

## MATH431 - Modern Particle Physics

### Set Work: Sheet 7; Due:

1. Show that a unitary matrix  $U$  can be written as  $U^{iH}$ . What are the condition that the matrix  $H$  must satisfy?
2. Consider the simple unitary group  $SU(4)$ .
  - (a.) How many diagonal generators of the Lie algebra are there? Write down a representation of the diagonal generators in the terms of  $4 \times 4$  hermitian matrices.
  - (b.) What is the dimension of the group? Write down a representation of the generators in terms of  $4 \times 4$  hermitian matrices.
  - (c.) What is the fundamental representation of  $SU(4)$ ? Write down its decomposition in terms of a maximal subgroup.
  - (d.) Draw the graphic illustration of the fundamental representation.
  - (e.) Find the product and the decomposition under the maximal subgroup of the fundamental times the anti-fundamental representations of  $SU(4)$ .
  - (f.) Find the product and the decomposition under the maximal subgroup of the fundamental times the fundamental representations of  $SU(4)$ .
  - (g.) Discuss the interpretation of the decomposition of the  $SU(4)$  group, and its fundamental representation, in terms of the Standard Model subgroups. What can you say about the  $U(1)$  charges of the Cartan generators?