

Upgraded Facility for Development of Silicon and Diamond Particle Detector Systems

PARTICLE DETECTORS

Tome Anticic

<http://lnr.irb.hr/pd>

FP7 Capacities,
Start 01.08.2010
End 01.08.2013



Division of experimental physics (DEP)

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Scientific activities at DEP at RBI

62 seniors and grad students

Particle physics
Nuclear physics

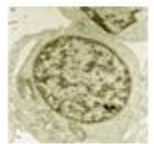
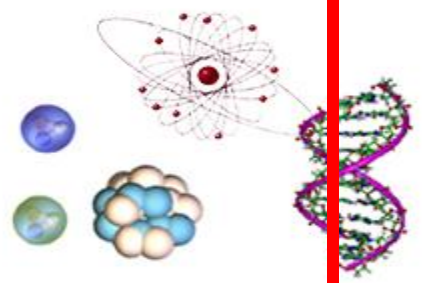
Solid state physics

Chemistry-biology

geophysics

astronomy

cosmology
astrophysics



10^{-15} 10^{-12} 10^{-9} 10^{-6} 10^{-3} 1 10^3 10^6 10^9 10^{12} 10^{15} 10^{18} 10^{21} 10^{24}



fm pm nm μ m mm m km Mm Gm Tm Pm Em

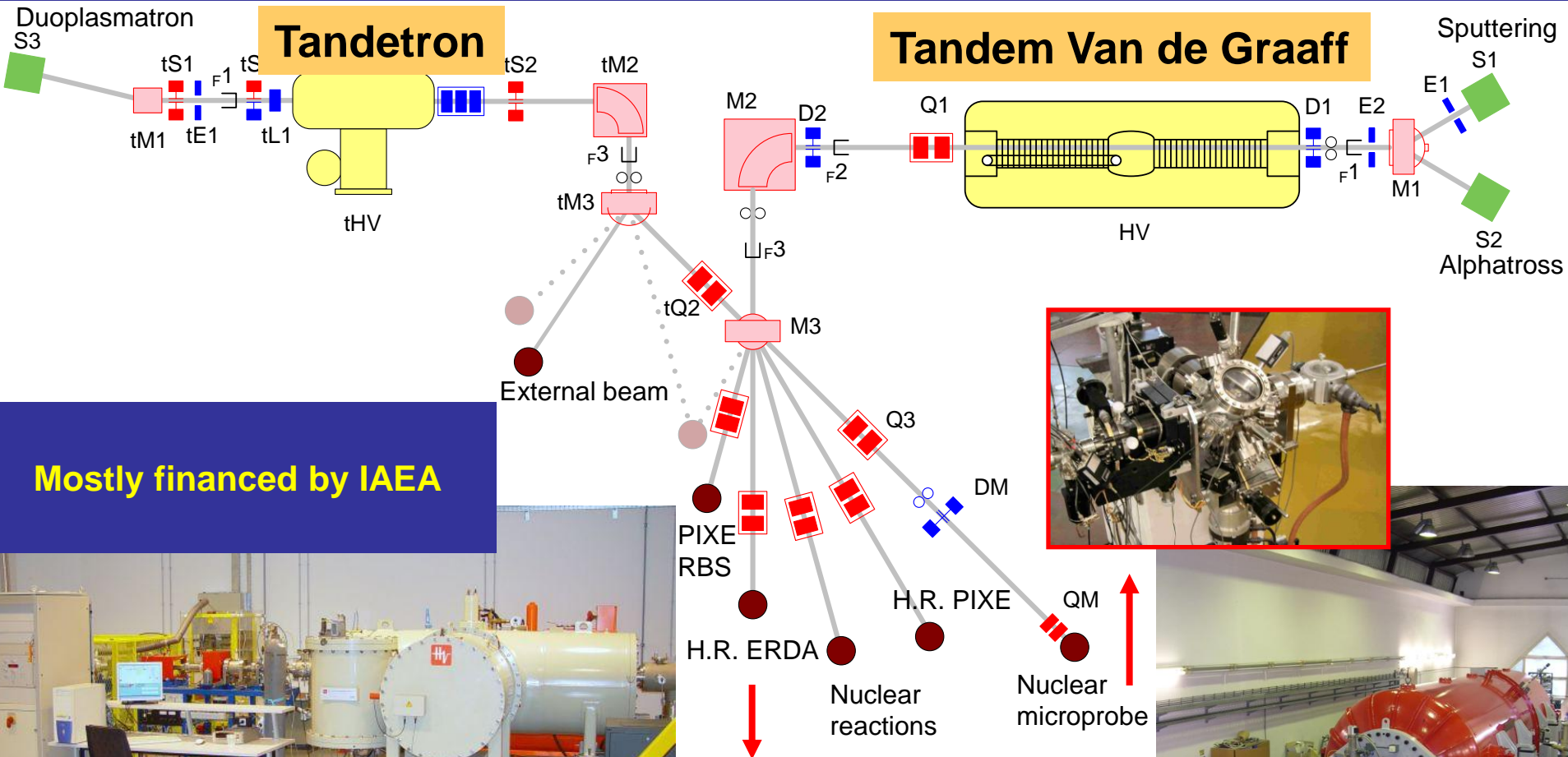


10^{-15} m = 0,000 000 000 000 001 m

International facilities used



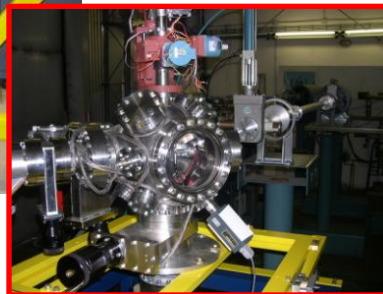
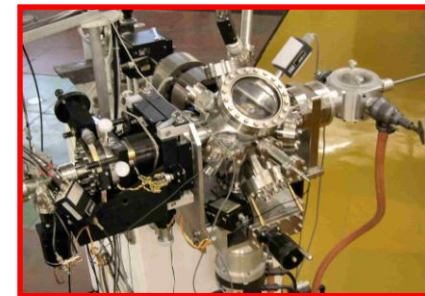
Equipment



Mostly financed by IAEA

Numerous international users

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Project goal

Even though RBI has

- **Good physicists,**
- **Active on numerous top experiments,**
- **Possesses good know-how,**
- **Has a good detector testing facility (Van De Graaff)**

But

- **lack of specialized equipment, instrumentation, staff, detectors**
- **very excessive fragmentation of small groups across many experiments**

Prevents:

- **A more prominent role in international experiments,**
- **Greater scientific impact**
- **A larger experimental contribution to international and local experimental facilities.**

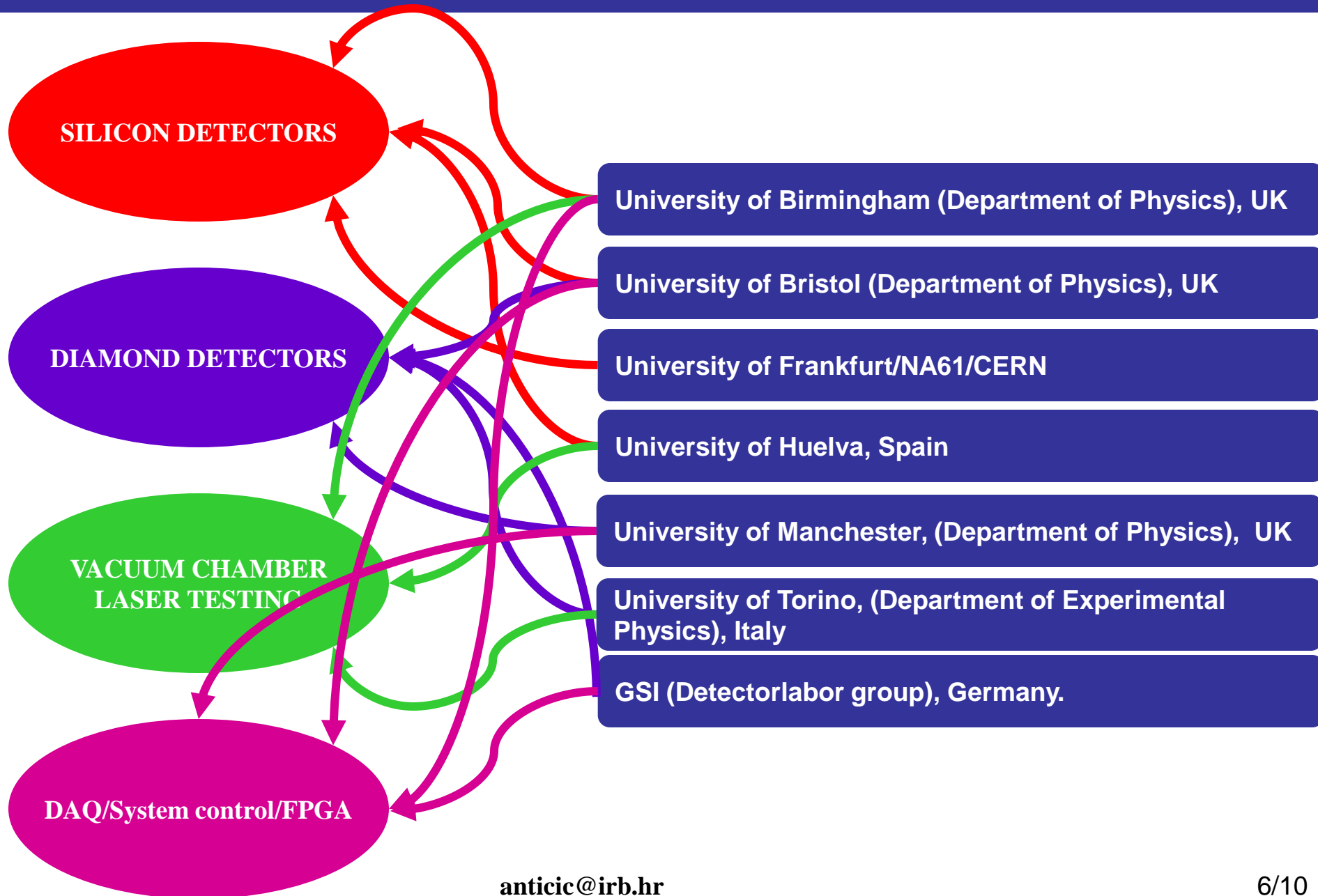
Solution

FP7 project that builds on existing know-how, puts to use existing strong facilities, uses existing membership in top experiments in order to significantly increase the experimental capacity and human potential

Focus

- **silicon detectors** and readout
- **diamond detectors** and readout
- testing detectors: **vacuum chamber and laser system**
- **DAQ and detector control**

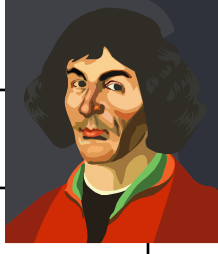
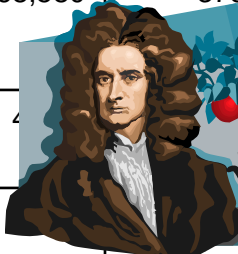
Partners



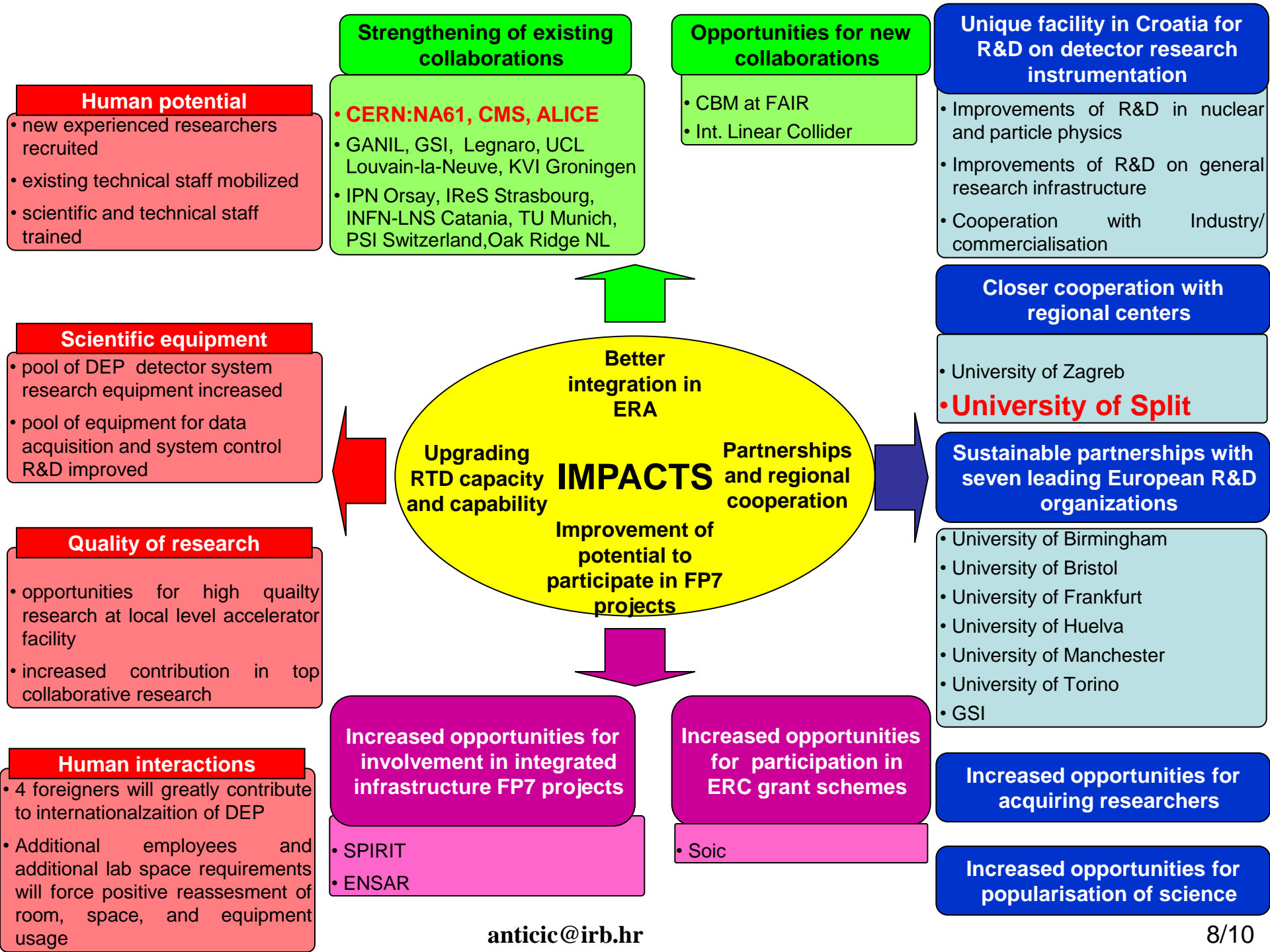
Finances + manpower

	Management	Silicon	Diamond	Detector testing	DAQ/control	Dissemination	Total
Labour cost	40,500	114,750	101,250	93,850	110,250	13,500	474,100
Travel	28,080	56,400	35,160	18,600	26,100	32,400	196,740
Workshop	0	10,200	10,200	0	10,200	14,500	45,100
Equipment	0	183,000	91,000	121,000	75,500	0	470,500
Materials	0	11,000	0	0	0	9,300	37,600
Other	0	0	0	0	0	4,500	4,500
Sub-total	68,580	378,650	243,110	241,950	222,050	74,200	1,228,540
Overhead 7%	4,801	26,506	17,018	16,937	15,543	5,194	85,998
Subcontracting /audit costs	0	0	0	0	0	0	5,000
Totals						94	1,319,538 €

+ 4 Foreign experts (~postdocs)

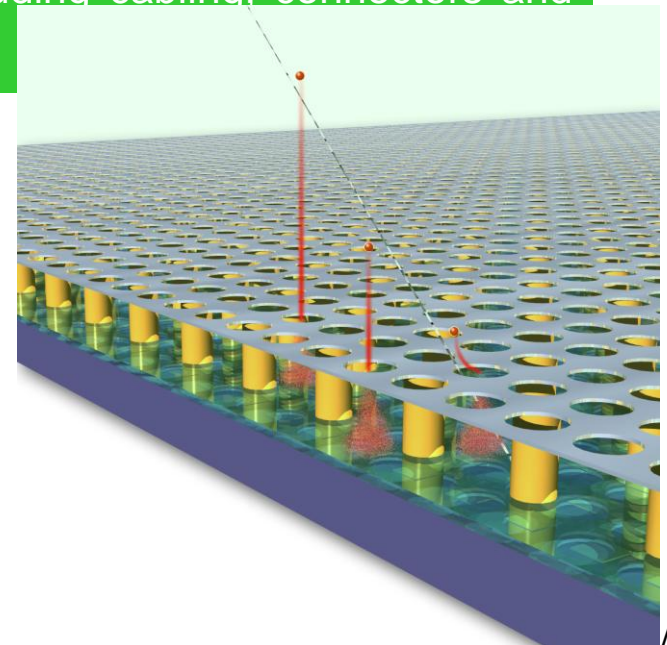
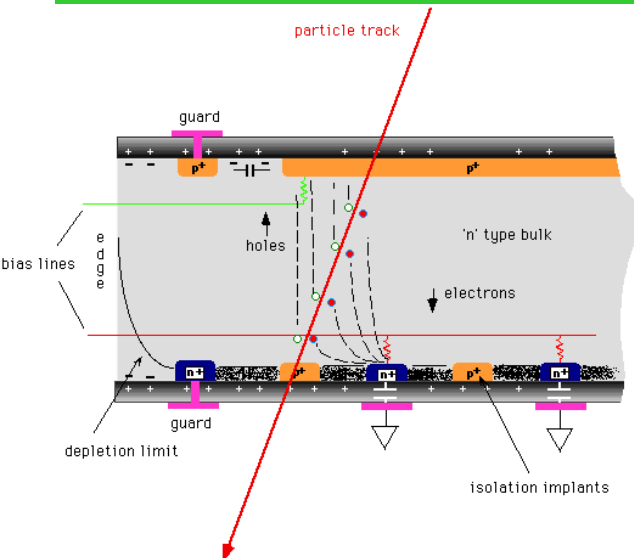


Positions open, if you have candidates, send an email



Silicon

- silicon detectors for charged particles detection (thin 10-20 μm small area detectors, 1D position sensitive detectors, double-sided strip detectors, thin 20-30 μm large area strip detectors and position sensitive strip detectors). The estimated cost for these is 83500 €.
- State-of-the-art silicon pixel detectors as part of **CERN upgrades: NA61 at CERN (GOSSIP/MediPix/TimePix)- ? ATLAS?**. The estimated cost for these is 41500 €.
- Procurement of detector readout electronics and modules including crates and related materials. Included are pre-amplifiers, multi-channel amplifiers, gate generators, FIFOs, logic units, multi-channel fast discriminators, counters, logic analyser, and power supplies. Estimated cost is 58000 €. Material costs, including cabling, connectors and adapters are about 14300 €.

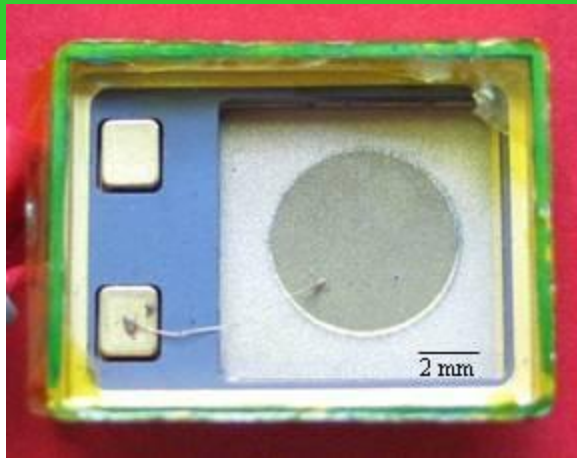


Thank you

**And hope we will cooperate much
more in the near future**

Diamond

- Procurement of state-of-the-art diamond detectors: CERN, FAIR (CBM). The estimated cost for these is 62500 €.
- Procurement of diamond detector readout electronics and modules, and related materials. Estimated cost is 28500 €. Material costs, including cabling, connectors and adapters are about 5500 €.



+ 1 Foreign expert

Detector testing: Vacuum chamber + laser

- Procurement of equipment/tools for assembly of the vacuum chamber. Included are a dedicated vacuum system (pumps, valves and vacuum-meters), a beam-guiding system (electro-magnetic elements and collimators) and a detector signal feed-through system for large number of detector elements. The estimated cost is 79000 €. Material cost is about 8500 €.
- Procurement of a 3-stage goniometer to be able to rotate a detector in the vacuum chamber. Estimated cost is 22500 €.
- Procurement of a table-top laser testing setup. Included is an optical table, motorized x-y translation stage with micrometer accuracy, and a mW CW laser. Estimated cost is 19 500 €.



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+ 1 Foreign expert

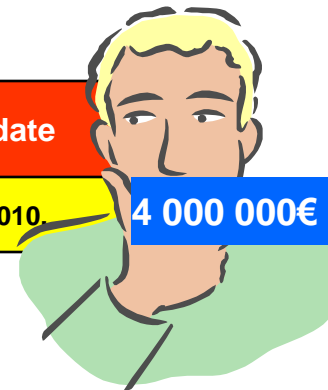
DAQ/FPGA/LabView

- Electronics circuits simulation and design software as well as of the equipment for PCB prototyping. Estimated cost is 11500 €.
- Procurement of PCI bus based DAQ board systems. Estimated cost is 9500 €.
- Procurement of Field Programmable Gate Arrays (FPGA), as well as state of the art FPGA development boards Estimated cost is about 19000 €.
- Procurement of site-wide software for programming and controlling FPGAs and FPGA development boards, based on the Matlab and Simulink environment. Estimated cost is 11600 €.
- Procurement of site-wide LabView software, with real time simulation extension. This software is in common use for detector system control at numerous experiments, including many of the ones researchers from the NPP laboratories are part of (NA61 at CERN, PRISMA/CLARA setup at INFN-LNL, experimental end stations at GANIL). Estimated cost is 9500 €.
- Upgrade and enlargement of existing Data Acquisition VME modules (ADC and QDC units, processor, crate). Estimated cost is 14500 €.

+ 1 Foreign expert

More finances and equipment

•FP7, IPA and many other external sources of funding...



Planned project	Description	Coordinator	Due date
FP7-REGPOT-2011-1	Astroparticle at RBI	Antičić/Surić	Fall 2010.

4 000 000€

Division has excellent track record (6 ongoing FP7 projects)

MZOS

FP/IAEA/industry ...

~210 000 €

2009

~500 000 €

~150 000 € ?

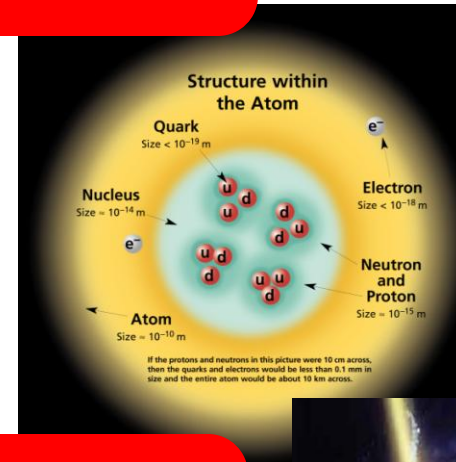
2010

~1 000 000 €

Scientific activities II

Elementary nuclear and particle physics

- **Properties of elementary particles and interactions:**
 - Heavy boson production
 - Matter/antimatter symmetry
 - axions
- **Properties of nuclei and nuclear reactions:**
 - Composition of nuclei
 - Properties of extremely energetic and pressured nuclei
 - Strangeness



Fundamental astrophysics and cosmology

- **Structure and evolution of universe, galaxies, black holes, stars, dark matter**

Nuclear physics applications and other applications

- **Development of materials and their modification/nanostructures**
- **Carbon dating**
- **Interdisciplinarity: quantum computing, archaeology, geology ...**
- **Mine and bomb detection through nuclear methods**



Work at local and international experimental facilities

DEP performs at several levels top science

• Reflected in number and quality of publications:



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From 1998 till 2008 DEP :

575 publications (15% IRB)

7677 citations (30% IRB)

(DEP 9% IRB)

Participants

- Laboratory for ion beam interactions
- Laboratory for nuclear physics
- Laboratory for high energy physics

Largest DEP laboratories

~33 employees,
15 directly included

Dr. Stjepko Fazinic
Dr. Milko Jaksic
Dipl. ing. Natko Skukan
Dipl. ing. Mladen Bogovac
Dr. Tonci Tadic
Dr. Iva Bogdanovic

Dr. Tome Anticic
Dr. Vuko Brigljevic
Dr. Tatjana Susa

Dr. Neven Soic
Dr. Mladen Kis
Dr. Suzana Szilner
Dr. Zoran Basrak
Dr. Roman Caplar
Dr. Sasa Blagus



deciding on how much
money to ask for...

Staff

Senior Scientist	12
Senior Research Associate	11
Research Associate	6
Senior Assistant	4
Students and assistants (12 Ph.D. candidates)	15

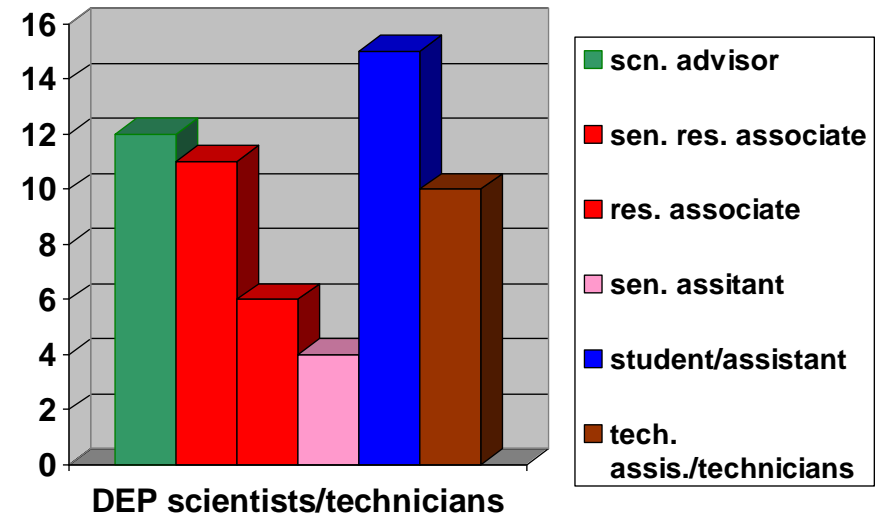
Technical assistants	4
Tehnical staff	6

58 scientists and technicians



9% RBI science potential

Volunteer students 4



Administrative staff 2

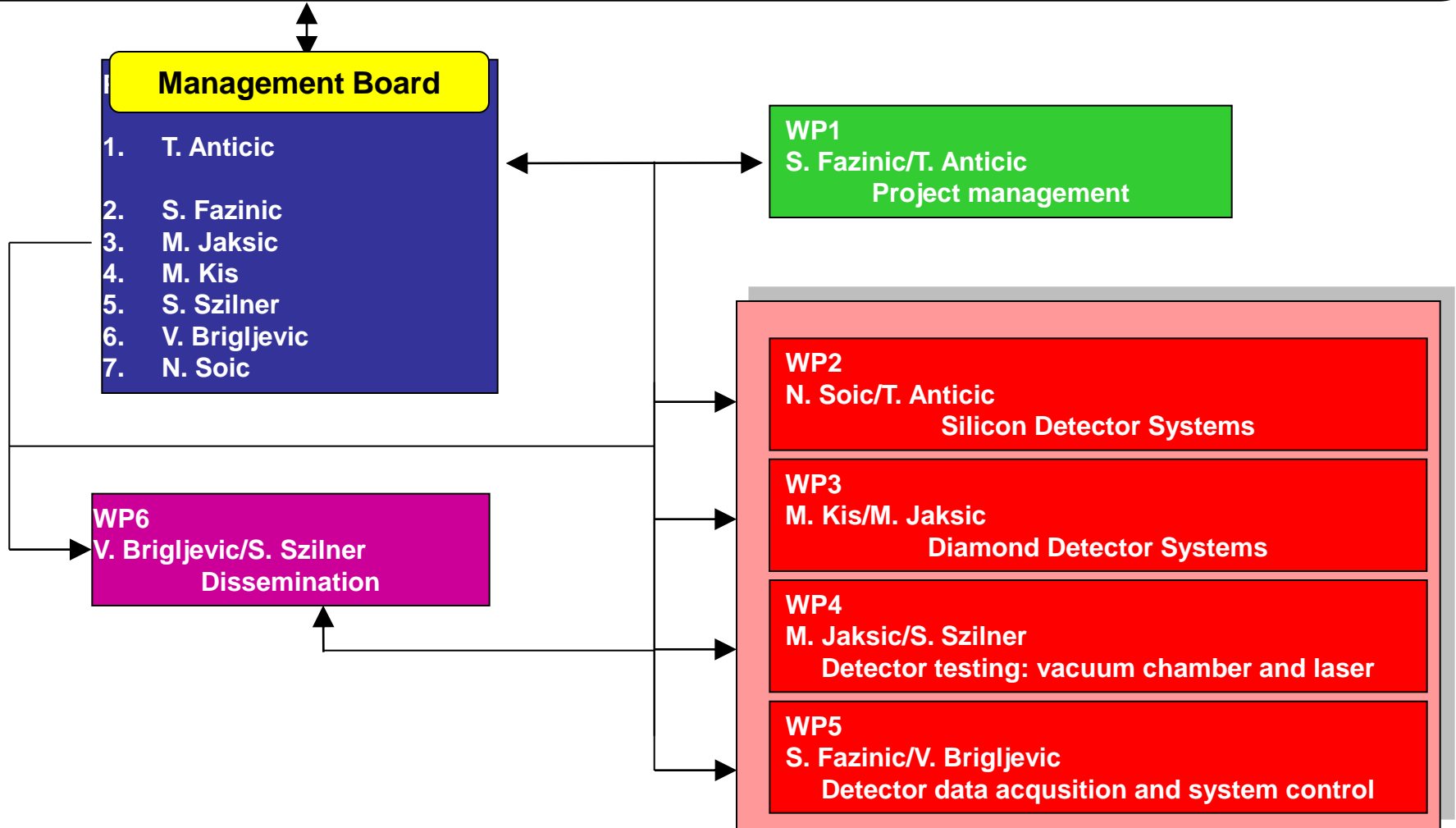
Several retired DEP staff who contribute to DEP in numerous ways

A very large number are either expats or have a significant scientific experience outside Croatia

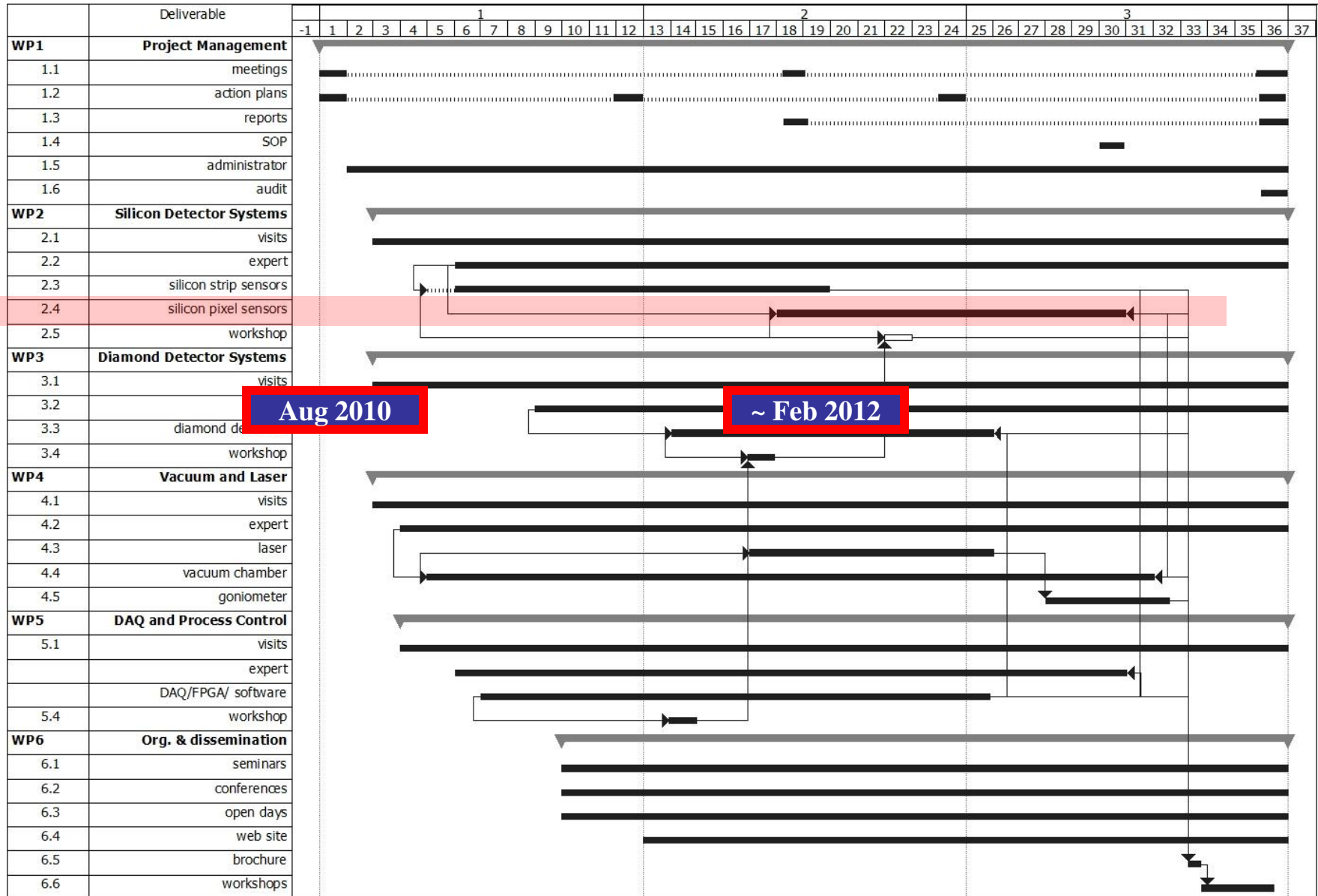
Project Steering Committee

Marek Gadzinski, University of Frankfurt/CERN/NA61
Joel Goldstein, University of Bristol
Martin Freer, University of Birmingham
Danica Ramljak, RBI director

Djuro Miljanic, Croatian National Science Council
Alexander Oh, Manchester University
Ettore Vittone, University of Torino
Ismael Martel, University of Huelva
Christian Joachim Schmidt, GSI



Timeline for pixel detectors



Current and new FP7 and European projects



Obhodaš	FP7	UNCOSS	12/2008	11/2011	404 000
Supek	FP7	HadronPhysics2	1/2009	6/2011	11 000
Jakšić	FP7	SPIRIT	3/2009	2/2013	214 000
Obelić	FP7	SOWAEUMED	12/2009	11/2012	75 000
Iva Bogdanović Radović	IAEA	Upgrading Nuclear Analysis Techniques for Air Pollution Monitoring	1/2009	12/2011	167 000
Siketić	IAEA	Improvement of the Reliability and Accuracy of Heavy Ion Beam Nuclear Analytical Techniques	9/2007	12/2011	15 000
Soić	FP7	CLUNA	5/2008	4/2010	291 000
Soić	ESF	Physics of Compact Objects: exploring nucleosynthesis and evolution	2010	2012	150 000
Antičić	FP7	Particle Detectors	2010	2012	1 320 000