Third International Conference on
Geometry, Integrability and Quantization
June 14–23, 2001, Varna, Bulgaria
Ivaïlo M. Mladenov and Gregory L. Naber, Editors
**Coral Press**, Sofia 2001, pp 369–381

# TWO DIMENSIONAL HAMILTONIAN WITH GENERALIZED SHAPE INVARIANCE SYMMETRY

H. PANAHI-TALEMI[*‡] and M. A. JAFARIZADEH[*†‡]

[*] *Department of Theoretical Physics and Astrophysics, Tabriz University 51664 Tabriz, Iran*

[†] *Institute for Studies in Theoretical Physics and Mathematics 19395-1795 Tehran, Iran*

[‡] *Research Institute for Fundamental Sciences, 51664 Tabriz, Iran*

**Abstract**. The two dimensional Hamiltonian with generalized shape invariance symmetry over $S^2$, has been obtained via Fourier transformation over the three coordinates of the $SU(3)$ Casimir operator defined on $SU(3)/SU(2)$ symmetric space. It is shown that the generalized shape invariance is equivalent to $SU(3)$ symmetry and that there is one to one correspondence between the representations of the generalized shape invariance and $SU(3)$ Verma modules. Also the two dimensional Hamiltonian in $\mathbb{R}^2$ space which posseses ordinary shape invariance symmetry with respect to two parameters, has been obtained via Inönü–Wigner contraction over $SU(3)$ manifold.

## 1. Introduction

Exactly solvable potentials are among the central and fundamental problems of mathematical physics, consequently they have attracted much interest both in theoretical physics and mathematics. They are also extensively applied in the investigation of many physical systems in quantum optics, condensed matter, nuclear physics, and solid state physics. There are many methods of obtaining exactly solvable potentials in quantum mechanics. The most powerful are the algebraic, supersymmetric and shape invariant factorization methods of Schrödinger equation [1–5]. One of the authors has shown the equivalence of these two methods in one [6], two and three dimensional [7–10] exactly solvable models. In all these works it is shown that there is a close connection between