

COST

Domain Committee "Materials, Physics and Nano Sciences"

COST Action 1002

Start Date: 7.12.2010

Nanoscale insights into Ion Beam Cancer Therapy

MONITORING PROGRESS REPORT

Reporting Period: from 7.12.2010 to 26.07.2013

This Report is presented to the relevant Domain Committee.
It contains two 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

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

Executive summary (max.250 words):

Ion beam therapy offers the possibility of excellent dose localization for treatment of malignant tumours, minimizing radiation damage in normal tissue, while maximizing cell-killing within the tumour. The first ion beam cancer therapy clinical centres are now opening in Europe. However, the full potential of such therapy can only be realized by better understanding the physical, chemical and biological mechanisms, that lead to cell death under ion irradiation. The proposed Action aims to combine, using a multiscale approach, the unique experimental and theoretical expertise available within Europe to acquire greater insight at the nanoscopic and molecular level into radiation damage induced by ion impact. Ion therapy provides potentially a revolution in cancer therapy and this COST action is very significant in ensuring European leadership in this field. Twenty COST and five non-COST countries (8 institutions) have currently joined the Action. The Nano-IBCT website is operational from March 2011 and contains all the up-to-date information about the Action. During the reporting period there were issued five newsletters, which informed readers (currently 592 subscribers) about the progress of the COST Action, meetings and the forthcoming events. The important component of the COST Action activities is the organization of the short term scientific missions (STSM). 19 STSMs have been completed in 2011, 36 STSMs were completed in 2012 and 16 STSMs during January- July 2013 have been fulfilled.

The first and the second Nano-IBCT conferences with more than 100 participants from 28 countries were organized. Nano-IBCT data base development started in 2012. The road map for the creation of the Data Base for Radiation Damage in Biomolecular Systems has been created.

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



I.A. COST Action Fact Sheet

- *COST Action MP1002- Nanoscale insights into Ion Beam Cancer Therapy (Nano-IBCT)*
- **Domain:** *Materials, Physics and Nanosciences*

- **Action details:**

CSO Approval: 25/05/2010

End date: 6/12/2014

Entry into force: 25/08/2010

Extension:

Objectives: The main objective of the Action is to address the basic scientific questions which underpin the nanoscopic and molecular mechanisms associated with Ion Beam Cancer Therapy.

In particular, we point to the following general objectives:

(i) Understanding the unique features of ion irradiation on the molecular level, e.g. site and bond selectivity, clustered damage, time scales, local temperature and chemical effects. Some of the questions are related to the ratio of direct/indirect damage, preferred mechanism of double strand break (single or double electron involvement), elucidation of possible lethal effects not occurring at all in the case of photons, etc. Comparison with state of the art achievements in photon irradiation will be the final part of the analysis.

(ii) To achieve comprehensive databases of recommended values for all the major processes involved in IBCT: ion and electron interaction cross sections, energy loss in biologically relevant systems, etc. This objective implies an important experimental and theoretical effort to determine differential and integral cross sections, both elastic and inelastic, for low incident energies.

(iii) To yield a quantitative prediction of dose distribution and molecular damage generated by the passage of an ion beam through cells, for example determining the rate and type of initial double strand breaks.

(iv) To develop a multiscale code for the quantitative analysis of radiobiological effects and therapy planning, tested at different levels with experiments; also including reliable estimates of the relative biological effectiveness (RBE) for different ions.

(v) To develop a new low energy particle track simulation method based on the distribution functions derived from evaluated experimental and theoretical cross sectional data and energy loss providing information on energy distribution and induced damage at the molecular level.

Parties: list of countries and date of acceptance

Parties							
Country	Date	Country	Date	Country	Date	Country	Date
Austria	27/10/2010	Belgium	30/11/2010	Czech Republic	25/08/2010	Denmark	08/12/2010
Finland	17/11/2010	France	20/09/2010	Germany	14/09/2010	Hungary	21/10/2010
Iceland	07/12/2010	Ireland	25/08/2010	Israel	06/04/2011	Italy	25/08/2010
Netherlands	07/12/2010	Poland	17/01/2011	Portugal	23/09/2010	Serbia	01/03/2011
Slovak Republic	25/08/2010	Spain	16/09/2010	Sweden	21/10/2010	United Kingdom	25/08/2010

• **Other participants:**

1. School of Chemical and Physical Sciences, Adelaide, Australia.
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3. School of Chemistry The University of Melbourne, Victoria, Australia.
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5. RIKEN, Tokyo University, Tokyo, Japan.
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7. Centre for Medical Radiation Physics, University of Wollongong, Australia.
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• **Working Groups** (*list of WGs and names and affiliations of participants*)



WG1: Propagation of ions:

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3. Prof. Karen BELKIC, Karolinska Institute Oncology Pathology, Stockholm, Sweden.
4. Dr. Emiliano DAGOSTINO, Belgian Nuclear Research Center, Belgium.
5. Prof. John R. SABIN, IFK-University of Southern Denmark, Denmark.
6. Prof. Gustavo GARCIA, Consejo Superior de Investigaciones Científicas, Madrid, Spain.
7. Prof. Yasunori YAMAZAKI, Atomic Physics Laboratory Riken, Wako, Japan.
8. Prof. Andrey SOLOV'YOV, FIAS, Frankfurt, Germany.
9. Prof. Jean BOURHIS, IGR, Paris, France.
10. Prof. Henrik CEDERQUIST, Department of Physics, Stockholm University, Sweden.
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12. Dr. Serge BOUFFARD, CIMAP-Caen, France.
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14. Dr. Jean-Yves CHESNEL, CIMAP-Caen, France.
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18. Mr. Eric GIGLIO, CIMAP-Caen, France.
19. Dr. Matthias HANAUSKE, FIAS, Germany.
20. Prof. Eugen ILLENBERGER, Freie Universität Berlin, Germany.
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23. Mr. Remi MAISONNY, CIMAP-Caen, France.
24. Ms. Christiane MALOT, CIMAP-Caen, France.
25. Dr. Marjan MOREELS, SCK-CEN, Belgian Nuclear Research Center, Belgium.
26. Mr. Jean-Christophe POULLY, CIMAP-Caen, France.
27. Prof. Eric SURAUD, LPT-IRSAMC, France.
28. Mr. Ilya VOLKOVETS, Extended Security Technologies B.V., Netherlands
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30. Dr. Elahe ALIZADEH, Canada.
31. Mr. Petr CARSKY, Academy of Sciences of the Czech Republic, Czech Republic.
32. Dr. Phuong MAI, Dinh, Laboratoire de Physique Théorique, IRSAMC, France.
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39. Mr. Zdenek MASIN, The Open University, UK.
40. Ms. Anna MICHAELIDESOVA, Czech Republic.
41. Prof. Zoran PETROVIC, Institute of Physics, Zemun, Serbia.
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43. Dr. Emmanuel BALANZAT, CIMAP-Caen, France.
44. Mr. Hermann Rothard, CIMAP-Caen, France.
45. Dr. Martine Sence, UPS-TLSE, Toulouse, France.

WG2: PRIMARY IONIZATION IN THE MEDIUM (WATER AND BIOLOGICAL MOLECULES), DIRECT DAMAGE AND PRODUCTION OF SECONDARY SPECIES.

1. Dr. Thomas SCHLATHOELTER, University of Groningen, Netherland.
2. Dr. Ronnie HOEKSTRA, University of Groningen, Netherland.

3. Dr. Lorenzo AVALDI, CNR-Istituto di metodologie, Roma, Italy.
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6. Dr. Peter VAN DER BURGT, National University of Ireland Maynooth, Maynooth, Ireland.
7. Prof. Joachim ULLRICH, Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Heidelberg, Germany.
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9. Prof. Agnes VIBOK, University of Debrecen, Debrecen, Hungary.
10. Dr. Sadia BARI, FLASH, Hamburg, Germany.
11. Dr. Eugene SURDUTOVICH, Oakland University, Rochester, MI, USA.
12. Mr. Julien LEROY, University Paris Sud, Orsay, France
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14. Dr. Peter BECK, AIT Austrian Institute of Technology GmbH, Vienna, Austria.
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20. Mr. Mingchao JI, LASIM, France.
21. Mr. Zoltan JUHASZ, Institute of Nuclear Research, Debrecen, Hungary
22. Dr. Jakob KARAFFA, DNA-Technology, Denmark.
23. Mr. Sandor KOVACS, Institute of Nuclear Research, Debrecen, Hungary.
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25. Mr. Alain MERY, CIMAP-Caen, France.
26. Mr. Martin NIKLAS, Dkfz-Heidelberg, Germany
27. Mr. Johannes POSTLER, Institut für Ionenphysik und Angewandte Physik, Universität Innsbruck, Austria.
28. Mr. Jimmy RANGAMA, CIMAP-Caen, France.
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30. Mr. Pedro ARCE, Spain.
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32. Dr. Aliaksandr BANTSAR, Portugal.
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55. Ms. Kathrin TANZER, Institute for Ion Physics and Applied Physics, Austria.

56. Dr. Ronald WHITE, James Cook University, Australia.

WG3: Propagation of secondary species (secondary electrons, radicals, holes).

1. Prof. David FIELD, Faculty of Science, University of Aarhus, Aarhus, Denmark.
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5. Prof. Svend Aage ENGELHOLM, University of Copenhagen, Department of Radiation Oncology, Copenhagen, Denmark.
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7. Prof. Ulrik UGGERHOJ, IFA Aarhus University, Aarhus, Denmark.
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36. Dr. Luca CHIARI, Flinders University, Australia.
37. Dr. Sylwia PTASINSKA, University of Notre Dame, Notre Dame, United States.

WG4: ELECTRON ATTACK ON DNA (DISSOCIATIVE ELECTRON ATTACHMENT AND DIRECT IONIZATION).

1. Prof. Francesco GIANTURCO, University of Rome "Sapienza", Department of Chemistry, Rome, Italy.
2. Dr Janina KOPYRA, University in Siedlce, Siedlce, Poland.
3. Dr Stanislaw PSZONA, The Andrzej Soltan Institute for Nuclear Studies Otwock/Swierk, Poland.
4. Prof. Ana PASCOAL, Universidade Católica Portuguesa - Faculdade de Engenharia, Rio de Mouro, Portugal.

5. Prof. Paulo LIMA-VIEIRA, Atomic and Molecular Collisions Laboratory Department of Physics, Universidade Nova de Lisboa, Caparica, Portugal.
6. Dr Frederick CURRELL, Queens University Belfast, Belfast, United Kingdom.
7. Dr Stephan DENIFL, University of Innsbruck, Institute of Ion Physics, Innsbruck, Austria.
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9. Dr. Francesco SEBASTIANELLI, University la Sapienza, Rome, Italy.
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28. Dr. Mina VELTCHEVA, LOA, Ecole Polytechnique ENSTA, Palaiseau, France.
29. Dr. Isabel ABRIL, Universitat Alacant, Spain.
30. Mr. Diogo ALMEIDA, FCT-UNL, Caparica, Portugal.
31. Dr. Ana BANKOVIC, Institute of Physics, Belgrade, Serbia.
32. Ms. Mattea C. CASTROVILLI, CNR, Rome, Italy.
33. Prof. Konrad CZERSKI, Poland.
34. Mr. Marcin Dampc, Gdańsk University of Technology, Gdańsk, Poland.
35. Mr. Pablo DE VERA, Universitat d'Alacant, Alicante, Spain.
36. Dr. Alberto FRAILE, Institute of Nuclear Fusion, Spain.
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51. Mr. Samuel ZÖTTL, Institute of Ion Physics and Applied Physics, University of Innsbruck, Austria.

WG5: RADIOBIOLOGICAL SCALE EFFECTS (DNA DSBs DETECTION, PREDICTION AND CELLULAR CONSEQUENCES).

1. Prof. Kevin PRISE, Queen's University Belfast, Centre for Cancer Research & Cell Biology, Belfast, United Kingdom.

2. Prof. Brenda LASTER, Ben Gurion University Department of Nuclear Engineering, Beer Sheva, Israel
3. Dr Martin FALK, Institute of Biophysics of ASCR, Brno, Czech Republic.
4. Dr Marie DAVIDKOVA, Nuclear Physics Institute ASCR, Prague, Czech Republic.
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26. Ms. Lila BOUESSEL-DU-BOURG, United Kingdom.
27. Dr. Gonzalo CABAL, Faculty of Physics LMU, Germany.
28. Prof. Franck DENAT, University of Burgundy, DIJON, France.
29. Mr. Jaime GONZALEZ DE CHAVES, Imperial College London, United Kingdom.
30. Dr. Adrian KELLER, Interdisciplinary Nanoscience Center, Aarhus, Denmark.
31. Prof. Jorge KOHANOFF, Queen's University Belfast, United Kingdom.
32. Dr. Michael WALIGORSKI, Krakow Oncology Center, Poland.
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34. Prof. Michael BRUNGER, School of Chemistry, Physics and Earth Sciences, Adelaide, Australia.
35. Prof. Anatoly ROZENFELD, University of Wollongong, Wollongong, Australia.
36. Dr. Zorica JURANIC, Institute of Oncology and Radiology of Serbia, Belgrade, Serbia.

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I.C. Overview activities and expenditure

2011 Budget

Total Action Budget: 101.248,80

Meetings

Meeting Type	Date	Place	Paid part	Status	Total
Kick-off meeting	07.12. 2010	Brussels (BE)	25	Paid	12.148,80
STPC meeting	8.04.2011	Frankfurt (DE)	8	Paid	4.172,00
STPC meeting Local costs	8.04.2011	Frankfurt (DE)	13	Paid	390,00
1 st Nano-IBCT Conference	2.10.2011 - 6.10.2011	Caen (FR)	40	Paid	25.647,00
1 st Nano-IBCT Conference , local costs	2.10.2011 - 6.10.2011	Caen (FR)	100	Paid	3.000,00
MC meeting	6.10.2011	Caen (FR)	21	Paid	9.185,40
STPC meeting	3.12.2011- 3.12.2011	Frankfurt (DE)	10	Paid	3.811,00
STPC meeting local costs	3.12.2011- 3.12.2011	Frankfurt (DE)	10	Paid	270,00
					58.624,20

STSM

Beneficiary	Date	Place	Status	Total
Michele Siggel-King	4.04-8.04.11	Gdansk, PL	Paid	800,00
Hassan Abdoul-Carime	24.04-29.04.11	Siedlce, PL	Paid	940,00
Paolo Limaov-Viera	1.05-13.05.11	Innsbruck, AT	Paid	1505,00
Gabriel Horvath	1.05-05.06.11	Brno, CZ	Paid	1700,00
Rochus Herrmann	5.06-11.06.11	Heidelberg, DE	Paid	700,00
Julien Leroy	20.06-25.06.11	Groningen, NL	Paid	670,00
Olmo Gonzalez-Magana	7.07-21.07.11	Madrid, ES	Paid	1490,00
Eric Suraud	5.09-11.09.11	Frankfurt, DE	Paid	1500,00
Filipe Ferreira da Silva	29.08-2.09.11	Innsbruck, AT	Paid	800,00
Andrey Solov'yov	18.10-25.11.11	Prague, CZ	Paid	1500,00
Pablo de Vera	24.10-4.11.11	Frankfurt, DE	Paid	1295,00
Nevena Puac	24.10-14.11.11	SOLEIL, FR	Paid	2200,00
Ilko Bald	20.11- 26.11.11	Siedlce (PL)	Paid	900,00
Adrian Keller	20.11- 26.11.11	Siedlce (PL)	Paid	1000,00
Janina Kopyra	4.12- 17.12.11	Lisboa (PT)	Paid	1400,00
Giuseppe Schettino	4.12- 18.12.11	Catania (IT).	Paid	1500,00

Richard Bredy	5.12- 9.12.11	Groningen (NL)	Paid	1000,00
Jean-Christophe Pouilly	12.12- 16.12.11	Aarhus, DK	Paid	1000,00
Serge Martin	5.12- 9.12.11	Groningen, NL	Paid	1000,00
Jimmy Rangama	12.12- 16.12.11	Aarhus, DK	Paid	1000,00
Sylvain Maclot	12.12- 16.12.11	Aarhus, DK	Paid	1000,00
				24.900,00

Dissemination

Title	Date	Place	Status	Total
Web page Nano-IBCT design, Newsletter 1 release and distribution	May 2011	Frankfurt, DE	Paid	500,00
Innovation report publication	October 2011	Frankfurt, DE	Paid	2.250,00
Innovation report publication	October 2011	Frankfurt, DE	Paid	427,50
				3.177,50

Others

Title	Date	Place	Status	Total
Bank fees	January – December 2011	Frankfurt, DE	Paid	600,00
Financial & Scientific Administration and Coordination	January- December 2011	Frankfurt, DE	Paid	11.137,35

2012 Budget

Total Action Budget: 134.400,00€

Meetings

Meeting Type	Date	Place	Paid part	Status	Total
IBCT Database workshop	24.02-26.02.2012	Vienna (AT)	23	Paid	13.054,20
IBCT Database workshop, local costs	24.02-26.02.2012	Vienna (AT)	27	Paid	750,00
Nano-IBCT tutorial workshop on complex targets	31.05-01.06.2012	Groningen [NL]	16	Paid	8.932,60
NanoIBCT tutorial workshop on complex targets, local costs	31.05-01.06.2012	Groningen (NL)	20	Paid	600,00
STPC meeting	20.10-20.10.2012	Paris (FR)	7	Paid	2.842,63
STPC meeting, local costs	20.10-20.10.2012	Paris (FR)	10	Paid	300,00

MC meeting	7.11.2012	Madrid (ES)	15	Paid	1.915,63
MC meeting, local costs	7.11.2012	Madrid (ES)	25	Paid	750,00
Workshop "Quantum scattering codes and Monte Carlo simulations to model dynamical processes in biosystems"	7.11-9.11.2012	Madrid (ES)	34	Paid	22.685,62
Workshop "Quantum scattering codes ", local costs	7.11-9.11.2012	Madrid (ES)	45	Paid	1.300
WG meeting "Quantum Mechanic-Molecular Dynamic (QM-MD) simulations"	22.11-23.11.2012	Frankfurt (DE)	7	Paid	2.313,50
WG meeting "Quantum Mechanic-Molecular Dynamic (QM-MD) simulations", local costs	22.11-23.11.2012	Frankfurt (DE)	10	Paid	300
					55.744,18

STSMs

Beneficiary	Date	Place	Status	Total
Mr Benedikt Omarsson	09/01/2012-23/01/2012	University of Iceland, IS	Paid	1.500,00
Mr Diogo Almeida	01/02/2012-01/03/2012	Lisboa, PT	Paid	2.000,00
Dr Lopez-Duran David	01/02/2012 09/03/2012	Madrid, ES	Paid	2.500,00
Ms Ana Garcia Sanz	02/02/2012 17/02/2012	Madrid, ES	Paid	1.350,00
Mr Jean-Christophe Pouilly	13/02/2012 17/02/2012	Caen, FR	Paid	800,00
Mr Jimmy Rangama	13/02/2012 17/02/2012	Caen, FR	Paid	800,00
Mr Sylvain Maclot	13/02/2012 17/02/2012	Caen, FR	Paid	800,00
Mr Pierre Eustache	18/03/2012 28/03/2012	Orsay, FR	Paid	1.080,00
Mr Patrick Rousseau	23/03/2012 31/03/2012	Caen, FR	Paid	800,00
Dr Alicja Domaracka	23/03/2012 31/03/2012	Caen, FR	Paid	800,00
Pr Andrey Solov'yov	01/04/2012 14/04/2012	Frankfurt DE	Paid	1.500,00
Dr Aleksandar Milosavljevic	11/04/2012 30/04/2012	Belgrade, RS	Paid	1.800,00
Dr Malgorzata Smialek-Telega	13/04/2012 22/04/2012	Gdansk PL	Paid	1.200,00
Dr Peter Van Der Burgt	22/04/2012 28/04/2012	Maynooth, IE	Paid	850,00

Dr Ilko Bald	09/05/2012 18/05/2012	Potsdam, DE	Paid	1.200,00
Dr Jan Franz	02/04/2012 13/04/2012	Bonn, DE	Paid	900,00
Mr Marcin Dampc	21/05/2012 10/06/2012	Gdansk PL	Paid	1.720,00
Dr Paola Bolognesi	17/06/2012 24/06/2012	Rome, IT	Paid	800,00
Dr Mattea Carmen Castrovilli	17/06/2012 24/06/2012	Rome, IT	Paid	800,00
Dr Lenka Stefančíková	3/06/2012 31/08/2012	Brno, CZ	Paid	2.400,00
Filipe Ferreira da Silva	26/08/2012 08/09/2012	Lisbon, PT	Paid	1.560,00
Dr Jan Franz	8/10/2012 18/10/2012	Bonn, DE	Paid	1.000,00
Pr Francesco Gianturco	01/11/2012 20/11/2012	Rome, IT	Paid	2.300,00
Mr Diogo Almeida	18/11/2012 08/12/2012	Lisboa, PT	Paid	1.650,00
Mr Johannes Postler	19/11/2012 23/11/2012	Innsbruck, AT	Paid	500,00
Mr Sylvain Maclot	25/11/2012 02/12/2012	Caen, FR	Paid	1.300,00
Dr Violaine Vizcaino	25/11/2012 02/12/2012	Caen, FR	Paid	1.000,00
Ms Lenka Stefancikova	25/11/2012 08/12/2012	Brno, CZ	Paid	2.200,00
Pr Agnes Vibok	25/11/2012 02/12/2012	Debrecen, HU	Paid	1.000,00
Pr Bernd Huber	02/12/2012 08/12/2012	Caen, FR	Paid	1.000,00
Mr Kevin Klawitter	02/12/2012 07/12/2012	Innsbruck, AT	Paid	1.100,00
Dr Ana Bankovich	10/12/2012 17/12/2012	Belgrade, RS	Paid	1.010,00
Ms Marion Bug	05/12/2012 13/12/2012	Braunschweig, DE	Paid	2.400,00
Dr Marie-Christine Bacchus	09/12/2012 15/12/2012	Lyon, FR	Paid	1.000,00
Dr Armin Luhr	10/12/2012 15/12/2012	Aarhus, DK	Paid	800,00
Mr Srdan Marjanovich	10/12/2012 17/12/2012	Belgrade, RS	Paid	1.010,00
				46.430,00

Dissemination

Title	Date	Place	Status	Total
Workshop program booklets IBCT Database workshop	February 2012	Frankfurt, DE	Paid	117,49

Posters, conference booklets	September 2012	Frankfurt, DE	Paid	183,97
Publication of the Proceedings of the Nano-IBCT Conference	November 2012	London, UK	Paid	2.500,00
20th Australian Physics Congress	October 2012	Frankfurt, DE	Paid	832,73
Publication of the Proceedings of the Workshop “Quantum scattering codes and Monte Carlo...”	December 2012	Madrid, ES	Paid	2.380,00
				6.014,19

Others

Title	Date	Place	Status	Total
Bank costs	January – December 2012	Frankfurt, DE	Paid	300,00
Financial & Scientific Administration and Coordination	January- December 2012	Frankfurt, DE	Paid	16.240,77

2013 Budget

Total Action Budget: 134.400,00€

Meetings

Meeting Type	Date	Place	Paid part	Status	Total
Nano-IBCT Database workshop	21.02-22.02.2013	Innsbruck (AT)	6	Paid	3.859,30
Second Nano-IBCT Conference	20.05-24.05.2013	Sopot, PL	60	Partly paid	41.191,92
Second Nano-IBCT Conference, local cost	20.05-24.05.2013	Sopot, PL	103	Paid	3.000,00
MC meeting	24.05.2013	Sopot (PL)	8	Partly paid	1377,86
Nano-IBCT Database workshop	1.10-3.10.2013	Caen (FR)	15	Planned	6.500,00
STPC meeting	1.10.2013	Caen (FR)	10	Planned	3.850,00
WG5 meeting Experimental data, biological aspects	1.11-4.11.2013	Belfast (UK)	20	Planned	8.460,00
					68.239,08

STSMs

Beneficiary	Date	Place	Status	Total
Mr Geert Reitsma M	14/01/2013 21/01/2013	Groningen, NL	Paid	1.000,00
Mr Toke Printz Ringbak	14/01/2013 19/01/2013	Aarhus, DK	Paid	670.00
Pr Alexander S. Botvina	21/01/2013 27/01/2013	Frankfurt, DE	Paid	960.00

Dr Michele Siggel-King	04/02/2013 11/02/2013	Liverpool, UK	Paid	1.250,00
Mr Jonas Warneke	11/02/2013 02/03/2013	Bremen, DE	Paid	1.700,00
Pr Hassan Abdoul-Carime	24/02/2013 02/03/2013	Lyon, FR	Paid	1.265,00
Mr Pablo De Vera Gomis	01/03/2013 29/03/2013	Alacant, ES	Paid	2.190,00
Pr Paulo Limao-Vieira	17/03/2013 23/03/2013	Lisboa, PT	Paid	950,00
Dr Lorenzo Avaldi	06/04/2013 13/04/2013	Rome, IT	Paid	900,00
Dr Andrzej Pelc	08/04/2013 19/04/2013	Lublin, PL	Paid	1.300,00
Mr Diogo Almeida	14/04/2013 11/05/2013	Lisboa, PT	Paid	1.900,00
Dr Jean-Christophe Pouilly	05/05/2013 11/05/2013	Caen, FR	Paid	900,00
Mr Martin Sefl	20/05/2013 03/06/2013	Prague, CZ	Paid	1.400,00
Ms Lila Bouessel Du Bourg	01/03/2013 16/06/2013	Paris, FR	Approved	3.000,00
Mr Pablo De Vera Gomis	06/05/2013 30/06/2013	Alacant, ES	Approved	2.500,00
Pr Andrey Solov`yov	24/06/2013 29/06/2013	Frankfurt, DE	Approved	700,00
21 STSMs	September - December	To be selected and approved by STPC		22.837,50
				45.422,50

Dissemination

Title	Date	Place	Status	Total
Publication of the Proceedings of the DYSON Conference	November 2013	London, UK	Planned	2.900,00
				2.900,00

Others

Title	Date	Place	Status	Total
Bank fees	January – December 2013	Frankfurt, DE	Partly paid	100,00
Financial & Scientific Administration and Coordination	January- December 2011	Frankfurt, DE	Partly paid	17.500

II. Scientific Report

II.A. Innovative networking

- *Innovative knowledge resulting from COST networking through the Action.*

During the reported period of the Action the following activities aimed at obtaining the innovating knowledge have been performed.

COST Nano-IBCT Workshop “Quantum Scattering calculations and Monte Carlo simulations to model dynamical processes in biosystems (QSMC2012) was held in Madrid, 7th to 9th of November 2012. The workshop was co-organised by Prof. Gustavo García, Scientific Researcher of the CSIC National Spanish Center of Research and Appointed Professor of the Australian University of Wollongong, and Prof. Franco Gianturco, Professor of the University of Rome “La Sapienza”. It was mainly devoted to discuss new scattering calculation procedures and modelling programmes to be used in biomedical applications of radiation. There were 52 participants whose contributions were distributed as 32 oral presentations and 13 posters as well as final roundtable to discuss and organize databases needed for modeling purposes.

The Second Workshop on RADAM databases was organised in February, 2013 in Innsbruck, Austria. At current stage all interested partners can start to collect the experimental and theoretical data, they have. Development of the Protocol for Database would be very useful at this stage to make possible the search of the data for the potential users. In the long term perspective the partners can think about possible proposals for the database development, to be able to maintain the database and also develop them for the broader community, than Nano-IBCT.

The second Nano-IBCT Conference of the COST Action MP1002 - Nano-scale Insights into Ion Beam Cancer Therapy took place in Sopot, Poland, from May 20th to May 24th, 2013.

The conference gathered 95 participants from 20 countries, representing 50 different scientific institutions. We were also happy to see our colleagues working in countries outside the EU, like Canada, Australia, India or the USA. During the conference there were 44 oral presentations on various topics, covering biological, chemical, physical and medical developments towards ion beam cancer therapy and general radiation research with research carried in both experimental and computational manner. In addition, an excellent overview of some new approaches was given during a poster session, where 45 posters were presented.

The following 36 STSMs were performed in 2012:

1. Mr. Jean-Christophe Pouilly, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen.
2. Mr Jimmy Rangama, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen.
3. Mr. Benedikt Omarsson, University of Iceland, Reykjavik (IS) to Comenius University, Bratislava (SK), **Topic:** Chemical control through HF formation in DEA, the role of temperature. **Host:** Stefan Matejcik.
4. Ms. Ana Garcia Sanz, Instituto de Fisica Fundamental, CSIC, Madrid (ES) to Dipartimento di Chimica Universita di Roma La Sapienza, Rome (IT). **Topic:** Electron collisions with anthracene: total elastic cross sections and dynamical study of resonances. **Host:** Franco Gianturco.
5. Mr. Sylvain Maclot, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen.
6. Mr. Diogo Almeida, CEFITEC, FCT-UNL, Caparica (PT) to Madrid (SP). **Topic:** Anion and electron interaction measurement to pyrimidine bases. **Host:** Gustavo Garcia.
7. Dr. Patrick Rousseau, CIMAP, Caen (FR) to IMIP-CNR, Monterotondo Scalo (IT). **Topic:** Inner-shell excitation/ionisation of halogenated uracil. **Host:** Paola Bolognesi.

8. Dr. David López Durán, CSIC, Madrid (ES) to Dipartimento di Chimica Università di Roma La Sapienza, Rome (IT). **Topic:** A stochastic study of simple biological molecules in helium clusters. **Host:** Franco Gianturco.
9. Dr. Aleksandar Milosavljevic, Institute of Physics Belgrade, Belgrade (RS) to Synchrotron SOLEIL, Gif-sur-Yvette Cedex (FR). **Topic:** Photoionization of nanosolvated biomolecular ions isolated in the gas phase. **Host:** Alexandre Giuliani.
10. Dr. Alicja Domaracka, CIMAP, Caen (FR) to IMIP-CNR, Monterotondo Scalo (IT). **Topic:** Inner-shell excitation/ionisation of halogenated uracil. **Host:** Paola Bolognesi.
11. Mr. Pierre Eustache, Institute of Molecular Sciences, Orsay (ISMO), (FR) to Kernfysisch Versneller Instituut, Groningen (NL). **Topic:** Sensitization induced by Nanoparticles in DNA irradiated by a proton beam. **Host:** Thomas Schlatholter.
12. Dr. Ilko Bald, University of Potsdam to University of Iceland, Reykjavik (IS). **Topic:** Sequence specific detection of electron induced strand breaks in DNA oligonucleotides. **Host:** Oddur Ingolfsson
13. Dr. Jan Franz, University of Bonn, Bonn (DE) to The University of Rome La Sapienza, Rome (IT). **Topic:** A computational study of low-energy positron scattering from tetrahydrofuran. **Host:** Franco Gianturco.
14. Dr. Malgorzata Smialek-Telega, Gdansk University of Technology, Gdansk (PL) to Institute for Storage Ring Facilities, Aarhus University, Aarhus (DK). **Topic:** DNA film density measurements. **Host:** Søren Vrønning Hoffmann.
15. Prof. Andrey Solov'ov, Frankfurt Institute for Advanced Studies, Frankfurt (DE) to Department of Physics And Astronomy, the Open University, Milton Keynes (UK). **Topic:** Ion Beam Cancer Therapy and Scientific Data Infrastructure for Simulation Methods. **Host:** Nigel Mason.
16. Dr. Peter van der Burgt, National University of Ireland Maynooth, Maynooth (IE) to The Open University, Milton Keynes (UK). **Topic:** Cluster source development and experiments probing hydration effects on the dissociative ionization. **Host:** Samuel Eden.
17. Dr. Paola Bolognese, CNR-IMIP, Monterotondo Scalo (Roma) (IT) to CIMAP - Centre de Recherche sur les Ions, les Matériaux et la Photonique, Caen (FR). **Topic:** Fragmentation of amino acids by low-energy ions. **Host:** Patrick Rousseau.
18. Mr. Marcin Dampc, Department of Physics of Electronic Phenomena, Gdansk University of Technology, Gdansk (PL) to Department of Experimental physics, Comenius University, Bratislava (SK), **Topic:** Ionization and fragmentation of pyrimidine and its derivatives by electron impact, **Host:** Štefan Matejčík.
19. Dr. Lenka Stefančíková, Institute of Biophysics, Academy of Science of the Czech Republic, Brno (CZ) to Institute of Molecular Science - Orsay (ISMO), Paris (FR) **Topic:** Radiosensitizing properties of metal nanoparticles in cancer cells. **Host:** Sandrine Lacombe.
20. Dr. Mattea Carmen Castrovilli, IMIP Institut of Inorganic Methodologies and Plasma CNR, Roma (IT) to CIMAP - Centre de Recherche sur les Ions, les Matériaux et la Photonique, Caen (FR). **Topic:** Fragmentation of amino acids by low-energy ions. **Host:** Patrick Rousseau.
21. Dr. Marie-Christine Bacchus, University Lyon I (FR) to University of Debrecen, Debrecen (HU). **Topic:** indirect effect in collision of ions with biomolecules. **Host:** Agnes Vibok.
22. Dr. Ana Bankovic, Institute of Physics, Belgrade (RS) to Instituto de Física Fundamental (IFF) Consejo Superior de Investigaciones Científicas (CSIC), Madrid (ES). **Topic:** Cross section data and computer code improvements for simulation of positron transport in tissue. **Host:** Gustavo Garcia.
23. Prof. Francesco Gianturco, University of Rome, Rome (IT) to Instituto de Física Fundamental, CSIC, Madrid (ES). **Topic:** Studying Quantum Dynamics of bioanions. **Host:** Gustavo Garcia.
24. Mr. Kevin Klawitter, Institut für Ionenphysik und Angewandte Physik, Innsbruck (AT) to Atomic Physics, Stockholm (SE). **Topic:** Fragmentation studies of aromatic molecules produced by Electrospray Ionization (ESI). **Host:** Henrik Cederquist.
25. Dr Armin Lühr, Experimental Clinical Oncology, Aarhus University Hospital (DK) to German Cancer Research Center (DKFZ) Heidelberg (DE). **Topic:** Nanoscale insights into Ion Beam Cancer Therapy (Nano-IBCT). **Host:** Steffen Greilich.
26. Mr. Srdan Marjanovic, Institute of Physics, Belgrade (RS) to Instituto de Física Fundamental, Madrid (ES). **Topic:** Cross-section data and computer code improvements for simulation of positron transport in tissue. **Host:** Gustavo García.

27. Dr. Lenka Stefancikova, Institute of Biophysics, Academy of Sciences of the Czech Republic, Brno (CZ) to Institute of Molecular Sciences –ISMO, Paris (FR). **Topic:** Continuation of the research on radiosensitizing properties of metal nanoparticles in cancer cells. **Host:** Sandrine Lacombe.
28. Prof. Ágnes Vibók, University of Debrecen, Department of Theoretical Physics, Debrecen (HU) to University of Lyon, Laboratoire de Spectrométrie Ionique et Moléculaire (LASIM) Université Lyon I, Lyon (FR). **Topic:** Non-adiabatic interactions in charge transfer collisions. **Host:** Marie-Christine Bacchus-Montabonel.
29. Mr. Sylvain Maclot, CIMAP, Caen (FR) to Aarhus University, Aarhus(DK), Topic: Effect of UV excitation on the fragmentation of small isolated peptide cations upon electron capture **Host:** Steen Bronsted-Nielsen
30. Dr. Filipe Ferreira da Silva, Nova University, Caparica (PT) to Institut für Ionenphysik und Angewandte Physik, Innsbruck (AT). **Topic:** DEA studies in amino acid derivatives. **Host:** Stephan Denifl.
31. Dr. Violaine Vizcaino, CIMAP, Caen (FR) to CNR-IMIP, Monterotondo Scalo, Roma (IT). **Topic:** X-ray ionisation and fragmentation of nucleosides and their radiosensitising analogues. **Host:** Paola Bolognesi.
32. Prof. Bernd Huber, CEA-CIMAP, Caen (FR) to Stockholm University, Stockholm (SE). **Topic:** Fragmentation of AMP- anions with internal energy control. **Host:** Henrik Cederquist.
33. Mr. Johannes Postler, Institut fuer Ionenphysik und Angewandte Physik, Universitaet Innsbruck, Innsbruck (AT) to CIMAP, Université de Caen Basse-Normandie, Caen(FR). **Topic:** Ionisation and Fragmentation of Nucleosides in Gasphase and Discussion of a Database Project. **Host:** Patrick Rousseau.
34. Ms. Marion Bug,Physikalisch-Technische Bundesanstalt,Braunschweig (DE) to Centre for Antimatter-Matter-Studies, Adelaide (AU). **Topic:** Monte Carlo simulations of the track structure of heavy ions. **Host:** Michael Brunger.
35. Dr Jan Franz, University of Bonn, Bonn (DE) to The University of Rome La Sapienza, Rome (IT). **Topic:** A computational study of low-energy positron scattering from tetrahydrofuran. **Host:** Franco Gianturco.

The following 16 STSMs were performed in January- July 2013:

1. Prof. Alexander S. Botvina, Frankfurt Institute for Advanced Studies, Frankfurt am Main (DE) to Dept. of Physics and Astronomy, Aarhus (DK). **Topic:** Nuclear fragmentation in Monte Carlo particle transport codes. **Host:** Niels Bassler.
2. Mr. Geert Reitsma, KVI Atomic and Molecular Physics, Groningen (NL) to Helmholtz Zentrum Berlin GmbH, Berlin (DE). **Topic:** Radiation effects on free protonated peptides. **Host:** Antje Vollmer.
3. Prof. Hassan Abdoul-Carime Institut de Physique Nucléaire, Lyon Villeurbanne (FR) to University of Podlasie Siedlce (PL). **Topic:** Degradation of biomolecules by low energy electrons. **Host:** Janina Kopyra.
4. Mr. Jonas Warneke, University of Bremen, Bremen (DE) to Comenius University Bratislava. **Topic:** Radical formation and scavenging - Differences in CH₃ release from seemingly similar molecules. **Host:** Stefan Matejčík
5. Dr. Michele Siggel-King, Cockcroft Institute and University of Liverpool, Daresbury, Warrington (UK) to Gdansk University of Technology, Gdansk(PL). **Topic:** Experimental set-up for secondary electron measurements from biomolecular films. **Host:** Malgorzata Smialek-Telega.
6. Dr. Lenka Stefancikova, Institute of Biophysics, Academy of Sciences of the Czech Republic, Brno(CZ) to Institute of Molecular Science, Orsay, Paris (FR). **Topic:** Radiosensitizing properties of metal nanoparticles in cancer cells using medical protons. **Host:** Sandrine Lacombe.
7. Prof. Gustavo Garcia, Instituto de Fisica Fundamental-CSIC, Madrid (ES) to ARC Centre for Antimatter-Matter Studies, Flinders University, Adelaide (AU). **Topic:** Electron and positron interactions with polar molecules **Host:** Michael Brunger (RASTSM).
8. Ms. Lila Bouessel du Bourg, Ecole Normale Supérieure-chimie, Paris (FR) to Queen's University Belfast, Belfast (UK). **Topic:** Electron attack on DNA. **Host:** Jorge Kohanoff.

9. Mr. Pablo de Vera Gomis, University of Alacant, Alacant (ES) to Frankfurt Institute for Advanced Studies, Frankfurt (DE). **Topic:** Development and improvement of a model for charged particle ionization of complex biological media. **Host:** Andrey Solov'yov.
10. Prof. Paulo LIMA-O-VIEIRA, Universidade Nova de Lisboa, Lisboa (PT) to Institute for Ionic Physics, Innsbruck (AT). **Topic:** Dissociative Electron Attachment Experiments to dimethyldisulphide. **Host:** Stephan Denifl.
11. Mr. Diogo Almeida, CEFITEC, Caparica (PT) to Instituto de Física Fundamental (IFF) Consejo Superior de Investigaciones Científicas (CSIC), Madrid (ES). **Topic:** Negative ion formation in anion-molecule collisions with pyrimidine. **Host:** Gustavo Garcia.
12. Dr. Andrzej Pelc, Marie Curie-Skladowska University, Lublin (PL) to Institute for Ionic Physics, Innsbruck (AT). **Topic:** Inelastic electron interaction (electron ionization/attachment) with platinum bromide. **Host:** Stephan Denifl.
13. Dr. Lorenzo Avaldi, CNR-Istituto di Metodologie Inorganiche e dei Plasmi, Monterotondo Scalo(IT) to CIMAP – GANIL, Caen (FR). **Topic:** Ion-induced fragmentation in halogenated uracil molecules **Host:** Patrick Rousseau.
14. Dr. Jean-Christophe POULLY, CIMAP laboratory, CAEN (FR) to Open University, Milton Keynes (UK). **Topic:** UV multi-photon ionization and electron-impact ionization of isolated and clustered hypoxanthine. **Host:** Samuel EDEN.
15. Mr. Martin ŠEFL, Faculty of Nuclear Sciences and Physical Engineering, Prague (CZ) to National Institute of Nuclear and Particle Physics (IN2P3) of the CNRS, Gradignan (FR). **Topic:** Theoretical modeling of LET distribution in proton and carbon beam. **Host:** Sebastien Incerti.
16. Mr. Alberto Fraile, Institute of Nuclear Fusion, Madrid (ES) to Queen`s University Belfast, Belfast (UK). **Topic:** Atomistic study of shock wave damage in DNA. **Host:** Jorge Kohanoff.

- *Significant scientific breakthroughs as part of the COST Action.*

Published in Nature scientific report: Biodamage via shock waves initiated by irradiation with ions

Radiation damage following the ionizing radiation of tissue has different scenarios and mechanisms depending on the projectiles or radiation modality. There was investigated the radiation damage effects due to shock waves produced by ions. It was analysed the strength of the shock wave capable of directly producing DNA strand breaks and, depending on the ion's linear energy transfer, it was estimated the radius from the ion's path, within which DNA damage by the shock wave mechanism is dominant. At much smaller values of linear energy transfer, the shock waves turn out to be instrumental in propagating reactive species formed close to the ion's path to large distances, successfully competing with diffusion.

Detailed description of this research is given in the recent paper: "Biodamage via shock waves initiated by irradiation with ions" by Eugene Surdutovich, Alexander V. Yakubovich & Andrey V. Solov'yov published in the high impact factor journal from the Nature Group (Scientific Reports, 3:1289, DOI: 10.1038/srep01289).

Call for publications of a Topical Issue of European Physical Journal D on "Nano-IBCT" (to be published in 2014).

We are planning to summarize the recent developments in the field by publishing a Topical Issue of European Physical Journal D in 2014.

- *Tangible medium term socio-economic impacts achieved or expected.*

Location of proton beam facilities announced by National Health Service, UK.

Cutting-edge proton beam therapy units will be located in London and Manchester. The NHS will invest up to £250 million in the new facilities, which will benefit around 1,500 patients a year. This

type of radiotherapy was previously unavailable in the NHS and patients were sent abroad for their treatment.

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

The present Action is an ideal mechanism for developing an integrated and collaborative programme in the field of IBCT, since this new field requires the networking of international researchers and practitioners from disparate disciplines. The proposal “*Advanced Radiotherapy, Generated by Exploiting Nanoprocesses and Technologies*” has been submitted in November 2012. The proposal has received a score 94 from 100 after the evaluation by the REA services and was selected for support. Six COST action Nano-IBCT-partners from 5 COST countries are the participants of new ITN project which will start in 2014.

II.B. Inter-disciplinary networking

The COST Action Nano-IBCT is relevant for many communities (scientific, medical, technological, industrial) which deal with radiation and radiation protection and are interested in a detailed understanding of molecular and nanoscale interaction mechanisms.

Second Nano- IBCT conferences ‘Radiation Damage of Biomolecular Systems: Nanoscale Insights into Ion Beam Cancer Therapy’, which took place in May 2013 in Sopot, Poland demonstrated the highly multidisciplinary character of the COST Action MP1002 by the participation of scientists with the scientific background, covering fields like physics, chemistry and biology, practical applications in hospitals and medical institutions, industrial applications and patient treatment in ion beam cancer therapy centers.

The following topics were discussed at the Conferences:

- Ion propagation in matter
- Primary ionization in medium, direct damage and production of secondary electrons and radicals
- Propagation of secondary electrons and radicals
- Electron attack on DNA and proteins
- Radiobiological scale effects
- Hadron therapy centers

II.C. New networking

- *Total number of individual participants involved in the Action work. Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs and networking activities*

There are 20 European countries which signed the MoU. Currently, 10 well-established research teams, which are leaders in the relevant fields, participate actively in the Action. There are 225 individual researchers who have been officially associated with the Working Groups within Nano-IBCT during the reported period (about 100 individual researchers joint the action in the second reporting period and 69 researchers joint the action in the third reporting period).

It is a declared intention of the proposers and participants of this Action to promote equal opportunities for participants of either gender regarding the organization and decision making within the Action. As of now, out of the total number of individual researches there are about 75% of male and 25% of female researchers and about 35 per cent are Early Stage Researches (ESR). The number of the ESR increased from 20 up to 35% in the last reporting period.

On the second Nano-IBCT Conference over a quarter of participants were postgraduate students and more than half of them were young female researchers. Also, in total, two thirds of all of the participants were early stage researchers. The overall attendance of female researchers to the conference was 30%.

The Action provides ESR unique opportunities to establish contacts and to collaborate with the leading groups via the mechanism of Short-Term Scientific Missions (STSM). Out of 56 STSMs, which have been supported in the first and second reporting periods, 31 implied the involvement of ESRs. Out of 16 STSMs, which have been already supported in the third reporting period, 9 implied the involvement of ESRs. This will be an essential complement to the local and national

PhD and young scientist training programmes. Such a possibility enables ESR to identify the most challenging problems open in the field and the most efficient ways for their solution.

- *Involvement of researchers from outside of COST Countries*

Eight groups from non-COST countries, headed by the following research leaders, have joined the Action (approved by CSO):

- 1) Prof. Dr. Yasunori Yamazaki (Japan)
- 2) Prof. Dr. Michael Brunger (Australia)
- 3) Dr. Linda Feketova (Australia)
- 4) Dr. Silwia Ptasinska (USA)
- 5) Dr. Eugene Surdutovich (USA).
- 6). Prof. Ziad Fransis (Lebanon).
- 7). Prof. Sergiy Volkov (Ukraine)
- 8). Prof. Anatoly Rosenfeld (Australia).

- *Advancement and promotion of scientific knowledge through publications and other outreach activities.*

The following dissemination activities resulted from COST networking through the Nano-IBCT Action in the reporting period:

- The operating the Action web-page.
- The publication and distribution of three Nano-IBCT Newsletter with 592 subscribers.
- Organization of the Second Nano-IBCT conference in May 2013
- Publications: 134 papers were published in the peer-reviewed journals from the beginning of the Action.
- Presentations on conferences: the book of abstracts has been published after the Nano-IBCT conference.

II. Scientific Report 2011- July 2012

II.A. Innovative networking

- *Innovative knowledge resulting from COST networking through the Action.*

During the reported period of the Action the following activities aimed at obtaining the innovating knowledge have been performed.

First Nano- IBCT conference ‘Radiation Damage of Biomolecular Systems: Nanoscale Insights into Ion Beam Cancer Therapy’ took place in October 2011 in Caen, France. The highly multidisciplinary character of the conference and of the COST Action MP1002 was demonstrated by the participation of **116 scientists** from **28 countries** with the scientific background, covering fields like physics, chemistry and biology, practical applications in hospitals and medical institutions, industrial applications and patient treatment in ion beam cancer therapy centers.

About 25 to 35 % of the participants, speakers and session chair persons were represented by female scientists and that about 40% of the participants were young scientists (13% PhD students).

From the 24th to the 26th of February 2012, the Nano-IBCT Workshop entitled “**Towards a Data Base for Radiation Damage in Biomolecular Systems**” has taken place in Wien in Austria, organized in the framework of the COST Action MP1002. The **Nano-IBCT database** workshop was devoted to the discussion of a new database to be created within the COST Action Nano-IBCT: **Data Base for Radiation Damage in Biomolecular Systems (RADAM)**. The aim of this workshop was the establishment of contacts between the teams willing to participate in the development of the RADAM data base, to link this development to the existing project Virtual Atomic and Molecular Data Center (VAMDC, <http://www.vamdc.eu>), and to establish standards for the newly created RADAM Data Base. **VAMDC** aims at building an interoperable e-Infrastructure for the exchange of atomic and molecular data. The project is supported by the EU in the framework of the FP7 "Research Infrastructures - INFRA-2008-1.2.2 - Scientific Data Infrastructures" initiative. VAMDC's funding will end in 2013.

COST NanoIBCT tutorial workshop on complex targets took place in Groningen, the Netherlands, 31 May - 1 June 2012. The aim of this tutorial workshop is to introduce a number of promising experimental techniques for preparation of such complex targets. Most of these techniques have already been employed recently and the respective lectures are given by scientists with laboratory experience on these techniques. The workshop aimed at young researchers (undergraduate and graduate students as well as postdocs).

STSMs

21 STSMs were completed in 2011:

1. Dr. Michele Siggel-King, Cockcroft Institute, Daresbury (UK) to Gdansk University of Technology, Gdansk (PL). **Topic:** Experimental set-up for secondary electron measurements from biomolecular films. **Host:** Malgorzata Smialek-Telega.
2. Mr. Olmo Gonzalez-Magana, Nuclear-physics Accelerator Institute (KVI), Groningen(NL) to Instituto de Física Fundamental (IFF), Madrid (ES), **Topic:** Anion scattering from biologically relevant molecules. **Host:** Gustavo Garcia.
3. Mr Gabriel Horvath, Faculty of Mathematics, Physics and Informatics, Bratislava (SK) to University of Technology, Faculty of Chemistry, Brno (CZ). **Topic:** Irradiation of biofilms and yeasts by an atmospheric pressure plasma pencil. **Host:** František Krcma.
4. Dr Hassan Abdoul-Carime, Institut de Physique Nucléaire - Lyon, Villeurbanne (FR) to University of Podlase, Siedlce (PL), **Topic:** DEA to sulfur contained methionine Amino Acid. **Host:** Janina Kopyra.
5. Pr Paulo LIMA-O-VIEIRA, Universidade Nova de Lisboa, Lisboa (PT) to Institute for Ionic Physics,

- Innsbruck(AT), **Topic:** DEA to 1-methyl thymine and 3-methyl uracil. **Host:** Paul SCHEIER
6. Mr Rochus Herrmann, Department of Physics and Astronomy, Aarhus University, Aarhus (DK) to German Cancer Research Center (DKFZ) Heidelberg (DE), **Topic:** Influence of track structure on amorphous-track model prediction of detector response. **Host:** Oliver Jäkel
 7. Dr Ilko Bald, Aarhus University, Aarhus(DK) to Siedlce University, Siedlce (PL). **Topic:** Dissociative electron attachment to the radiosensitizer gemcitabine. **Host:** Janina Kopyra.
 8. Dr. Giuseppe Schettino, Centre for Cancer and Cell Biology, Belfast, Northern Ireland (UK) to INFN-LNS, Catania (IT). **Topic:** Mapping the radiobiological effectiveness of a pristine carbon beam peak. **Host:** Pablo Cirrone
 9. Dr Adrian Keller, Helmholtz-Zentrum Dresden-Rossendorf, Dresden (DE) to Siedlce University, Siedlce (PL). **Topic:** Fragmentation of the anti-cancer drug gemcitabine by secondary low-energy electrons. **Host:** Janina Kopyra
 10. Mr. Sylvain Maclot, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen.
 11. Dr Janina Kopyra, Siedlce University, Siedlce (PL) to Universidade Nova de Lisboa, Lisboa (PT). **Topic:** Electron transfer induced fragmentation in biologically relevant molecules **Host:** Paulo Limao-Vieira
 12. Dr Nevena Puac, Institute of physics, Belgrade (RS) to Société Civile Synchrotron SOLEIL (FR), **Topic:** Coincidence studies on biomolecules dissociation in the soft X-ray regime. **Host:** Christophe Nicolas.
 13. Mr Julien Leroy, University Paris Sud, Orsay (FR) to KVI Atomic and Molecular Physics, Groningen (NL) **Topic:** Nanosensitization with protons. **Host:** Thomas Schlatholter
 14. Mr. Jean-Christophe Pouilly, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen.
 15. Dr Richard BREDY, Université de Lyon ,CNRS, UMR 5579, LASIM, Villeurbanne (FR) to University of Groningen KVI ,Groningen (NL). **Topic:** Slow Highly Charged Ion Induced Dissociation (SHCI-ID) of proteins. **Host:** Thomas Schlathölter,
 16. Mr Jimmy Rangama, CIMAP-Caen (FR) to Aarhus University (DK). **Topic:** Effect of nanosolvation on the fragmentation of small isolated peptide cations upon electron capture. **Host:** Steen Bronsted-Nielsen
 17. Pr Eric Suraud, LPT-IRSAMC, Toulouse (FR) to Frankfurt Institute for Advanced Studies, Frankfurt (DE), **Topic:** Towards microscopic computing of irradiation of biomolecules. **Host:** Andrey Solov`yov.
 18. Mr Pablo de Vera Gomis, Universitat d'Alacant, San Vicente del Raspeig, Alicante (ES) to Frankfurt Institute for Advanced Studies, Frankfurt (DE). **Topic:** Energy deposition in biological media by swift ion beams: comparison of theoretical models. **Host:** Andrey Solov`yov.
 19. Dr Serge Martin, LASIM, Villeurbanne (FR) to University of Groningen KVI ,Groningen (NL). **Topic:** Slow Highly Charged Ion Induced Dissociation (SHCI-ID) of proteins. **Host:** Thomas Schlathölter,
 20. Pr. Andrey Solov`yov, Frankfurt Institute for Advanced Studies, Frankfurt (DE) to Nuclear Physics Institute ASCR, Prague (CZ). **Topic:** DNA damage induced by ionizing radiation. **Host:** Marie Davidkova.
 21. Dr Filipe Ferreira da Silva, New University of Lisbon, Caparica (PT) to Institut für Ionenphysik und Angewandte Physik, Innsbruck (AT). **Topic:** CNO anion formation upon electron attachment in pyrimidine bases. **Host:** Stephan Denifl,

- *Significant scientific breakthroughs as part of the COST Action.*

New aspect of DNA double-strand break repair: an influence of higher-order chromatin structure.

Using high-resolution confocal microscopy in combination with immunostaining, immunoFISH and *in vivo* single-cell observation, the group of scientists (M.Falk, E. Lukášová, S.Kozubek, L.Štefančíková, L.Weiterová) from Institute of Biophysics of ASCR, Brno, Czech Republic studied

spatio-temporal orchestration of DSB repair from minutes post-irradiation (PI) up to several days PI.

New working model that describes the relationship between higher-order chromatin structure, DSB repair and formation of chromosomal translocations was proposed.

It was revealed that DSBs are induced preferentially in decondensed, transcriptionally active euchromatin as compared with condensed, genetically largely silent and protein-abundant heterochromatin. This phenomenon could be explained by better shielding of DNA from free radicals by heterochromatin-binding proteins in heterochromatin and/ or “protrusion” of heterochromatic (hc) DSBs from heterochromatin into euchromatin more suitable for repair. DSB repair is faster and more efficient in euchromatin, since decondensation steps are necessary to allow processing of hcDSBs. It seems that DSBs are repaired individually at the sites of their origin and migrate neither for long distances nor into putative “repair factories”; however, chromatin decondensation at the sites of hcDSBs may result in relocation of these lesions from dense to sparse chromatin domains. This “movement” is influenced by local higher-order chromatin structure and may accidentally result in clustering of previously “distant” DSBs.

Detailed description of this research is given in: M. Falk et al., Repair of DNA Double-Strand Breaks - Biochemical and Spatio-Temporal Aspects, in Radiation Damage in Biomolecular Systems, Springer, Eds.: G. Garcia, M. Fuss , 2011.

Biological consequences of nanoscale energy deposition near irradiated heavy atom nanoparticles

A highly-innovative research in the field of biological consequences of nanoscale energy deposition was reported by the group of scientists from Belfast (Northern Ireland, UK), which participate in the COST Nano-IBCT action. In their research they demonstrated that gold nanoparticles (GNPs) are being proposed as contrast agents to enhance X-ray imaging and radiotherapy, seeking to take advantage of the increased X-ray absorption of gold compared to soft tissue. However, there is a great discrepancy between physically predicted increases in X-ray energy deposition and experimentally observed increases in cell killing. In this work, we present the first calculations which take into account the structure of energy deposition in the nanoscale vicinity of GNPs and relate this to biological outcomes, and show for the first time good agreement with experimentally observed cell killing by the combination of X-rays and GNPs. These results are not only relevant to radiotherapy, but also have implications for applications of heavy atom nanoparticles in biological settings or where human exposure is possible because the localised energy deposition high-lighted by these results may cause complex DNA damage, leading to mutation and carcinogenesis.

Detailed description of this research is given in a recent paper: “*Biological consequences of nanoscale energy deposition near irradiated heavy atom nanoparticles*”, by S.J. McMahon, W.B. Hyland, M.F. Muir, J.A. Coulter, S. Jain, K.T. Butterworth, G. Schettino, G.R. Dickson, A.R. Hounsell, J.M. O’Sullivan, K.M. Prise, D.G. Hirst and F.J. Currell (Belfast, Northern Ireland, UK), *Sci. Rep.* **1**, 18; DOI:10.1038/srep00018 (2011), published in the high impact factor journal *Scientific Research* from the *Nature Group*.

- *Tangible medium term socio-economic impacts achieved or expected.*

Action has attracted a lot of attention in various scientific, technological, industrial and medical communities. The number of research groups, already involved in the Action, provides the estimate of the economic dimension for manpower on the level of about 20 Million €, if calculated on the basis of 100,000 €/PY.

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

The present Action is an ideal mechanism for developing an integrated and collaborative programme in the field of IBCT, since this new field requires the networking of international researchers and practitioners from disparate disciplines. The idea of creation of the common training programme on the basis of the COST Action was actively discussed in MC meetings. In 2012 the work on the application for proposal: Advanced Radiotherapy, Generated by Exploiting Nanoprocesses and Technologies (ARGENT) has been started. Proposal was submitted in the frame of the ITN-Program in January 2012. The proposal has got a total score 80,20 from 100. Although it was judged to be of sufficient quality to warrant funding it was not funded due to budgetary constraints.

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

Several proposals were submitted by the Action partners within the frameworks of different national programmes in 2011. These include:

- “*Multiscale physics of radiation damage caused by energetic ions*” submitted by A. Solov'yov, (FIAS Goethe University) to Deutsche Forschungsgemeinschaft.
- “*Biological effectiveness of ion beams for cancer therapy*” by G. Schettino (PI), F. Currell and K. Prise (Queen's University Belfast, UK) has been awarded for 01/10-11 – 30/09/14 by National (UK) MRC.
- “*Further development of multiscale approach to the radiation damage by ions*”, submitted by E. Surdutovich (Oakland University) to the National Institute of Health, USA.

II.B. Inter-disciplinary networking

The COST Action Nano-IBCT is relevant for many communities (scientific, medical, technological, industrial) which deal with radiation and radiation protection and are interested in a detailed understanding of molecular and nanoscale interaction mechanisms.

First and Second Nano- IBCT conferences ‘Radiation Damage of Biomolecular Systems: Nanoscale Insights into Ion Beam Cancer Therapy’, which took place in October 2011 in Caen, France and in May 2013 in Sopot, Poland demonstrated the highly multidisciplinary character of the COST Action MP1002 by the participation of scientists with the scientific background, covering fields like physics, chemistry and biology, practical applications in hospitals and medical institutions, industrial applications and patient treatment in ion beam cancer therapy centers.

The following topics were discussed at the Conferences:

- Ion propagation in matter
- Primary ionization in medium, direct damage and production of secondary electrons and radicals
- Propagation of secondary electrons and radicals
- Electron attack on DNA and proteins
- Radiobiological scale effects
- Hadron therapy centers

Currently, there are several EU-supported projects, running within the framework of FP7, which are thematically related to the Nano-IBCT. These are: ENLIGHT (European Network for LIGHT ion Hadron Therapy), MELUSYN (Medicine and synchrotron Light), ULICE (Union of Light Ion Centres in Europe) and ENVISION (European NoVel Imaging Systems for ION therapy).

These large projects are more related to medical applications of the Cancer Beam Therapy. The fundamental aspects, which are the main goal of the NANO- IBCT, are often missed or underrepresented in the projects. Therefore, the research within the frame of Nano-IBCT will be complementary to the work proposed in these projects.

Members from MELUSYN, ENLIGHT and ENVISION consortia have attended the Nano-IBCT Conference in Caen.

II.C. New networking

- *Total number of individual participants involved in the Action work. Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs and networking activities*

There are 20 European countries which signed the MoU. Currently, 10 well-established research teams, which are leaders in the relevant fields, participate actively in the Action. There are 156 individual researchers who have been officially associated with the Working Groups within Nano-IBCT during the reported period (about 100 individual researchers joined the action in the reporting period).

It is a declared intention of the proposers and participants of this Action to promote equal opportunities for participants of either gender regarding the organization and decision making within the Action. As of now, out of the total number of individual researchers there are about 75% of male and one 25% of female researchers and about 20 per cent are Early Stage Researchers (ESR).

About 25 to 35 % of the participants, speakers and session chair persons the 1st Nano-IBCT Conference were represented by female scientists and that about 40% of the participants were young scientists (13% PhD students).

COST NanoIBCT tutorial workshop on complex targets in Groningen aimed at young researchers (undergraduate and graduate students as well as postdocs) to introduce a number of promising experimental techniques for preparation of complex targets.

The Action provides ESR unique opportunities to establish contacts and to collaborate with the leading groups via the mechanism of Short-Term Scientific Missions (STSM). Out of 20 STSM, which have been already supported in the reporting period, 10 imply the involvement of ESRs. This will be an essential complement to the local and national PhD and young scientist training programmes. Such a possibility enables ESR to identify the most challenging problems open in the field and the most efficient ways for their solution.

- *Involvement of researchers from outside of COST Countries*
 -
 - Five groups from non-COST countries, headed by the following research leaders, have already joined the Action (approved by CSO):
 - 1) Prof. Dr. Yasunori Yamazaki (Japan)
 - 2) Prof. Dr. Michael Brunger (Australia)
 - 3) Dr. Linda Feketova (Australia)
 - 4) Dr. Silwia Ptasinska (USA)
 - 5) Dr. Eugene Surdutovich (USA).
 - Two participants are from Australia, which is the country with the reciprocal agreement with COST.
 - 3 applications from non-COST countries have been made in the reporting period and are under consideration:
 - Prof. Ziad Fransis (Lebanon).
 - Prof. Sergiy Volkov (Ukraine)
 - Prof. Anatoly Rosenfeld (Australia).
- *Advancement and promotion of scientific knowledge through publications and other outreach activities.*

The following dissemination activities resulted from COST networking through the Nano-IBCT Action in the reporting period:

- The operating the Action web-page.
- The publication and distribution of three Nano-IBCT Newsletter with 300 subscribers.
- Organization of the First Nano-IBCT conference in October 2011.
- Publications: 91 papers were published in the reporting period in the peer-reviewed journals.
- Presentations on conferences: the book of abstracts has been published after the Nano-IBCT conference.
- International Innovation - Healthcare, An eye on ions, March 2012, p.81-83, <http://www.research-europe.com/magazine/EUROFOCUS/2012-8/index.html>; interview by Research Media Ltd www.researchmedia.eu, the leading global dissemination resource.

Annex1. List of the publications in the reporting period:

1. Absolute cross sections for elastic electron scattering from methylformamide, Maljkovic J. B.; Blanco F.; Garcia G.; et al., PHYSICAL REVIEW A Volume: 85 Issue: 4 Article Number: 042723, 2012.
2. All that is gold does not glitter, not all those that wander are lost': the dual behaviour of gold nanoparticles in vitro, Hyland Wendy B.; McMahon Stephen J.; Muir Mark F.; et al., MUTAGENESIS Volume: 27 Issue: 1 Pages: 105-105 Meeting Abstract: 7, 2012.
3. A combined molecular dynamics and Monte Carlo simulation of the spatial distribution of energy deposition by proton beams in liquid water, Garcia-Molina Rafael; Abril Isabel; Heredia-Avalos Santiago; et al., PHYSICS IN MEDICINE AND BIOLOGY Volume: 56 Issue: 19 Pages: 6475-6493, OCT 2011.
4. Anionic fragmentation of glycine upon potassium-molecule collisions, Ferreira da Silva F.; Lanca M.; Almeida D.; et al., EUROPEAN PHYSICAL JOURNAL D Volume: 66 Issue: 3 Article Number: 78, 2012.
5. Angular correlations in radiative cascades following resonant electron capture by highly charged ions, Matula O.; Fritzsche S.; Currell F. J.; et al., PHYSICAL REVIEW A Volume: 84 Issue: 5 Article Number: 052723, NOV 2011.
6. Applications of FLUKA Monte Carlo code for nuclear and accelerator physics, Battistoni Giuseppe; Broggi Francesco; Brugger Markus; et al., NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS Volume: 269 Issue: 24 Pages: 2850-2856, DEC 2011.
7. A study of selected fragmentation paths of the ethyne dication: theory and experiment, Author(s): Flammini R.; Satta M.; Fainelli E.; et al., PHYSICAL CHEMISTRY CHEMICAL PHYSICS Volume: 13 Issue: 43 Pages: 19607-19614, 2011.
8. Biological effectiveness on live cells of laser driven protons at dose rates exceeding 10(9) Gy/s, Doria D.; Kakolee K. F.; Kar S.; et al., AIP ADVANCES Volume: 2 Issue: 1 Article Number: 011209, 2012.
9. Bond dissociation of the dipeptide dialanine and its derivative alanine anhydride induced by low energy electrons, Alizadeh Elahe; Gschliesser David; Bartl Peter; et al., JOURNAL OF CHEMICAL PHYSICS Volume: 134 Issue: 5, Article Number: 054305, FEB 2011.
10. Calculation of complex DNA damage induced by ions, Surdutovich Eugene; Gallagher David C.; Solov'yov Andrey V., PHYSICAL REVIEW E Volume: 84 Issue: 5 Article Number: 051918, NOV 2011.
11. Cell type-dependent uptake, localization, and cytotoxicity of 1.9 nm gold nanoparticles, Coulter Jonathan A.; Jain Suneil; Butterworth Karl T.; et al., INTERNATIONAL JOURNAL OF NANOMEDICINE Volume: 7 Pages: 2673-2685, 2012.
12. Cell Survival Responses after Exposure to Modulated Radiation Fields, Trainor C.; Butterworth K. T.; McGarry C. K.; et al., RADIATION RESEARCH Volume: 177 Issue: 1 Pages: 44-51, 2012.
13. Contribution of the BRCA/FA Pathway to the Radiation-induced DNA Damage Response in Non-targeted Cells, Burdak-Rothkamm S.; Rothkamm K.; Prise K. M., JOURNAL OF PATHOLOGY Volume: 224 Supplement: 1 Pages: S12-S12, 2011.

14. Comment on 'Therapeutic application of metallic nanoparticles combined with particle-induced x-ray emission effect', Sech Claude; Kobayashi Katsumi; Usami Noriko; et al., *Nanotechnology* Volume: 23 Issue: 7 Pages: 078001, 2012.
15. Comparison of nanodosimetric parameters of track structure calculated by the Monte Carlo codes Geant4-DNA and PTr, Lazarakis P.; Bug M. U.; Gargioni E.; et al. *PHYSICS IN MEDICINE AND BIOLOGY* Volume: 57 Issue: 5 Pages: 1231-1250, 2012.
16. Cosmic ray impact on astrophysical ices: laboratory studies on heavy ion irradiation of methane, de Barros A. L. F.; Bordalo V.; Seperuelo Duarte E.; et al., *ASTRONOMY & ASTROPHYSICS* Volume: 531 Article Number: A160, JUL 2011.
17. Design of a Compton camera for 3D prompt-gamma imaging during ion beam therapy, Roellinghoff F.; Richard M. -H.; Chevallier M.; et al., *NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT* Volume: 648 Supplement: S1 Pages: S20-S2, AUG 2011.
18. Dissociative electron attachment to triflates, Ptasinska Sylwia; Gschliesser David; Bartl Peter; et al., *JOURNAL OF CHEMICAL PHYSICS* Volume: 135 Issue: 21, DEC 2011.
19. Dissociative electron attachment to CF₃Cl An experimental study using the velocity slice imaging technique, Omarsson F. H.; Ingolfsson O.; Mason N. J.; et al., *EUROPEAN PHYSICAL JOURNAL D* Volume: 66 Issue: 2, Article Number: 51, 2012.
20. Direct Observation of Crack Propagation in Copper-Niobium Multilayers, Hattar K.; Misra A.; Dosanjh M. R. F.; et al., *JOURNAL OF ENGINEERING MATERIALS AND TECHNOLOGY-TRANSACTIONS OF THE ASME* Volume: 134 Issue: 2, Article Number: 021014, 2012.
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24. Electron attachment to the N-substituted amino acids N-methylglycine and N-methylalanine: Effective cleavage of the N-C-alpha bond at sub-excitation energies, Kopyra Janina, *CHEMICAL PHYSICS LETTERS*, Volume: 533, Pages: 87-91. 2012.
25. Electron interaction with nitromethane embedded in helium droplets: attachment and ionization measurements, Ferreira da Silva F; Ptasinska S; Denifl S; et al., *The Journal of chemical physics* Volume: 135 Issue: 17 Pages: 174504, Nov 2011.
26. Electron-induced damage of DNA and its components: Experiments and theoretical models, Baccarelli Isabella; Bald Ilko; Gianturco Franco A.; et al., *PHYSICS REPORTS-REVIEW SECTION OF PHYSICS LETTERS* Volume: 508 Issue: 1-2 Pages: 1-44, NOV 2011.
27. Electron transfer processes in potassium collisions with 5-fluorouracil and 5-chlorouracil, Ferreira da Silva F; Almeida D; Antunes R; et al., *Physical chemistry chemical physics : PCCP* Volume: 13 Issue: 48 Pages: 21621-9, Dec 2011.

28. Energy-loss straggling study of proton and alpha-particle beams incident onto ZrO₂ and Al₂O₃ films, Behar M.; Fadanelli R. C.; Abril I.; et al., EUROPEAN PHYSICAL JOURNAL D Volume: 64 Issue: 2-3, Pages: 297-301, OCT 2011.
29. Energy Dependence of Gold Nanoparticle Radiosensitization in Plasmid DNA, McMahon Stephen J.; Hyland Wendy B.; Brun Emilie; et al., JOURNAL OF PHYSICAL CHEMISTRY C Volume: 115 Issue: 41 Pages: 20160-20167, OCT 2011.
30. Excess Electron Interactions with Solvated DNA Nucleotides: Strand Breaks Possible at Room Temperature, Smyth Maeve; Kohanoff Jorge, JOURNAL OF THE AMERICAN CHEMICAL SOCIETY Volume: 134 Issue: 22 Pages: 9122-9125, 2012.
31. Excess electron localization in solvated DNA bases, Smyth Maeve; Kohanoff Jorge, Physical review letters Volume: 106 Issue: 23 Pages: 238108, 2011
32. Evaluation of polarizable continuum model for the prediction of vibrational frequencies of biomimetic molecules in solution, Bouteiller Yves; Pouilly Jean-Christophe; Gregoire Gilles, COMPUTATIONAL AND THEORETICAL CHEMISTRY Volume: 966 Issue: 1-3 Pages: 220-224, JUN 2011.
33. Fast and metastable fragmentation of deprotonated D-fructose - A combined experimental and computational study, Flosadottir Helga D.; Bald Ilko; Ingolfsson Oddur, INTERNATIONAL JOURNAL OF MASS SPECTROMETRY Volume: 305 Issue: 1 Pages: 50-57, AUG 2011.
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