DEPARTMENT OF PHYSICAL FOUNDATIONS OF ENGINEERING

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DEPARTMENT OF PHYSICAL FOUNDATIONS OF ENGINEERING

MAIN RESEARCH FIELDS

- Galvanomagnetic effects studies

Keywords: transducers, circuits

- Fault analysis in medium-voltage power networks and the new protections conception and the calculation parameters of overhead lines.

Keywords: circuits, networks, protections

- Numerical simulation of electromagnetic field

Keywords: electric & magnetic field, 2D and 3D-FEM.

- Technical applications of magnetic liquids

Keywords: magnetic field, forces, geometry improvement, nonlinear materials.

- The analysis of two port networks as a gyrator

Keywords: gyrator, two port networks.

- The analysis and processing of biological signals

Keywords: biological signals, wavelet analysis, biomagnetic field, ECG, MCG.

- Studies and investigation in solar energy

Keywords: solar energy, photovoltaic cells, numerical simulation.

- Optical features of ferofluids

Keywords: ferofluids, electromagnetic radiation, magnetic particles, heat pumps.

- Preparation of metallic oxides systems materials by several methods and structural, electric, magnetic properties study of these materials

Keywords: polycrystalline, crystalline structure, silicon solar panel, magnetic properties.

- Master equations and digital industrial radiography

Keywords: Black-Sholes equation, Fokker-Planck equations, stock market

- Heat, mass and momentum transfer processes, solidification of the materials

Keywords: heat, mass, momentum transfer processes, numerical simulation

- Quantum information and the coherent states formalism

Keywords: quantum mechanics, theory of information, quantum information

Researches in *GALVANOMAGNETIC EFECTS STUDIES*

FIELD DESCRIPTION

The domain refers to the analysis of electrical field in Hall plates and the behavior of Hall generator as a non-reciproc circuit component. Also the study refers to the determination of parameters of the Hall generator as function of the direction of the magnetic induction.

ACTIVITIES AND RESULTS

We have developed computing methods of the electric field in the Hall plates. The problem of the non-reciprocity of the Hall generator was completely elucidated by the introduction of the Hall generator non-reciprocity. As a consequence, was established a most general formulation of the condition of non-reciprocity. There were made devices as wattmeters Hall, ampermeters Hall, tesllameters Hall, and others.

RESEARCH TEAM

- Prof. doc. dr. eng. Constantin ŞORA, head of the team
- Prof. dr. eng. Ioan VETREŞ
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Assist. dr. eng. Ildiko TATAI

RESEARCH OFFERS

Consulting on the achievement of the Hall generator and for the calculation of the electric field in the Hall plates

Researches in *FAULT ANALYSIS IN MEDIUM-VOLTAGE POWER NETWORK*

FIELD DESCRIPTION

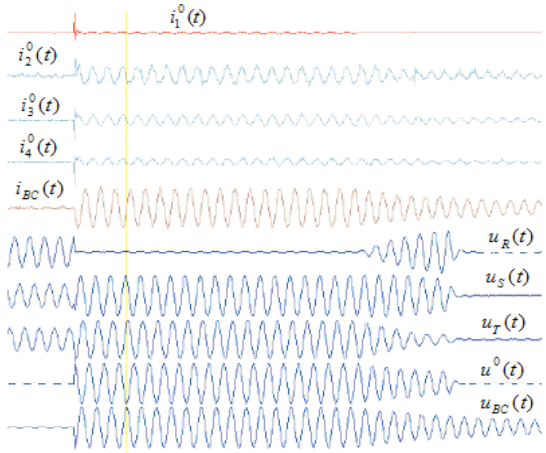
Proper detection of line-to-ground faults in medium-voltage power network depends on the neutral-grounding system in use in the considered network. Intensive research was made, both analytical and by numerical simulation, in order to obtain the correct value of the fault currents and other quantities needed for the protection.

Also, we have calculated the internal parameters of a conductor of overhead power lines using an analytical computer model, numerical methods, respectively.

ACTIVITIES AND RESULTS

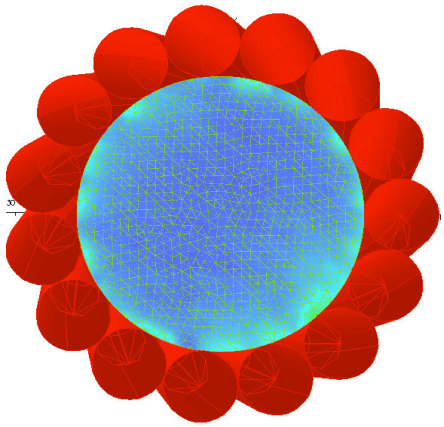
Analysis of single and double fault groundings in medium voltage power networks. Design and realization of digital relays to detect such faults in medium voltage power networks with not grounded

neutral, respectively grounded via a compensation reactor. The possibility of the detection of nonsimmetries in low voltage power network was also investigated, and a digital protective device to detect such regimes has been designed.
Simple ground faults have been simulated using PSPICE medium, in transient regimes. The results have been used to design the protection blocks. The Qfield FEM-2D program has been used to analyze the step voltage values for a ground fault in an electrical overhead line.
The results were published in technical journals, and the protective devices were implemented in the National Power System in the frame of three Grants namely MENER and CEEX. The quality of electrical energy and the compatibility of Romanian quality of electrical energy with the E.U. standards was also investigated.



Time variation of the phase voltages and zero sequence currentat for the phase-to-ground when the network is in resonant regime

The analytical model used to calculate the parameters of the conductors of overhead lines is based on Biot-Savart-Laplace's relation. The numerical model uses finite element method implemented in the software package OPERA. An example of discretization of the field in a conductor with three layers, is shown in the figure below.



Meshing of a heart of steel used in the phase conductor overhead lines

RESEARCH TEAM

- Prof. dr. eng. Dumitru TOADER
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Prof.dr.eng. Dumitru RADU
- Lect.dr.eng. Constantin BLAJ
- Lect.dr.eng. Marian GRECONICI
- Assist. drd. eng. Daniela VESA
- drd. eng. Iulia CATA

RESEARCH OFFERS

Research for specifically medium voltage power network, technical advice and the digital protective devices, are offered. Virtual systems for flexible modelization of different faults in medium voltage networks. Also calculation of internal parameters of a conductor of overhead lines using an analytical computer model, numerical methods that, since its construction (number of layers, the heart of steel, etc.).

Researches in *NUMERICAL SIMULATION OF ELECTROMAGNETIC FIELDS*

FIELD DESCRIPTION

The use of numerical methods based on the finite element method (FEM) for solving electromagnetic and thermal fields in technical devices: electrical machines, galvanomagnetic devices, electromagnets and permanent magnet systems, magnetoelastic and high DC currents transducers, induction heating equipments. The 2D and 3D FEM program OPERA 13 of Vector Field was used in the analyzed examples.

ACTIVITIES AND RESULTS

Numerical simulation and optimization of the wind generators with permanent magnets has been analyzed. Referring to some quantities of high importance in the design process, there have been analyzed how they change when some parameters of the generators (geometry) change.

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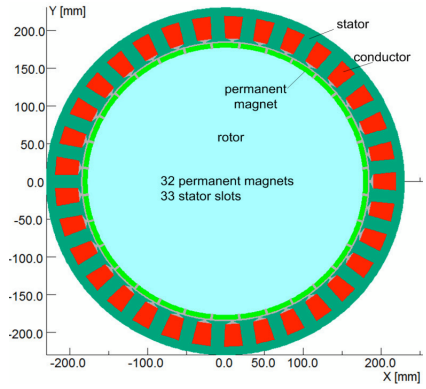
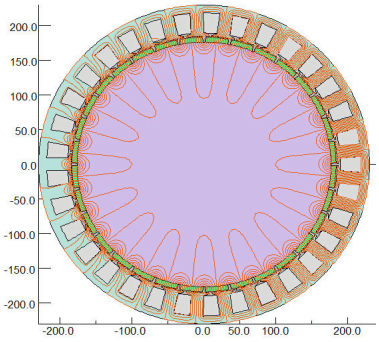


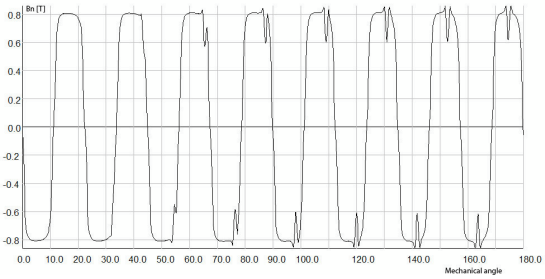
The analyzed PM wind generator

There have been analyzed the magnetic field, the flux density distribution, the radial component of

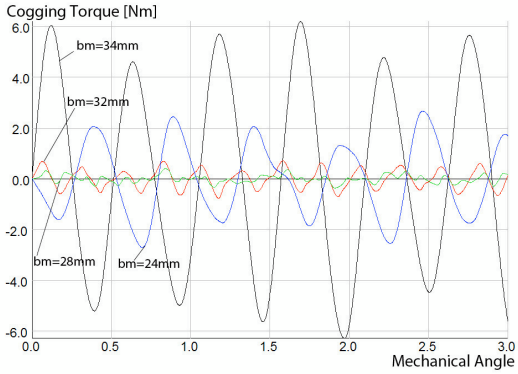
the flux density in the air gap, the cogging torque and the back EMF.



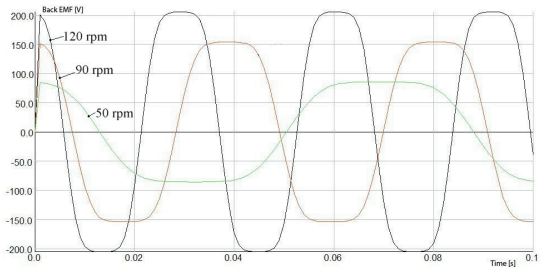
Magnetic field lines distribution



The radial component of the flux density in the air gap



The dependence cogging torque versus mechanical angle for different magnets widths



The back EMF induced fir different rotor speeds

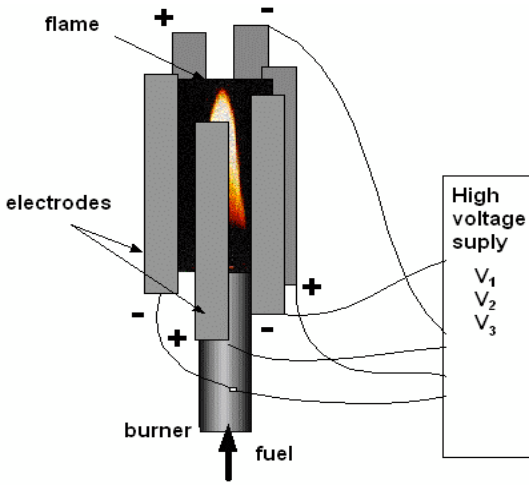
The FEM analysis of the electrical generators used in wind energy conversion systems, in the design process avoids some errors that could be encountered and allows optimizing some performances of the generators by some corrections on the preliminary design.
Such adjustments in the generators design could have considerable economical benefits.

RESEARCH TEAM

- Prof. doc. dr. eng. Constantin ŞORA
- Prof. dr. eng. Dumitru RADU
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Prof. dr. eng. Ioan BERE
- Assoc. prof. dr. eng. Dumitru IRIMIA
- Assoc. prof. dr. eng. Mariana TITIHĂZAN
- Lect. dr. eng. Constantin BLAJ
- Lect. dr. eng. Marian GRECONICI
- Assist. eng. Daniela VESA
- Assist. dr. eng. Ildiko TATAY

RESEARCH OFFERS

Optimal design of electromagnetic devices using numerical methods. 2D-FEM numerical analysis of electromagnetic and thermal field in inductive heating processes. Dielectrics in high frequency electromagnetic fields.



The electrodes position to adjust the flame in a electrostatic field.

Researches in *TEHNICAL APPLICATIONS OF MAGNETIC LIQUIDS*

FIELD DESCRIPTION

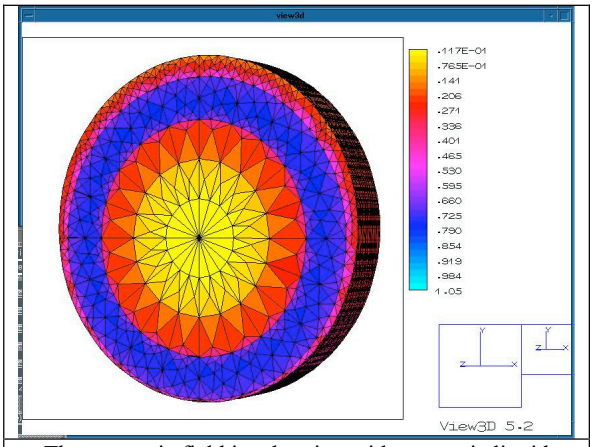
The magnetic liquids have found a large interest in technical applications such as: magneto gravimetric separation, magnetic bearings and seals, pressure and flow transducers, inclinometers, accelerometers. Most of these applications are based on the magnetic field forces, depending on the magnetic properties of magnetic liquid and the geometry of the devices. The research of our group is concerned to find the adequate magnetic liquid and the geometry of the devices, in order to improve their performances.

ACTIVITIES AND RESULTS

The analytical and numerical evaluation of the magnetic force that acts on the shaft of cylindrical bearings represents the main research of the group. There has been investigated the cylindrical bearing with permanent magnetized shaft and magnetic liquid, and the cylindrical bearing with alternating poles (sandwich type structure). An approximate analytical expression of the magnetic force that acts on the shaft has been established, analyzing the influence of the geometrical design of the bearing and the magnetic properties of the liquid. The analytical results have been compared with the numerical results using a 3D-FEM program.

RESEARCH TEAM

- Lect. dr. eng. Marian GRECONICI
- Lect. dr. eng. Constantin BLAJ



The magnetic field in a bearing with magnetic liquid

RESEARCH OFFERS

Magnetic field computation for magnetofluidic devices. The evaluation of the forces and energy distribution in magnetic liquids. Geometry design improvement of ferrofluidic devices, based on field calculation.

Researches in *ANALYSIS AND PROCESSING OF BIOLOGICAL SIGNALS*

FIELD DESCRIPTION

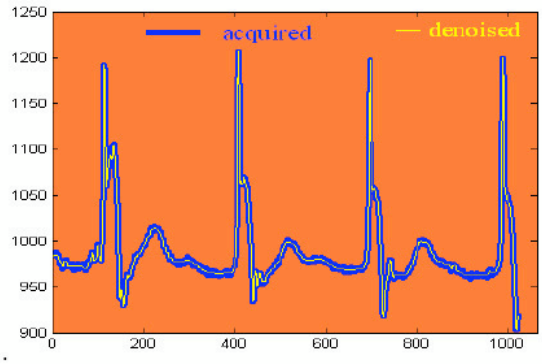
An accurate ECG signal, unaffected by low-frequency and high-frequency interferences, is seldom encountered in practice. Usually an electrocardiogram is affected by noise and the artifactual data is due to the movement, perspiration or breathing of the patient, electrode contact, power-line interferences, etc. This noise influences the baseline of the ECG signal, introducing a wandering which can make the inspection difficult and even mask some significant features.

ACTIVITIES AND RESULTS

A method to reduce the baseline wandering of an electrocardiogram signal has been developed. The method is based on stationary wavelet approximation of the whole signal. The main advantage of this method, compared with others, is the fact that it is a nonsupervised method, allowing the process to be used in an automatic analysis of electrocardiograms. Also, a denoising algorithm particularly suited to ECG signals processing has been developed. The main stage of this algorithm consists in a MAP filtering in the wavelet domain. Its effectiveness relies on the qualities of the wavelet transform and of the statistical filter used. Tests made on ECG signals, in realistic conditions, showed very promising results. The noise is almost completely removed, while the useful waveforms are preserved.

RESEARCH TEAM

- PhD. Stud. eng. Beatrice ARVINTI
- Lect. dr. Marius COSTACHE
- PhD.eng. Alexandru ISAR
- As. PhD.eng. Corina NAFORNITA
- PhD.eng. Dumitru TOADER



The superposition of the waveforms of the acquired and the denoised signal

RESEARCH OFFERS

The processing of biologic signals, the removal of baseline wander and denoising of ECGs using the Stationary Wavelet Transform.

Researches in *STUDIES AND INVESTIGATIONS IN SOLAR ENERGY*

FIELD DESCRIPTION

Energetic and exegetic efficiency of solar systems as a relation between controllable variables (flow, caption surface) as well as between uncontrollable variables (climatic and insulation magnitudes)

ACTIVITIES AND RESULTS

Solar systems producing electric energy, thermal energy, hot sanitary water and ventilation;

In the Physics Department:

Innovations for devices used in the intensity of the solar radiation measurement, installations for bitumen fluidization, solar collectors with self-focalization; experimental studies and numerical simulation of the thermal phenomena in solar collectors.

RESEARCH TEAM

- Lect. dr. Ioan LUMINOSU
- Assist. dr. Viorel CHIRITOIU
- Lect. dr. Ioan DAMIAN
- Lect. dr. Ioan ZAHARIE
- Lect. dr. Marius COSTACHE
- Lect. dr. Romeo NEGREA
- Lect. Dr. Nicolina POP
- As. Dr. Bogdan CARUNTU

RESEARCH OFFERS

The setting, through numerical simulation, of the parameters which influence the maximizing of the photovoltaic cells efficiency.

Researches in *OPTICAL FEATURES OF FEROFLUIDS*

FIELD DESCRIPTION

Transmission and absorption of electromagnetic radiation by the ferofluids in the presence or absence of the magnetic field;

The distribution of magnetite particles after the dimension criteria;

The reology of colloidal solutions.

ACTIVITIES AND RESULTS

Heat pumps, measurement devices, magneto fluid sealing, optical transmission of the information through light signals modulation.

RESEARCH TEAM

- Lect. dr. Ioan LUMINOSU
- Prof. dr. Dusan POPOV
- Lect. dr. Ioan ZAHARIE
- Lect. Dr. Nicolina POP

RESEARCH OFFERS

The invention called Solar Installation for heating through auto pumping.

Researches in *PREPARATION OF METALLIC OXIDES SYSTEMS MATERIALS BY SEVERAL METHODES AND STRUCTURAL, ELECTRIC, MAGNETIC PROPERTIES STUDY OF THESE MATERIALS*

FIELD DESCRIPTION

Preparation of polycrystalline. Transition elements oxides containing samples by using the coprecipitates thermal decomposition, ceramic and melting methods.

Crystalline structure, dielectric and magnetic properties in low or radio frequency fields, magnetic loops in the static and dynamic regime study.

The modeling of silicon solar cell, from solar panel.

ACTIVITIES AND RESULTS

a) Elaboration of ternary oxidic samples α(Fe2O3-Cr2O3-Al2O3) with different composition at the constant content of 50% and 70% mol, αFe2O3, by thermal decomposition of hydroxide coprecipitates. The investigation of these samples by X-ray diffraction and IR absorption spectra in order to correlate structure and physical properties with composition of polycrystalline samples.

Investigation on the physicochemical properties of different proveniences dolomites, as eaw dolomites and after thermal decomposition up oxides.

b) Experimental study on obtaining and on the visible and IR transmission of selective layers, SnO2 and Si, for solar radiation.

The modeling of the typical silicon solar cell, from solar panel.

RESEARCH TEAM

- Prof. dr. Minerva CRISTEA
- Prof. dr. Alicja RATUSZNA
- Lect. dr. Ioan DAMIAN
- Lect. dr. Ioan ZAHARIE
- Lect. dr. Ioan LUMINOSU
- Cercet.1 dr. Lidia TAUBERT
- Lect. dr. Marius COSTACHE
- Asist. drd. Viorel CHIRITOIU

RESEARCH OFFERS

a) This study is a part from a larger program of study of physical properties in the ternary sesquioxides system, because there is a lack of data and some data are contradictory, concerning binary and ternary systems of these Me2O3 oxides. This system presents interesting thermal, electric and magnetic properties.

Our results allow explaining some aspects of these properties.

b) The properties of obtained SnO2 and Si thin layers recommends like selective layer for insulators.

The modeling of Si solar cell yield to a numerically simulation of photovoltaic panels in different naturally insulation conditions and optimization of photovoltaic energy systems.

Researches in *MASTER EQUATIONS AND DIGITAL INDUSTRIAL RADIOGRAPHY*

FIELD DESCRIPTION

Nowadays, there is a boom in using master equation for a better understanding of market's

price evolution. One tries to find reasonable solution for Black – Sholes equation, for instance. I have proposed to use the Fokker – Planck equation instead of the above one. The Fokker – Planck equation, or forward Kolmogorov equation, intends to find out the probability to have, in future, a price of a stock, if we know the price now. I solved the Fokker – Planck equation for two cases of stocks' price evolution. This field is a part of what is called today Econophysics.
Using the non-destructive methods to find the defects in materials became a usual procedure. In the last time, the radiographic methods with X and gamma rays using semiconductor detection instead of film radiography started to be of extensively use.

ACTIVITIES AND RESULTS

Regarding this subject I have proposed, to International Atomic Energy Agency, a research project, which have been approved and it will be extended on three years.

RESEARCH TEAM

- Assoc.Prof.dr. Vasile DOROBANTU
- Prof. dr. Nicolae ROBU
- Lect. dr. Simona PRETORIAN
- Assist. drd. Viorel CHIRITOIU
- Lect. dr. Marius COSTACHE
- Assist. drd. Robert MARIA
- Assist. drd. Daniel POPA

RESEARCH OFFERS

Regarding master equations, a new field is to describe the stock market using Fokker-Planck equations.

Researches in *HEAT, MASS AND MOMENTUM TRANSFER PROCESSES, SOLIDIFICATION OF THE MATERIALS*

FIELD DESCRIPTION

The solidification of the crystals (nano-crystals) and of the polycrystals (multi-crystalline Silicon) takes place within various heat, mass and momentum fields. The numerical models of the transfer processes is a very active domain of the research and can provide a deep knowledge of the phenomena associated with the solidification matter. The numerical soft Fluent^{TM} is a commercial soft-ware, and I am using it for numerical modeling of the heat, mass and momentum fields in various solidification furnaces.

ACTIVITIES AND RESULTS

A time dependent 3D numerical model of the solidification process of large size photovoltaic Si ingots is realized. The difficulty of the model is related to the relative movement of various parts of the furnace that we solve by using a dynamic layering mesh approach. This permitted to calculate the thermal gradient, solidification rate and hydrodynamics of the silicon, which are important in order to control and optimize the grain structure of the ingot. The comparison between the numerical predictions and the experimental measurements shows a reasonable agreement. The effect of some geometrical modifications of the equipment on the thermal field is studied in order to improve the solidification process and the structure of the ingot.

RESEARCH TEAM

- Assoc. Prof. dr. Floricica BARVINSCHI
- Prof. dr. Thierry DUFFAR

RESEARCH OFFERS

The numerical simulations of heat, mass and momentum transfer can offer a deep knowledge of the phenomena associated with the solidification matter.

Researches in *QUANTUM INFORMATION AND THE COHERENT STATES FORMALISM*

FIELD DESCRIPTION

The quantum mechanics and the theory of information are two very prolific scientific fields founded in XX century. The synergetic result of their interaction is the theory of quantum information. In our researches we examine the connection between the information and the quantum states, particularly the coherent states. In this way, the coherent states formalism becomes an useful instrument to characterize the quantum information. On the other hand, a quantum system is connected by the corresponding density matrix. Their trace is the quantum partition function, which contains maximal information about the properties of the systems.

ACTIVITIES AND RESULTS

Since 1978, theoretical investigation were made on the description of the multielectronical systems (particularly, diatomic molecules) by means of the density matrix approach. This approach was applied, also, to the harmonic or anharmonic oscillators, especially the pseudoharmonical and Morse oscillators. Some results were used for the elaboration of the doctoral thesis and other scientific works in the physics journals.

RESEARCH TEAM

- Prof. dr. Duşan POPOV
- Lect. dr. Ioan ZAHARIE
- Assoc. Prof. dr. Mihai V. PUTZ
- Lect. Dr. Nicolina POP
- Eng. Deian POPOV

Researches in *REACTIVE COLLISION BETWEEN ELECTRONS AND MOLECULAR CATIONS WITH APLICATIONS IN PLASMA PHYSICS AND ASTROPHYSICS*

FIELD DESCRIPTION

Dissociative recombination (DR) of molecular cations with electrons is a major elementary process in the kinetics and in the energy balance of astrophysical ionized media (supernovae, interstellar molecular clouds, planetary iono-spheres), fusion plasmas in the divertor region, hypersonic entry plasmas and in many other cold media of technological interest.

The 'Rydberg resonances', induces prominent structures in the measured cross sections, and is elegantly modelled by an approach of the DR based on the Multichannel Quantum Defect Theory(MQDT). In terms of this theory, the temporary capture states are involved in the dynamics by allowing closed channels to act on equal footing with the open ones.

ACTIVITIES AND RESULTS

The applicationof the MQDT theory to the two-channel and three-channel cases was studied byour research using an analitical model in order to explain the enhancing role of the closed channels in the case of weak coupling between the entrance channel and the dissociative one.
The resulting analytical formulas are used to make model predictions for H_3^+.
The computational results obtained for cross section and rate coefficients was in reasonable agreement with experimental data.

RESEARCH TEAM

- Lect. dr. Nicolina POP
- Prof. dr. Ioan SCHNEIDER
- Prof. dr. Ousmanou MOTAPON
- Prof. dr. Christian JUNGEN

RESEARCH CONTRACTS

1. Greconici Marian, *Research and development of energy efficient systems for power supply and drive of electric vehicles*, partener in cadrul Proiectului Universitatii din Novi Sad, Serbia finantat de Secretariatul pentru Stiinta si Tehnologie al Provinciei Voivodina, Serbia.
2. Vasiu Radu, Toader Dumitru ş.a., Dezvoltarea si sustinerea de programe postdoctorale multidisciplinare in domenii tehnice prioritare ale strategiei nationale de cercetare - dezvoltare - inovare 4D-POSTDOC, POSDRU(87/1.5/S/52603.
3. Ionel Ioana, Toader Dumitru, Greconici Marian, ş.a., Reţea naţională de formare continuă a cadrelor didactice din învăţământul preuniversitar profesional ş i tehnic – CONCORD, POSDRU/87/1.3/S/61397

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5. Doca Nicolae, Pop Nicolina, Mogos Alin, Albu Paul, Vlase Titus, *Selective activation of Heterogeneous Systems:A Consequence of the Jahn-Teller,* Revue Roumain de Chimie, vol. 56(10-11) pp. 953-957, ISSN 0035-3930;
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7. Eugenia Paulescu, Nicoleta Stefu, Paul Gravila, Remus Stefan Boata , Pop Nicolina, Marius Paulescu, *Procedure of embedding biological action functions into the atmospheric transmittance,* Theor. Appl. Climatology, DOI: 10.1007/s00704-011-0581-y, acceptata decembrie, ISSN 0177-798X;

8. Tatai Ildiko, *A Comparation of Two Gyrator Realization as regarding the Energy Flow control from One Port to the Other,* The 6th IEEE International Symposium on Applied Computational Intelligence and Informatics (SACI 2011), 5 pg, ISSN 978-1-4244-9107-0;

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11. Luminosu Ioan, De Sabata Aldo, De Sabata Coleta, Silaghi Marius, *Impact of usingtracking surfaces on necessary solar radiation collecting area in stock raising applications,* Journal of Electrical and Electronics Engineering, vol. 4(2) 83-87, 5pg, ISSN 18.446.035;

12. Arvinti Beatrice, Isar Alexandru, Toader Dumitru, Costache Marius, *Wavelet Theory Applied to Biophysical Signals*, Buletinul Stiintific al U.P.T, Seria Matematica-Fizica, 56(70)2, p 82-88, 7 pag, ISSN 1224-6069;

13. Vesa Daniela, *Fem Modelling Of The Magnetic Field In The Air Gap Of Weiss Electromagnet*, Scientific Bulletin Of "Politehnica" University of Timişoara, Romania, Tom 56(70), Fascicola 2, pagina 89, 7 pg, ISSN 1224-6069;

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