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## Microscopic polarization and magnetization fields: Towards a “post-modern” theory

# physikalisches

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The response of solids to incident electromagnetic fields is often heuristically described in terms of macroscopic polarization and magnetization fields.

In condensed matter physics, the “modern theory of polarization”, and its extension to magnetization, gives this a new level of rigour for time independent and uniform applied fields. We review the philosophy and main results of that strategy, and report on a new approach based on introducing microscopic polarization and magnetization fields.

This “post-modern” approach can be used to address the response of crystals to electromagnetic fields varying arbitrarily in space and time, and connects that response to aspects of the underlying topology of the band structure. We compare it to earlier work on atoms and molecules, identifying important similarities and differences.

