Science Frontiers at FERMI

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Today the scientific grand-challenge is to visualize the evolution of matter at its shortest time and space scales in order to reach the frontier of ultrafast fs and sub-fs electron motion around the atoms, the spatial scale of the interatomic distances and the energy scale of the chemical bonds, distinguishing not only different atoms but also their chemical states. Once crossed these borders, one can get the very essence of biology, chemistry and condensed matter physics. Undoubtedly, shedding light on the properties of matter arising from complex correlations of its atomic or electronic constituents will have a very strong impact on the development of future technologies as well. However, the experimental control and theoretical understanding of physical, chemical and biochemical processes in complex systems on the fundamental time and length scales of their building blocks need continuous development of advanced tools that should overcome the limitation of the existing ones. In this paper, we will discuss how the advances in the performance of the free electron lasers may push the development of original experimental strategies to study behavior of matter at the femtosecond–nanometer time–length scales. This would have a tremendous impact as an experimental tool to investigate a large array of phenomena ranging from nano dynamics in complex materials to phenomena that are at the heart of conversion of light into other forms of energy [1,2].

References

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