

The Space-Time Scaling Problem in Materials Science

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INTRODUCTION & AIM

The aim of this study is to define the conditions and assumptions used in developing physical-mathematical models that reproduce—or, to some extent, question—the results of experiments and numerical calculations at the appropriate scales. The goal of describing a physical phenomenon as accurately as possible at larger scales starts with fermionic interactions in the excited state, such as Compton waves, which already have experimental and practical applications. This work presents that even in the unexcited state, electrons act as electrostatic oscillators of the wave function. At the atomic scale, the assumption of a process at the speed of light is no longer possible. Here, we discuss Fermi quantities. This work also asks the question of the constancy of Planck's constant, which arises from the angular momentum and is influenced by the electron density of an individual material. The function that would link the relationship between distance and time changes begins with the creation of a physical model of the wave function that allows the speed of light to transition to Fermi quantities, which helps to connect free (valence) electrons in physical chemistry problems. The scaling procedure is based on the 2D screening of a certain experiment and acquires a more realistic application that can be verified experimentally. Its use is equivalent to the square of the wave function. The problem of quantum mechanics with a volumetric change in space is also associated with scaling, which can be described as one of the Lebesgue in 3D-spaces. Scaling allows us to obtain a topological sequence of the necessary physical quantities and form a complex chain connected by a causal relationship of space-time variation.

METHOD

Any changes in a macro-system that can be measured are influenced by transformations in micro-systems. Let's say that initially the system is in a certain micro-state of thermodynamic equilibrium. In an excited system, a particle will pass through a series of other micro-states until it experiences the steady state again after some time. In other words, during excitation, when a microsystem is brought out of thermodynamic equilibrium and one becomes non-equilibrium (accelerating or decelerating), it is possible to study the duration of such processes in certain localized spaces. One of the tasks posed in this study is the shape of this space, which would probably determine the success of the description of physical processes and practical calculations. The entire description of such states is complicated by the simultaneous occurrence of physical processes of different nature, such as the Lorentz force, responsible for the interaction of electric and magnetic fields, or the Fermi temperature, which is an example of short-term adiabatic descriptions that can occur even under certain conditions of an excited macro-system. In this study, the microsystem describes the electron-positron interaction in the valence subshell of an atom. Taking this interaction into account, a physical mathematical model was developed that can be universal for both excited-/steady-state systems. It was also tested for cases larger than the atomic scale. For such a space-time model to become a practical tool, its description must be consistent with probabilities that confirm that a measurement will yield a certain result, given that the system is in one of the previously simulated states. This method was called Space-time of non-equilibrium systems (acronym STONES).

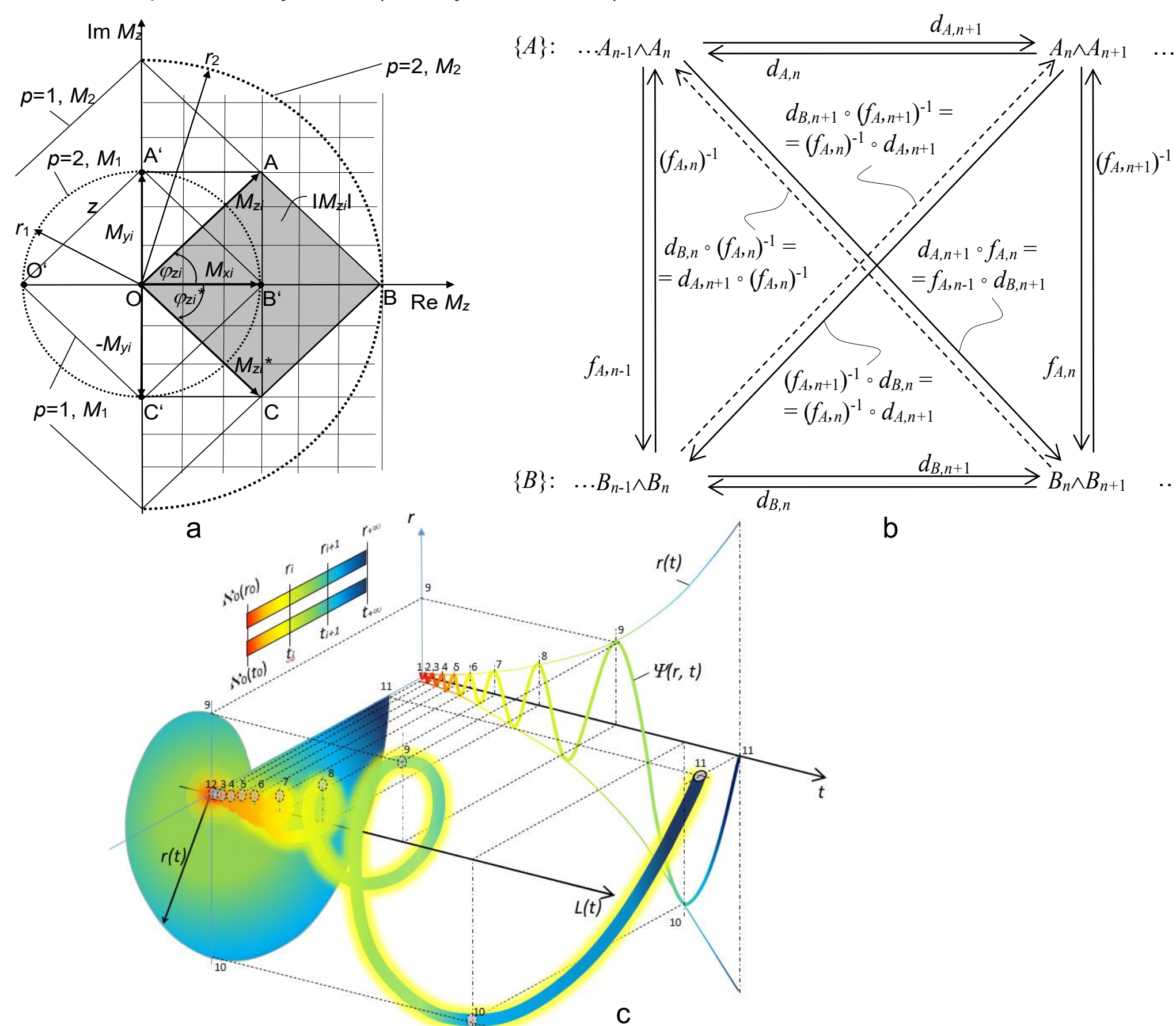


Figure 1. A model of normed vector spaces L^p joining circular motion of a particle and its scale M adopted to complex axes, if $p \in \{1, 2\}$ and $M \in \{0, +\infty\}$ (a); a homomorphic diagram that connects the scaling variables – time in set A and distance in set B – by the covariant and contravariant transformations (b); a diagrammatic explanation of quantum space-time in 3D model of moving electron along its free path $L(t)$, formation of rotational hologram $r(t)$ and a projection of wave function $\psi(r,t)$ with its smooth curve $r(t)'$ (c); in the two colorful rulers, spacetime starts with the cardinal numbers of distance and time of excited state, $N_0(r_0)$ and $N_0(t_0)$, respectively

RESULTS & DISCUSSION

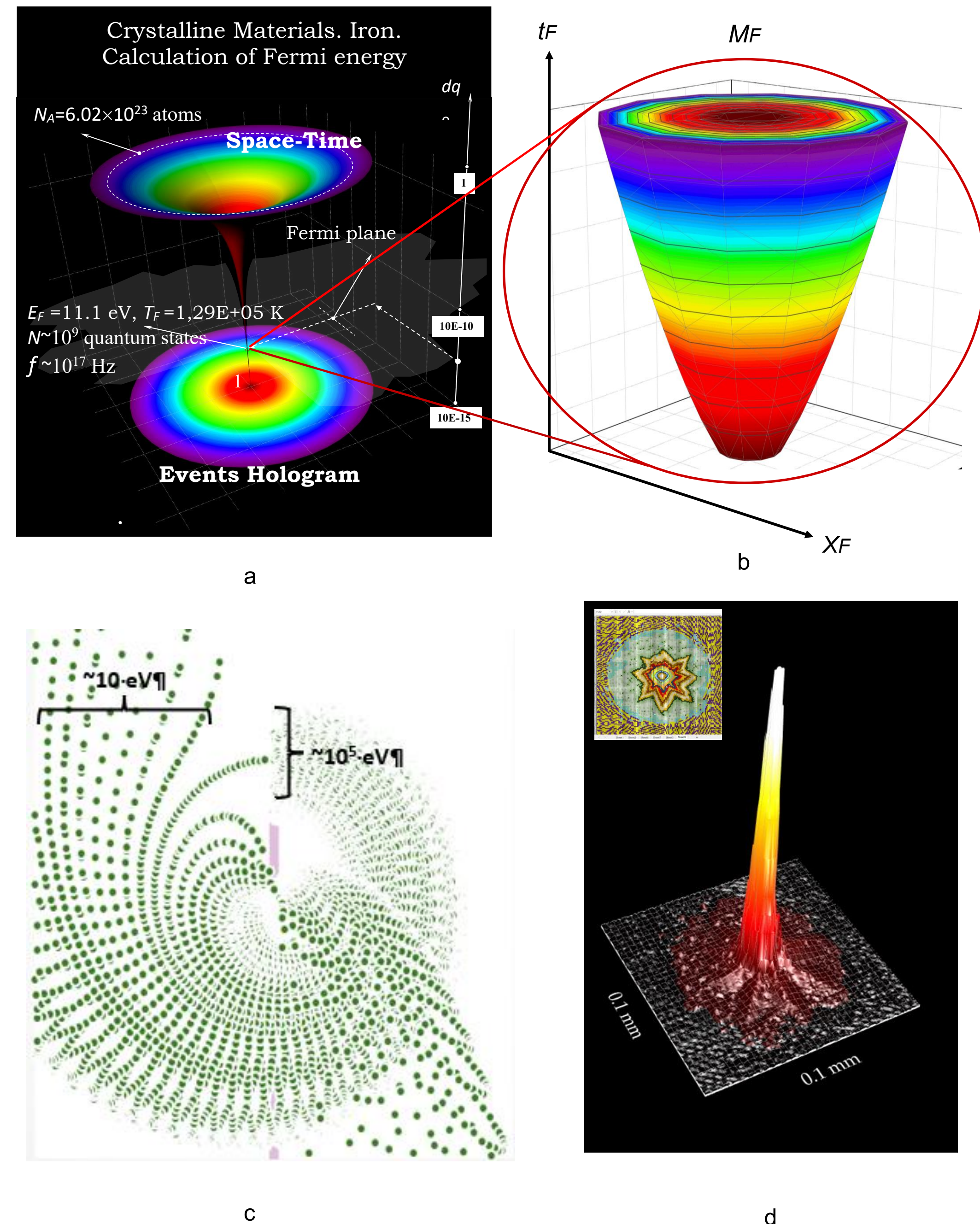


Figure 2. Mathematical visualization of space-time for one mole atoms of Iron with Fermi quantities (a); a singleton of scaled space-time at Fermi level, MF (b); a propagating light wave, represented as a path of moving states of photon in a simulated excitation (c); a simulated Bose-Einstein condensate with 20736 points was used in a 0.1×0.1 mm matrix (d)

The main result allows us to relate various physical processes on a small scale $\Upsilon(\aleph_0)$ in spacetime into one large system Υ_∞ , which is summarized with sufficient accuracy by a smooth curve with a wave function inside it, describing a quantum or macroscale phenomenon

$$\Upsilon(\aleph_0) = \Upsilon_\infty = 1.$$

CONCLUSION

As a basic paradigm, this model of particles interaction can represent matter duality as a particle and a wave, solving many problems in physical-chemistry, electromagnetism, thermodynamics and other fields. The scales M are used as a quantitative indicator to define a functional relationship with another quantity and defines the range of application of this connection in the selected functional interval. For example, the scales $\{M_0; M_5\} = \{1E+0; 1E+05\}$ define the set between the dimensions of the electron and the atom. Time is a free variable here, but at the same time a scale-dependent variable, so the application of the spacetime formula is directly related to the scale range. Distance and time scales are injective. The identity of the change in electron density as the electron states of the corresponding scale allows us to calculate the elastic constant as the Bulk modulus.

FUTURE WORK / REFERENCES

Future activities involve describing electromagnetic fields and calculating the constants of materials that are difficult to experiment with due to their short lifetimes. Experimental analysis of thermal fields provided reliable confirmation of the variation of exothermic temperature fields in terms of space-time scaling.