## Quantum field theory

Exercises 8.
2005-12-19

## - Exercise 8.1.

In the rest frame the solution of the Dirac equation has the form

$$
u=\binom{u_{L}}{u_{R}}, \quad u_{L}=u_{R}=\sqrt{m} \xi
$$

where $\xi$ is some two-component vector normalized to one $\xi^{\dagger} \xi=1$ (there are two such orthogonal vectors, corresponding to two spin states). Perform the Lorentz boost of this solution to an arbitrary frame and compare with the generic result given in the lectures.

- Exercise 8.2.

Calculate traces of the expressions

$$
\begin{array}{cccccc}
\gamma^{\mu}, & \gamma^{\mu} \gamma^{v}, & \gamma^{\mu} \gamma^{v} \gamma^{\lambda}, & \gamma^{\mu} \gamma^{v} \gamma^{\lambda} \gamma^{\rho}, & \gamma^{\mu} \gamma^{v} \sigma^{\mu v}, & \sigma^{\mu v} \sigma^{\mu v}, \\
& \gamma^{\mu} \gamma^{v} \gamma^{5}, & \gamma^{\mu} \gamma^{v} \gamma^{\lambda} \gamma^{\rho} \gamma^{5}, & \gamma^{\mu} \gamma^{v} \sigma^{\lambda \rho} \gamma^{5}, & \sigma^{\mu v} \sigma^{\lambda \rho} \gamma^{5} .
\end{array}
$$

## - Exercise 8.3.

Consider the two Dirac Lagrangians

$$
\mathscr{L}=\bar{\psi}(i \not \partial-m) \psi, \quad \mathscr{L}^{\prime}=\bar{\psi}\left(\frac{1}{2} \stackrel{\leftrightarrow}{\partial}-m\right) \psi .
$$

Verify that they are classically equivalent. Compute the energy-momentum tensor in the two cases. Verify that they are different, but lead to the same conserved charges.

