

**Title:** Lecture - QFT I, PHYS 601

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**Collection/Series:** Quantum Field Theory I (Core), PHYS 601, October 7 - November 6, 2024

**Subject:** Condensed Matter, Particle Physics, Quantum Fields and Strings

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Quotient group

simple no non-trivial invariant/normal subgroup  
complicated invariant subgroup has proper <sup>invariant</sup> subgroup

for all  $g \in G$   $h \in N$

$$gh = h'g$$

solution  $h' \in N$

left cosets  $\{N, gN, g^2N, \dots\}$   
= right cosets

Quotient group

$$Q = \frac{G}{N}$$

Quotient group

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$$D_3 = \mathbb{Z}_2 \times \mathbb{Z}_3$$

$$\{e, p\}$$

$$\{e, r, r^2\}$$

check  $\{e, p\}$  ← not invariant

$$rp = r$$

check  $\{e, r, r^2\}$

$$pr = r^2p$$

Quotient group

$$Q = \frac{G}{N}$$

$$\{e, p\}$$

$$\{e, r, r^2\}$$

$$D_3 = \mathbb{Z}_2 \ltimes \mathbb{Z}_3$$

$\parallel \quad \parallel$   
 $Q \quad N$

check  $\{e, p\}$  ← not invariant

$$rp = r$$

check  $\{e, r, r^2\}$  ← xp on the left

$$pr = r^2p$$

N

$\{p, pr, pr^2\}$  ← left coset

$$\{e, p\}$$

$$T(\lambda, b) T(1, a) = \underline{T(1, \lambda a)} T(\lambda, b)$$

$\uparrow$   
 $\mathbb{R}$

$\uparrow$   
 $\mathbb{R}^{1,3}$

$$x' = \lambda x + b$$

$$x' = \lambda(x + a) + b$$



gmc cosets

$$[T_a, T_b] = i f_{abc} T_c$$

$OB(1)$  is our only hope

$\mathbb{R}^2 \times D_2$  is " "

$SU(2)$  is our hope

gmc cosets

$$[T_a, T_b] = i f_{abc} T_c$$

$OB(1)$  is our only hope

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$SU(2)$  is our hope

best scenario

real  
completely antisymmetric

Levi civita

$$[T_a, T_b] = i \epsilon_{abc} T_c$$