

## Exercices and questions for lectures 9 & 11

- 1.- Determine the transformation of scalar and pseudoscalar bilinears under  $C$ ,  $P$ .
- 2.- Check the requirements that hermiticity of the Lagrangian forces on  $\lambda$ ,  $\eta$  in the terms (376).
- 3.- Find out how  $\vec{W}_\mu$  must transform under a  $SU(2)$  transformation for the covariant derivative to transform as in (396).
- 4.- Prove by explicit calculation that  $\Sigma = \sigma I + i\vec{\pi}\vec{\tau}$  satisfies  $\Sigma\Sigma^\dagger \propto I$ .
- 5.- Write the relevant Feynman rules for the sigma model of Gell-Mann and Levy.
- 6.- Prove that

$$\delta\psi = i\gamma_5\epsilon_5^a T^a\psi \tag{478}$$

is a symmetry of the sigma model lagrangian. Write  $\epsilon_5^a$  in terms of  $\epsilon_L^a$  and  $\epsilon_R^a$ . Derive the Noether current associated to this symmetry.

- 7.- Prove (477).
- 8.- Determine the matrix element  $iM$  for the weak decay  $\pi^- \rightarrow \mu^- \bar{\nu}_\mu$ .