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1. Lifetimes of Λ_b^0 and $\bar{B}_0$

The LHCB Collaboration, in which researchers from the Russian Academy of Sciences institutes play an important active role has measured the ratio between lifetimes of the Λ_b^0 barion and $\bar{B}_0$ meson born in pp-collisions at the center-of-mass energy of 7 TeV. Λ_b^0 particles were first studied on the basis of their decay chains, $\Lambda_b^0 \to J/\psi\pi^+K^-$. The measured ratio $\tau_{\Lambda_b^0}/\tau_{\bar{B}_0}$ amounted to $0.976 \pm 0.012\,(\text{stat}) \pm 0.006\,(\text{syst})$ ps. Taking into account the lifetime of $\tau_{\bar{B}_0}$ known from other experiments, the lifetime of the Λ_b^0 barion was found to be $1.482 \pm 0.018\,(\text{stat}) \pm 0.012\,(\text{syst})$ ps. According to theoretical calculations carried out using the 'heavy quark expansion' technique, the nearness of lifetimes of the two particles may find its explanation in the fact that both incorporate a b-quark whose properties to a large extent dictate their decay lifetimes.

Source: *Phys. Rev. Lett.* **111** 102003 (2013)
http://arxiv.org/abs/1307.2476

2. Relaxation in an isolated quantum system

T Langen (Vienna Institute of Technology, Austria) and his colleagues have traced the transition of an isolated quantum system, which initially was placed in a certain quantum state, to a classical equilibrium state. An elongated cloud of several thousand ^{87}Rb Bose atoms resided on an 'atomic chip' was split into two parts occupying phase-coherent states. The interaction between the parts led to chaotization of the quantum phases and to relaxation to a classical state even without any external effect on the quantum system. The region of relaxation gradually spread from the area of contact of the two parts to the entire system. Phase correlation at different points of the atomic cloud was measured from the observations of wave interference of the atoms at this stage of cloud expansion once the trap potential was turned off. The maximum velocity of relaxation spreading came to 1.2 ± 0.1 mm s^{-1}. An alternative version of cloud evolution could be a simultaneous transition of the entire system to a new state instead of the expansion of the relaxation region; however, the experiment rejected this version. The mechanisms of transition of the isolated quantum system to a classical state has already been discussed in theoretical publications, and the occurrence of the above-given limiting velocity has already been predicted.

Source: *Nature Physics*
inline publication dated 8 September 2013
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3. Structure of metallic glasses

A Hirata and his colleagues at Tohoku University (Japan) and the Joint Institute for High Temperatures of the Russian Academy of Sciences (Moscow) have for the first time resolved with the help of the developed new method the individual elemental icosahedra (regular twenty-facet forms) in the atomic structure of metallic glasses, i.e., solid metallic substances that are ordered on a small scale but are amorphous on a large scale. F C Frank theoretically predicted in 1952 that atoms in metallic glasses join into icosahedral structures. Manifestations of icosahedral structures of metallic glasses have indeed been observed in numerous X-ray and neutron diffraction experiments, though only on average. The new experiment succeeded in observing individual elementary icosahedra. To achieve this, a very narrow electron beam (only 0.36 nm wide) was passed through a thin layer of $Zr_{80}Pt_{20}$ metallic glass. If the beam passed through an icosahedron, the characteristic electron diffraction pattern was observed, depending on the orientation of the icosahedron. In this manner, symmetry axes of the second, third, and fifth orders were observed, as derived from the positions of diffraction spots. It was revealed that the icosahedra in the metallic glass are somewhat distorted. The reason for this is that regular icosahedra cannot fully fill the space and, therefore, they are distorted in the metallic glass as a result of competition with the face-centered cubic structure.

Source: *Science* **341** 376 (2013)
http://dx.doi.org/10.1126/science.1232450

4. Neutrons produced in artificial electric discharges

Neutron fluxes generated during natural atmospheric discharges with energies from $\sim 10^{-2}$ eV to tens of MeV have been recorded on numerous occasions [see *UFN* **182** 568 (2012) *Phys. Usp.* **55** 532 (2012)]. A V Agafonov (Lebedev Physical Institute of the Russian Academy of Sciences) and his colleagues were the first to record neutron pulses generated by artificial high-voltage discharges set up in the lab environment. In order to generate electric field strengths on the order of 1 MV m^{-1}, a Marx generator was employed and discharge current ranged approximately between 10 and 15 kA. Neutrons were recorded both by the calorimetric method using track detectors and in real time tapping plastic scintillation detectors. Track detectors fixed alpha particles from the reaction $^{10}\text{Be} + \text{n} \to {}^7\text{Li} + {}^4\text{He}$ occurring due to low-energy (thermal) neutrons, and due to the reaction $^{12}\text{C} + \text{n} \to {}^3\alpha + \text{n}'$ initiated by neutrons with energies of $\geqslant 10$ MeV. The experiment was unique in that, inter alia, the track detectors were for the first time placed directly in the discharge zone. The confidence level in observing triplets of alpha particles produced in disintegration of ^{12}C nuclei is higher than 10σ. Neutron pulses were observed in 25–30% of the total number of all discharges when the neutron flux was several times higher than the background level caused by

cosmic rays. Neutron pulses were produced at the initial stage of the electric discharge and correlated with X-ray pulses. The neutron flux varied with distance more slowly than according to the inverse squares law and, therefore, the region of generation of neutrons was likely not limited to a single point in the discharge area but was extended. So far, the mechanism of generation of neutrons due to electric discharges remains unclear.

Source: *Phys. Rev. Lett.* **111** 115003 (2013)
http://arXiv.org/abs/1304.2521

5. New PAMELA results

The PAMELA detector aboard the Russian satellite Resurs-DK1 has received new data on the content of e^+ positrons as a component of cosmic rays. Earlier PAMELA measurements established that the relative content of e^+ (with respect to the sum of e^+ and e^- fluxes) begins to increase in the neighborhood of the 10 GeV energy, even though, according to standard computations, this ratio should be expected to decrease with energy. This result was later confirmed by the data of the Fermi Gamma-ray Space Telescope and the AMS-2 experiment on the International Space Station. The new PAMELA results were obtained during the period of minimum solar activity in 2006–2009 and are characterized by very good accuracy. The growth in the relative value of the e^+ flux was confirmed up to energies of about 300 GeV, with the e^+ spectrum being measured up to 200 GeV, while that in the range 200–300 GeV was bounded from below. It is important that, in contrast to earlier PAMELA measurements, not only the relative but also the absolute value of the e^+ flux was measured. The cause of the growth in the relative e^+ flux has not been clarified so far. The annihilation of dark matter or the acceleration of positrons in pulsars or in stellar flashes has been suggested as a possible explanation, as was an additional injection and the acceleration of particles from supernova explosions. Russian scientists from the National Research Nuclear University MEPhI, the Lebedev Physical Institute of the RAS, and the Joffe Physical-Technical Institute of the Russian Academy of Sciences took part in the international PAMELA experiment.

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