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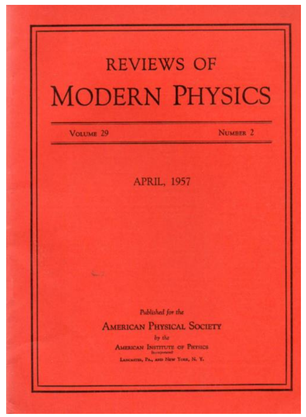

Reviews of Modern Physics

IF 45.049

2019 JCR Ranking*: 1/85 Physics, Multidisciplinary Category

Годы охвата: от 1929 до 2021 гг.

Physical Review X

IF 12.577

2019 JCR Ranking*: 5/85 Physics, Multidisciplinary Category

Годы охвата: от 2011 до 2021 гг.

Physical Review Letters

IF 8.385

2019 JCR Ranking*: 6/85 Physics, Multidisciplinary Category

Годы охвата: от 1958 до 2021 гг.

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Physical Review D

IF 4.833

2019 JCR Ranking: 16/68 Astronomy & Astrophysics Category

Годы охвата: от 2016 до 2021 гг.


PHYSICAL REVIEW APPLIED **15,** 064004 (2021)

Skyrmion-Based Programmable Logic Device with Complete Boolean Logic Functions

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A skyrmionic programmable logic device (SPLD) with complete Boolean logic functions is proposed and analyzed by micromagnetic simulations. The SPLD is based on an antiferromagnet-ferromagnet bilayer structure, in which the antiferromagnetic layer supports the interfacial Dzyaloshinskii-Moriya interaction and the out-of-plane exchange-bias field for stabilizing a zero-field skyrmion. By varying the local exchange-bias field, artificial pinning sites are introduced to trap skyrmions. Depending on the input currents and initial position of skyrmions at different pinning sites, different logic functions can be realized. Micromagnetic simulations show that the proposed SPLD has a robust performance, even under thermal fluctuations and inhomogeneity effects. Our work can provide insights for the design of programmable spin-logic devices.

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I. INTRODUCTION

Magnetic order that can be harnessed via a magnetic field or electrical current is widely explored for memory, logic, and sensor applications [1–5]. The demand for scaling down the size of magnetic devices grows with developments in information processing and storage technologies. To this end, nanosized magnetic textures have been extensively studied with promising prospects on dense magnetic devices. A magnetic skyrmion is a newly discovered topological magnetic texture, which has received much attention because of its nanometric size, stability at nanoscale size, nontrivial topology, and low driving current density [5–10]. These properties lead to proposals for a range of prototypes of skyrmionic devices, such as skyrmion racetrack memory [5,8,10–12] and skyrmion logic [13–17].

Boolean logic devices comprise the basic elements in modern electronic circuits. Conventional logic devices can be classified into two broad categories: a fixed logic device (FLD) and a programmable logic device (PLD) [18]. In recent years, many FLDs that are based on magnetic devices have been proposed. For example, a single magnetic domain, domain wall, or skyrmion can be employed as information bits to achieve different logic functionalities in FLD [13–17,19–26]. However, the logic functionality of the FLD is fixed once it has been manufactured, which means that different logic functions in such devices can be reconfigured and, hence, possesses multiple functionalities. Nonetheless, there are only a few research works reporting the realization of a skyrmion-based PLD [16]. Similar to the racetrack device, in a skyrmionic programmable logic device (SPLD), the input and output binary data bits "1" and "0" are encoded by the state with and without a skyrmion, respectively. Based on the voltage-controlled magnetic anisotropy effect, some SPLDs have been proposed [16,27]. However, racetrack-based devices may suffer from the skyrmion Hall effect (SKHE), thermal fluctuations, and edge roughness, especially in constricted devices [7,12,27–31].

Here, we report a SPLD with complete Boolean logic functions (16 functions, including AND, NAND, XOR, etc.) based on artificially induced skyrmion pinning sites and current-driven skyrmion motion. Depending on the initial skyrmion position and applied currents, full logic

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Physical Review Applied

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Physical Review B

IF 3.575

2019 JCR Ranking: 39/155 Physics, Applied Category

Годы охвата: от 2016 до 2021 гг.


PHYSICAL REVIEW C **103,** 064608 (2021)

Shadow poles in the alternative parametrization of *R*-matrix theory

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We discover new, hitherto unknown, shadow poles in Brune's alternative parametrization of *R*-matrix theory [Brune, Phys. Rev. C **66**, 044611 (2002)]. Where these poles are, and how many there are, depends on how one continues *R*-matrix operators to complex wave numbers (especially the shift *S* and penetration *P* functions). This has little consequence for the exact *R*-matrix formalism (past the last energy threshold), as we show one can still always fully reconstruct the scattering matrix with only the previously known alternative parameters (poles and boundary-condition residues). But this has a crucial impact on the practice of *R*-matrix theory. Indeed, Brune provides the alternative parametrization to the Reich-Moore formalism and shows that the choice of continuation is now critical as it changes the alternative parameters values (poles and residue widths are now complex). In order to establish nuclear libraries with alternative parameters, the nuclear community will thus have to decide what convention to adopt. We argue in favor of analytical continuation (against the legacy of Lane and Thomas approach) in the second article [P. Ducru, B. Forget, V. Sobes, G. Hale, and M. Paris, Phys. Rev. C **103**, 064609 (2021)] of this trilogy on pole parametrizations of *R*-matrix theory, on which we build to establish the *windowed multipole* representation of cross sections [B. Forget, P. Ducru, and K. Smith, Ann. Nucl. Energy **146**, 107598 (2020); B. Forget, V. Sobes, C. Josey, and J. Liang, Phys. Rev. C **103**, 064610 (2021)]. We observe the first evidence of shadow poles in the alternative parametrization of *R*-matrix theory in the isotope ^{178}Ta: spin-parity group $J^{\pi} = 1/2^{+}$ and show how they indeed depend on the choice of continuation to complex wave numbers.

DOI: 10.1103/PhysRevC.103.064608

I. INTRODUCTION

When two nuclear bodies collide at a given energy—say, a neutron and a ^{178}U nucleus ($n + {}^{178}$U), a γ particle (photon) and a beryllium atom ($\gamma + {}^{9}$Be), or an α particle (2He) and a gold atom ($\alpha + {}^{197}$Au)—the outcomes of this interaction are expressed as nuclear cross sections. These cross sections are a fundamental component of our nuclear physics knowledge, and nuclear libraries such as ENDF [1], JENDL [2], JEFF [3], JENDL [3], BROND [4], CENDL [5], and FENDL [6,7]. To coordinate nuclear data libraries, we synthesize precise experimental measurements of reaction rates with a parametric model of nuclear interaction cross sections called *R*-matrix theory, using evaluation codes such as EDA [8,9], SAMMY [10], or AZURE [11]. *R*-matrix theory models nuclear interactions as two incoming bodies yielding two outgoing bodies through the action of a total Hamiltonian. The latter is assumed to be the addition of a short-range, interior Hamiltonian that is null beyond channel radius a, and a long-range, exterior Hamiltonian that we know, say, Coulomb potential for charged particles. Consequently, under the well-motivated assumption of channels at the channel boundary, is what we could call the *R-matrix scattering model*, described by Kapur and Peierls in their seminal article [12], unified by Bloch [13] and reviewed by Lane and Thomas [14]. The outcomes of the interaction depend on the energy at which the interaction occurs, and *R*-matrix theory parametrizes, for calculability purposes, the energy variable with a set of poles and residues. The one that has come to prevail in the nuclear physics community is the Wigner-Eisenbud parametrization [15–17].

There are good reasons for this: The Wigner-Eisenbud parameters are unconstrained real parameters, i.e., though physically and statistically correlated, any set of real parameters is mathematically acceptable (though not necessarily right). Besides, the Wigner-Eisenbud *R*-matrix of a two-body Hamiltonian (usually an interactable many-body nuclear problem) and separate it from the exterior one (usually a well-known free-body or Coulomb Hamiltonian with

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Physical Review C

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2019 JCR Ranking: 5/19 Physics, Nuclear Category

Годы охвата: от 2016 до 2021 гг.

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PHYSICAL REVIEW A 103, 062205 (2021)

Editors' Suggestion

Doppler-broadened quantum electromagnetically-induced-transparency heat engines

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A nontraditional quantum heat engine based on electromagnetically induced transparency has recently been suggested and experimentally demonstrated in ultracold atoms. In more practical setups with warm atoms, thermal atomic motions might hamper this heat engine mechanism. We here show that a Doppler-broadened atomic sample can still behave like an engine. However, only photons emitted in the direction of the coupling laser have the same brightness as for the Doppler-free engine, while the larger the angular deviation of emission, the lower the brightness. Our results suggest that the lower brightness can be seen as an act of Doppler broadening as if the thermal exception number of the reservoir serving as entropy sink is increased, and the quantum heat engines may be feasible in warm atomic interfaces.

DOI: 10.1103/PhysRevA.103.062205

I. INTRODUCTION

Atomic coherence built in the interaction between lasers and atomic ensembles is the basis of a well-known phenomenon called electromagnetically induced transparency (EIT). Many related effects have been intensively studied, such as lasing without inversion [1], slow and stored light [2,3], stationary light pulses [4], entangled photon pairs [5], and optical solitons [6]. In Ref. [7], Kocharovskaya *et al.* showed that, under the coupling laser beam (Ω_c), a lambda EIT medium in contact with two blackbody reservoirs at temperatures T_H and T_C supports a nonlinear process ($\omega_c \xrightarrow{\omega_H} \omega_p \xrightarrow{\omega_C} \omega_c$) which can be regarded as a heat engine cycle [see Fig. 1(a)]. The atoms, in fact, convert heat from the first reservoir (T_H), releasing some of it into the other reservoir (T_C) while generating low-grade work at the (output) photon mode at Ω_p. The entropy change associated with photon absorption from the *ideal* laser beam (Ω_c) is zero [9] and the brightness of the generated radiation, i.e., the number of photons per second per unit area, is the same as what one would obtain in the presence of the two reservoirs alone [8]. Such a nontraditional EIT-based engine has been experimentally demonstrated in ultracold samples of ^{87}Rb atoms [10], where Doppler broadening is absent.

Doppler broadening, which is caused by the random thermal motion of atoms, is nevertheless present in warm atom samples and is responsible for a number of effects, including [11], optical nonreciprocity [12–15], and narrowband high-ton generation [16], just to name a few phenomena. Actual implementations of an atomic heat engine would also benefit from using warm atoms due to the simplicity and convenience in their preparation and manipulation, yet in most cases Doppler broadening is known to play a hampering role because averaging over the atom velocities could wash out fragile quantum coherent effects. Hence the effect of the thermal atomic motion on the engine performance has to be properly assessed.

We discuss here a quantum heat engine designed to work with a warm atomic gas (see Fig. 1) through the inclusion of Doppler broadening in the model of Ref. [8]. We limit ourselves to a two-dimensional (2D) space, which is the simplest extension to a configuration that provides a detailed quantitative description of the engine cycle and a clear insight on the behavior of an EIT-based engine. Doppler-broadened transitions are well known to exhibit a *Gaussian lineshape* profile (Maxwell-Boltzmann distribution) and this is first used to numerically compute the brightness of the output radiation. A deeper insight into the role of Doppler broadening is instead gained by adopting a *Lorentzian lineshape* profile [17,18] which allows us to derive simple and analytic closed-form expressions for the brightness. Both numerical and analytic results for a thermal sample anticipate a reduction of the brightness distribution over the emission angle as one moves away from the forward direction [see Fig. 3(b)], findings that are quite relevant to practical experimental implementations. The Lorentzian case, in addition, yields a sound physical picture pointing to the role of Doppler broadening as a reservoir. Finally, we discuss the heat engine performance in terms of the entropy flux carried by the output radiation [8,9,20,21].

II. BRIGHTNESS OF THE DOPPLER-BROADENED QUANTUM HEAT ENGINE

Let us consider the atomic system depicted in Fig. 1(a) where three-level atoms are in contact with two (Ma-Hawley)

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Physical Review A

IF 2.777

2019 JCR Ranking: 31/97 Physics, Atomic, Molecular & Chemical Category

Годы охвата: от 2016 до 2021 гг.


PHYSICAL REVIEW E

STATISTICAL, NONLINEAR, AND SOFT MATTER PHYSICS

Physical Review E

IF 2.296

2019 JCR Ranking: 9/55 Physics, Mathematical Category

Годы охвата: от 2016 до 2021 гг.


PHYSICAL REVIEW FLUIDS 6, 063901 (2021)

Editors' Suggestion

Frequency prediction from exact or self-consistent mean flows

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A number of approximations have been proposed to estimate basic hydrodynamic quantities, in particular, the frequency of a limit cycle. One of these, real zero imaginary frequency (RZIF), calls for linearizing the governing equations about the mean flow and estimating the frequency as the imaginary part of the leading eigenvalue. A further reduction, the self-consistent model (SCM), approximates the mean flow as well, as resulting only from the nonlinear interaction of the leading eigenmode with itself. Both RZIF and SCM have proven dramatically successful for the archetypal case of the wake of a circular cylinder. Here, the SCM is applied to thermoconvital convection, for which a supercritical Hopf bifurcation gives rise to branches of standing waves and traveling waves. The SCM is solved by means of a full Newton method coupling the approximate mean flow and leading eigenmode. Although the RZIF property is verified for the traveling waves, the SCM reproduces the nonlinear frequency only very near the onset of the bifurcation and for another isolated parameter value. Thus, the nonlinear interaction arising from the leading mode is insufficient to reproduce the nonlinear mean field and frequency.

DOI: 10.1103/PhysRevFluids.6.063901

I. INTRODUCTION

Periodic emission or translation of vertical structures is one of the most important phenomena observed in hydrodynamic configurations. The amplitude and frequency are two essential characteristics of these time-periodic systems. These are usually obtained either by experiment or by solving the full Navier-Stokes equations by direct numerical simulation. The archetype of such configurations is the wake of a circular cylinder, in which the visually appealing Bénard-von-Kármán vortex "street" [1,2] appears above a Reynolds-number threshold [3,4] of 46.

When periodic oscillations such as these originate from a supercritical Hopf bifurcation, linear stability analysis about the equilibrium solution at the threshold yields a leading eigenvalue whose real part is zero and whose imaginary part is the oscillation frequency. Away from the threshold, this is no longer the case. However, for the cylinder wake, linearization about the *time-averaged field* has been shown to yield the nonlinear frequency [5–8] as the imaginary part of the leading eigenvalue. Moreover, Barkley [9] noted that the real part of this eigenvalue is nearly zero, meaning that the mean flow can be considered to be marginally stable, as had been suggested by Malkus [9] in the context of turbulent shear flow. This property, given the name real zero imaginary frequency (RZIF) by Turton *et al.* [10], has since been demonstrated to hold for several other flow

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Physical Review Fluids

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Годы охвата: от 2016 до 2021 гг.


PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH 17, 010114 (2021)

Editors' Suggestion | Featured in Physics

Effect of culture on women physicists' career choice: A comparison of Muslim majority countries and the West

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Women continue to be underrepresented in physics in the United States. This is while many Muslim majority (MM) countries have a high representation of women in undergraduate and graduate physics programs. While there is a growing awareness of this trend, little is being done to understand why and how this trend has manifested and how it can be used to inform broadening the participation of women in physics in the U.S. To better understand how cultural experiences can influence the pursuit of physics, this study examines the lived experiences of female physics faculty members in the U.S. who came from MM countries. The study draws on the sociocultural framework of physics identity to explore the differences and similarities between how and why they chose physics. The results reveal interesting possible hypotheses on the differences and similarities in how physics and gender identities intersect in MM countries as opposed to what has been found in the West. In particular, expressions of femininity in MM countries can have a more constructive intersection with expressions of physics identity in ways that promote participation and persistence.

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I. INTRODUCTION

The underrepresentation of women in physics has been a persistent concern in many countries (including the U.S.) and attempts to increase women's representation in physics have not been very successful [1]. In the past, while women's participation in physics in the U.S. was increasing, it has stagnated at around 20% for more than a decade [2,3]. To better address the underrepresentation of women in physics and factors contributing to this problem, researchers have attempted to understand these factors from various perspectives. From studies focusing on the influence of others including parents, teachers, peers, the scientific community, etc., [4–7], to classroom and curricular level work [8–10], there has been considerable work on the experiences of women in physics in the Western contexts. However, this problem cannot be meaningfully addressed unless we better understand the underlying cultural values that drive the problem and address questions such as the following: what does it mean to be a physicist, what does it mean to be a woman, and what is it about being a physicist and a woman that make these identities culturally incongruent.

Learning physics does not merely entail gaining knowledge and acquiring the ability to solve problems, but also entails a process of identity formation [11]. In the process of learning physics students become familiar with what is considered relevant and irrelevant, how to approach what is considered relevant, and how to present their thoughts and ideas in ways that are deemed acceptable by the physics community. During this process, students learn how to become part of the physics community and to act based on the norms of this community [12]. As a result, particular attitudes, attributes, and identities, although not explicitly rejected, may be considered incongruent with the physics community's norms. As such, those who possess these attributes and identities are not considered to fully fit in the physics community and might feel rejection. Since physics is often viewed as a culture of objectivity and rigor [13], women and people of color do not fit these norms and must either abandon expressing some of their identities to fit in the norms of the physics community or leave altogether.

However, there is no reason to believe that these cultural norms, congruences, and incongruences, are the same around the globe. As we know gender has a strong cultural

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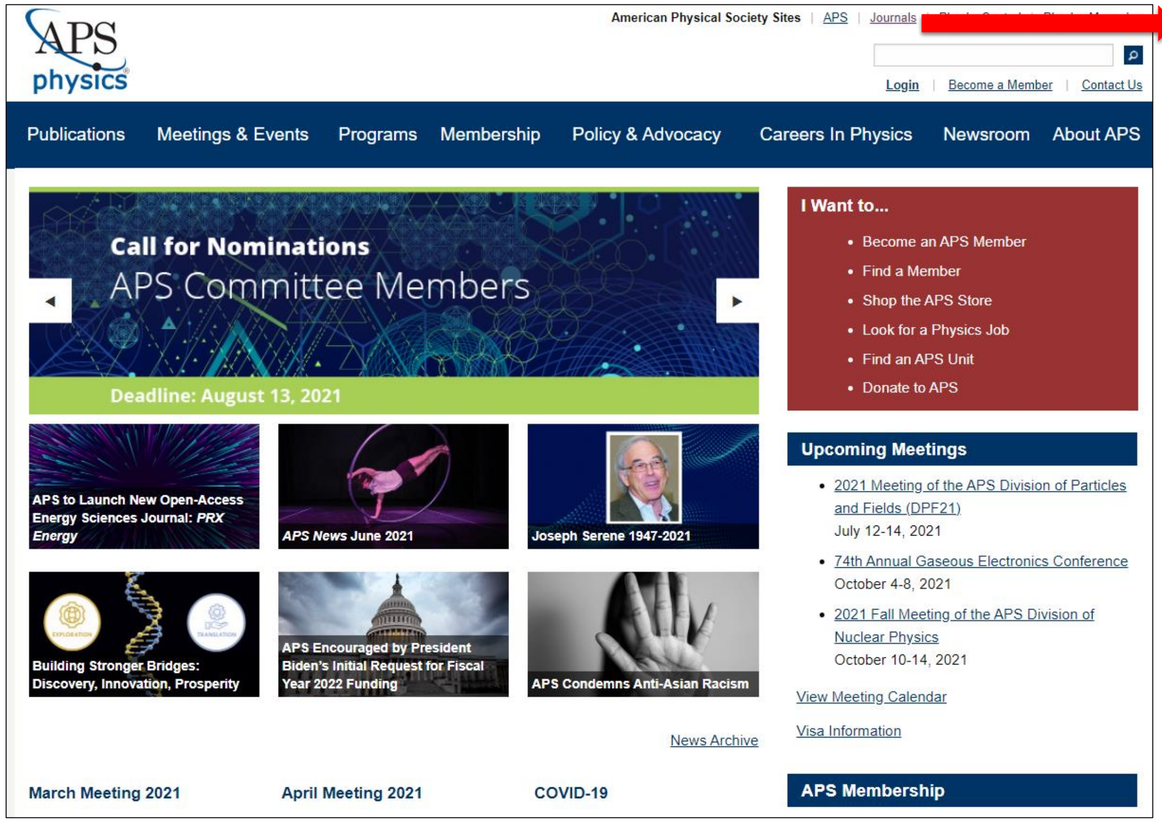

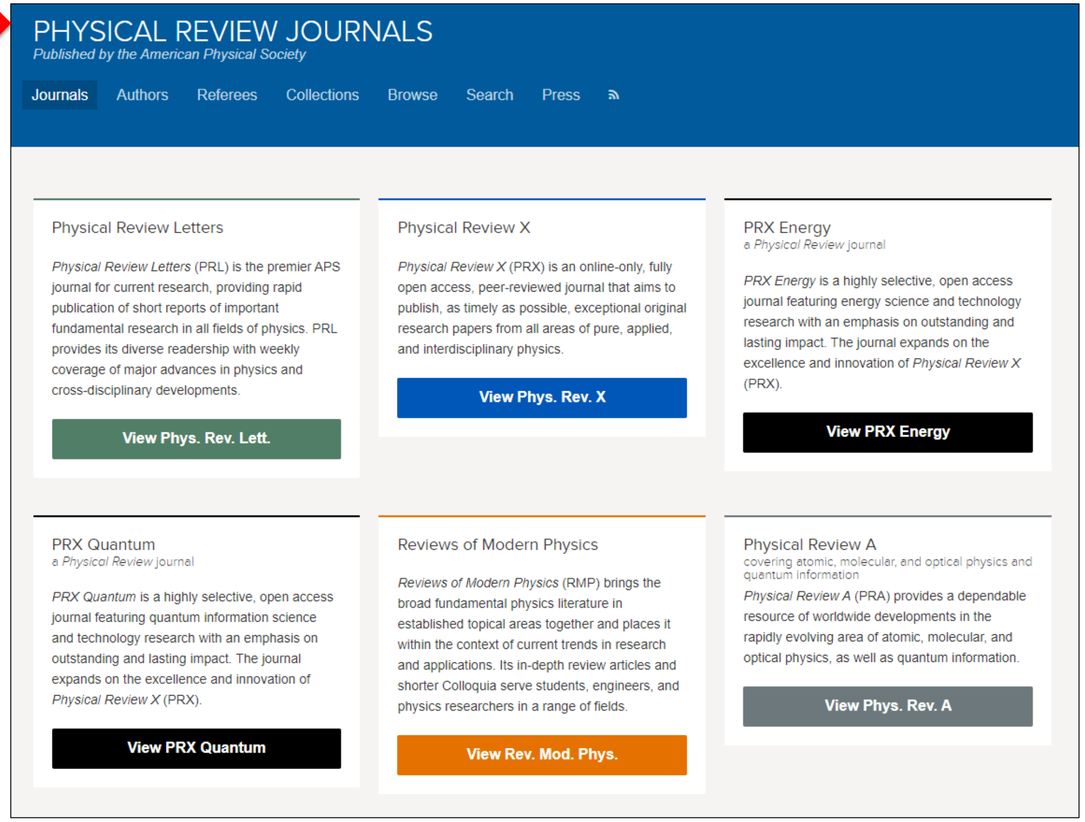

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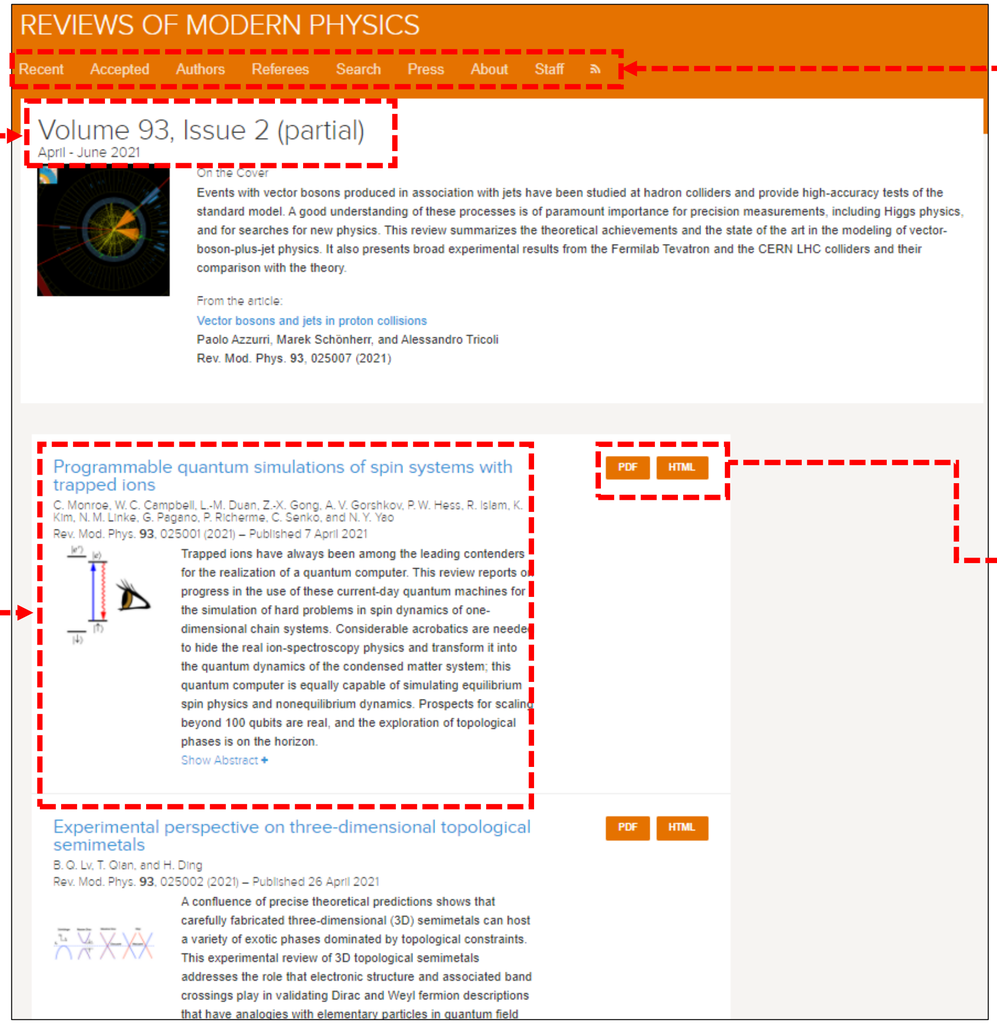

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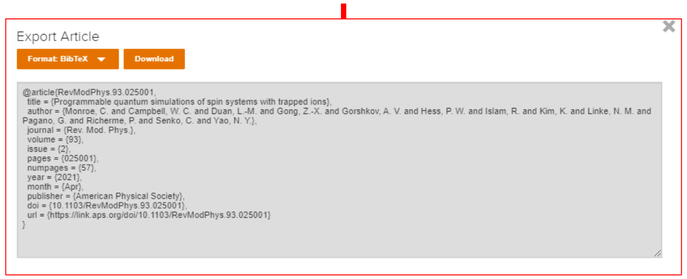

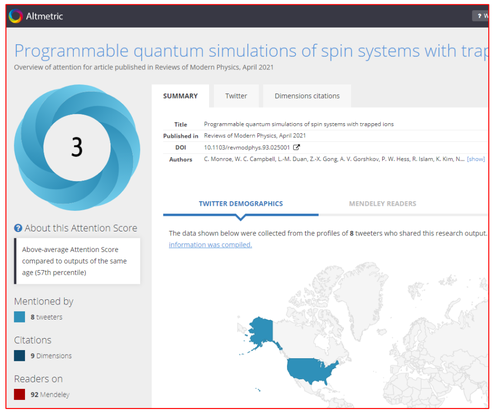

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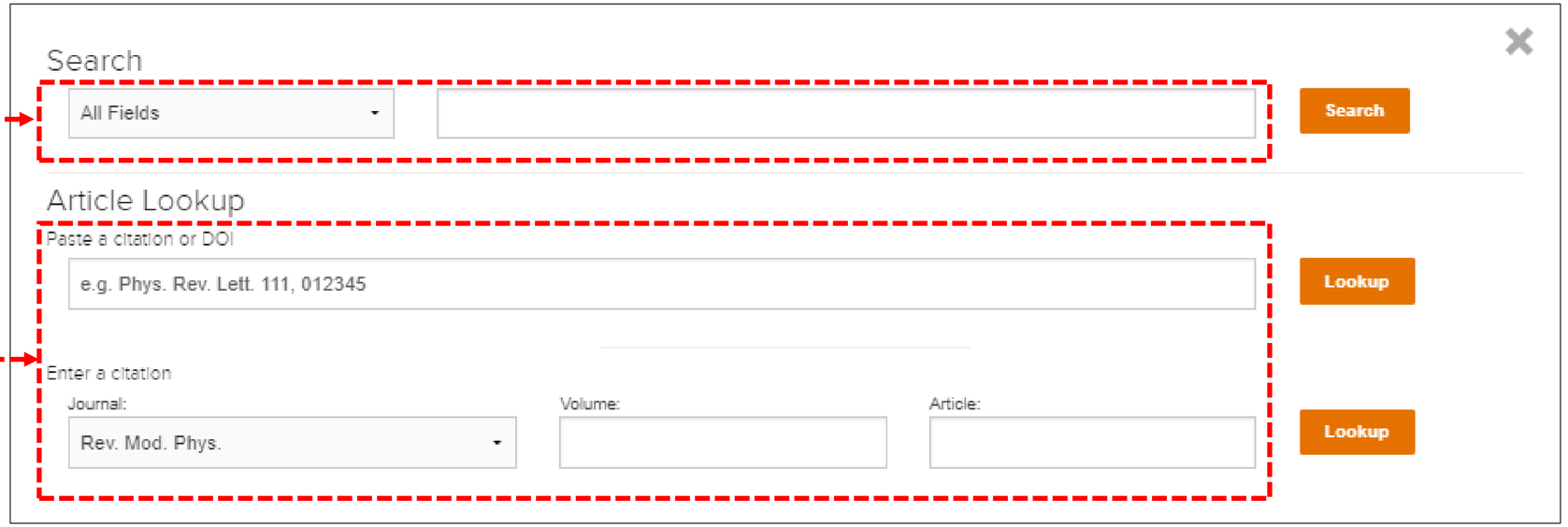

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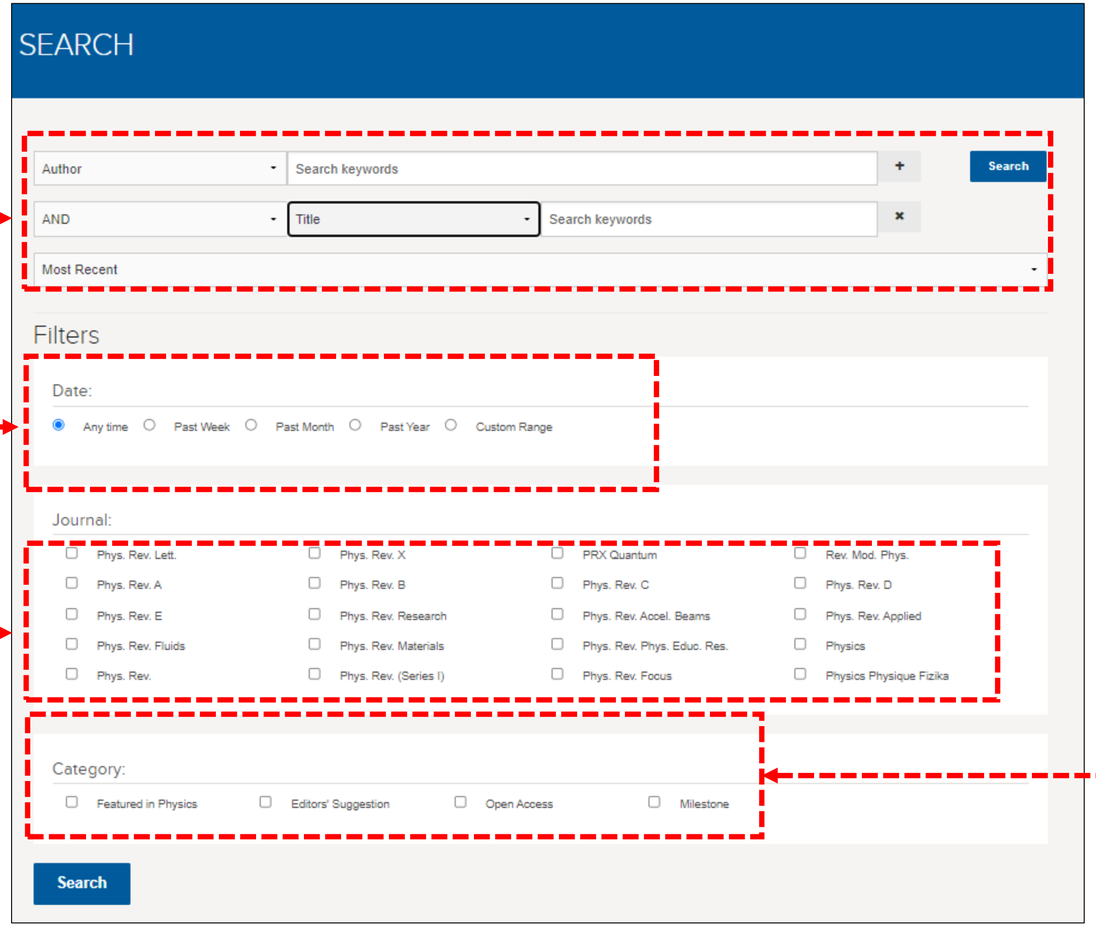

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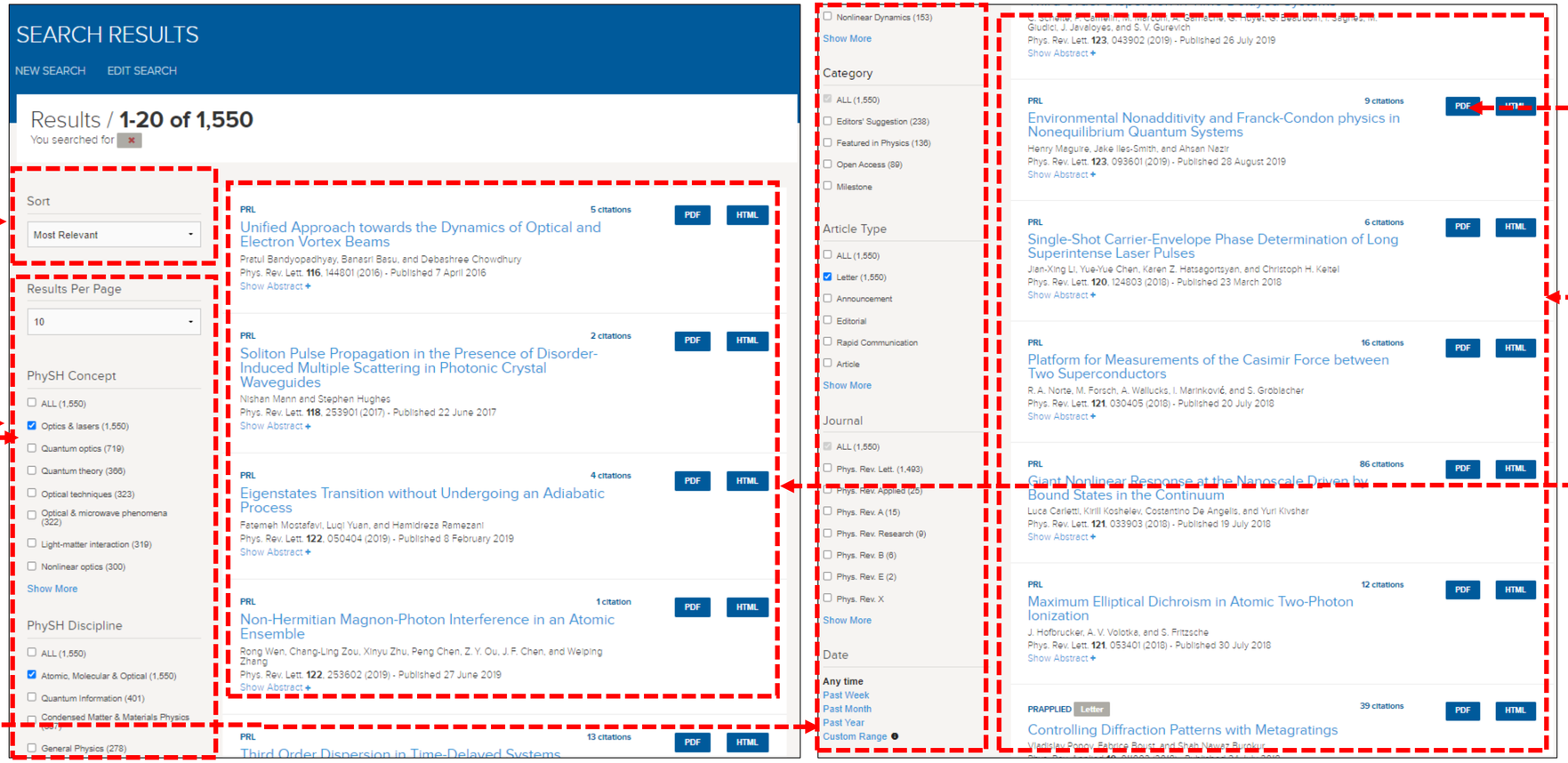

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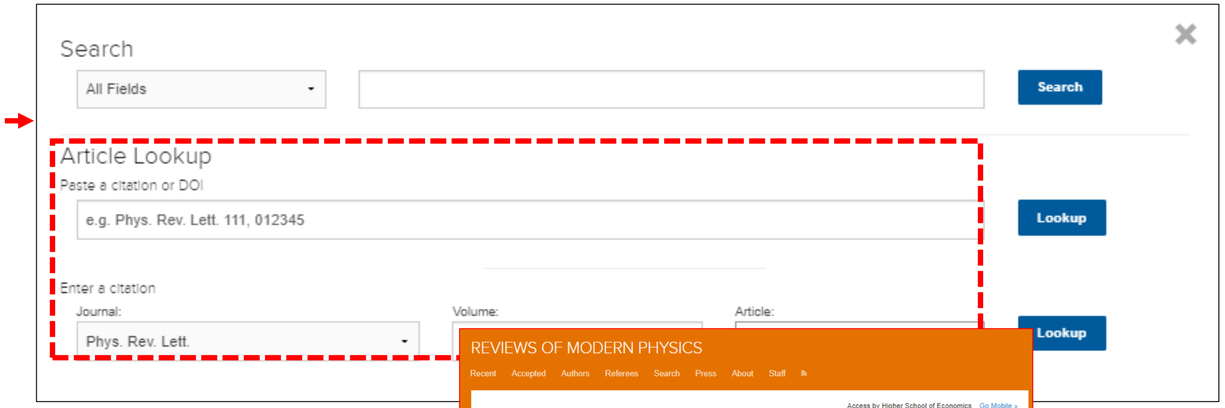
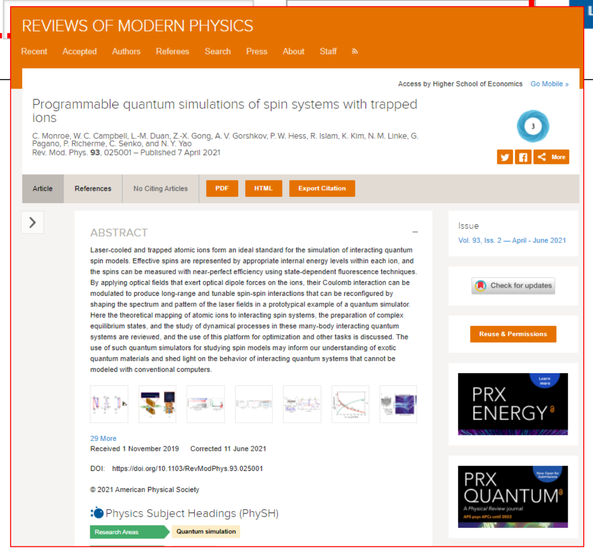


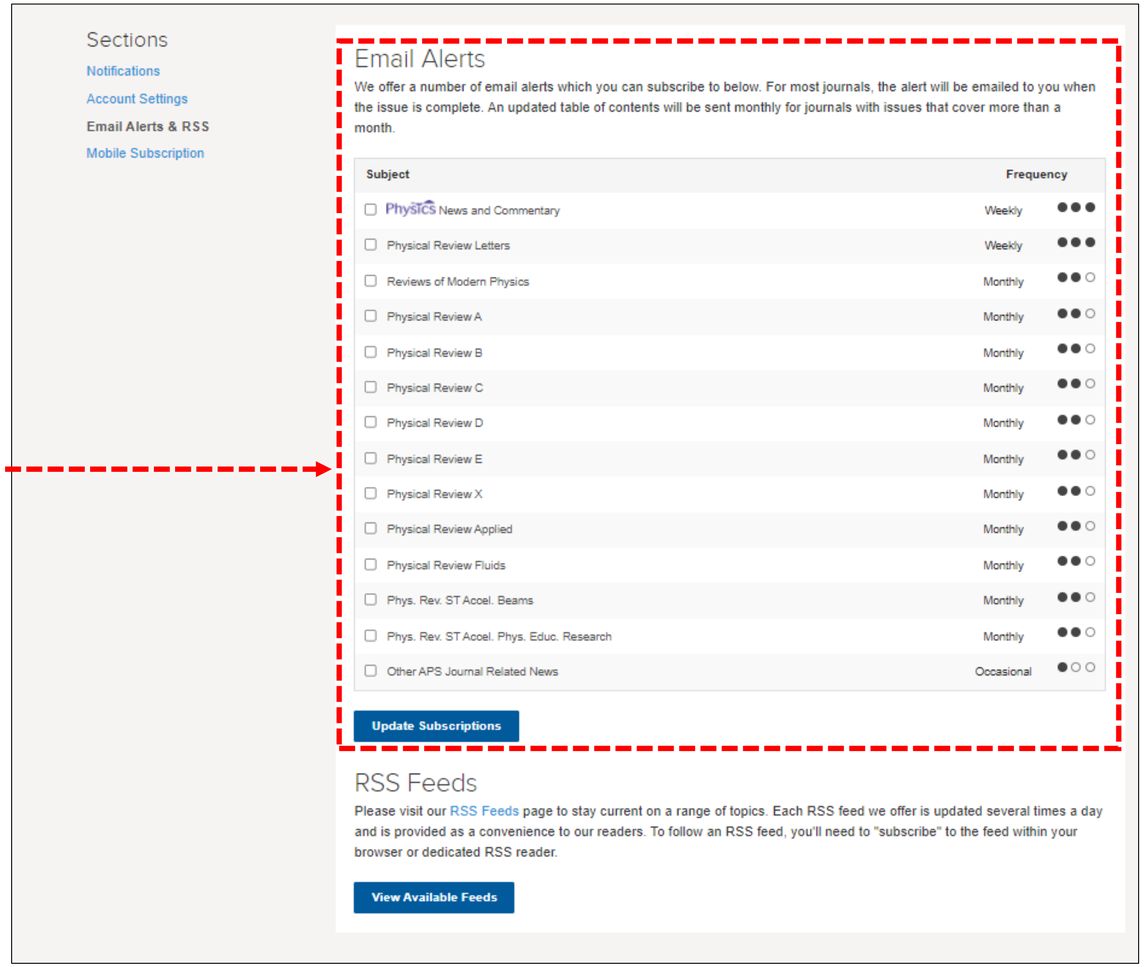
Результат поиска



APS PHYSICS

Уведомления

Подписка на уведомления



НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ

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