

Quantum Physics

Quantum and semiclassical spin networks: from atomic and molecular physics to quantum computing and gravity

V. Aquilanti, A.C.P. Bitencourt, C. da S. Ferreira, A. Marzuoli, M. Ragni

(Submitted on 8 Jan 2009)

The mathematical apparatus of quantum--mechanical angular momentum (re)coupling, developed originally to describe spectroscopic phenomena in atomic, molecular, optical and nuclear physics, is embedded in modern algebraic settings which emphasize the underlying combinational aspects. $SU(2)$ recoupling theory, involving Wigner's $3nj$ symbols, as well as the related problems of their calculations, general properties, asymptotic limits for large entries, play nowadays a prominent role also in quantum gravity and quantum computing applications. We refer to the ingredients of this theory -and of its extension to other Lie and quantum group- by using the collective term of `spin networks'. Recent progress is recorded about the already established connections with the mathematical theory of discrete orthogonal polynomials (the so-called Askey Scheme), providing powerful tools based on asymptotic expansions, which correspond on the physical side to various levels of semi-classical limits. These results are useful not only in theoretical molecular physics but also in motivating algorithms for the computationally demanding problems of molecular dynamics and chemical reaction theory, where large angular momenta are typically involved. As for quantum chemistry, applications of these techniques include selection and classification of complete orthogonal basis sets in atomic and molecular problems, either in configuration space (Sturmian orbitals) or in momentum space. In this paper we list and discuss some aspects of these developments -such as for instance the hyperquantization algorithm- as well as a few applications to quantum gravity and topology, thus providing evidence of a unifying background structure.

Subjects: **Quantum Physics (quant-ph)**; General Relativity and Quantum Cosmology (gr-qc)

Journal reference: Phys.Scripta 78:058103,2008

DOI: [10.1088/0031-8949/78/05/058103](https://doi.org/10.1088/0031-8949/78/05/058103)

Cite as: [arXiv:0901.1074v1](https://arxiv.org/abs/0901.1074v1) [quant-ph]

Submission history

From: Annalisa Marzuoli [[view email](#)]

[v1] Thu, 8 Jan 2009 15:52:26 GMT (63kb)

[Which authors of this paper are endorsers?](#)

Download:

- [PDF](#)
- [PostScript](#)
- [Other formats](#)

Current browse context:

quant-ph

[< prev](#) | [next >](#)

[new](#) | [recent](#) | [0901](#)

Change to browse by:

[gr-qc](#)

References & Citations

- [SLAC-SPIRES HEP](#)
([refers to](#) | [cited by](#))
- [CiteBase](#)

Bookmark([what is this?](#))

[CiteULike logo](#)

[Connotea logo](#)

[BibSonomy logo](#)

[Mendeley logo](#)

[Facebook logo](#)

[del.icio.us logo](#)

[Digg logo](#)

[Reddit logo](#)

