РІШЕННЯ

Вченої ради Харківського національного університету імені В. Н. Каразіна з питання: «Про утворення в Харківському національному університеті імені В. Н. Каразіна разової спеціалізованої вченої ради з правом прийняття до розгляду та проведення разового захисту дисертації здобувача Протектора Дениса Олеговича з метою присудження йому ступеня доктора філософії зі спеціальності 105 – Прикладна фізика та наноматеріали у галузі 10 – Природничі науки»

від 31 жовтня 2022 року, протокол №17

Заслухавши та обговоривши інформацію директора навчально-наукового інституту комп'ютерної фізики та енергетики Ірини ГАРЯЧЕВСЬКОЇ, відповідно до пунктів 3, 17-18 Порядку присудження ступеня доктора філософії та скасування рішення разової спеціалізованої вченої ради закладу вищої освіти, наукової установи про присудження ступеня доктора філософії, затвердженого постановою Кабінету Міністрів України від 12 січня 2022 року № 44, та підпункту 26 п. 13.2. Статуту Харківського національного університету імені В. Н. Каразіна Вчена рада ухвалила:

1. Утворити в Харківському національному університеті імені В. Н. Каразіна разову спеціалізовану вчену раду з правом прийняття до розгляду та проведення разового захисту дисертації здобувача Протектора Дениса Олеговича з метою присудження йому ступеня доктора філософії зі спеціальності 105 – Прикладна фізика та наноматеріали у галузі 10 – Природничі науки (додаток 1).

2. Оприлюднити з урахуванням вимог законодавства з питань державної таємниці та службової інформації на офіційному веб-сайті університету електронну копію дисертації у форматі PDF/A з текстовим шаром з накладенням електронного підпису здобувача, що базується на кваліфікованому сертифікаті електронного підпису (з використанням кваліфікованої електронної позначки часу), та інформацію про склад разової ради, посилання на веб-сайт, де здійснюватиметься трансляція захисту дисертації.

Відповідальний: фахівець відділу аспірантури, докторантури та супроводу PhD-програм Каріна ЗВЯГІНЦЕВА
Термін виконання до: 03.11.2022 р.

3. Внести інформацію про утворення разової ради до інформаційної системи Національного агентства із забезпечення якості вищої освіти.

Відповідальний: фахівець відділу аспірантури, докторантури та супроводу PhD-програм Каріна ЗВЯГІНЦЕВА
Термін виконання до: 03.11.2022 р.

4. Передати друкований примірник дисертації, підписаний здобувачем, до Центральної наукової бібліотеки університету.

Відповідальний: *фахівець відділу аспірантури, докторантури та супроводу PhD-програм Каріна ЗВЯГІНЦЕВА*
Термін виконання до: 03.11.2022 р.

5. Подати електронний примірник дисертації до державної наукової установи "Український інститут науково-технічної експертизи та інформації" та до репозитарію університету.

Відповідальний: *фахівець відділу аспірантури, докторантури та супроводу PhD-програм Каріна ЗВЯГІНЦЕВА*
Термін виконання до: 03.11.2022 р.

6. Підготувати наказ про введення в дію рішення Вченої ради Харківського національного університету імені В. Н. Каразіна.

Відповідальний: Завідувач аспірантурою та докторантурою відділу аспірантури, докторантури та супроводу PhD-програм Наталія ПЕТРЕНКО
Термін виконання до: 03.11.2022 р.

Голова Вченої ради Тетяна КАГАНОВСЬКА

Учений секретар Олена ФРІДМАН

Додаток 1

Склад
разової спеціалізованої вченої ради з правом прийняття до розгляду та проведення разового захисту дисертації здобувача Протектора Дениса Олеговича з метою присудження йому ступеня доктора філософії зі спеціальності 105 – Прикладна фізика та наноматеріали у галузі 10 – Природничі науки

Голова	*Лазоренко Олег Валерійович*	Завідувач кафедри загальної фізики фізичного факультету Харківського національного університету імені В. Н. Каразіна, *доцент, доктор фізико-математичних наук* **1.** Chernogor L. F., Garmash K. P., Lazorenko O. V., Onishchenko A. A. Multi-fractal analysis of the earth's electromagnetic field time variations caused by the powerful geospace storm occurred on september 7-8, 2017 // Problems of Atomic Science and Technology. 2018. Vol. 116, No. 4. P. 118-121. (**Scopus, Web of Science, Q3**) URL: http://dspace.nbuv.gov.ua/handle/123456789/147346 https://www.scopus.com/record/display.uri?eid=2-s2.0-85052535821&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=62922361fe8a2c12aa0eee7abff445eb&sot=aut&sdt=cl&cluster=scopubyr%2c%222018%22%2ct%2bscosubtype%2c%22ar%22%2ct&sl=17&s=AU-ID%288221324700%29&relpos=0&citeCnt=0&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000451578500025 **Abstract:** The results of multi-fractal analysis of time variations of the Earth's electromagnetic field caused by the powerful geospace storm occurred on September 7-8, 2017 were considered. To obtain the most detailed results, the multi-fractal detrended fluctuation analysis, the Hurst exponent in

		sliding time domain window and the continuous wavelet transform were simultaneously applied. The set of numerical characteristics, which describe the peculiarities of the Earth's electromagnetic field time variations, was estimated. **Key words:** multi-fractal analysis, electromagnetic field, multi-fractal detrended fluctuation analysis, continuous wavelet transform, sliding time domain window. **2.** Chernogor L. F., Lazorenko O. V., Onishchenko A. A. Dispersive distortions of the fractal ultra-wideband signals in plasma media // Problems of Atomic Science and Technology. 2018. Vol. 116, No. 4. P. 135-138. (**Scopus, Web of Science, Q3**) URL: http://dspace.nbuv.gov.ua/handle/ 123456789/147349 https://www.scopus.com/record/display.uri?eid=2-s2.0-85052493828&origin=resultslist &sort=plf-f&src=s&nlo=&nlr=&nls=&sid= 62922361fe8a2c12aa0eee7abff445eb&sot= aut&sdt=cl&cluster=scopubyr%2c%222018 %22%2ct%2bscosubtype%2c%22ar%22%2ct &sl=17&s=AU-ID%288221324700%29& relpos=1&citeCnt=0&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000451578500029 **Abstract:** The results of numerical modeling of dispersive distortions of the model high-frequency fractal ultra-wideband (UWB) signals propagating in linear and parabolic plasma layers are considered. The character of the dispersive distortions appeared is described and the corresponding numerical characteristics are estimated. Special attention is paid to the comparison of the results with similar ones obtained for non-fractal ultra-short UWB signals. **Key words:** dispersive distortions, numerical modeling, high-frequency fractal ultra-wideband signal, plasma media, parabolic plasma layers. **3.** Лазоренко О. В., Чорногор Л. Ф.

		Фрактальна радіофізика. 1. Теоретичні основи // Радіофізика і радіоастрономія. 2020. Т. 25, № 1. С. 3-77. DOI: https://doi.org/10.15407/rpra25.01.003 URL: http://rpra-journal.org.ua/index.php/ra/article/view/1326 **Анотація:** Розглянуто методи побудови геометричних монофракталів і мультифракталів. Дається порівняльна характеристика методів оцінки розмірності фізичних фракталів. Наводяться приклади фізичних фракталів. У розвитку “фракталізації” науки виділено 4 етапи: епоха “монстрів”, підготовчий етап, етап становлення та розвитку, сучасний етап. Для коректного опису фракталів використовується розмірність Хаусдорфа–Безиковича, яка може набувати й нецілочислових значень. Розглянуто наступні класифікації фракталів: математичні та фізичні, геометричні й алгебраїчні, моно- та мультифрактали, регулярні та стохастичні, однорідні та неоднорідні. Продемонстровано, що фрактальна розмірність об’єктів може бути як дробовою, так і цілочисловою, важливо, щоб фрактальна розмірність була більше їх топологічної розмірності. З рівності фрактальної розмірності двох об’єктів не випливає подібності їх структури. При описі товстих фракталів як регулярних монофракталів замість розмірності Хаусдорфа–Безиковича застосовуються показники скейлінгу. Викладено математичні основи теорії фракталів, використовуваної в сучасній теоретичній радіофізиці. **Ключові слова:** фрактал, фрактальна розмірність, класифікація фракталів, монофрактал, мультифрактал, мультифрактальний формалізм, види розмірності, скейлінг.

Рецензент	*Кокодій Микола Григорович*	Професор кафедри інформаційних технологій в фізико-енергетичних системах навчально-наукового інституту комп’ютерної фізики та енергетики Харківського національного університету імені В. Н. Каразіна, *професор, доктор фізико-математичних наук* **1.** Kokodii N. G., Pogorelov S. V. Heat Localization in the Medium in Blow-Up Regime // East European Journal of Physics. 2020. No. 4. P. 13-20. DOI: https://doi.org/10.26565/2312-4334-2020-4-02 (**Scopus, Web of Science**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85097214110&origin=resultslist&sort=plf-f&src=s&st1=Heat+Localization+in+the+Medium+in+Blow-Up+Regime&sid=c4810c19d6318d3af6b9238a86244960&sot=b&sdt=b&sl=64&s=TITLE-ABS-KEY%28Heat+Localization+in+the+Medium+in+Blow-Up+Regime%29&relpos=0&citeCnt=0&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000596007500002 **Abstract:** The existence of the effect of heat metastable localization in the medium in the blow-up heating regime was experimentally proved. This is the regime in which the heating energy for a finite period of time tends to infinity. Previous theoretical studies have shown that in this case some regions, inside of which the temperature increases, may arise, while their size remains constant or decreases with time (heat localization regions). These regions exist as long as there is some energy input from the outside. An installation for the experimental study of the thermal blow-up regimes in a solid was developed. The object of research was an aluminum rod with a heater at its end. The temperature distribution along the rod was measured with thermocouples. The temperature of the rod end could vary according to the given law. Calibration of the installation was performed. The sensitivity of

		thermocouples was determined. The inertia of the heating and cooling process was estimated. The mathematical description of the thermal processes, occurring during the experiment, was made. The nonlinear equation of heat conduction for the rod was solved, with the heat exchange with the environment by convection and radiation taken into account. The thermal regime at the boundary, which is necessary to create the thermal structures, was determined. The temperature distribution in the rod in the blow-up regime and non-blow-up regime was measured. In the blow-up regime the heat front (the coordinate of the point with the temperature equal to half the maximum temperature) initially shifts from the heat source, and then in the opposite direction, and the size of the area under heating decreases. In the non-blow-up regime the size of the heated region increases all the time. The predicted effect was supposed to be used in installations for thermonuclear fusion where the target was heated by laser radiation pulses of a special shape. This effect can also be used for localized heating in cutting and welding, when the adjacent regions are not to get very hot, and in other similar situations. **Key words:** heating, blow-up regime, heat structures, experiment. **2.** Kokodiy N., Natarova A., Pogorelov S. Measurement of the characteristics of protective screens for microwave radiation made of thin conductive fibers // Ukrainian Metrological Journal. 2020. No. 3. P. 20-26. DOI: https://doi.org/10.24027/2306-7039.3.2020.216802 (**Web of Science**) URL: https://www.webofscience.com/wos/woscc/full-record/WOS:000595047100003 http://nbuv.gov.ua/UJRN/Umlzh_2020_3_5 **Abstract:** In thin conductive fibers, which diameter is much smaller than the wavelength, under certain conditions, a very strong absorption of the microwave radiation can occur. The absorption efficiency factor can

		reach several thousand. It is suggested to use this effect for creation of protective screens. The absorption of radiation occurs in segments of graphite fibers with a diameter of tens micrometers (12…15 μm), which are randomly arranged on the paper or polyethylene film substrate. With such arrangement of fibers, characteristics of the screen do not depend on the radiation polarization. An advantage of the screens is also the uniformity of the frequency characteristics of transmission, absorption and reflection of radiation. The paper describes experiments on measurement of the transmission, reflection and absorption of radiation by screens in the centimeter wave range. The screens were placed in free space under different angles of the incident radiation. The measurement results were compared with the results obtained during measurements in waveguides. As it turned out, the results obtained by both methods are consistent. This makes it possible to recommend waveguide methods based on reflectometers. They are more convenient, fast and accurate than free space measurement methods. Formulas for estimating the transmission, absorption and reflection of screens are given. **Key words:** microwave radiation, thin fiber, protective screen, transmission, reflection, absorption, measurement methods. **3.** Kokodii N. G., Korobov A. M., Shi He, Posokhov M. F., Shulga S. N., Timaniuk V. A. Thermal processes during local laser heating of biological tissues // Photobiology and Photomedicine. 2019. No. 27. P. 49-57. DOI: https://doi.org/10.26565/2076-0612-2019-27-06 URL: https://periodicals.karazin.ua/photomedicine/article/view/14684 **Abstract:** Introduction. Lasers in medicine are currently widely used for both diagnosis and treatment. Studies of the thermal processes that occur when a person is exposed to laser

		radiation have made it possible to developinnovative methods of treating many diseases. Purpose: to study thermal processes in biological tissues during their local laser heating (mathematical model and experiment). Materials and methods. Using the developed mathematical model of the process of local heating of a certain region inside biological tissue, we studied the process of heating the environment by continuous and pulsed laser radiation using infrared light with a wavelength of 0.98 μm, red light with a wavelength of 0.65 μm, green light with a wavelength 0.5 microns and blue light with a wavelength of 0.435 microns. Results. The sizes of the heated region, the time of establishment and decrease in temperature are determined. The calculation results are in good agreement with the obtained experimental data. Findings. The mode of heating biological tissue with laser radiation depends on the wavelength. The maximum heating temperature of the irradiated section with a radiation pulse duration much shorter than the thermal time constant is independent of the shape and duration of the pulse and is determined only by the energy of the absorbed radiation. The distribution of heat into the medium during the duration of the pulse is determined by its duration and thermal diffusivity of the tissue. To reduce the heating of the surrounding tissue, it is necessary to use short radiation pulses. The progress of tissue heating by a sequence of radiation pulses depends on the relationship between the duration of the pulses, the period of their repetition, and the thermal time constant of the medium. The average (smoothed) temperature is the same as when heated with continuous power equal to the average power of the pulse-modulated radiation. **Key words:** laser radiation, biological tissue, mathematical model of local heating, thermal time constant, continuous mode, pulsed mode,

		pulse-modulated mode. **4.** Kokodiy N. G., Kaydash M. V., Pogorelov S. V. Thermal action of microwave radiation on a very thin conductive fiber // Telecommunications and Radio Engineering. 2018. Vol. 77, No. 19. P. 1719-1727 DOI: https://doi.org/10.1615/TelecomRadEng.v77.i19.40 (**Scopus, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85057843718&origin=resultslist&sort=plf-f&src=s&st1=Thermal+action+of+microwave+radiation+on+a+very+thin+conductive+fiber&sid=77b6e3c8c47ca75944706deaadfe080a&sot=b&sdt=b&sl=84&s=TITLE-ABS-KEY%28Thermal+action+of+microwave+radiation+on+a+very+thin+conductive+fiber%29&relpos=0&citeCnt=0&searchTerm= **Abstract:** The paper presents experimental findings of a new physical effect arising as a result of a strong interaction of microwave radiation with very thin (d << l) conductive fibers. The calculations show that the absorption efficiency factor of a fiber having a diameter of several micrometers, being exposed to radiation in a centimeter range, can reach the value of several hundreds. It was found that the effect can be enhanced by oblique incidence of the radiation beam. An experiment to measure the absorption of microwave radiation with a wavelength of 1 cm in a graphite fiber of 12 μm in diameter has been carried out. To determine the radiation absorption in a fiber its resistance changing under radiation heating was measured. To reduce the error of results, the average value of resistance for 1 minute with a frequency of 2 Hz was measured. A thermal image of the heated fiber was observed using a thermal imager. A mathematical model of the process of fiber heating with a radiation beam has been developed. It has been shown experimentally that a graphite fiber with 12 μm in diameter absorbs about 10% of the energy of the

		incident microwave beam having a wavelength of 1 cm. The heating temperature at the beam incidence point reaches 200 °C. The developed mathematical model describes well the radiation-fiber interaction process. Investigation results confirm the existence of a strong interaction between the microwave radiation and very thin conductive fibers. The effect under consideration can be applied in facilities in order to transfer the electromagnetic radiation energy for small targets. Another use of this effect is the creation of protective screens against the microwave radiation effect on humans or on different facilities. **Key words:** microwave radiation, thin fiber, heating, absorption efficiency.
Рецензент	*Хардіков Вячеслав Володимирович*	Доцент кафедри теоретичної радіофізики факультету радіофізики, біомедичної електроніки та комп'ютерних систем Харківського національного університету імені В. Н. Каразіна, *доцент, кандидат фізико-математичних наук* **1.** Shamuilov G., Domina K., Khardikov V., Nikitin A. Y., Goryashko V. Optical magnetic lens: towards actively tunable terahertz optics // Nanoscale. 2021. Vol. 13, No. 1. P. 108-116. DOI: https://doi.org/10.1039/D0NR06198K (**Scopus, Web of Science, Q1**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85099244649&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=932326c2993e7487f46be3e04ade4cf3&sot=aut&sdt=cl&cluster=scopubyr%2c%222022%22%2ct%2c%222021%22%2ct%2c%222020%22%2ct%2c%222019%22%2ct%2c%222018%22%2ct%2bscosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2814024424900%29&relpos=1&citeCnt=5&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000607350900010 **Abstract:** As we read this text, our eyes

		dynamically adjust the focal length to keep the image in focus on the retina. Similarly, in many optics applications the focal length must be dynamically tunable. In the quest for compactness and tunability, flat lenses based on metasurfaces were introduced. However, their dynamic tunability is still limited because their functionality mostly relies upon fixed geometry. In contrast, we put forward an original concept of a tunable Optical Magnetic Lens (OML) that focuses photon beams using a subwavelength-thin layer of a magneto-optical material in a non-uniform magnetic field. We applied the OML concept to a wide range of materials and found out that the effect of OML is present in a broad frequency range from microwaves to visible light. For terahertz light, OML can allow 50% relative tunability of the focal length on the picosecond time scale, which is of practical interest for ultrafast shaping of electron beams in microscopy. The OML based on magneto-optical natural bulk and 2D materials may find broad use in technologies such as 3D optical microscopy and acceleration of charged particle beams by THz beams. **Key words:** charged particles, light, magnetic lenses, magnetism, particle beams. **2.** Domina K. L., Khardikov V. V., Goryashko V., Nikitin A. Y. Bonding and Antibonding Modes in Metal–Dielectric–Metal Plasmonic Antennas for Dual-Band Applications // Advanced Optical Materials. 2020. Vol. 8, No. 5. P. 1900942. DOI: https://doi.org/10.1002/adom.201900942 (**Scopus, Web of Science, Q1**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85070796780&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=932326c2993e7487f46be3e04ade4cf3&sot=aut&sdt=cl&cluster=scopubyr%2c%222022%22%2ct%2c%222021%22%2ct%2c%222020%22%2ct%2c%222019%22%2ct%2c%222018%22%2ct%2bscosubtype%2c%

		22ar%22%2ct&sl=18&s=AU-ID%2814024424900%29&relpos=3&citeCnt=5&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000481432200001 **Abstract:** Resonant optical antennas supporting plasmon polaritons (SPPs)—collective excitations of electrons coupled to electromagnetic fields in a medium—are relevant to sensing, photovoltaics, and light-emitting devices, among others. Due to the SPP dispersion, a conventional antenna of fixed geometry, exhibiting a narrow SPP resonance, cannot simultaneously operate in two different spectral bands. In contrast, here it is demonstrated that in metallic disks, separated by a nanometric spacer, the hybridized antibonding SPP mode stays in the visible range, while the bonding one can be pushed down to the mid-infrared range. Such an SPP dimer can sense two materials of nanoscale volumes, whose fingerprint central frequencies differ by a factor of 5. Additionally, the mid-infrared SPP resonance can be tuned by employing a phase-change material (VO2) as a spacer. The dielectric constant of the phase-change material is controlled by heating the material at the frequency of the antibonding optical mode. These findings open the door to a new class of optoelectronic devices able to operate in significantly different frequency ranges in the linear regime, and with the same polarization of the illuminating wave. **Key words:** bonding and antibonding modes, dual band, optical antennas, phase change material, surface enhanced spectroscopy, surface plasmon polariton. **3.** Sayanskiy A., Kupriianov A. S., Xu S., Kapitanova P., Dmitriev V., Khardikov V. V., Tuz V. R. Controlling high-Q trapped modes in polarization-insensitive all-dielectric metasurfaces // Physical Review B. 2019. Vol. 99, No. 8. P. 085306. DOI:

		https://doi.org/10.1103/PhysRevB.99.085306 (**Scopus, Web of Science, Q1**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85061961094&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=932326c2993e7487f46be3e04ade4cf3&sot=aut&sdt=cl&cluster=scopubyr%2c%222022%22%2ct%2c%222021%22%2ct%2c%222020%22%2ct%2c%222019%22%2ct%2c%222018%22%2ct%2bscosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2814024424900%29&relpos=4&citeCnt=40&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000458859100006 **Abstract:** We reveal peculiarities of the trapped (dark) mode excitation in a polarization-insensitive all-dielectric metasurface, whose unit supercell is constructed by particularly arranging four cylindrical dielectric particles. Involving group-theoretical description we discuss in detail the effect of different orientations of particles within the supercell on characteristics of the trapped mode. The theoretical predictions are confirmed by numerical simulations and experimental investigations. Since the metasurface is realized from simple dielectric particles without the use of any metallic components, they are feasibly scalable to both μm- and nanometer-size structures, and they can be employed in flat-optics platforms for realizing efficient light-matter interaction for multiple hot-spot light localization, optical sensing, and highly efficient light trapping. **Key words:** dielectric particles, experimental investigations, light-matter interactions, light-trapping, mode excitation, optical sensing, polarization-insensitive.
Опонент	*Кривчіков Олександр Іванович*	Провідний науковий співробітник відділу теплових властивостей та структури твердих тіл та наносистем Фізико-

		технічного інституту низьких температур ім. Б. І. Вєркіна НАН України, *професор, доктор фізико-математичних наук* **1.** Konstantinov V. A., Krivchikov A. I., Karachevtseva A. V., Sagan V. V. Thermal transport in dynamically disordered phases of molecular crystals: A thermo activation mechanism // Solid State Communications. 2021. Vol. 329. P. 114241. DOI: https://doi.org/10.1016/j.ssc.2021.114241 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85102555927&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=4&citeCnt=1&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000659869000002 **Abstract:** Isochoric thermal conductivity of crystalline 1,1-difluoroethane (F-152a freon) is measured on samples of different densities in the dynamically orientationally disordered (DOD) phase. The thermal conductivity increased with temperature, similar to how it occurs in amorphous and glass-like substances above the plateau area. It is found that this behavior can be described by a thermo-activation mechanism with constant activation energy and density-dependent pre-exponential factor. Bridgman coefficient $g = -(\partial \ln\kappa/\partial \ln V)_T$ is 6.0 ± 0.5. It is shown that the thermal conductivity of a number of other molecular crystals with the dynamic orientational disorder can be described in a similar way. Possible reasons for the thermal activation behavior of thermal conductivity are discussed. **Key words:** 1,1-difluoroethane, orientational disorder, thermal activation mechanism, thermal conductivity.

		2. Szewczyk D., Gebbia J. F., Jeżowski A., Krivchikov A. I., Guidi T., Cazorla C., Tamarit J.-L. Heat capacity anomalies of the molecular crystal 1-fluoro-adamantane at low temperatures // Scientific Reports. 2021. Vol. 11. P. 18640. DOI: https://doi.org/10.1038/s41598-021-97973-2 (**Scopus, Web of Science, Q1**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85115396466&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=2&citeCnt=4&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000700289800061 **Abstract:** Disorder–disorder phase transitions are rare in nature. Here, we present a comprehensive low-temperature experimental and theoretical study of the heat capacity and vibrational density of states of 1-fluoro-adamantane ($C_{10}H_{15}F$), an intriguing molecular crystal that presents a continuous disorder–disorder phase transition at T = 180 K and a low-temperature tetragonal phase that exhibits fractional fluorine occupancy. It is shown that fluorine occupancy disorder in the low-T phase of 1-fluoro-adamantane gives rise to the appearance of low-temperature glassy features in the corresponding specific heat (i.e., “boson peak” -BP-) and vibrational density of states. We identify the inflation of low-energy optical modes as the main responsible for the appearance of such glassy heat-capacity features and propose a straightforward correlation between the first localized optical mode and maximum BP temperature for disordered molecular crystals (either occupational or orientational). Thus, the present study provides new physical insights into the possible origins of the BP appearing in disordered materials and expands

		the set of molecular crystals in which “glassy-like” heat-capacity features have been observed. **Key words:** disorder–disorder phase transitions, low-temperature, 1-fluoro-adamantane, low-energy optical modes, boson peak. **3.** Korolyuk O. A., Krivchikov A. I., Romantsova O. O. Universal temperature dependence of the thermal conductivity of clathrate compounds, molecular crystals, and glasses at low temperatures // Low Temperature Physics. 2020. Vol. 46, No. 2. P. 111-117. DOI: https://doi.org/10.1063/10.0000528 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85081136543&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=6&citeCnt=1&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000525444100004 **Abstract:** A new approach is used to analyze the experimental data on the temperature dependence of low-temperature thermal conductivity κ(T) of some typical disordered complex crystals: clathrate hydrates (tetrahydrofuran, methane, xenon), $Sr_8Ga_{16}Ge_{30}$ and p-type $Ba_8Ga_{16}Ge_{30}$ clathrate compounds, YSZ ceramics, molecular structural glasses of 1-propanol, glycerol and D-ethanol exhibiting glass-like behavior of κ(T), and some representatives of regular complex crystals: tetrahydrofuran clathrate hydrate, n-type $Ba_8Ga_{16}Ge_{30}$ clathrate compound, $CsDy(MoO_4)_2$ layered crystal, 1-propanol, and D-ethanol. A universal approach to normalizing low-temperature thermal conductivity is proposed, based on the theoretical model of hybridized Klinger-

		Kosevich excitations. The low-temperature universal behavior of the thermal conductivity of both crystalline and amorphous solids is shown to be a result of the same phenomenon: the hybridization of acoustic and low-lying optical branches. **Key words:** clathrate compound, clathrate hydrate, molecular structural, temperature dependence, tetrahydrofuran clathrate hydrates, theoretical modeling. **4.** Jeżowski A., Strzhemechny M. A., Krivchikov A. I., Pyshkin O. S., Romantsova O. O., Korolyuk O. A., Zloba D. I., Horbatenko Yu. V., Filatova A. Thermoactivated heat transfer mechanism in molecular crystals: Thermal conductivity of benzophenone single crystals // AIP Advances. 2019. Vol. 9, No. 1. P. 015121. DOI: https://doi.org/10.1063/1.5038676 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85060176897&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=16&citeCnt=4&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000457407600051 **Abstract:** Thermal conductivities of two benzophenone single crystals have been measured at temperatures from 4.7 to 270 K. The experimental data for both are consistent for temperatures above 15 K. The thermal conductivity of benzophenone can be represented as a sum of two contributions: $\kappa_1 + \kappa_{TA}$ where κ_1 is due to the standard phonon mechanisms accepted for ordered crystals and κ_{TA} takes into account the heat flow due to intermolecular hopping of thermally activated intramolecular vibrational modes. The thermal activation contribution in unsubstituted benzophenone is substantially smaller when

		compared to that in any of the two para-bromobenzophenone polymorphs studied previously. Unlike in the 4-bromobenzophenone crystals, the microscopic agent responsible for intramolecular excitation(s) was not determined. The characteristic intramolecular excitation energy was evaluated to be 220 K, about three times less compared to 4-bromobenzophenone. **Key words:** heat transfer, molecular crystals, single crystals, thermal activation, thermal conductivity. **5.** Nomoto T., Imajo S., Yamashita S. Akutsu H., Nakazawa Y., Krivchikov A. I. Construction of a thermal conductivity measurement system for small single crystals of organic conductors // Journal of Thermal Analysis and Calorimetry. 2019. Vol. 135, No. 5. P. 2831-2836. DOI: https://doi.org/10.1007/s10973-018-7799-1 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85055524289&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=12&citeCnt=8&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000460527700023 **Abstract:** We newly constructed a thermal conductivity measurement system for single crystals of molecular compounds. This system enables us to measure the thermal conductivity of samples with the length of less than 1.0 mm. In order to evaluate the capability of detection of phase transitions occurred in molecule-based materials, we performed the thermal conductivity measurement of single crystals of organic conductors α-$(BEDT\text{-}TTF)_2I_3$ and κ-$(BEDT\text{-}TTF)_2Cu[N(CN)_2]Br$, where BEDT-TTF denotes bis(ethylenedithio)tetrathiafulvalene. From

		the temperature dependence of the thermal conductivity of α-(BEDT-TTF)$_2$I$_3$, we succeeded in observing the metal–insulator transition as a sudden drop of κ(T) at 135 K. In the temperature dependence of thermal conductivity of κ-(BEDT-TTF)$_2$Cu[N(CN)$_2$]Br, we could observe the increment of κ(T) at the metal-superconducting transition (T_c = 11.4 K). These results show that the newly developed system has high performance enough to detect various kinds of phase transitions in small crystals of molecular compounds. **Key words:** metal–insulator transition, molecular compound, steady-state method, superconducting transition, thermal conductivity. **6.** Horbatenko Y. V., Romantsova O. O., Korolyuk O. A., Jeżowski A., Szewczyk D., Tamarit J. L., Krivchikov A. I. Anomalous behavior of thermal conductivity at high temperatures for molecular crystals composed of flexible molecules // Journal of Physics and Chemistry of Solids. 2019. Vol. 127. P. 151-157. DOI: https://doi.org/10.1016/j.jpcs.2018.12.017 (**Scopus, Web of Science, Q2**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85058952453&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls=&sid=7c7a20f196eb89ad4556ac2d98656235&sot=aut&sdt=cl&cluster=scosubtype%2c%22ar%22%2ct&sl=18&s=AU-ID%2835611706800%29&relpos=11&citeCnt=2&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000461405200020 **Abstract:** The temperature dependence of thermal conductivity κ(T) of selected molecular polycrystals consisting of flexible molecules was investigated within 20–260 K. The materials were para-chloronitrobenzene, pentachloronitrobenzene and freons F-112 and F-113. The κ(T) of these crystals increased

		with temperature in the interval where processes of phonon–phonon scattering were dominant. The increase was observed both in the orientationally-ordered and -disordered phases and is typical of the thermally activated heat transfer by localized molecular excitations [M. A. Strzhemechny et al., Chem. Phys. Lett. 647 (2016) 55]. In a wide interval of temperatures, irrespective of the glass transition temperature, the κ(T) could be described by a sum of three components: $\kappa(T) = A/T + B + \kappa_{TA}(T)$. The term A/T accounts for phonon–phonon scattering processes and B accounts for diffuse phonon scattering. The third contribution is described by the Arrhenius equation, $\kappa_{TA}(T) = \kappa_0 \exp(-E/k_BT)$, where E is the activation energy and κ_0 is the pre-exponential factor characterizing intensity of the activation process. A comparative analysis of anomalous thermal conductivities of some other molecular crystals was carried out. It was found that κ_0 linearly depended on E and a similar relationship was evident for a series of quasicrystals. **Key words:** diffusive modes, hybridization, locons, phonons, polymorphism, thermal conductivity.
Опонент	*Стрельнікова Олена Олександрівна*	Провідний науковий співробітник відділу гідроаеромеханіки енергетичних машин Інституту проблем машинобудування ім. А. М. Підгорного НАН України, *професор, доктор технічних наук* **1.** Matsevityi Y. M., Strel'nikova E. A., Povgorodnii V. O., Safonov N. A., Ganchin V. V. Toward the Solution of Inverse Thermal Conductivity and Thermal Elasticity Problems // Journal of Engineering Physics and Thermophysics. 2022. Vol. 95, No. 2. P. 374-379. DOI: https://doi.org/10.1007/s10891-022-02491-1 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85127653434&origin=resultslist&sort=plf-f&src=s&st1=Toward+

		the+Solution+of+Inverse+Thermal+Conductivity+and+Thermal+Elasticity+Problems &sid=0c1ae1bd5e5d9625d10ffff34647977d&sot=b&sdt=b&sl=98&s=TITLE-ABS-KEY%28Toward+the+Solution+of+Inverse+Thermal+Conductivity+and+Thermal+Elasticity+Problems%29&relpos=0&citeCnt=0&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000778913800008 **Abstract:** The article describes a method of solving inverse problems, which is based on the joint application of the A. N. Tikhonov regularization principle and of the method of influence functions that play an important role in obtaining stable solutions of ill-posed problems and in facilitating the computational process due to the preliminarily determined influence functions. The method is the result of development of the methodology previously developed by the authors for solving inverse problems, which is based on the various methods of regularizing solutions to multiparameter ill-posed problems of field theory, as well on the experience in identifying the parameters of mathematical models of various levels. The results of identification of heat transfer at the boundary of a body by displacements measured with an error characterized by a random variable distributed by the normal law are presented. The proposed method makes it possible to use experimental information obtained from several sensors. It is applicable to the study of heterogeneous media and combines the simplicity of programming with the ability of parallelizing the computational process, which meets modern requirements for methods and algorithms of solving direct and inverse problems. **Key words:** identification, influence functions, inverse problem, regularization, stabilizing functional, thermal stresses.

		2. Matsevityi Y. M., Strel'nikova E. A., Povgorodnii V. O., Safonov N. A., Ganchin V. V. Methodology of Solving Inverse Heat Conduction and Thermoelasticity Problems for Identification of Thermal Processes // Journal of Engineering Physics and Thermophysics. 2021. Vol. 94, No. 5. P. 1110-1116. DOI: https://doi.org/10.1007/s10891-021-02391-w (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85118209647&origin=resultslist&sort=plf-f&src=s&st1=Methodology+of+Solving+Inverse+Heat+Conduction+and+Thermoelasticity+Problems+for+Identification+of+Thermal+Processes&sid=08a704dc6fe2172f1059818e77ca3679&sot=b&sdt=b&sl=131&s=TITLE-ABS-KEY%28Methodology+of+Solving+Inverse+Heat+Conduction+and+Thermoelasticity+Problems+for+Identification+of+Thermal+Processes%29&relpos=0&citeCnt=1&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000711308200017 **Abstract:** An approach to solving the inverse problem of thermoelasticity that employs A. N. Tikhonov′s regularization principle and the method of influence functions has been suggested. The use of A. N. Tikhonov′s regularization with an efficient algorithm of the search for the regularization parameter makes it possible to obtain a stable solution of the inverse problem of thermoelasticity. The unknown functions of displacement and temperature are approximated by the Schoenberg splines, whereas the unknown coefficients of these functions are calculated by solving the system of linear algebraic equations. This system results from the necessary condition of the functional minimum based on the principle of least squares of the deviation of the calculated stress from the stress obtained experimentally. To regularize the solutions of the inverse heat

		conduction problems, this functional also employs a stabilizing functional with the regularization parameter as a multiplicative multiplier. The search for the regularization parameter is effected with the aid of an algorithm analogous to the algorithm of the search for the root of a nonlinear equation, whereas the use of the influence functions makes it possible to represent temperature stresses and temperature as a function of one and the same sought vector. This article presents numerical results on temperature identification by thermal stresses measured with an error characterized by a random quantity distributed by the normal law. **Key words:** functional, identification, influence function, inverse problem, regularization, spline, thermal stress. **3.** Karaiev A., Strelnikova E. Axisymmetric polyharmonic spline approximation in the dual reciprocity method // ZAMM – Journal of Applied Mathematics and Mechanics / Zeitschrift für Angewandte Mathematik und Mechanik. 2021. Vol. 101, No. 4. P. e201800339. DOI: https://doi.org/10.1002/zamm.201800339 (**Scopus, Web of Science, Q3**) URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85099022944&origin=resultslist&sort=plf-f&src=s&st1=Axisymmetric+polyharmonic+spline+approximation+in+the+dual+reciprocity+method&sid=ebde8a39d9cc93b05f7c5c824cecd08b&sot=b&sdt=b&sl=92&s=TITLE-ABS-KEY%28Axisymmetric+polyharmonic+spline+approximation+in+the+dual+reciprocity+method%29&relpos=0&citeCnt=5&searchTerm= https://www.webofscience.com/wos/woscc/full-record/WOS:000605062200001 **Abstract:** The paper is devoted to developing the dual reciprocity boundary element method for axisymmetric problems based on usage of axisymmetric polyharmonic splines. The

		axisymmetric polyharmonic spline is introduced as a linear combination of polyharmonic radial basic functions and polynomial terms. The analytical expressions for proposed axisymmetric polyharmonic radial basic functions are obtained for splines with arbitrary degrees. These expressions include special elliptic integrals that are analyzed and calculated for the first time. The relationships between radial basic functions with positive and negative degree numbers are obtained that allows us to receive the recurrence formulae for specific elliptic integrals with nearest indexes. It reveals the possibility of calculating radial basic functions with arbitrary orders by using the combination of only the first two members in recursive sequence. Implementation of the Gauss well-known arithmetic-geometric mean technique provides calculation of the specific elliptic integrals and axisymmetric polyharmonic splines with any given accuracy. Numerical examples for solving two axisymmetric problems in potential theory using the proposed dual reciprocity boundary element method demonstrate high calculation accuracy with low computational costs. **Key words:** dual-reciprocity method, polyharmonic spline, radial-basis functions, special elliptic integrals.