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ON THE DETECTION OF NEW PARTICLES FROM DATA AT ACCELERATORS AND ULTRA-HIGH ENERGY COSMIC RAYS

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The search for new particles beyond the Standard Model at accelerators is undoubtedly one of the main tasks of modern nuclear physics. On the other hand, the interpretation of the spectra of soft photons in collisions of high-energy elementary particles is also a mystery for elementary particle physics.

Here we have proposed a development of the approach [1, 2] for interpreting the spectra of soft photons based on the transverse momentum in pp collisions with an incident proton momentum of 450 GeV/c [3]. The spectrum of soft photons [3] cannot be explained by the traditional bremsstruhlung mechanism. It can be explained taking into account the X17 boson with a mass of 17 MeV - a new particle, a possible candidate for the role of dark matter particles, discovered in the experiment [4]. The X17 boson was discovered in the ATOMKI experiment [4] in atomic transitions with Be, which requires independent confirmation. Here we propose to improve the agreement with experimental data [3] in order to more convincingly isolate the signal about the detection of the X17 boson. Our interpretation of photon momentum spectra is to use the formula for temperature [2]. The corresponding temperature is T =3.8 MeV. Unlike [2], here we take into account the isentropic decrease in temperature according to the formula $T^3V = {T_0}^3V_0$, where T_0 is the initial temperature before expansion, $V_0/V = G$ is the Lorentz contraction of volume. The corresponding excess of the spike over the undisturbed curve is 4 standard deviations. This can be verified after subtracting the corresponding values of the unperturbed curve from the experimental data [3]. In the spectra of photons emitted in the reactions of protons with carbon nuclei at a momentum of incident protons of 5.5 GeV/c [5], a boson with a mass of 38 MeV appears. Based on the combination of two-dimensional quantum chromodynamics and quantum electrodynamics in the tube model, we found the masses of these particles [2] with $m \sim \sqrt{\alpha}$, where α is the coupling constant, which is compatible with the resulting meson masses for the hadronic string-tube at $\alpha = 0.5$. That is, such an interpretation of the spectrum of soft photons can serve as further evidence in favor of the existence of a new particle of the X17 boson. The contribution of the X38 boson, predicted in the experiments carried out in Dubna [5], is also compatible with our approach. And based on temperature analysis for high-energy particle collisions, the contribution of the decay of the X17 and X38 bosons into two photons can be seen by relativistic kinematics to have an effect on the spectrum of emitted photons. It's a matter of subsequent experiments. These new particles may manifest themselves in ultra-high-energy cosmic rays on the order of 10^{11} GeV, unattainable with modern accelerators. We were able to reproduce the burst detected in experiments [6,7] due to the X17 and X38 bosons. The corresponding formulas used an approximation of the experimental spectrum of cosmic rays, proportional to E^{-3} , and the contribution of the decay of X-bosons to photons according to the black body radiation formulas.

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Section

Heavy ion collisions at Intermediate and high energies

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