

# Lecture 11. Problems.

## 1 Problems

1. The Lorentz group in two dimensions  $\mathbf{SO}(1,1)$  is characterized by one parameter, the angle of rotation  $a$  ( $0 \leq a < 2\pi$ ):

$$D(a) = \begin{pmatrix} \cosh a & -\sinh a \\ \sinh a & \cosh a \end{pmatrix}. \quad (1)$$

Find the infinitesimal operator of this group.

2. Construct  $d_{mm'}^{(1)}(\beta)$ .
3. In the laboratory system the particle with an angular momentum  $l = 2$  has the projection on the  $z$ -axis  $m = 1$ . Find the probability  $W(m')$  that the projection of this moment on the axis which is turned on  $\theta = 60^\circ$  to  $z$ -axis is equal to  $m'$  ( $m' = -2, -1, 0, 2, 1$ ).
4. Consider a system having the symmetry  $\mathbf{SO}(3)$ . Suppose a perturbation is applied which reduces the symmetry to  $\mathbf{O}$ . How will the  $J = 4$  levels will be splitted?
5. Construct the eigenstates of a two-nucleon system corresponding to  $T = 1$  and  $T = 0$ .
6. Assuming that in the reaction  $^{16}\text{O} + ^2\text{H} \rightarrow ^{18}\text{F}$  the isospin is conserved, find the isospin of final states of  $^{18}\text{F}$  (consider that  $^{16}\text{O}$  is in its ground state and  $^2\text{H}$  has the isospin  $T = 0$ ).
7. Find the ratio of the reaction cross-sections:  
 $^{16}\text{O} + ^3\text{He} \rightarrow ^{18}\text{F} + \text{p}$   
 $^{16}\text{O} + ^3\text{He} \rightarrow ^{18}\text{Ne} + \text{n}$   
where  $^{18}\text{F}$  and  $^{18}\text{Ne}$  have isospin  $T = 1$ .