Computation of the low-energy Spectrum of $SU(3)$ Yang-Mills Quantum Mechanics

Hans-Peter Pavel (Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Russia)
E-mail address: pavel@theor.jinr.ru

The low-energy spectrum of $SU(3)$ Yang-Mills quantum mechanics of spatially constant fields is computed in the unconstrained approach after exact implementation of the Gauss-law operators using a new algebraic gauge with a simple but non-trivial Jacobian (Faddeev-Popov determinant). To compute the eigensystem of the reduced $SU(3)$ Yang-Mills Hamiltonian, the corresponding harmonic oscillator problem in reduced space (replacing the magnetic potential by the multidimensional harmonic oscillator potential) is considered, which is trigonal in the space of monomials in the reduced gauge fields, and hence integrable. The eigenfunctions, which are polynomials in the 16 reduced gauge fields (generalisations of the Hermite polynomials), serve as an orthonormal basis for the Hilbert space of reduced $SU(3)$ Yang-Mills QM. Calculating its energy-spectrum in the truncated space of polynomials for higher and higher degree using algebraic operations, convergence for the lowest eigenvalues is found already at degree 9 and 10. The obtained energy-eigenvalues are in excellent agreement with the values obtained by Weisz and Ziemann in the constrained approach in the 0^{++} and 2^{++} sectors, and give considerably improved values for the sectors 1^{--}, 3^{--}, 0^{-+}, 2^{-+}, 1^{+-}, 3^{+-}.