To confirm our results these terms have been compared with the corresponding Born Terms of Yates[1] and the two types of Born terms show good agreement. The most notable observation is that when $\beta_i \to 0$ few of the Yates[1] integrals were divergent and cancelled with the opposite types of integrals. However, in the present studies there are no divergent integrals as can be seen from equation (10). In order to see the validity of the present approach we have calculated TCS for lithium atom using the optical theorem[7]. The TCS results are found to be in good agreement at higher incedent energies with the other data[8].

The present calculations are simpler than the Yates[1] approximation and one can calculate TCS and DCS very easily for any atom. Further work is in progress.

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GELL-MANN-OKUBO MASS FORMULA-A MODIFIED VERSION

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IN the absence of an exact theory of strong interactions, phenomenological theories based on approximate symmetries have played an increasingly important role in hadron physics since the early sixties. The successes of the SU(3) symmetry[1] and its chiral extension SU(3) × SU(3) are well known and need not be recounted here. For the breaking of this symmetry, the most popular and successful model in the past has been the (3,3*) + (3*,3) representation[2,3] of SU(3) × SU(3).

However, it is well known that the conventional (3,3*) + (3*,3) model cannot successfully account for certain experimental data, *e.g.*, the meson-meson scattering lengths, meson-nucleson σ — terms and the amplitute for the $\eta \to 3\pi^0$ decay. So the (8,8) representation of SU(3) × SU(3) has been proposed as a possible alternative to the more popular (3,3*) + (3*,3) model. In the present note, we have exploited the (8,8) model to derive a modified version of the famous Gell-Mann-Okubo mass formula for the pseudoscalar mesons. Our modified formula shows much better agreement with the experimental data than the original one and it reduces to the original formula in the limit of an exact SU(3) symmetry.

Our approach here is similar to that of Cicogna and co-workers[4], who used the functional method to treat the spontaneous breaking of symmetries in quantum field theory. The details of our approach, the use of the (8,8) model to derive the expressions for the masses and decay constants of the pseudoscalar mesons and our notations are explained in full details elsewhere[5].

Following the approach and notations of Ref. 4, we get the following expressions for the squared masses of the pseudoscalar mesons:

$$M^2_{\pi} = \frac{\sqrt{10}\, d_0 + 2 d_8}{\sqrt{10}\lambda_0 + 2\lambda_8},$$

$$M^2_{K} = \frac{\sqrt{10}\, d_0 - d_8}{\sqrt{10}\lambda_0 - \lambda_8},$$

$$M^2_{\eta} = \frac{\sqrt{10}\, d_0 - 2 d_8}{\sqrt{10}\lambda_0 - 2\lambda_8}, \qquad (1)$$

These expressions have been derived on the assumption that the strong interaction Hamiltonian H can be written as

$$H = H_0 + H', \quad \text{where } H' = d_0 z_0 + d_8 z_8. \qquad (2)$$

Here H_0 is SU(3) × SU(3) invarient, while H' breaks this symmetry; d_0 and d_8 being symmetry breaking parameters. The quantities λ_0 and λ_8 in Eq (1) are the vaccum expectation values of the meson fields z_0 and z_8. This form of symmetry breaking given in Eq. (2) satisfies the requirements of the conservation of isospin and hypercharge for strong interactions.

Moreover, it can be shown[5] that the application of the PCAC (partial conservation of axial-vector currents) hypothesis gives the following expressions for the decay constants F_i of the pseudoscalar mesons π and K:

$$F_\pi = (3\sqrt{3}/10)\,(\sqrt{10}\lambda_0 + 2\lambda_8),$$

$$F_\lambda = (3\sqrt{3}/10)\,(\sqrt{10}\lambda_0 - 2\lambda_8). \qquad (3)$$

Combining Eqs. (1) and (3), we get the remarkable relation

$$4\frac{F_K}{F_\pi} M_K^2 = 4\frac{F_K}{F_\pi} - 1 \quad M_\eta^2 + M_\pi^2 \qquad (4)$$

which is the modified Gell-Mann-Okubo mass formula obtained from the (8,8) model of the broken SU(3) × SU(3) symmetry.

We note here that in the limit of an exact SU(3) symmetry (*i.e.* $F_K \approx F_\pi$), Eq. (4) reduces to the original Gell-Mann-Okubo mass formula[6] for the pseudoscalar mesons:

$$4M^2{}_K = 3M^2{}_\eta + M^2{}_\pi \qquad (5)$$

If we use the average experimental masses of π, K and η in Eq. (5), it is satisfied to within 6.3%. On the other hand, if we use the accepted value $F_K / F_\pi = 1.25$, along with the experimental masses, as input in our modified relation (4), we find that the agreement is of the order of 0.4%. Thus our modified formula is much better than the original mass formula

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EVALUATION OF NITRATE DISPLACEMENT AND WETTING FRONT DEPTH FOLLOWING INFILTRATION IN COARSE-TEXTURED SOIL

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IN soil, fertilizer nitrogen is mostly converted into nitrate form which moves through the soil with irrigation water. The nitrate is either available to the crops or is leached down beyond the root zone. Prediction of nitrate movement under varying amounts of water supply is thus, important for optimizing nitrogen management in soil. Such a study usually requires solving the second order partial differential equation for water flow, measurement of Darcian flow velocity, constant monitoring of influx rate and lengthy mathematical computations[1-4]. Recently Rose *et al*[5] advocated simplified mathematical treatment to predict nitrate movement in soil under field conditions. The present study attempts to determine if nitrate displacement depth in coarse-textured soil could be computed by simple mathematical relationships.

Nitrate movement was studied in laboratory experiments, using alluvial sandy loam soil (a typic Ustochrept having clay 18.6% silt 12.5% and sand 68.9%) during downward as well as horizontal infiltration of water at two levels of bulk densities (1.5 and 1.6 g cm^{-3}), each at two initial soil water contents (0.02 and 0.08 cm^3 cm^{-3}). Three different quantities of water (2.5, 5.1 and 8.6 cm) were allowed to infiltrate through one end of the soil column where chemical grade potassium nitrate (at the rate of 562.5 μg of N per gram of soil mixed in 2 cm layer) was added. After the entry of desired quantity of water, nitrate as well as water contents were determined at different soil depths and the maximum nitrate concentration displacement (X_m) and wetting front depths (X_f) were found out. The details of the experimental procedures were similar to those reported earlier[3].

During the study, it was observed that the nitrate moved with the water flowing through the profile and the depth of the fertilizer displacement increased proportionately with the quantity of influx (table 1). The depth of maximum nitrate concentration (X_m) was not affected by the initial soil wetness for any particular amount of infiltration and the wetting front (X_f) coincided with X_m in intially dry soil. However, in initially moist soil X_m lagged behind X_f. The lagging effect became more pronounced with higher quantum of infiltration as the invading solution displaced more of the antecedent water from a larger soil volume which increased as water penetrated deeper in the profile. These observations were similar to the earlier findings in the case of nitrate[3,6] and chloride[7] both showing similar behaviour. It was also observed that irrespective of the quantity of water influx the soil water content distribution in the wetted profile was fairly uniform and the average profile water content θ_f following infiltration was 0.3329 and 0.3216 $cm^3 cm^{-3}$ for 1.5 and 1.6 g cm^{-3} bulk densities. These θ_f values were used in the following three equations to compute X_f, X_m and the lag factor Y.

$$X_f = Q_i(\theta_f - \theta_i), \qquad (1)$$

$$X_m = Q\,\theta_f. \qquad (2)$$