13th Summer School on Condensed Matter Research Zug, 9 – 15th August 2014

Time and Length Scales in Condensed Matter

Bruce D. Patterson, SwissFEL Project, Paul Scherrer Institut, CH-5232 Villigen, Switzerland

Abstract
Time and length are related by a velocity, and the large difference between electron and atom velocities is the basis of the Born-Oppenheimer approximation. I present examples of characteristic time and length scales in various condensed matter systems (liquid-phase chemistry, surface catalysis, correlated-electron materials, magnetism, biology). A description of the solidification of a glass is one of the major unsolved problems in condensed matter science, and it leads to an overview discussion of fluctuations, dissipation, non-equilbrium thermodynamics, fractals and self-organization. The talk ends with a plea to the students to apply their knowledge of condensed matter science to address the major problem of our time: the production of carbon-neutral energy.