-disciplinary networking

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

There is ongoing work with groups from chemistry and biochemistry. The workshop on Cold Molecules in November 2012 extended far beyond the ion trap community. It triggered many collaborations in that field, a new edition is already scheduled for September 2013. The publication of a special volume in the new Springer book series "Quantum Science and Technology" is under preparation.
The Action itself already brings together researchers from different disciplines, which has turned out very fruitful in terms of new collaborations. A common workshop with Action MP1006 "Fundamental Problems in Quantum Physics" is planned for 2013.

2012-III.C. New networking

- *Additional new members joining the Action during its life.*
- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*
- *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.*
- *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)*
- *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)*
- *Activities and projects with COST network colleagues.*
- *The capacity of the Action members to raise research funds.*

All European countries with an Ion trapping activity have signed the MoU and are active in the Action. In our second year we now have the official affiliation of some of our colleagues outside Europe (NIST, Boulder, Colorado, represented by Dr. Dietrich Leibfried; UCLA, California, reprensented by Dr. Eric Hudson), with four more applications pending (Dr. Hermann Uys, CSIR, Pretoria; Dr. Svetlana Kotochigova, Temple University, Philadelphia; Prof. Altaf Nizamani, Pakistan; Prof. Dave Kielpinski, Griffith University, Brisbane). Approximately 220 scientists have participated in one of our events, around 15 % of these in more than one event. Slightly more than a tenth of the participants are women (26), this fraction increases in the training events, reflecting

the relative distribution of women in the physics groups corresponding to different age groups.

In all events, around twenty colleagues from abroad have been invited as experts in 2012, not all have been paid from the Action budget (for administrative reasons), but their actual implication and contribution is important in the Action events. In addition (and on supplementary funds raised for the event), we could also invite (and pay) for three PhD students from India to attend the Winter School in Les Houches. We will pursue this policy for future training events.

Several collaboration projects have been submitted (see II.A). A special issue on Ion Trapping (http://www.springerlink.com/content/1654124l2l58h76x/?MUD=MP) has been published in July 2012 by Applied Physics B. All publications are listed on our website, and publications involving members from more than one European country are listed in the annex.

The Action has organized an eleven-day Winter School in January in Les Houches, France for 70 participants. This training event was dedicated to PhD students and young postdocs, and due to the limited size of the center and the large number of candidates, a selection had to be made (geographical and gender balance). The school topics were largely covering trapping devices from antimatter and storage rings to microtraps, and the background of the audience was very diverse. A large number of lectures, exercises, two poster sessions until late at night were on the program, allowing to have long breaks at noon dedicated to informal discussions and skiing. An evaluation questionnaire has reflected the very positive echo of that school.

The workshop on Quantum Information and Quantum Dynamics in Ion Traps (Qion'12) is a classic in the community, and has been held in Tel Aviv in March 2012. This event is designed for few participants and many interactions, with a large contribution of the theoretical community.

67 participants attended the first workshop on Technology for trapped ions organized by WG1 and WG3, with the local organizer C Wunderlich, member of the MC. Resumed by a participant: "We spend 95 % of our time in the lab struggling with technical problems, and the traditional conferences discuss the 5% of physics. 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 a perfect and very nice organisation have raised an enthusiastic echo among the audience. There is unanimity that this kind of workshop has to be repeated, the MC will discuss about the frequency.

Trapped ions are a part of the non-neutral plasma community which extends the applications from micro- and mini-traps to large confinement machines like storage rings and plasma reactors. The NNP community organizes a workshop every 2 or 3 years bringing together participants from different background. The 2012 edition is scheduled for the last week of August in Greifswald/Germany.

Our main event is the European Conference on Trapped Ions, to be held 9-14 September 2012, in the conference centre of Innsbruck University in Obergurgl, Austria. The choice of the site which is limited to 120 participants has been made on purpose, in order to limit the conference to a reasonable scale and privilege interactions between the attendees. As a consequence some participants had to be put on the waiting list, but we will of course see to a balanced participants list.

Annex – Collaboration Publications 2011-2012
(only publications involving at least two groups from different countries are listed)

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

Quantum Simulation of Cooperative Jahn-Teller Systems with Linear Ion Crystals,
D. Porras, P.A. Ivanov, F. Schmidt-Kaler
Phys. Rev. Lett. 108, 235701 (2012)

Photon-Assisted-Tunneling Toolbox for Quantum Simulations in Ion Traps,
A. Bermúdez, T. Schaetz, D. Porras
New Journal of Physics, Volume 14, 053049 (2012)

Experimental quantum simulations of many-body physics with trapped ions,
Ch. Schneider, D. Porras, T. Schaetz
Reports on Progress in Physics 75, 024401 (2012)

Simulating accelerated atoms coupled to a quantum field,
M. Del Rey, D. Porras, E. Martín-Martínez
Physical Review A 85, 022511 (2012)

Synthetic Gauge Fields for Vibrational Excitations of Trapped Ions,
A. Bermúdez, T. Schätz, D. Porras
Physical Review Letters 107, 150501 (2011)

Observation of v' = 8 – v = 0 vibrational overtones in trapped HD+ molecular ions,
J.C.J. Koelemeij, D.W.E. Noom, D. de Jong, M.A. Haddad, W. Ubachs,
Applied Physics B: Lasers and Optics 107(4), 1075-1085 (2012).

Temperature-independent quantum logic for molecular spectroscopy,
Jordi Mur-Petit, Juan Jose Garcıa-Ripoll, Jesus Perez-Rios, Jose Campos-Martinez, Marta I. Hernandez, and Stefan Willitsch;
Phys. Rev. A 85, 022308 (2012)

Light-assisted ion-neutral reactive processes in the cold regime: radiative molecule formation vs. charge exchange,
Felix H.J. Hall, Mireille Aymar, Nadia Bouloufa, Olivier Dulieu, and Stefan Willitsch,
Phys. Rev. Lett. 107, (2011) 243202

Massimo Borrelli, Laura Mazzola, Mauro Paternostro, and Sabrina Maniscalco, Phys. Rev. A 84, 012314 (2011).

Spectroscopy and Thermometry of Drumhead Modes in a Mesoscopic Trapped-Ion Crystal Using Entanglement
Brian C. Sawyer et al.
Phys. Rev. Lett., Vol. 108, 213003 (2012)

Robust trapped-ion quantum logic gates by continuous dynamical decoupling,
A. Bermudez, P. O. Schmidt, M. B. Plenio, and A. Retzker
Phys. Rev. A., Vol. 85, 040302 (2012)

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)

Quantum superpositions of crystalline structures
Jens D. Baltrusch, Cecilia Cormick, Gabriele De Chiara, Tommaso Calarco, and Giovanna Morigi
Phys. Rev. A 84, 063821 (2011)

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)

Quantum light by atomic arrays in optical resonators
H. Habibian, S. Zippilli, and G. Morigi
Phys. Rev. A 84, 033829 (2011)

Entangling two distant oscillators with a quantum reservoir
A. Wolf, G. De Chiara, E. Kajari, E. Lutz and G. Morigi
Eur. Phys. Lett. 95, 60008 (2011)

Tripartite nonlocality and continuous-variable entanglement in thermal states of trapped ions
Jie Li, Thomás Fogarty, Cecilia Cormick, John Goold, Thomas Busch, and Mauro Paternostro
Phys. Rev. A 84, 022321 (2011)

Trapping ions with lasers
Cecilia Cormick, Tobias Schaetz, and Giovanna Morigi
New. J. Phys. 13, 043019 (2011)

Designing spin-spin interactions with one and two dimensional ion crystals in planar micro traps
J. Welzel, A. Bautista-Salvador, C. Abarbanel, V. Wineman-Fisher, C. Wunderlich, R. Folman, and F. Schmidt-Kaler
Eur. Phys. J. D 65, 285 (2011)

Rydberg excitation of trapped cold ions: a detailed case study
F. Schmidt-Kaler, T. Feldker, D. Kolbe, J. Walz, M. Müller, P. Zoller, W. Li, I. Lesanovsky
New J. Phys. 13, 075014 (2011)

Fabrication and heating rate study of microscopic surface electrode ion traps
N. Daniilidis, S. Narayanan, S. A. Möller, R. Clark, T. E. Lee, P. J. Leek, A. Wallraff, St. Schulz, F. Schmidt-Kaler, H. Häffner
New J. Phys. 13, 013032 (2011)

2011-III. Scientific Report *prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is "cumulative"). All items listed in Sections A, B, and C, below, must be addressed.*

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.

The COST-Action MP1001 "Ion Traps for Tomorrow's Application" has held its scientific kick-off meeting in March 2011 in Heidelberg. There is a rich programme of meetings and collaborations which is actually being set-up for 2011 and 2012, but many of the topics cited below have not yet arrived at maturity to be listed in the following.

2011-III.A. Innovative networking

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

Different collaborations on specific topics have started in the first few months of this action. The project implementing quantum logic spectroscopy at the molecular level connects a theoretical group of quantum information processing with an experimental group in ultra-cold chemistry for this completely original project. An extremely interesting project is also the use of laser-cooling techniques for interrogation of highly-charged ions (2 planned STSMs).

- *Significant scientific breakthroughs as part of the COST Action. (Specific examples)*
- *Tangible medium term socio-economic impacts achieved or expected. (Specific examples)*

WG1 "Technology" is setting up contacts to industry partners in order to involve them in the ongoing work program. We expect a medium-term implication of at least three economic partners, in order to allow fruitful mutual exchanges.

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

The EU FP7 research project "PICC: The Physics of Ion Coulomb Crystals – Thermodynamics, Quantum Control and Quantum Simulators" emerges from the Ion trappers community. One of the workpackages 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)*

Prof. Stefan Willitsch, Universität Basel:CH, A cold- chemistry laboratory on a chip: microtraps for ultracold molecular ions"

2011-III.B. Inter-disciplinary networking

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts. (Specific examples)*
- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

There is ongoing work with groups from chemistry and biochemistry (T Rizzo, Lausanne/CH, R Antoine, Lyon/F and others) about technological aspects of ion trapping, and on the interrogation protocols of ions. It is too early to evaluate these contacts in terms of mean term impact.

2011-III.C. New networking

- *Additional new members joining the Action during its life.*
- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*
- *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.

- *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)*
- *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)*
- *Activities and projects with COST network colleagues.*
- *The capacity of the Action members to raise research funds.*

The Action has not yet a full year of lifetime. 16 countries have signed the MoU until now and there is work in progress to associate various colleagues from non-COST Institutes, in particular in the US, but also special agreements with a group from South Africa (Dr. Hermann Uys, CSIR, Pretoria), and one from Australia (Prof. Dave Kielpinski, Griffith University, Brisbane).

The Action has held its scientific kick-off in March in Heidelberg, with a total of 75 participants (13 female; 32 ESR) in a three-day meeting. One afternoon session was dedicated on a colloquium on the "Variation of Fundamental Constants"; all other time-slots had been reserved for the presentation of groups and the discussion of the programs of the different WGs. In fact, every group had a 10-minute slot to present its organisation and topics, three dedicated template slides gave insight into the expectance of the groups towards the Action and their future involvement. The extremely sunny spring weather in a charming location contributed to a very fruitful meeting which initiated many contacts and several spontaneous candidates for future organisations.

A more specialized workshop has been the Workshop on Quantum Information and Quantum Dynamics in Ion Traps (Qion'11) in Madrid from 26 to 29 April 2011. 35 participants attended this meeting, which has been a joint venture between Working Groups 2 and 3. Only three participants were female, but 18 were ESR !

A special issue on the Physics of Trapped Ions is scheduled to appear in autumn 2011 in Applied Physics B as a follow-up of last-year's European Conference on Trapped Ions which was held before the official start of the Action. 29 manuscripts have been submitted to this issue, and the refereeing process is still ongoing.

It has turned out that there is a large demand to work on technical topics. A dedicated meeting (joint WG1 and WG3) is therefore scheduled in spring of 2012.
Several bilateral projects have been initiated at the scientific kick-off in early spring. There is ongoing work, which will be reported next year.