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1. $\gamma p \to p\pi^0$ reaction cross section for different helicities

The spiral asymmetry of neutral pion photoproduction in the $\gamma p \to p\pi^0$ scattering has been measured at the ELSA accelerator (Bonn, Germany) under the CBELSA/TAPS collaboration. Earlier, similar measurements were only performed for photon energies $E < 750$ MeV in a confined angular interval. The new experiment covered the energy interval of $E = 0.6 - 2.3$ GeV, and the observations were carried out in all directions of velocity of outgoing π^0 with a set of detectors surrounding the reaction zone and recording both the charge particles and the photons produced from $\pi^0 \to \gamma\gamma$ decays. Only collision events with one proton and two photons were selected for the analysis. The reaction cross sections were measured in those cases when the spin of a linearly polarized photon and that of the proton in the atom of the C_4H_9OH (butanol) target had either the same or opposite directions, i.e., the resultant helicities were either 3/2 or 1/2. The measured cross sections depend differently on the photon energy even in the low-energy region. It has been found that the measured asymmetry and the asymmetry obtained by the present-day theoretical calculations differ significantly. This discrepancy is probably due to an insufficiently accurate allowance for baryon resonances.

Source: *Phys. Rev. Lett.* **112** 012003 (2014)
http://dx.doi.org/10.1103/PhysRevLett.112.012003

2. Electron diffraction and Aharonov–Bohm effect

P Khatua, B Bansal, and D Shahar (Weizmann Institute, Israel and the Indian Institute of Science Education and Research, Calcutta) have carried out an experiment resembling in its setup the R Feynman gedanken experiment on two-slit electron diffraction in the presence of a magnetic field. The Aharonov–Bohm effect (the effect of the vector potential on the phase of the wave function) induces an interference pattern shift. An insignificant difference from the Feynman experiment was that one- rather than two-slit electron diffraction took place, the slit size being comparable to the de Broglie electron wavelength. Quantum point contacts were utilized for electron injection and recording. The source-contact was placed into the gap between two conductors, which served as a slit whereupon the diffraction took place. The electrons made up a two-dimensional electron gas on a GaAs substrate in a magnetic field directed perpendicular to the plane. As the magnetic field increased, the recorded signal experienced oscillations due to the shift of the interference pattern, as predicted. Also in accordance with Feynman's prediction, the magnitude of the shift corresponded to the magnitude which could be calculated in terms of the Lorentz force acting on electrons in classical electrodynamics. The experimentally examined effect can find practical applications, for instance, in spintronics for controling the fluxes of spin-polarized electrons.

Source: *Phys. Rev. Lett.* **112** 010403 (2014)
http://dx.doi.org/10.1103/PhysRevLett.112.010403

3. Obtaining quantum entanglement by way of classical transport

It has been shown in three independent experiments that two particles can be brought into an entangled quantum state by transmitting information between them with the aid of a third particle which itself was entangled with neither the first nor the second particle. The method is based on the theoretical calculations of T Cubitt and his colleagues, who showed the possibility of entanglement transport using so-called separable quantum states. In the experiment by A Fedrizzi (University of Queensland, Australia) and his co-workers, A and B photons were preliminarily brought to the state of superposition of four basis Bell states. Then A and C photons interfered in a phase-controlled cell, and the states of two cubits encoded by photon polarization became correlated but not quantum entangled. The C photon transferred and was registered with photon B, after which quantum tomography of the states showed that the A and B photons had become quantum entangled. The two other experiments, by C E Vollmer (Albert Einstein Institute, Germany) and her colleagues and by C Peuntinger (Max Planck Institute for the Science of Light, Germany) and others, were carried out not with separate photons, but with light beams. The quantum states of the beams were mixed by a successive interference of two beams in splitters. A potentially useful property of classical entanglement transport consists in low sensitivity to noises in the path of a particle-carrier, which in the quantum case would lead to decoherence phenomenon.

Source: *Phys. Rev. Lett.* **111** 230504, 230505, 230506 (2013)
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(230505, 230506)

4. Dyakonov–Tamm waves

D P Pulsifer, M Faryad, and A Lakhtakia, researchers from Pennsylvania State University (USA), have become the first to demonstrate experimentally the propagation of surface electromagnetic waves referred to as Dyakonov–Tamm waves. Waves at the boundary between two crystals were considered by I E Tamm as far back as 1932, and were examined experimentally in 1978. Analogous waves at the boundary of two dielectrics, one of which is anisotropic, were predicted by M I Dyakonov in 1988. These waves were revealed experimentally in 2009. Finally, in 2007, A Lakhtakia and J A Polo Jr. considered theoretically a combined version of waves, called Dyakonov–Tamm waves, which must emerge at the boundary between two dielectrics, at

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least one of which is anisotropic and contains periodic inhomogeneities along the boundary. In the described experiment, the Dyakonov–Tamm waves were excited by a laser light at the boundary between a thin MgF_2 film and a relief ZnSe film whose inhomogeneities consisted of a body of helical structures. The Dyakonov–Tamm waves were identified by the characteristic local minimum in the angular distribution of reflected light. Dyakonov–Tamm waves are less subject to attenuation than surface plasmon polaritons and, therefore, propagate much farther and can move at almost any angle. Owing to these properties, Dyakonov–Tamm waves can be tapped in optical sensors and for data transfer in chips.

Source: *Phys. Rev. Lett.* **111** 243902(2013)
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5. Millisecond pulsar in a triple system

By way of observations with the Robert C Byrd Green Bank Telescope, the Arecibo Telescope, and the Westerbork Synthesis Radio Telescope, it has been established that the millisecond pulsar PSR J0337 + 1715 is resided in a hierarchic triple system with two white dwarfs. Only systems with a pulsar, one white dwarf, and planets have been known earlier. Observations were carried out at several radio frequencies. By the shape of pulse profiles, it was concluded that the pulsar makes up a pair with a white dwarf, and the second white dwarf rotates around them at a greater distance. The ratio of the orbit radii measured about 200, and the masses of the pulsar and the indicated two white dwarfs are equal to 1.4378(13), 0.19751(15), and 0.4101(3) of the solar mass, respectively. This triple system has become the best candidate among known ones for verification, planned for the near future, of the strong equivalence principle, since a pulsar constitutes a strongly gravitationally coupled system, and together with the much less bound nearest white dwarf it moves in the united gravitational field of the external white dwarf.

Source: *Nature* **505** 520 (2014)
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