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Hit ~me baby~ Quarkonium One More Time (with QTRAJ 1.1 beyond the dipole).

In 2021, in the pursuit of a simulation framework for the propagation of quarkonium, a joint effort between Munich (TUM) and Kent (KSU) developed QTRAJ 1.0. This code, based on the Quantum Trajectories algorithm, solves Lindblad's equation numerically as long as it is expressed in an Open Quantum System (OQS) form. However, QTRAJ 1.0 could only simulate the system the dipolar limit, meaning $rT \ll 1$ being T the temperature and r the relative distance of the pair.

In our work, we present QTRAJ 1.1, an extended version that goes beyond this restriction, up to $rT \sim 1$. Following the approach of Blaizot and Escobedo (2018), which recovers Laine's original idea of the One Gluon Exchange (OGE) as the source of the complex potential, we expand the original dipolar implementation. To validate our code, we reproduce the dipolar limit, thereby demonstrating consistency by construction. By introducing new selection rules and improving numerical robustness, QTRAJ 1.1 enables predictions beyond the dipolar regime, providing a basis for future phenomenological applications.

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