Thiemann, T.; Winkler, O.
Gauge field theory coherent states (GCS). III: Ehrenfest theorems. (English)  
Classical Quantum Gravity 18, No. 21, 4629-4681 (2001).

This is the third in a series of papers by the authors devoted to Quantum General Relativity (QGR). First, the authors briefly outline the work of the past decade on this topic. They state that this work has now culminated in a starting point for a quantum theory of the gravitational field plus matter so that the stage is set to pose the most basic physical question: Does the QGR constructed to date have classical general relativity as its classical limit? The paper does a step towards answering this question. After summarizing the classical and quantum kinematical framework of diffeomorphism-invariant quantum gauge field theories and a brief review of the heat kernel coherent states, they prove Ehrenfest theorems for the gauge-invariant coherent states for the gauge group \( G = SU(2) \). That means, the Ehrenfest property of the coherent states is established by showing that the expectation value of the elementary operators (and of their commutators divided by \( i\hbar \), respectively) in the coherent state are, to zeroth order in \( \hbar \), given by the values of the elementary functions (and their Poisson brackets, respectively) at a point of the phase space given by the connection and the electric field. The authors mention that the obtained results can be extended to all polynomials of elementary operators and to a certain non-polynomial function of elementary operators associated with the volume operator of QGR. The calculations carried out are lengthy and complicated. They are displayed in detail because calculations of this kind have not yet appeared in the literature and can also apply to other problems.

Reviewer: Horst-Heino von Borzeszkowski (Berlin)

MSC:

83C45  Quantization of the gravitational field  
83C47  Methods of quantum field theory in general relativity and gravitational theory  
81T13  Yang-Mills and other gauge theories in quantum field theory  
58D20  Measures (Gaussian, cylindrical, etc.) on manifolds of maps  
81R30  Coherent states

Keywords:  
quantum general relativity; coherent states; Ehrenfest theorems

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