PROJECT FINAL REPORT

Grant Agreement number: 207122

Project acronym: RADDOS

Project title: JOINT RESEARCH ON VARIOUS TYPES OF RADIATION DOSIMETERS

Funding Scheme: SUPPORT ACTION

Period covered: from 01/05/2008 to 30/04/2012

Name, title and organisation of the scientific representative of the project's coordinator[1]:

Aleksandar Jaksic
Tyndall National Institute,
University College Cork
"Lee Maltings"
Ireland

Tel: +353 21 490 4262
Fax: +353 21 490 4058
E-mail: aleksandar.jaksic@tyndall.ie
Project website[2] address: www.apl.elfak.rs

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

1. Table of Contents

2.1 Executive summary

RADDOS project was a four year support action programme in the radiation dosimeters area containing coherent set of actions involving the three partners:

- From EU Member state: Tyndall National Institute, University College Cork, Ireland; Tyndall was a project co-ordinator.
- From Western Balkan country: Faculty of Electronic Engineering, University of Nis, Serbia,
- From convergence region in EU Member state: Institute Josef Stefan, Ljubljana, Slovenia.

During the four years of the project the following objectives were achieved:

- Six secondments between the project partners have been realised.
- Thirteen short visits between the project partners have been realised.
- Fourteen short visits by the project partners to third laboratories have been organised.
- Five young promising researchers have been hired by the Serbian partner.
- Several major equipment items related to electrical characterisation of semiconductor devices have been purchased for the Serbian partner.
- Web page of the Applied Physics Laboratory (laboratory in Serbia participating in the project) has been established and promotional leaflet designed and distributed to the existing and prospective partners in Serbia, Western Balkan Region, and European Union.
- "The First International Conference on Radiation and Dosimetry in Various Fields of Research – RAD 2012" was organised from 25-27 April 2012, in Nis, Serbia.

The project fully achieved its objectives, thereby greatly contributing to the increase of technological, scientific, and human potential of the Serbian partner. The two EU partners have also achieved significant technical and scientific benefits.

For further information about the project, please contact project co-ordinator:

Aleksandar Jaksic
Tyndall National Institute,
University College Cork
Ireland

Tel: +353 21 490 4262
Fax: +353 21 490 4058
E-mail: aleksandar.jaksic@tyndall.ie
Project website: www.apl.elfak.rs

2.2 Project context and objectives

Radiation dosimeters have found applications in a broad range of areas, such as space exploration, nuclear facilities, high energy physics laboratories, quality assurance of cancer radiation treatments, medical imaging, and monitoring of health and safety of personnel working close to radiation sources. Radiation dosimetry can often be extremely complicated and there are extensive research and development activities worldwide in this field, with significant scientific and commercial impacts.

RADDOS project was a four year support action programme in the radiation dosimeters area containing coherent set of actions involving the three partners:

- From EU Member state: Tyndall National Institute, University College Cork, Ireland (short name TNI-UCC, "Tyndall"); Tyndall is project co-ordinator.
- From Western Balkan country: Faculty of Electronic Engineering, University of Nis, Serbia (short name EF-UNNIS, "EF"),
- From convergence region in EU Member state: Institute Josef Stefan, Ljubljana, Slovenia
  (short name EPP-IJS, "IJS").

The project partners have been running various research programmes in radiation dosimetry, funded from national and international sources, and, in the case of Tyndall, commercial income as well. The project was aimed at establishing research partnerships between the participants and stimulating networking and joint research with renowned third parties. Particular emphasis was placed on measures to improve the S&T human potential and infrastructure of the Western Balkan partner thereby facilitating their better inclusion in European research community and participation in EU funding programmes in the future. As the partners have complementary expertise and research infrastructures, they are all emerged from the project with enhanced know-how, research output, and links with the third institutions.

During the four years of the project, the project objectives have been fully achieved, as follows:

- Realisation of six secondments has been completed. Young and experienced researchers have worked for the periods ranging from three to twelve months at partners' laboratories on relevant practical projects, thereby gaining valuable knowledge and experience.
- Realisation of thirteen short visits (up to one month) between the partners has been completed. The aim of these visits was joint work on particular short experiments.
- Fourteen short visits of project partners to third laboratories have been organised. Researchers visited ESA, CERN, and Vinca Institute to get acquainted with hosts' organisation and infrastructure and perform concrete experiments, gaining valuable experience in the new research environments.
- Five young promising researchers have been hired by EF, significantly increasing human potential of the Applied Physics Laboratory (EF laboratory involved in the project).

- Several major equipment items related to electrical characterisation of semiconductor devices have been purchased. The purchase of the equipment substantially enhanced research infrastructure of the Applied Physics Laboratory, making the laboratory a centre of excellence in Serbia for electrical characterisation of semiconductor devices and one of the best equipped laboratories in the Western Balkan Region.
- Web page of the Applied Physics Laboratory (www.apl.elfak.rs) has been established and promotional leaflet designed and distributed to the existing and prospective partners in Serbia, Western Balkan Region, and European Union. This has contributed to increased visibility of EF and also to better knowledge in Western Balkan specialised and general scientific communities about the positive impact of the FP7 programmes.
- "The First International Conference on Radiation and Dosimetry in Various Fields of Research – RAD 2012" was organised from 25-27 April 2012, in Nis, Serbia. The conference attracted 149 participants from 30 countries all around the world, with strong participation from Western Balkan countries. The conference was a great success and the new edition, RAD 2014 is already in preparation.

While the strongest emphasis was placed on the benefits to the Western Balkan country partner (EF), it was essential that the two EU partners also had the clear benefits from their participation in the project. This was indeed the case as complementary profiles of the partners and increased research interactions between them and with third parties led to enhanced research output and know-how of all three participants in the project. It is expected that partnerships established during the project will continue after project completion leading to long-term research co-operation and joint participation in the EU programmes in the future.

Group photo of the participants of the RAD 2012 conference in Nis

2.3 Main S&T results/foregrounds

This section provides an overview of work and main results by project work packages. Only a brief description of project activities is given in this report; more details are provided in project periodic progress reports and relevant deliverables. Impact of described activities is discussed in the next section.

WP1: Secondments of research staff between the partners

The following six secondments were realised. More details are provided in deliverable D1.

Secondment 1.1
Summary: Visit of Dr. Milic Pejovic, experienced researcher at APL, to Tyndall
Duration: 3 months (14 January – 13 April 2009)
Main topic: Software for automated RADFET measurements

Secondment 1.2
Summary: Visit of Marko Vuckovic, young researcher at APL, to IJS
Duration: 2 months (23 February – 26 April 2009)
Main topic: Hardware and software for Transient Current Technique – TCT
The main

Secondment 3.1
Summary: Secondment of Nikola Vasovic, young researcher at APL, to Tyndall
Duration: one year (03 May 2010 – 17 April 2011)
Main topic: Hardware and software for scintillator based detector for radiochemistry application

Secondment 3.2
Summary: Secondment of Matej Batić, experienced researcher at IJS, to Tyndall
Duration: three months (June – 16 September 2010)
Brief description: Monte Carlo simulation of scintillator based detector for radiochemistry application

Secondment 4.1
Summary: Secondment of Nikola Vasovic, young researcher at APL, to Tyndall
Duration: seven months (05 August 2011 – 24 February 2012)
Brief description: Hardware and software for scintillator based detector for security applications

Secondment 4.2
Summary: Secondment of Miomir Todorovic, young researcher at APL, to IJS
Duration: three months (02 October – 25 December 2011)
Brief description: Development of pulsed laser for study of semiconductor detector properties

Miomir Todorovic (left) and Gregor Kramberger in IJS laboratory

WP2: Short visits between partners

The following thirteen short visits between the partners were realised. The purpose of these visits was to perform joint work, including experiments, analysis, and simulation. The visits were also used to review the progress of the project and discuss future activities. More details are provided in deliverable D2.

Short visit between the partners 1.1
Summary: Visit of Aleksandar Jaksic, experienced researcher at Tyndall, to EF-UNINIS
Duration: 1 week (11-19 December 2008)

Short visits between partners 2.1-2.3
Summary: Three visits of Aleksandar Jaksic, experienced researcher at Tyndall, to EF-UNNIS
Duration: two weeks (02-17June 2009), two weeks (03-19 October 2009), two weeks (02-16 April 2010)

Short visit between partners 3.1
Summary: Visit of Marko Zavrtanik, experienced researcher at IJS, to Tyndall
Duration: one week (23 June – 01 July 2010)

Short visit between partners 3.2
Summary: Visit of Jugoslav Karamarkovic, experienced researcher at APL, to Tyndall
Duration: one month in total (02-21 July and 04-16 September 2010)

Short visit between partners 3.3
Summary: Visit of Aleksandar Jaksic, experienced researcher at Tyndall, to EF-UNINIS
Duration: two weeks (15 August – 02 September 2010)

Short visit between partners 3.4
Summary: Visit of Aleksandar Jaksic, experienced researcher at APL, to EF-UNINIS
Duration: one week (21 - 28 December 2010)

Short visit between partners 4.1
Summary: Visit of Aleksandar Jaksic, experienced researcher at Tyndall, to APL
Duration: two weeks (03 – 17 May 2011)

Short visit between partners 4.2
Summary: Visit of Goran Ristic, experienced researcher at APL, to Tyndall
Duration: one month (14 July – 14 August 2011)

Short visit between partners 4.3
Summary: Visit of Goran Ristic, experienced researcher at APL, to IJS
Duration: two weeks (18 September – 02 October 2011)

Goran Ristic, Marko Zavtanik and Gregor Kramberger (from left to right) beside S-TCT system at IJS

Short visit between partners 4.4
Summary: Visit of Goran Ristic and Jugoslav Karamarkovic, experienced researchers at APL, and Nikola Vasovic, Miomir Todorovic, and Ugljesa Jovanovic, young researchers at APL, to IJS
Duration: four days (27 February – 02 March 2012)

Short visit between partners 4.5
Summary: Visit of Miomir Todorovic, young researcher at APL, to IJS
Duration: three weeks (01 – 20 April 2012)

WP3: Short visits to third laboratories

The following fourteen short visits to third laboratories were realised. The purpose of these visits was to discuss and perform joint experiments at third party laboratories and get acquainted with the infrastructure and organisation of renowned European facilities. More details are given in deliverable D3.

Short visits to third laboratories 2.1-2.2
Summary: Two visits of Gregor Kramberger to CERN
Duration: one week (12-20 November 2009), one week (05-13 March 2010)

Short visit to third laboratories 2.3
Summary: Visit of Gregor Kramberger to INFN-Torino
Duration: two days (19-20 September 2009)

Short visit to third laboratories 3.1
Summary: Visit of Aleksandar Jaksic, Goran Ristic, Nikola Vasovic, and Marko Andjelkovic to Vinca Institute
Duration: one day (26 December 2010)

Short visits to third laboratories 3.2-3.3
Summary: Two visits of Gregor Kramberger to CERN
Duration: two weeks (09-24 February 2011), one week (02-09 March 2011)

Short visit to third laboratories 3.4
Summary: Visit of Aleksandar Jaksic to ESA-ESTEC
Duration: two days (27/28 March 2011)

Short visit to third laboratories 3.5
Summary: Visit of Aleksandar Jaksic and Nikola Vasovic to ESA-ESTEC
Duration: one week (05-12 April 2011)

Short visit to third laboratories 4.1
Summary: Visit of Goran Ristic, Marko Andjelkovic, and Ugljesa Jovanovic from APL and Nikola Vasovic (at that time on secondment at Tyndall) to Vinca Institute
Duration: one day (19 December 2011)

Short visit to third laboratories 4.2
Summary: Visit of Goran Ristic, Nikola Vasovic, and Marko Andjelkovic from APL to Vinca Institute
Duration: one day (17 March 2012)

Short visit to third laboratories 4.3
Summary: Visit of Goran Ristic and Jugoslav Karamarkovic to CERN
Duration: three days (21-23 November 2011)


Jugoslav Karamarkovic, Aleksandar Jaksic, Oskar Olszewski, Goran Ristic, and Ali Zadeh at ESA-ESTEC

Short visit to third laboratories 4.4
Summary: Visit of Aleksandar Jaksic to Austrian Institute of Technology (AIT), Vienna
Duration: two days (16-17 December 2011)

Short visit to third laboratories 4.5
Summary: Visit of Aleksandar Jaksic, Oskar Olszewski from Tyndall and Nikola Vasovic (on secondment from APL at Tyndall) to ESTEC, The Netherlands
Duration: four weeks (04 February – 04 March 2012)

Short visit to third laboratories 4.6
Summary: Visit of Goran Ristic and Jugoslav Karamarkovic from APL, and Aleksandar Jaksic and Oskar Olszewski from Tyndall to ESTEC, The Netherlands
Duration: three days (28-30 March 2012)

WP4: Recruitment of new researchers

During the course of the project, within the limits of budget originally planned for hiring, national legislation and EC guidelines for recruitment of researchers, the following five young researchers were employed at APL at EF-UNINIS:

- Marko Vukcevic, from May 2008 to December 2009 (left for private reasons),
- Nikola Vasovic, from May 2008 to April 2012,
- Marko Andjelkovic, from April 2010 to April 2012,
- Miomir Todorovic, from September 2010 to April 2012,
- Ulgljesa Jovanovic, from September 2011 to April 2012.

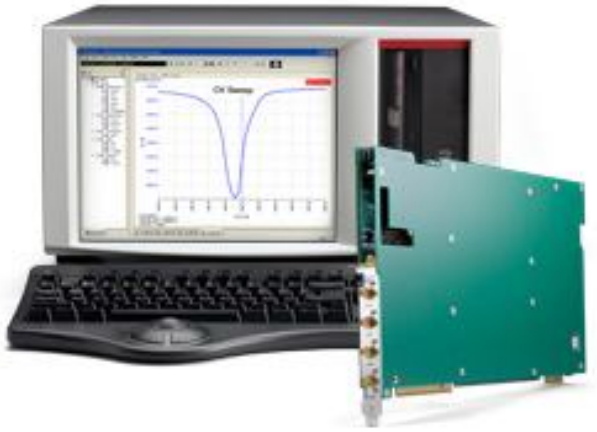
WP5: Upgrade and renewal of equipment

The bulk of most critical and expensive equipment was purchased at the beginning of the project (in the first year); this is described in deliverable D5.1. In the subsequent years the renewal of APL equipment was continued in accordance with original project plan and the needs that have arisen in the meantime. The following tables summarise purchased equipment by the project year.

Year 1/2 (see deliverable 5.1 for details)

No	Equipment Item	Description	List Price (USD)
1	Keithley 4200-SCS/F	Semiconductor Characterization System with two Medium Power Source Measure Units with Flat Panel Display	36,915
1.1	Keithley 4200-SMU	Additional Medium Power Source Measure Unit for 4200-SCS	5,980
1.2	Keithley 4210-SMU	High Power Source Measure Unit for 4200-SCS	9,545
1.3	Keithley 4200-PA	Remote PreAmp Option for 4200-SMU, extends SMU to 0.1fA resolution	2,294
1.4	Keithley 4200-PG2	Dual Channel Pulse Generator Module for 4200-SCS	11,960
1.5	Keithley 4200-CVU	CV Module for 4200-SCS	10,965
2	Keithley 2636	Dual Channel System SourceMeter (Low Current)	16,094
3	Keithley 4200-UL-LS-12	Ultra Low Current, Local Sense, Switch Matrix, 8 inputs by 12 outputs, 3-lug Triaxial Cables	16,675
4	Keithley Component Text Fixture	Test fixture for connection of packaged semiconductor devices to measurement equipment	4,000
			Total with discount 91,542 USD **(64,643 EUR)**

Total for Year 1/2: 64,643 EUR



Keithley 4200-SCS/F (Item 1 in the equipment table above)

Year 3

Item No.	Description	Price (EUR)	Purchase date	Installation date	Remarks
1	2 x automated RADFET reader	2 x 3,831 = 7,662	29/09/2010	01/11/2010	Item No. 6 in equipment list
2	Model 2400 Keithley SourceMeter, 200 V, 1 A, 20 W	3,359	29/03/2011	20/05/2011	Item No. 8 in equipment list
3	Model 3390 Keithley 50 MHz Arbitrary Waveform Function Generator	1,488	29/03/2011	20/05/2011	Item No. 4 in equipment list
4	Desktop working station PC for MC simulations	1,015	09/09/2010	20/09/2010	Item No. 5 in equipment list
5	Microcontroller board kit	630	26/11/2010	08/12/2010	Item not on list
6	Notebook computer	523	23/12/2010	29/12/2010	Item No. 5 in equipment list

Total for Year 3: 14,677 EUR

Year 4

Item No.	Description	Price (EUR)	Purchase date	Installation date	Remarks
1	Spectrum analyzer Aaronia SPECTRAN V4 up to 9.4 GHz	1931.32	14/10/2011	15/11/2011	Item No. 12 in equipment list
2	Scanning Transient Current Technique (S-TCT) System for silicon diode radiation defects investigation	9398.70	12/3/2012	23/4/2012	Item not on list
3	Oscilloscope Tektronix DPO 5104 (Digital Phosphor, 1GHz, 10 GS/s, 4 channels, 25M Record Length) with communication adapter	12930.80	25/4/2012	10/5/2012	Item not on list
4	Notebook computer	310.54	11/7/2011	1/8/2011	Item No. 5 in equipment list
5	Gas discharge electronic kit	675.87	6/5/2011	15/6/2011	Item not on list
6	Voltage source electronic kit	717.33	24/6/2011	15/9/2011	Item not on list
7	PIC Microcontroller programmer	81.18	24/2/2012	1/3/2012	Item not on list
8	Desktop computer	485.92	8/7/2011	1/8/2011	Item No. 5 in equipment list
9	Copy/printer/scan device HPLJ M1132	115.09	11/4/2012	15/4/2012	Item not on list

Total for Year 4: 25,735 EUR

Total during the project: 105,055 EUR

Total equipment purchases in the project were within the project budget (original budget ~114 kEUR).

Most of equipment items purchased were on the original equipment list submitted at the proposal stage. There are a few minor items (microcontroller kit in Years 3 and 4, and electronic kits in Year 4) that are outside the list. The need for these items has arisen during the project and the nature of these items is such that it is difficult to specify them before the actual work in which they are needed starts.

In Year 4 two major items not on the original list were purchased (items 2 and 3 in Year 4 equipment table). Both are related to the Scanning Transient Current Technique (S-TCT) on which APL and IJS have worked extensively during the project. After analysis of the future activities after the project, it was decided to purchase these two items. They will enable application of S-TCT in APL laboratory and facilitate future co-operation between Serbian and Slovenian laboratories.

WP6: Attendance of conferences and short courses

The following conferences were attended by project partners during the project.

Year 1
No conferences/short courses attended.

Year 2
One experienced (Goran Ristic) and one young researcher (Nikola Vasovic) from the Serbian partner (Applied Physics Laboratory – APL at EF-UNINIS) attended a one day "Radiation detection and safety course" at the Institute of Nuclear Science Vinca, Belgrade on 16 December 2009.

The same two staff members attended the national symposium "Electronic engineering applications in medicine" in Novi Sad, Serbia, 24-26 March, 2010. They presented an oral paper entitled (translation from Serbian):

- Nikola Vasovic, Goran Ristic, "Development of the prototype of the RADFET reader for medical applications"

Year 3
Goran Ristic, Head of APL, attended the most popular Serbian conference in the field of electronics. The conference is organised by the Serbian Society for Electronics, Telecommunications, Computers, Automation and Nuclear Engineering (ETRAN), and this edition was held in Donji Milanovac, Serbia, 7-10 June 2010. During the conference, Goran had an opportunity to meet numerous scientists from electronics research fields and promote APL activities and possibilities for joint work. No technical presentation was given at the conference.

Igor Mandic, experienced researcher at IJS, presented a well-received talk "The effect of magnetic field to diodes used as NIEL counters" at 11th European Conference on Radiation and its Effects on Components and Systems (RADECS), 20-24 September 2010, Austria. The part of the work was done in the RADDOS project. The influence of magnetic field on the pin diode and also RADFET readout is often not important or not considered. However, in their applications at high energy physics experiments (and potentially also in medicine) the sensors are readout in the presence of strong magnetic field, which significantly alters their response. The presented work addressed these effects. After a separate review, the paper was also published in the journal *IEEE Trans. Nucl. Sci.* Full details are as follows:

- Mandic, Igor, Ravoti, F., Glaser, M. A., Sersa, Igor, Hartert, Jochen, Franz, Sebastien, Cindro, Vladimir, Dolenc, Irena, Gorisek, Andrej, Kramberger, Gregor, Mikuz, Marko, "The effect of magnetic field on readout of diodes used as NIEL counters"

Year 4

Goran Ristic, Marko Andjelkovic, and Ugljesa Jovanovic attended the most popular Serbian conference in the field of ionizing radiation and protection – 26th Conference of the Society for Radiation Protection of Serbia and Montenegro, held at Tara, Serbia, 12 – 14 October, 2011. Marko and Ugljesa gave two very well received oral presentations relating to the realized amplifiers based on the current integration and transimpedance gain for measuring

low level direct current in dosimetric applications. The authorship and titles of these papers are as follows:

- Ugljesa Jovanovic, Marko Andjelkovic, Goran Ristic, “Realization of two amplifiers based on current integration for measuring low level direct current in dosimetric applications”
- Marko Andjelkovic, Ugljesa Jovanovic, Goran Ristic, “Realization of two amplifiers based on transimpedance gain for measuring low level direct current in dosimetric applications”

During the conference, Goran had an opportunity to meet numerous scientists from various fields of radiation, radiation dosimetry and radiation protection, promoting APL activities and RAD 2012 Conference. A lot of people who attended this Conference participated in RAD 2012 Conference.

Zbigniew (Oskar) Olszewski from Tyndall attended “Design, Test, and Packaging of MEMS/MOEMS – DTIP 2012” Conference in Cannes, France, from 25-27 April 2012. He presented an oral paper on MEMS capacitor reliability and radiation response:

- Zbiniew Olszewski, Russell Duane, Aleksandar Jaksic, “MEMS RF capacitor reliability under Co-60 irradiation”

Finally, as planned in the RADDOS proposal, the project partners Tyndall and IJS have taken strong participation at the RAD 2012 conference. Participants from IJS were: Gregor Kramberger, Marko Zavrtanik, and Igor Mandic. Participants from Tyndall were: Aleksandar Jaksic, Russell Duane, Anne-Marie McGarrigle, and Cormac Ryan.

WP7: Conference organisation

As the final activity in the RADDOS project, EF-UNINIS, with the main role of the people from APL, organized "The First International Conference on Radiation and Dosimetry in Various Fields of Research - RAD 2012", in Nis, from April 25 to April 27, in cooperation with two other project partners, Tyndall and IJS. The Conference chairman was Prof. Goran Ristic from APL and venue of the Conference was Faculty of Electronic Engineering, University of Nis. Scientific Committee consisted of 21 persons (1 from EF-ININIS, 2 from Tyndall, 3 from IJS, 4 from 4 different Universities in Serbia, and 11 from other distinguished European Institutions.

The main topics of the Conference were:

- Basic effects of ionizing radiation,
- Ionizing radiation and dosimetry in natural sciences and engineering,
- Ionizing radiation and dosimetry in medicine and environmental protection, and
- Non-ionizing radiation.

The peer reviewing process was organized for 183 received abstracts and the accepted abstracts were later printed in the Book of Abstracts. 99 contributions were received in the form of 4 page papers and printed in the Conference Proceedings. Some of the thematically matched papers will be also printed in *Safety Engineering Journal*. The quality of the contributions is evaluated as high, initially in the reviewing process, as well as during the presentations.

The Conference was structured in 5 plenary sessions with 11 invited lectures, 9 oral sessions with 51 contributions, organized in three rooms simultaneously, and 4 poster sessions organized in two terms (2 sessions were held simultaneously) with 84 contributions. Beside the presentation of invited lectures and the contributions, the Conference comprised a round table "Perspectives of Joint Research on Radiation and Dosimetry" and the special talk "First steps into the big snow – Marie Sklodowska Curie" (The life of fighting against discrimination), story told by Prof. Mimoza Ristova from Ss. Cyril and Methodius University in Skopje, Macedonia. Based on the idea of round table, the questionnaire has been prepared and research groups interested in participating in possible joint project proposals are encouraged to submit relevant data. Up to now 8 groups have been active in this informal networking.

During the Conference two exhibitors were present: Epsilon Landauer Dosimetry Technologies from Turkey and Canberra Packard Central Europe GmbH from Austria.

In total, the Conference was attended by 149 participants from 30 countries all around the world. Using the RADDOS funds, the organizers supported participation for 31 participants from Western Balkan countries, Central and Eastern Europe, former Soviet Union and third world countries providing them free accommodation in Nis during the Conference.

There are many arguments that RAD 2012 Conference was the final and the crucial event of the RADDOS project. The quality of the contributions, excellent organization of the Conference, the number of participants (initially planned for up to 50 people it ended up with three times more), their distribution (approximately one third from Serbia, one third from the region and last third from the rest of the Europe and worldwide) and the reactions after the

Conference confirmed that Applied Physics Laboratory of EF-UNINIS has become the recognizable point on the European scientific map.

The Conference was organized by the hard and enthusiastic work of a small group of APL members, supported by some MSc students from the University of Nis. Beside the appropriately scheduled presentation of invited lectures, oral and poster contributions, rich social life and numerous events enabled participants to feel friendly and encouraged the professional discussions.

It should be noted that the project partners, Tyndall and IJS, very significantly contributed to the success of the conference. They were actively involved in the conference planning from the beginning and contributed with attracting world renown scientists to give a talk at the conference. In addition to the help in conference organisation, Tyndall organised and fully financially supported the gathering of distinguished participants and invited speakers in Belgrade before the conference, during which a visit to the Vinca Institute radiation facilities was organised.

Following the great success of RAD 2012, it has already been decided to organize the second conference, RAD 2014 in Nis.

WP8: Dissemination and promotional activities

The web page of the Applied Physics Laboratory of EF-UNINIS (www.apl.elfak.rs), containing the information about the RADDOS project, has been regularly updated.

The promotional leaflet of APL was designed and put on the web site. In addition, a high quality hard copy of the leaflet was produced in 1,000 copies and distributed to interested parties in Serbia, Western Balkan countries, Europe, and worldwide.

RAD 2012 Conference, covered in detail in a separate work package description, was an ideal opportunity for dissemination with distribution of promotional leaflets, visits to the laboratory facilities, and indirect advertising of APL through excellent organisation of all events. In conjunction with RAD 2012, several local and national newspapers published interviews with the conference organisers. Finally, a debate about importance of radiation and dosimetry research was organised at the television station TV5, with the participation of conference chairman, RADDOS project co-ordinator, and one of the invited speakers at the conference.

2.4 Potential impact

This section outlines the impact of the project activities by work packages. Dissemination activities are addressed in the previous section, under description of activities in WP7 (conference organisation) and WP8 (dissemination and promotional activities). Further, the list of all publications arising from the project is given in deliverable D9.

Regarding WP1 (secondments), WP2 (short visits between the partners), and WP3 (short visits to third laboratories), visits resulted in acquainting of participating staff with new working environments, new technical and social experience, and gaining technical expertise at world leading facilities. The visiting researchers were trained in state of the art research techniques and upon return to Serbia were able to transfer that knowledge to Serbian colleagues. In this way, the Serbian partner, and Serbian society in general, has benefited from increased potential to produce new value in science and technology. The project activities were also very useful for EU participants (Tyndall and IJS), as they had access to talented Serbian researchers who contributed to fulfilment of scientific and technical goals of host EU institutions.

In WP4 (recruitment), the APL directly benefited from access to the most talented young researchers available. The inverse staff experience pyramid is a problem in Serbia, with a small number of young researchers available to work in laboratories due to lack of funding and relatively large numbers of experienced researchers with limited output due to lack of younger colleagues who could realise research ideas. This situation was reversed with the RADDOS funding and APL has benefited from young enthusiastic researchers who were included in the new activities.

In WP5 (equipment renewal), the direct impact of project funds on enhancement of APL infrastructure is evident. It should be noted that the national and even international projects aimed at such a significant boost of research infrastructure are rare, so the RADDOS project was a unique opportunity in that respect. The opportunity was used very efficiently and effectively, with flexible approach in accordance with strategic and “tactical” needs. It should be emphasised that the infrastructure/equipment upgrade have brought APL to the same level as Tyndall and IJS in the relevant area covered by the project and that APL has established itself as a centre of excellence for radiation dosimetry studies in the Western Balkan region.

Both human and technological potential of APL were very significantly increased by the project, so research output increased substantially and will continue to rise as the project related upgraded infrastructure and human potential continue to act as catalysts of new technical expertise and research excellence.

WP7 (conference organisation) crowned all project activities. Conference served as the best advertisement for the APL, having in mind successful organisation of the event and opportunities that naturally presented themselves during the conference organisation. APL was presented in the best light to the scientific, technical, and political communities, the result of this exposure already visible in increased involvement with APL of national and international players.

In WP8 (dissemination activities), the direct impact of all activities is evident. Increased visibility though the new web page, promotional leaflets, conference advertising/organisation and related publicity in the press and television, has contributed to the great visibility of APL as the major research group in its research field in both national and international levels. This

has already resulted in increased co-operation with complementary groups in Serbia (important new national project), Western Balkan, and internationally (established co-operation with several world renown research institutions).

To summarise, though carefully planned and efficiently executed set of concerted interdependent actions, RADDOS project has significantly enhanced human, scientific, and technological potential of the Applied Physics Laboratory at EF-UNINIS and increased its visibility at the national, regional, and international level. Activities are under way to fully exploit these results by enhancing the network of research collaborators and increase participation in the research community by new projects, including those funded by EC.

Expected impact of the REGPOT-2007-3 activity, under which the project was funded, was:

- Accelerate the setting up of sustainable partnerships between the most competitive RTD centres of EU's convergence and outermost regions, Member States and Western Balkan Countries whilst boosting regional cooperation contributing to socio-economic needs;

- Improving and/or enlarging the RTD capacity of Western Balkan centres of competence in terms of S&T policy and research programmes, scientific and technical human resources and S&T infrastructures;

- Better and more integrate Western Balkan countries in the FP7 networks and RTD projects as well as in the Member State's national cooperation programmes as a prerequisite of these countries successful integration into the European Research Area.

It can be concluded that the RADDOS project has fully achieved the expected impact.