14th International Conference

ELEKTRO 2022

Krakow, Poland

www.elektro.uniza.sk

MAY
23rd—26th
2022

CONFERENCE PROGRAM

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FOREWORD

Dear friends, co-operators and colleagues!

Allow me to welcome you from the beautiful Krakow, which is the venue of the 14th of the series of the international conference ELEKTRO 2022.

Unfortunately, we have not been able to fully realize this dream of ours. The Covid pandemic is in decline, but another threat has emerged that no one really expected - a war in neighbouring Ukraine. This has also affected the nature of our conference, which takes place in a hybrid form. Therefore, allow me to welcome you, both in person and through an online connection.

I especially welcome our sponsors, of whom the company A2B in particular significantly supported this event. I also welcome our scientific co-operators from Poland, Italy, Spain, Germany, Romania, Croatia and the Czech Republic, as well as from non-European countries, who have made a significant contribution to the content and scientific level of the conference.

We have managed to do a lot of work in the past period. The importance of the conference increased with its inclusion among the prestigious IEEE events, indexed to WoS. Selected conference papers will also be published in journals indexed in the Current Content Connect, WoS and Scopus databases.

However, the main importance of the conference is about meetings, professional discussions, exchange of knowledge and information, as well as about new inventions and friendships.

Dear friends, co- operators and colleagues!

As I have already said, the conference is not only about professional issues, but also about friendships, cooperation and common pleasant experiences. I wish you to enjoy everything to the maximum and satisfaction, even though many of you participate online. I firmly believe that the next conference in 2024 will be in a purely present form and will allow us to take full advantage of all the benefits that personal meetings bring.

Prof. Pavol Špánik
Chairman of the conference

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SHORT PROGRAM

SHORT PROGRAM

Monday, May 23, 2022

12.00 – 14.00	Registration	
14.00 – 14.15	Opening Ceremony (Room Krakowska 1)	link to Webex room

09.30 - 10.30 — link to Webex

Invited Lecture — **Room Krakowska 1**

Grzegorz Putynkowski, Krzysztof Wożny
CBRTP S.A. R&D Center of Technology for Industry, Warsaw, Poland
Destructive states in the area defined as the no-damage region in the ITIC / SEMI F47 characteristics

15.00 – 15.30	Coffee Break	
15.30 – 16.00	Partners and sponsors	Room Krakowska 1
16.00 – 18.00	Oral Sessions - TPC1, TPC2 - see detailed program	Room Krakowska 1
19.00	Dinner – Welcome party	

Tuesday, May 24, 2022

08.00 – 8.30	Registration	

08.30 - 9.10 — link to Webex

Invited Lecture — **Room Krakowska 2**

Peter Svolik
A2B, s.r.o., Zilina, Slovakia
Aggregation of small energy storage systems

09.10 - 9.50 — link to Webex

Invited Lecture — **Room Krakowska 2**

Milan Dado
University of Zilina, Slovakia
Advanced optical and radio communication systems to support the IT ecosystem

09.50 – 10.00	Coffee Break

10.00 – 12.00	Oral Sessions - TPC2, TPC3 - see detailed program	Room Krakowska 2,3
12.00 – 13.00	**Lunch**	
13.30 – 15.30	Oral Sessions - TPC2, TPC3 - see detailed program	Room Krakowska 2,3
15.30 – 16.00	**Coffee Break**	
16.00 – 18.00	Oral Sessions - TPC1, TPC4 - see detailed program	Room Krakowska 2,3
18.00 – 19.00	STEM education meeting	Room Krakowska 3
19.00	**Dinner**	

Wednesday, May 25, 2022

08.00 – 8.30	**Registration**	

08.30 – 9.10 — link to Webex — **Room Krakowska 2**

Invited Lecture

Giacomo Scelba
University of Catania, Italy
Wide Band Gap Technologies for Electric Motor Drives

09.10 – 9.50 — link to Webex — **Room Krakowska 2**

Invited Lecture

Aleksander Sieroń
Medical University of Silesia in Katowice, Poland
Electricity Way for Progress in Medicine

09.50 – 10.00	**Coffee Break**	
10.00 – 12.00	Oral Sessions - TPC2, TPC3 - see detailed program	Room Krakowska 2,3
12.00 – 13.00	**Lunch**	
13.30 – 15.30	Oral Sessions - TPC2, TPC5 - see detailed program	Room Krakowska 2,3
15.30 – 16.00	**Coffee Break**	
16.00 – 18.00	Oral Sessions - TPC4, TPC5 - see detailed program	Room Krakowska 2,3
18.00 – 19.00	Meeting OC, IEEE Czechoslovakia Section Meeting	Room Krakowska 3

20.00 **Conference Gala Dinner - Closing Ceremony (Best Paper Awards)** — link to Webex room

Thursday, May 26, 2022

09:00 – 12:00 Social program (Old Town – guided tour)

TPC1

Informatics & Information Technologies

Section Contacts

Chairman

Robert Hudec
Ivan Glesk

Technical Staff

Patrik Kamencay, patrik.kamencay@uniza.sk

Notes

MONDAY, MAY 23, 2022

TPC1 – Session 1

TPC1 - Virtual Lectures

16.00 - 18.00 (CEST) - Online

link to Webex room

chairman. **Robert Hudec**

technical staff. **Patrik Kamencay**

0003	R. VRSKOVA, R. HUDEC, P. KAMENCAY, P. SYKORA **Recognition of Human Activity and Abnormal Behavior using Deep Neural Network**
0010	S. MATUSKA, R. HUDEC, P. KAMENCAY **IoT Based System for Detecting the Number of People and their Distribution in Classroom**
0023	V. HROMADOVÁ, P. KASÁK, R. JARINA, P. BRÍDA **Frequency Response of Smartphones at the Upper Limit of the Audible Range**
0034	A. ŠTECH, P. KAMENCAY, R. HUDEC **Digitalization and 3D Reconstruction of Object using Photogrammetry**
0060	S. MATUSKA, R. HUDEC **A Functional IoT Based System Design of the Connected University**
0071	A. HOLESOVA, P. SYKORA, P. KAMENCAY, M. UHRINA **Convolutional Neural Network for Visual Artifacts Classification**
0072	P. KAMENCAY, M. BENCO, R. HUDEC, P. SYKORA, M. PARALIC **The Intelligent System for Mask Detection using Deep Learning**
0111	K. M. SAN, A. OSTANKOV, A. NECHAEV, S. DACHIAN, T. DEMINA, A. FAULGABER **Synthesizing the Sector Directional Pattern with Improved Quality Indicators**
0153	A. ZGANK **Reduced MFCC Feature Extraction Dimension for Acoustic Classification of Bee Swarm Activity**

TUESDAY, MAY 24, 2022

TPC1 - Session 2

TPC1 - Virtual Lectures

16.00 - 18.00 (CEST) - Online

link to Webex room

chairman. **Robert Hudec**

technical staff. **Patrik Kamencay**

0007	J. BAJZIK, R. JARINA **Sound event detection using class activation maps**
0062	P. KASÁK, R. JARINA **Evaluation of blind source separation algorithms applied to music signals**
0067	P. VESTENICKÝ, A. KANÁLIKOVÁ **Comparison of Various Mathematical Models of 8/20 µs Current Surge and their Influence on RFID Marker**
0080	J. HRBČEK, J. ŽDÁNSKY, K. RÁSTOČNÝ **Problems related to the two-channel connection of sensors to the safety PLC**
0082	G. CIBIRA **Simplified statistical thresholding techniques for dynamic bandwidth allocation in shared Super-PON**
0112	O. CHERNOYAROV, V. LITVINENKO, K. M. SAN, A. GLUSHKOV, Y. LITVINENKO **On the Demodulation of the ADPSK signals**
0118	D. PEREPELKIN, M. PHAM **Planning and Distribution Algorithm of Heterogeneous Resources in Industrial Telecommunication Networks with Ordered Sets of Tasks**
0120	D. PEREPELKIN, T. V. NGUYEN **Research of Multipath Routing and Load Balancing Processes in Software Defined Networks Based on Artificial Bee Colony Algorithm**
0150	L. RODIO, V. SCHENA, M. GRANDE, G. CALÒ, A. D'ORAZIO **Photonic multi-frequency down conversion in hybrid microwave-photonic SATCOM payload**

TPC2

Power Electronics and Energy Systems

Section Contacts

Chairman

Michal Frivaldsky
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Jozef Dubovan, jozef.dubovan@uniza.sk

MONDAY, MAY 23, 2022

TPC2 - Session 1

TPC2 - In-Person Lectures/Virtual Lectures

16.00 - 18.00 (CEST) - Room Krakowska 1

link to Webex room

chairman. **Michal Frivaldsky, Mario Cacciato**

technical staff. **Marek Roch, Pavol Makyš**

0087	P. RESUTÍK, S. KAŠČÁK, J. KELLNER **Design, Simulation, and Analysis of Compact 3x1 Matrix Module Prototype in 3x3 Matrix Converter Application**
0099	J. SIMCAK, M. FRIVALDSKY, M. PRAZENICA **The Application for Systematic Formulation of State-Space Representation of Linear Circuits in the MATLAB Environment**
0100	J. SIMCAK, M. FRIVALDSKY, M. PRAZENICA **The Algorithm for Systematic Formulation of State-Space Representation of Linear Circuits in the MATLAB Environment**
0103	M. FRIVALDSKY **Evaluation of the PFC inductor core losses in dependency on magnetic circuit properties**
0104	M. FRIVALDSKY **Analysis of the PFC inductor winding losses for different geometry of wire**
0110	M. FRIVALDSKY, P. RESUTIK, J. SEDO, B. HANKO **Evaluation of the loss model accuracy of 3-phase NPC converter**
0113	R. ZELNÍK, M. FRIVALDSKY **Driving methods of the High Voltage GaN transistor module**
0115	S. CZAPP, H. TARIQ **Tripping of F-type RCDs for Sinusoidal Residual Current with Superimposed Smooth DC Component**
0129	M. FRIVALDSKY, J. SEDO, P. RESUTIK, B. HANKO **Comparisons of operational performance between T-NPC, NPC and A-NPC multillevel converters**

TUESDAY, MAY 24, 2022

TPC2 - Session 2

TPC2 - In-Person Lectures/Virtual Lectures

10.00 - 12.00 (CEST) - Room Krakowska 2

link to Webex room

chairman. **Marek Höger**

technical staff. **Marek Roch, Michal Regula**

0031	P. BELANY, P. HRABOVSKY, K. BEDNARCIKOVA, Z. KOLKOVA, N. CAJOVA KANTOVA **Domestic Hot Water Heating Prediction with the Utilization of Artificial Neural Network**
0033	P. BELANY, Z. KOLKOVA, K. BEDNARCIKOVA, P. HRABOVSKY **Long-term Analysis and Comparison Electricity Consumption of Retrofitted Lighting Systems**
0091	J. ŠKORVAGA, M. PAVELEK **Comparison of 3D models of the circular and square coupling coils for WPT with power 44kW**
0092	K. TAKÁCS, M. FRIVALDSKY **Simulation design of residential smart-grid based on solid-state transformer**
0144	I. YUDAKOV, A. DANILOV, R. AUBAKIROV **An Algorithm For the Design of Flat Air-Core Coils with Target SelfInductance for An Inductive Power Transfer Systems**
0146	J. MORGOS, K. HRUDKAY, M. SIMCAK, J. SKORVAGA **Safety system for monitoring of the dangerous gases in electromobility laboratory**
0151	S. OSTKOTTE, C. PETERS, F. HUENING, M. BRAGARD **Design, Implementation and Verification of an Rotational Incremental Position Encoder based on the Magnetic Wiegand Effect**
0156	M. GUTTEN, D. KORENCIAK, V. CEFER, M. KARMAN **Use of diagnostic system for analysis of mechanical condition of transformers winding**
0157	M. KUCERA, M. GUTTEN, M. KARMAN, D. KORENCIAK **Analysis of the condition of dry transformers by acoustic emission measurement**

TPC2 - Session 3

TPC2 - In-Person Lectures/Virtual Lectures

13.30 - 15.30 (CEST) - Room Krakowska 2

link to Webex room

chairman. **Pavol Rafajdus**

technical staff. **Jozef Dubovan, Pavol Makyš**

0064	M. FURMANIK, M. VIDLÁK, P. RAFAJDUS **Current Harmonics Control in Six-Phase PMSM**
0069	M. VIDLÁK, L. GOREL, M. FURMANIK, P. MAKYŠ **Analysis and comparison of the advanced PMSM model-based motor control strategies**
0075	D. KONVIČNÝ, P. MAKYŠ, O. V. NOS **Dependency Of Modified Resonant Controllers With Time Delay Compensation On Gain factor**
0090	J. KELLNER, S. KAŠČÁK, M. PRAŽENICA, P. RESUTÍK, Z. FERKOVA **Implementation of New Fault Tolerant Control for Five-Phase Induction Motor in Fault Operation**
0128	P. PEČÍNKA, S. KOCMAN, V. V. PEČÍNKOVÁ **Use of FEM modeling to optimize the design of induction motor**
0141	M. KOVACIK, P. RAFAJDUS, M. STANO **Analysis of Loss and Thermal Performance of High Speed PMSM for Automotive Application**
0142	R. A. MARTIS, B. VARATICEANU, F. A. POP PIGLESAN, M. SULOWICZ, C. S. MARTIS **Permanent Magnet Assisted Synchronous Reluctance Machine validation for NDEC standard assessment**
0147	P. KARBAN, I. PETRÁŠOVÁ, I. DOLEZEL **DC Motor Benchmark with Prediction Based on Mixture of Experts**
0149	M. KAMHAL, P. MAKYŠ, L. DURIN, I. KISTER **Reduction of AC Winding Losses in 8/6 SRM**

WEDNESDAY, MAY 25, 2022

TPC2 - Session 4

TPC2 - In-Person Lectures/Virtual Lectures

10.00 - 12.00 (CEST) - Room Krakowska 2 link to Webex room

chairman. **Peter Bracinik**

technical staff. **Marek Roch, Michal Regula**

0037	S. KARABANOV, P. BEZRUKIKH, S. BELYKH, D. SUVOROV, O. LOBAN, E. SLIVKIN **Study of the Possibility of IoT Use in a Microgrid on the Basis of Renewable Energy Sources**
0053	M. HÖGER, M. BAHERNIK, M. REGULA, M. KAJANOVA **Stochastic Modelling of Loads in Medium Voltage Distribution Networks**
0086	P. BRACINIK, M. RYBARIK, M. HÖGER, M. REGULA **The influence of direct current distribution networks on the formation of stray currents**
0093	M. HÖGER, M. REGULA, P. BRACINIK, A. OTCENASOVA **Influence of VVN and ZVN lines on the propagation of stray currents from DC traction**
0152	D. KISIRA, M. EDIMU, J. SERUGUNDA **Cost Effective Approach for Limiting Voltage Dip Severity on Radial Industrial Feeders in Uganda**
0159	P. DURANA, T. BETKO, P. DRGONA **Analysis of smart aplications influence on public lighting systems**

TPC2 - Session 5

TPC2 - In-Person Lectures/Virtual Lectures

13.30 - 15.30 (CEST) - Room Krakowska 2 link to Webex room

chairman. **Michal Frivaldsky**

technical staff. **Marek Roch, Michal Regula**

0040	D. KONIAR, L. HARGAS, M. PASKALA **Automated Testing of Electronic Devices. Virtual Instrumentation-Based Platform**
0085	M. RYBARIK, P. BRACINIK, M. KAJANOVA **Overview of the Usability of Second-Life Batteries in Smart Distribution Grids**
0089	M. ŠIMČÁK, M. FRIVALDSKÝ **Evaluation of accuracy of simulation model and real electrochemical cell based on LiFePO4 chemistry**

O116	D. MALJAR, V. STOPJAKOVÁ, D. ARBET **The autocalibration of analog ICs for suppressing the influence of process variations**
O123	K. KIERCZYNSKI, M. ZENKER, D. KORENCIAK **Activation energy of DC conductivity of high moisture content electrical pressboard impregnated with mineral oil of natural origin NYNAS NYTRO BIO300X**
O125	P. ROGALSKI, M. ZENKER, M. SEBOK **The AC measurmets of the composite of cellulose – bio-based hydrocarbon transformer oil – water nanodrops**
O148	M. DANKO, M. POLASEK **Testing of batteries used in electric cars**
O161	E. VASTA, D. GRECO, G. SCELBA, M. CACCIATO, O. EBERHARDT, D. DUGO, G. SEMINARA **Design of a battery testing system with software/hardware interface**

TPC3

Materials and Technologies, Biomedical Engineering

Section Contacts

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TUESDAY, MAY 24, 2022

TPC3 - Session 1

TPC3 - In-Person Lectures/Virtual Lectures

10.00 - 12.00 (CEST) - Room Krakowska 3

link to Webex room

chairman. **Norbert Tarjányi**

technical staff. **Štefan Hardoň, Zuzana Pšenáková**

0005	D. KÁČIK, I. MARTINCEK, N. TARJÁNYI, M. GORAUS, J. MACIAK, J. HORÁK **Optical Fiber Fabry-Pérot Interferometer and its Application to Railway Transport**
0006	M. JANEK, V. P. LADYGIN, A. V. TISHEVSKY, M. VEVERICIK, S. G. REZNIKOV, A. Y. ISUPOV **Particle's position estimation in neutron and hodoscope detectors**
0030	S. HARDOŇ, J. KÚDELČÍK **The influence of a magnetic field on the properties of ferrifluids based on new generation of transformer oil Shell**
0051	M. VEVERIČÍK, P. BURY, F. ČERNOBILA **Analysis of SAW interaction with liquid nanocomposites**
0059	N. TARJÁNYI, D. KÁČIK **Quantification of birefringence of magnetic fluid exposed to weak magnetic fields**
0070	P. GAŠO, D. JANDURA **Waveguide Bragg grating prepared by direct laser writing technology**
0079	P. W. GAŁASZKIEWICZ **Resonance Phenomena in MXene on PCL Nanocomposite**
0122	T. MIZERA, D. PUDIŠ, A. KUZMA, P. GAŠO, P. MIČEK, D. SEYRINGER **New concept of 3D MMI splitters based on polymer**
0137	J. DURISOVA **Metal-dielectric structure with 2D surface grating for refractive index sensor**

TPC3 - Session 2

TPC3 - In-Person Lectures/Virtual Lectures

13.30 - 15.30 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Mariana Benova**

technical staff. **Štefan Hardoň, Zuzana Pšenáková**

0029	I. KRALIKOVA, B. BABUSIAK, M. LABUDA **Textile Electrodes for Bioelectrical Signal Measurement**
0044	L. HARGAS, D. KONIAR, S. STEFUNOVA, J. BULAVA **Comparison of image processing methods for tensile test**
0074	Z. PŠENÁKOVÁ, D. GOMBARSKA, F. BACOVA, L. CARNECKA **Comparison of different antennae arrangement for study of high frequency electromagnetic field influence to tumor tissue**
0078	P. PROCKA, S. BORIK **System for contactless monitoring of tissue perfusion**
0130	L. CARNECKA, M. BAJTOS, Z. JUDAKOVA, R. RADIL, L. JANOUSEK **Proliferative Activity of Eukaryotic Cells Affected by Extremely Low-Frequency Electromagnetic Field**
0145	M. LABUDA, J. KAFKOVA, I. KRALIKOVA **Intelligent sleeve prototype for monitoring muscle activity**
0154	S. JURECKA, M. KRALIK **Microstructure and optical properties of etched silicon layers for photovoltaic applications**

WEDNESDAY, MAY 25, 2022

TPC3 - Session 3

TPC3 - In-Person Lectures/Virtual Lectures

10.00 - 12.00 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Mariana Benova**

technical staff. **Štefan Hardoň, Zuzana Pšenáková**

0026	K. BEDNARCIKOVA, M. SMETANA, P. BELANY **Mobile communication devices and their interaction with biological structures**
0038	R. RADIL, M. BAJTOS, L. CARNECKA, K. HARGASOVA, P. KAMENCAY **Numerical approach to design of low frequency magnetic field irradiation system for lab on chip experiments**

0041	L. HARGAS, D. KONIAR, F. JABLONCIK, J. BULAVA **SVM texture classification and recurrent convolutional neural network approach on medical image**
0052	A. ŠKRVÁŇ, R. HUDEC, S. MATUSKA **Design of a cheap pulse oximeter for home care systems**
0056	F. VAVERKA, M. SMETANA, D. GOMBARSKA, L. JANOUSEK **Application of Sweep Frequency Eddy Current Testing to Material Defect Evaluation**
0073	M. BENOVA, F. BACOVA **The EM fields investigation of specific microwave sources in specific areas**
0163	M. MULÍK, I. JANČIGOVÁ, I. CIMRÁK **Contact area of cell cluster in a simple bifurcation**

TPC4

Robotics, Cybernetics, Mechatronics

Section Contacts

Chairman
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Notes

TUESDAY, MAY 24, 2022

TPC4 - Session 1

TPC4 - In-Person Lectures/Virtual Lectures

16.00 - 18.00 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Ondrej Hock**

technical staff. **Dusan Nemec, Matus Danko**

0107	M. DANKO, O. HOCK, R. PLSICIK **Design of automated measuring system for goniophotometer**
0095	R. PLŠIČÍK, M. DANKO **Introduction to using mmWave Radar development board AWR1843**
0136	A. A. LIGOCKI, A. JELÍNEK, L. ŽALUD **Atlas Fusion - Modern Framework for Autonomous Agent Sensor Data Fusion**
0124	V. TUDIĆ, A. STANČIĆ, D. KRALJ, T. TROPČIĆ **Application of computer vision in education in mechatronic control system**
0055	O. MAJIDZADEH GORJANI, P. BILIK, J. KOZIOREK **Activity recognition within smart homes using logistic regression**

WEDNESDAY, MAY 25, 2022

TPC4 - Session 2

TPC4 - Virtual Lectures

16.00 - 18.00 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Ondrej Hock**

technical staff. **Matus Danko, Vojtech Šimák**

0014	M. BUJŇÁK, R. PIRNÍK, P. KUCHÁR, A. KANALIKOVA **Reconnaissance Robot for Rescue Services**
0049	D. NEMEC, J. ANDEL, V. SIMAK, R. PIRNIK **Safety Aspects of the Wheeled Mobile Robot**
0016	A. KANALIKOVA, M. MIHÁLIK, M. HRUBOŠ, B. MALOBICKÝ **Electric three-wheel chassis**

0139	M. VAGAS, A. GALAJDOVA **Integration of LED SmartLight device into the automated process**
0094	R. PLŠIČÍK, J. ŠEDO **Smart Security Systems for motorbikes**

TPC5

Education in Electrical Engineering & ICT

Section Contacts

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WEDNESDAY, MAY 25, 2022

TPC5 - Session 1

TPC5 - In-Person Lectures/Virtual Lectures

13.30 - 15.30 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Peter Hockicko**

technical staff. **Dusan Nemec, Ondrej Hock**

0065	J. KUDELCIK, P. HOCKICKO, M. KUDELCIKOVA **The application of program Tracker at the analyse of rotation motion**
0063	M. HÖGER, M. REGULA, M. KAJANOVA, P. BRACINIK **Education Innovation in the Field of Electric Power Engineering Considering New Trends in Power Network Automation and Management**
0004	M. MORAVCIK, I. BRIDOVA, P. SEGEC **Usage of clouds in the education process**
0160	O. HOCK, M. DANKO, R. PLSICIK **Design of a simulator of communication buses in a car for the needs of external teaching**
0011	I. MELO **Introduction to quantum mechanics for the students of Photonics**
0017	M. JANEK **Diffraction measurement - remote experiment**
0101	N. TARJÁNYI, G. TARJÁNYIOVÁ **Video analysis of physical phenomena as a training of students for solving practical technical problems**
0076	G. TARJÁNYIOVÁ, T. MIZERA **Home experiment as one of the possibilities of laboratory exercises during online education**

TPC5 - Session 2

TPC5 - In-Person Lectures/Virtual Lectures

16.00 - 18.00 (CEST) - Room Krakowska 3 link to Webex room

chairman. **Peter Hockicko**

technical staff. **Patrik Kamencay, Zuzana Pšenáková**

0042	S. KARABANOV, Y. MERKULOV, I. KUVAKOVA, E. KISTRINA **Materials Science Training Programs for Students and Masters with a Specialization in Electric Engineering**

0018	N. A. KOPYLOVA **Different forms of online-education in a technical university**
0019	N. A. KOPYLOVA **The use of interactive educational forms in a technical university**
0024	G. TARJANYIOVA, P. HOCKICKO, N. A. KOPYLOVA, A. DYAGILEV, A. IVANIKOV **Force Concept Inventory during three years of teaching physics at two technical universities**