

Exercise Sheet 12
Advanced Quantum Theory
WS 2010/11

Fakultät Mathematik und Physik
Universität Stuttgart
Prof. Dr. R. Hilfer

Exercise 1: **(3 points)**

Construct an explicit representation of the parity operator in terms of \vec{x} and \vec{p} . (Hint: Write P in the x -representation, introduce polar coordinates (r, θ, φ) , and see how P acts on the total set $\{f(r)Y_l^m(\theta, \varphi)\}$ where $Y_l^m(\theta, \varphi)$ are spherical harmonics.)

Exercise 2: **(3 points)**

Verify the fact that

$$L_{\pm}|l, m\rangle = c_{\pm}|l, m \pm 1\rangle$$

with

$$c_{\pm} = \sqrt{l(l+1) - m(m \pm 1)}$$

from III.2.9 in the lecture.

Exercise 3: **(10 points)**

Transform the angular momentum operators L_x, L_y, L_z and L_{\pm} to spherical coordinates.