DAYS OF THE SCIENCE of the Technical University of Sofia, SOZOPOL 2024

ДНИ НА НАУКАТА на Технически университет – София, СОЗОПОЛ 2024

ДНИ НАУКИ Технического университета – София, СОЗОПОЛЬ 2024

34th INTERNATIONAL SCIENTIFIC SYMPOSIUM

XXXIII МЕЖДУНАРОДЕН НАУЧЕН СИМПОЗИУМ

XXXIII МЕЖДУНАРОДНЫЙ НАУЧНЫЙ СИМПОЗИУМ

METROLOGY AND METROLOGY ASSURANCE 2024

МЕТРОЛОГИЯ И МЕТРОЛОГИЧНО ОСИГУРЯВАНЕ 2024

МЕТРОЛОГИЯ И МЕТРОЛОГИЧЕСКОЕ ОБЕСПЕЧЕНИЕ 2024

PROGRAMME

ПРОГРАМА

ПРОГРАММА

September 7 – 11, 2024, Sozopol, Bulgaria

7 – 11 Септември 2024 г., Созопол, България

7 – 11 Сентября 2024 г., Созополь, Болгария

ORGANISED BY

Technical University of Sofia

- ***Department of Electrical Measurements***
- ***Department of Precision Engineering and Measuring Instruments***

Institute of Electrical and Electronics Engineers, Bulgaria Section

WITH THE ATTENDANCE OF

Bulgarian Institute of Metrology

Union of Metrologists in Bulgaria

Bulgarian Academical Association of Metrology

Kozloduy Nuclear Power Plant

WITH THE SUPPORT OF

RESEARCH AND DEVELOPMENT SECTOR BY THE TU-SOFIA

SOFTTRADE **NIK 47 Ltd** **R&DL "CMME"**

ОРГАНИЗИРАН ОТ

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- ***Катедра “Електроизмервателна техника”***
- ***Катедра “Прецизна техника и уредостроене”***

Институт на инженерите по електротехника и електроника, Българска секция

С УЧАСТИЕТО НА

Български институт по метрология

Съюз на метролозите в България

Българско академично метрологично дружество

“АЕЦ Козлодуй” ЕАД

С ПОМОЩТА НА

III. ТУ-СОФИЯ – НАУЧНО-ИЗСЛЕДОВАТЕЛСКИ СЕКТОР СОФТТРЕЙД ЕООД НИК 47 НПЛ „КИМ”

СИМПОЗИУМ ОРГАНИЗУЕТСЯ

Техническим университетом София

- ***Кафедрой Электроизмерительной техники***
- ***Кафедрой Прецизионной техники и приборостроения***

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С УЧАСТИЕМ

Болгарского института метрологии

Союза метрологов Болгарии

Болгарского академического метрологического сообщества

"АЭС Козлодуй" ОАО

ПРИ ПОДДЕРЖКЕ

ТУ-СОФИЯ - НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ СЕКТОР

СОФТТРЕЙД **НИК 47 ООО** **НПЛ „КИМ"**

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PROGRAMME / ПРОГРАМА / ПРОГРАММА

REGISTRATION / РЕГИСТРАЦИЯ	**Hotel Lobby or On-line**	**7.09.2024**	**10:00 – 13:00** **14:00 – 17:00**
OPENING / ОТКРИВАНЕ / ОТКРЫТИЕ	**Hall/Зала/Зал 1**	**8.09.2024**	**10:00 – 10:30**
PAPERS AND SCIENCE NOTES **ДОКЛАДИ И НАУЧНИ СЪОБЩЕНИЯ** **ДОКЛАДЫ И НАУЧНЫЕ СООБЩЕНИЯ**	**Hall/Зала/Зал 1**	**8.09.2024**	**10:30 – 11:15** **11:30 – 12:30** **13:00 – 15:00** **15:15 – 16:45** **17:00 – 19:00**
		9.09.2024	**09:00 – 10:30** **10:45 – 12:15** **13:00 – 14:45** **15:00 – 16:45** **17:00 – 18:15**
		10.09.2024	**09:00 – 10:30** **10:45 – 11:45**
WELCOME / ДОБРЕ ДОШЛИ / ДОБРО ПОЖАЛОВАТЬ		**8.09.2024**	**19:30**
COCKTAIL / КОКТЕЙЛ / КОКТЕЙЛЬ		**9.09.2024**	**19:00**
CLOSING / ЗАКРИВАНЕ / ЗАКРЫТИЕ	**Hall/Зала/Зал 1**	**10.09.2024**	**12:00**
DEPARTURE / ОТПЪТУВАНЕ / ОТЪЕЗД		**11.09.2024**	

7 September / Септември / Сентября 2024 (Saturday / Събота / Субота)	
10:00 – 13:00	**Registration / Регистрация**
14:00 – 17:00	**Registration / Регистрация**

8 September / Септември / Сентября 2024 (Sunday / Неделя / Воскесение)	
10:00 –10:30	**Opening / Откриване / Открытие**
10:30 – 11:15	**Plenary Session / Пленарно заседание / Пленарное заседание**
11:15 – 11:30	**Coffee break / Кафе пауза / Кофе перерыв**
11:30 – 12:30	**Section / Секция I** General Aspects of Metrology. Measurement Methods. Unity and Accuracy of Measurements Общи аспекти на метрологията. Методи на измерване. Единство и точност на измерванията Общие аспекты метрологии. Методы измерения. Единство и точность измерений
12:30 – 13:00	**Free time / Свободно време / Свободное время**
13:00 – 15:00	**Section / Секция I:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
15:00 – 15:15	**Coffee break / Кафе пауза / Кофе перерыв**
15:15 – 16:45	**Section / Секция IV** Measurements in the Industry Измервания в индустрията Измерения в промышленности
16:45 – 17:00	**Coffee break / Кафе пауза / Кофе перерыв**
17:00– 19:00	**Section / Секция IX** Metrology Practice Метрологична Практика Метрологическая Практика
19:30	**Welcome / Добре дошли / Добро пожаловать**

9 September / Септември / Сентября 2024 (Monday / Понеделник / Понедельник)	
09:00 – 10:30	**Section / Секция III** Measurement and Information Systems and Technologies Измервания и информационни системи и технологии Измерительные и информационные системы и технологии
10:30 – 10:45	**Coffee break / Кафе пауза / Кофе перерыв**
10:45 – 12:15	**Section / Секция III:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
12:15 – 13:00	**Free time / Свободно време / Свободное время**
13:00 – 14:45	**Section / Секция VI** Measurements in the Electrical Power Engineering Измервания в електроенергетиката Измерения в электроэнергетике
14:45 – 15:00	**Coffee break / Кафе пауза / Кофе перерыв**
15:00 – 16:45	**Section / Секция II** Sensors, Transducers and Devices for Measurement of Physical Quantities Сензори, преобразуватели и уреди за измерване на физични величини Сенсоры, преобразователи и приборы для измерения физических величин
16:45 – 17:00	**Coffee break / Кафе пауза / Кофе перерыв**
17:00 – 18:15	**Section / Секция XI** Quality Management and Control, Standardization, Certification, Accreditation Управление и Контрол На Качеството, Стандартизация, Сертификация, Акредитация Управление и Контроль Качества, Стандартизация, Сертификация, Акредитация
19:00	**Cocktail / Коктейл / Коктейль**

10 September / Септември / Сентября 2024 (Tuesday / Вторник / Вторник)	
09:00 – 10:30	**Section / Секция VIII** Ionizing Radiation Measurements Измерване на Йонизиращи Лъчения Измерение Ионизирующих Излучений
10:30 – 10:45	**Coffee break / Кафе пауза / Кофе перерыв**
10:45 – 11:30	**Section / Секция VIII:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
12:00 – 12:30	**Closing Session / Закриваща сесия / Заключительное заседание**

11 September / Септември / Сентября 2024 (Wednesday / Сряда / Среда)
Departure / Отпътуване / Отъезд

SCIENTIFIC PROGRAMME
НАУЧНА ПРОГРАМА
НАУЧНАЯ ПРОГРАММА

8 September / Септември / Сентября 2024
(Sunday / Неделя / Воскесение)

OPENING / ОТКРИВАНЕ / ОТКРЫТИЕ

10:00 – 10:30
Chairman: Prof. D. Diakov, PhD
Secretary: Assoc. Prof. G. Milushev, PhD
N. Gurov, MEng

PLENARY SESSION / ПЛЕНАРНА СЕСИЯ / ПЛЕНАРНОЕ ЗАСЕДАНИЕ

10:30 – 11:15
Chairman: Prof. D. Diakov, PhD
Secretary: Assoc. Prof. G. Milushev, PhD
N. Gurov, MEng

P.1. EC 63	Valentin Starev CHALLENGES TO THE BULGARIAN INSTITUTE OF METROLOGY (BIM) IN ENSURING TRACEABILITY AND IMPLEMENTING CONTROL OF MEASURING INSTRUMENTS FOR ALTERNATIVE FUELS
P.2. EC 17	Philippe Cassette METROLOGY OF RADIOACTIVITY AND RADIONUCLIDES: PAST, PRESENT AND FUTURE
P.3. EC 52	Roald Taymanov and Kseniia Sapozhnikova MEASUREMENTS AND ARTIFICIAL INTELLIGENCE. A NEW STAGE
P.4	George Milushev INFORMATION ABOUT IMEKO 2024 WORLD CONGRESS

Section / Секция I

GENERAL ASPECTS OF METROLOGY. MEASUREMENT METHODS. UNITY AND ACCURACY OF MEASUREMENTS

ОБЩИ АСПЕКТИ НА МЕТРОЛОГИЯТА. МЕТОДИ НА ИЗМЕРВАНЕ. ЕДИНСТВО И ТОЧНОСТ НА ИЗМЕРВАНИЯТА

ОБЩИЕ АСПЕКТЫ МЕТРОЛОГИИ. МЕТОДЫ ИЗМЕРЕНИЯ. ЕДИНСТВО И ТОЧНОСТЬ ИЗМЕРЕНИЙ

11:30 – 12:30
13:00 – 15:00
Chairman: A. Yovcheva, PhD
Secretary: Assist. Prof. I. Blagov, PhD
N. Gurov, MEng

I.1. EC 5	Tetyana Gordiyenko and Oleh Velychko REGULAR TRAINING OF METROLOGISTS ON NATIONAL LEVEL
I.2. EC 8	Velizar Vassilev STUDY OF THE CAPABILITIES OF A RETROFITTED ROUNDNESS MEASURING INSTRUMENT

I.3. EC 25	Sergii Shevkun, Maryna Dobroliubova and Oleksii Statsenko MEASUREMENT UNCERTAINTY EVALUATION DURING CALIBRATION OF PRECISION LCR METERS ON NATIONAL CAPACITY AND INDUCTANCE STANDARDS IN THE FULL FREQUENCY RANGE AND RANGE OF VALUES

I.4. EC 27	Krasimir Bosilkov, Snezhana Spasova and Elena Nikolova INTERLABORATORY COMPARISON OF DIGITAL THERMOMETER IN THE TEMPERATURE RANGE FROM MINUS 40 °C TO 200 °C
1.5. EC 28	Branko Sotirov, Miryana Masheva and Tzvetelin Gueorguiev METHOD FOR TAXIMETER VERIFICATION WITH ROLLER TEST BENCH
I.6. EC 38	Oleksandr Degtiarov, Oleg Zaporozhets, Volodymyr Skliarov, Mykola Moskalets and Viktor Lutsenko DEVELOPMENT OF METHOD AND MEASURING EQUIPMENT IN FIELD OF RESEARCH OF LOW-FREQUENCY MAGNETIC FIELD PARAMETERS
I.7. EC 51	Igor Zakharov, Olesia Botsiura and Iryna Zadorozhna MEASUREMENT UNCERTAINTY EVALUATION OF OBJECTS COORDINATES IN A PLANE
I.8. EC 62	Igor Zakharov, Olesia Botsiura and Kiril Banev APPLICATION OF THE LAW OF PROPAGATION OF EXPANDED UNCERTAINTY TO MEASUREMENT DATA PROCESSING AT CALIBRATION
I.9. EC 64	Dimitar Dichev, Iliya Zhelezarov, Borislav Georgiev, Ivo Malakov, Oleksandr Kupriyanov, Dimcho Pulov, Ralitza Dicheva and Hristofor Kovachev ANALYSIS OF ERRORS IN ROLL AND PITCH MEASUREMENTS FOR MOVING OBJECTS
I.10. EC 65	Dimitar Dichev, Iliya Zhelezarov, Oleksandr Kupriyanov, Ivo Malakov, Borislav Georgiev, Dimcho Pulov, Ralitza Dicheva and Hristofor Kovachev KALMAN FILTER INTEGRATION IN ORIENTATION MEASUREMENT SYSTEMS WITH MEMS SENSORS UNDER DYNAMIC CONDITIONS
I.11. EC 67	Dimcho Pulov PASSIVE ATHERMALIZATION OF COMPACT IR LENSES FOR ACCURATE MEASUREMENTS AND VISUALIZATION OF TEMPERATURE FIELDS
I.12. EC 47	Oleksandr Samoilenko, Serhii Pronenko and Yevheniia Volkova ORGANIZING THE METROLOGICAL MEASUREMENTS NETWORK — THE WAY TO UPGRADE THE ESTABLISHMENT OF TRACEABILITY AND COMPARABILITY OF MEASUREMENTS RESULTS

Section / Секция IV

MEASUREMENTS IN THE INDUSTRY
ИЗМЕРВАНИЯ В ИНДУСТРИЯТА
ИЗМЕРЕНИЯ В ПРОМЫШЛЕННОСТИ

15:15 – 16:45

Chairman: Prof. B. Sotirov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. I. Blagov, PhD

IV.1. EC 10	Alexander L. Shestakov, Denis K. Lebedev, Vladimir V. Sinitsin, Ivan I. Fedosov and Olga L. Ibryaeva INTELLIGENT MULTI-ZONE TEMPERATURE SENSORS DATA PROCESSING FOR ROLLING BEARINGS DIAGNOSIS
IV.2. EC 11	Ivan Fedosov and Alexander Shestakov A METHOD TO ESTIMATE A MEASUREMENT VALUE STATUS FOR A MEASUREMENT CIRCUIT OF FOUR-WIRE THERMOELECTRIC CONVERTER

IV.3. EC 14	Bondan Dwisetyo, Maharani Ratna Palupi, Denny Hermawanto, Ninuk Ragil Prasasti, Chery Chaen Putri, Asep Hapiddin, Fajar Budi Utomo, Adindra Vickar Ega, Muhammad Azzumar, Miftahul Munir, Rudi Anggoro Samodro, Gigin Ginanjar, Yonan Prihhapso DEVELOPMENT OF AN INDUSTRIAL SCALE ACOUSTIC MEASURING INSTRUMENT CALIBRATION SYSTEM

IV.4. EC 33	Miroslav Kokalarov, Dimitar Dichev, Branko Sotirov and Boris Sakakushev AN APPLICATION OF THE PHOTOGRAMMETRIC METHOD FOR MEASURING IN MECHANICAL STRUCTURES
IV.5. EC 34	Miroslav Kokalarov, Dimitar Dichev, Branko Sotirov and Boris Sakakushev A STEREO PHOTOGRAMMETRIC METHOD FOR MEASURING THE DEFORMATIONS OF MECHANICAL STRUCTURES
IV.6. EC 40	Penko Mitev DESIGN AND PRODUCTION OF A FEEDING AND WEIGHING SYSTEM FOR FASTENERS

Section / Секция IX

METROLOGY PRACTICE
МЕТРОЛОГИЧНА ПРАКТИКА
МЕТРОЛОГИЧЕСКАЯ ПРАКТИКА

17:00 – 19:00

Chairman: Prof. D. Dichev, DSc
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. I. Blagov, PhD

IX.1. EC 16	Yosif Munev METHODOLOGY OF SURFACE PROFILE FILTERING AND ROUGHNESS EVALUATION
IX.2. EC 48	Zlatka Chavdarova, Desislava Koleva and Hristiana Nikolova "METROLOGICAL EXAMINATION OF A REFERENCE SYSTEM FOR SPEED MEASUREMENT BASED ON GPS SIGNALS"
IX.3. EC 50	Todor Todorov, Blagovest Bankov, Mihail Zagorski, Todor Gavrilov and Konstantin Dimitrov RAPID PROTOTYPING AND MEASURING ASSESSMENT OF A COMPLEX GEOMETRY
IX.4. EC 68	Dobri Komarski and Dimitar Diakov EXPERIMENTAL STUDY OF THE RADIAL AND AXIAL STIFFNESS OF MICRO-POSITIONING ELASTIC MODULE WITH “BUTTERFLY” FLEXURES
IX.5. EC 69	Dobri Komarski EXPERIMENTAL STUDY OF ROTATIONAL AXIS STABILITY OF MICRO-POSITIONING ELASTIC MODULE WITH “BUTTERFLY” FLEXURES
IX.6. EC 70	Dimitar Diakov, Desislava Dimitrova and Hristiana Nikolova SYSTEMS FOR MEASURING DEVIATIONS OF SHAPE, ORIENTATION AND POSITION
IX.7. EC 71	Dobri Komarski and Dimitar Diakov SIMULATION ANALYSIS OF A GONIOMETRIC MODULE WITH CRUCIFORM ELASTIC GUIDES
IX.8. EC 72	Dobri Komarski INFLUENCE OF GEOMETRIC CHARACTERISTICS AND MATERIAL SELECTION ON THE PERFORMANCE CHARACTERISTICS OF A GONIOMETRIC FOUR-LINK ELASTIC MODULUS

9 September / Септември / Сентября 2024
(Monday / Понеделник / Понедельник)

Section / Секция III

MEASUREMENT AND INFORMATION SYSTEMS AND TECHNOLOGIES

ИЗМЕРВАНИЯ И ИНФОРМАЦИОННИ СИСТЕМИ И ТЕХНОЛОГИИ

ИЗМЕРИТЕЛЬНЫЕ И ИНФОРМАЦИОННЫЕ СИСТЕМЫ И ТЕХНОЛОГИИ

09:00 – 10:30
10:45 – 12:15

Chairman: Prof. I. Zakharov, DSc
Secretary: Assoc. Prof. N. Stoyanov, PhD
Assist. Prof. B. Dzhudzhev, PhD

III.1. EC 54	Rosen Pasarelski, Plamen Tzvetkov, Teodora Pasarelska and Krasen Angelov POWER CONTROL ALGORITHMS IN 5G NETWORKS
III.2. EC 1	Maryna Miroshnyk, Olga Zaichenko, Anatolii Miroshnyk, Nataliia Hapon, Yurii Pakhomov and Liubov Klymenko PULLING FIGURE OF DIELECTRIC RESONATOR FOR 3D FILAMENT DEFECTOSCOPY
III.3. EC 2	Maryna Miroshnyk, Petro Kahanov, Borys Sytnyk, Volodymyr Bryksin, Anatolii Miroshnyk and Andrei Shafranskyi FORMATION OF NONLINEAR TRAJECTORIES OF GUARANTEED ACCURACY IN APPROXIMATION AREAS
III.4. EC 4	Oleh Velychko, Vasyl Dovhan, Denys Nikitenko and Jaroslav Brezytskyi EVALUATION OF THE LONG-TERM DRIFT OF PRECISION RESISTANCE MEASURES
III.5. EC 21	Nikolay Koshevoy, Tetiana Rozhnova, Olena Kostenko, Oleksii Potylchak, Vitalii Siroklyn and Andrey Bychkov FIBER-OPTIC SYSTEMS OF LINEAR AND ANGULAR MOVEMENTS
III.6. EC 32	Filip Filipov, Biser Borisov and Krasimir Bosilkov DATA STORAGE AND PREPARATION OF REPORTING DOCUMENTS FROM METROLOGICAL VERIFICATION OF MEASURING CHANNELS OF ELECTRICAL QUANTITIES FROM THE KIUS "OVATION" SYSTEM WITH A DATABASE IN MS ACCESS
III.7. EC 44	Roumiana Ilieva and Antoni Angelov ADVANCED TECHNIQUES FOR REMOTE CONTROL IN WORK ENVIRONMENT
III.8. EC 53	Oleksandr Samoilenko, Hanna Fursa, Volodymyr Zayets and Yevheniia Volkova THE EXPERIENCE OF THE GEODETIC METHODS APPLICATION FOR TANKS CALIBRATION
III.9. EC 12	Martin Dimitrov VALIDATION OF ULTRASONIC WELDING MACHINE USING CAPABILITY INDEX
III.10. EC 73	R. Miltchev, V. Pechovski, D. Ginchev and M. Zagorski AN APPROACH FOR INTEGRATION OF BIOFEEDBACK AND NEUROFEEDBACK DATA IN SIMULATOR PILOT TESTING
III.11. EC 26	Tsanko Karadzhov, Dimitar Dichev and Miroslav Kokalarov DYNAMIC ACCURACY MEASUREMENT SYSTEM FOR MECHANICAL WATCH VIA COMPUTER'S BUILT-IN MICROPHONE

III.12. EC 66	Dimitar Dichev, Iliya Zhelezarov, Oleksandr Kupriyanov, Borislav Georgiev, Ivo Malakov, Ralitza Dicheva, Hasan Hasanov and Kaloyan Libchev IMPROVING THE ACCURACY OF SYSTEMS FOR MEASURING THE ANGULAR POSITION OF MOVING OBJECTS WITH AN ADAPTIVE WIENER FILTER

Section / Секция VI

MEASUREMENTS IN THE ELECTRICAL POWER ENGINEERING

ИЗМЕРВАНИЯ В ЕЛЕКТРОЕНЕРГЕТИКАТА

ИЗМЕРЕНИЯ В ЭЛЕКТРОЭНЕРГЕТИКЕ

13:00 – 14:45

Chairman: Assoc. Prof. G. Milushev, PhD
Secretary: Assist. Prof. A. Pandelova, PhD
N. Gurov, Meng

VI.1. EC 41	Anna Krylovich, Sergey Podobuev, Vadim Loginov, Dmitry Zolkin, Nikolay Serov and Andrey Serov QUADRATURE DEMODULATION AS A TECHNIQUE TO MEASURE SIGNAL PARAMETERS WITH INCREASED ACCURACY
VI.2. EC 42	Sergey Podobuev, Anna Krylovich, Alexandra Evsenkina, Alexander Shatokhin, Nikolay Serov and Andrey Serov COMPARATIVE ANALYSIS OF DFT AND QUADRATURE DEMODULATION ALGORITHMS FOR COMPLEX SPECTRUM MEASUREMENTS
VI.3. EC 58	Georgi Ivanov, Valentin Mateev and Iliana Marinova LOAD CHARACTERISTICS OF LOW POWER STEP-DOWN TRANSFORMER IN LIQUID NITROGEN
VI.4. EC 59	Georgi Ivanov, Martin Ralchev, Valentin Mateev and Iliana Marinova MEASUREMENT OF SN SOLDERING CONTACT RESISTANCE IN LIQUID NITROGEN
VI.5. EC 24	Iurii Kuzmenko, Sergii Shevkun, Maryna Dobroliubova and Oleksii Statsenko COMPARATIVE ANALYSIS OF DAYLIGHT TIME LOSSES AND ELECTRICAL ENERGY LOSSES WHEN TRANSITIONING TO WINTER AND SUMMER TIME
VI.6. EC 61	George Milushev and Antonia Pandelova COMPARATIVE DATA FOR SORT FULL ACCELERATE PERFORMANCE TEST BASED ON POWER LOAD CURVES
VI.7. EC 60	George Milushev ELECTRICAL POWER - THE MISSING ELEMENT IN ELECTRICAL POWER QUALITY ASSESSMENT

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SENSORS, TRANSDUCERS AND DEVICES FOR MEASUREMENT OF PHYSICAL QUANTITIES

СЕНЗОРИ, ПРЕОБРАЗУВАТЕЛИ И УРЕДИ ЗА ИЗМЕРВАНЕ НА ФИЗИЧНИ ВЕЛИЧИНИ

СЕНСОРЫ, ПРЕОБРАЗОВАТЕЛИ И ПРИБОРЫ ДЛЯ ИЗМЕРЕНИЯ ФИЗИЧЕСКИХ ВЕЛИЧИН

15:00 – 16:45

Chairman: Prof. D. Diakov, DSc
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. B. Dzhudzhev, PhD

II.1. EC 7	Velizar Vassilev RETROFIT OF A ROUNDNESS MEASURING INSTRUMENT

II.2. EC 9	Chingiz Hajiyev ORBITAL CALIBRATION OF NANOSATELLITE MAGNETOMETERS VIA LINEAR TWO-STAGE KALMAN FILTER
II.3. EC 20	Nikolay Koshevoy, Tetiana Rozhnova, , Olena Kostenko, Oleksandr Zabolotnyi, Maksym Tsekhovskyi and Denys Kuraksin MODERN FIBER-OPTIC CONVERTERS OF PHYSICAL QUANTITIES
II.4. EC 23	Ivan Ivanchev, Georgi Ivanov, Lachezar Hrischev, Ivan Rostovsky and Maria Gueorguieva ASSESSMENT OF CONCRETE COMPRESSIVE STRENGTH AT EARLY STRIKING BY SONREB METHOD
II.5. EC 37	Siya Lozanova, Avgust Ivanov, Martin Ralchev and Chavdar Roumenin VERTICAL SILICON HALL MICROSENSOR BASED ON THREE-CONTACT ELEMENTS
II.6. EC 39	Ivan Ivanchev MEASUREMENT OF CONCRETE ELECTRICAL RESISTANCE FOR ASSESSMENT OF REINFORCEMENT CORROSION IN REINFORCED CONCRETE ELEMENTS USING THE 4-POINT WENNER PROBE
II.7. EC 55	Bozhidar Dzhudzhev, Radoslav Deliyski and Antonia Pandelova INFLUENCE OF ENVIRONMENT CONDITION ON THE INFRA-RED OBJECT DETECTION SENSOR FC-51

QUALITY MANAGEMENT AND CONTROL, STANDARDIZATION, CERTIFICATION, ACCREDITATION

УПРАВЛЕНИЕ И КОНТРОЛ НА КАЧЕСТВОТО, СТАНДАРТИЗАЦИЯ, СЕРТИФИКАЦИЯ, АКРЕДИТАЦИЯ

<u>Section / Секция XI</u>

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17:00 – 18:15

Chairman: Assoc. Prof. N. Stoyanov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. I. Blagov, PhD

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XI.2. EC 30	Velizar Zaharinov, Ivo Malakov and Hasan Hasansabri DETERMINING THE INFLUENCE OF MODEL PARAMETERS ON THE CHOOSING OF AN OPTIMAL SIZE RANGE OF LINEAR MODULES FOR AUTOMATED SLIDING DOORS
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XI.4. EC 56	Radostina Angelova, Maria Ivanova and Daniela Sofronova TESTING METHODOLOGY FOR MEASURING CARBON DIOXIDE CONCENTRATION, TEMPERATURE, AND HUMIDITY UNDER SURGICAL FACE MASKS
XI.5. EC 57	Radostina Angelova, Maria Ivanova and Daniela Sofronova ASSESSING THERMOPHYSIOLOGICAL COMFORT AND AIRFLOW EFFICIENCY OF VARIOUS FACE MASK TYPES

10 September / Септември / Сентября 2024
(Tuesday / Вторник / Вторник)

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IONIZING RADIATION MEASUREMENTS
ИЗМЕРВАНЕ НА ЙОНИЗИРАЩИ ЛЪЧЕНИЯ
ИЗМЕРЕНИЕ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ

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10:45 – 11:30

Chairman: Assoc. Prof. K. Mitev, PhD
Secretary: Assist. Prof. B. Dzhudzhev, PhD
Assist. Prof. A. Pandelova, PhD

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VIII.2 EC 49	Marian Genovski, Delyan Damyanov, Victor Mladenov and Mihail Balachev EUROPEAN INTERLABORATORY COMPARISON OF TECHNICAL EQUIPMENT FOR WHOLE-BODY COUNT DUE TO GAMMA-EMITTING RADIONUCLIDES PRESENT IN THE HUMAN BODY - EIVIC2020
VIII.3. EC 36	Daniel Hristov, Georgi Vodenicharski and Aleksandar Stoyanov WORLDWIDE PROFICIENCY TEST FROM INTERNATIONAL ATOMIC ENERGY AGENCY IAEA-TERC-2022-01 AND IAEA-TERC-2022-01 ON DETERMINATION OF ANTHROPOGENIC AND NATURAL RADIONUCLIDES IN WATER, SOIL AND SIMULATED CONTAMINATED SURFACE SAMPLES.
VIII.4. EC 19	Krasimir Mitev, Neli Ivanova, Alexander Stoyanov and Daniel Hristov METROLOGICAL STUDY OF A LARGE-AREA GAS-FLOW PROPORTIONAL COUNTER FOR STANDARDIZATION OF LARGE-AREA SOURCES
VIII.5. EC 15	Strahil Georgiev, Ivelina Dimitrova, Vladislav Todorov, Angelika Popova, Valentin Genov and Krasimir Mitev LARGE VOLUME RADON EXPOSURE SYSTEM FOR CALIBRATION AND STUDIES OF THE DYNAMIC CHARACTERISTICS OF RADON MONITORS
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VIII.7. EC 18	Vladislav Todorov, Philippe Cassette, Strahil Georgiev, Hristiana Stoycheva, Radostina Vasileva and Krasimir Mitev PRIMARY STANDARDIZATION OF RADON-IN-WATER SAMPLES BY TDCR COUNTING
VIII.8. EC 35	Temenuzhka Stoyanova, Borislav Dobrinov, Yana Georgieva and Aleksandar Stoyanov METROLOGY ASSURANCE OF NEUTRON DOSIMETERS
VIII.9. EC 31	Hristiana Stoycheva and Krasimir Mitev AN APPROACH FOR CORRECTION FOR TRUE COINCIDENCES IN HPGE MEASUREMENTS IN CLOSE GEOMETRIES BASED ON MONTE CARLO AND ETNA CALCULATIONSS

CLOSING SESSION / ЗАКРИВАЩА СЕСИЯ / ЗАКЛЮЧИТЕЛЬНОЕ ЗАСЕДАНИЕ

12:00 – 12:30 *Chairman: Prof. D. Diakov, PhD*
Secretary: Assoc. Prof. G. Milushev, PhD
Assist. Prof. B. Dzhudzhev, PhD

C.1.	G. Milushev SUMMARY REPORT ON 34^{TH} ISS MMA 2024
C.2.	I. Kodjabashev SCIENCE NOTES REGARDING 34^{TH} ISS MMA 2024 AND THE NEXT 35^{TH} ISS MMA 2025

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Notes / Бележки / Ноты

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Modern fiber-optic converters of physical quantities

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Abstract - **Fiber-optical transducers have been developed for measuring such physical quantities as acceleration, temperature, and humidity. The proposed converters make it possible to increase the accuracy and sensitivity of the specified quantities, simplify designs and increase their reliability, manufacturability, expand functionality, and reduce weight and size characteristics.**

Keywords - ***Converter, physical quantity, accuracy, design, reliability, manufacturability***

IV. Introduction

For the modern information and measurement systems development for industrial purposes [1-8] usage of fiber-optic converters of physical quantities of various origins is essential; including temperature, humidity, which is an important component of many production processes. This circumstance is explained by a number of well-known advantages characteristic of fiber-optic converters: the possibility of continuous measurement of a physical quantity over time, a wide range of measurement limits both in the direction of very large values and in the direction of very small values of the measured quantity, the possibility of measuring rapidly changing quantities using a small amount of the inertial component of the fiber-optic converter.

The design and development of these transducers are simultaneously related to the problems of increasing their accuracy and sensitivity, simplifying the design and increasing their reliability, increasing the manufacturability and reducing the weight and size characteristics, as well as the constant expansion of the functional capabilities of the transducers.

V. Resources and publications analysis

The following disadvantages of such transducers for measuring the specified parameters are known: the complexity of the design and the process of their manufacture, insufficient reliability, the need to increase accuracy and sensitivity, the need to expand functional capabilities, and reduce mass-dimensional characteristics.

In this regard, it is necessary to develop modern fiber-optic converters of the specified physical quantities, free from the listed disadvantages

VI. Research

In order to simplify the design, improve manufacturability, and ensure the issuance of information in digital form, in the utility model patent of Ukraine No. 153837, a converter for measuring humidity is proposed in co-authorship.

Fig. 1 shows a simplified design of a fiber optic humidity sensor.

In the perforated housing 1 of the fiber-optic humidity sensor, a light guide 2 is fixed, installed in a sleeve 3 made of hygroscopic material. In front of the input end of the optical fiber 2, a source of optical radiation 4 is installed, and in front of its output end there is a photodetector 5 connected to a serially connected amplifier 6, an analog-to-digital converter 7 and an information display device 8.

The fiber-optic humidity sensor works as follows.

When the humidity of the monitored environment changes, the volume of the bushing 3 made of hygroscopic material changes. As a result, there are changes in its linear dimensions and the amount of deflection of the light guide 2. This leads to a change in the intensity of the light flux spreading from the source of optical radiation 4 to the photoreceptor 5. The magnitude of the electrical signal at the output of the photoreceptor 5, which is proportional to the value of the controlled humidity, is amplified in the amplifier 6, is converted into a binary code in the analog-to-digital converter 7 and displayed on the information display device 8.

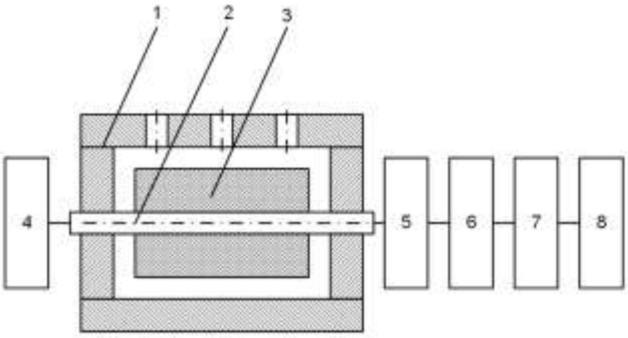

Fig. 1. Construction of a fiber-optic humidity sensor

Fig. 2 shows a simplified design of a fiber-optic temperature sensor.

A bimetallic spiral spring 2 is fixed in the housing 1 of the fiber-optic temperature sensor, to the output end of which is connected an opaque plate 3 with a hole 4, which can be moved along guides 5. The transmitting 6 and receiving 7 optical fibers are placed on opposite sides of the plate 3 one under one in the direction of its movement and rigidly fixed in the housing 1. In front of the input ends of the transmission 6 optical fibers, a radiation source 8 is installed, for example, an LED in front of each optical fiber. The output ends of the receiving 7 optical fibers are laid out in the holes of the fiber-optic converter 9 in order to receive information in a binary code. In fig. 2 presents a 4-bit fiber-optic converter 9.

The fiber optic temperature sensor works as follows.

When the temperature in the housing 1 of the sensor increases, the bimetallic spiral spring 2 unwinds and the opaque plate 3 moves down along the guides 5, and when the temperature decreases, the bimetallic spiral spring 2 twists, which leads to the movement of the plate 3 upwards.

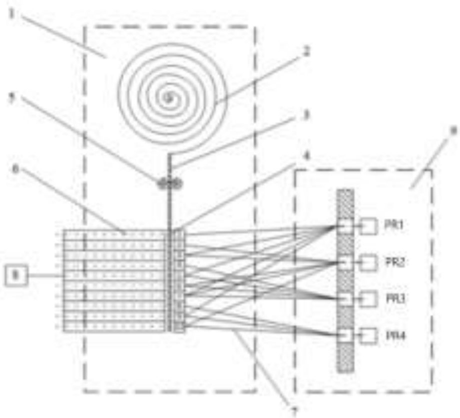

Fig. 2. Simplified design of a fiber-optic temperature sensor

At the same time, the hole 4 of the plate 3 is installed opposite the corresponding input end of the receiving 7 optical fibers. The light flux from the radiation source 8 flows along the transmitting optical fiber 6 through the opening 4 of the opaque plate 3 to the corresponding input end of the receiving optical fibers 7 and illuminates the corresponding photoreceptors (PR1...PR4) of the fiber-optic converter 9.

At the outputs of the photoreceptors (PR1....PR4) a binary code is formed that corresponds to the measured temperature.

Thus, the proposed fiber-optic temperature sensor makes it possible to simplify the design, increase the sensitivity and accuracy of the measurement, and obtain the initial information in the binary code. In addition, it has absolute spark, explosion, and fire safety.

In order to expand the functionality of the prototype by ensuring the temperature measurement of the environment, a fiber-optic sensor for measuring humidity and temperature is proposed in the utility model patent of Ukraine No155988 in co-authorship.

In fig. 3 shows a simplified design of a fiber optic sensor for measuring humidity and temperature.

In the perforated case 1 of the fiber-optic sensor for measuring humidity and temperature, a light guide 2 is rigidly fixed, installed in a tube 3 made of hygroscopic material.

The additional optical fiber 4 is mounted on a bimetallic spring 5 fixed to the cantilever in the housing 1. The input ends of optical fibers 2, 4 are placed in front of the source of optical radiation 6, and their output ends are installed in front of the corresponding photoreceptors 7, 8. The photodetector 7 is connected to the series-connected amplifier 9 and the analog-to-digital converter 10, and the photodetector 8 is connected to the electrical circuit of the series-connected amplifier 11 and the analog-to-digital converter 10.

The fiber optic sensor for measuring humidity and temperature works as follows.

When the humidity of the monitored environment changes, the volume of the bushing 3 made of hygroscopic material changes. At the same time, its linear dimensions and the amount of deflection of the light guide 2 change. This in turn, leads to a change in the intensity of the light flux spreading from the source of optical radiation 6 to the photodetector 7. The magnitude of the electrical signal from the output of the photodetector 7 is amplified in the amplifier 9 and converted into binary N_B code in analog-digital converter 10.

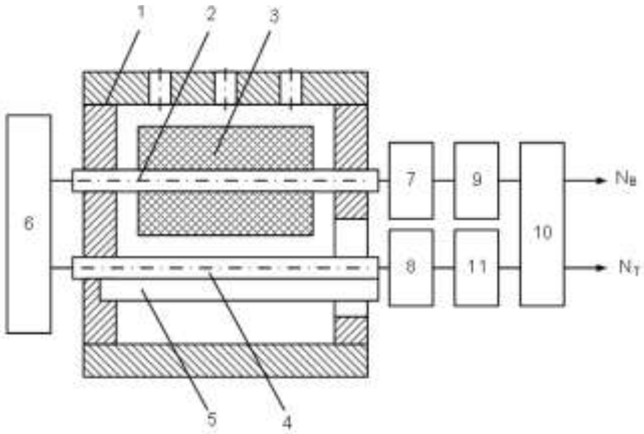

Fig. 3 Simplified design of a fiber optic sensor for measuring humidity and temperature

When the temperature of the medium changes, the bimetallic spring 5, on which the additional light guide 4 is mounted, bends. As a result of the bending of this light guide, the intensity of the light flux, which spreads from the source of optical radiation 6 to the photodetector 8, changes. The electrical signal from the output of the photodetector 8 is amplified in the amplifier 11 and converted into a binary N_T code in analog-digital converter 10.

Thus, the proposed fiber-optic sensor for measuring humidity and temperature allows to expand the functionality of the prototype by providing temperature measurement of the monitored environment.

When the temperature of the medium changes, the bimetallic spring 5, on which the additional light guide 4 is mounted, bends. As a result of the bending of this light guide, the intensity of the light flux, which spreads from the source of optical radiation 6 to the photodetector 8, changes. The electrical signal from the output of the photodetector 8 is amplified in amplifier 11 and converted into a binary N_T code in the analog-digital converter 10.

Therefore, the suggested fiber-optic sensor for measuring humidity and temperature enables an expansion of the prototype's functionality by incorporating temperature measurement of the monitored environment.

The optical fiber sensor contains a housing 1, through the opening of which an input light guide 2 is passed, fixed on a cantilever flat spring 3, a light source 4. An inertial element 5 is installed on the free ends of the cantilever flat spring 3 and the input light guide 2.

On a metal arc 6 of radius L symmetrically relative to the output the input ends of the output optical fibers 7 are located at the end of the input light guide 2, and their output ends are optically connected to the fiber-optic converter 8 to receive information in binary code. Figure 4 shows a four-bit fiber optic converter.

The fiber optic sensor works as follows.

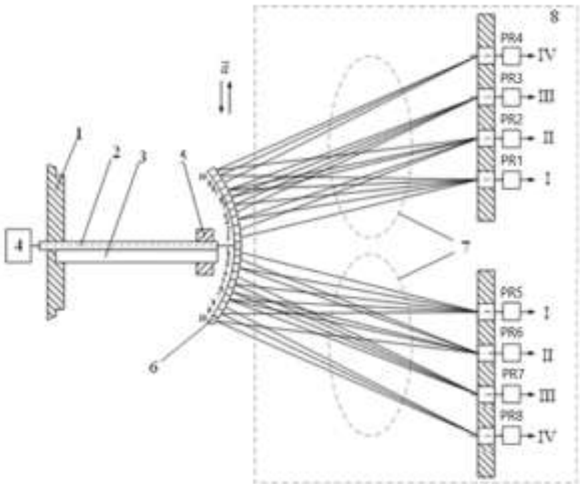

Fig. 4. Pressure sensor with fiber-optic transducer

Under the action of acceleration ā, the inertial element 5 is affected by the force of inertia, which causes the bending of the cantilever flat spring 3 and the input light guide 2. The light flux from the light source 4 through the input light guide 2 enters the corresponding input ends of the output light guides 7 and illuminates the corresponding photoreceptors of the FP of the fiber optic converter 8. Moreover, if the flat spring 3 bends up, then the photodetectors PR1...PR4 are triggered, and if the flat spring is bent down, then the photodetectors PR5...PR8 are triggered. At the output of the corresponding photodetectors, a signal is formed in the form of a four-bit binary code (corresponding bits I...IV), which reflects the measured acceleration.

Therefore, the proposed optical fiber sensor not only improves manufacturability during production but also ensures the output of acceleration information in binary code format.

In order to simplify the design of the sensor, increase the manufacturability of its manufacture, and reduce the weight and size characteristics, in comparison with the analogue, a fiber-optic sensor for measuring acceleration is proposed (utility model patent of Ukraine No. 154961).

Fig. 5 shows a simplified design of a fiber-optic sensor.

The fiber-optic sensor contains a housing 1, in which an axis 2 of a square section is rigidly fixed, which penetrates the inertial mass 3. The optical fiber 4 is made in the form of two coiled springs, which are attached to the inertial mass 3 and the housing 1 from opposite sides. The input end of the optical fiber 4 is optically connected to the radiation source 5, and its output end is connected to the measuring system 6, which includes optical and computing devices. Body 1 is fixed on the surface of the controlled object.

To measure vertical oscillations, the fiber-optic sensor is oriented along the axis OY, and to register horizontal oscillations – along the axis OX.

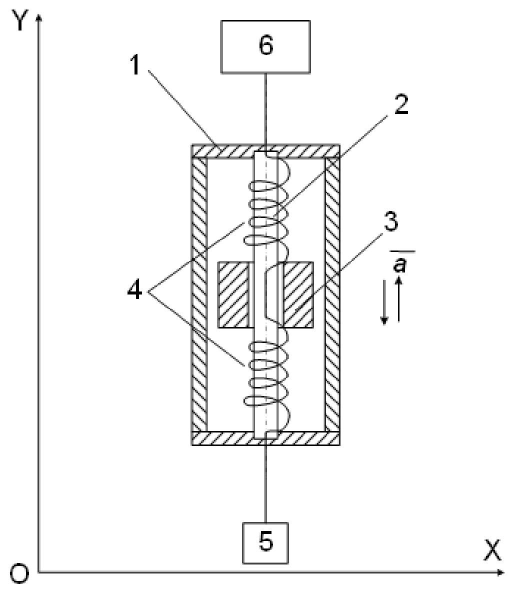

Fig. 5. Pressure sensor with fiber-optic transducer

The fiber optic sensor works as follows.

As a result of the action of the linear acceleration ā on the inertial mass 3, one of the twisted sections of the optical fiber 4 is compressed, and the second is stretched (depending on the direction of the acceleration). The light flux from the radiation source 5 is transmitted through optical fiber 4 to the optical device of the measuring system 6.

As a result of the deformation of the optical fiber 4, the value of the intensity of the light flux changes, which is proportional to the amount of the acting acceleration, is fixed by the optical device and is converted into a digital code in the computing device of the measuring system 6.

Therefore, the suggested fiber-optic sensor enables the simplification of the prototype's design, enhances manufacturability during production, and decreases its weight and size characteristics.

Modern measuring transducers are often developed based on fiber-optic sensitive elements.

Figure 6 illustrates the construction of a fiber-optic sensitive element. Optical fibers 1 and 2 create a flexible element to which an inertial mass 3 is attached. Opposite the transmitting optical fiber 1, there are n stationary receiving optical fibers 4, which, during the displacement of the inertial mass 3, sequentially form optically coupled pairs with fiber 1. The number n of stationary optical fibers 4 is determined by the maximum value of the measured physical quantity. Optical fibers 4 are formed in the shape of an optical cable.

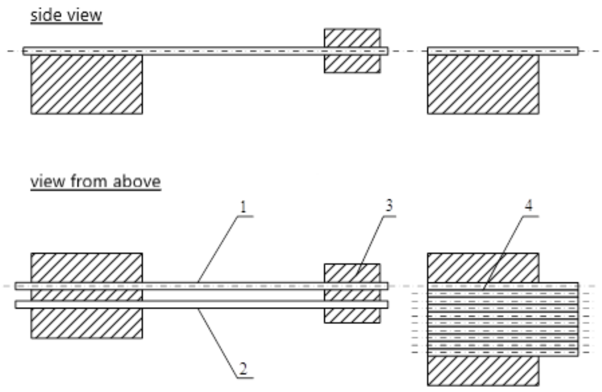

Fig. 6. Fiber-optic sensitive element for measurement transducers of physical quantities

The fiber-optic sensitive element operates as follows: the transmitting optical fiber 1 of the elastic element is connected to the source of optical signal (not shown in Figure 6), and the output ends of the stationary receiving optical fibers 4 are optically connected to the optical signal receivers (photodetectors not shown in Figure 6). The optical signal propagates from the source to the receiver through fiber optic cable 1 and the corresponding fiber optic 4. When acceleration is applied to the inertial mass 3, displacement of the output end of the optical fiber 1 relative to the input ends of the optical fibers 4 occurs.

Depending on the magnitude of the acceleration, the input ends of the stationary optical fibers 4 are sequentially illuminated, and at the output of the photodetectors, output signals are generated, forming a binary code, the number of ones of which corresponds to the number of photodetectors that received optical signals from the transmitting fiber optic 1.

CONCLUSIONS

The use of the proposed converters of physical quantities makes it possible to simplify their design, increase their reliability, sensitivity and measurement accuracy, as well as increase the manufacturability of their manufacture, expand their functional capabilities and reduce their weight and size characteristics.

When producing these sensors, it's beneficial to utilize methods of optimal experimental planning in terms of both cost and time efficiency [9,10].

These converters are poised to have broad utility across information and measurement systems in diverse sectors of the national economy, thanks to the inherent advantages of fiber-optic converters.

These advantages include the ability to achieve high sensitivity and necessary precision, facilitate continuous time measurement and recording of physical quantities, cover a wide range of measurement limits, and enable the measurement of rapidly changing values through the use of a low-inertia fiber-optic component in the converter.

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