

## 831 Homework set 6 (due Oct. 20)

### 1. Dirac matrices

Considering the Lorentz contraction for the Dirac matrices, prove the following identities:

$$\gamma^\mu \gamma_\mu = 4 \quad (1)$$

$$\gamma^\mu \not{a} \gamma_\mu = -2\not{a} \quad (2)$$

$$\gamma^\mu \not{a} \not{b} \gamma_\mu = 4a \cdot b \quad (3)$$

$$\gamma^\mu \not{a} \not{b} \not{c} \gamma_\mu = -2\not{c} \not{b} \not{a} \quad (4)$$

where  $\not{a} = a^\mu \gamma_\mu$ .

### 2. Gordon decomposition:

Let  $u_1(p_1)$ ,  $u_2(p_2)$  be two Dirac spinors. Show that

$$\bar{u}_1 \gamma^\mu u_2 = \frac{1}{2m} \bar{u}_1 (P^\mu + i q_\nu \sigma^{\mu\nu}) u_2 \quad (5)$$

where  $P^\mu = p_1^\mu + p_2^\mu$ ,  $q^\mu = p_1^\mu - p_2^\mu$ , and  $\sigma^{\mu\nu} = i[\gamma^\mu, \gamma^\nu]/2$ .