Relativistic Corrections to Baryon Magnetic Moments.

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Summary. — We derive the explicit form of the relativistic corrections (both nonanomalous and anomalous) to baryon magnetic moments, by taking the nonrelativistic limit of a many-body Dirac's equation with electromagnetic interactions. The resulting Schrödinger-like equation is solved in a harmonic-oscillator basis, and the baryon states are built up so as to be completely symmetric in all the space, spin and flavour variables, also for different quark masses. Besides relativistic corrections, other effects, able to modify the baryon moments (like configuration mixing, isospin breaking and pion exchange), are also considered. The estimated values of the hyperon moments are in good agreement with the recent experimental data. It is shown that the relevant corrections to the baryon moments come from the relativistic contributions and from the two-body effect of pion exchange. Our analysis supports both the presence of anomalous quark moments and the validity of a quasi-nuclear constituent quark model.

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1. – Introduction.

One of the successes of the naive nonrelativistic quark model in its early days was fitting the magnetic moments of the baryons belonging to the low-
lying $SU_3$ octet. To achieve this, very few ingredients were needed, since, as is well known, in the naive-quark-model baryon moments are determined in a simple, additive way by the moments of the quarks composing the particle considered \(^{(1)}\); these, in turn, are supposed to bear Dirac moments \(^{(2,3)}\).

However, the recent, improved measurements of the magnetic moments of the hyperons \(^{(4-8)}\) have produced a much less satisfactory situation and even some troubles for the quark model in the above simple form. Indeed, only the experimental value of the $A^+$ moment is still in reasonable agreement with the theory, while discrepancies between calculations and experiments for the other hyperons are remarkable (of the order of $(15\div35)\%$).

A number of effects, able to accommodate the new data within the framework of the constituent quark model, have been discussed by many authors \(^{(9-24)}\).