PROPERTIES OF BARYONS AS RELATIVISTIC THREE-QUARK SYSTEMS

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I will present comprehensive results of the ground-state and excitation spectra of all baryons with flavors u, d, s, c, and b [1]. In addition I will address the electroweak form factors of the $SU(3)_F$ baryon ground states [2]. For the nucleons I will furthermore discuss the flavor decompositions of the elastic electromagnetic form factors [3], vis-à-vis recent experimental data, as well as the axial [4,5], scalar [6], and gravitational form factors [7]. All results are consistently obtained from a relativistic constituent-quark model, whose dynamics include confinement - corresponding to the string tension of QCD - and the hyperfine dynamics derived from the spontaneous breaking of chiral symmetry of low-energy QCD; the latter consists in the formation of constituent quarks with dynamical masses and interacting by Goldstone-boson exchange [8].

The three-quark systems (baryons) are treated by solving the eigenvalue problem of the relativistically invariant mass operator. Lorentz transformations, necessary for calculating covariant transition matrix elements for baryon reactions, are performed in the point form of relativistic quantum mechanics.

It turns out that such a relativistic constituent-quark model respecting strict Poincaré invariance, essentially succeeds in describing all known properties of baryons at low energies in agreement with phenomenology. In cases where experimental data are missing the results compare reasonably well with available predictions from lattice QCD.

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