

# Physics news on the Internet: February 2026

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## 1. Experimental confirmation of the Migdal Effect

In 1939, the outstanding physicist A.B. Migdal predicted theoretically the effect of energy transfer from an atomic nucleus to the surrounding electrons [1]. Under scattering of a neutral particle, the nucleus undergoes recoil, the electron shells of the atom do not have time enough to reconstruct at once, and their deformation shows up as an electron excitation or ionization [2, 3]. The Migdal effect may appear to be very useful for recording rare processes, but it has not been observed earlier in nucleus scattering experiments. D. Yi (University of the Chinese Academy of Sciences and Guangxi University, China) and their co-authors were the first to obtain a direct experimental confirmation of the Migdal Effect in the course of neutron-nucleus collisions [4]. A special low-background gas detector was elaborated, in which tracks of scattered nuclei and electrons coming from one vertex (scattering point) were observed with the help of a pixel chip. Six events out of almost  $10^6$  examined neutron-nucleus interaction events were consistent with the Migdal effect, and the statistical significance of the effect recording reached  $5\sigma$ . The measured cross section of the Migdal effect is consistent with the calculated cross section within the experimental error. Thus, paper [4] resolves the long-standing gap in the experimental validation of the Migdal effect and shows that it is in principle possible to use this effect for recording light dark matter particles of masses from 1 to  $10^3$  MeV [5]. March 11, 2026 marks the 115th anniversary of A.B. Migdal's birth. Papers [6–8] present recollections of his life and scientific work.

## 2. Interference of positronium

The positronium Ps, the bound state of an electron and a positron  $e^-e^+$ , has the lifetime of 142 ns before annihilation and behaves as a neutral atom, similarly to a hydrogen atom. Y. Nagata (Tokyo University of Science, Japan) and their co-authors were the first to demonstrate quantum interference of Ps as an integer (rather than a system of two separate particles) in free space [9]. A pure Ps beam was obtained as a result of photodisintegration of  $\text{Ps}^-$  ions occurring in the

flight of  $e^+$  beam from a radioactive source through tungsten. The Ps diffraction proceeded on graphene — a carbon layer of atomic thickness. The first interference peak precisely corresponded to the period of graphene crystal lattice and the Ps energy as a whole, while no peaks corresponding to the energy of separate  $e^-$  or  $e^+$  were observed. This shows that it was interference of Ps as an integer object and not of its components. Being a neutral particle, Ps interacts with electromagnetic fields, e.g., surface charges, much weaker than  $e^-$  or  $e^+$ , and can, therefore, be used in diffraction studies of crystalline substances to exclude part of noises. For the technique of work with positrons (see [10]).

## 3. Cloning of encrypted qubits

The unitarity property in quantum mechanics leads to the ‘no-cloning theorem,’ according to which an unknown quantum state cannot be exactly copied. This theorem imposes a significant restriction on the possibility of a nondestructive quantum information copying. It is also important for quantum cryptography. In their theoretical analysis, K. Yamaguchi (University of Waterloo, Canada and University of Electro-Communications, Japan) and A. Kempf (University of Waterloo and Perimeter Institute for Theoretical Physics, Canada) showed that quantum state can be copied, but only provided such a state is encrypted [11]. Many encrypted qubit clones can be made using a special unitary transformation, but a successive decrypt is possible for one clone only. A decryption of any qubit eliminates the encryption key, thus obstructing decryption of other qubits, as required by the ‘no-clone theorem.’ Thus, the theorem itself is not violated by copying. For quantum technology and quantum cryptography (see [12–16]).

## 4. Even-denominator fractional Hall states

As a rule, fractional-charge quasiparticles [17, 18] obey anyon statistics — intermediate between boson and fermion statistics. It is assumed that even-denominator states may include non-Abelian states, when the exchange of two particles changes not only the phase of their common wavefunction, but also its shape. J. Kim (Weizmann Institute, Israel) and their co-authors obtained experimental evidence of a possible existence of non-Abelian anyons [19]. A bilayer van der Waals heterostructure, based on a graphene bilayer sandwiched between layers of hexagonal boron nitride was studied. In this structure, quasiparticles — anyons propagated along different trajectories, and their interference depending on the magnetic field was observed. The interference pattern showed periodicity of the Aharonov–Bohm effect with a period of two quanta of the magnetic field flux  $\Phi_0$ . The most

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conservative interpretation is the interference of Abelian quasiparticles with charge  $e^* = (1/2)e$ , but a version with non-Abelian quasiparticles carrying charges  $e^* = (1/4)e$  and making two detours around the contour is also possible. It is not yet possible to say for sure which of the two versions was observed in the experiment. Non-Abelian states may find application in the transmission of quantum information with topological protection.

## 5. DAMPE gamma telescope observations

The so-called ‘Fermi bubbles,’ i.e., giant formations on both sides of the Galactic disk, and an excessive gamma-ray emission from the central Galactic region, were detected earlier by the Fermi-LAT telescope on board the Fermi space gamma-ray observatory. The origin of Fermi bubbles is probably explained by jet-stream ejections from the Galactic center during the central black hole activity, and the excessive gamma-ray emission from the Galactic center may be due to dark matter annihilation or millisecond pulsar radiation [5]. Until recently, Fermi-LAT was the only telescope to observe these two phenomena. The Dark Matter Particle Explorer (DAMPE) gamma-ray space telescope, launched in 2015 and recording gamma photons with energy above 2 GeV, provided the first independent confirmation of the existence of Fermi bubbles and the gamma-ray excess from the Galactic center [20]. The reliability of recording these gamma-ray sources, based on the data accumulated over 8.5 years of observations was  $\sim 26\sigma$  and  $\sim 7\sigma$ , respectively, and their spectra and morphology are fully consistent with the previous Fermi-LAT data. The nature of the gamma-ray excess from the center of the Galaxy is in good agreement with the model of annihilation of dark matter particles with masses of  $\sim 50$  GeV and annihilation cross section  $\langle\sigma v\rangle \sim 10^{-26}$  cm<sup>3</sup> s<sup>-1</sup> (via the b-quark channel) close to the dark matter particle production cross section in the early Universe via the thermal mechanism, but the annihilation channel into  $\tau$  leptons is also acceptable

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