



JR06: EWIRA

East-West Integrated Research Activities

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Warsaw Town Meeting, June 17th – 20th, 2013

History

FP6: THE EAST-WEST-OUTREACH NUCLEAR PHYSICS NETWORK (EWON)



The network aimed to:

- a) strengthen the involvement of their nuclear physics communities in the research programmes of the European Large Research Infrastructures (ELRIs), and
- b) enhance collaboration between scientists in these communities.

FP7: East-West Integrated Research Activities (EWIRA)

... a key activity aims at integrating the laboratories in ***Central and South-Eastern European countries*** with those elsewhere in Europe, by developing novel technologies and methodologies of universal benefit that could be used both at these laboratories and elsewhere (**EWIRA**). These developments will give a strong impetus to these laboratories and their communities and enhance their external use.

LABORATORIES

- Tandem Laboratory, National Centre for Scientific Research (NCSR) “Demokritos” Athens, Greece
- Tandem Laboratory, National Institute for Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
- Cyclotron Laboratory, Institute of Nuclear Research (ATOMKI-HAS), Debrecen, Hungary
- Cyclotron Laboratory, Nuclear Physics Institute of the ASCR (NPI), Rez near Prague, Czech Republic
- Heavy Ion Laboratory, University of Warsaw (UWAR), Poland
- Tandem Accelerator Center, Rudjer Boskovic Institute (RBI), Zagreb, Croatia
- The Institute of Nuclear Research and Nuclear Energy (INRNE-BAS), Sofia, Bulgaria
- The Henryk Niewodniczanski Institute of Nuclear Physics (IFJ-PAN), Krakow, Poland

TASKS

T1: Novel approach to static moments and lifetime measurement techniques and novel instrumentation for rare nuclear processes (IFIN-HH)

T1.1: New plunger devices for stable and radioactive beams in different energy regimes and Doppler-shift techniques for lifetime measurements

(Uni Köln , **IFIN-HH**, NCSRD, INRNE-BAS, CNRS, CEA)

T1.2: New instrumentation for ultra-high efficiency and precise off-beam γ -ray spectroscopy studies

(**IFIN-HH**, INRNE-BAS, TUD, CNRS)

T1.3: Static moments of isomeric and short-lived excited states
(**CNRS**, INRNE-BAS, IFIN-HH)

T1.4: New e^+e^- spectrometer for rare nuclear processes
(**ATOMKI-HAS**, NCSRD, RUG, NIKEFF, Free Uni, JYU)

T2: Novel highly-segmented detectors for Coulex measurements and ion-beam applications and novel target developments (UWAR)

T2.1: Novel highly-segmented CVD scattered beam detector and novel techniques for data analysis for Coulomb excitation measurements (IFJ-PAn, **UWAR**, CEA, RBI, NCSRD, IFIN-HH, Uni Köln, INRNE-BAS, UoY)

T2.2: Segmented detection systems for increased particle detection sensitivity and imaging of light elements using coincidence ion beam analysis techniques (**RBI**, UWAR, ATOMKI-HAS, IFJ-PAN)

T2.3: Development of novel targets for neutron production (**NPI**, CEA, FZK)

T3: Outreach activities (INRNE-BAS)

T3.1: Setting a common Scientific Advisory Committee (SAC) and organizing a User Community for the Central and South-Eastern European laboratories (**INRNE-BAS**)

T3.2: Foresight study of the strategic development of the EWIRA laboratories (**NPI**)

INSTRUMENTATION, METHODOLOGY AND SOFTWARE

- plunger device with tracking capabilities
- ultra-high efficiency array for off-beam γ spectroscopy
- array of CVD diamond pixel detectors
- new position sensitive detectors for IBA applications (M-JRA06-2.2)
- MICROMEGAS e^+e^- detector system (M-JRA06-1.4)
- software for analysis of multiple Coulex
- conceptual design of a neutron production target (M-JRA06-2.5)
- novel methods for moment measurements

WORKING GROUPS

- WG on static moments and TF and RIV techniques (M-JRA06-1.2)
- WG on DS lifetime measurements (M-JRA06-1.3)
- WG on Coulex analysis (M-JRA06-2.3)
- WG on EWIRA foresight study

MEETINGS

- EWIRA workshop (Sofia) – month 42 (2014)
- establishment of a common SAC of the EWIRA laboratories – month 32 (will be in the fall 2013)

DELIVERABLES

- plunger device with tracking capabilities (36)
- report on novel experimental techniques for static moments and lifetime measurements (48)
- report on novel experimental approaches on electromagnetic moments via Coulex measurements, on the performance tests of an array of position sensitive detectors for IBA and on design studies for neutron production targets (48)
- MICROMEGAS detector for rare nuclear processes (46)
- work agenda of the EWIRA SAC and report on foresight study (48)
- EWIRA web-cite (6)



JRA06

Table 2: Deliverables and milestones

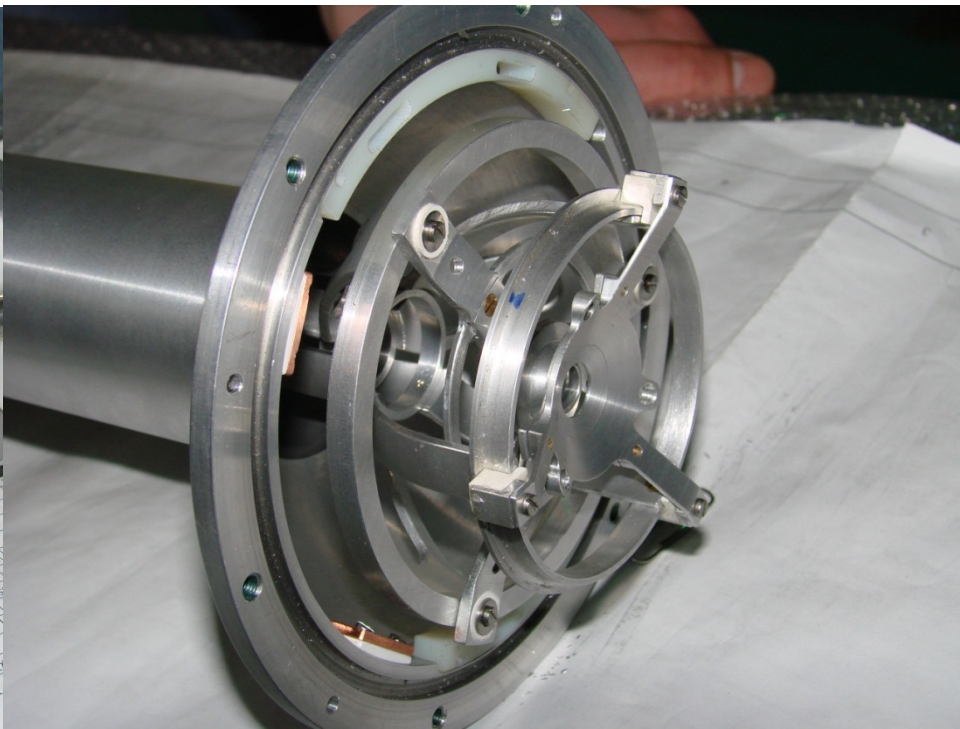
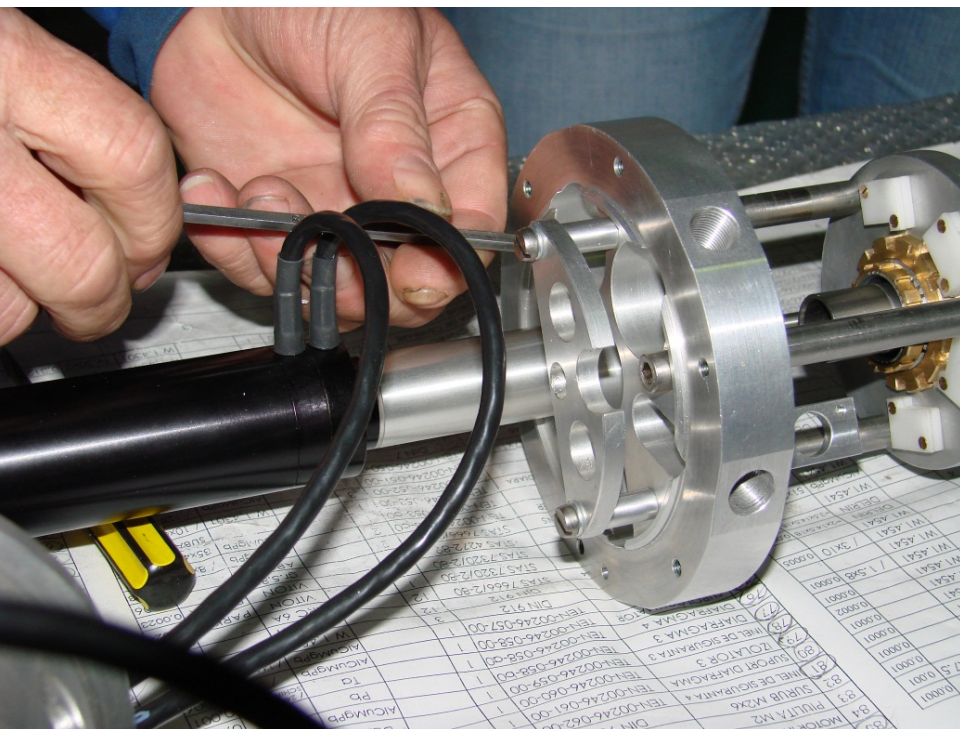
D-J06-3.1 EWIRA website to disseminate information on EWIRA activities

T-J06-3 INRNE 6

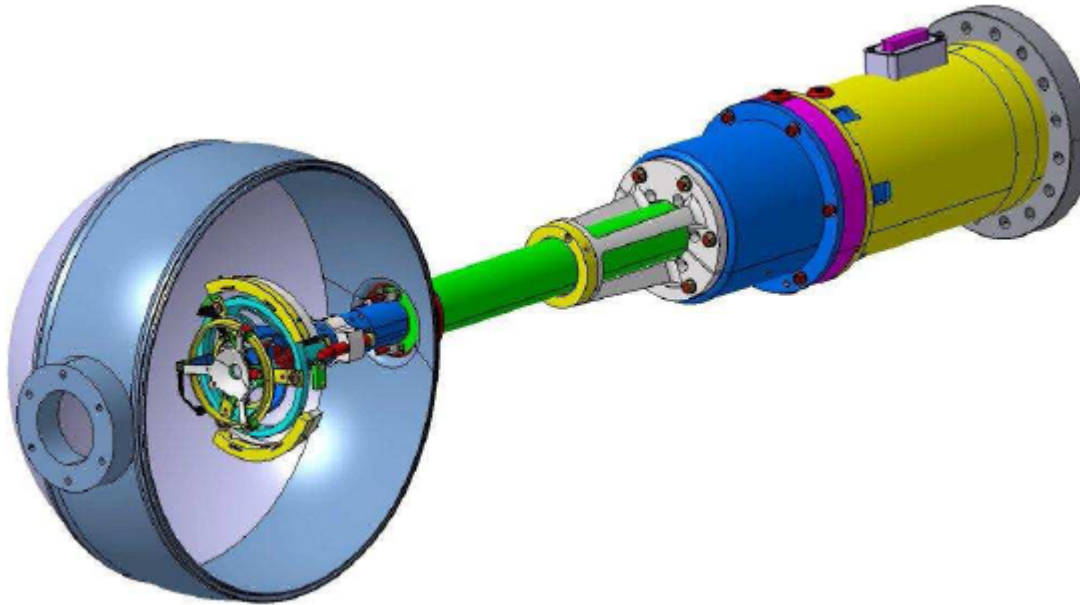
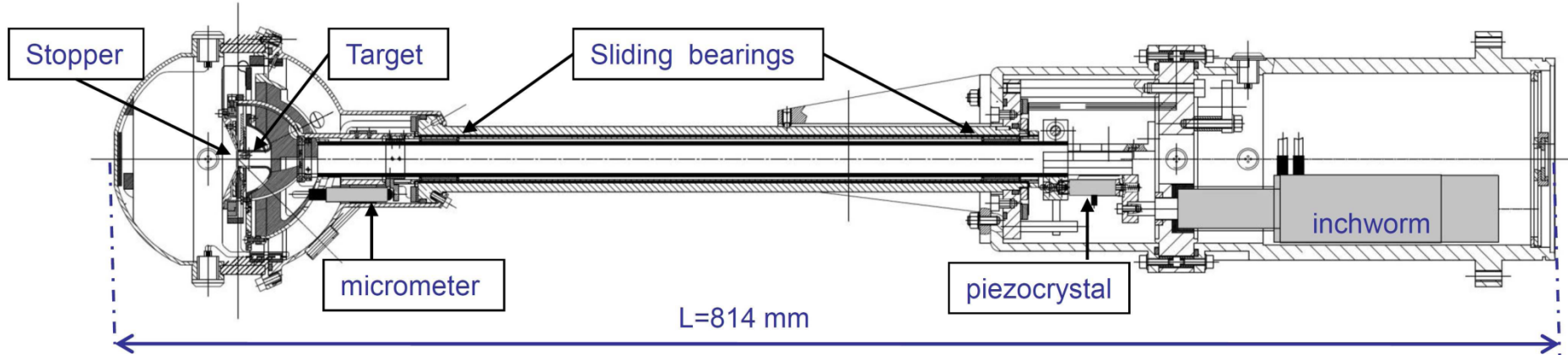
<http://web.inrne.bas.bg/ENSAR/>

M-J06-1.1 Design of a plunger for stable beams with tracking capabilities

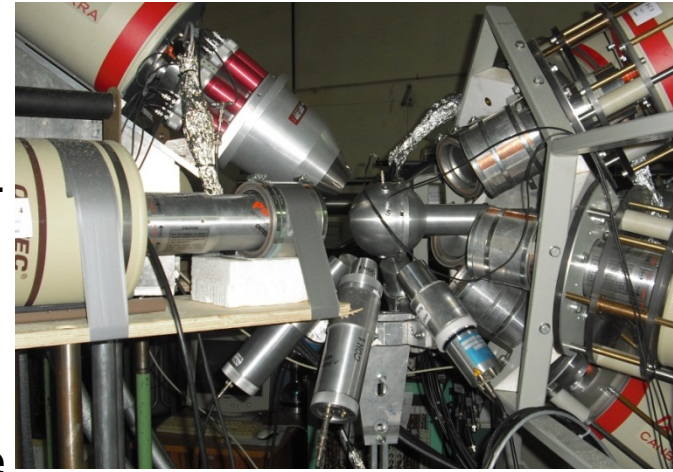
T-J06-1 IFIN-HH 17



The Bucharest plunger



Plunger detector chamber



ST1: Design of a plunger device with tracking capabilities. Meeting on RIV plunger at Cologne in 2012.

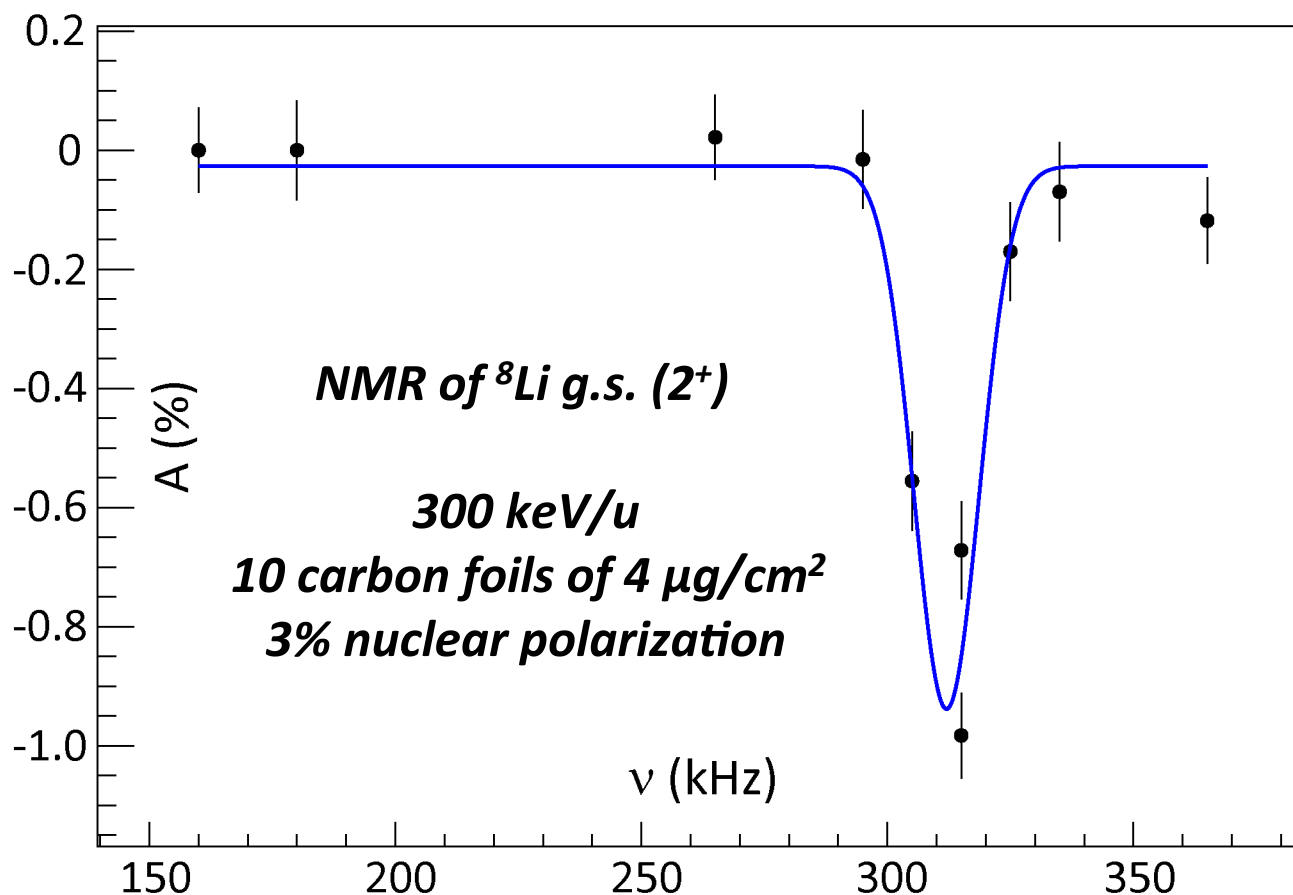
ST2: The off-beam γ -ray spectroscopy setup will include CLOVER detectors, $\text{LaBr}_3(\text{Ce})$ or CeBr_3 scintillators and a moving tape for radioactivity transport. The setup will be installed on a dedicated beam line at IFIN-HH (month 42).

ST3: A working group on developments related to the measurements of static nuclear moments with radioactive beams has been established (meeting at Orsay, May 2013) Experiments have been performed at (i) LNL for investigating the possibilities of using multinucleon transfer reactions for nuclear moment studies of isomeric states, (ii) at the Tandem-ALTO laboratory – a proof of principle of the TDRIV method, and (iii) at ISOLDE for polarization of post-accelerated RIBs.

(see the talk of Deyan Yordanov on Wednesday, June 19th, 2013)

ST4: Mechanical design and (partly) the construction of the COPE (Compact e^-e^+) spectrometer are ready. The design of the TPCs is ready and a prototype is under construction. New software for reading out a DT5740 (CAEN) digitizer is developed. The electronics has been tested. (month 46)

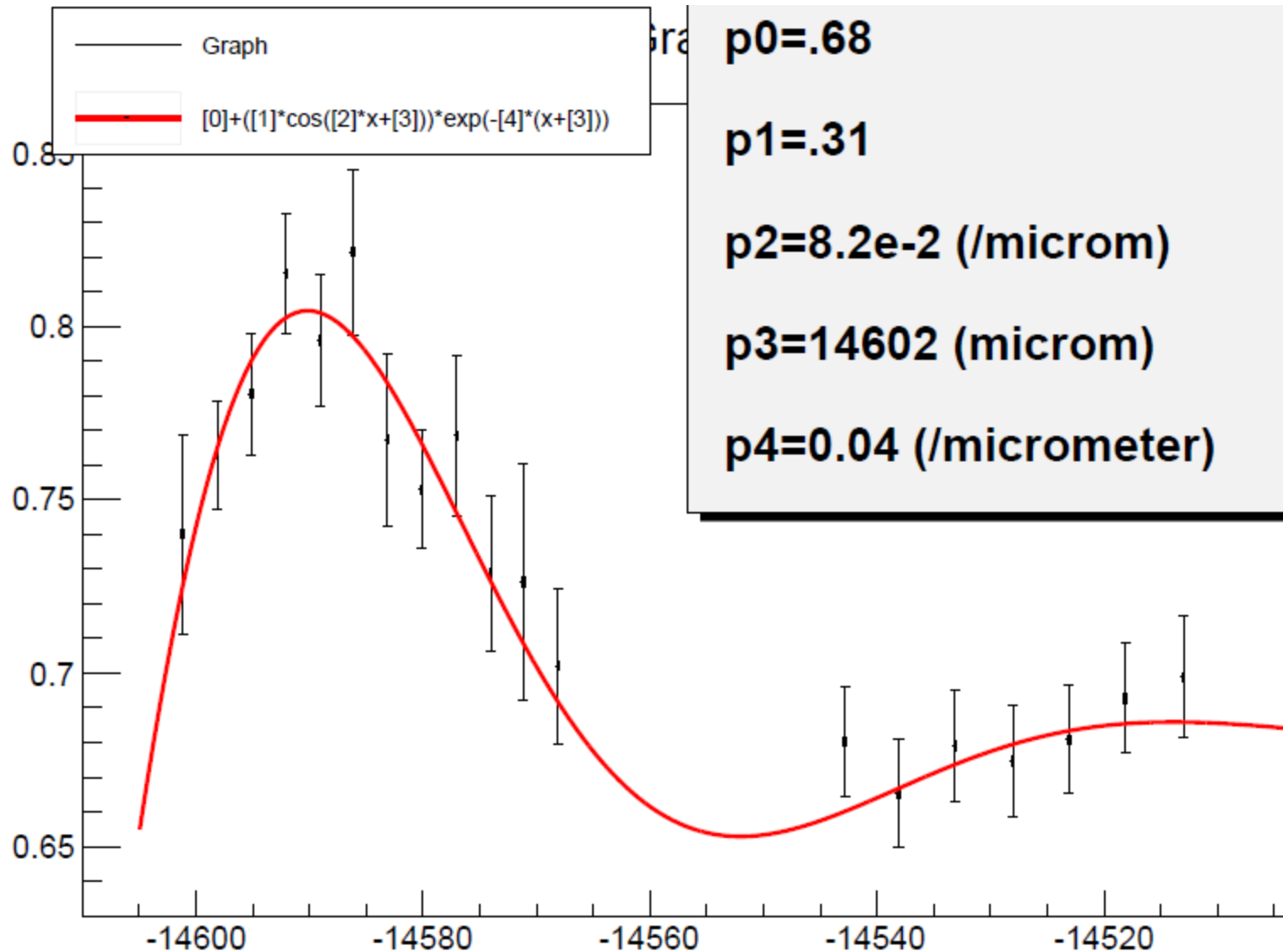
July 2012: First successful TF test at REX-ISOLDE (INTC-I-083)



consistent with: Hirayama et al., Eur. Phys. J. A 48, 54 (2012)

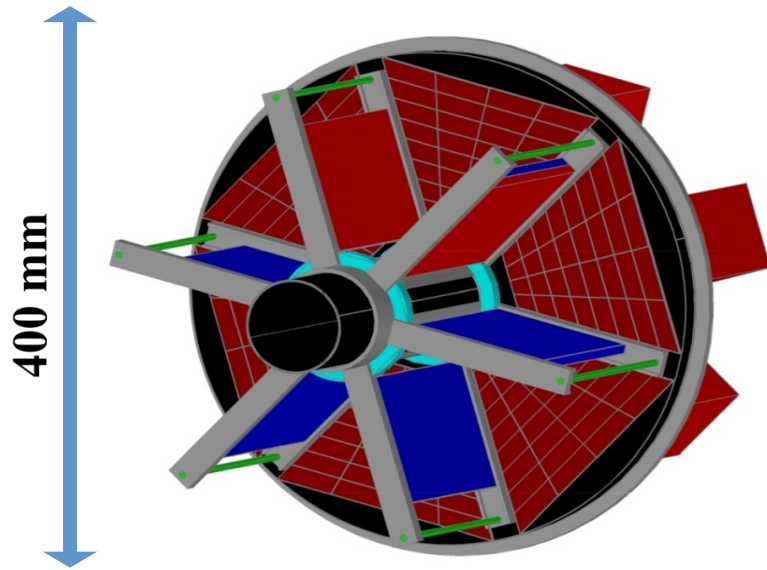
see the talk of Deyan Yordanov on Wednesday, June 19th, 2013

N-SI-44: October 29th – November 7th, 2012 (2^+ state in ^{24}Mg)

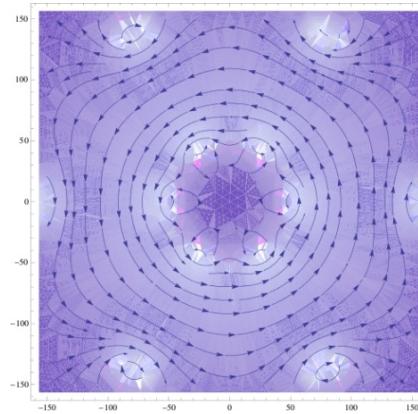
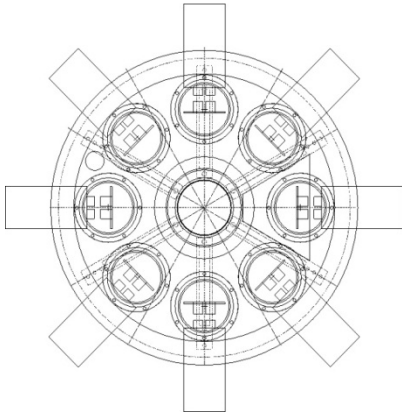


see the talk of Deyan Yordanov on Wednesday, June 19th, 2013

A Compact Positron Electron spectrometer (COPE) for internal pair creation studies



The COPE spectrometer consists of 6 pieces of NdFeB permanent magnets. The 6 identical magnets create a near homogeneous toroidal magnetic field of about 0.3 T which bends the electrons and positrons emitted in nuclear transitions.



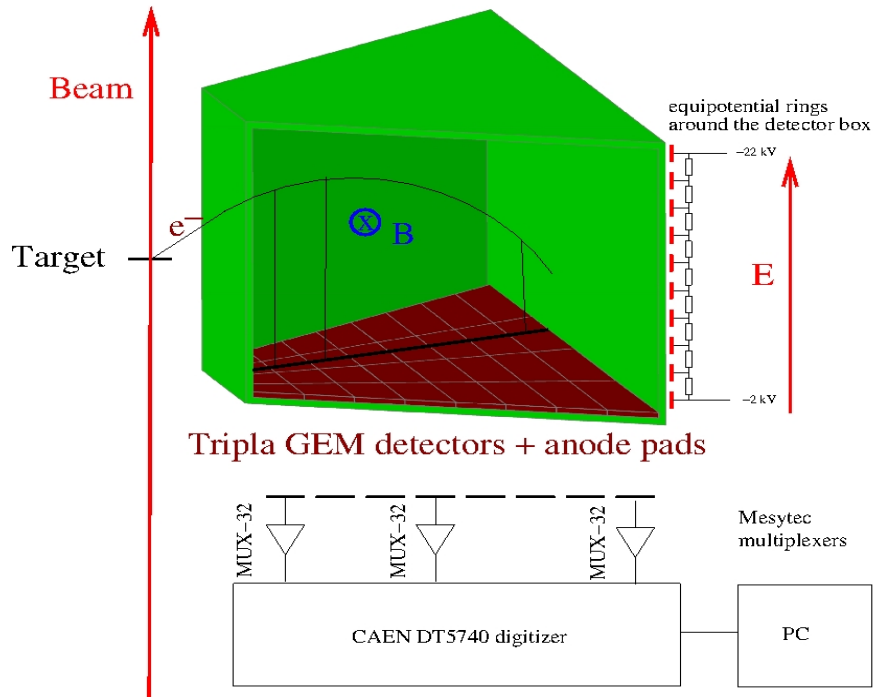
The magnetic field distribution plays an important role concerning to the tracking. It has been calculated and checked experimentally

We have spent about 30 person-months on the project.

The mechanical design and (partly) the construction of the spectrometer is ready.

Design (and prototyping) of the TPCs

The tracking of the electrons (positrons) will be performed by micro TPCs.



Their design is ready, and we have constructed a prototype of the TPC with tripla GEM detectors. We are expecting to finish our deliverable, a prototype of the spectrometer in time (48. months).

Electronics for the TPCs

The readout of the anode pads is performed by charge sensitive preamplifiers, with appropriate shapers and multiplexers (Mesytec MUX32) and digital electronics (Caen DT5740 digitizer).

The electronics has been tested. The energy as well as the timing signals, which determine the drift time and the z coordinate of the tracks are calculated from the digitized signals by using a versatile data acquisition system developed for the COPE spectrometer:

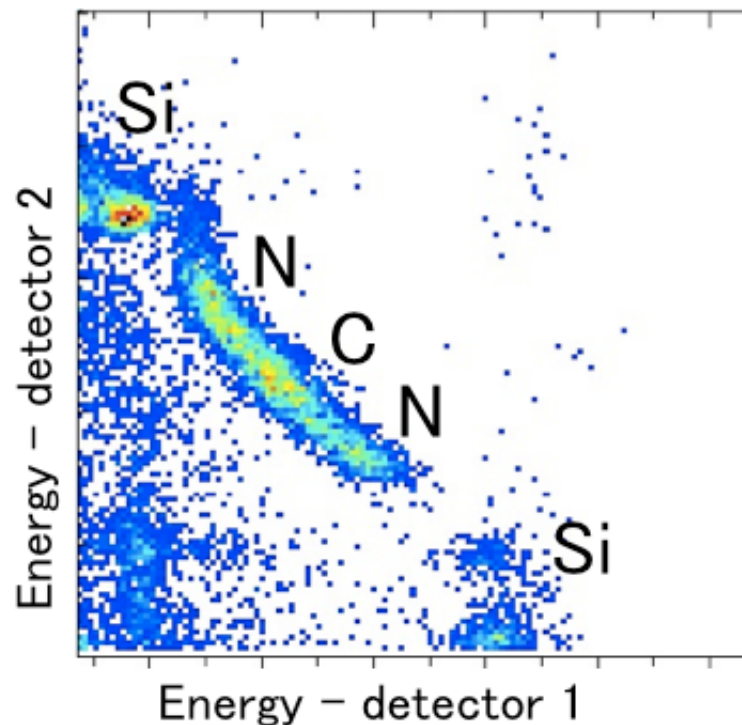
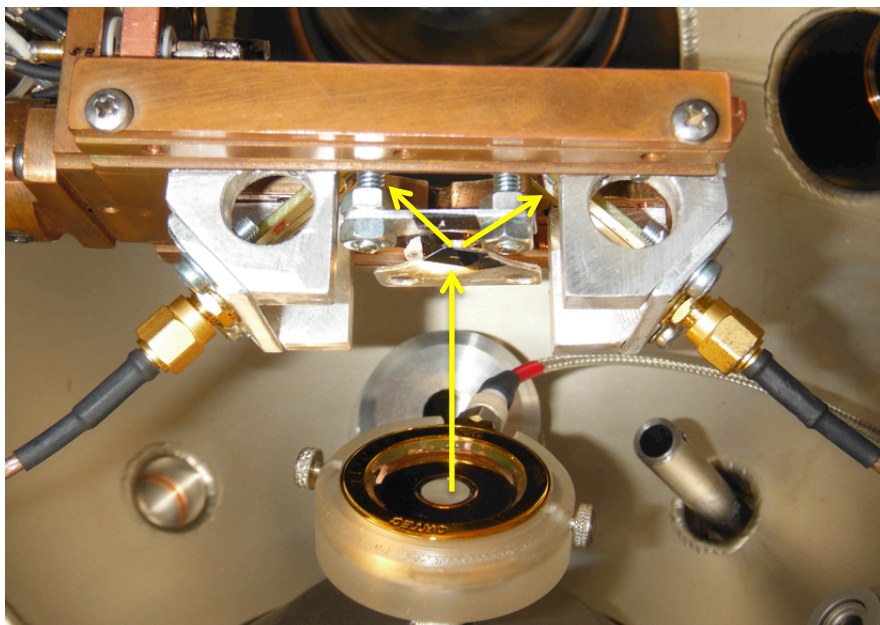
<http://sourceforge.net/projects/at-cda/>

ST1: The proposal to perform a comprehensive test of diamond detectors with heavy ions beams from Warsaw Cyclotron was presented on the PAC meeting in January, 2012. The experiment is scheduled for the fall of 2013.

Coulex GOSIA software is being improved. A GOSIA workshop took place in April 2013.
(see the talk of Pawel Napiorkowski on Wednesday, June 19th, 2013)

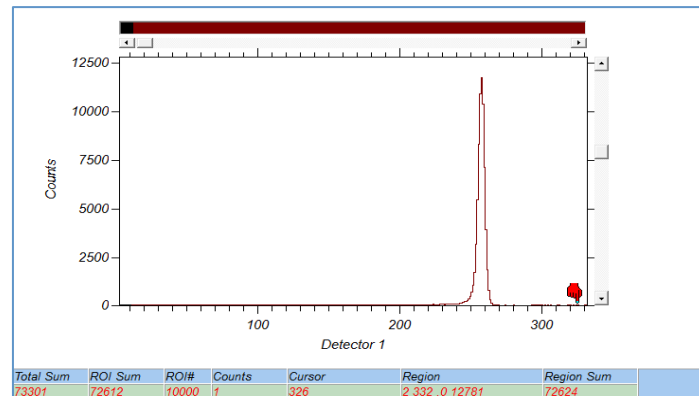
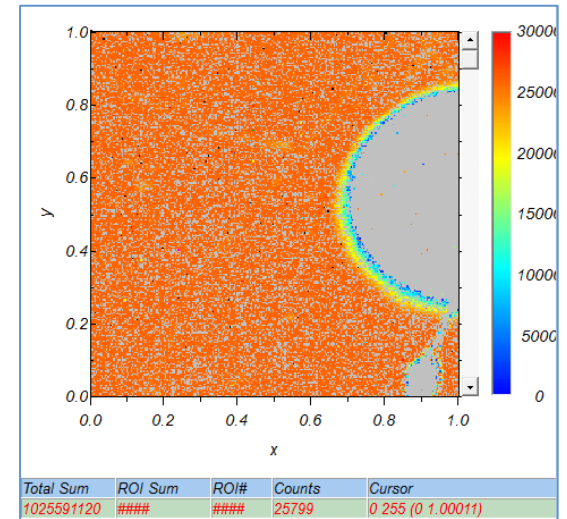
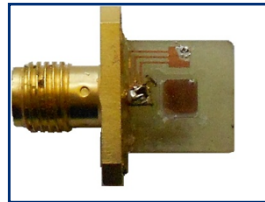
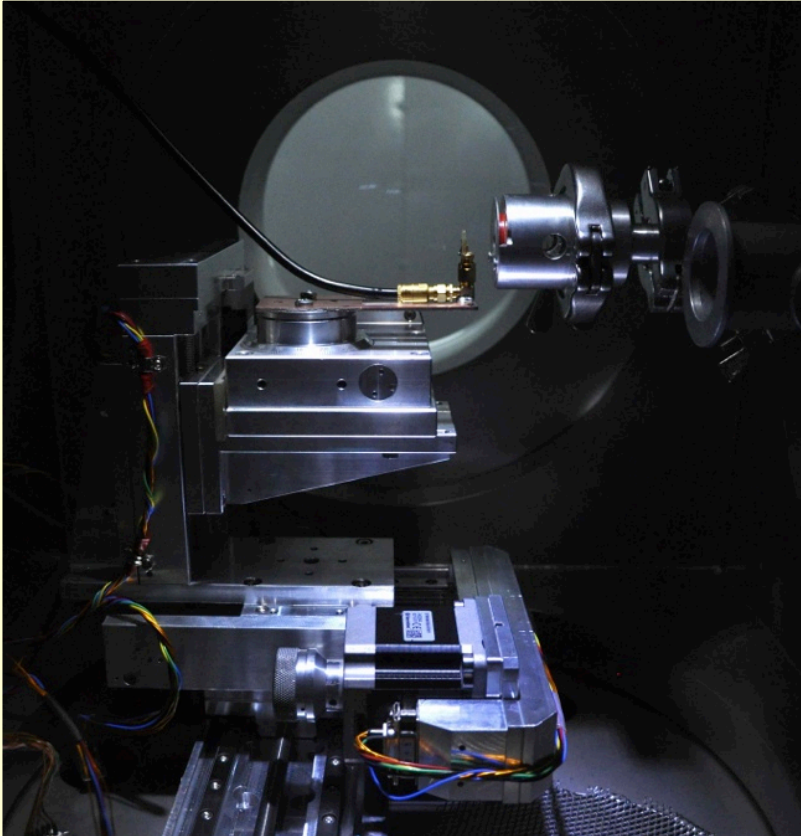
ST2: The first experimental evidence of lower radiation hardness for CVD diamond in comparison with silicon and for detection of low MeV energy range of light ions (protons and C ions). Purchased two CVD detectors (4.5 x 4.5 mm) from Cividec company with fast timing preamplifiers and are constructing detection system for the first tests which are planned in the first quarter of 2013. Prototype of diamond detector setup for the separation of scattered and recoiled nuclei by energy and timing information obtained is being tested.

ST3: Tests with a Li target and online temperature measurement with a commercially available device were done. In the first calculations with rotating Li target, critical parameters for the target cooling by heat irradiation were identified. MCNPX calculations were done to estimate the TOF spectrum and thus a viability of the target with respect to the TOF distance.



Within the WP12 EWIRA, RBI is prototyping diamond detector setup (left) for the separation of scattered and recoiled nuclei by energy and timing information obtained. 2D energy spectrum of 6 MeV O ion microbeam focused to 50 nm thick SiN foil is shown (right)

Since the main supplier of diamond detectors (DDL) siezed its operation, RBI started production of diamond detectors from Element 6 CVD diamond crystals. Detector of 3 x 3 x 0.1 mm is shown here together with IBIC (ion beam induced charge) spectrum and IBIC intensity map using 2 MeV proton microbeam



Interior of detector testing chamber

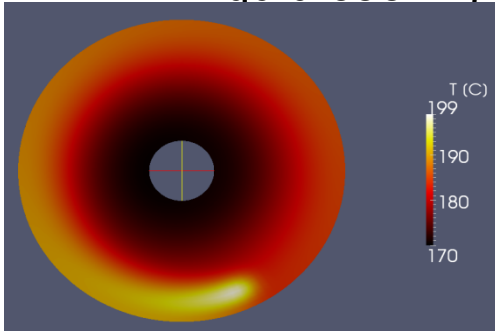
Neutron target development

NPI ASCR, Rez

The need of development in a direction of quasi-monoenergetic target for NFS has recently appeared

Part I - Li thermal calculations

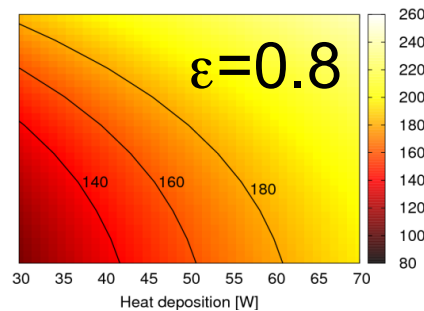
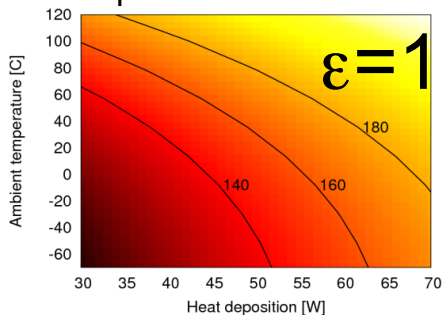
- static vs. rotating target
- p + Li vs. p + Be target
- liquid cooling vs. radiative cooling



Rotating target @ 12 rpm, temperature distribution.



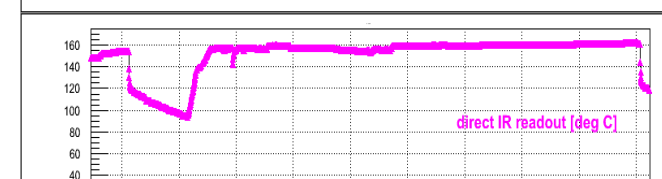
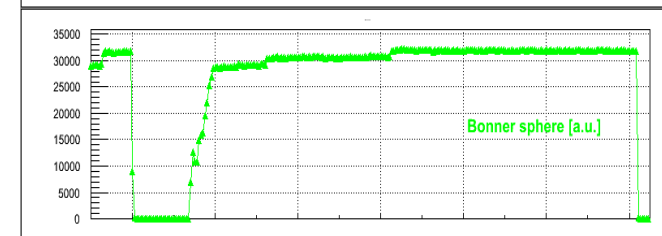
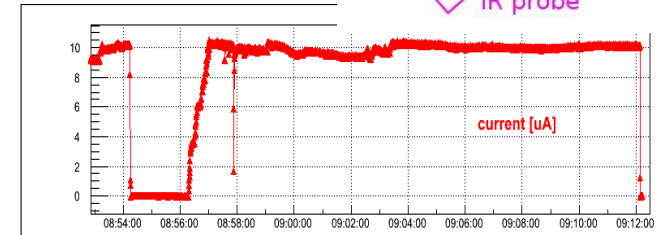
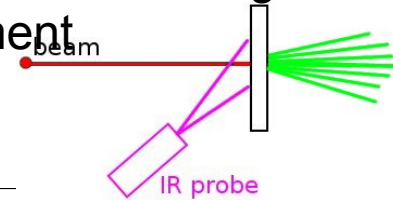
Melted Li target in Rez
After irradiation with 12 uA.



Maximal temperature on Li strongly depends on ambient temperature, emissivity and heat deposition (50uA@40MeV ~ 70 W). All this suggest that the calculations and their dependence on critical parameters should be tested experimentally.

Part II – experimental tests on static Li

- acquisition
- IR probe installation & setting
- in beam experiment



IR readout (bottom curve) follows perfectly the current recorded on the target and the readout of online neutron monitor (Bonner).

EWIRA/ENSAR meeting on static nuclear moment measurements with radioactive ion beams,

Orsay, France 13 May 2013.

"Microsecond isomeric-state moments from GANIL to RIKEN"

Jean-Michel Daugas, CEA DAM/DIF, Arpajon, France

"TDRIV on H-like ions in radioactive beam geometry"

Asli Kusoglu, Orsay, France and University of Istanbul, Istanbul, Turkey

"Moment measurements of short-lived excited states from RIV and TF methods: present results and future perspectives."

Andrew Stuchbery, Canberra, Australia

"Spin alignment in deep-inelastic reactions products"

Natalia Cieplicka, Krakow, Poland

"Nuclear polarization using the Tilted Foils technique. Recent results and future possibilities"

Georgi Georgiev, Orsay, France / Michael Hass, Rehovot, Israel

"Possibilities for iPAC measurements after n-induced fission of $^{241}\text{Pu}/^{238}\text{U}$ at ILL"

Radomira Lozeva, IPHC, Strasbourg, France

"A status report on the proposal for g-factor measurements at GSI: past, present and future."

Theodor Mertzimekis, University of Athens, Athens, Greece

"g-factor measurements at SPES"

Calin Ur, Padova, Italy

"Are moment measurements possible at ELI-NP?"

Dimiter Balabanski, INRNE, BAS, Sofia, Bulgaria and ELI-NP/IFIN-HH, Magurele, Romania

"Addressing nuclear moments with atomic physics techniques in ion-storage rings"

Carsten Brandau, GSI, Germany

2nd GOSIA WORKSHOP

9-11 April, 2013



- 27 participants
from 15 institutes
- 12 presentations
examples of COULEX analysis
- 3 working groups for
hands-on session
practice with the GOSIA code
- round-table discussion
future development of the GOSIA



Summary

- Milestones – according to the plan (with some small delays);
- Deliverables – at the end of the project;
- Person months involvement – according to the plan;
- Construction of equipment – according to the plan (with small delays);
- Hiring people
 - Prague, Zagreb, Warsaw, Krakow, Bucharest (up to 50-70%)
 - Sofia, Saclay (in 2013-2014)
 - Cologne (40% of the money transferred; in 2013-2014).

Outlook

- **IFIN-HH, Bucharest:** new machines operational, the ESFRI ELI-NP project under development (asking for a TNA status within Horizon 2020);
- **HIL, Warsaw** and **IFJ, Krakow:** new machines operational (asking for a TNA status within Horizon 2020);
- **RBI, Zagreb** and **Demokritos, Athens** (FP7 Regpot projects for improvement of the existing infrastructure)
- **NPI, Prague** – new Tandetron operational (focus on nuclear applications) and new high-current 24 MeV cyclotron is being designed (national funding);
- **ATOMKI, Debrecen** – AMS and a dedicated radiochemical laboratory are operational, new machine is expected by the end of 2013 (national funding).