Contraction of broken symmetries via Kac-Moody formalism

Jamil Daboul
Physics Department, Ben Gurion University of the Negev, Israel.

Abstract

I investigate contractions of broken symmetries via Kac-Moody formalism. I will first review and compare the dynamical symmetries of the hydrogen atom and harmonic oscillator. Then I show how the symmetry algebra of the hydrogen atom leads to an *infinite-dimensional Kac-Moody loop algebra*, which I shall also review. I then show how this algebra yields the finite-dimensional algebras $\mathfrak{so}(N+1), \mathfrak{so}(N,1)$ and their contraction to $\mathfrak{e}(N)$. Along the way I will review the basic ideas of contraction.

Then I study the symmetry algebra of the standard 2-D Kepler system, which has an additional symmetry breaking term, defined by the Hamiltonian

$$H = \frac{1}{2m}(p_1^2 + p_2^2) - \frac{\alpha}{r} - \beta\, r^{-1/2} \cos((\varphi - \gamma)/2) \ .$$

I will show how the symmetry breaking can be treated in the Kac-Moody formalism.

In this talk I will try to explain and illustrate several mathematical concepts and ideas by applying them to relatively simple physical models.