

Peer Review

Review of: "Terahertz-Induced Second-Harmonic Generation in Quantum Paraelectrics: Hot-Phonon Effect"

Zafer Özer¹

1. Mersin University, Turkey

This article presents a significant advancement in understanding the long-lived, non-oscillatory second-harmonic generation (SHG) observed in terahertz (THz)-pump SHG-probe experiments on quantum paraelectrics (QPEs), particularly KTaO₃. The authors argue convincingly that this phenomenon is attributable to a hot-phonon effect, challenging the previously held notion of transient ferroelectric order. The authors effectively integrate experimental measurements with a newly developed temperature-dependent dynamic model that incorporates the hot-phonon effect.

SHG and Ferroelectricity: The assertion that a finite SHG signal does not necessarily indicate ferroelectric order is crucial and warrants expansion. While referenced in the Supplementary Materials, a brief explanation in the main text would benefit readers by clarifying what specifically prevents a finite SHG signal from being a definitive indicator of ferroelectricity in this context.

"Near-equilibrium response": The classification of the observed SHG response as a "near-equilibrium response" requires clearer definition, and further clarification on how the hot-phonon effect fits within this classification would be beneficial.

"Soft-mode frequency doubling phenomenon": This phenomenon is briefly mentioned but could benefit from a more detailed explanation within the main text. Clarifying why this doubling occurs specifically in QPEs at the verge of the central-symmetric state would enhance understanding.

Overall Assessment:

The study is well-executed and holds significant implications for quantum paraelectrics research, with the authors presenting a robust case for attributing the long-lived SHG component to the hot-phonon effect. While certain aspects of clarity could be improved, the novelty and potential impact of

this research are substantial. I recommend publication pending resolution of the clarity issues outlined above.

Declarations

Potential competing interests: No potential competing interests to declare.