

Nuclear Instruments and Methods

João B. Manteigas

The strategy of the group involves activities in the following lines:

1. Modelling of radiation fields, calculation of neutron physic parameters, measurement of neutron cross-sections;
2. Modelling and applications of gas discharges;
3. Development of software for control and data analysis;
4. Design of electronic instrumentation for nuclear applications;
5. Instrumentation and technical assistance;
6. Co-operation with other institutions.

Modelling of radiation fields, calculation of neutron physic parameters

Monte Carlo calculations have been carried in the framework of the n_TOF Collaboration (ITN participation on the n_TOF-Ph2 experiment at CERN).

Measurement of neutron cross-sections

The analysis of the data for cross-section measurement, taken in the TOF spectrometer installed at the CERN, was carried out.

Modelling and application of gas discharges

1. The study of methane conversion by a non-thermal plasma produced by a dielectric barrier discharge system (DBD) to obtain Syngas and other hydrocarbons has continued with (a) the study of conversion, selectivities (for H₂, CO, CO₂, C₂H₆ and C₃H₈) and abilities in mixtures of CH₄/O₂ or CH₄/CO₂ with a rare gas (helium or argon), (b) coupling the plasma with a catalyst, either using commercial catalysis or catalysts developed on ITN, (c) study of the influence on voltage pulse shape, and (d) development of theoretical models to explain the variation of i) breakdown voltage with rare gas concentration and, ii) conversion with the specific input energy.

2. The development of a corona discharge system for processing of polymers by a non-thermal plasma was started.

Development of software for control and data analysis in nuclear spectrometry

The gamma spectrometry system developed in the group was adapted to measure the half-life of radionuclide with interest to nuclear astrophysics. The OpenSource *PyMCA* for X-ray analysis software was extended to support equipments based on EPICS.

Technical assistance in nuclear spectrometry

The group has started to provide a service of maintenance and repairing of HPGe detectors as well as technical advice in the installation of gamma spectrometry equipment.

Instrumentation and technical assistance

1. The main objectives are the development of equipment for ITN groups, fabrication of equipment for specific applications and assistance to industrial companies and scientific institutions as well as technical consulting.
2. The technical assistance takes mainly the forms of specialised consultant engineering advice, installation of nuclear gauges, including calibration maintenance and repair and recharging of gauges with imported radioactive sources.

Co-operation with other institutions

1. Plasma Physics Centre / Gas Electronics Group, IST;
2. ISEL, Dept. of Automation and Electrotechnical Engineering;
3. Comenius Univ., Dept. of Experimental Physics, Bratislava, Slovakia;
4. Nuclear Physics Centre of the University of Lisbon.
5. n_TOF collaboration, a consortium of several laboratories in Europe, USA and Japan.

Research Team

Researchers

J. MANTEIGAS, Aux., Group Leader
C. CRUZ, Aux.
I. F. GONÇALVES, Aux.
J. NEVES, Aux.
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Students

C.M.CARRAPIÇO, PhD Student, IST (IG)
R. SARMENTO, PhD Student, IST (IG)
R.P.F. MENDES, Collaborator (NP, 20%)
A. JANECO, Project Grantee (NP)
S. BARROS, Project Grantee (IG)

Technical Personnel

T. JESUS, Electronic Technician
N. INÁCIO, Electronic Technician
M. Cabaça, Mechanical Technician
Gabriel Silva, Collaborator (20%)

Technical Assistance in the Field of Engineering Applications of Radiation and Radioisotopes

J.B. Manteigas, J. Neves, C. Cruz

Objectives

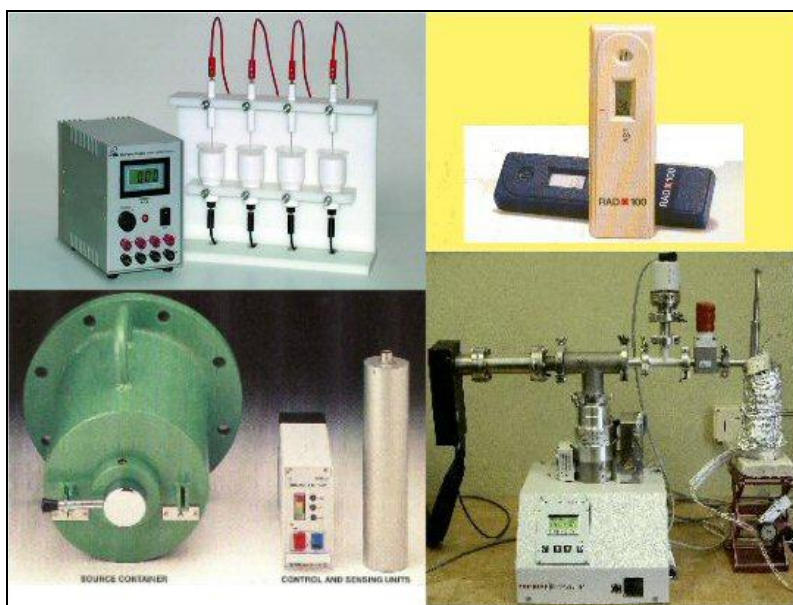
The main objectives are the development of equipment for internal groups, fabrication of equipment for specific applications and assistance to industrial companies and scientific institutions as well as technical consulting.

Results

A summary of the more relevant work carried out is:

- (i) Collaboration in corrective and preventive maintenance of the “Ion Beam Laboratory” – TANDEM 3 MV” at the Physics Unit.
- (ii) Optimization of the electronic device “Photo-multiplier Divider” for the BaF₂ calorimeter under the project n_TOF-Ph2 experiment at CERN.

DEVELOPMENT AND MAINTENANCE OF ELECTRONIC EQUIPMENT TO UFA, UPSR, URSN, UCQR AND UTR.



Summary of the more relevant Services/Equipments rendered in 2010

Activity	Qty	Client
Electronic Equipment	1	NATS (Arabic Emirates)
Laboratory equipment for the determination of radioactive element traces by electrodeposition	1	IAEA (Qatar)
	1	RPII (Ireland)
	2	PORTUCEL/SOPORCEL (Portugal)
Electronic Equipment	2	PORTUCEL/SOPORCEL (Portugal)
Personal Radiation Dosimeter Equipment	2	TECNILAB (Portugal)
	4	CIMPOR (Souselas/Portugal)
Electronic Equipment	4	CIMPOR (Souselas/Portugal)
Electronic Equipment Technical Assistance to Nuclear Equipment	21	EMA21 – Portucel/Soporcel (Portugal)
	20	EMA21 – Portucel/Soporcel (Portugal)
	1	EMA21 – Portucel/Soporcel (Portugal)
	6	SIDERURGIA NACIONAL (Portugal)
	6	SIDERURGIA NACIONAL (Portugal)
	32	EMA21 – Portucel/Soporcel (Portugal)
	4	MINISTÉRIO DA MARINHA (Portugal)
	4	ITN/URSN, ITN/UCQR, ITN/UPSR (Portugal)
Prices including TAX (VAT)		Total Amount: 26 581,77 €

Participation of ITN in the n_TOF-Ph2 experiment at CERN

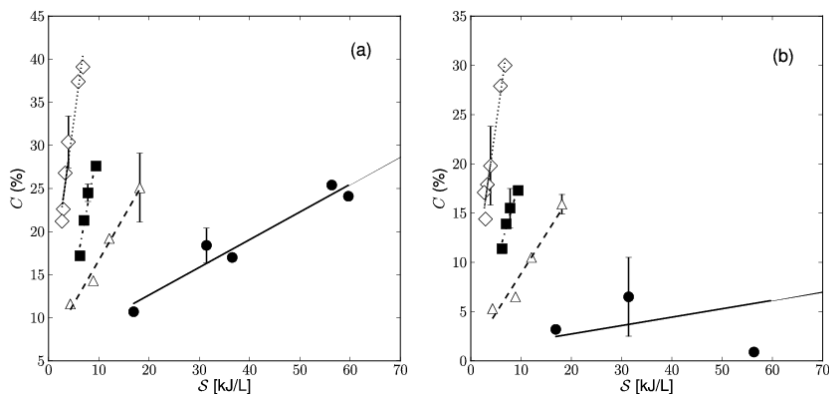
I.F. Gonçalves, P. Vaz, C. Cruz, J. Neves, C. Carrapiço, R. Sarmiento, S. Barros

The n_TOF-Ph2 project is the continuation of the involvement of ITN in the activities of the n_TOF Collaboration. The intention of the n_TOF Collaboration is to build a second beam-line and a new experimental area. ITN was involved in the commissioning of the new target, the construction of the new micro Megas detector and the data taken of 2010.

ITN was strongly involved in collaboration with INFN-Bari and CEA-Saclay in the following areas: Monte Carlo full and detailed simulation of the geometry of the new experimental area and the new spallation target, data analysis of the data on neutron capture on U-233, taken during 2004 using the BaF₂ calorimeter, data on neutron-induced fission on U-236, Am-241, Am-243 e Cm-245, taken during 2004 using the FIC ("Fast Ionization Chambers") detectors, analysis of the data sets relative to the neutron capture cross-sections, that were taken during 2009 using the BaF₂ calorimeter and the C6D6 detectors for the Fe and Ni isotopes (of relevance for innovative technological systems and for Nuclear Astrophysics), and electronics developments for the DAQ and the BaF₂ calorimeter.

Conversion of methane by a non-thermal plasma using rare-gas/CH₄/O₂ and rare-gas/CH₄/CO₂ mixtures on a dielectric barrier discharge system

J. Branco, N. R. Pinhão, A. Janeco, A. Ferreira, L. Redondo



Dependency of conversion for (a) CH₄ and (b) CO₂ with the specific energy for different values of helium concentration: ●, —: 55%, △, - - - -: 75%, ■, — · —: 85%, ◇, · · · · ·: 95%. Symbols: experimental values, lines: regression curves. For each set of data only a representative error bar is indicated.

The conversion of methane by a non-thermal plasma produced by DBD (dielectric barrier discharge) was studied using mixtures of CH₄/O₂ or CH₄/CO₂ with a rare gas (helium or argon). The dependency of conversion, electricities (for H₂, CO, CO₂, C₂H₆ and C₃H₈) and abilities on rare gas concentration and the specific input energy (SIE) were characterized. The variation of breakdown voltage with rare gas concentration and conversion with SIE were explained by theoretical models. The study of synergies between catalysts and the plasma was started using both commercial catalysts and

catalysts developed by the Inorganic and Organometallic Chemistry Group. The influence of the electric excitation of the plasma on the results is under way using sinusoidal and pulsed power supplies.

Development of software for control and data analysis in nuclear spectrometry

R. P. F. Mendes, N. R. Pinhão

The development of Open Source software for gamma and X-ray spectrometry has continued with the (a) an extension of the software to the measurement of the half-life of radionuclide with interest to nuclear astrophysics, and (b) the extension of the Open Source software for analysis of X-ray spectra, PyMCA, to support online acquisition from equipments based on EPICS.