

# Massachusetts Institute of Technology

## Department of Physics

Course: 8.701 – Introduction to Nuclear and Particle Physics

Term: Fall 2020

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### Discussion Problems

from recitation on September 15th, 2020

#### Problem 1: Triangle Group

Consider symmetries of the equilateral triangle, see Fig. 1. It is carried into itself by a clockwise rotation through  $120^\circ$  ( $R_+$ ), and by a counterclockwise rotation through  $120^\circ$  ( $R_-$ ), by flipping it about the vertical axis  $a$  ( $R_a$ ) and axis  $b$  ( $R_b$ ) and  $c$  ( $R_c$ ). Construct a multiplication table for the triangle group, filling the blanks in Tab. 2. In row  $i$ , column  $j$  put the product  $R_i R_j$ . Is this an Abelian group? How can you tell, just by looking at the table?

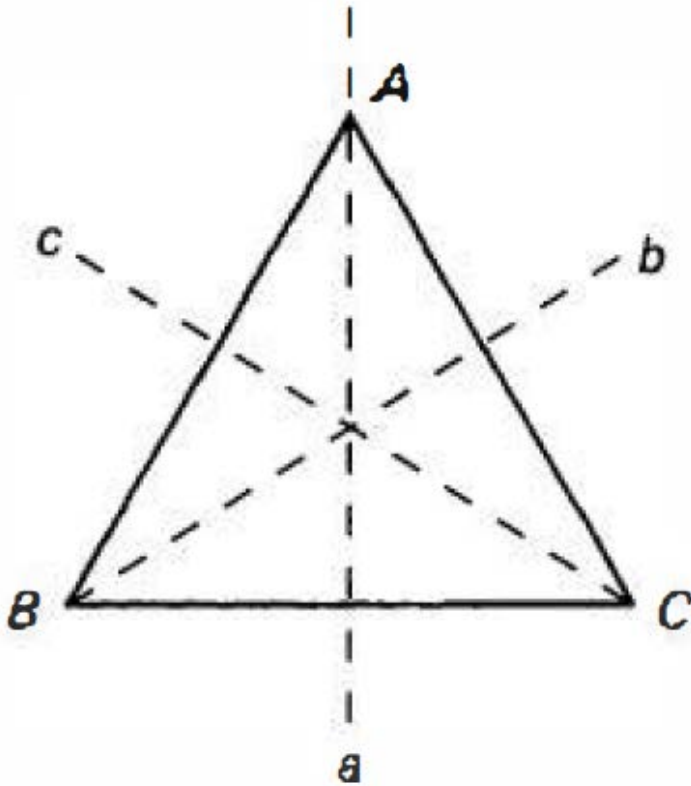


Figure 1: Equilateral triangle.

	$I$	$R_+$	$R_-$	$R_a$	$R_b$	$R_c$
$I$						
$R_+$						
$R_-$						
$R_a$						
$R_b$						
$R_c$						

Figure 2: Multiplication table for triangle group.

## Problem 2: Isospin - dynamic implications

Consider three nucleon-nucleon scattering processes

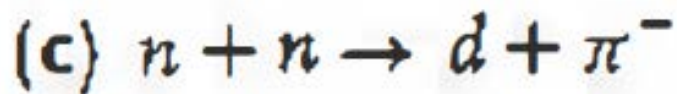
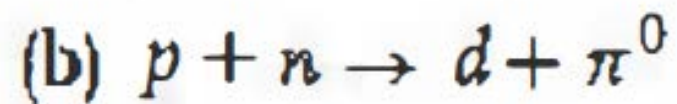
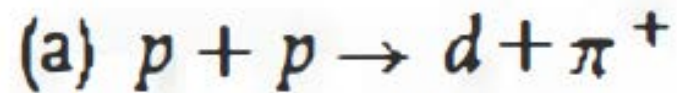


Figure 3: Nucleon-nucleon scattering processes.

The deuteron has isospin  $I=0$  and the pion  $I=1$ . Isospin is conserved in the scattering process. Cross-sections go like the absolute square of the amplitude. What is the ratio of cross sections,  $\sigma_a : \sigma_b : \sigma_c$ ?

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