



Как работать с научной литературой. Виды и рейтинги журналов

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31 год, к.ф.-м.н. (2014 г.)

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- Статьи в Nature Comm., Phys.Rev.Lett, Optica
- Руководство проектами РФФИ и РНФ
- Защиты бакалавров и магистров
- Подготовка аспиранта
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- Преподаю C, C++ на 1, 2 курсе ФФ МГУ

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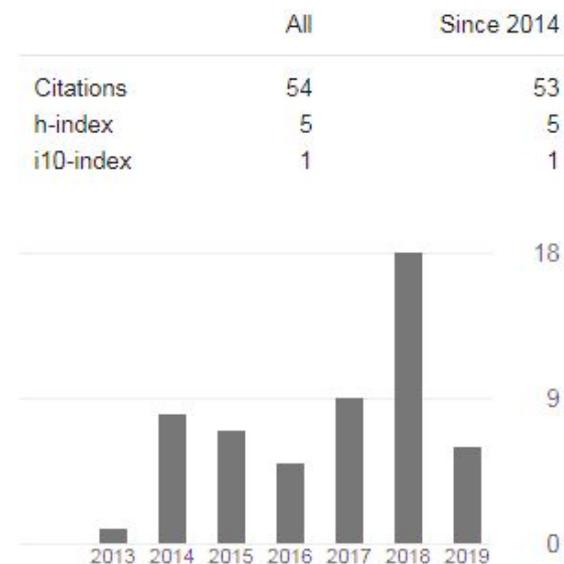
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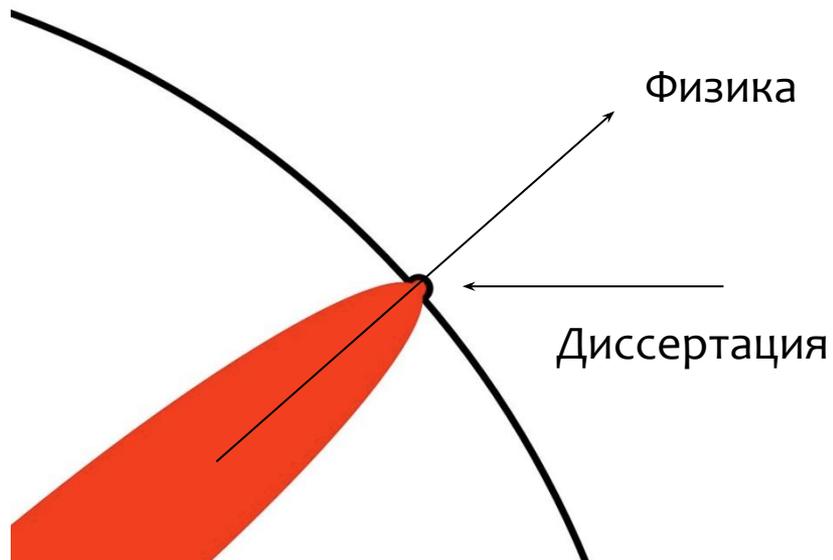
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Содержание встречи

- зачем нужно работать с научной литературой
- какая бывает научная литература
- как эффективно читать научную литературу
- ключевые библиометрические показатели
- как и где искать научную литературу
- способы ведения и использования своей библиотеки

Зачем надо работать с литературой

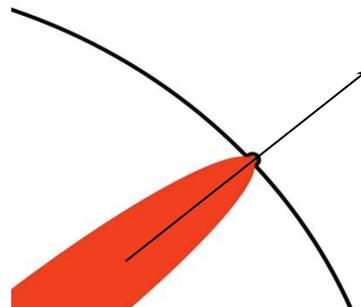
Все знания человечества



Зачем надо работать с литературой

Быть на «острие» науки:

Следить за последними достижениями



Важно оставаться актуальным:

Заниматься важными, популярными, денежными исследованиями;

Помещать уже совершенные ранее открытия в новый контекст;

Расширять научный кругозор:

Написать обзор литературы из свежих материалов;



Виды научной литературы

Формирование научного бэкграунда

- Учебники, монографии



Современные научные
взгляды, концепции

- Обзорные статьи



Последние научные результаты

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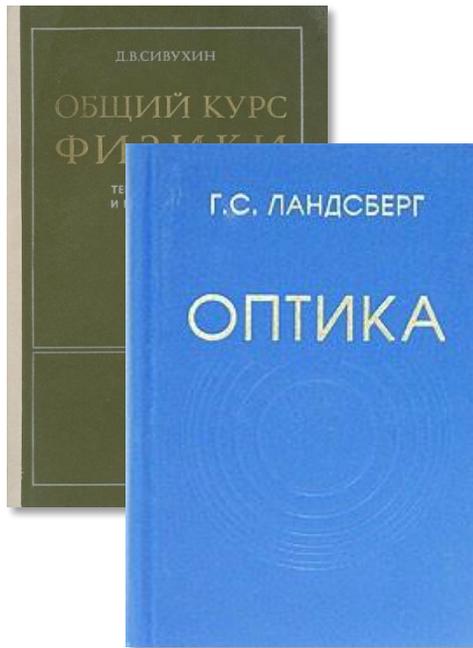
Формирование научного базиса по направлению:

- Учебники (для студентов) (-20-50 лет);
- Книги, монографии (для специалистов) (-10-20 лет);

Общая физика

Необходимый минимум

Методология очень важна



Теоретическая физика

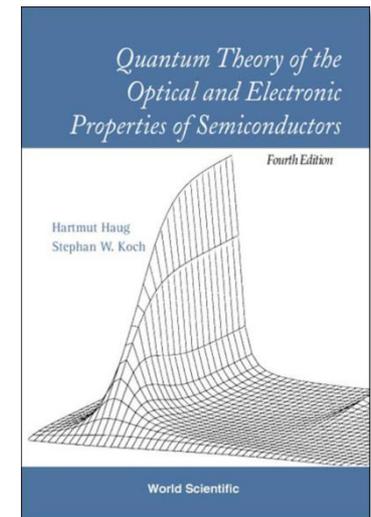
Не теряют актуальности

Методология важна



Монографии

Сильная специализация



Виды научной литературы

Г.С.Ландсберг
Оптика

Д.И.Блохинцев
Основы квантовой механики

G.Agrawal
Application of Nonlinear Fiber Optics

§ 42. Дифракция от прямоугольного и круглого отверстий

Если щель имеет ограниченную длину l , т.е. представляет собой прямоугольник со сторонами b и l , то, очевидно, и в направлении длины щели будет наблюдаться дифракционная картина. Общий вид, получаемый в этом случае, изображен на рис. 9.7 а. Форма отверстия показана маленьким белым прямоугольником в правом углу фотографии; источником света служит маленькая яркая освещенная дырочка (точечный источник), расположенная в фокусе большой линзы. Согласно изложенному в § 40 дифракционная картина шире в том направлении, которое соответствует более короткой стороне прямоугольника. В случае квадратного отверстия картина в обоих направлениях будет симметричной.

При графической реверсии этой задачи волновой фронт разделяется на элементы в виде маленьких прямоугольников, получаемых от разницы поверхности отверстия рядом линий, параллельных той и другой стороне прямоугольника. Направление дифракционного луча определяется следующим образом.

Через направление первоначального распространения луча проведем две плоскости, параллельные сторонам прямоугольника l и b соответственно. Тогда направление дифракционного луча будет характеризоваться углами ψ и φ между его проекциями на указанные плоскости и направлением первоначального распространения. Направление, удовлетворяющее условиям $l \sin \psi = n\lambda$ или $b \sin \varphi = m\lambda$, где n и m — целые числа, соответствуют, очевидно, минимумам интенсивности, т.е. черным полосам на фотографии. Аналитическое рассмотрение задачи о прямоугольном отверстии не представляет трудностей и может быть выполнено по схеме § 39.

Результаты вычисления интенсивности выражаются формулой

$$I_{\psi, \varphi} = I_0 \frac{\sin^2(\pi b \sin \varphi / \lambda)}{(\pi b \sin \varphi / \lambda)^2} \frac{\sin^2(\pi l \sin \psi / \lambda)}{(\pi l \sin \psi / \lambda)^2}, \quad (42.1)$$

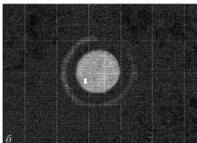
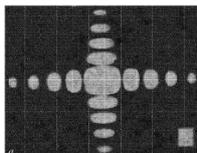


Рис. 9.7. Картина дифракции от прямоугольного (а) и круглого (б) отверстий; стороны прямоугольника относятся как 4 к 5

уравнение Шредингера для этой системы имеет вид

$$i\hbar \frac{\partial \Psi}{\partial t} = \left\{ \sum_{k=1}^N \hat{H}(q_k) + \sum_{k>j}^N W(q_k, q_j) \right\} \Psi, \quad (118.1)$$

где $\hat{H}(q_k) = -\frac{\hbar^2}{2m} \nabla_k^2 + U(q_k)$ есть оператор энергии k -й частицы, $U(q_k)$ — потенциальная энергия k -й частицы во внешнем поле, а $W(q_k, q_j)$ — энергия взаимодействия k -й и j -й частиц. Разложим теперь волновую функцию Ψ по собственным функциям $\Psi_{nk}(q_k)$ операторов L_k, L_j, L_s , с точно таким же путем, как это делалось в § 116. Тогда получим

$$\Psi(q_1, q_2, \dots, q_N, t) = \sum_{n_1} \sum_{n_2} \dots \sum_{n_N} c(n_1, n_2, \dots, n_N, t) \Psi_{n_1}(q_1) \Psi_{n_2}(q_2) \dots \Psi_{n_N}(q_N). \quad (118.2)$$

$c(n_1, n_2, \dots, n_N, t)$ есть, очевидно, волновая функция нашей системы в « L »-представлении, $|c(n_1, n_2, \dots, n_N, t)|^2$ есть вероятность того, что первая частица находится в состоянии n_1 (имеет четверку L_1, L_2, L_3, s , обозначенную одной буквой n_1), вторая частица в состоянии n_2 (имеет четверку L_1, L_2, L_3, s' , обозначенную через n_2) и т. д. Подставляя (118.2) в (118.1), умножая уравнения слева на $\Psi_{m_1}^*(q_1) \Psi_{m_2}^*(q_2) \dots \Psi_{m_N}^*(q_N)$ и интегрируя по q_1, q_2, \dots, q_N , получим

$$i\hbar \frac{d}{dt} c(m_1, m_2, \dots, m_k, \dots, m_j, \dots, m_N, t) = \sum_{n_1} \sum_{n_2} \dots \sum_{n_N} H_{m_1 n_1} c(m_1, m_2, \dots, m_k, \dots, m_j, \dots, m_N, t) + \sum_{k>j} \sum_{n_k} \sum_{n_j} W_{m_k n_k, m_j n_j} c(m_1, m_2, \dots, m_k, \dots, m_j, \dots, m_N, t). \quad (118.3)$$

Здесь $H_{m_k n_k}$ и $W_{m_k n_k, m_j n_j}$ суть матричные элементы

$$H_{m_k n_k} = \int \Psi_{m_k}^*(q_k) \hat{H}(q_k) \Psi_{n_k}(q_k) dq_k, \quad (118.4)$$

$$W_{m_k n_k, m_j n_j} = \int \Psi_{m_k}^*(q_k) \Psi_{m_j}^*(q_j) W(q_k, q_j) \Psi_{n_k}(q_k) \Psi_{n_j}(q_j) dq_k dq_j. \quad (118.5)$$

Уравнение (118.3) есть уравнение (118.1) в « L »-представлении. В силу одинаковости частиц матричные элементы (118.4), (118.5) зависят лишь от значения квантовых чисел m_k, n_k, m_j, n_j , а не от номера частиц k, j . Обозначая какое-нибудь значение n_k через m, n_k через n , подобным образом m_j через m', n_j через n' , координаты k -й частицы через q, a j -й — через q', a' , мы можем написать

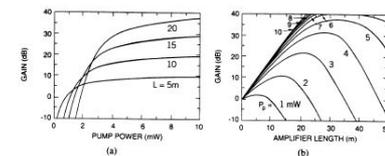


Figure 4.6 Small-signal gain at 1.55 μm as a function of (a) pump power and (b) amplifier length for an EDFA pumped at 1.48 μm . (After Ref. [34]. © 1991 IEEE)

where $\alpha_p = \Gamma_p \sigma_p N$ and $\alpha_s = \Gamma_s \sigma_s N$ are the absorption coefficients at the pump and signal wavelengths, respectively. These equations govern the evolution of signal and pump powers inside an EDFA. Their predictions are in good agreement with experiments as long as the amplified spontaneous emission (ASE) remains negligible [36]. The inclusion of fiber losses is essential for distributed-gain amplifiers, which amplify signals over long fiber lengths. For lumped amplifiers with fiber lengths under 1 km, α and α' can be set to zero.

A drawback of the above model is that the absorption and emission cross sections are taken to be the same for both the pump and signal beams. As was seen in Fig. 4.6(b), these cross sections are generally different. It is easy to extend the model to include such differences [34]. An analytic solution can still be obtained [33]. Figure 4.6 shows the small-signal gain at 1.55 μm as a function of the pump power and the amplifier length by using typical parameter values. For a given amplifier length L , the gain increases exponentially with pump power initially, but at a much reduced rate when pump power exceeds a certain value [corresponding to the "knee" in Fig. 4.6(a)]. For a given pump power, amplifier gain becomes maximum at an optimum value of L and drops sharply when L exceeds this optimum value. The reason is that the end portion of the amplifier remains unpumped and absorbs the amplified signal.

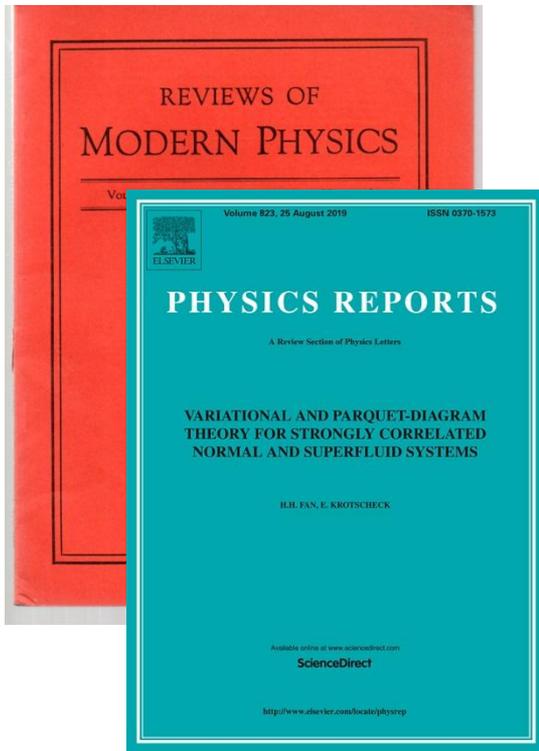
Since the optimum value of L depends on the pump power P_p , it is necessary to choose both L and P_p appropriately. Figure 4.6(b) shows that for 1.48- μm pumping, 35-dB gain can be realized at a pump power of 5 mW for $L = 30$ m. It is possible to design high-gain amplifiers using fiber lengths as

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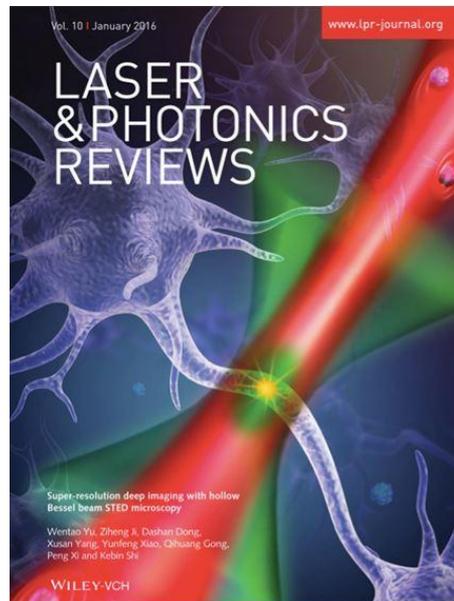
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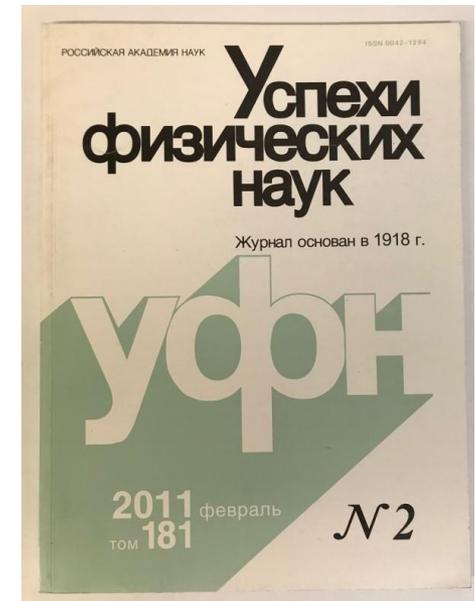
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Femtosecond filamentation in transparent media

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Abstract

This paper introduces and discusses the main aspects of ultrashort laser pulse filamentation in various transparent media such as air (gases), transparent solids and liquids. The properties of femtosecond filaments and their applications are presented. Theoretical models developed to explain filaments and the main predictions inferred from these models are reviewed. The various techniques to observe filaments and to measure their characteristics are described. The main measurements of filament features performed so far are reviewed.

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Keywords: Filamentation; Ultrashort laser pulses; Optical Kerr effect; Multiphoton ionization; Nonlinear propagation

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Third-generation femtosecond technology

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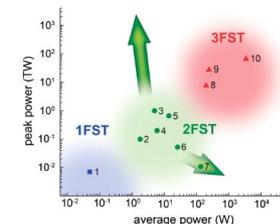


1. INTRODUCTION

Femtosecond technology was born in the 1970s, when passively mode-locked dye lasers produced the first pulses shorter than 1 ps [1–3]. Subsequent advances led to pulse durations of a few tens of femtoseconds directly from laser oscillators [4–7]. The poor energy storage capability of laser dyes limited amplification to microjoule energies and megawatt peak powers [8,9]. This first-generation femtosecond technology (1FST) opened the door for direct time-domain investigations of hitherto immeasurably fast processes such as molecular dynamics, chemical reactions, and phase transitions in condensed matter [10,11].

Broadband solid-state lasers with large energy storage capabilities appeared by the end of the 1980s [12–14]. They offered the potential for further pulse shortening as well as boosting the pulse energy and peak power by many orders of magnitude. Second-generation femtosecond technology (2FST), based on chirped-pulse amplification (CPA) [15] in solid-state lasers, in particular, in Ti:sapphire-based systems [16–18], and dispersion control by chirped multilayer mirrors (henceforth, for brevity, chirped mirrors) [19–21] paved the way for the emergence of entirely new research fields and technologies such as attosecond science [22] and laser-driven particle acceleration [23].

2FST is now capable of providing pulses with ultrahigh (petawatt) peak power at moderate average power [24] and moderate-peak-power (gigawatt) pulses at ultrahigh (approaching the kilowatt scale) average power levels [25]; see Fig. 1.



	τ_{pulse}	E_{pulse}	P_{peak}	P_{average}
system 8	5 fs	40 mJ	7.5 TW	200 W
system 9	1.7 fs	49 mJ	27 TW	245 W
system 10	5 fs	345 mJ	65 TW	3450 W

Fig. 1. Summary of recorded performances of 1FST and 2FST and the expected performance of 3FST, in terms of average and peak powers. These systems are reviewed in detail in Supplement 1. The blue square represents the best performance achieved by dye-laser technology [1, corresponding to Ref. [9]], the green dots show femtosecond CPA solid-state technology [2–7, corresponding to Refs. [60,71,66,18,67], and [23], respectively], and the red triangles represent the simulated results for

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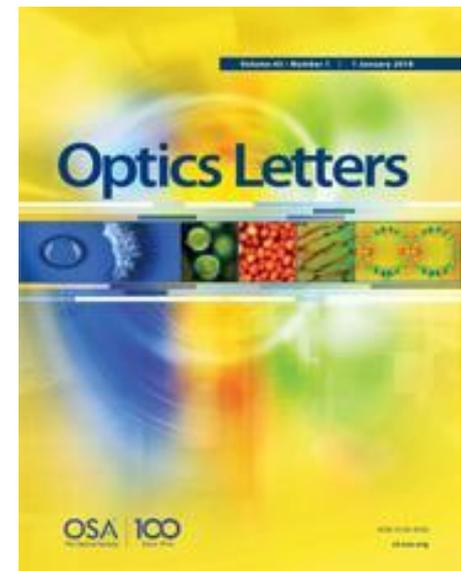
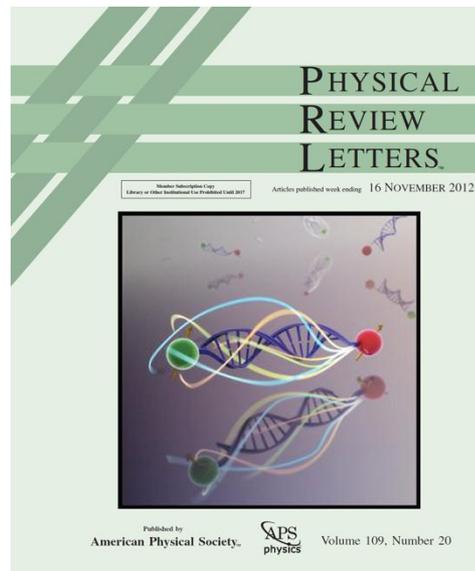
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membrane. In this case, the force originates from the vesicle-imposed curvature of a membrane with some degree of stiffness. In living cells, even larger forces may be expected, and may be mediated through lateral membrane tension^{10,11}, attached to both sides. Next, we used HS-AFM to investigate whether PIEZO1 can change its shape in a reversible manner.

HS-AFM of PIEZO1 in supported membranes

HS-AFM imaging is mediated by raster-scanning the sample with a nanometric tip at the end of a cantilever that oscillates at resonance frequency (about 600 kHz). The topography (that is, the dimension) is a surface that is contoured by the same oscillation-septon amplitude (A_{osc}), which must be smaller than the amplitude of the cantilever when it swings freely (A_{lim}). The ratio of A_{osc} to A_{lim} defines how much the oscillation is damped through the sample interaction. Thus, at constant A_{lim} , lowering A_{osc} leads to a higher applied force (F_{app}) and on each tap (Fig. 4a). The peak force and average force during an oscillation cycle can be determined by the analysis of the force trajectories from experiment¹² or by numerical simulation¹³ using the point-mass model¹⁴ (Extended Data Fig. 3, Methods). In our HS-AFM setup, the average applied force ($\langle F_{app, av} \rangle$) to the imaged objects can be approximated by

$$\langle F_{app, av} \rangle = \frac{kA_{lim}}{2Q} \left[1 - \frac{A_{osc}}{A_{lim}} \right]^{1/2} \quad (1)$$

features a triangular ring of 'negative height' between the C-terminal extracellular domain and the periphery of the arms, which is a recognizable feature that we term the halo.

For HS-AFM, we found the best conditions were those in which PIEZO1 channels were reconstituted into small unilamellar vesicles of 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine (POPC) and 1-palmitoyl-2-oleoyl-sn-glycero-3-phospho(1'-rac-glycerol) (POPC) (at a ratio of 85:15, w/w). These vesicles spread into a continuous, supported lipid bilayer with embedded PIEZO1 channels. When imaged under both low (about 20 pN) and high (about 50 pN) scanning force, the extracellular face of PIEZO1 was identifiable by the halo that surrounds a central protruding cap, and three membrane-extended arms that reach out into the membrane plane (Fig. 4c-f) (two panels). The radial profile within the halo area of the extracellular PIEZO1 face imaged at about 50 pN highlights the three-fold symmetry of the channel, with the three arms protruding with approximately 120° periodicity from a presumably suspended bilayer between the arms (green trace in Fig. 4c right, Supplementary Video 1). The intracellular face of PIEZO1 exhibits a featureless dome with around 8.2 nm height above the membrane (Fig. 4d). However, the dome-like intracellular face was observed only rarely which is consistent with vesicles bearing on mica to expose the concave extracellular face of PIEZO1 to the tip of the HS-AFM.

The experimental topographies (Fig. 4c, d) resemble qualitatively the simulated topographies (Fig. 4b); however, PIEZO1 viewed from the extracellular side matched the structure only when imaged at low force (around 20 pN). The halo expands outwards under increasing force.

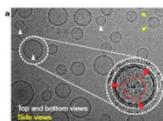


Fig. 2 | Reconstructions of PIEZO1 in vesicles exhibit various orientations in cryo-EM micrographs. a, PIEZO1 channels reconstituted in POPC:POPC:cholesterol (8:1:1) vesicles ($\geq 1,000$ images). Top- and bottom-view or side-view particles are highlighted by white or yellow arrows, respectively. Inset, magnified and contrast-adjusted top-view

PIEZO1 with left-handed curved arms (red arrowheads). b, Averages of the top-view ($n = 322$) and bottom-view ($n = 120$) PIEZO1 compared to the structural model (RCSB Protein Data Bank code 1D983R). The handedness of the three arms in projection permits the determination of PIEZO1 orientation. Scale bars, 20 nm.

shorter than the momentum relaxation time in GaAs, which is ≈ 200 fs [53,54].

Figure 1 shows the residual current density,

$$j(F_0, \varphi_{CEP}) = -\frac{2e}{(2\pi)^2} \sum_{\mathbf{k}} \int_{\mathcal{BZ}} d^3k n_{\mathbf{k}}(k_{\perp, \text{max}}) \hat{\mathbf{v}}_{\mathbf{k}}(k). \quad (2)$$

for the cases of two [Figs. 1(a)-(c)] and six [Figs. 1(d)-(f)] bands, as well as for different values of T_2 . Using more than three conduction bands does not qualitatively change our results [23]. In Fig. 2(a), $v_g(k) = \hbar^{-1} \nabla_{\mathbf{k}} E_{\mathbf{k}}$ is the group velocity in band i , and $t_{\text{max}} = 36.2$ fs is the final time of our simulations. When the field is weak, the photocurrent is excited due to the $\omega + 2\omega$ interference [18,19]. In this case, it is known that $j_{\text{max}}(F_0) \propto F_0^2$. If, in contrast,

the fact that the probability amplitudes of one- and two-photon processes are proportional to F_0 and F_0^2 , respectively, while their interference makes a contribution proportional to F_0^3 . In Fig. 2, this cubic dependence breaks down for $F_0 \geq 0.1$ V/Å, which we visualize in Fig. 1 by representing $F_0^2 j(F_0, \varphi_{CEP})$ with color coding. In Fig. 1, the results obtained for two- and six-band differ significantly, which is consistent with recent findings [11]. However, they also share a few remarkable features.

First, we observe CEP-controlled light-induced residual current, which implies that it is due to ultrafast, subcycle processes. The cases of no polarization relaxation ($T_2 = \infty$) [panels (a) and (d)] and fast dephasing ($T_2 = 10$ fs, panels (b) and (e)) differ very little, which suggests that there is fast effective dephasing within the purely Hamiltonian system described by the Schrödinger equation. Note that the fastest electron dephasing time in semiconductors (GaAs) was measured to be $T_2 = 14$ fs [55], which was consistent with theory [36]. At the same time, recent experiments on high-harmonic generation in solids [8-12] suggest that dephasing times in the strong-field regime may be on the order of femtoseconds, so we also present results for $T_2 = 2$ fs. We note that T_2 has a stronger impact on the two-band results.

Second, for any chosen CEP, $j(F_0, \varphi_{CEP})$ changes its sign at certain values of F_0 . In the two-band model, the maximum magnitude of the current at any field amplitude is always obtained for the antisymmetric pulse ($\varphi_{CEP} = \pm \pi/2$). In contrast, for more realistic six-band calculations, the maximum current nontrivially depends on the CEP, which causes the appearance of 'vortices' in panels (d)-(f).

Third, starting from $F_0 \approx 0.2$ V/Å, the residual current is much stronger than that obtained by extrapolating the weak-field current according to the $\propto F_0^3$ law. This fact is more clearly seen in Fig. 2, from which we also conclude that dephasing tends to reduce the magnitude of the residual current.

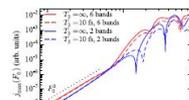


Fig. 2 | (Color online) Spectra of the residual current density $j(F_0, \varphi_{CEP})$ (normalized for each diagram) versus pump wavelength λ_{pump} and CEP. The x-axis is the pump wavelength in nm, and the y-axis is the residual current density in units of 10^{12} A/m². The color scale represents the current density. The dashed lines indicate the theoretical F_0^3 law.

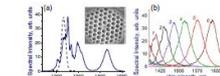


Fig. 1 | (Color online) (a) Spectrum of C60-tertiary-laser pulses (dashed line) and spectrum at the output of a 20 nm piece of PCF (dotted line) measured with an input energy of 5 nJ (solid line). (b) Spectra of wavelength-shifted solitons at the output of a 20 cm piece of PCF measured with an input energy of 0.5 nJ (1), 4 nJ (2), 4.4 nJ (3), 4.9 nJ (4), 6.3 nJ (5) and 7.5 nJ (6).

wavelengths from 1400 to 1500 nm, the 20 nm LBO crystal provided a typical SHG efficiency of about 40%, yielding second harmonic pulses in the 600 to 750 nm wavelength range with an energy up to 0.5 nJ. Thus, in the case of a long nonlinear crystal, the spectral brightness of the second harmonic in our experiments was higher than the spectral brightness of the soliton, which becomes possible, as demonstrated in the earlier work [14], due to $(\omega_1 + \theta) + (\omega_2 - \theta) = 2\omega_0$ sum-frequency generation process. The average output peak power of no less than 10 mW was achieved within the entire range from 600 to 750 nm. Beyond this region, the output power gradually decreased, reaching ≈ 5 mW at 800 nm. A thinner 2 mm LBO crystal provided the second harmonic output power above 4.0 mW within the range from 680 to 700 nm, decreasing to 1.5 mW at 800 nm. Ultrashort pulses in this wavelength range, albeit with much lower energies, can be generated directly by using ultrasmall core tapered fibers [15].

The pulse width of the second harmonic generated in the LBO crystal can be tuned by varying the thickness of the nonlinear crystal, beam-focusing geometry, and the wavelength of the soliton PCF output, providing the pump field for the SHG process. Due to the mismatch of the group velocities v_g and v_{2g} of the pump and second

harmonic pulses in an SHO crystal, the pulse width of the second harmonic increases [16], in accordance with $\tau_{2g} \approx \tau_g^2 / 2(1 - \beta^2)^{1/2}$, where τ_g is the pulse width of the pump, $\theta = k_{\text{SH}}(\omega_1^2 - \omega_2^2) / k_{\text{SH}}$, $k_{\text{SH}} = \text{min}(k_1, k_2)$ is the interaction length, L is the thickness of the nonlinear crystal, $\beta = c/v_g$ is the cordical parameter, ω_0 is the pump wavelength, and ω_1 is the waist radius of the pump beam. The second harmonic pulse width calculated as a function of the pump and second harmonic wavelengths for a thin ($L = 2$ mm) and a thick ($L = 20$ mm) nonlinear crystals is shown by the dashed lines in Fig. 3(a). Dispersion of the nonlinear crystal was included in these calculations through the Sellmeier equation with appropriate coefficients for LBO. In the case of a thin nonlinear crystal, a lens with a focal length $f = 7.5$ cm is most giving $\theta = 0.8$ mm for $\lambda_0 = 1500$ nm. In this regime, $L < \theta$ and τ_2 is close to θ , giving rise to a weak dependence of τ_{2g} on λ_0 [curve 1 in Fig. 3(a)]. In the case of a thick crystal, we take $f = 15$ cm, leading to $\theta = 0.5$ mm for $\lambda_0 = 1500$ nm. In this case, $\tau_2 \ll \theta$ and $\tau_{2g} \approx \tau_g^2 / 2(1 - \beta^2)$, leading to a strong dependence of τ_{2g} on λ_0 , controlled by the dispersion of the nonlinear crystal [curve 2 in Fig. 3(a)].

Typical autocorrelation traces of second harmonic pulses produced with thin (2 mm) and thick (20 mm) LBO crystals are presented in Fig. 3(b). These traces were measured using the SHG process in a 0.5 mm thick LBO crystal. The second harmonic output of a 2 mm LBO crystal centered at 700 nm [curve 1 in Fig. 3(b)] can be accurately fitted with a Gaussian envelope with an FWHM pulse width of 75 fs. For the 20 mm crystal, the pulse width of second harmonic output ranged from 210 to 600 fs within the range of wavelengths from 700 to 1000 nm. A typical autocorrelation trace for the second harmonic at 700 nm is shown by curve 2 in Fig. 3(b), corresponding to an FWHM pulse width of 580 fs. The pulse width of the second harmonic output measured as a function of λ_0 for 2 mm and 20 mm thick nonlinear crystals is shown by the circles and rectangles, respectively, in Fig. 3(c). Results of these experiments agree well with theoretical predictions (dashed lines in Fig. 3(a)).

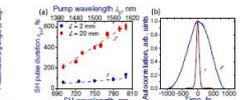


Fig. 3 | (Color online) (a) Pulse width of the second harmonic as a function of the pump (upper abscissa axis) and second harmonic (lower abscissa axis) wavelengths. Results of experiments using an LBO crystal with $L = 2$ mm (circles) and $L = 20$ mm (rectangles) are shown. Dashed lines represent theoretical predictions.

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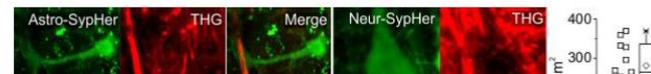
Nonlinear-optical stain-free stereoimaging of neurons, astrocytes and gliovascular interfaces

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Nonlinear microscopy techniques are widely used in the field of biophotonics thanks to their ability to image in highly scattering tissues such as brain [1]. Techniques that use intrinsic sources of contrast rather than exogenous labels are of great interest, because they are suitable not only for fundamental biological research but also for clinical applications [2]. Neurons are the most studied cells in the central nervous system of mammals. However, in certain parts of brain glial cells called astrocytes outnumber neurons. Historically, astrocytes considered to be simple support cells that structure the brain and control blood brain barrier, but recently were discovered to have great functional diversity and play many roles in healthy tissues as well as in CNS disorders [3].

Here we show that combination of harmonics generation and multiphoton microscopy of endogenous chromophores enables imaging of neurons, astrocytes and gliovascular interfaces in rat brain. Our experiments were done on fixed and fresh rat brain slices. Imaging was performed using Cr:Forsterite femtosecond source operating at 1250 nm, providing average power of 450 mW, pulse width of 90 fs and repetition rate of 29 MHz. Standard epidetection scheme is used to collect scattered photons. The main source of THG signal are myelinated axons. Because there is no THG signal when laser beam is focused inside homogenous media, cell bodies are seen as dark areas surrounded by bright background (Fig. 1a-1c, red). Cell specific fluorescent tagging using genetically encoded fluorescent sensor SypHer was utilized to identify astrocytes (Figs. 1a, 1b) and neurons (Fig. 1c) on THG label-free images. Soma area determined from THG images can be used to distinguish between these cells (Fig 1d). Other than size, astrocytes we found to have much brighter nuclear membrane, while neurons contain a lot of small organelles clearly seen in autofluorescence channel at 650 nm, as well as in THG channel (Fig. 1c). These findings, combined with difference in size can be used to develop automatic label-free cell detection and analysis algorithms.



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Synchronous multi-color laser network with daily sub-femtosecond timing drift

Kemal Şafak, Ming Xin, Michael Y. Peng, Franz X. Kärtner

(Submitted on 26 Oct 2017 (v1), last revised 14 Aug 2018 (this version, v2))

Filming atoms in motion with sub-atomic spatiotemporal resolution is one of the distinguished scientific endeavors of our time. Newly emerging X-ray laser facilities are the most likely candidates to enable such a detailed gazing of atoms due to their angstrom-level radiation wavelength. To provide the necessary temporal resolution, numerous mode-locked lasers must be synchronized with ultra-high precision across kilometer-distances. Here, we demonstrate a metronome synchronizing a network of pulsed-lasers operating at different center wavelengths and different repetition rates over 4.7-km distance. The network achieves a record-low timing drift of 0.6 fs RMS measured with 2-Hz sampling over 40 h. Short-term stability measurements show an out-of-loop timing jitter of only 1.3 fs RMS integrated from 1 Hz to 1 MHz. To validate the network performance, we present a comprehensive noise analysis based on the feedback flow between the setup elements. Our analysis identifies nine uncorrelated noise sources, out of which the slave laser's inherent jitter dominates with 1.26 fs RMS. This suggests that the timing precision of the network is not limited by the synchronization technique, and so could be much further improved by developing lasers with lower inherent noise.

Comments: 12 pages, 4 figures
Subjects: Instrumentation and Detectors (physics.ins-det)

Journal reference: Ic[Ş]afak, K., Xin, M., Peng, M. Y., & K[ä]rtner, F. X. (2018). Synchronous multi-color laser network with daily sub-femtosecond timing drift. Scientific Reports, 8(1), 11948
DOI: 10.1038/s41598-018-30348-2
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graph TD; A[ОЦЕНКА НАУЧНОЙ ДЕЯТЕЛЬНОСТИ] --> B[НАУЧНАЯ ПРОИЗВОДИТЕЛЬНОСТЬ]; A --> C[НАУЧНАЯ ВЛИЯТЕЛЬНОСТЬ]; B --- D[Количество публикаций]; C --- E[Количество цитирований];
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Количество публикаций

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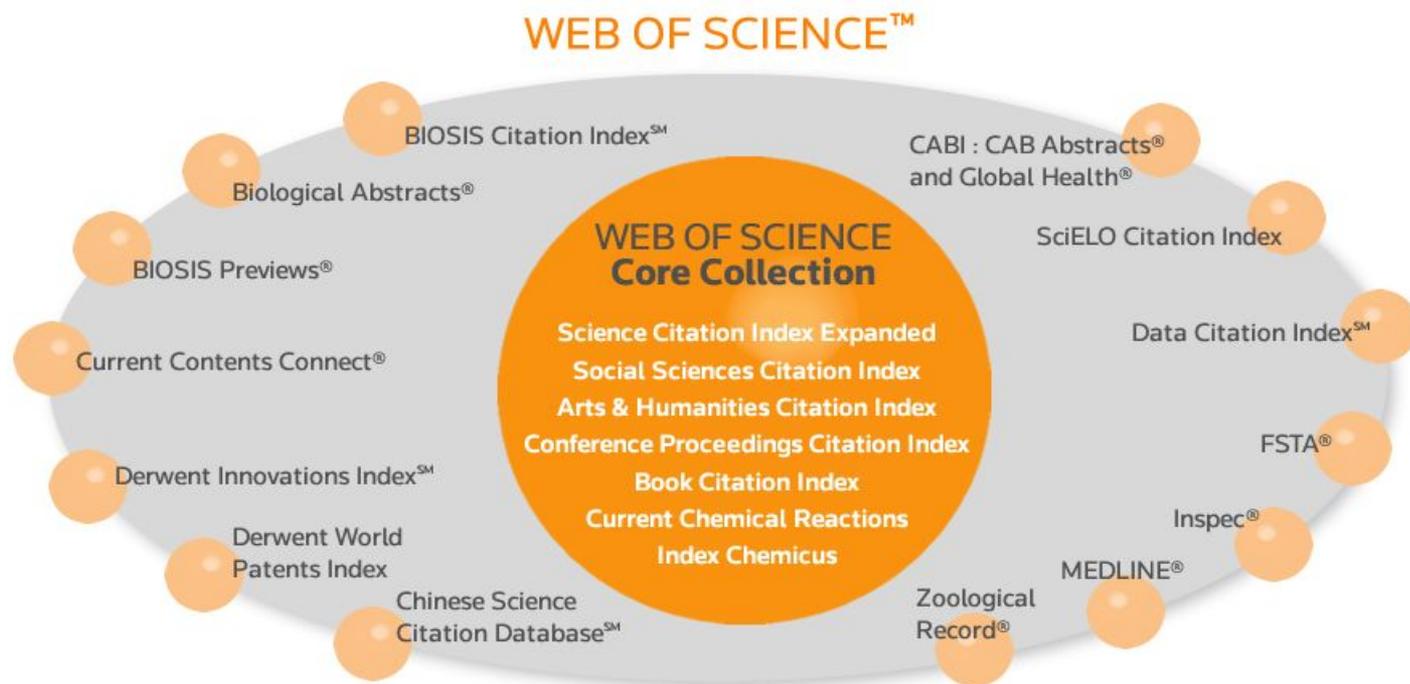
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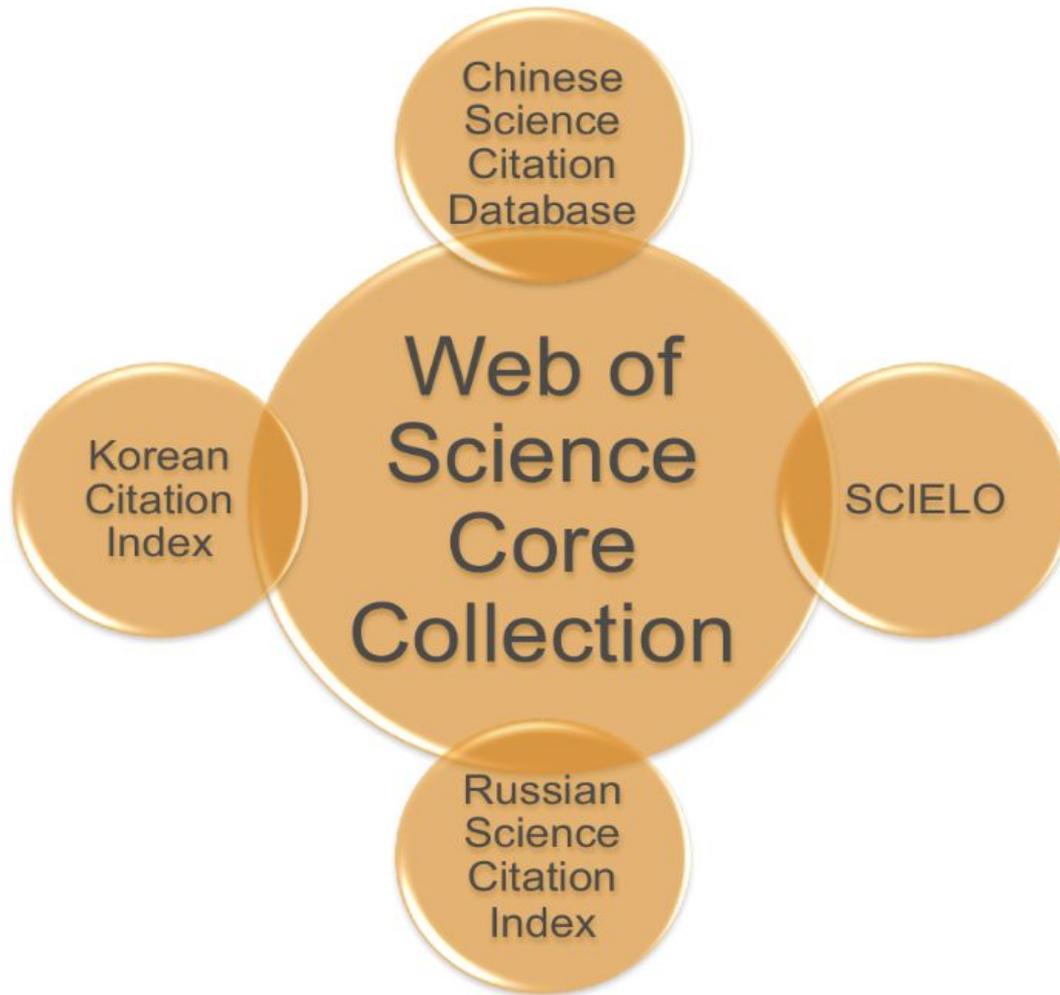
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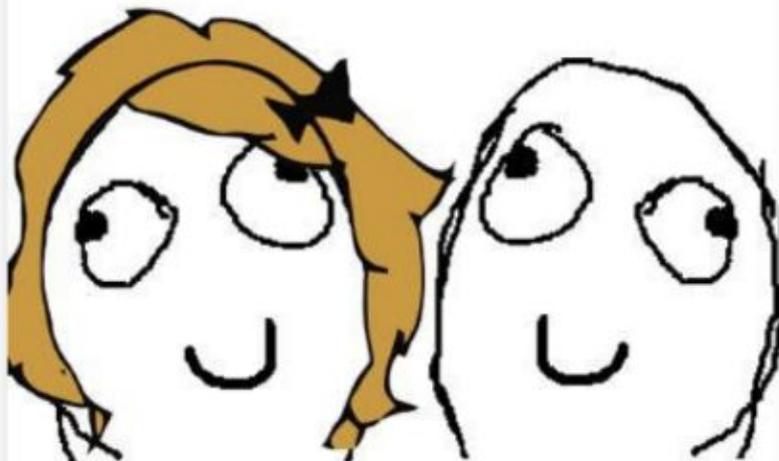
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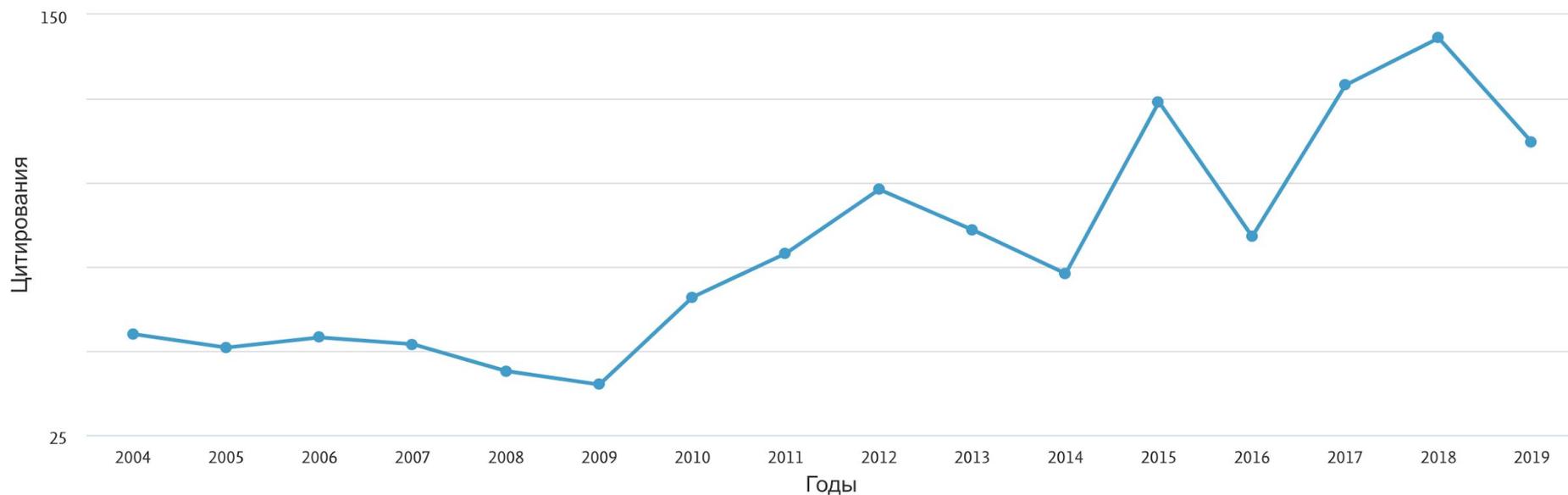
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Tiunova A.A., Komissarova N.V., Anokhin K.V.

в журнале *Frontiers in physiology*, издательство *Frontiers Research Foundation (Switzerland)* DOI

 **2019** [Modeling of Post-Traumatic Stress Disorder in Mice: Nonlinear Relationship with the Strength of the Traumatic Event](#)

Toropova K.A., Anokhin K.V.

в журнале *Neuroscience and Behavioral Physiology*, издательство *Kluwer Academic/Plenum Publishers (United States)*, том 49, № 7, с. 875-886 DOI

★  **2018** [Активация экспрессии c-fos в ретроспленальной коре, но не гиппокампе, сопровождается формированием ассоциации между обстановкой и безусловным стимулом и ее последующее извлечение у мышей](#)

Торопова К.А., Трошев Д.В., Ивашкина О.И., Анохин К.В.

в журнале *Журнал высшей нервной деятельности им. И. П. Павлова*, издательство *Федеральное государственное унитарное предприятие Академический научно-издательский, производственно-полиграфический и книгораспространительский центр Наука (Москва)*, том 68, № 6, с. 756-770 DOI

★ **2018** [Восстановление поврежденной зрительной системы](#)

Тиунова А.А., Безруков С.В.
в журнале *Биохимия*

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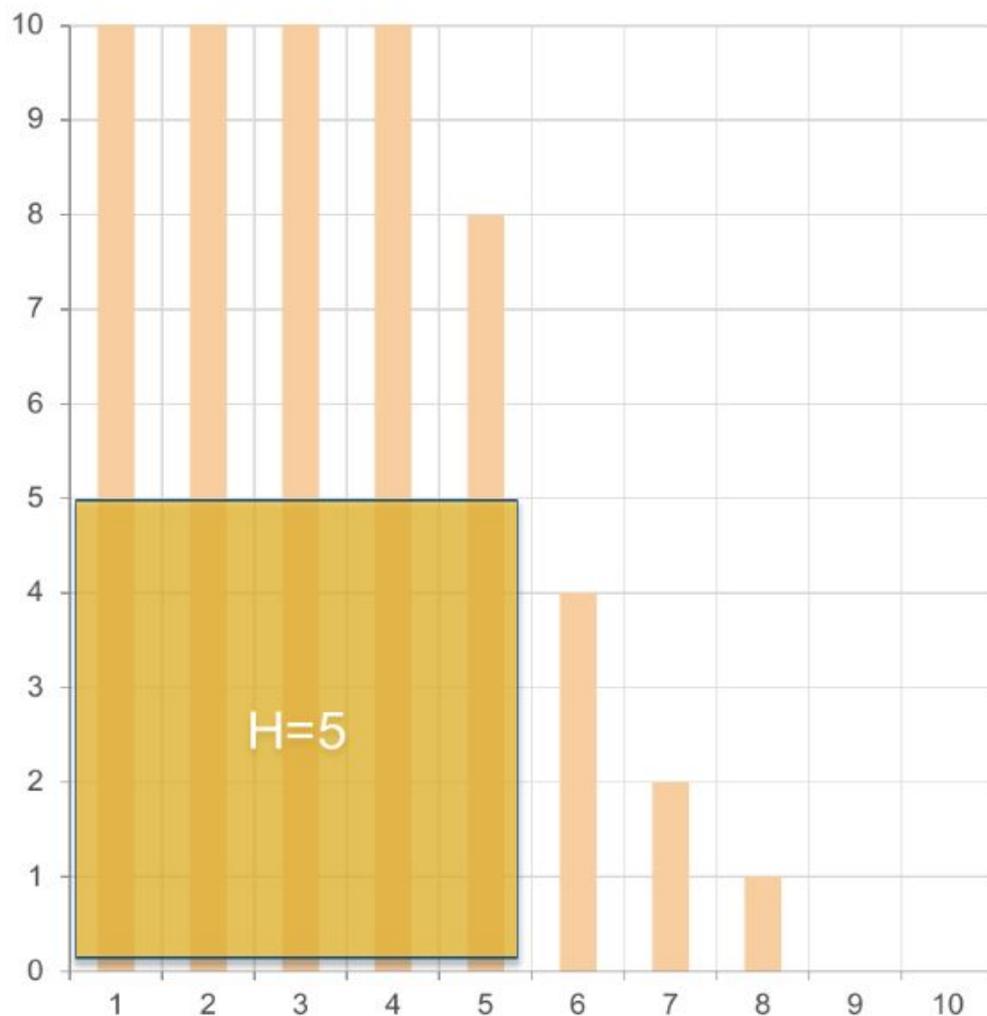
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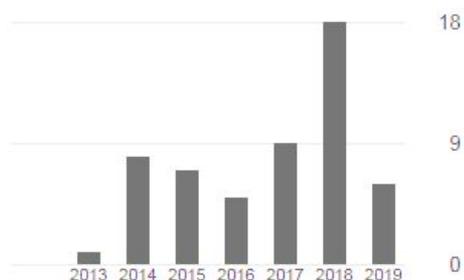
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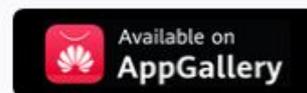
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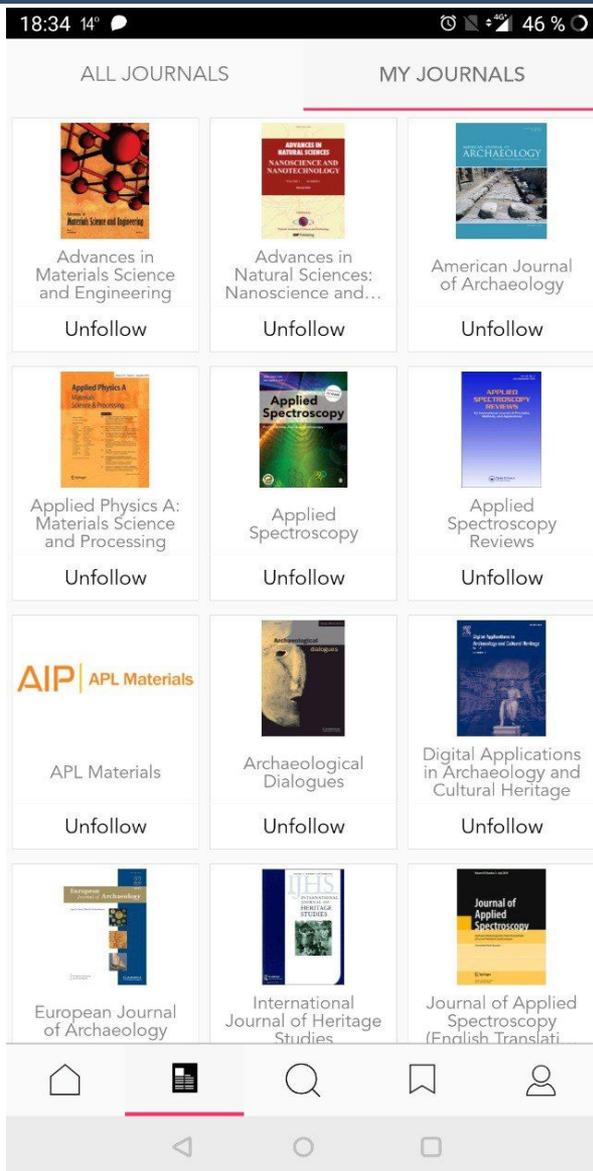
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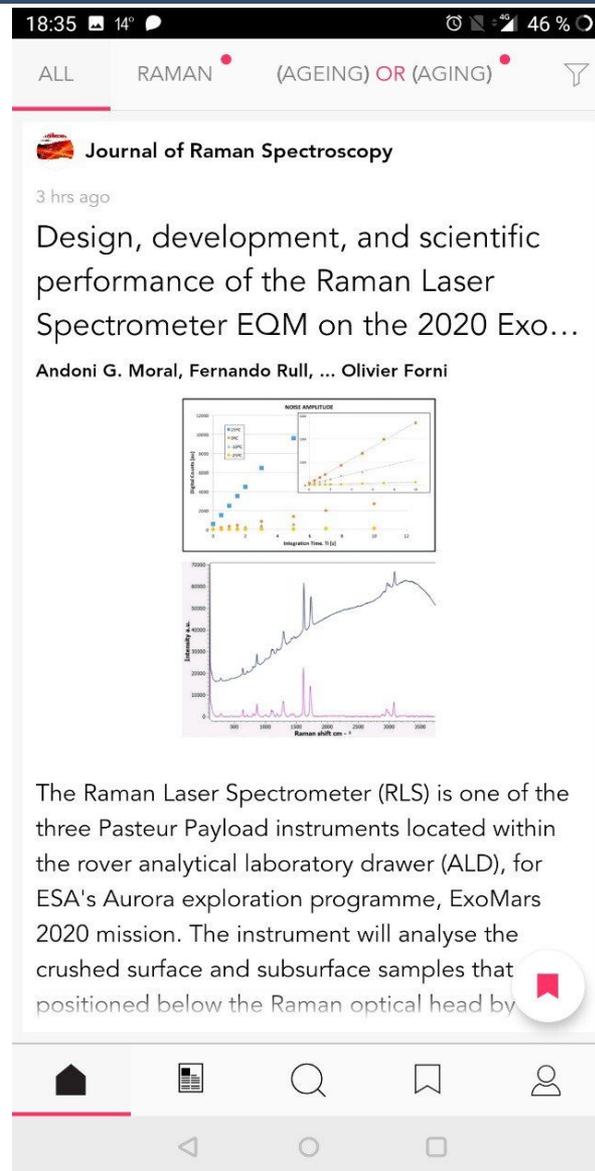
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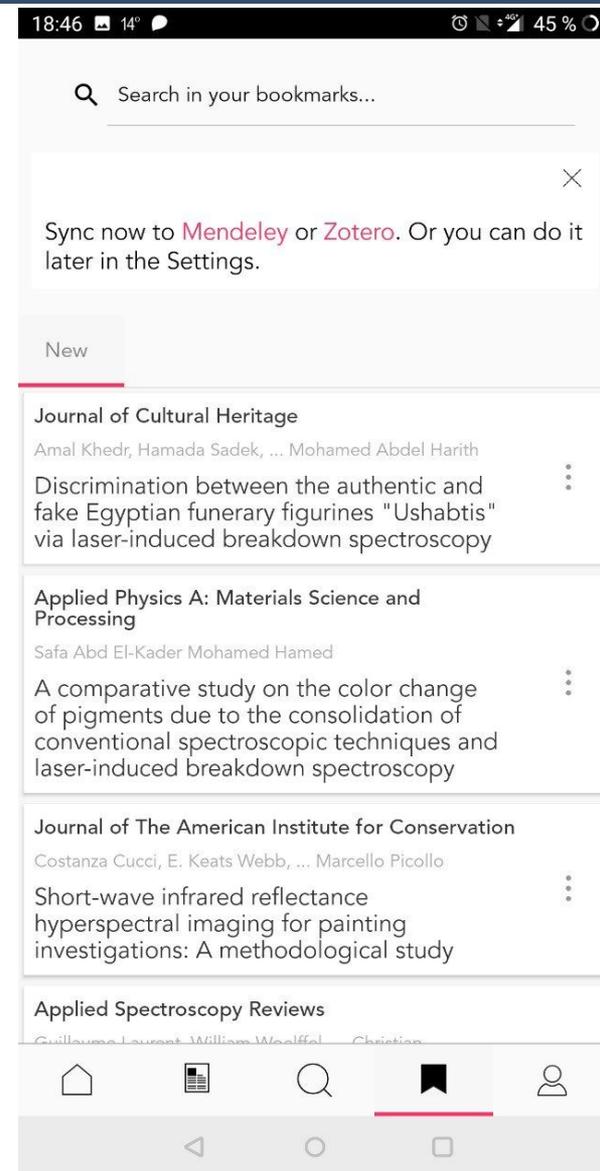
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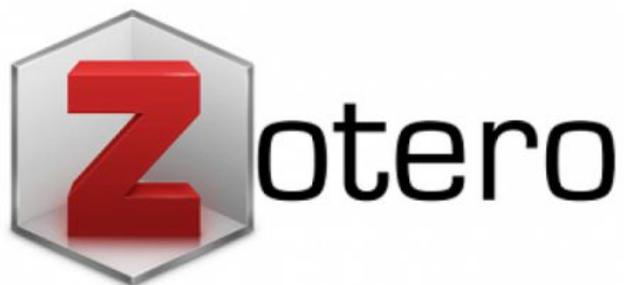
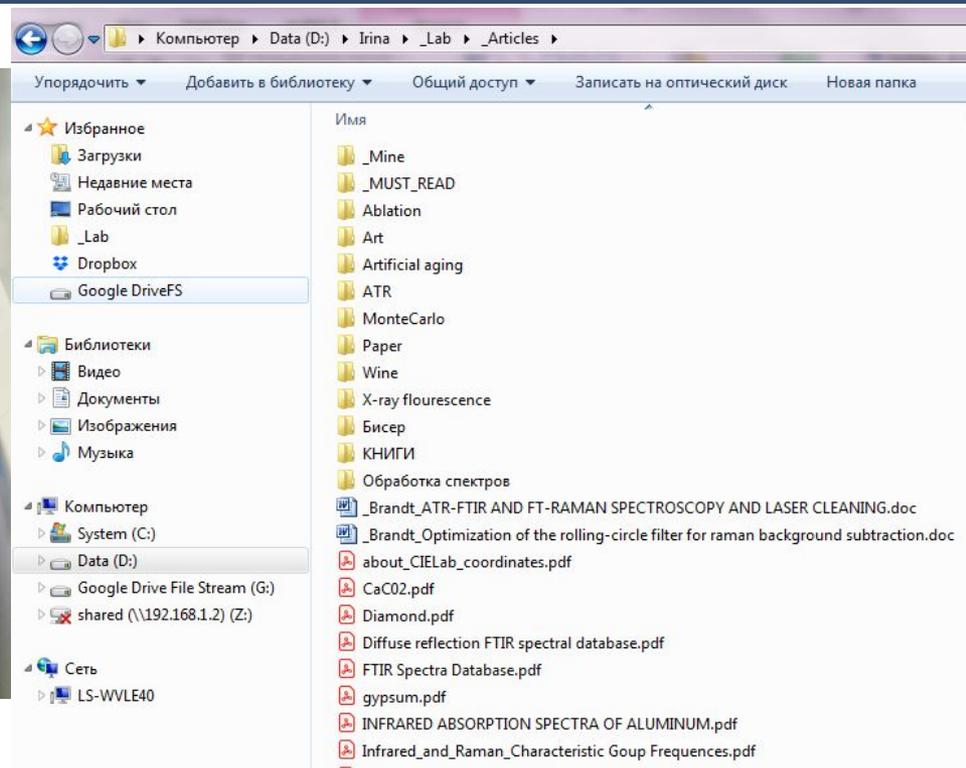
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Название: The Current Status of Chinese Freshwater Cultured Pearls

Автор: Akamatsu, Shigeru

Автор: Zansheng, Li Tajima

Автор: Moses, Thomas M.

Автор: Scarratt, Kenneth

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10

NOTES & NEW TECHNIQUES

X-RAY COMPUTED MICROTOMOGRAPHY: DISTINGUISHING NATURAL PEARLS FROM BEADED AND NON-BEADED CULTURED PEARLS

Michael S. Krzemnicki, Sebastian D. Friess, Pascal Chalus, Henry A. Hänni, and Si

Расширение Zotero

The distinction of natural from cultured pearls traditionally has been based on X-radiography. X-ray computed microtomography (μ -CT) has recently been applied to gain more insight into pearl structures. Using this technique, this article presents features observed in a selection of natural pearls and beaded and non-beaded cultured pearls. Based on these observations, μ -CT is shown to be a powerful tool for pearl identification.

In recent years, we have seen more interest in natural pearls, especially in the high-end jewelry trade (figure 1). A number of important historic natural pearls have been sold at auction in New York, Geneva, Hong Kong, and Dubai. However, the supply of newly harvested natural pearls is very small, and is restricted to only a few local sources, mainly in the Middle East and Southeast Asia. Therefore, most natural pearls in the market today are from old stocks and historical collections, accumulated over many years. They may be found in estate jewelry or restrung into contemporary necklaces.

Cultured pearls are far more abundant than natural pearls in today's market. They mainly consist of Chinese freshwater cultured pearls from *Hyriopsis* spp. (Akamatsu et al., 2001) and saltwater cultured pearls from several mollusks, including *Pinctada maxima* oysters in Australia and along the coast of Southeast Asia, *P. margaritifera* in the Pacific and the Red Sea, *P. martensii* in Japan, *P. chemnitzii* in China, and *Pteria sterna* in Mexico. As cultivation techniques have improved (Hänni, 2007), the distinction between natural and cultured pearls has become more difficult (see, e.g., Scarratt et al., 2000; Akamatsu et al., 2001; Hänni, 2006; Sturman and Al-Attawi, 2006; Sturman, 2009), and we predict it will be even more challenging in the future.

For decades now, gemologists have relied primarily on X-radiographs for the separation of natural from cultured pearls (Webster, 1994; Sturman, 2009; and references therein). Only recently has X-ray computed microtomography (μ -CT) been applied to pearls (Strack, 2006; Soldati et al., 2008; Wehmeister et al., 2008; Krzemnicki et al., 2009; Kawano, 2009) and gemstone analysis (Hänni, 2009). This article focuses on the features observed with μ -CT in natural and cultured pearls (non-beaded and beaded). For background on the technique, the reader is referred to Karamelas et al. (2010).

MATERIALS AND METHODS

From over 50 pearls analyzed with μ -CT, we selected 11 natural and 19 cultured pearls for this study, from both freshwater and saltwater mollusks (see table 1). The samples are from the SSEE reference collection, and from reputable sources consisting of pearl farms and collectors of natural pearls (see Acknowledgments).

Imaging was performed on a SkyScan 1172 high-resolution μ -CT scanner (SkyScan NV, Kontich, Belgium), equipped with a 100 kV / 100 μ A X-ray source and a 10 megapixel (4000 \times 2000) X-ray sensitive CCD camera. The system allows for a flexible geometry along the sample path (i.e., objects can be magnified until the boundaries of the field-of-view of the camera are reached). The sample

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Название: X-Ray Computed Microtomography: Distinguishing Natural Pearls from Beaded and Non-Beaded Cultured Pearls

Автор: Krzemnicki, Micha...
Friess, Sebastian D.
Chalus, Pascal
Hänni, Henry A.
Karampelas, Stefa...

Выдержка

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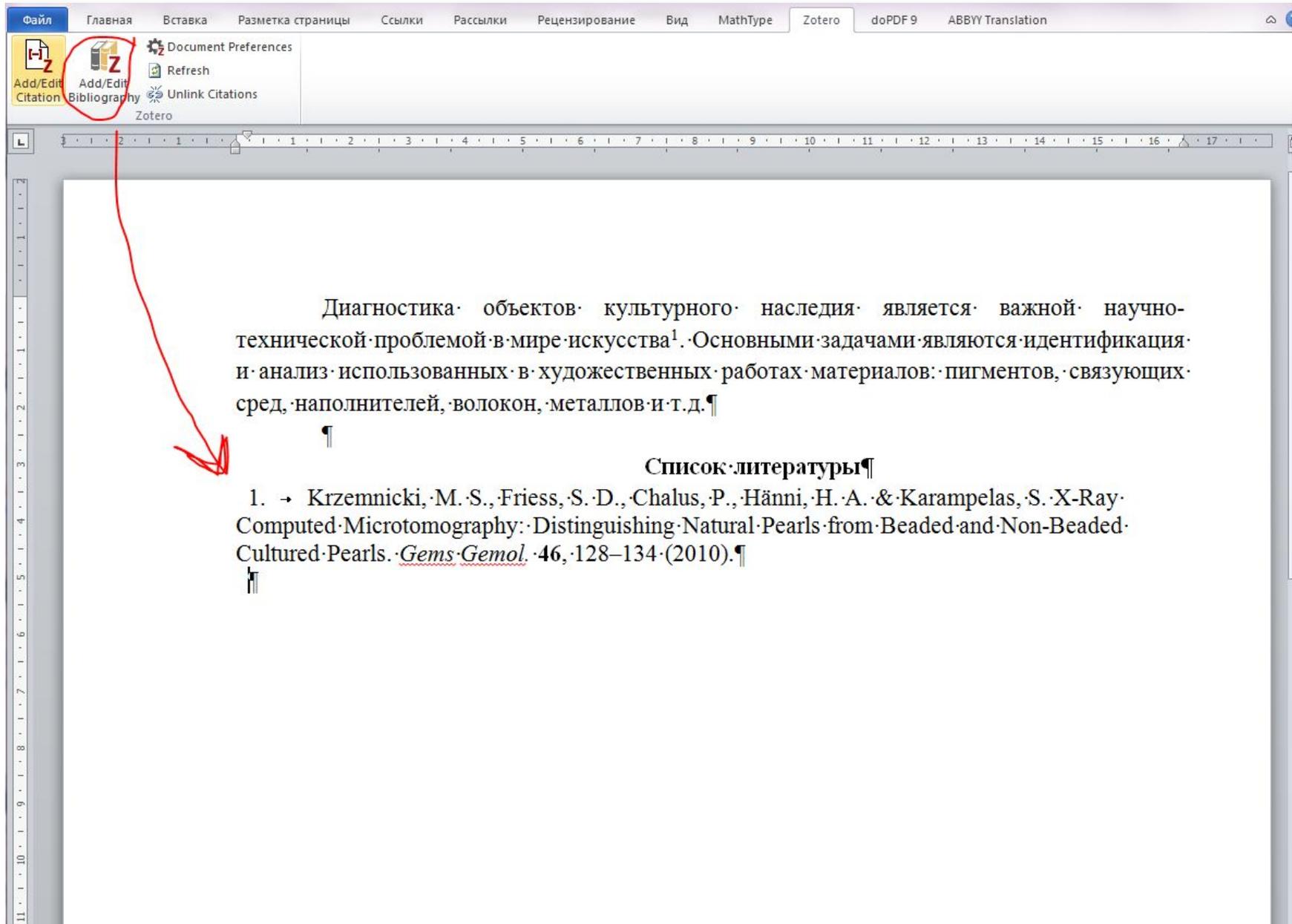
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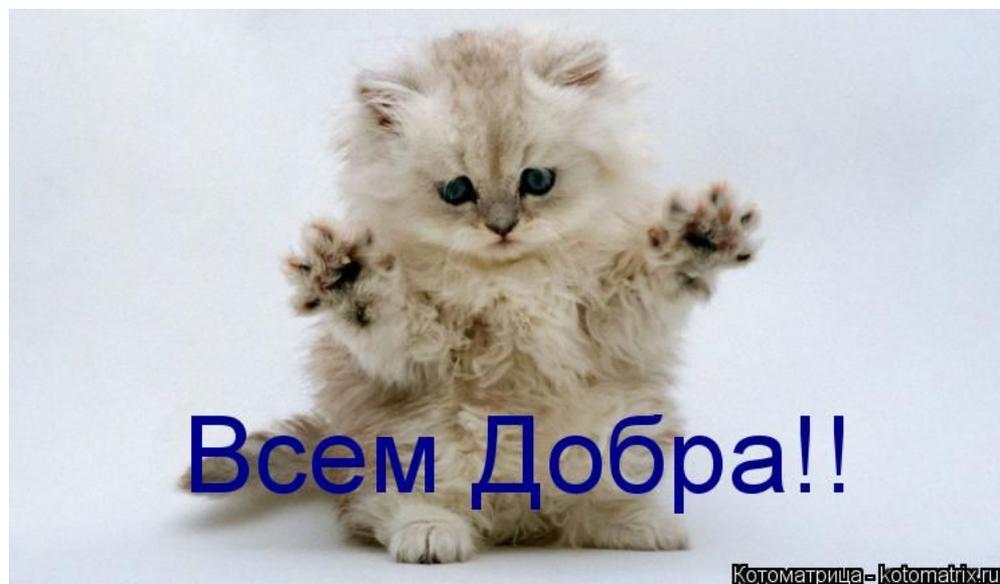
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